PART C

PROTISTA 2

SARCODINA
CHIEFLY "THECAMOEBIANS" AND FORAMINIFERIDA

By ALFRED R. LOEBLICH, JR., and HELEN TAPPAN
with additions by others

VOLUME 2

Suborder ROTALIINA Delage & Hérouard, 1896

[*nom. correct.* LOEBLICH & TAPPAN, 1961, p. 219 (*pro* Rotalidae DELAGE & HÉROUARD, 1896, p. 143)]——[In synonymic citations superscript numbers indicate taxonomic rank assigned by authors [1]subclass, [2]tribu, [3]division, [4]order, [5]suborder, [6]group); dagger(†) indicates *partim*]——[=[4]Polythalamacea and [4]Polythalamacés DE BLAINVILLE, 1825, p. 375; [4]Cellulacea and [4]Cellulacés DE BLAINVILLE, 1825, p. 368]——[=[2]Nantilites LATREILLE, 1825, p. 165; =[2]Polycyclica LATREILLE, 1825, p. 164; =[2]Milleporita LATREILLE, 1825, p. 166]——[=[4]Enallostègues† D'ORBIGNY in DE LA SAGRA, 1839, p. xxxix, 125 (*nom. neg.*); =[4]Stichostègues D'ORBIGNY in DE LA SAGRA, 1839, p. xxxvii, 5 (*nom. neg.*); =[4]Helicostègues† D'ORBIGNY in DE LA SAGRA, 1839, p. xxxviii, 27 (*nom. neg.*); =[4]Cyclostègues† D'ORBIGNY, 1851, p. 192 (*nom. neg.*); =[6]Helicoidea† SCHULTZE, 1854, p. 53; =Rhabdoidea SCHULTZE, 1854, p. 53; =Nautiloidea REUSS, 1860, p. 151; =Helicostegia REUSS, 1860, p. 151, 205; =Turbinoidea REUSS, 1860, p. 151]——[=[4]Monostègues D'ORBIGNY in DE LA SAGRA, 1839, p. xxxvii, 1 (*nom. neg.*); =[5]Monosomatia EHRENBERG, 1839, table opposite p. 120; =[4]Monostega DIESING, 1848, p. 497; =Monothalamia† SCHULTZE, 1854, p. 52; =[3]Monothalamia† MARRIOTT, 1878, p. 30; =[4]Monothalamia HAECKEL, 1894, p. 164; =[4]Monosomatia COPELAND, 1956, p. 183]——[=Foraminifera Monomera REUSS, 1862, p. 362; =Foraminifera Polymera REUSS, 1862, p. 365; =[6]Vitrea CARPENTER, 1879, p. 375, 378; =Canaliculata MÖBIUS, 1880, p. 104; =Basistoma SCHUBERT, 1920, p. 148; =Telostoma SCHUBERT, 1920, p. 172; =Schizostoma† SCHUBERT, 1920, p. 179; =[4]Flexostylidia CALKINS, 1926, p. 355; =Sektion Neohellenoidea† WEDEKIND, 1937, p. 72, 84; =[4]Hellenoidea WEDEKIND, 1937, p. 79; =[5]Biloculinidea† SIGAL in PIVETEAU, 1952, p. 157; =[5]Pluriloculinidea† SIGAL in PIVETEAU, 1952, p. 160]——[=[5]Perforata CARPENTER, PARKER & JONES, 1862, p. 149; =[2]Perforata CLAUS, 1872, p. 108; =[6]Perforata CARPENTER, 1879, p. 375; =[1]Perforata LANKESTER, 1885, p. 847; =Perforata (Foraminifera) HAECKEL, 1894, p. 164; =[4]Perforida DELAGE & HÉROUARD, 1896, p. 135; =[5]Perforina CALKINS, 1901, p. 108; =[4]Orthostili (Perforata) SILVESTRI, 1937, p. 89]——[=[4]Dentata HOFKER, 1951, p. 14; =[5]Protoforaminata HOFKER, 1951, p. 42; =[5]Biforaminata HOFKER, 1951, p. 306; =[5]Conorbida HOFKER, 1951, p. 307; =[5]Deuteroforaminata HOFKER, 1951, p. 412]——[=[4]Lagenidea LANKESTER, 1885, p. 847; =[5]Lagenidae DELAGE & HÉROUARD, 1896, p. 136; =[4]Lagenaceae HARTOG in HARMER & SHIPLEY, 1906, p. 59; =[4]Lagenida CALKINS, 1909, p. 39]——[=[4]Nodosalidia CALKINS, 1926, p. 355; =[4]Nodosaridia KÜHN, 1926, p. 135; =[4]Nodosarioidea WEDEKIND, 1937, p. 86; =[5]Cristellariaceaf† WEDEKIND, 1937, p. 93; =[5]Lenticulinacea WEDEKIND, 1937, p. 99; =[5]Polymorphinacea WEDEKIND, 1937, p. 103; =[5]Robulinacea WEDEKIND, 1937, p. 104]——[=[4]Buliminida FURSENKO, 1958, p. 24]——[=[4]Chilostomellidea LANKESTER, 1885, p. 847; =[5]Chilostomellidae DELAGE & HÉROUARD, 1896, p. 138; =[4]Cheilostomellaceae HARTOG in HARMER & SHIPLEY, 1906, p. 59; =[4]Chilostomellida CALKINS, 1909, p. 39]——[=[4]Rotalidea LANKESTER, 1885, p. 847; =[5]Rotalidae DELAGE & HÉROUARD, 1896, p. 143; =[4]Rotaliaceae HARTOG in HARMER & SHIPLEY, 1906, p. 59; =[4]Rotalida CALKINS, 1909, p. 39; =[4]Rotaliaridia KÜHN, 1926, p. 152; =[5]Rotaliacea WEDEKIND, 1937, p. 85, 115; =[4]Rotaliida FURSENKO, 1958, p. 23]——[=[4]Globigerinidea LANKESTER, 1885, p. 847; =[5]Globigerinidae DELAGE & HÉROUARD, 1896, p. 141; =[4]Globigerinidae HARTOG in HARMER & SHIPLEY, 1906, p. 59; =[4]Globigerinida CALKINS, 1909, p. 39; =[4]Heterohelicida FURSENKO, 1958, p. 24]——[=[4]Nummulinidea LANKESTER, 1885, p. 848; =[5]Nummulitidae DELAGE & HÉROUARD, 1896, p. 147; =[5]Nummulitidea LISTER in LANKESTER, 1903, p. 146; =[4]Nummulitaceae HARTOG in HARMER & SHIPLEY, 1906, p. 59; =[4]Nummulitida CALKINS, 1909, p. 39; =[6]Nummulitacea WEDEKIND, 1937, p. 119; =[4]Nummulitinidea COPELAND, 1956, p. 188]——[=[5]Tinoporinae CALKINS, 1901, p. 109; =[4]Textulinida CALKINS, 1926, p. 356]

Wall calcareous, perforate. *Perm.-Rec.*

Superfamily NODOSARIACEA Ehrenberg, 1838

[*nom. correct.* LOEBLICH & TAPPAN, 1961, p. 295 (*pro* superfamily Nodosariidea NØRVANG, 1957, p. 23, *nom. transl. ex* family Nodosarina EHRENBERG, 1838)]——[In synonymic citations superscript numbers indicate taxonomic rank assigned by authors ([1]superfamily, [2]group, [3]family group) and a dagger(†) indicates *partim*]——[[2]=Lagenidae BÜTSCHLI in BRONN, 1880, p. 196; =Titanostichostegia EIMER & FICKERT, 1899, p. 676; =[1]Enclinostegia† EIMER & FICKERT, 1899, p. 682 (*nom. nud.*); =[3]Nodosalidia† RHUMBLER in KÜKENTHAL & KRUMBACH, 1923, p. 86; =[1]Lagenidea GLAESSNER, 1945, p. 126; =[1]Lagenicae EASTON, 1960, p. 65, 78]

Wall of finely perforate, radial laminated calcite; chambers planispirally coiled or uncoiled, or straight, or coiled about longitudinal axis; aperture peripheral or terminal, typically radiate, or may be slitlike or rounded. *Perm.-Rec.*

Family NODOSARIIDAE Ehrenberg, 1838

[*nom. correct.* LISTER in LANKESTER, 1903, p. 144 (*pro* family Nodosarina EHRENBERG, 1838, p. 200)]——[All names of family rank, a dagger(†) indicates *partim*]——[=Polystomat† LATREILLE, 1825, p. 161 (*nom. nud.*); =Polythalama† LATREILLE, 1825, p. 161 (*nom. nud.*); =Helicostègues† D'ORBIGNY, 1826, p. 268 (*nom. nud., nom. neg.*) =Stichostègues† D'ORBIGNY, 1826, p. 251 (*nom. nud., nom. neg.*); =Stichostegia† REUSS, 1860, p. 151, 178]——[=Equilateralidae† D'ORBIGNY in DE LA SAGRA, 1839, p. xxxvii, 11 (*nom. nud.*); =Aequilateralidae† D'ORBIGNY, 1846, p. 28]——[=Nautiloidae† D'ORBIGNY in DE LA SAGRA,

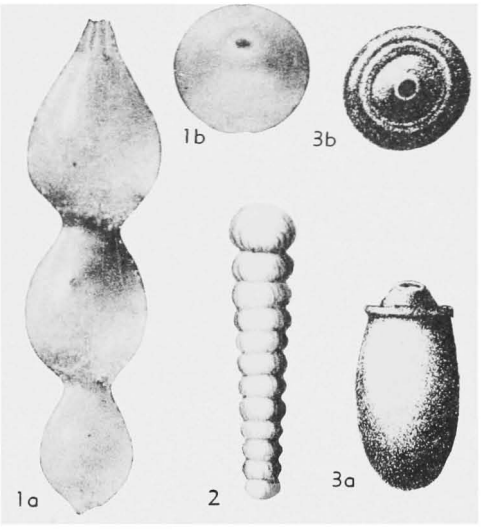

FIG. 400. Nodosariidae (Nodosariinae; *1-3, Nodosaria*) (p. C512).

1839, p. xxxviii, 38 *(nom. nud.)*; =Nautiloida† SCHULTZE, 1854, p. 53; =Nautiloidea REUSS, 1860, p. 151 *(nom. nud.)*] ——[=Rhizopodes† DUJARDIN, 1841, p. 126, 240 *(nom. nud., nom. neg.)*; =Rhabdoidea† REUSS, 1862, p. 365 *(nom. nud.)*; =Rhabdoina† BÜTSCHLI in BRONN, 1880, p. 197 *(nom. nud.)*]——[=Frondicularidae REUSS, 1860, p. 151, 191; =Frondicularideae GÜMBEL, 1870, p. 53]——[=Vaginulinidae REUSS, 1860, p. 151; =Vaginulinideae GÜMBEL, 1868, p. 53]——[=Dentalinoidea SCHWAGER, 1877, p. 18; =Les Lenticulacées LAMARCK, 1809, p. 322 *(nom. neg.)*; =Lenticulinidae CHAPMAN, PARR & COLLINS, 1934, p. 554; =Robulinidae WEDEKIND, 1937, p. 104; =Marginulinellidae WEDEKIND, 1937, p. 94; =Marginulinidae WEDEKIND, 1937, p. 99; =Hydromylinidae DE WITT PUYT, 1941, p. 54]—— [=Lagenidea REUSS, 1862, p. 305; =Lagenida CARPENTER, PARKER & JONES, 1862, p. 154; =Lagenideae GÜMBEL, 1870, p. 28; =Lagene SCHWAGER, 1876, p. 476; =Lagenoidea SCHWAGER, 1877, p. 18; =Lagenidae SCHULZE, 1877, p. 29; =Lagenina LANKESTER, 1885, p. 847; =Lagenetta HAECKEL, 1894, p. 164; =Lageninae DELAGE & HÉROUARD, 1896, p. 137; =Lagénidos GADEA-BUISÁN, 1947, p. 18 *(nom. neg.)*]—— [=Nodosarida SCHULTZE, 1854, p. 53; =Nodosaridae REUSS, 1860, p. 151, 178; =Nodosarideae GÜMBEL, 1870, p. 30; =Nodosarie SCHWAGER, 1876, p. 476; =Nodosaretta HAECKEL, 1894, p. 164; =Nodosarinae DELAGE & HÉROUARD, 1896, p. 137; =Arnodosaridia RHUMBLER, 1913, p. 342 *(nom. van.)*; =Nodosariellidae WEDEKIND, 1937, p. 93; =Plectofrondicularidae MONTANARO GALLITELLI, 1957, p. 143]——[=Orthocerata, and Orthocérés DE BLAINVILLE, 1825, p. 376; =Orthoceratidae† BRODERIP, 1839, p. 321; =Radiolata† CROUCH, 1827, p. 41 *(nom. nud.)*; =Radiolididae† BRODERIP, 1839, p. 321; =Orthocerinida SCHMARDA, 1871, p. 165; =Cristacea† & Cristacés DE BLAINVILLE, 1825, p. 383; =Spherulacea and Sphérulacés DE BLAINVILLE, 1825, p. 369]

Test free, one or more chambers in planispiral, biserial, uncoiling, curved or straight series; aperture simple, slitlike or radiate, peripheral in coiled forms, terminal in straight forms, may have apertural chamberlet, or may have elongate neck. *Perm.-Rec.*

Subfamily NODOSARIINAE Ehrenberg, 1838

[*nom. correct.* CHAPMAN, 1900, p. 30 (*pro* subfamily Nodosaridea REUSS, 1862, p. 334, *nom. transl. ex* family Nodosarina EHRENBERG, 1838)]——[All names of subfamily rank] ——[=Vaginulinidea REUSS, 1862, p. 366; =Frondicularidea REUSS, 1862, p. 307, 335, 366, 395; =Dentalinidae SCHWAGER, 1877, p. 18; =Lageninae BRADY, 1881, p. 44; =Nodosarinae BRADY, 1884, p. 69; =Glandulonodosariinae SILVESTRI, 1901, p. 109; =Frondicullariinae GALLOWAY, 1933, p. 235; =Robulinae GALLOWAY, 1933, p. 250; =Lenticulininae CHAPMAN, PARR & COLLINS, 1934, p. 554; =Marginulinae NØRVANG, 1957, p. 83 *(nom. imperf.)*; =Lenticulinae NØRVANG, 1957, p. 93 *(nom. imperf.)*]

Test with one or more chambers arranged in straight, arcuate or enrolled series; aperture terminal, rounded or radiate. *Perm.-Rec.*

Nodosaria LAMARCK, 1812, *1087, p. 121 [**Nautilus radicula* LINNÉ, 1758, *1140, p. 711; SD (SM) LAMARCK, 1816, *1089, pl. 465] [=*Orthocera* MODEER in SOLDANI, 1789, *1809, p. 41 (obj.); SD MELVILLE, 1959, *1253, p. 21, *nom. reject.* ICZN pending, see MELVILLE, 1959, *1253; *Orthocera* LAMARCK, 1799, *1083, p. 80 (type, *Nautilus raphanus* LINNÉ, 1758, *1140, p. 711) (*non Orthocera* MODEER, 1789, *nom. reject.* ICZN pending, see MELVILLE, 1959, *1253); *Nodosarina* PARKER & JONES, 1859, *1417a, p. 477 (type, *Nautilus raphanus* LINNÉ, 1758); *Pyramidulina* COSTA in FORNASINI, 1894, *731, p. 224 (type, *Pyramidulina eptagona* COSTA, 1894); *Herrmannia* ANDREAE, 1895, *20, p. 172 *(nom. nud.)*; *Nodosariopsis* RZEHAK, 1895, *1605, p. 228 (type, *Nodosaria perforata* SEGUENZA, 1880, *1713, p. 332, SD LOEBLICH & TAPPAN, herein); *Lagena (Cidaria)* GRZYBOWSKI, 1896, *835, p. 267, 292 (type, *Lagena (Cidaria) cidarina* GRZYBOWSKI, 1896, SD LOEBLICH & TAPPAN, herein) (*non Cidaria* TREITSCHKE, 1825); *Glandulonodosaria* SILVESTRI, 1900, *1751, p. 4 (type, *Nodosaria ambigua* NEUGEBOREN, 1856, *1351, p. 71; *Pseudoglandulina* CUSHMAN, 1929, *442, p. 87 (type, *Nautilus comatus* BATSCH, 1791, *102, pl. i, fig. 2a,b; *Nodosariella* WEDEKIND, 1937, *2041, p. 93 (type, *Nautilus raphanus* LINNÉ, 1758)]. Test free, multilocular, rectilinear, rounded in section, sutures distinct and commonly perpendicular to axis of test, surface smooth, costate, striate, hispid or tuberculate; aperture terminal, central basically radiate, may be produced on neck. *Perm.-Rec.*, cosmop.——FIG. 400,*1*. **N. radicula* (LINNÉ), U. Plio., Italy; *1a,b*, side, top views, ×40 (*7).—— FIG. 400,*2*. *N. ambigua* NEUGEBOREN, Mio., Rumania; ×25 (*700).——FIG. 400,*3*. *N. cidarina* (GRZYBOWSKI), L.Oligo., Pol.; *3a,b*, side, top views, ×45 (*835).

Alfredosilvestris ANDERSEN, 1961, *18, p. 71 [**A. levinsoni*; OD]. Test free, uniserial, chambers of microspheric form and early chambers of megalospheric form arched and compressed with chevron-shaped sutures, as in *Lingulina*, later chambers rounded in section, with straight and horizontal sutures; aperture terminal, radiate. [*Alfredosilvestris* resembles *Lingulina* in the compressed early stage, but differs in having a radiate instead of slitlike aperture.] *Rec.*, USA (La.).——FIG. 401,*8*. **A. levinsoni*; *8a,b*, side, edge views of megalospheric holotype, ×66 (*18).

Amphicoryna SCHLUMBERGER in MILNE-EDWARDS, 1881, *1285, p. 881 [**Marginulina falx* JONES & PARKER, 1860, *998, p. 302; SD (SM) BRADY, 1884, *200, p. 556, =*Nautilus scalaris* BATSCH, 1791, *102, p. 1, 4] [=*Plesiocorine* SCHLUMBERGER in MILNE-EDWARDS, 1882, *1286, p. 31

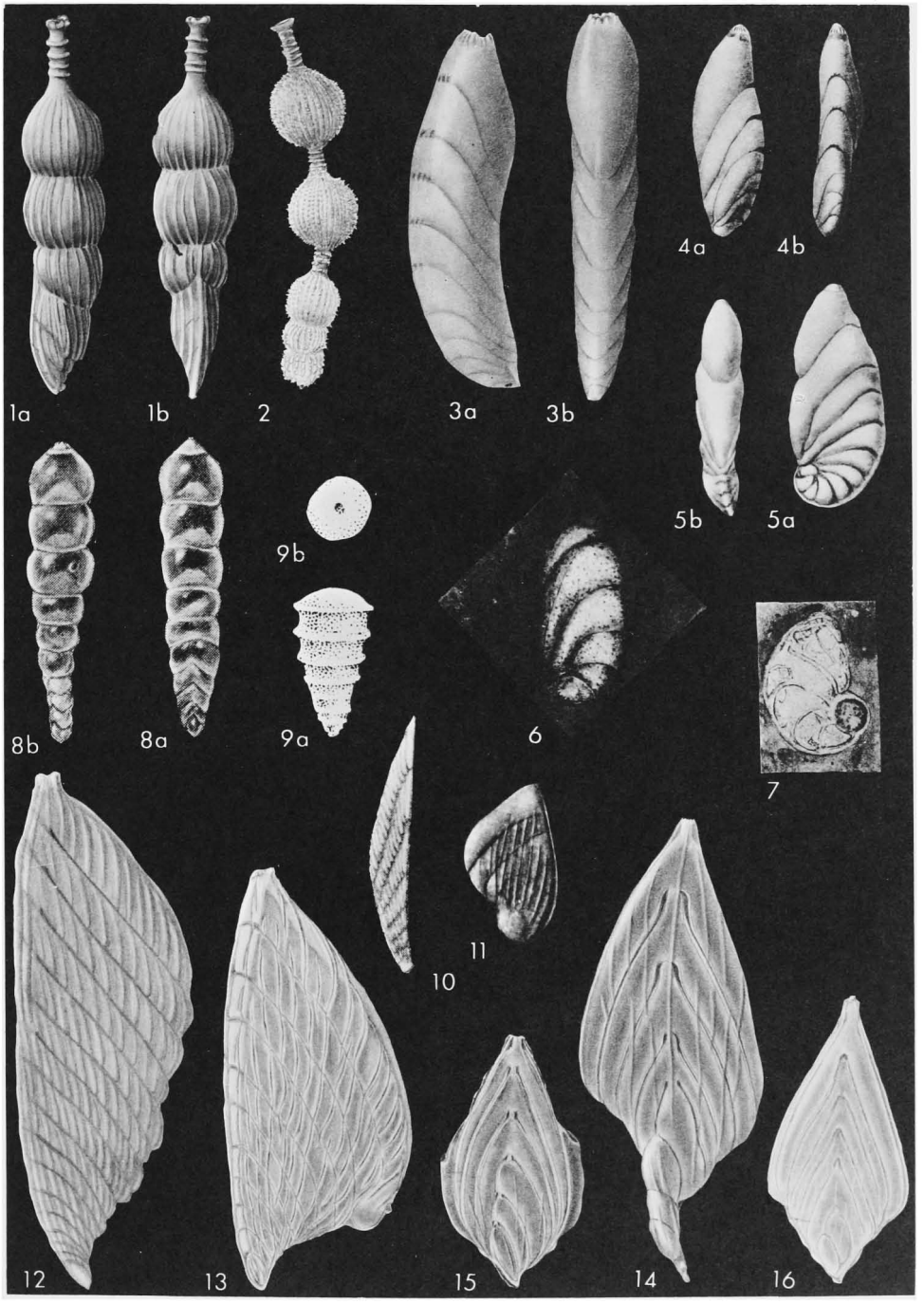

FIG. 401. Nodosariidae (Nodosariinae; *1,2, Amphicoryna; 3-7, Astacolus; 8, Alfredosilvestris; 9, Austrocolomia; 10-13, Citharina; 14-16, Citharinella*) (p. C512-C516).

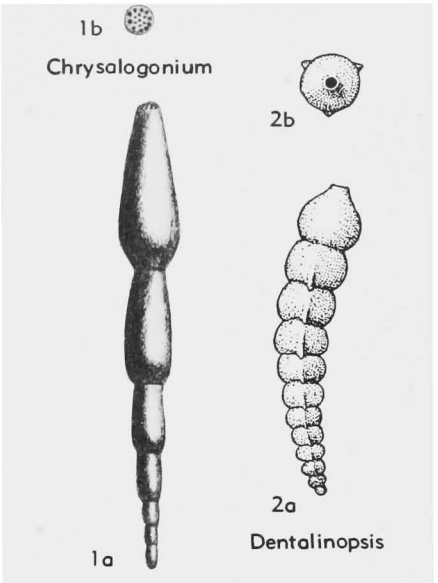

FIG. 402. Nodosariidae (Nodosariinae; *1, Chrysalogonium; 2, Dentalinopsis*) (p. C514, C516).

(type, *P. edwardsi* SCHLUMBERGER, 1882); *Plesiocoryna* SCHLUMBERGER in MILNE-EDWARDS, 1882, *1286, p. 31 *(nom. null.)*; *Amphicoryne* BRADY, 1884, *200, p. 556 *(nom. van.)*; *Amphycorina* DE FOLIN & PERIER, 1887, *727Ab, p. 159 *(nom. null.)*; *Lagenonodosaria* SILVESTRI, 1900, *1751, p. 3 (type, *Nodosaria scalaris* var. *separans* BRADY, 1884, *200, p. 510); *Nodosariopsis* SILVESTRI, 1902, *1755, p. 52 (type, *Marginulina falx* JONES & PARKER, 1860, SD LOEBLICH & TAPPAN, herein (obj.) *(non Nodosariopsis* RZEHAK, 1895; =*?Vaginuloglandulina* SILVESTRI, 1906, *1764, p. 24 (type, *V. laevigata*)]. Test free, elongate, early chambers compressed, in microspheric form arranged in loose coil as in *Astacolus,* later development uniserial; sutures oblique and flush in early stages, later constricted and horizontal; wall smooth or longitudinally costate; aperture terminal, radiate, at end of distinct neck. *Mio.-Rec.,* cosmop.——FIG. 401,*1*. **A. scalaris* (BATSCH), Rec., Syra Arch., Medit.; *1a,b,* side, dorsal views, ×46 (*2117).——FIG. 401,*2*. *A. separans* (BRADY), Rec., Pac.; ×17 (*2117).

Astacolus DE MONTFORT, 1808, *1305, p. 262 [**Astacolus crepidulatus* DE MONTFORT, 1808, =*Nautilus crepidulus* FICHTEL & MOLL, 1798, *716, p. 64; OD] [=*Chrysolus* DE MONTFORT, 1808, *1305, p. 26 (obj.); *Periples* DE MONTFORT, 1808, *1305, p. 270 (type, *P. elongatus* DE MONTFORT, 1808); *Crepidulina* DE BLAINVILLE, 1824, *141a, p. 188 (type, *C. astacolus* DE BLAINVILLE, 1824, =*Nautilus crepidulus* FICHTEL & MOLL, 1798, SD LOEBLICH & TAPPAN, herein) (obj.); *Cochlidion* ZALESSKY, 1926, *2099, p. 92 (type, *C. alexandrae* ZALESSKY, 1926); *Cochlea* ZALESSKY, 1926, *2099, p. 93 (type, *C. sapracolli* ZALESSKY, 1926, SD LOEBLICH & TAPPAN, herein) (*non Cochlea* DA COSTA, 1778; *nec* MARTYN, 1784; *nec* HITCHCOCK, 1888); *Polymorphinella* CUSHMAN & HANZAWA, 1936, *504, p. 46 (type, *P. vaginulinaeformis* CUSHMAN & HANZAWA, 1936); *Polymorphinoides* CUSHMAN & HANZAWA, 1936, *504, p. 48 (type, *P. spiralis* CUSHMAN & HANZAWA); *Saccullariella* WEDEKIND, 1937, *2041, p. 102 (type, *S. ensis* WEDEKIND, 1937); *Gladiaria* WEDEKIND, 1937, *2041, p. 105 *(nom. nud.)* (*non* WICK, 1939); *Gladiaria* WICK, 1939, *2059, p. 479 (type, *Cristellaria hermanni* ANDREAE, 1896, *21, p. 298); *Gladiaria* THALMANN, 1941, *1897e, p. 652 (type, *Cristellaria decorata* REUSS, 1855, *1544, p. 269) *(non Gladiaria* WICK, 1939); *Enantiovaginulina* MARIE, 1941, *1215, p. 160, 255 (type, *Cristellaria recta* D'ORBIGNY, 1840, *1394, p. 28)]. Test free, elongate, arcuate, compressed; chambers numerous, low, broad, added along slightly curved axis; sutures oblique, highest at outer margin, curved, straight or sinuate; aperture radiate, terminal, at peripheral angle. *Perm.-Rec.*——FIG. 401,*3*. **A. crepidulus* (FICHTEL & MOLL), Plio., Italy; *3a,b,* side, face views, ×33 (*2117).——FIG. 401,*4*. *A. vaginulinaeformis* (CUSHMAN & HANZAWA), Pleist., Ryukyu Is.; *4a,b,* side, dorsal views, ×33 (*504).——FIG. 401,*5*. *A. spiralis* (CUSHMAN & HANZAWA), Pleist., Ryukyu Is.; *5a,b,* side, face views, ×22 (*504).——FIG. 401,*6*. *A. alexandrae* (ZALESSKY), Jur., USSR; ×73 (*2099).——FIG. 401,*7*. *A. sapricolli* ZALESSKY), Jur., USSR; ×73 (*2099).

[*Astacolus* differs from *Vaginulina* in having oblique sutures and a more distinctly curved axis. It differs from *Lenticulina* in having a curved axis, rather than a closely enrolled test, and in later chambers being added so as to touch only the chamber immediately preceding, and in not being involute. Slightly irregular forms have been described as *Enantiovaginulina, Polymorphinella,* and *Polymorphinoides,* but as some specimens of most nodosariid genera may show irregular chamber development, this is not regarded as of generic or even specific importance.]

Austrocolomia OBERHAUSER, 1960, *1384, p. 37 [**A. marschalli*; OD]. Similar to *Nodosaria,* but with rounded aperture and no neck; chambers considerably overlapping and in type-species with elevated "sutures"; wall single-layered. *U.Trias. (Carn.),* Aus.——FIG. 401,*9*. **A. marschalli; 9a,b,* side, top views, ×45 (*1384).

Chrysalogonium SCHUBERT, 1907 (separate of 1908), *1687, p. 243 [**Nodosaria polystoma* SCHWAGER, 1866, *1703, p. 217; OD (M)]. Test similar to *Nodosaria* but with series of pores taking place of radial apertural slits of *Nodosaria. U. Cret.-Rec.,* Pac.-N. Am.-Eu.-Atl.-Carib.——FIG. 402,*1*. **C. polystoma* (SCHWAGER), U.Tert., India (Kar Nicobar); *1a,b,* side, top views, ×22.5 (*700).

Citharina D'ORBIGNY in DE LA SAGRA, 1839, *1611, p. XXXVII [**Vaginulina (Citharina) strigillata* REUSS, 1846, *1538, p. 106; SD LOEBLICH & TAP-

PAN, 1949, *1156, p. 259] [=*Cytharina* D'ARCHAIC, 1843, *36, p. 333 *(nom. null.)*; ***Hybridina*** KÜBLER & ZWINGLI, 1866, *1060, p. 8 (type, *H. obliqua* KÜBLER & ZWINGLI, 1866, SD LOEBLICH & TAPPAN, herein); *Pseudovaginulina* WEDEKIND, 1937, *2041, p. 95 (type, *P. oxyacan-*

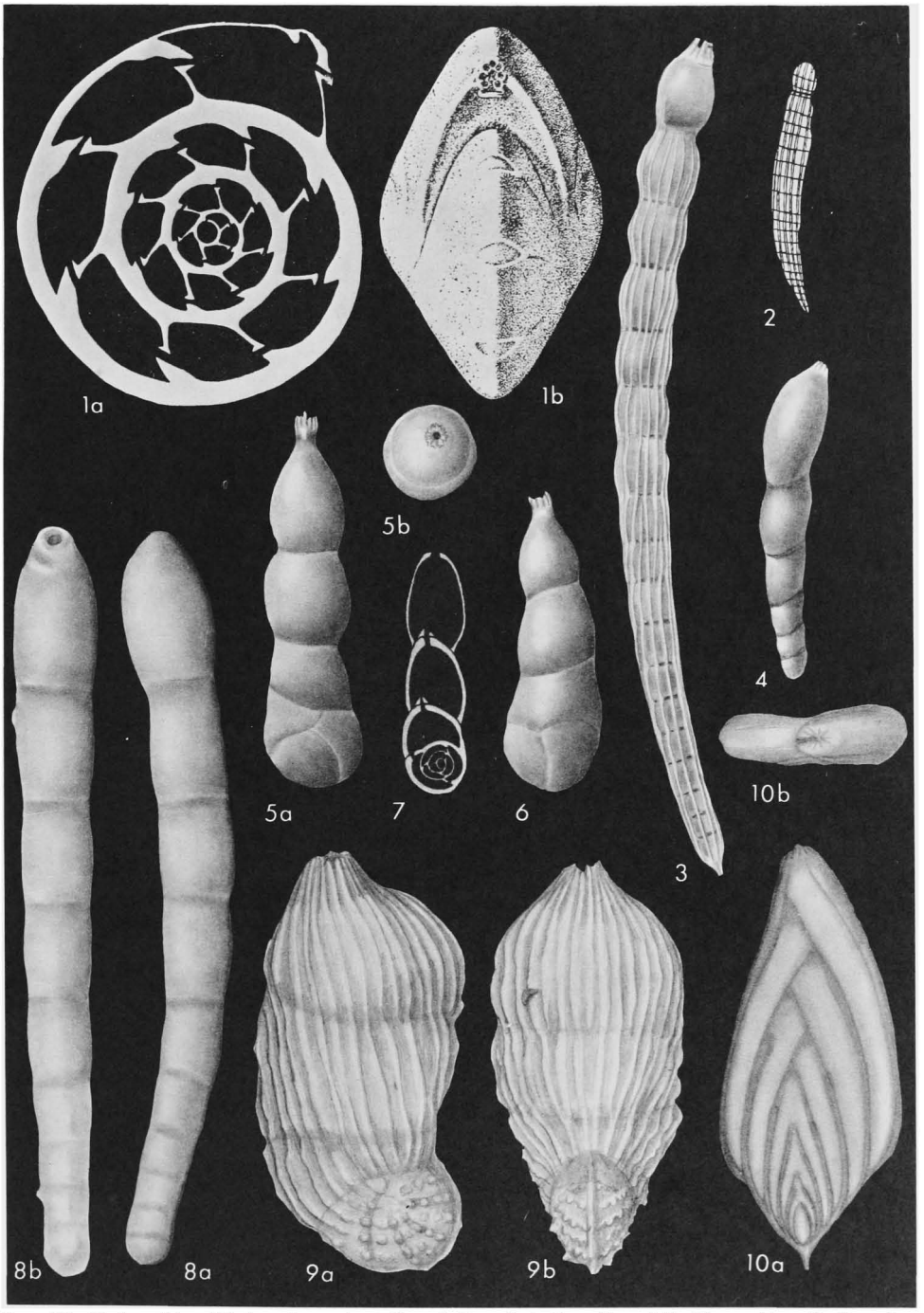

FIG. 403. Nodosariidae (Nodosariinae; *1, Cribrorobulina; 2-4, Dentalina; 5-7, Dimorphina; 8, Dentalinoides; 9, Marginulinopsis; 10, Dyofrondicularia*) (p. C516, C521-C522).

tha WEDEKIND, 1937); *Saccularia* WEDEKIND, 1937, *2041, p. 95 (type, *Marginulina inaequistriata* TERQUEM, 1864, *1885, p. 401); *Pseudocitharina* PAYARD, 1947, *1432, p. 118 (type, *Marginulina colliezi* TERQUEM, 1866, *1886, p. 430)]. Test flattened, subtriangular in outline, may be keeled; chambers numerous, extending nearly to base at inner margin; wall smooth, striate or costate; aperture radiate, at outer margin. *L.Jur.-Paleoc.,* cosmop.——FIG. 401,*10*. **C. strigillata* (REUSS), Cret., Boh.; enlarged (*700).——FIG. 401,*11*. *C. inaequistriata* (TERQUEM), L.Jur. (Lias.), Ger.; ×20 (*92).——FIG. 401,*12*. *C. colliezi* (TERQUEM), L.Jur.(U.Lias.), Fr.; lectotype here designated and refigured (specimen in TERQUEM Coll., Muséum Natl. Hist. Nat., Paris, *1886, pl. 17, fig. 10), ×48 (*2117).——FIG. 401,*13*. *Citharina discors* (KOCH), L.Cret.(Gault), Eng.; ×46 (*2117).

Citharinella MARIE, 1938, *1214, p. 99 [**Flabellina karreri* BERTHELIN, 1880, *133, p. 62; OD]. Test free, flattened, lanceolate to flabelliform, chambers low, broad, uniserial early ones arranged as in *Citharina,* extending backward toward ovate or fusiform proloculus at one side, later chambers chevron-shaped and symmetrical, as in *Frondicularia*; surface may be smooth, costate or striate; aperture terminal, slightly produced, radial. *Jur.-Cret.,* Eu.-N.Am.——FIG. 401,*14*. **C. karreri* (BERTHELIN), L.Cret.(Alb.), Eng.; ×100 (*2117).——FIG. 401,*15,16*. *C. tarrantensis* (LOEBLICH & TAPPAN), L.Cret.(Alb.), USA(Tex.); *15,16,* megalospheric and microspheric tests, ×44 (*2117).

Cribrorobulina THALMANN, 1947, *1897g, p. 372 [**Robulina serpens* SEGUENZA, 1880, *1713, p. 143; OD] [=*Cribrorobulina* SELLI, 1941, *1716, p. 90 *(nom. nud.)*]. Test like *Lenticulina,* but aperture consisting of numerous small round openings instead of being radiate. *Mio.-Rec.,* Eu.——FIG. 403,*1*. **C. serpens* (SEGUENZA), L.Plio., Italy; *1a,b,* sec. and idealized apert. view, ×66 (*1716).

Dentalina RISSO, 1826, *1579a, p. 16 [**Nodosaria (Dentaline) cuvieri* D'ORBIGNY, 1826, *1391, p. 255, OD (M)] [=Les Dentalines D'ORBIGNY, 1826, *1391, p. 254 *(nom. neg.)*; *Svenia* BROTZEN, 1937, *238, p. 66 (type, *Nodosaria laevigata* NILSSON, 1826, *1358, p. 342); *Dentalinella* WEDEKIND, 1937, *2041, p. 94 (type, *D. cuneata* WEDEKIND, 1937); *Enantiodentalina* MARIE, 1941, *1215, p. 149, 255 (type, *Nodosaria (Dentaline) communis* D'ORBIGNY, 1826, *1391, p. 254)]. Test elongate, arcuate, uniserial; sutures commonly oblique; aperture radiate, terminal, may be eccentric or nearly central. [Differs from *Nodosaria* in being asymmetrical.] *Perm.-Rec.,* cosmop.——FIG. 403,*2,3*. **D. cuvieri,* Rec., Adriatic *(2),* Rec., Gulf Mex. *(3)*; *2,* enlarged (*700); *3,* ×22 (*2117).——FIG. 403,*4*. *D. trujilloi* LOEBLICH & TAPPAN [*nom. nov. pro Dentalina intermedia* REUSS, 1860, *1548, p. 186 (*non Dentalina intermedia* CORNUEL, 1848; *nec* HANTKEN, 1875)], U.Cret.(Cenom.), USA(Tex.); ×48 (*2117).

Dentalinoides MARIE, 1941, *1215, p. 207, 256 [**D. canulina*; OD]. Test elongate, straight or slightly arcuate, uniserial, circular in section; sutures horizontal; wall calcareous, perforate; aperture large, rounded, slightly to one side of center and opening toward concave side of arcuate test. *U.Cret.,* Eu.-N.Am.——FIG. 403,*8*. **D. canulina,* Senon., Fr.; *8a,b,* ×216 (*2117).

[This genus was originally placed in the Ellipsoidinidae (=Pleurostomellidae) because of the eccentric rounded aperture, but that family consists of perforate granular-walled forms with internal siphons between chambers, neither of which have been demonstrated for *Dentalinoides*. It is here placed with the Nodosariidae, differing from *Dentalina* in the rounded, rather than radiate aperture.]

Dentalinopsis REUSS, 1860, *1547, p. 81 [**D. semitriquetra*; OD (M)]. Test free, elongate, uniserial, straight or arcuate, early chambers angled or triangular in section, later rounded; aperture terminal, rounded. *L.Cret.,* cosmop.——FIG. 402,*2*. **D. semitriquetra,* Apt., Ger.; *2a,b,* side, top views, enlarged (*762).

[Placed in the family Buliminidae (subfamily Uvigerininae) by CUSHMAN (*486) and in the Uvigerinidae (subfamily Angulogerininae) by GALLOWAY (*762), the genus is here believed closely related to the Nodosariidae. It cannot be an end member of the above-mentioned subfamilies, as it is found only in the Lower Cretaceous, whereas these subfamilies are largely Cenozoic. The absence of phialine lip and internal tube also indicates that it is not related to these forms. Jurassic species previously placed here should be referred to *Tristix*.].

Dimorphina D'ORBIGNY, 1826, *1391, p. 264 [**D. tuberosa*; OD (M)] [=*Glandulodimorphina* A. SILVESTRI, 1901, *1752, p. 17 (type, *Dimorphina tuberosa* D'ORBIGNY, 1826, SD LOEBLICH & TAPPAN, herein) (obj.)]. Test free, elongate, early portion close-coiled, later uncoiling and uniserial, as in *Marginulina*; aperture terminal, radiate, produced on neck, at the outer margin. [*Dimorphina* differs from *Marginulina* in having an enrolled early stage. Regarded previously as having an initial polymorphine stage (*486), it is now known to be lenticuline in early development (*1717).] *Jur.-Rec.,* cosmop.——FIG. 403,*5-7*. **D. tuberosa,* Plio., Italy *(5,6),* Rec., Adriatic *(7)*; *5a,b,* side, top views; *6,* side view; all ×44 (*2117); *7,* sec. showing early coil, ×24 (*1717).

Dyofrondicularia ASANO, 1936, *46, p. 330 [**D. nipponica*; OD]. Test free, elongate, flattened, early chambers equitant, uniserially arranged, later broad, low chambers biserially arranged; aperture radiate. *Plio.,* Japan.——FIG. 403,*10*. **D. nipponica; 10a,b,* side, top views of holotype, refigured, ×48 (*2117).

Flabellinella SCHUBERT, 1900, *1680, p. 551 [**Frondicularia tetschensis* MATOUSCHEK, 1895, *1235, p. 143; OD (M)]. Early stage as in *Vaginulina,* later chambers equitant as in *Frondicularia*; aperture radiate. *U.Cret.,* Eu.——FIG. 404, *4*. *F. zitteliana* (EGGER), U.Cret., Bavaria, *4a,b,* side, top views, ×44 (*2117).

Frondicularia DEFRANCE in D'ORBIGNY, 1826, *1391,

p. 256 [**Renulina complanata* DEFRANCE, 1824, *141a, p. 178, SD CUSHMAN, 1913, *404c, p. 81] [=*Pleiona* FRANZENAU, 1888, *744, p. 146, 203 (type, *P. princeps* FRANZENAU, 1888) (*non Pleiona* DEYROLLE, 1864; *nec* PAETEL, 1875); *Frondovaginulina* SCHUBERT, 1912, *1691, p. 179 (type,

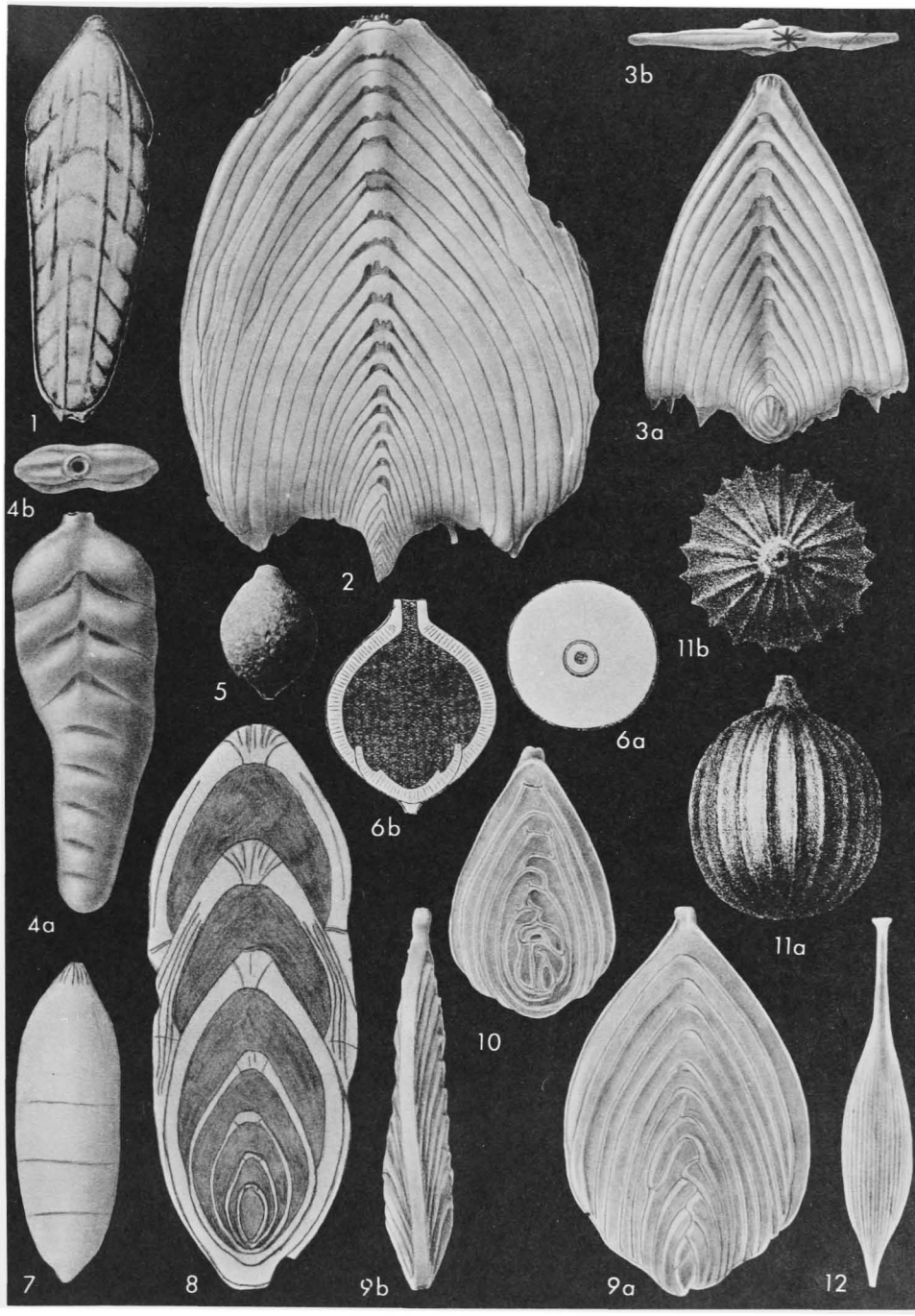

FIG. 404. Nodosariidae (Nodosariinae; *1-3, Frondicularia; 4, Flabellinella; 5,6, Lagenoglandulina: 7,8, Involutaria; 9,10, Kyphopyxa; 11,12, Lagena*) (p. C516-C518).

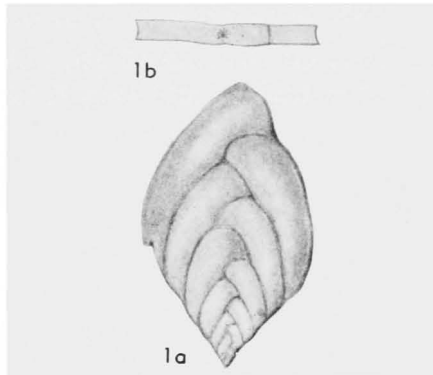

FIG. 405. Nodosariidae (Nodosariinae; *1, Lankesterina*) (p. C518).

Frondicularia inversa REUSS, 1844, *1537, p. 211, SD LOEBLICH & TAPPAN, herein); *Ichthyolaria* WEDEKIND, 1937, *2041, p. 93 (type, *Frondicularia bicostata* d'ORBIGNY, 1850, *1397b, p. 242); *Pseudofrondicularia* WEDEKIND, 1937, *2041, p. 94 (type, *Frondicularia carinata* BURBACH, 1886, *253a, p. 47); *Annulofrondicularia* KEIJZER, 1945, *1030, p. 196 (type, *Frondicularia annularis* d'ORBIGNY, 1846, *1395, p. 59)]. Test free, elongate or palmate, flattened; chambers low, broad, and equitant; sutures strongly arched or angled at center of test; aperture terminal, radiate, may be produced on short neck. *Perm.-Rec.*——FIG. 404,*1*. *F. bicostata* d'ORBIGNY, L.Jur.(M. Lias.), Fr.; side view of holotype, ×36 (*1198). ——FIG. 404,*2,3*. **F. complanata* (DEFRANCE), M.Plio.(Piacenz.), Italy; *2*, microspheric form, ×10; *3a,b*, megalospheric form, ×10 (*2117).

Involutaria GERKE, 1957, *778, p. 33 [**I. triassica*; OD]. Test elongate, chambers uniserially arranged, similar to *Nodosaria* or *Pseudonodosaria*, but with early chambers (wall and chamber cavity) completely overlapping and only few final chambers not enclosing all previous ones; wall calcareous, finely perforate, hyaline, radial; aperture terminal, radiate. *U.Trias.*, USSR(Krasnodar).——FIG. 404, *7,8*. **I. triassica*; *7*, side view of holotype, ×45; *8*, long. sec., ×83 (*778).

Kyphopyxa CUSHMAN, 1929, *440, p. 1 [**Frondicularia christneri* CARSEY, 1926, *282, p. 41; OD]. Test palmate, early chambers citharine in microspheric form, followed by biserial stage which occupies about half of test, final chambers uniserial, equitant, and strongly overlapping, random chambers may even envelop early stage and be cyclical; sutures commonly thickened and elevated; aperture terminal, radiate. *U.Cret.*, N.Am. ——FIG. 404,*9*. **K. christneri* (CARSEY), USA (Tex.); *9a,b*, side, edge views of topotype, ×28; *10*, side view, ×28 (*2117).

Lagena WALKER & JACOB in KANMACHER, 1798, *1011, p. 634 [**Serpula (Lagena) sulcata* WALKER & JACOB, 1798; SD PARKER & JONES, 1859, *1417b, p. 337] [=*Serpula (Lagena)* BOYS & WALKER, 1784 (publ. rejected, ICZN Op. 558, 1959); *Vermiculum* MONTAGU, 1803, *1298, p. 517 (type, *V. perlucidum* MONTAGU, 1803); *Lagenula* DE MONTFORT, 1808, *1305, p. 311 (type, *L. floscula* DE MONTFORT, 1808); *Amphorina* d'ORBIGNY, 1849, *1396, p. 666 (type, *A. gracilis* COSTA, 1856, *392, p. 121), *non Lagena gracilis* WILLIAMSON, 1848, =*Amphorina costai* ANDERSEN, 1961, *18, p. 78) (*non Amphorina* DE QUATREFAGES, 1844); *Phialina* COSTA, 1856, *392, p. 122 (type, *P. piriformis* COSTA, 1856, SD LOEBLICH & TAPPAN, herein) (*non Phialina* BORY DE ST. VINCENT, 1827); *Tetragonulina* SEGUENZA, 1862, *1712, p. 53 (type, *T. prima* SEGUENZA, 1862); *Capitellina* MARSSON, 1878, *1228, p. 122 (type, *C. multistriata* MARSSON, 1878); *Ectolagena* SILVESTRI, 1900, *1751, p. 4 (type, *Serpula (Lagena) sulcata* WALKER & JACOB, 1798, SD LOEBLICH & TAPPAN, herein (obj.); *Procerolagena* PURI, 1954, *1487, p. 104 (type, *Lagena gracilis* WILLIAMSON, 1848, *2064, p. 13)]. Test unilocular, rarely 2 or more chambers; surface variously ornamented; aperture on elongate neck which may have phialine lip, not radiate. [Differences in chamber shape are here regarded as of specific, not generic, value, hence the elongate forms (e.g., *"Amphorina," "Procerolagena,"* Fig. 404,*12*), are considered congeneric.] *Jur.-Rec.*, cosmop.——FIG. 404,*11*. **L. sulcata* (WALKER & JACOB), Rec., S.Pac.; *11a,b*, side, top views, ×80 (*200).——FIG. 404,*12*. *L. mollis* CUSHMAN, Rec., Baffin Is.; ×102 (*2117).

Lagenoglandulina SILVESTRI, 1923, *1775, p. 12 [**Glandulina subovata* STACHE, 1865, *1825, p. 185; OD (M)]. Test free, subovate, similar to *Pseudonodosaria* in development, but with final chamber completely overlapping earlier uniserial chambers, which are apparent only in section; aperture terminal, rounded. *Eoc.-Rec.*, N.Z.-Eu.-C.Am.——FIG. 404,*5,6*. **L. subovata* (STACHE), Eoc., Italy; *5*, ext., ×15; *6a,b*, outline view of top and long. sec. showing strong overlap of uniserial chambers resulting in unilocular appearance, ×34 (*1775).

Lankesterina LOEBLICH & TAPPAN, 1961, *1181, p. 219 [**Bolivina frondea* CUSHMAN, 1922, *417, p. 126; OD]. Test free, small, symmetrically biserial throughout, with flattened sides and truncate margins; chambers low and broad, as in later stage of *Dyofrondicularia*, but without early uniserial stage; wall calcareous, finely perforate; aperture terminal, radial. *Oligo.*, N.Am.——FIG. 405,*1*. **L. frondea* (CUSHMAN), USA; *1a,b*, side, top views, ×80 (*514).

[Differs from *Polymorphina* in being completely symmetrical throughout and in having truncate margins, similar to the other palmate genera of the Nodosariinae, but differs from these in being biserial throughout. *Polymorphina* is somewhat asymmetrical, particularly in its early development, and may show traces of a sigmoid development.]

Lenticulina LAMARCK, 1804, *1085a, p. 186 [**Lenti-*

culites rotulata LAMARCK, 1804; SD CHILDREN, 1823, *337, p. 153] [=*Lenticulites* LAMARCK, 1804, *1085a, p. 187 (obj.); *Phonemus* DE MONTFORT, 1808, *1305, p. 11 (type, *Nautilus vortex* FICHTEL & MOLL, 1798, *716, p. 33); *Pharamum* DE MONTFORT, 1808, *1305, p. 34 (type, *Nautilus*

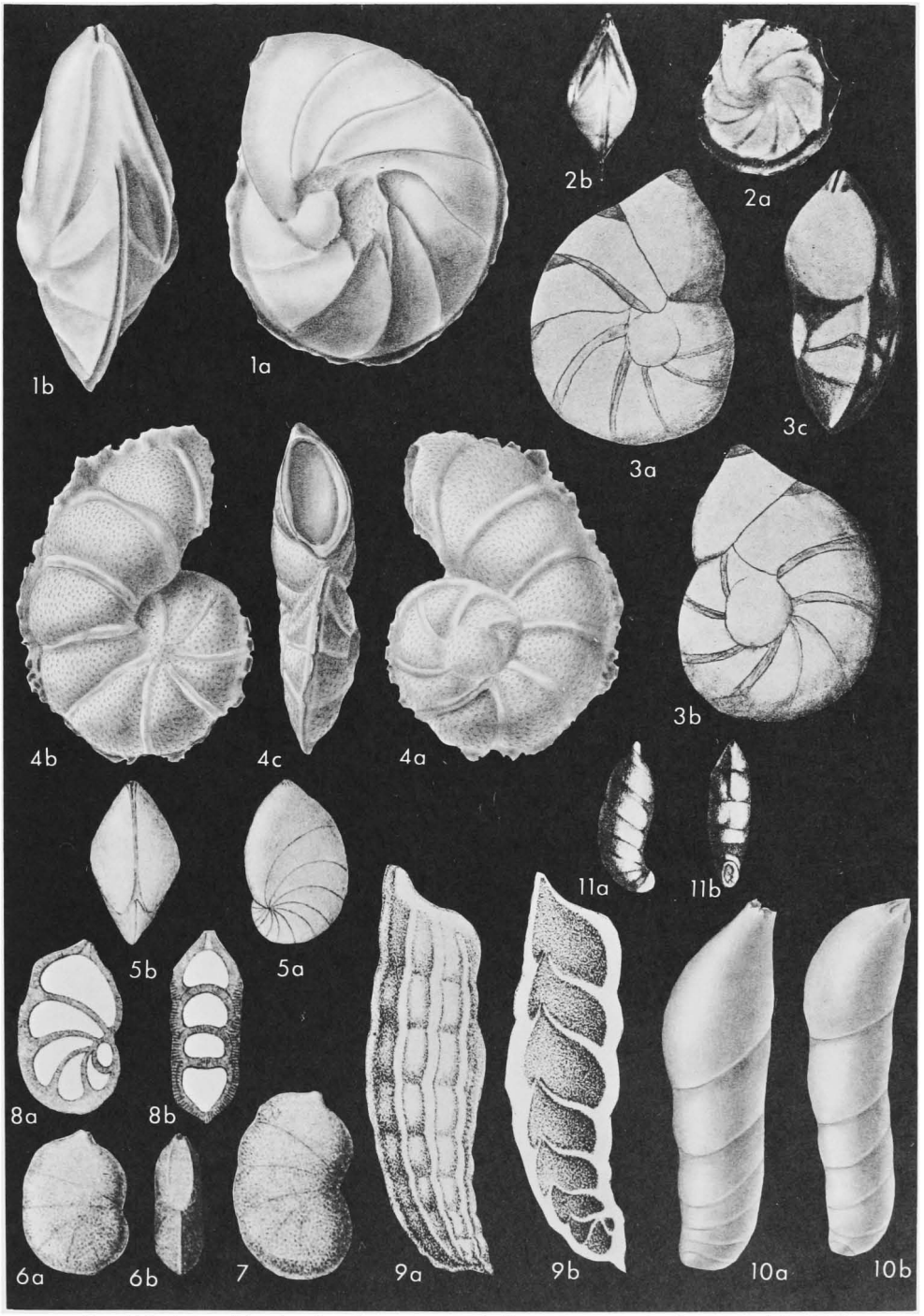

FIG. 406. Nodosariidae (Nodosariinae; *1-8, Lenticulina; 9-11, Marginulina*) (p. C518-C521).

calcar LINNÉ, 1758, *1140, p. 709); *Antenor* DE MONTFORT, 1808, *1305, p. 70 (type, *A. diaphaneus* DE MONTFORT, 1808); *Oreas* DE MONTFORT, 1808, *1305, p. 94 (type, *O. subulatus* DE MONTFORT, 1808, =*Nautilus acutauricularis* FICHTEL & MOLL, 1798, *716, p. 102) (*non Oreas* HUEBNER, 1807); *Robulus* DE MONTFORT, 1808, *1305, p. 214 (type, *R. cultratus* DE MONTFORT, 1808); *Patrocles* DE MONTFORT, 1808, *1305, p. 218 (type, *P. querelans* DE MONTFORT, 1808); *Spincterules* DE MONTFORT, 1808, *1305, p. 222 (type, *Nautilus costatus* FICHTEL & MOLL, 1798, *716, p. 47, *non Nautilus (Orthoceras) costatus* BATSCH, 1791); *Clisiphontes* DE MONTFORT, 1808, *1305, p. 226 (type, *C. calcar* DE MONTFORT, 1808); *Herion* DE MONTFORT, 1808, *1305, p. 231 (type, *H. rostratus* DE MONTFORT, 1808); *Rhinocurus* DE MONTFORT, 1808, *1305, p. 234 (type, *R. araneosus* DE MONTFORT, 1808); *Macrodites* DE MONTFORT, 1808, *1305, p. 238 (type, *M. cucullatus* DE MONTFORT, 1808); *Lampas* DE MONTFORT, 1808, *1305, p. 242 (type, *L. trithemus* DE MONTFORT, 1808) (*non Lampas* MEUSCHEN, 1787); *Scortimus* DE MONTFORT, 1808, *1305, p. 250 (type, *S. navicularis* DE MONTFORT, 1808); *Linthuris* DE MONTFORT, 1808, *1305, p. 254 (type, *L. cassidatus* DE MONTFORT, 1808); *Robulina* D'ORBIGNY, 1826, *1391, p. 282, 283, 287 (type, *Robulus cultratus* DE MONTFORT, 1808); *Soldania* D'ORBIGNY, 1826, *1391, p. 281 (type, *S. carinata* D'ORBIGNY, 1826; SD LOEBLICH & TAPPAN, herein); *Nautilina* COSTA, 1856, *392, p. 370 (type, *N. puteolana* COSTA, 1856) (*non Nautilina* STEIN, 1850); *Clisophontes* SCUDDER, 1882, *1709a, p. 77 (*nom. van.*); *Linthurus* SHERBORN, 1893, *1731a, p. 181, 182 (*nom. van. pro Linthuris* DE MONTFORT, 1808); *Cristellariopsis* RZEHAK, 1895, *1605, p. 227 (type, *C. punctata* RZEHAK, 1895); *Darbyella* HOWE & WALLACE, 1932, *972, p. 23 (type, *D. danvillensis* HOWE & WALLACE, 1932); *Perisphinctina* WEDEKIND, 1937, *2041, p. 105 (type, *Robulina depauperata* REUSS, 1851, *1541, p. 70) (erroneously cited as *R. pauperata* REUSS, 1851, by THALMANN, 1941, *1897e, p. 658); *Perisphinctina* WICK, 1939, *2059, p. 482 (type, *Cristellaria (Robulina) articulata* REUSS, 1863, *1553, p. 53, *non Cristellaria articulata* TERQUEM, 1862); *Enantiocristellaria* MARIE, 1941, *1215, p. 162, 255 (type, *Cristellaria navicula* D'ORBIGNY, 1840, *1394, p. 27); *Hydromylina* DEWITT PUYT, 1941, *2069, p. 54 (type, *H. rutteni* DEWITT PUYT, 1941); *Rimalina* PÉRÉBASKINE, 1946, *1444, p. 359 (type, *R. pinatensis* PÉRÉBASKINE, 1946); *Eoflabellina* PAYARD, 1947, *1432, p. 101 (type, *Peneroplis d'orbignyi* ROMER, 1839, *1582, p. 47); *Darbyellina* HARRIS & SUTHERLAND, 1954, *882, p. 207 (type, *D. hempsteadensis* HARRIS & SUTHERLAND, 1954)]. Test free, planispiral or rarely slightly trochoid, lenticular, biumbonate, periphery angled or keeled; chambers increasing gradually in size, in general of greater breadth than height; sutures radial, straight or curved and depressed, flush or elevated; surface may be variously ornamented with thickened, elevated sutures, bosses or sutural nodes; aperture radial at peripheral angle. *Trias.-Rec.,* cosmop.——FIG. 406,*1*. **L. rotulata* (LAMARCK), U.Cret.(Senon.), Fr.; *1a,b,* side, face views, ×30 (*2117).——FIG. 406,*2*. *L. cultrata* (DE MONTFORT), L. Plio., Italy; *2a,b,* side, face views, ×27 (*7).——FIG. 406,*3*. *L. danvillensis* (HOWE & WALLACE), U.Eoc.(Jackson.), USA(La.); *3a-c,* opposite sides and face views, ×40 (*972).——FIG. 406,*4*. *L. hempsteadensis* (HARRIS & SUTHERLAND), Paleoc.(Midway.), USA(Ark.); *4a-c,* opposite sides and face view of holotype, refigured, ×47 (*2117).——FIG. 406,*5*. *L. pinatensis* (PÉRÉBASKINE), U.Cret., Fr.; *5a,b,* side, face views, ×33 (*1444).——FIG. 406,*6-8*. *L. punctata* (RZEHAK), L.Tert., Aus.; *6a,b,* side, face views; *7,* side view; *8a,b,* long. secs. in plane of coiling and perpendicular to this plane, showing radial laminated wall characteristic of Nodosariidae, but described by RZEHAK as characterizing *Cristellariopsis*; all ×28 (*1605).

[*Robulus* is regarded as a synonym of *Lenticulina,* as considerable gradation in length of the radial apertural slits may occur. *Darbyella* is merely an abnormal asymmetrical form of *Lenticulina,* and in large assemblages of any species of this genus random asymmetrical, twinned, or even partially uncoiled specimens may be obtained. Similarly *Darbyellina* is represented by an abnormal specimen showing both a slight asymmetrical development and a final chamber which fails to reach the earlier whorl, and thus appears to be uncoiling. These aberrant forms do not warrant distinct generic assignments.]

Marginulina D'ORBIGNY, 1826, *1391, p. 258 [**M. raphanus* D'ORBIGNY, 1826, *non Nautilus raphanus* LINNÉ, 1758; SD DESHAYES, 1830, *590, p. 416 (LOEBLICH & TAPPAN, 1961,*1179, p.77)] [=*Buccinina* COSTA, 1861, *393, p. 53 (type, *B. subrecta* COSTA, 1861, SD LOEBLICH & TAPPAN, herein); *Hemicristellaria* STACHE, 1865, *1825, p. 222 (type, *H. procera* STACHE, 1865); *Ellipsomarginulina* A. SILVESTRI, 1923, *1774, p. 265 (type, *Marginulina raphanus* D'ORBIGNY, 1826, *1391, p. 258, SD LOEBLICH & TAPPAN, herein) (obj.); *Marginulinella* WEDEKIND, 1937, *2041, p. 94 (type, *Nautilus (Orthoceras) costatus* BATSCH, 1791, *102, pl. i, fig. 1a-g); *Enantiomarginulina* MARIE, 1941, *1215, p. 163, 255 (type, *E. d'orbignyi* MARIE, 1941); *Enantioamphicoryna* MARIE, 1956, *1221, p. B243 (type, *E. obesa* MARIE, 1956)]. Early portion slightly coiled but not completely enrolled, as in *Marginulinopsis,* later rectilinear; sutures oblique, especially in early portion; aperture of dorsal angle, somewhat produced. *Trias.-Rec.,* cosmop.——FIG. 406,*9*. **M. raphanus*; *9a,b,* side view and long. sec., enlarged (*1391).——FIG. 406,*10*. *M. glabra* D'ORBIGNY, Plio., Italy; *10a,b,* side views, ×60 (*2117).——FIG. 406,*11*. *M. procera* (STACHE), L.Tert., N.Z.; *11a,b,* ×13 (*700).

[*Marginulina glabra* D'ORBIGNY, 1826, was cited as type of the genus by CUSHMAN (1913, *404c, p. 79), despite the fact that the type had previously been fixed by DESHAYES (1830 *590, p. 416) as *Nautilus raphanus* LINNÉ (=*Mar-*

ginulina raphanus D'ORBIGNY, *590, p. 418). The status of the genus as based on the type-species is discussed by LOEBLICH & TAPPAN (1961, *1179).]

Marginulinopsis A. SILVESTRI, 1904, *1760, p. 253 [*M. *densicostata* THALMANN, 1937; SD THALMANN, 1937, *1899a, p. 348]. Test with early stage as in *Lenticulina,* later uncoiling and rec-

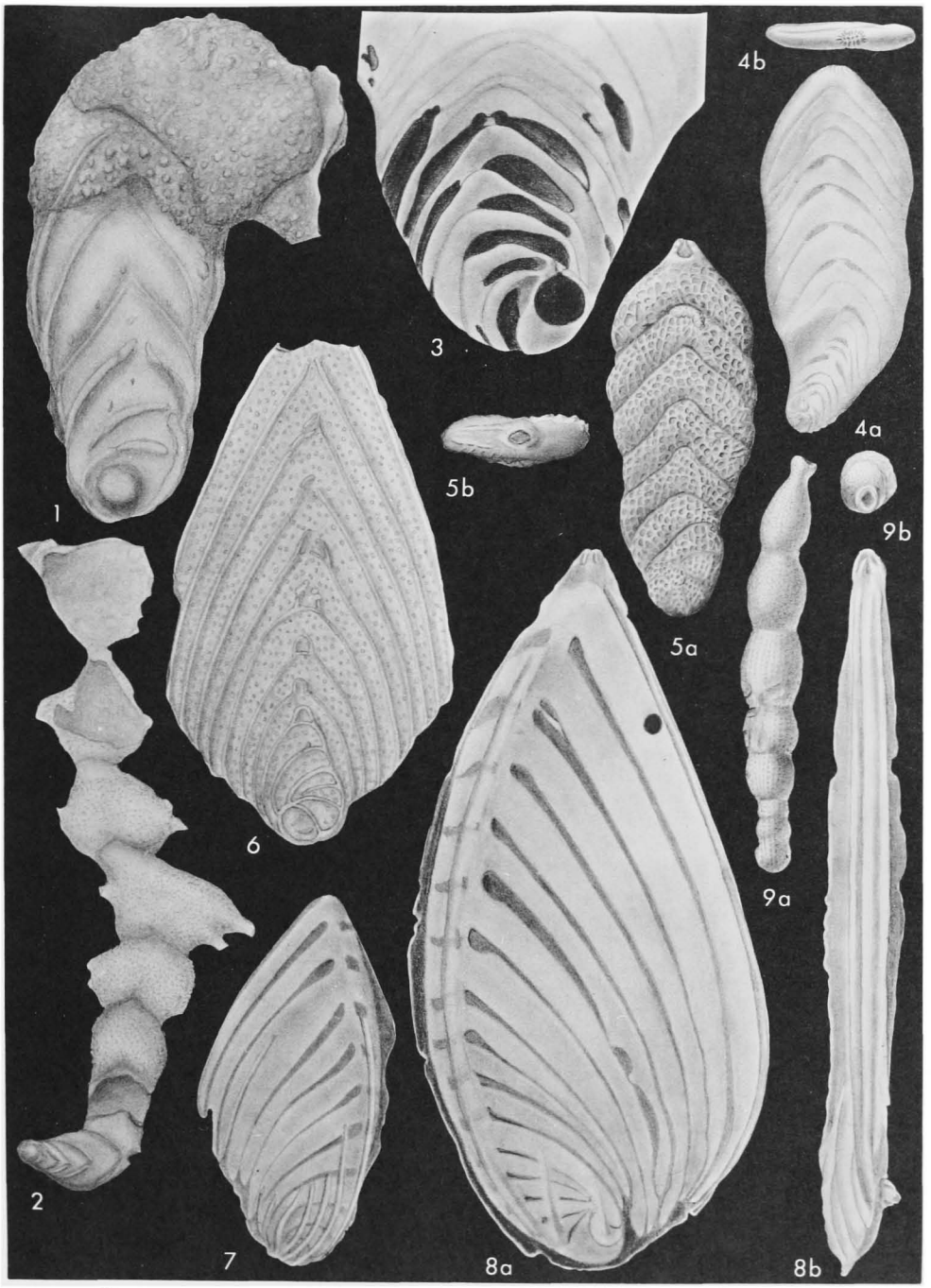

FIG. 407. Nodosariidae (Nodosariinae; *1,2, Tentifrons; 3-5, Palmula; 6, Neoflabellina; 7,8, Planularia; 9, Orthomorphina*) (p. C522, C524).

tilinear as in *Marginulina;* aperture terminal, radiate. [*Marginulinopsis* is similar to *Dimorphina,* but differs in having a keeled or angular periphery in the coiled portion.] *Jur.-Rec.,* cosmop.——Fig. 403,*9*. **M. densicostata* Thalmann, Rec., *Challenger* Sta. 24, off Culebra Is., W.Indies, 390 fathoms; holotype (BMNH-ZF 1808) refigured, originally described as *Marginulina costata* Batsch by Brady (*200, pl. 65, fig. 11), *9a,b,* ×50 (*2117).

Neoflabellina Bartenstein, 1948, *90, p. 122 [**Flabellina rugosa* d'Orbigny, 1840, *1394, p. 23; SD Cushman, *433, p. 189] [=*Flabellina* d'Orbigny in de la Sagra, 1839, *1611, p. 42 (obj.) (*non* Voight, 1834; *nec* Forbes & Hanley, 1851; *nec* de Gregorio, 1930)]. Test large, palmate, similar to *Palmula* but with flattened, parallel sides, and angular or keeled margins, thickened and elevated sutures, surface commonly highly ornamented with ribs, reticulations or nodes. *U.Cret.-Paleoc.,* cosmop.——Fig. 407,*6*. **N. rugosa* (d'Orbigny), U.Cret., Fr.; lectotype (MNHN) here designated and refigured, ×48 (*2117).

Orthomorphina Stainforth, 1952, *1833, ♀ 8 [**Nodogenerina havanensis* Cushman & Bermudez, 1937, *491, p. 14; OD]. Test rectilinear, uniserial; chambers inflated; wall calcareous, perforate, surface smooth or costate; aperture terminal, rounded, and may have slight neck or everted rim. [Differs from *Nodosaria* in having rounded, rather than radiate, aperture, and from *Siphonodosaria* in lacking apertural tooth. Originally placed in the Heterohelicidae, this form seems to have no relation to those planktonic genera and is here transferred to the Nodosariidae.] *Eoc.-Rec.,* Carib.-Eu.-N. Am.-Pac.-Asia-Atl.——Fig. 407,*9*. **O. havanensis* (Cushman & Bermudez), Eoc., Cuba; *9a,b,* side, top views of paratype, ×44 (*2117).

Palmula Lea, 1833, *1099, p. 219 [**P. sagittaria;* OD (M)] [=*Planularia* Nilsson, 1826, *1358, p. 342 (type, *P. elliptica* Nilsson, 1826, SD Loeblich & Tappan, herein) (*non Planularia* Defrance, 1826); *Frondiculina* von Münster in Roemer, 1838 (*non* Lamarck, 1816), *1581, p. 382 (type, *F. obliqua* von Münster, 1838, SD Loeblich & Tappan, herein); *Falsopalmula* Bartenstein, 1948, *90, p. 124, 127 (type, *Flabellina tenuistriata* Franke, 1936, *741, p. 93); *Phalsopalmula* Agalarova, 1960, *3A, p. 79 *(nom. van.)*]. Test free, flattened, elongate or palmate, early portion planispirally coiled in microspheric forms, or arcuate in megalospheric forms, later becoming uncoiled and rectilinear, with low, broad, arched, and equitant chambers, as in *Frondicularia*; sutures radial in early portion, later strongly arched or angled at center of test; aperture terminal, radiate. [Certain of the geologically older species were separated as *Falsopalmula,* being somewhat smaller, and considered to be more closely related to ancestral *Lenticulina.* The differences are here regarded as specific only, as early forms of most nodosariid genera show their close interrelationship.] *L.Jur.-Rec.,* N.Am.-Eu.——Fig. 407,*3,4*. **P. sagittaria,* Paleoc., USA (N.J.); *4a,b,* side and top views, ×5; *3,* early portion of test partially acid-treated to show coil, ×22 (*2117).——Fig. 407,*5*. *P. tenuistriata* (Franke), L.Jur.(U.Lias.), Ger.; *5a,b,* side, top views of topotype, ×65 (*2117).

Pandaglandulina Loeblich & Tappan, 1955, *1167, p. 7 [**P. dinapolii*; OD] [=*Pandoglandulina* Gerke, 1957, *778, p. 36 *(nom. null.)*]. Test free, uniserial, chambers strongly overlapping, and with slightly arcuate axis; sutures very slightly radiate in early portion, later horizontal, may be slightly depressed; aperture terminal, radiate. *Mio.-Rec.,* Eu.——Fig. 408,*1,2*. **P. dinapolii,* L.Plio., Italy; *1,* paratype; *2a,b,* side, top views of holotype; all ×45 (*2117).

Planularia Defrance in de Blainville, 1826, *141c, p. 244 (*non* Nilsson, 1826) [**Peneroplis auris* Defrance in de Blainville, 1824, *141a, p. 178; OD (M)] [=*Megathyra* Ehrenberg, 1843, *672, p. 409 (type, *M. planularia,* SD Loeblich & Tappan, herein)]. Similar to *Astacolus,* but with compressed sides and carinate margins. *Mio.-Rec.,* cosmop.——Fig. 407,*7,8*. **P. auris* (Defrance), Plio., Italy; *7,8a,* side views; *8b,* edge view; all ×33 (*2117).

Pseudarcella Spandel, 1909, *1823, p. 199 [**P. rhumbleri*; OD] [=*Arpseudarcelloum* Rhumbler, 1913, *1572b, p. 349 *(nom. van.)* (obj.)]. Test free, consisting of single conical or plano-convex chamber; wall calcareous, finely perforate, lamellar character and microstructure unknown, surface smooth or reticulate; aperture a large round opening in center of flat to concave surface of test. [The systematic position is doubtful. Because of the calcareous wall it is not considered to be related to the pseudochitinous Arcellidae. Petrographic and X-ray studies of the test wall are needed to aid in its placement, but none have been made to date. At least a superficial similarity to the tests of the Nodosariidae has been noted, and as all known perforate calcareous unilocular hyaline foraminifers are currently placed in the Nodosariacea, the present genus is also tentatively included.] *Eoc.-Mio.,* Eu.(Fr.-Ger.-Belg.-Italy)-Carib.(Puerto Rico).——Fig. 409,*1*. **P. rhumbleri,* M.Oligo., Ger.; *1a-c,* side and apert. views and axial sec., approx. ×55 (*1823).——Fig. 409, *2*. *P. feugueuri* Y. Le Calvez, Eoc., Belg.; *2a,b,* oblique side and apert. views, ×90 (*1115).——Fig. 409,*3*. *P. campanula* Y. Le Calvez, Eoc., Belg.; *3a,b,* oblique side and apert. views, ×84 (*1115).——Fig. 409,*4*. *P. patella* Galloway & Heminway, U.Oligo., Carib.(Puerto Rico); *4a,b,* side and apert. views, ×56 (*764).

Pseudonodosaria Boomgaart, 1949, *173, p. 81 [**Glandulina discreta* Reuss, 1850, *1540, p. 366;

OD] [=*Rectoglandulina* Loeblich & Tappan, 1955, *1167, p. 3 (type, *R. appressa* Loeblich & Tappan, 1955)]. Test free, uniserial and rectilinear throughout, chambers embracing strongly, at least in early portion, later chambers may be inflated and less embracing; sutures horizontal;

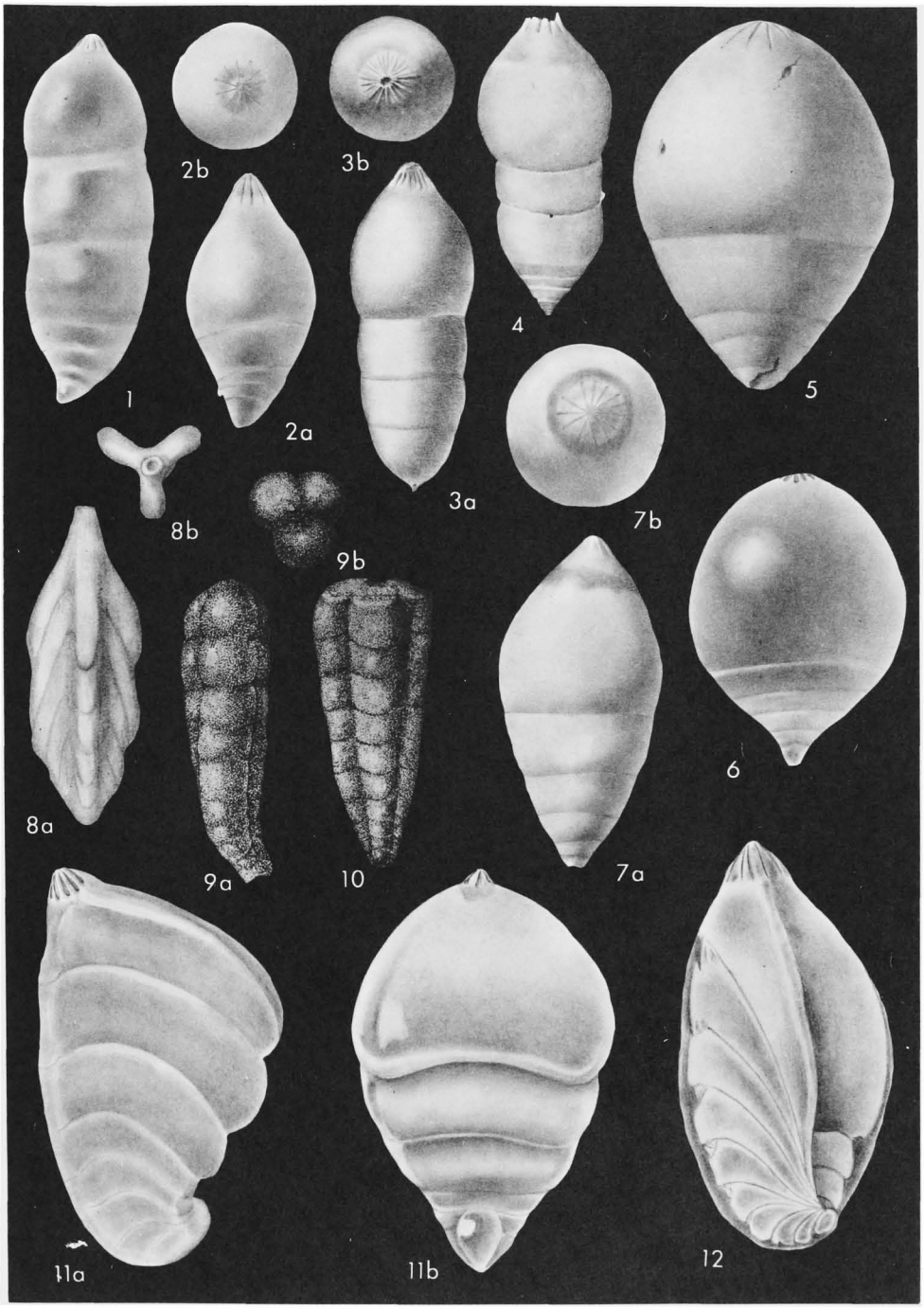

Fig. 408. Nodosariidae (Nodosariinae; *1,2, Pandaglandulina; 3-7, Pseudonodosaria; 8, Tribrachia; 9,10, Pseudotristix, 11,12, Saracenaria*) (p. C522-C524).

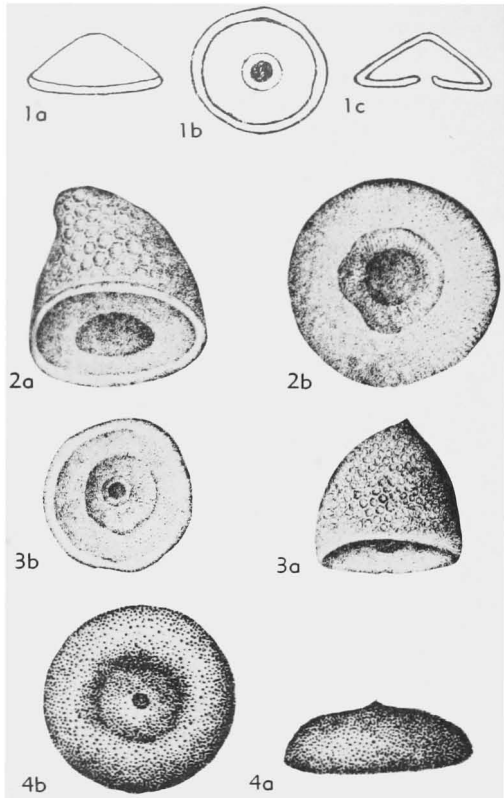

FIG. 409. Nodosariidae (Nodosariinae; *1-4, Pseudarcella*) (p. C522).

aperture terminal, radiate. *Perm.-Rec.*, Eu.-N.Am.-Australia-Asia-Pac.-Atl.——FIG. 408,*3,4*. **P. discreta* (REUSS), U.Tert., Java; *3a,b*, side, top views, ×62; *4*, side view, ×53 (*2117).——FIG. 408, *5,6*. *P. obesa* (LOEBLICH & TAPPAN), U.Cret., USA(Ark.); microspheric and megalospheric specimens, ×116 (*2117).——FIG. 408,*7*. *P. appressa* (LOEBLICH & TAPPAN), U.Cret., USA(Ark.); *7a,b*, side, top views, ×107 (*2117).

Pseudotristix K. V. MIKLUKHO-MAKLAY, 1960, *1279, p. 156 [**Tristix (P.) techerdynzevi*; OD] [=*Pseudotristix* K. V. MIKLUKHO-MAKLAY, 1958, *1278, p. 481, 484 (*nom. nud.*); *Tristix (P.)* K. V. MIKLUKHO-MAKLAY, 1960, *1279, p. 156 (obj.)]. Test uniserial, chambers low, gradually enlarging, trilobate in section, not overlapping; sutures straight, horizontal; wall calcareous; aperture terminal, radiate. *U.Perm.(Kazan.)*, Russian Platform.——FIG. 408,*9,10*. **P. tcherdynzevi*; *9a,b*, side, apert. views, ×66; *10*, side view, ×71 (*1279).

Saracenaria DEFRANCE in DE BLAINVILLE, 1824, *141a, p. 176 [**S. italica* DEFRANCE, 1824; OD (M)] [=*Hemirobulina* STACHE, 1865, *1825, p. 227 (type, *H. arcuatula* STACHE, 1865); *Saracenella* FRANKE, 1936, *741, p. 87 (type, *Marginulina trigona* TERQUEM, 1866, *1886, p. 435)]. Test free, planispiral in early stage, later with tendency to uncoil; triangular in section, with broad flat apertural face, the outer margin and 2 angles of face may be acute and keeled to somewhat rounded; aperture at peripheral angle, radiate. *Jur.-Rec.*, cosmop.——FIG. 408,*11*. **S. italica*, Rec., Carib.; *11a,b*, side, face views, ×35 (*2117). ——FIG. 408,*12*. *S.* sp., Rec., Gulf Mex.; ×44 (*2117).

Tentifrons LOEBLICH & TAPPAN, 1957, *1172, p. 225 [**T. barnardi* LOEBLICH & TAPPAN, 1957; OD]. Test free in early stages, with chambers in citharine arrangement, loosely coiled, becoming uniserial, flattened and palmate, with smooth and centrally excavated chevron-shaped chambers; attached in later stages with equitant chambers slightly inflated, extremely papillose and fistulose; sutures raised and thickened in early portion, slightly depressed in irregular attached portion; aperture as in *Citharinella* in early stages, later stage with numerous apertures at ends of fistulose extensions. *U.Cret.*, Eu.——FIG. 407,*1,2*. **T. barnardi*, Senon., Eng., *1*, paratype, ×57; *2*, holotype, ×21 (*1172).

Tribrachia SCHUBERT, 1912, *1691, p. 183 [**T. inelegans* LOEBLICH & TAPPAN, 1950; SD LOEBLICH & TAPPAN, 1950, *1157, p. 15]. Test free, elongate, tapering, chambers triangular to trifoliate in section, low, broad, extending backward toward proloculus at angles, strongly arched upward on concave faces of test; sutures distinct, strongly arched on sides of test, curving downward at angles; aperture terminal, radiate, may be produced on neck. *M.Jur.-Cret.*, N.Am.-Eu. ——FIG. 408,*8*. **T. inelegans*, M.Jur.(Callov.), Wyo.; *8a,b*, side, top views, ×48 (*1157).

Vaginulina D'ORBIGNY, 1826, *1391, p. 257 [**Nautilus legumen* LINNÉ, 1758, *1140, p. 711; SD CUSHMAN, 1913, *404c, p. 80] [=*Vaginulinella* KAPTARENKO-CHERNOUSOVA, 1956, *1017, p. 68 (*nom. null. pro Vaginulina*); *Vaginula* RISSO, 1826, *1579a, p. 16 (obj.)]. Test straight to arcuate as in *Dentalina*, but compressed or ovate in section; aperture at dorsal angle, radiate. *Trias.-Rec.*, cosmop.——FIG. 410,*1,2*. **V. legumen* (LINNÉ), Rec., Adriatic; *1a,b*, side, edge views; 2, side view; all ×15 (*2117).

Vaginulinopsis SILVESTRI, 1904, *1760, p. 251 [**Vaginulina soluta* SILVESTRI var. *carinata* SILVESTRI, 1898, *1750, p. 166; =*Vaginulinopsis inversa* (COSTA) var. *carinata* (SILVESTRI), 1904, =*Vaginulinopsis carinata* (SILVESTRI); SD THALMANN, 1937, *1899a, p. 347]. Test close-coiled, as in *Lenticulina*, in early stage, later uncoiling, slightly compressed as in *Vaginulina*, aperture at dorsal angle, radiate. [The type-species was not fixed by original designation, as was erroneously stated by THALMANN (1937, *1899a, p. 347). *Vaginulina soluta* SILVESTRI, 1898, was stated to

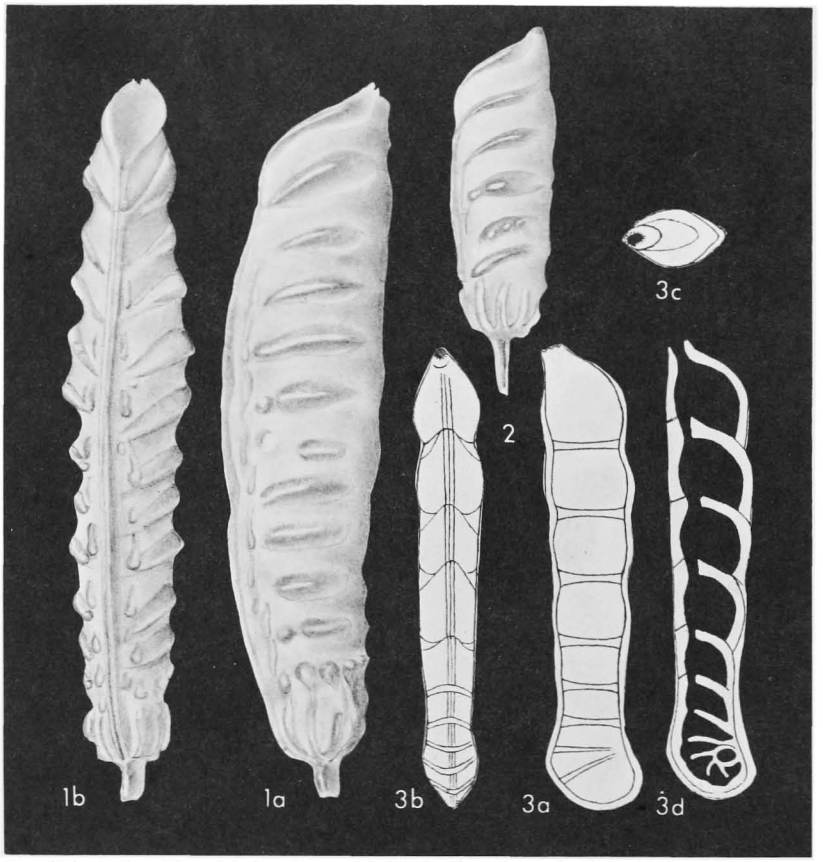

FIG. 410. Nodosariidae (Nodosariinae; *1,2, Vaginulina; 3, Vaginulinopsis*) (p. C524-C525).

be a synonym of *Marginulina inversa* COSTA (1856, *392, p. 183) and the variety *carinata* was transferred to *Vaginulinopsis inversa* (COSTA) by SILVESTRI, 1904. *M. inversa* was a homonym of *M. inversa* NEUGEBOREN, 1851, hence the specific name *soluta* should be retained for the noncarinate species described by SILVESTRI. If regarded solely as a subspecies, the present type-species should be referred to *V. soluta* subsp. *carinata*. However, as the types of *V. soluta* do not show the early coil, we regard the present form as a distinct species]. *Trias.-Rec.*, cosmop.——FIG. 410,*3*. **V. carinata*, Mio., Sicily; *3a-d*, side, edge, and top views and long. sec., ×30 (*1899a).

Subfamily PLECTOFRONDICULARIINAE Cushman, 1927

[Plectofrondicularinae CHAPMAN & PARR, 1936, p. 143 (*nom. correct. pro* Plectofrondicularinae CUSHMAN, 1927, p. 62)]

Test biserial to uniserial; aperture terminal, dentate or cribrate. *Eoc.-Rec.*

Plectofrondicularia LIEBUS, 1902, *1134, p. 76 [**P. concava*; SD CUSHMAN, 1928, *439, p. 238] [=*Parafrondicularia* ASANO, 1938, *49, p. 187, 189 (type, *P. japonica*)]. Test elongate, compressed, biserial in early stage, later uniserial, sutures limbate; aperture terminal, radial with elevated margin at outer edge, projecting laminae between grooves of aperture may fuse centrally, as in *Amphimorphina*, so that aperture consists of one or more small, irregularly distributed, elliptical openings. [As shown by MONTANARO GALLITELLI (1957, *1303, p. 144), this genus does not have an early coiled stage and no internal apertural modifications and is not related to the Heterohelicidae or Buliminidae.] *Eoc.-Rec.*, Eu.-N. Am.-N. Z.-Japan-S. Am.-Carib.-Sumatra-Cyprus.——FIG. 411,*1*. *P. floridana* CUSHMAN, U.Oligo., Dominican Republic; *1a,b*, side, top views of microspheric form, ×65 (*1303).——FIG. 411,*2*. **P. concava*, Tert., Ger.; *2a-d*, side and edge views, long. and transv. secs., ×44 (*1134).——FIG. 411,*3*. *P. japonica* (ASANO), Plio., Japan; *3a,b*, side, top views of holotype, ×48 (*2117).

Amphimorphina NEUGEBOREN, 1850, *1349, p. 125 [**A. haueriana*; OD (M)] [=*Amphimorphinella* KEIJZER, 1953, *1031, p. 274 (type, *A. butonensis*)]. Test elongate, early stage may be compressed, uniserial in megalospheric form, with

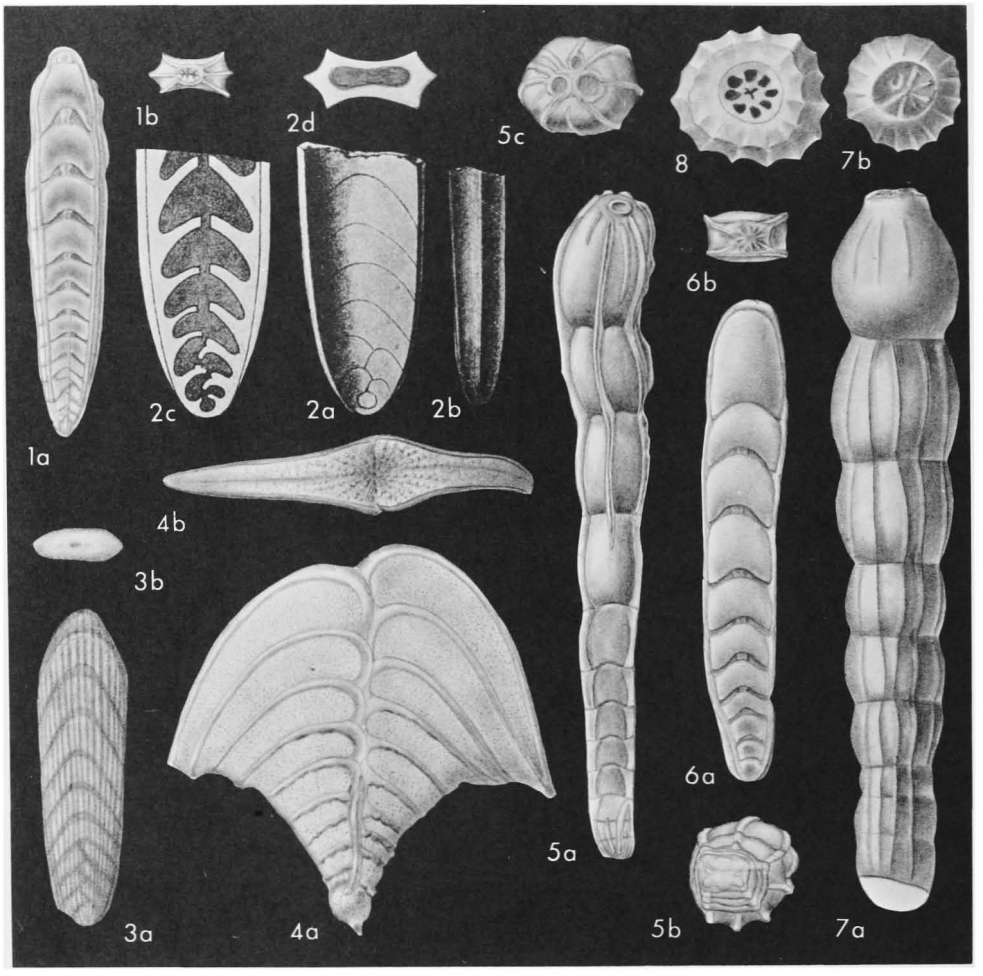

FIG. 411. Nodosariidae (Plectofrondicularriinae; *1-3, Plectofrondicularia; 4, Bolivinella; 5-8, Amphimorphina*) (p. C525-C528).

6 to 10 biserially arranged chambers in microspheric form, chambers equitant in early stage, then may be inflated; aperture in early stage radial, ribs between radial grooves converging in later growth to meet centrally, leaving 3 to 6 pores open between strong radial costae, forming cribrate aperture; apertural chamberlet may be present, as in other Nodosariidae. *M.Eoc.-Rec.*, Eu.-N.Am.-Carib.——FIG. 411,*5,6*. **A. hatieriana*, Mio., Hung. *(5)*, L.Mio., Fr. *(6)*; *5a-c*, side, basal and top views, ×52; *6a,b*, side and apert. views of megalospheric form, ×74 (*1303).——FIG. 411,*7,8*. *A butonensis* (KEIJZER), Mio.-Plio., Malay Arch.; *7a,b*, side, top views of holotype; *8*, top view of broken paratype showing intercameral openings; all ×47 (*1031).

Bolivinella CUSHMAN, 1927, *428, p. 79 [**Textularia folium* PARKER & JONES, 1865, *1418, p. 370, 420; OD]. Test compressed, flabelliform, biserial throughout, with no trace of coiling present; chambers broad, low, sutures may be limbate; aperture indistinct, but apparently basal and cribrate, apertural face obscured by numerous papillae commonly aligned in series radiating from apertural area. *Eoc.-Rec.*, Australia-Carib.-N.Am.-Eu.-Pac. ——FIG. 411,*4*. **B. folia* (PARKER & JONES), Rec., Fiji; *4a,b*, side and apert. views, ×130 (*1303).

[*Bolivinella* was placed by GALLOWAY (*762) and CUSHMAN (*486) near *Bolivinitella* in the Bolivinitinae. SIGAL in PIVETEAU (*1458) placed it in the Heterohelicidae (superfamily Buliminidea). POKORNÝ (*1478) assigned it to the superfamily Buliminidea but in the subfamily Plectofrondicularriinae, which MONTANARO GALLITELLI (*1303) elevated to family rank. The genus is here transferred to the Nodosariidae, since no trace of internal apertural modifications are seen, for example, internal tubes or tooth plates such as are characteristic of the Buliminacea. According to MONTANARO GALLITELLI (1957, *1303, p. 144), "the aperture in some specimens seems to consist of a cribrose lamina, with four or six minute openings and is covered by numerous papillae, sometimes hirsute and aligned in radiating rows. . . . An open elongate aperture, as described by Cushman and figured by Parker and Jones is only visible when the specimen is damaged. . . ." The original types of the genotype species in the PARKER & JONES collection in the British Museum (Natural History) were

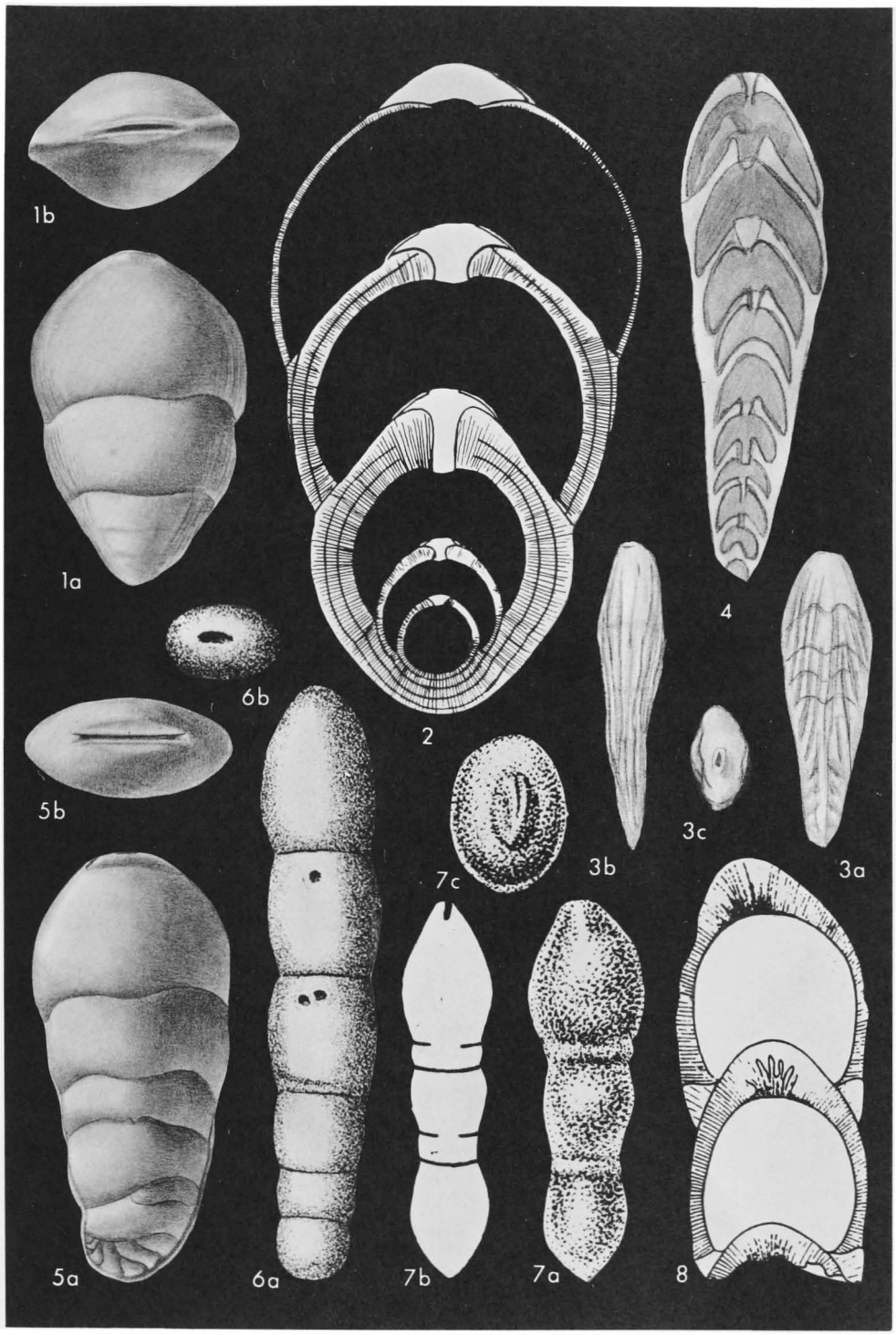

FIG. 412. Nodosariidae (Lingulininae; *1-4, Lingulina; 5, Lingulinopsis; 6-8, Lingulonodosaria*) (p. C528).

isolated by us in 1953. A lectotype was selected (BMNH-ZF3595, ex 94.4.3.1521) and paratypes isolated (BMNH-ZF3594), all from beach sand, Melbourne, Australia.]

Subfamily LINGULININAE Loeblich & Tappan, 1961

[Lingulininae Loeblich & Tappan, 1961, p. 298]

Test multilocular, chambers arranged in straight or arcuate series; aperture terminal, single elongate slit. *Perm.-Rec.*

Lingulina d'Orbigny, 1826, *1391, p. 256 [**L. carinata*; SD Cushman, 1913, *404c, p. 61] [=*Frondicularia (Frondiculina)* Gerke, 1957, *778, p. 43 (type, *F. (F.) dubiella*) (*non Frondiculina* Lamarck, 1816; *nec* Muenster, 1835); *Frondiculinita* Gerke, 1961, *782, p. 74 (*nom. nov. pro Frondicularia (Frondiculina)* Gerke, 1957)]. Test free, elongate, uniserial and compressed, with succeeding chambers strongly overlapping, as in *Pseudonodosaria*; aperture an elongate terminal slit in plane of compression. *Perm.-Rec.*, cosmop.——Fig. 412,*1,2*. **L. carinata*, Rec., Carib. *(1)*, Rec., Sicily *(2)*; *1a,b*, side, top views, ×15 (*2117); *2*, long. sec., ×48 (*700).——Fig. 412,*3,4*. *L. dubiella* (Gerke), L.Jur.(M.Lias.), USSR; *3a-c*, side, edge, and top views, ×68; *4*, sec., ×124 (*778).

Berthelinella Loeblich & Tappan, 1957, *1172, p. 225 [**Frondicularia paradoxa* Berthelin, 1879, *132, p. 33; OD]. Test free, elongate palmate, flattened; proloculus followed by reduced biserial stage of 1 or 2 pairs of chambers, later chambers uniserial and equitant; aperture slitlike. [*Berthelinella* resembles *Plectofrondicularia* in chamber arrangement and *Lingulina* in the slitlike aperture.] *Jur.*, Fr.-Alaska.——Fig. 413,*1,2*. **B. paradoxa* (Berthelin), L.Jur.(L.Pliensbach.), Fr.; *1*, side view; *2a,b*, side and top views; all ×137 (*2117).

Daucinoides de Klasz & Rérat, 1962, *1043, p. 181 [**D. circumtegens*; OD]. Test uniserial, subcircular in section, elongate proloculus followed by completely enveloping uniserial chambers, each succeeding one enclosing all previously formed; wall calcareous, finely perforate, microstructure not described, surface may be finely striate; aperture terminal, commonly a rectilinear slit or more rarely irregular in form. *L.Mio.*, W.Afr.(Gabon-Cameroon-Nigeria).——Fig. 413,*3,4*. **D. circumtegens*, Cameroon; *3a*, side view of holotype; *3b-d*, apert. views of different specimens; *4*, median sec. showing overlapping chambers; all ×27 (*1043).

[Originally placed in the Ellipsoidinidae (=Pleurostomellidae), the genus is here classed in the Lingulininae of the family Nodosariidae, because of the absence of an internal tube connecting successive apertures. As topotype specimens examined by us are pyritized, no evidence as to the wall structure is available. *Daucinoides* is similar to *Involutaria*, but differs in having a slitlike, rather than radial, aperture.]

Ellipsocristellaria Silvestri, 1920, *1773, p. 57 [**Lingulinopsis sequana* Berthelin, 1880, *133, p. 63; OD (M)]. Test enrolled as in *Lenticulina*, but with slitlike terminal aperture, as in *Lingulina*. *L.Cret.*, Fr.——Fig. 413,*5*. **E. sequana* (Berthelin), Alb., Fr.; *5a-c*, side, edge, and top views, ×80 (*133).

Gonatosphaera Guppy, 1894, *843, p. 651 [**G. prolata*; OD] [=*Linguloglandulina* Silvestri, 1903, *1756, p. 49 (type, *L. laevigata* Silvestri, 1903)]. Test free, uniserial, with strongly overlapping chambers, chambers circular in section, but with bilaterality shown in some species by development of marginal keel which extends from proloculus up sides of test to merge into apertural lips at apex of test; aperture a terminal, elongate, narrow slit, with distinctly projecting apertural lips or flanges which pass laterally into marginal keel when present. [Differs from *Lingulina* in being rounded in section, rather than compressed. Placed in the Pleurostomellinae by Cushman (*431), it differs in having a perforate radial wall and a symmetrical aperture.] *Eoc.-Mio.*, Carib.-S.Am.-Eu.——Fig. 413,*7*. **G. prolata*, Mio., Trinidad; *7a-c*, side, edge, and top views, ×40 (*2117).——Fig. 413,*8*. *G. laevigata* (Silvestri), Rec., Sicily; *8a,b*, top view and long. sec., ×29, ×32 (*700).

Lingulinopsis Reuss, 1860, *1545, p. 23 [**Lingulina bohemica* Reuss, 1846, *1538, p. 108; OD (M)]. Early stage enrolled as in *Lenticulina*, later uniserial as in *Lingulina*, compressed to slightly ovate in section; aperture a single terminal elongate slit in plane of compression. *U. Cret.-Rec.*, Eu.-S.Pac.——Fig. 412,*5*. *L. carlofortensis* Bornemann, Rec., Ki Is.; *5a,b*, side, top views, ×20 (*2117).

Lingulonodosaria Silvestri, 1903, *1756, p. 48 [**Lingulina nodosaria* Reuss, 1863, *1554, p. 59; SD Galloway, 1933, *762, p.252] [=*Lingulinella* Gerke, 1952, *777, *fide* Gerke, 1960, *780 (type, *L. arctica*)]. Test elongate, uniserial, ovate in section, with very little overlap of chambers; aperture a terminal slit; differs from *Lingulina* as *Nodosaria* does from *Pseudonodosaria*. *L.Perm.-L.Cret.*, Eu.-N.Am.-Sib.——Fig. 412,*6*. **L. nodosaria* (Reuss), L.Cret.(Gault), Eng.; *6a,b*, side, top views, ×120 (*311).——Fig. 412,*7,8*. *L. arctica* (Gerke), Perm., Sib.; *7a,b*, side, edge views; *7c*, apert. view of holotype; all ×100; *8*, long. sec., ×132 (*780).

Mucronina Ehrenberg, 1839, *667, table opposite p. 120 [**Nodosaria (Mucronine) hasta* d'Orbigny, 1826, *1391, p. 256; SD (SM) Parker, Jones & Brady, 1865, *1419, p. 27] [=*Les Mucronines* d'Orbigny, 1826, *1391, p. 256 *(nom. neg.)*; *Nodosaria (Mucronina)* Parker, Jones & Brady, 1865, *1419, p. 27; *Staffia* Schubert, 1911, *1689b, p. 78 (type, *Nodosaria tetragona* Costa, 1855, *391, p. 116); *Nodomorphina* Cushman, 1927, *428, p. 80 (type, *Nodosaria compressiuscula* Neugeboren, 1852, *1350, p. 59)]. Test elongate, narrow, uniserial, strongly carinate margins, later chambers becoming increasingly compressed;

aperture a terminal slit; differs from *Lingulonodosaria* in compressed sides and keeled margins. *Mio.-Rec.*, Eu.——Fig. 414,*1*. *M. tetragona* (Costa), Plio., Italy; *1a*, side view; *1b-f*, secs. of successive test stages, ×15 (*1899a).

Rimulina d'Orbigny, 1826, *1391, p. 257 [*R.*

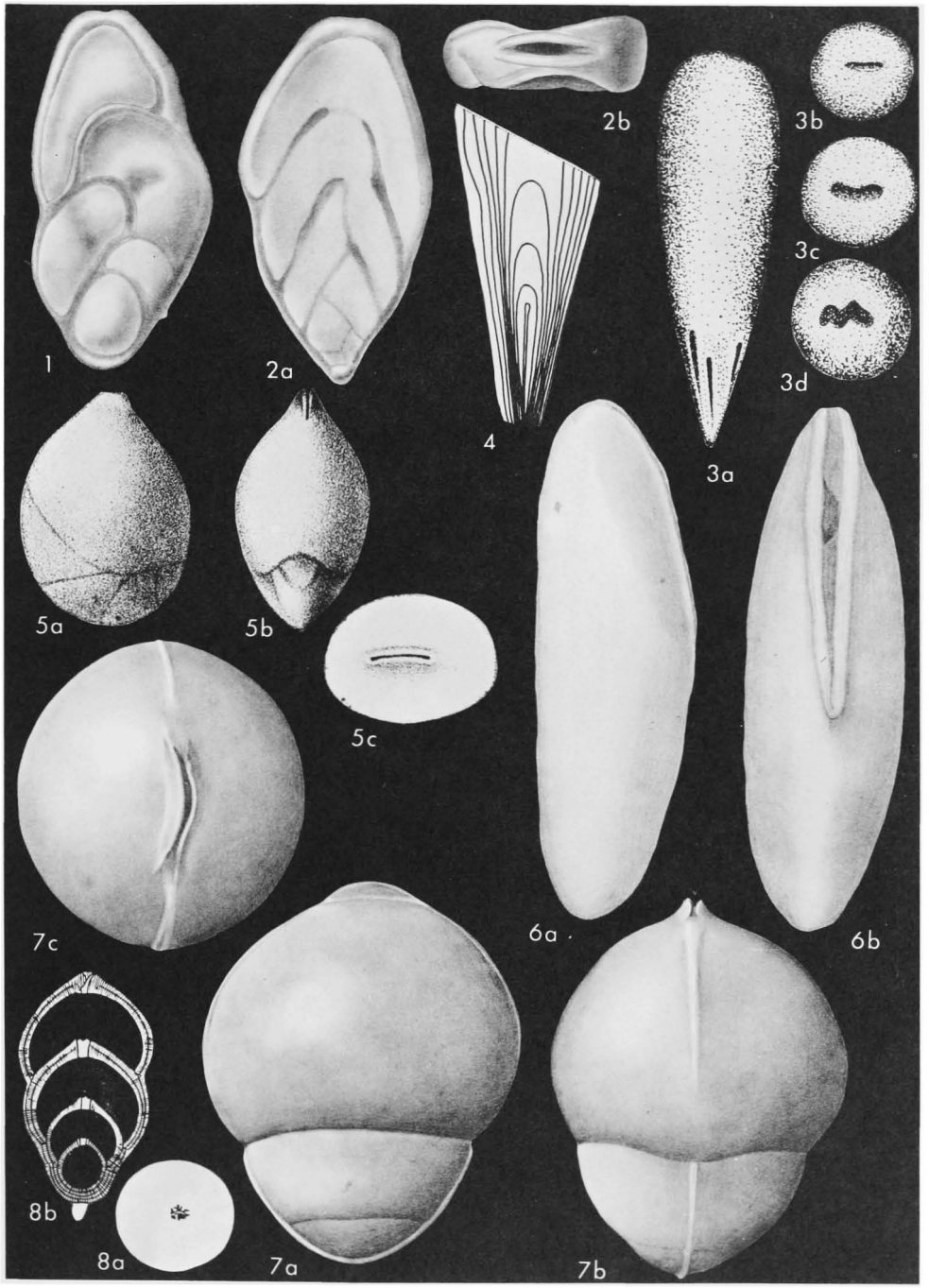

Fig. 413. Nodosariidae (Lingulininae; *1,2, Berthelinella; 3,4, Daucinoides; 5, Ellipsocristellaria; 6, Rimulina; 7,8, Gonatosphaera*) (p. C528-C530).

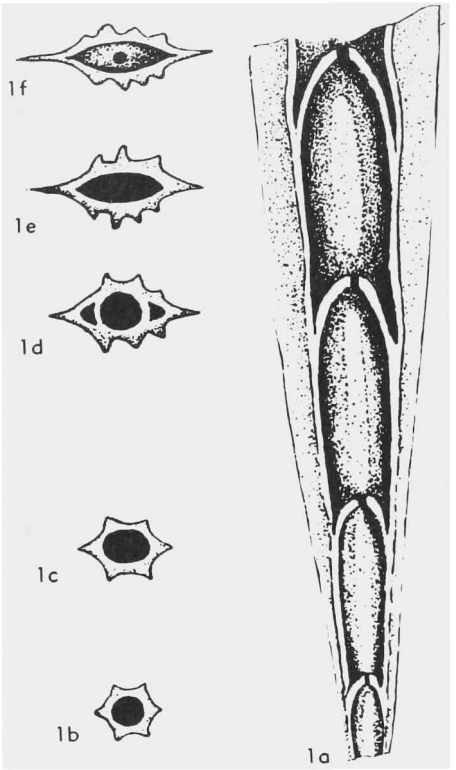

FIG. 414. Nodosariidae (Lingulininae; *1, Mucronina*) (p. C528-C529).

glabra; OD (M)]. Test elongate single chamber with elongate slit aperture extending from apex about half length of one edge. *Rec.*, Adriatic.——FIG. 413,*6*. **R. glabra; 6a,b*, side, edge views of holotype, refigured, ×77 (*2117).

Family POLYMORPHINIDAE d'Orbigny, 1839

[Polymorphinidae D'ORBIGNY in DE LA SAGRA, 1839, p. xxxix, 131]——[All names of family rank and a dagger(†) indicates *partim*]——[=Polymorphinidées D'ORBIGNY, 1840, p. 9 (*nom. neg.*); =Polymorphinideae REUSS, 1860, p. 230; =Polymorphinidea REUSS, 1860, p. 151; =Polymorphinida JONES in GRIFFITH & HENFREY, 1875, p. 320; =Polymorphinidee SCHWAGER, 1876, p. 479; =Polymorphinina BÜTSCHLI in BRONN, 1880, p. 200; =Polymorphinae DELAGE & HÉROUARD, 1896, p. 138]——[=Énallostègues† D'ORBIGNY, 1826, p. 260 (*nom. nud., nom. neg.*); =Turbinoidae D'ORBIGNY in DE LA SAGRA, 1839, p. xxxviii, 71 (*nom. nud.*); =Uvellina EHRENBERG, 1839, table opposite p. 120 (*nom. nud.*); =Enantiomorphinidae MARIE, 1941, p. 142]——[=Ramulinina LANKESTER, 1885, p. 847; =Ramulinae DELAGE & HÉROUARD, 1896, p. 138; =Ramulinidae LISTER in LANKESTER, 1903, p. 145]

Test multilocular, chambers in spiral or sigmoidal coil about longitudinal axis of growth, or biserial or uniserial, typically somewhat overlapping; aberrant forms may be irregular and attached; apertures all develop in same direction, terminal, radiate. *Trias.-Rec.*

Subfamily POLYMORPHININAE d'Orbigny 1839

[*nom. transl.* BRADY, 1881, p. 44 (*ex* family Polymorphinidae D'ORBIGNY, 1839]——[=Enantiomorphininae LOEBLICH & TAPPAN, 1961, p. 298]

Test free, chambers arranged in spiral, sigmoidal, biserial or asymmetrically alternating series; aperture terminal, radiate. *Trias.-Rec.*

Polymorphina D'ORBIGNY, 1826, *1391, p. 265 [**P. burdigalensis*; SD GALLOWAY & WISSLER, 1927, *766, p. 53] [=*Les Polymorphines* D'ORBIGNY, 1826, *1391, p. 265 (*nom. neg.*); *Rostrolina* VON SCHLICHT, 1870, *1648, pl. 25, 26 (type, *Polymorphina burdigalensis* D'ORBIGNY, 1826, *1391, p. 265, SD LOEBLICH & TAPPAN, herein) (obj.); *Glandulopolymorphina* A. SILVESTRI, 1901, *1752, p. 17 (type, *Polymorphina burdigalensis* D'ORBIGNY, 1826, SD LOEBLICH & TAPPAN, herein) (obj.)]. Test elongate, somewhat compressed, commonly twisted; chambers biserial, early ones may be somewhat sigmoid. *Paleoc.-Rec.*, cosmop.——FIG. 415,*1*. **P. burdigalensis*, Mio.(Burdigal.), Fr.; *1a,b*, ×49 (*2117).

Enantiomorphina MARIE, 1941, *1215, p. 144 [**E. lemoinei*; OD]. Test elongate, ovate to subcylindrical with chambers overlapping in alternating series, unequally inclined on longitudinal axis, although not completely biserial; sutures flush; aperture terminal, radiate. *U.Cret.(Senon.)*, Eu.——FIG. 415,*5*. **E. lemoinei*, Fr.; *5a,b*, opposite sides; *5c*, edge view, ×87 (*2117).

Eoguttulina CUSHMAN & OZAWA, 1930, *514, p. 16 [**E. anglica*; OD]. Test with chambers added in elongate spiral series in planes less than 90° apart, each succeeding chamber farther from base. *Jur.-U.Cret.*, Eu., N.Am.——FIG. 415,*2*. **E. anglica*. U.Cret.(Cenoman.), Eng.; *2a-c*, opposite sides and base of holotype, ×90 (*2117).

Falsoguttulina BARTENSTEIN & BRAND, 1949, *94, p. 671 [**F. wolburgi*; OD]. Test with chambers arranged in low spiral series, in planes approximately 120° apart; aperture a simple curved slit, not radiate. *L.Cret.(Valangin.)*, Ger.——FIG 415,*9*. **F. wolburgi*; *9a-d*, opposite sides, top, and basal views, ×156 (*2117).

Glandulopleurostomella SILVESTRI, 1903, *1757, p. 217 [**Polymorphina subcylindrica* HANTKEN, 1875, *863, p. 60; OD (M)] [=*Paleopolymorphina* CUSHMAN & OZAWA, 1930, *514, p. 12, 112 (type, *Polymorphina pleurostomelloides* FRANKE, 1928, *740, p. 121)]. Test elongate, early chambers spiral, later ones biserially arranged. *Jur.-Oligo.*, Eu.-N.Am.——FIG. 415,*3*. **G. subcylindrica* (HANTKEN), L.Oligo., Hung.; ×20 (*863).——FIG. 415,*4*. *G. pleurostomelloides* (FRANKE), U.Cret.(Cenoman.), Ger.; *4a-c*, side, edge, and top views, ×56 (*2117).

Globulina D'ORBIGNY in DE LA SAGRA, 1839, *1611, p. 134 [**Polymorphina (Globuline) gibba* D'ORBIGNY, 1826, *1391, p. 266; SD CUSHMAN,

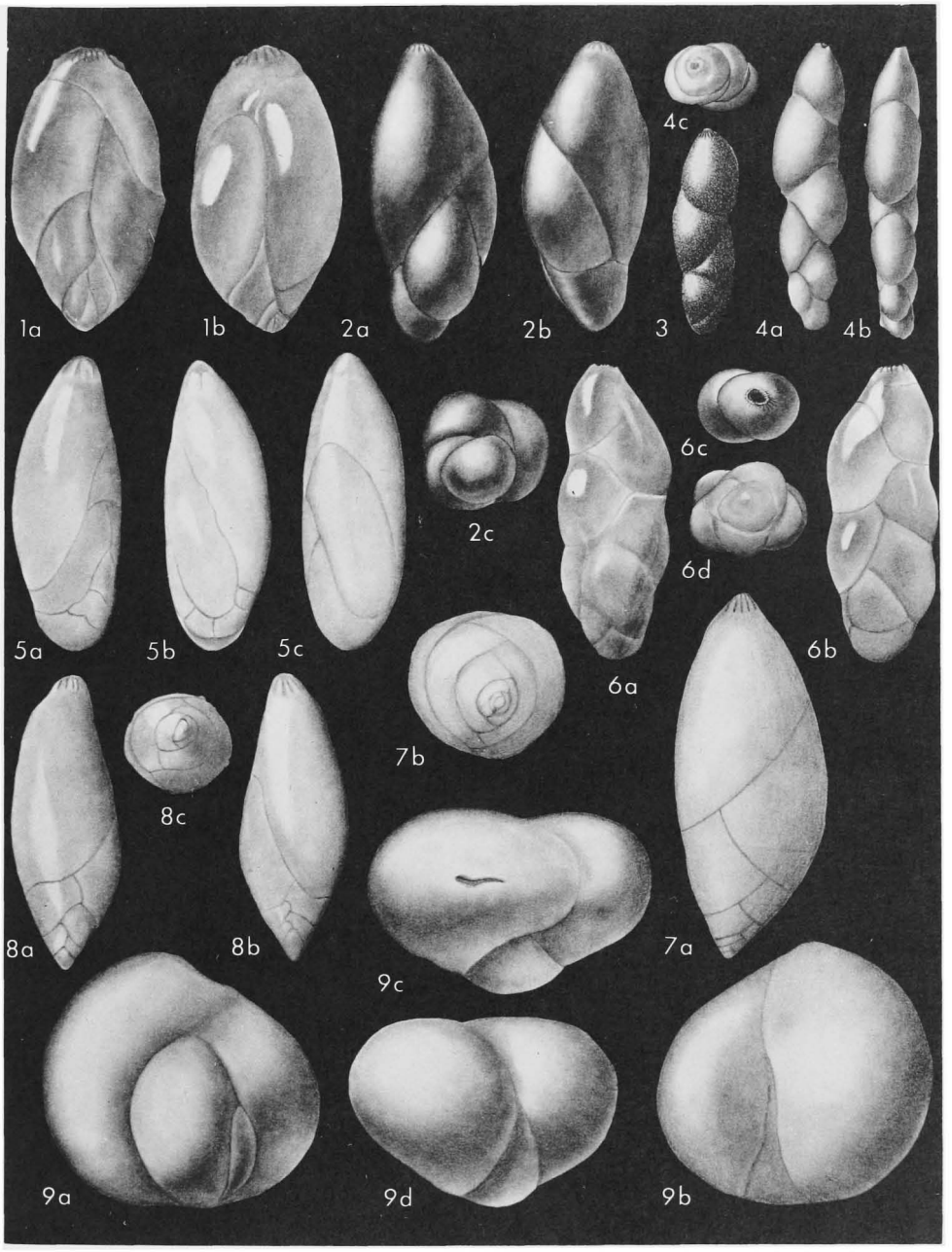

FIG. 415. Polymorphinidae (Polymorphininae; *1, Polymorphina; 2, Eoguttulina; 3,4, Glandulopleurostomella; 5, Enantiomorphina; 6, Pseudopolymorphina; 7,8, Pyrulinoides; 9, Falsoguttulina*) (p. C530, C533).

1927, *433, p. 189] [=*Polymorphina (Les Globulines)* D'ORBIGNY, 1826, *1391, p. 266 *(nom. van.)*; *Guttulina (Globulina)* D'ORBIGNY in DE LA SAGRA, 1839, *1611, p. 134 (obj.); *Aulostomella* ALTH, 1850, *13, p. 263 (type, *A. pediculus* ALTH, 1850, SD LOEBLICH & TAPPAN, herein)]. Test globular to ovate, chambers strongly overlapping, added in planes approximately 144° apart; sutures flush, not depressed, aperture radiate, but commonly obscured by fistulose growth. *U.Jur.-Rec.*, cosmop.——FIG. 416,*1*. **G. gibba*, Mio. (Torton.), Aus.; *1a,b*, side, basal views, ×45 (*514).

Guttulina D'ORBIGNY in DE LA SAGRA, 1839, *1611,

p. 132 [**Polymorphina (Guttuline) communis* D'ORBIGNY, 1826, *1391, p. 266; SD GALLOWAY & WISSLER, 1927, *766, p. 56] [=*Polymorphina (Les Gutttulines)* D'ORBIGNY, 1826, *1391, p. 266 (*nom. neg.*); *Guttulina (Guttulina)* D'ORBIGNY in DE LA SAGRA, 1839, *1611, p. 132 (obj); *Sig-*

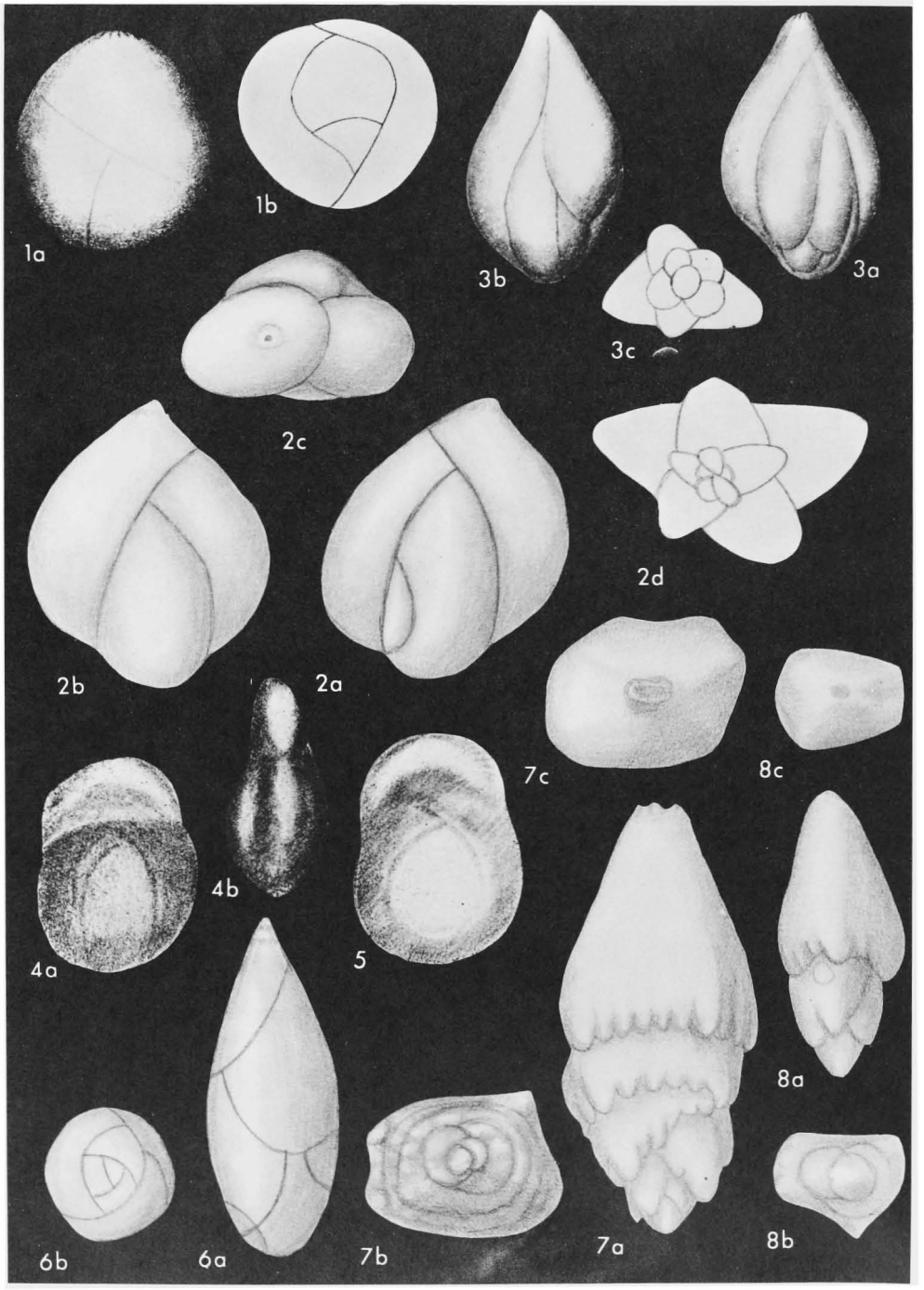

FIG. 416. Polymorphinidae (Polymorphininae; *1, Globulina; 2,3, Guttulina; 4,5, Pseudopolymorphinoides; 6, Pyrulina; 7,8, Sagoplecta*) (p. C530-C533).

momorpha CUSHMAN & OZAWA, 1928, *513, p. 17 (type, *S. sadoensis* CUSHMAN & OZAWA, 1928)]. Test ovate to elongate; inflated chambers added in quinqueloculine spiral series, in planes 144° apart, each successive chamber extending farther from base but strongly overlapping; sutures depressed; aperture radiate. *Jur.-Rec.,* cosmop.——FIG. 416,*2*. **G. communis* (D'ORBIGNY), Plio., Italy; *2a-d,* opposite sides, top view, and diagram. sec., enlarged (*1611).——FIG. 416,*3*. *G. sadoensis* (CUSHMAN & OZAWA), U.Plio., Japan; *3a-c,* opposite sides and basal view, ×45 (*514).

Paradentalina UCHIO, 1960, *1961, p. 60 [**Enantiodentalina muraii* UCHIO, 1953, *1960, p. 152; OD]. Like *Dentalina,* but with early chambers definitely biserial. [The Cretaceous species placed in *Enantiodentalina* are not congeneric with the Recent *Dentalina communis* D'ORBIGNY, which was selected as type of *Enantiodentalina*. As *Enantiodentalina* is thus a synonym of *Dentalina, Paradentalina* was proposed for species with an early biserial stage]. *Cret.-Rec.,* N.Am.-Eu.-Japan.——FIG. 417,*1,2*. **P. muraii* (UCHIO), Plio.-Pleist., Japan; *1,* holotype, ×70; *2a,b,* side, face views of paratype, ×65 (*1960).

Pseudopolymorphina CUSHMAN & OZAWA, 1928, *513, p. 15 [**P. hanzawai*; OD]. Test elongate; early chambers in quinqueloculine arrangement, later biserial; chambers high and overlapping only slightly; sutures depressed; aperture radiate. *Jur.-Rec.,* Japan-Pac.-Australia-Atl.-N.Am.-S.Am.-Eu.-Carib.——FIG. 415,*6*. **P. hanzawai,* Plio., Japan; *6a-d,* opposite sides, top, and basal views, ×15 (*2117).

Pseudopolymorphinoides VAN BELLEN, 1946, *113, p. 41 [**P. limburgensis*; OD]. Early stage inflated, with chambers in quinqueloculine arrangement, final chamber terminal and compressed; sutures flush; aperture an elongate slit. [Differs from *Falsoguttulina* in being quinqueloculine, rather than triloculine, in early stage]. *M.Eoc.,* Eu.(Neth.).——FIG. 416,*4,5*. **P. limburgensis; 4a,b,* side, edge views of holotype; *5,* side view of paratype; all ×35 (*113).

Pyrulina D'ORBIGNY in DE LA SAGRA, 1839, *1611, p. 107 [**Polymorphina (Pyruline) gutta* D'ORBIGNY, 1826, *1391, p. 267, 310; OD (M)] [=*Polymorphina (Les Pyrulines)* and *Polymorphina (Pyruline)* D'ORBIGNY, 1826, *1391, p. 267, 310 (subgeneric names=*nom. neg.*); *Pirulina* BRONN & ROEMER, 1853, *214a, p. 88 *(nom. van.)*; *Pyrulinella* CUSHMAN & OZAWA, 1928, *513, p. 16 (type, *Polymorphina lanceolata* REUSS, 1851, *1541, p. 83)]. Test fusiform; early chambers arranged in spiral series approximately 120° apart, later chambers biserial; sutures flush; aperture radiate. *Jur.-Rec.,* cosmop.——FIG. 416,*6*. **P. gutta* (D'ORBIGNY), Plio., Italy; *6a,b,* side, basal views, enlarged (*1391).

Pyrulinoides MARIE, 1941, *1215, p. 169, 255 [**Pyrulina acuminata* D'ORBIGNY, 1840, *1394, p. 43; OD]. Test free, elongate, fusiform; chambers biserially arranged, much embracing; sutures oblique, flush; aperture terminal, radiate. [*Pyrulinoides* differs from *Pyrulina* in being biserial throughout, and in lacking the early spiral stage.] *Trias.-U.Cret.,* Eu.-N.Am.——FIG. 415,*7,8*. **P. acuminata* (D'ORBIGNY), U.Cret.(Senon.), Fr.; *7a,b,* lectotype (MNHN), side, and basal views, ×36 (*2117); *8a-c,* opposite sides and basal view of hypotype, ×48 (*2117).

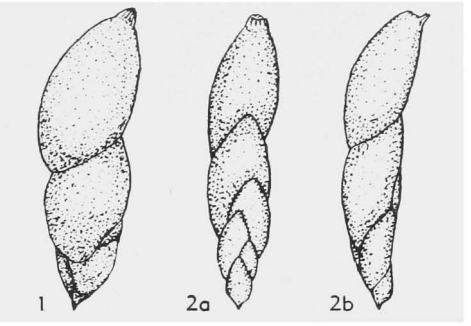

FIG. 417. Polymorphinidae (Polymorphininae; *1,2, Paradentalina*) (p. C533).

Sagoplecta TAPPAN, 1951, *1873, p. 14 [**S. goniata*; OD]. Test free, elongate, early portion biserial, later portion uniserial and quadrate or flattened with later chambers equitant and chevron-shaped, overhanging earlier chambers at angles of test; wall calcareous; aperture terminal, radiate. [*Sagoplecta* differs from *Spirofrondicularia* in having a distinctly biserial, rather than tetraloculine, early stage.] *U.Trias.,* N.Am.(Alaska).——FIG. 416, *7,8*. **S. goniata; 7a-c,* side, basal, and top views of microspheric holotype, ×95 (*1873); *8a-c,* side, basal, and top views of megalospheric paratype, ×95 (*1873).

Sigmoidella CUSHMAN & OZAWA, 1928, *513, p. 18 [**S. kagaensis*; OD] [=*Sigmoidella (Sigmoidina)* CUSHMAN & OZAWA, 1928, *513, p. 18 (type, *S. (S.) pacifica* CUSHMAN & OZAWA, 1928)]. Test compressed, chambers arranged in sigmoid series, those on each side reaching to base and covering earlier chambers on one side. *M.Eoc.-Rec.,* Japan-Formosa-Indon.-N.Am.-N.Z.——FIG. 418,*1*. **S. kagaensis,* U.Plio., Japan; *1a,b,* opposite sides of paratype, ×49 (*2117).——FIG. 418,*2*. *S. pacifica,* Rec., Philip.; *2a-c,* opposite sides and basal view, ×24 (*514).

Sigmomorphina CUSHMAN & OZAWA, 1928, *513, p. 17 [**Sigmomorpha (Sigmomorphina) yokoyamai*; OD] [=*Sigmomorpha (Sigmomorphina)* CUSHMAN & OZAWA, 1928, *513, p. 17 (obj.); *Ellisina* LALICKER, 1950, *1082, p. 18 (type, *Ellisina spatula* LALICKER, 1950) (*non Ellisina* NORMAN, 1903); *Pealerina* LALICKER in THALMANN, 1950, *1902, p. 43, *nom. subst. pro Ellisina* LALICKER, 1950 (*non Ellisina* NORMAN, 1903); *Sigmomorphina (Sigmomorphinoides)* ROUVIL-

LOIS, 1960, *1589, p. 62 (type, *Sigmomorphina (Sigmomorphinoides) parisiensis* ROUVILLOIS, 1960)]. Test elongate, compressed, chambers added in planes slightly less than 180° apart, forming sigmoid series, each chamber farther removed from base but strongly overhanging at

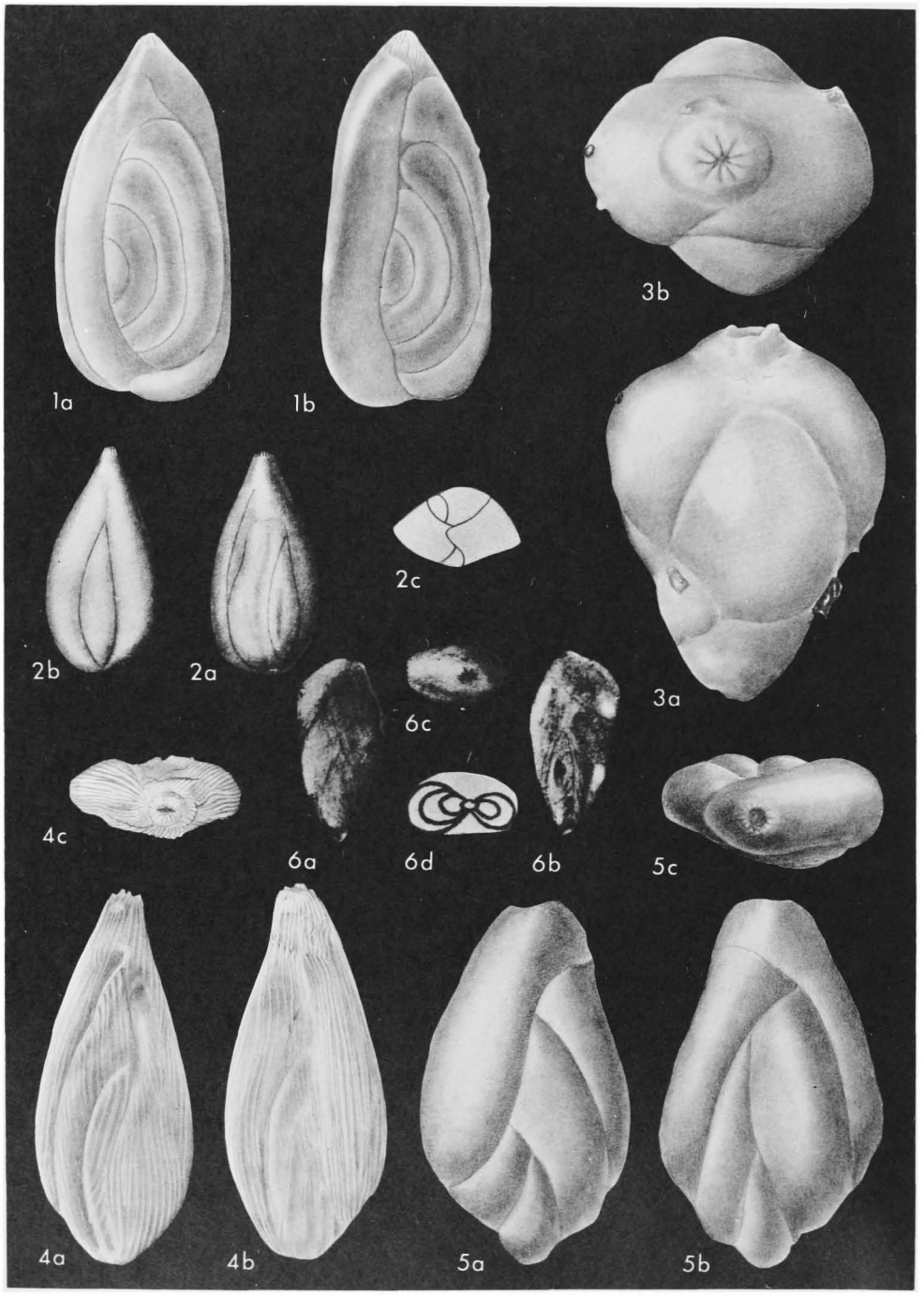

FIG. 418. Polymorphinidae (Polymorphininae; *1,2, Sigmoidella; 3, Spirofrondicularia; 4-6, Sigmomorphina*) (p. C533-C535).

edges of test; sutures depressed; aperture radiate. [*Sigmomorphinoides* was separated by the presence of 2 apertures on the final chamber, apparently an accidental occurrence in abnormal specimens and not here regarded as of generic importance.] *Jur.-Rec.,* Japan-Eu.-N. Am.-S. Am.-Cuba-Trinidad-N.Z.-Australia-Antarctic. —— FIG. 418,*4*. **S. yokoyamai,* Plio., Japan; *4a-c,* opposite sides and top view, ×61 (*2117).——FIG. 418,*5*. *S. spatula* (LALICKER), Jur., USA(Mont.); *5a-c,* opposite sides and top view of holotype, ×119 (*2117).——FIG. 418,*6*. *S. parisiensis* ROUVILLOIS, L.Eoc.(Thanet.), Fr.; *6a-d,* opposite sides, top, and basal view of holotype, ×30 (*1589).

Spirofrondicularia SCHUBERT, 1902, *1681, p. 16 [**Polymorphina frondicularioides* CHAPMAN, 1894, *310, p. 716; SD GALLOWAY, 1933, *762, p. 262] [=*Quadrulina* CUSHMAN & OZAWA, 1930, *514, p. 12, 18 (type, *Polymorphina rhabdogonioides* CHAPMAN, 1894, *310, p. 716)]. Test with early chambers tetraloculine, added in planes 90° apart; sutures depressed; aperture terminal, radiate. *L. Jur.-L.Cret.,* Eu.——FIG. 418,*3*. **S. frondicularioides* (CHAPMAN), L.Cret.(Apt.), Eng.; *3a,b,* side, top views, ×192 (*2117).

Tobolia DAIN in N. K. BYKOVA *et al.,* 1958, *265, p. 39 [**T. veronikae*=*T. veronica* E. V. BYKOVA, DAIN & FURSENKO in RAUZER-CHERNOUSOVA & FURSENKO, 1959, *1509, p. 17 *(nom. van.)*; OD]. Test globular, chambers added in planes 140° apart, as in *Guttulina,* strongly overlapping, sutures flush to slightly depressed; slitlike aperture somewhat produced. *U.Cret.(Maastricht.),* Sib. ——FIG. 419,*1*. **T. veronikae*; *1a-c,* opposite sides, edge, and basal views, ×72 (*265).

Subfamily WEBBINELLINAE Rhumbler, 1904

[Webbinellinae Rhumbler, 1904, p. 224] [=Arwebbina RHUMBLER, 1913, p. 346 *(nom. van.)*]

Test attached, one or more chambers connected by stolons, early portion may be globular or polymorphine, with attachment rounded or irregularly spreading. *Jur.-Rec.*

Webbinella RHUMBLER, 1904, *1569, p. 228 [**Trochammina (Webbina) irregularis hemisphaerica* JONES, PARKER & BRADY, 1865, *1002, p. 26, =*Webbina hemisphaerica* JONES, PARKER & BRADY, 1865, *1002, p. 27; SD CUSHMAN, 1918, *411a, p. 61] [=*Arwebbinum* RHUMBLER, 1913, *1572b, p. 346 (obj.) *(nom. van.)*]. Test attached, early multilocular polymorphine or pyruline stage surrounded by flangelike chamber spreading on surface of substratum; wall calcareous, perforate, no apparent aperture. [Restudy of the holotype of the type-species showed it to be a calcareous perforate polymorphinid and not an attached arenaceous single-chambered form (*1172). *L.Cret.-Rec.,* cosmop.——FIG. 420,*7*. **W. hemisphaerica* (JONES, PARKER & BRADY), Plio.(L.Crag), Eng.; ×48 (*1172).

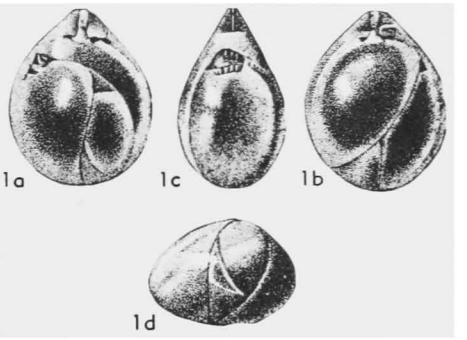

FIG. 419. Polymorphinidae (Polymorphininae; *1, Tobolia*) (p. *C*535).

Bullopora QUENSTEDT, 1856, *1495, p. 292 [**B. rostrata* QUENSTEDT, 1857; SD (SM) QUENSTEDT, 1857, *1495, p. 580]. [=*Arperneroum* RHUMBLER, 1913, *1572b, p. 444 (type, *Webbina irregularis* D'ORBIGNY, 1850, *1397b, p. 111); *Placopsum* RHUMBLER, 1913, *1572b, p. 445 (type, *Webbina breoni* TERQUEM & PIETTE in TERQUEM, 1862, *1883, p. 458); *Arplacopsum* RHUMBLER, 1913, *1572b, p. 445 (type, *Webbina breoni* TERQUEM & PIETTE in TERQUEM, 1862) *(nom. van.)*]. Test attached, composed of single series of hemispherical chambers, rounded to ovate in outline, earlier chambers may be closely appressed, later ones connected by more or less well-developed stoloniferous necks as in type-species; in microspheric forms chambers increase rapidly in size, but chambers may all be of approximately equal size in megalospheric forms; wall calcareous, perforate; aperture at open end of stolon-like neck. *Jur.-Cret.,* cosmop.——FIG. 420,*1*. **B. rostrata,* U.Jur.(Malm alpha), Ger.; *1a-d,* ×19 (*2117).——FIG. 420,*2,3*. *B. breoni* (TERQUEM & PIETTE), L.Jur.(Lias.), Fr.; *2,3a,b,* ×10 (*1572b).——FIG. 420,*4*. *B. irregularis* (D'ORBIGNY), U.Cret., Czech.; *4a,* side view, ×10; *4b,* view of detached specimen, ×22; *4c,* long. sec., ×28 (*1445).

[*Bullopora* was originally named and figured (QUENSTEDT, 1856, fasc. 2, p. 292, pl. 41, fig. 26 and 1856, fasc. 3, p. 554, pl. 72, fig. 35) with no species named. In 1857, (fasc. 4, p. 580, pl. 73, fig. 28) *B. rostrata* was named, automatically becoming the type of the genus by subsequent monotypy. Much confusion concerning the type-species is found, for it has been variously regarded as a calcareous imperforate form (*1200, p. 25), considered to be a senior synonym of *Nubeculinella* and *Nodobacularia* (*1200, p. 27), belonging to the Ophthalmidiidae (*1200, p. 25, *1478, p. 254), Nubeculariidae (*64, p. 838), Nodosinellidae (*762, p. 167) or as a calcareous perforate form belonging to the Polymorphinidae (*486, p. 230, *1509, p. 264) and including *Vitriwebbina* as a junior synonym. LOEBLICH & TAPPAN in 1954, with Drs. E. BUCH & K. FEIFEL collected at the type locality, which is an erosional slope exposing the Upper Jurassic (Malm alpha), middle *Impressa* Mergel, in the valley of Fils, between Unter Böhringer and Reichenbach i T., northeast of Reichenbach, Württemberg, Germany. The type-species was clearly stated by QUENSTEDT to be from the lower Weisse Jura alpha (explanation of pl. 73), not the Oberer Lias, Zeta zone, *Aalensis* Mergel, as reported by ELLIS & MESSINA (*700). The *Bullopora* recorded from the Lias Zeta

(p. 292, pl. 41, fig. 26) and from the Brauner Jura Zeta (p. 554, pl. 72, fig. 35) was never given a specific name, and does not show the stoloniferous necks which QUENSTEDT stated to be characteristic of the species *B. rostrata*.]

Histopomphus LOEBLICH & TAPPAN, 1949, *1156, p. 262 [**Globulina redriverensis* TAPPAN, 1943, *1872, p. 505; OD]. Test large, early portion

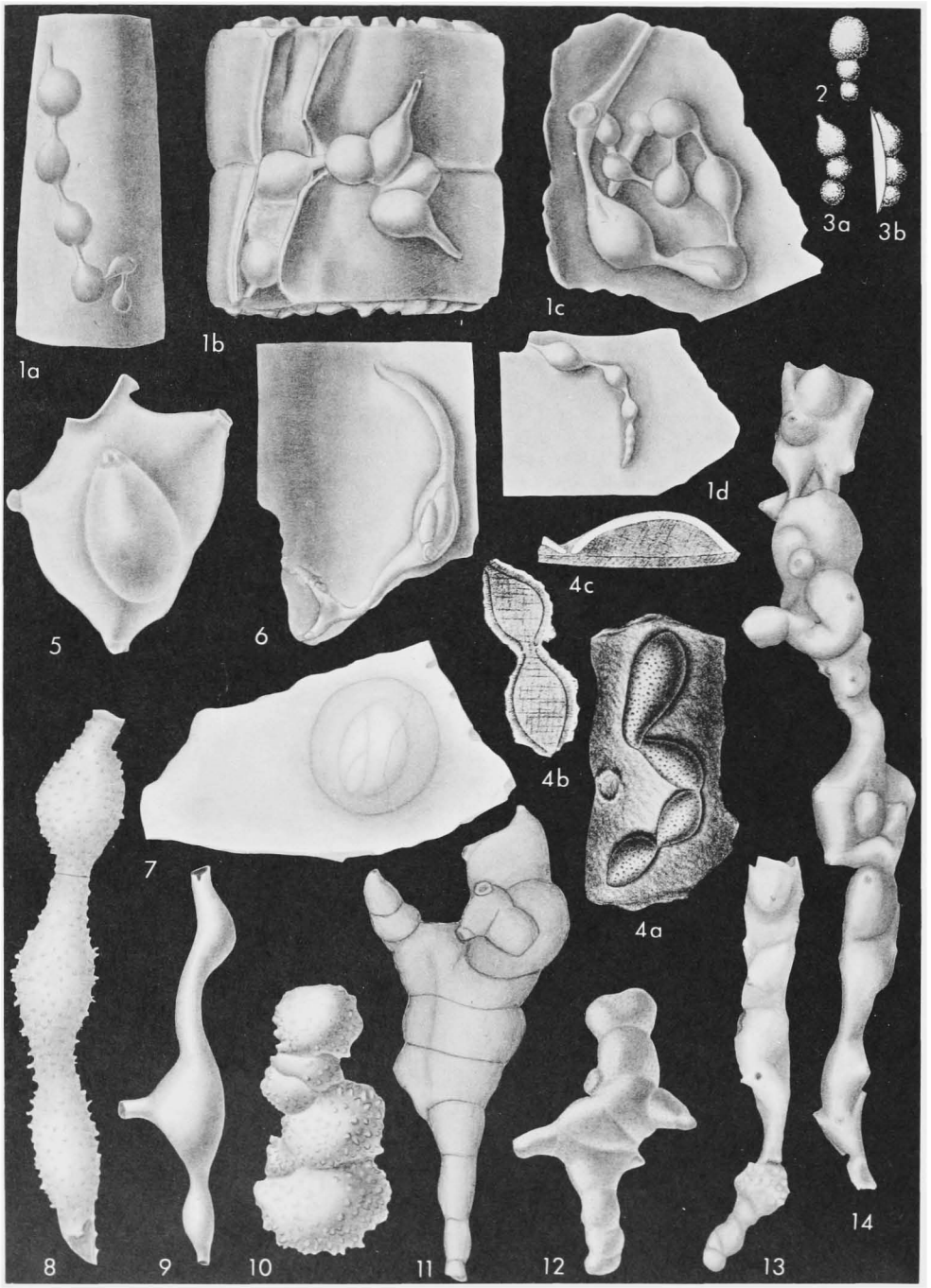

FIG. 420. Polymorphinidae (Webbinellinae; *1-4, Bullopora; 5, Vitriwebbina; 6, Histopomphus; 7, Webbinella;* Ramulininae; *8,9, Ramulina; 10, Ramulinella; 11,12, Washitella; 13,14, Sporadogenerina*) (p. C535-C537).

polymorphine, later attached portion consisting of branching or bifurcating undivided tubular chamber; wall calcareous, perforate; aperture rounded or low arch at ends of tubular chamber. [Differs from *Vitriwebbina* in possessing a multilocular early polymorphine stage, followed by an elongate branching tubular attached stage, and from *Webbinella* in having an irregular branching attachment, instead of the circular disclike attachment.] *L.Cret.*, N.Am.——Fig. 420,*6*. **H. redriverensis* (Tappan), L.Cret.(Alb.), USA(Okla.); ×20 (*2117).

Vitriwebbina Chapman, 1892, *309, p. 52, 53 [**V. sollasi* Chapman, 1892; SD Cushman, 1927, *433, p. 189]. Differs from *Bullopora* in having central initial chamber surrounded by broad flangelike chamber rather than uniserial series of simple chambers; may also have additional chambers after bilocular beginning; apertures at open ends of tubular projections from flange. [Lectotype of *V. sollasi* here designated, specimen figured by Chapman (*309, pl. 2, fig. 1). Chapman's specimen of fig. 3 is a *Bullopora*.] *Cret.*, Eu.-N.Am. ——Fig. 420,*5*. **V. sollasi*, L.Cret.(Gault), Eng.; specimen broken free of substratum to which it had been attached, ×70 (*2117).

Subfamily RAMULININAE Brady, 1884

[Ramulininae Brady, 1884, p. 71]

Test free, with one or more chambers connected by stolons. *Jur.-Rec.*

Ramulina Jones in Wright, 1875, *2079, p. 88 [**R. laevis*; OD]. Test consisting of globular or irregular chambers loosely connected by stolonlike necks, or by straight or branching tube with local irregular chamber-like swellings; apertures rounded, at open ends of tube or stoloniferous necks. [Because of confusion concerning the generic status of *R. aculeata* (d'Orbigny), which has been referred to both *Dentalina* and *Ramulina*, even in a single publication (*484, p. 67, 100), it was restudied by us in Paris and found to represent a true *Ramulina*.] *Jur.-Rec.*, cosmop. ——Fig. 420,*9*. **R. laevis*, U.Cret., Ire., ×17 (*2079).——Fig. 420,*8*. *R. aculeata* (d'Orbigny), U.Cret., Fr.; lectotype, here designated and refigured (MNHN), ×20 (*2117).

Ramulinella Paalzow, 1932, *1405, p. 135 [**R. suevica*; OD (M)]. Similar to *Ramulina* but with closely appressed irregularly arranged chambers and without intercameral stolons. *U.Jur.(Oxford.)*, Eu.-N.Am.(USA).——Fig. 420,*10*. **R. suevica*, Ger.; side view, ×42 (*1405).

Sporadogenerina Cushman, 1927, *430, p. 95 [**S. flintii* Cushman, 1927 (=**Ramulina proteiformis* Flint, 1899, *723, p. 321); OD]. Test elongate, with irregular early portion and later uniserial or branching stage; chambers inflated, somewhat overlapping; aperture radiate, terminal in early stage, later with multiple radiate apertures, irregularly placed. *Rec.*, Gulf Mex.——Fig. 420, *13,14*. **S. proteiformis* (Flint); *13*, side view of holotype of *S. flintii*; *14*, side view of hypotype; both ×25 (*2117).

Washitella Tappan, 1943, *1872, p. 515 [**W. typica*; OD]. Test free, consisting of well-defined but very irregularly arranged chambers, which may be in linear or slightly coiled series or variously branched; apertures simple, rounded, at ends of series of chambers, commonly more than one per chamber. [*Washitella* differs from *Sporadogenerina* in having rounded, rather than radiate, apertures and more regular chambers.] *L.Cret.(Alb.)-U.Cret.(Cenoman.)*, USA(Okla.-Tex.).—— Fig. 420,*11,12*. **W. typica*, L.Cret., Tex. *(11)*, Okla. *(12)*; *11*, hypotype, ×75; *12*, holotype, ×75 (*2117).

Family GLANDULINIDAE Reuss, 1860

[Glandulinidae Reuss, 1860, p. 151] [=Stichostègues d'Orbigny, 1826, p. 251 *(partim) (nom. nud., nom. neg.)*; =Ovulinida Haeckel, 1894, p. 185 *(nom. nud.)*]

Test unilocular or with chambers in biserial, uniserial or polymorphine arrangement; aperture terminal, radial or slitlike, with simple, straight or curved internal (entosolenian) tube. *Jur.-Rec.*

Subfamily GLANDULININAE Reuss, 1860

[*nom. correct.* Loeblich & Tappan, 1961, p. 299 *(pro* subfamily Glandulinidea Reuss, 1862, p. 307), *nom. transl. ex* family Glandulinidae Reuss, 1860] [=Glandulinea Hantken, 1875, p. 41]

Test biserial, uniserial or polymorphine; aperture terminal, radial or slitlike, with internal tube. *Jur.-Rec.*

Glandulina d'Orbigny in de la Sagra, 1839, *1611, p. 12 [**Nodosaria (Glanduline) laevigata* d'Orbigny, 1826, *1391, p. 252; SD Cushman, 1927, *433, p. 189] [=*Psecadium* Neugeboren, 1856, *1351, p. 99 (type, *P. ellipticum*); *Encorycium* Ehrenberg, 1858, *683, p. 12 (type, *E. nodosaria*); *Atractolina* von Schlicht, 1870, *1648, p. 69 (type, *Nodosaria (Glanduline) laevigata* d'Orbigny, 1826, SD Loeblich & Tappan, herein) (obj.)]. Test free, elongate, circular in section, early portion biserial, later uniserial; chambers strongly overlapping and increasing in size; sutures distinct, flush; aperture terminal, central, radiate, with entosolenian tube. [Although superficially resembling *Pandaglandulina*, type material of the type-species of *Psecadium* was stated by Cushman (*486, p. 228) to be biserial in the early stage and thus belongs with *Glandulina*.] *Paleoc.-Rec.*, cosmop.——Fig. 421,*1,2*. **G. laevigata* (d'Orbigny), Rec., Can. *(1)*, Greenl. *(2)*; *1*, side view; *2*, specimen showing internal tube, ×49 (*1162).

Dainita Loeblich & Tappan, herein [*nom. nov. pro Mariella* Dain in N. K. Bykova, *et al.*, 1958, *265, p. 41 (*non* Nowak, 1916; *nec* Mörch, 1865, *nom.*

null. pro Mariaella GRAY, 1855)] [**Mariella sibirica* DAIN in N. K. BYKOVA *et al.*, 1958, *265, p. 41, here designated as type-species)]. Similar to *Siphoglobulina* but with later stage biserial; aperture radiate, with tube attached to one wall of final chamber. *L.Cret.(Hauteriv.)-U.Cret.(Maas-*

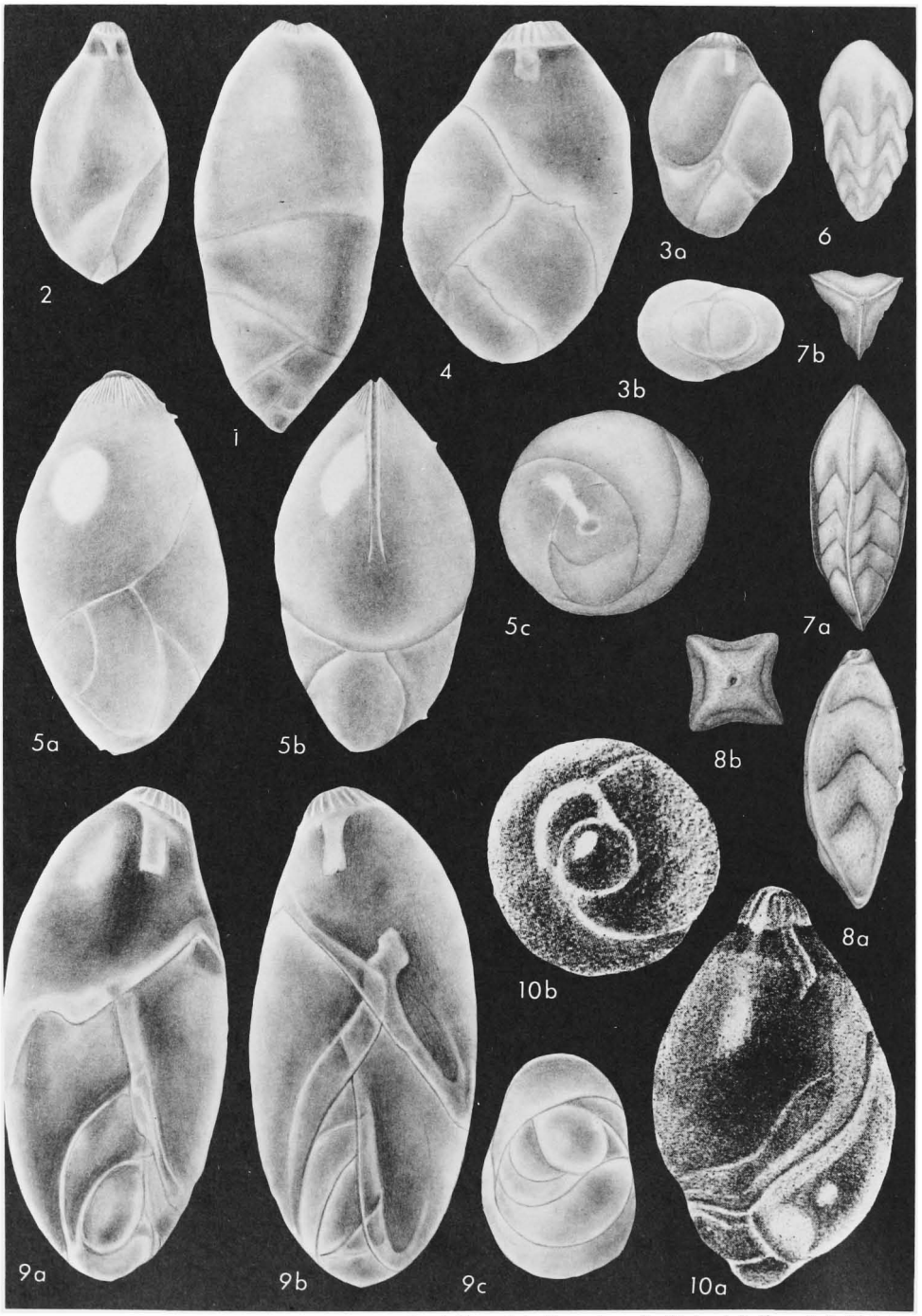

FIG. 421. Glandulinidae (Glandulininae; *1,2, Glandulina; 3,4, Esosyrinx; 5, Siphoglobulina; 6-8, Tristix; 9, Laryngosigma; 10, Globulotuba*) (p. C537, C539-C540).

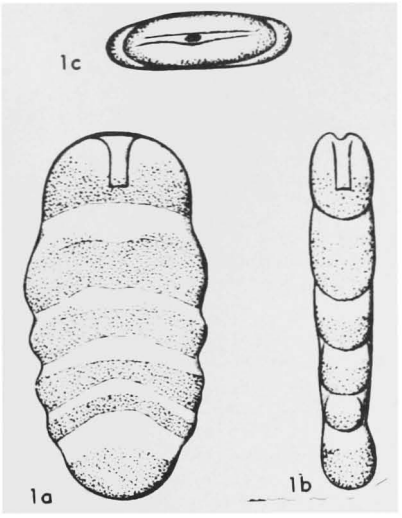

FIG. 422. Glandulinidae (Glandulininae; *1, Entolingulina*) (p. C539).

tricht.), Eu.-Sib.——FIG. 423,*1*. **D. sibirica* (DAIN), U.Cret.(Maastricht.), Sib.; *1a-d,* opposite sides, edge, and basal views, ×47 (*265).

Entolingulina LOEBLICH & TAPPAN, 1961, *1181, p. 220 [**Lingulina aselliformis* BUCHNER, 1942, *250, p. 121; OD]. Test free, elongate, compressed, of 2 or more chambers in rectilinear series, commonly with considerable overlap of earlier chambers; wall calcareous, finely perforate, hyaline; aperture ovate or elongate slit, with distinct entosolenian tube projecting into final chamber. *Rec.,* Eu.-Antarctic.——FIG. 422,*1*. **E. aselliformis* (BUCHNER), Rec., Italy; *1a-c,* side, edge, and top views, ×200 (*250).

Esosyrinx LOEBLICH & TAPPAN, 1953, *1162, p. 85 [**Pseudopolymorphina curta* CUSHMAN & OZAWA, 1930, *514, p. 105; OD]. Test free, chambers biserially arranged throughout and in single plane; aperture terminal, radiate, with internal tube. [*Esosyrinx* differs from *Pseudopolymorphina* in being biserial throughout and in having an internal tube, and from *Laryngosigma* in having chambers in a single plane rather than a sigmoid series.] *Rec.,* Atl.——FIG. 421,*3,4*. **E. curta* (CUSHMAN & OZAWA); *3a,b,* side and basal views of holotype, *4,* side view of hypotype; all ×48 (*1162).

Globulotuba COLLINS, 1958, *375, p. 385 [**G. entosoleniformis*; OD] Test ovate, circular in section; chambers in triloculine arrangement, sutures flush; aperture radiate, with short, free, internal entosolenian tube. *Rec.,* Australia.——FIG. 421,*10*. **G. entosoleniformis; 10a,b,* side and basal views, ×150 (*375).

Laryngosigma LOEBLICH & TAPPAN, 1953, *1162, p. 83 [**L. hyalascidia*; OD]. Test free, somewhat compressed; chambers biserially arranged, added in planes slightly less than 180° apart, forming sigmoid series with each succeeding chamber farther removed from base; aperture terminal, radiate, with entosolenian tube. *Rec.,* Atl.-Arctic-Antarctic-Australia.——FIG. 421,*9*. **L. hyalascidia,* Alaska; *9a-c,* opposite sides and basal view, ×100 (*1162).

[*Laryngosigma* is similar to *Sigmomorphina* but differs in possessing an entosolenian tube within the aperture. It differs from *Esosyrinx* in being sigmoid and biserial, and from *Siphoglobulina* in being biserial rather than triserial, and in having a free entosolenian tube which is not attached to the interior chamber wall.]

Oolitella MAKIYAMA & NAKAGAWA, 1941, *1206, p. 242, 243 [**O. irregularis*, OD]. Test with irregularly arranged inflated chambers; wall thin, finely perforate; aperture terminal, rounded, with entosolenian tube. *Pleist.,* Japan.——FIG. 424,*1-3*. **O. irregularis*; *1,* holotype, showing entosolenian tube; *2,3,* paratypes; all ×100 (*1206).

Siphoglobulina PARR, 1950, *1429, p. 332 [**S. siphonifera*; OD]. Test elongate-ovate to subfusiform; chambers in triloculine series, strongly overlapping but each farther removed from base; aperture radiate, with entosolenian tube extending downward along inner wall of final chamber and opening to exterior in short slit at its lower end, relict slits of earlier chambers remaining visible. *L.Tert.-Rec.,* Australia-Antarctic.——FIG. 421,*5*. **S. siphonifera,* Mio., Australia; *5a-c,* side, face, and basal views, ×44 (*2117).

Tristix MACFADYEN, 1941, *1200, p. 54 [**Rhabdogonium liasinum* BERTHELIN, 1879, *132, p. 35; OD] [=*Tricarinella* TEN DAM & SCHIJFSMA, 1945, *558, p. 233 (type, *Rhabdogonium excavatum* REUSS, 1863, *1554, p. 91; *Quadratina*

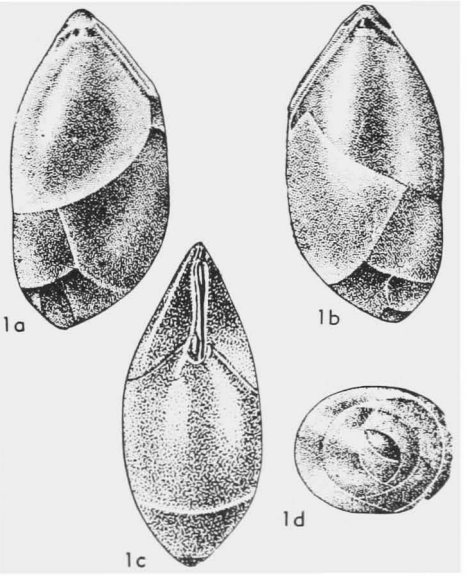

FIG. 423. Glandulinidae (Glandulininae; *1, Dainita*) (p. C537-C539).

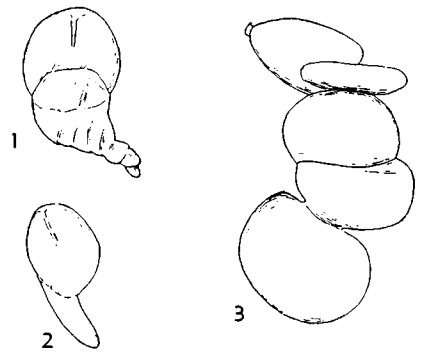

FIG. 424. Glandulinidae (Glandulininae; *1-3, Oolitella*) (p. C539).

TEN DAM, 1946, *552, p. 65 (type, *Q. depressula* TEN DAM, 1946)]. Test free, uniserial, generally triangular in section, but rarely quadrate; wall calcareous, hyaline; aperture terminal, rounded to radiate, with entosolenian tube in at least some species. [Differs from *Glandulina* in being uniserial throughout, angular in section and with less overlapping chambers.] *L.Jur.-Eoc.*, Eu.-N.Am.——FIG. 421,*6*. **T. liasina* (BERTHELIN), L.Jur.(L.Pleinsbach.), Fr.; side view, ×146 (*2117).——FIG. 421,*7,8*. *T. reesidei* LOEBLICH & TAPPAN, U.Jur., USA; *7a,b*, side and top views of normal triangular form, ×48; *8a,b*, side and top views of rarer quadrate form, ×64 (*2117).

Subfamily SEABROOKIINAE Cushman, 1927

[Seabrookiinae CUSHMAN, 1927, p. 86]

Test compressed, early stage with proloculus and 2 chambers to whorl, later chambers added 180° from preceding and completely enveloping earlier formed chambers; aperture terminal, oval to slitlike, commonly with thickened lip. *U.Cret.-Rec.*

Seabrookia BRADY, 1890, *202, p. 570 [**S. pellucida*; OD (M)] [=*?Cerviciferina* GODDARD & JENSEN, 1907, *799, p. 305 (type, *C. hilli* GODDARD & JENSEN, 1907)]. Test free, elongate ovate, compressed, early stage with 3 chambers to whorl, rapidly enlarging chambers 2 per coil in later stages, completely involute, aperture of successive chambers at opposite ends of test, as in miliolids; wall calcareous, perforate, radial in structure, may have peripheral keel, in type-species aboral end ornamented with small blunt spines along keel; aperture a terminal slit bordered by distinct lip. *U.Cret.-Rec.*, Eu.-Atl.-Pac.-Cuba.——FIG. 425,*1*. **S. pellucida*, Rec., Pac.; *1a-c*, opposite sides and apert. view, ×140 (*2117).

[*Seabrookia* has been included in the Chilostomellidae (*486, *762, *1458) but has a perforate radial wall, whereas tests of chilostomellid genera are granular. It resembles some of the Miliolidae in alternation of the aperture to opposite ends of the test in successive chambers, but differs from these in having a perforate radial wall. This wall character and the entosolenian tube places *Seabrookia* in the family Glandulinidae.]

Subfamily OOLININAE Loeblich & Tappan, 1961

[Oolininae LOEBLICH & TAPPAN, 1961, p. 299]

Test unilocular, with slitlike or radiate aperture and entosolenian tube. *Jur.-Rec.*

Oolina D'ORBIGNY, 1839, *1393, p. 18 [**O. laevigata*; SD GALLOWAY & WISSLER, 1927, *766, p. 50] [=*Ovulina* EHRENBERG, 1845, *675, p. 358 (*non Ovulina* SCHULTZE, 1854; *nec* GRUBER, 1884) (*nom. van. pro Oolina* D'ORBIGNY, 1839) (obj.); *Cenchridium* EHRENBERG, 1845, *675, p. 357 (type, *C. sphaerula* EHRENBERG, 1845); *Entosolenia* WILLIAMSON, 1848, *2064, p. 16 (type, *E. lineata* WILLIAMSON, 1848); *Entosalenia* PARKER & JONES, 1857, *1416, p. 278 (*nom. van.*) (obj.); *Obliquina* SEGUENZA, 1862, *1712, p. 75 (type, *O. acuticosta* SEGUENZA, 1862); *Lagenulina* TERQUEM, 1876, *1888, p. 67 (type, *L. sulcata* TERQUEM, 1876, SD LOEBLICH & TAPPAN, herein); *Entolagena* SILVESTRI, 1900, *1751, p. 4 (type, *Vermiculum globosum* MONTAGU, 1803, *1298, p. 523); *Lagena (Reussoolina)* COLOM, 1956, *376, p. 71 (type, *Oolina apiculata* REUSS, 1851, *1542, p. 22)]. Test single globular to ovate chamber, rarely somewhat asymmetrical; surface may be smooth or ornamented with striae, reticulations or costae; aperture rounded and may have radiating grooves surrounding aperture on exterior, internally provided with entosolenian tube; mononucleate; at least some species ectoparasitic on other foraminifers, having reproductive cycle reduced to only asexual generation, with small size and single nucleus suggesting that haploid stage is represented. *Jur.-Rec.*, cosmop.——FIG. 425,*2*. *O. lineata* (WILLIAMSON), Rec., Alaska; *2a,b*, side and top views, ×75 (*1162).——FIG. 425,*3*. *O. striatopunctata* (PARKER & JONES), Rec., Alaska; chamber broken, showing entosolenian tube, ×75 (*1162).——FIG. 425,*4*. **O. laevigata*, Rec., Falk. Is.; *4a,b*, side and top views of holotype (MNHN), ×58 (*2117).——FIG. 425,*5*. *O. apiculata* REUSS, U. Cret., Pol.; side view, ×54 (*700).——FIG. 425, *6*. *O. acuticosta* (SEGUENZA), Mio., Sicily; *6a-c*, side and opposite edges, ×30 (*700).

[*Oolina marginata* is an ectoparasite on *Discorbis*, and during its reproductive stage moves to margin of the host, constructs a chitinoid cyst around the aperture into which the protoplasm moves after dissolution of the entosolenian tube. The protoplasm and nucleus then divide asexually into 2 to 6 parts, each reorganizes, secretes a calcareous test, leaves the cyst, and returns to the host (*1109).]

Fissurina REUSS, 1850, *1540, p. 366 [**F. laevigata*; OD (M)] [=*Hyaleina* COSTA, 1856, *392, p. 366 (type, *Fissurina laevigata* REUSS, 1850, SD LOEBLICH & TAPPAN, herein) (obj.); *Trigonulina* SEGUENZA, 1862, *1712, p. 74 (*non* D'ORBIGNY, 1846) (type, *T. oblonga* SEGUENZA, 1862); *Ellipsolagena* A. SILVESTRI, 1923, *1774, p. 265, 268 (type, *Lagena acutissima* FORNASINI, 1890, *729, p. 1; *Ellip-*

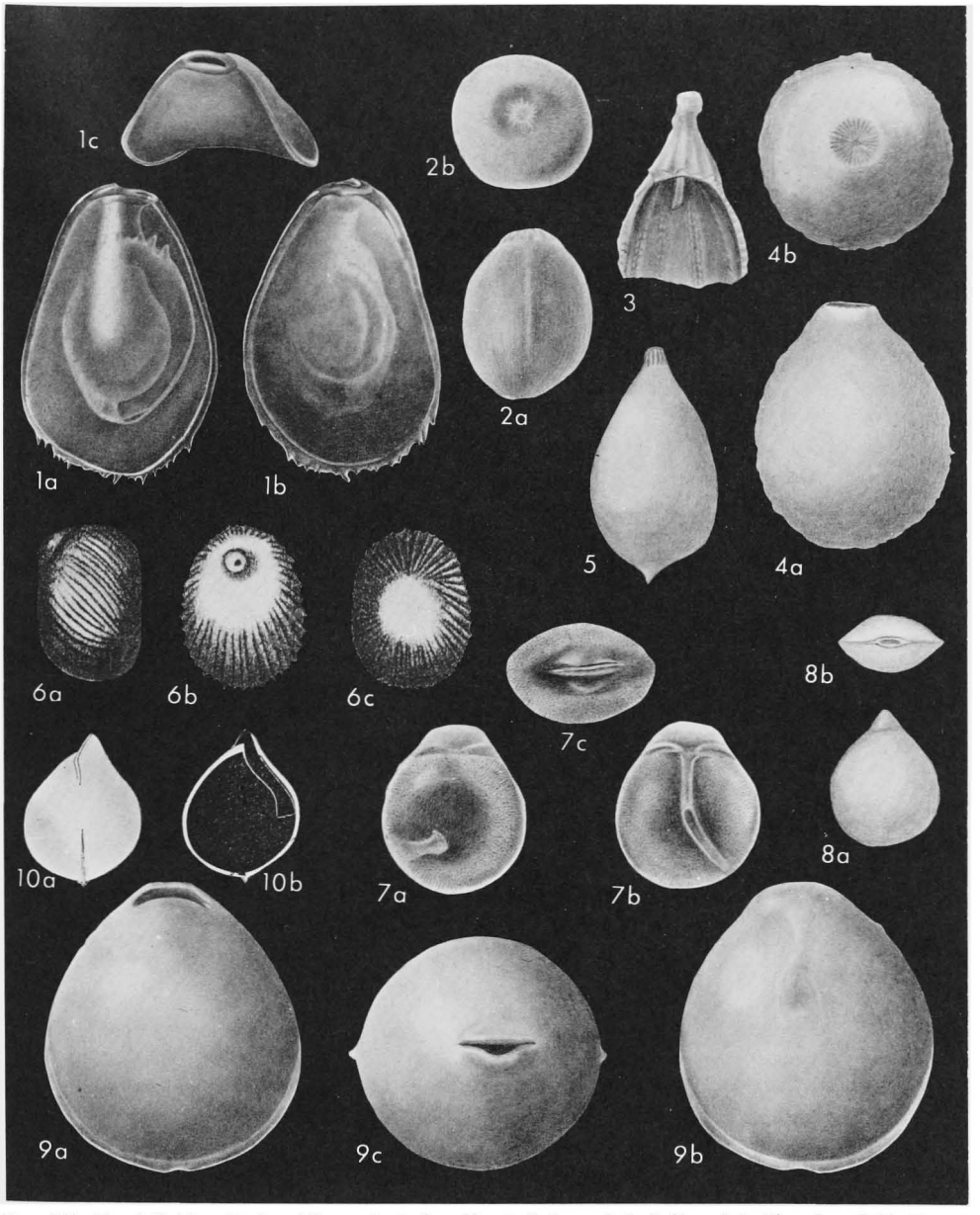

FIG. 425. Glandulinidae (Seabrookiinae; *1, Seabrookia;* Oolininae; *2-6, Oolina; 7,8, Fissurina; 9,10, Parafissurina*) (p. C540-C543).

sofissurina A. SILVESTRI, 1923, *1774, p. 265 (type, *Fissurina laevigata* REUSS, 1850, SD LOEBLICH & TAPPAN, herein) (obj.)]. Test rounded to ovate in outline; compressed, trigonal or tetragonal in section, and may be keeled; surface smooth, costate, beaded, pitted or reticulate; aperture slitlike to oval or rounded, in center of fissure-like cavity at one end of test; entosolenian tube projecting inward from aperture into chamber cavity. [*Ellipsolagena* is a synonym of *Fissurina* (*1428) with the type-species *Lagena acutissima* FORNASINI, 1890, by monotypy, and not with *Lagena ventricosa* SILVESTRI, 1904, as type by subsequent designation of CUSHMAN (1927, *431, p. 72).] *Cret.-Rec.,* cosmop.——FIG. 425,*7. F. marginata* (MONTAGU), Rec., Alaska; *7a-c,* side, edge, and top views, ×75 (*1162).——FIG. 425,*8. *F. laevigata* REUSS, Tert., Ger.; *8a,b,* side, apert. views, ×60 (*1540).

Parafissurina PARR, 1947, *1428, p. 123 [**Lagena*

ventricosa SILVESTRI, 1904, *1758, p. 10; OD]. Test single ovate chamber, commonly compressed; surface smooth or rarely keeled; aperture arched or crescentic subterminal opening at one side of test, with overhanging hoodlike extension of wall; entosolenian tube as in *Oolina* and *Fissurina*.

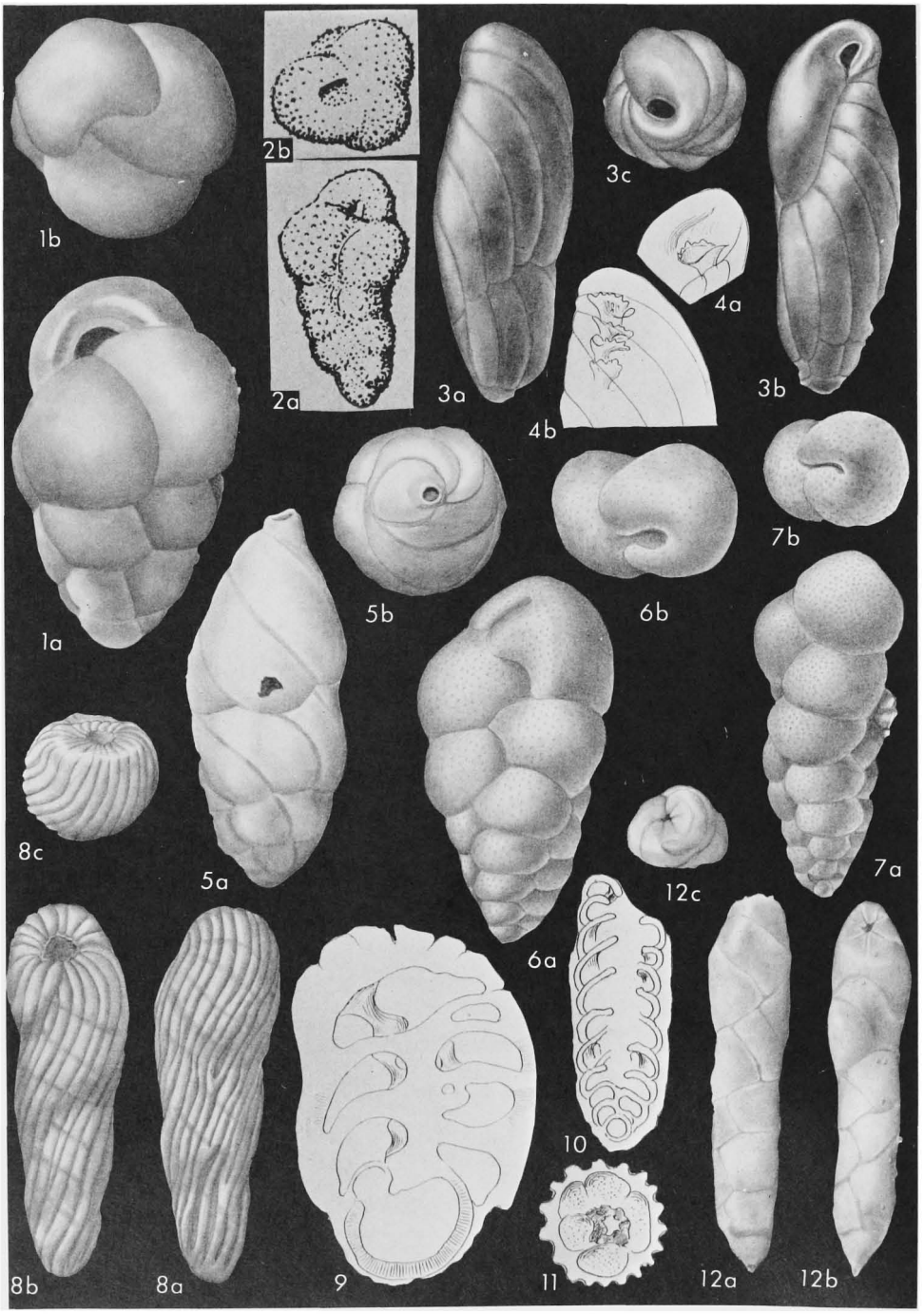

FIG. 426. Turrilinidae (Turrilininae; *1,2, Turrilina; 3,4, Buliminella; 5, Buliminellita; 6,7, Neobulimina; 8-12, Buliminoides*) (p. C543-C545).

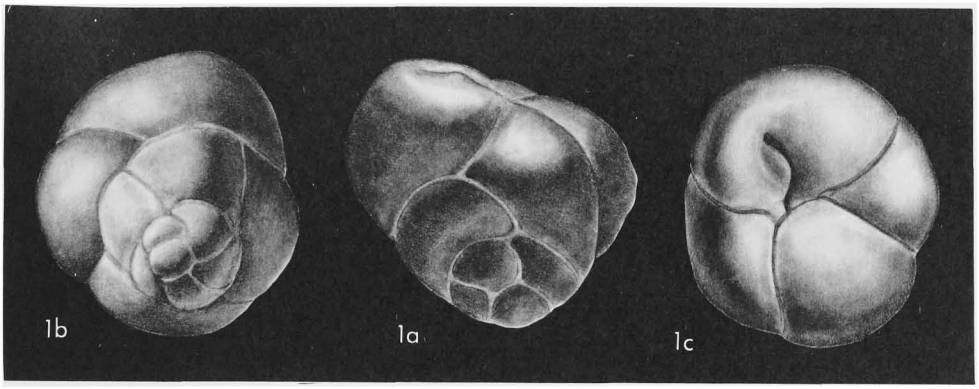

FIG. 427. Turrilinidae (Turrilininae; *1, Baggatella*) (p. C543).

[The hooded aperture is reminiscent of the Pleurostomellidae, but the radially built wall shows relationship with the Oolininae.] *M.Eoc.-Rec.*, cosmop.——FIG. 425,*9,10*. **P. ventricosa* (SILVESTRI), Mio., Italy; *9a*, side view showing hooded aperture; *9b*, opposite side showing entosolenian tube; *9c*, top view; all ×111 (*2117); *10a,b*, profile and cross sec., ×55 (*1758).

Superfamily BULIMINACEA Jones, 1875

[*nom. correct.* LOEBLICH & TAPPAN, 1961, p. 299 (*pro* superfamily Buliminidea GLAESSNER, 1945, p. 134, and Buliminicae EASTON, 1960, p. 65, 79)]——[In synonymic citations superscript numbers indicate taxonomic rank assigned by authors (¹superfamily, ²family group); dagger (†) indicates *partim*]——[=¹Enclinostegia† EIMER & FICKERT, 1899, p. 682 (*nom. nud.*); =²Textulinidia† RHUMBLER in KÜKENTHAL & KRUMBACH, 1923, p. 88]

Test high trochospiral or modified to biserial or uniserial; wall finely or coarsely perforate, of radially built calcite; aperture primary, basal slit, or in apertural face, or terminal; may have internal tooth plate or tube, and aperture may be on neck. *U. Trias.-Rec.*

Family TURRILINIDAE Cushman, 1927

[*nom. transl.* LOEBLICH & TAPPAN, 1961, p. 300 (*ex* subfamily Turrilininae CUSHMAN, 1927)] [=Buliminellidae HOFKER, 1951, p. 121]

Test high trochospiral, with more than 3 chambers to whorl, or may be reduced to biserial; wall of radially lamellar calcite; apertural face poreless, formed by outgrowth from tooth plate, may be radially grooved. *M.Jur.-Rec.*

Subfamily TURRILININAE Cushman, 1927

[Turrilininae CUSHMAN, 1927, p. 65] [=Buliminellinae N. K. BYKOVA in RAUZER-CHERNOUSOVA & FURSENKO, 1959, p. 323; =Baggatellinae N. K. BYKOVA in RAUZER-CHERNOUSOVA & FURSENKO, 1959, p. 325]

Test high-spired, with 3 or more chambers to whorl; aperture loop-shaped, in face of last-formed chamber. *M.Jur.-Rec.*

Turrilina ANDREAE, 1884, *19, p. 120 [**T. alsatica*; OD (M)] [=*Corrosina* NYIRÖ, 1954, *1382, p. 68, 71, 73 (type, *C. pupoides*)]. Test free, elongate, high-spired, 3 or more chambers to whorl; wall calcareous, finely perforate, monolamellar, microstructure unknown, surface smooth or roughened; aperture a small, basal arch in final chamber, presence or absence of internal tooth plate unknown. [Originally *Corrosina* was placed in the Heterohelicidae, as related to *Guembelitria*, but more prismatic in form. Both *Turrilina* and *Corrosina* were first described from the Oligocene of western and central Europe, respectively. More information is needed as to wall structure and the presence or absence of an internal tooth plate.] *Eoc.(Ypres.)-U.Oligo.*, Eu.——FIG. 426,*1*. **T. alsatica*, M.Oligo., Fr.; *1a,b*, side, top views, ×235 (*2117).——FIG. 426,*2*. *T. pupoides* (NYIRÖ), U.Oligo.(Chatt.), Fr.; *2a,b*, side, apert. views of holotype, ×115 (*1382).

Baggatella HOWE, 1939, *971, p. 79 [**B. inconspicua*; OD]. Test free, tiny, with relatively low spire, 4 or 5 chambers to whorl; aperture loop-shaped, extending up face of final chamber. *M. Eoc.-U.Oligo.*, N.Am.-Carpathians.——FIG. 427,*1*. **B. inconspicua*, M.Eoc.(Cook Mountain), USA (La.); *1a-c*, side, basal, and apert. views, ×300 (*2117).

Buliminella CUSHMAN, 1911, *404b, p. 88 [**Bulimina elegantissima* D'ORBIGNY, 1839, *1393, p. 51; OD]. Test free, elongate, with high close spiral formed by numerous very high, narrow chambers, commonly with many chambers to whorl and few whorls; wall calcareous, perforate, radial in structure, apertural face just above aperture poreless to sharp angle of apertural ridge, surface smooth to striate, rarely spinose; aperture loop-shaped, with upper end relatively broad, internal tooth plate connecting aperture with that of previous chamber. [Early Cretaceous species referred to *Buliminella* belong to *Praebulimina* or *Caucasina*.] *U.Cret.(Maastricht.)-Rec.*, cosmop. ——FIG. 426,*3,4*. **B. elegantissima* (D'ORBIGNY), Rec., Brazil *(3)*, Peru *(4)*; *3a-c*, opposite sides and apert. view, ×208 (*2117); *4a*, optical sec.

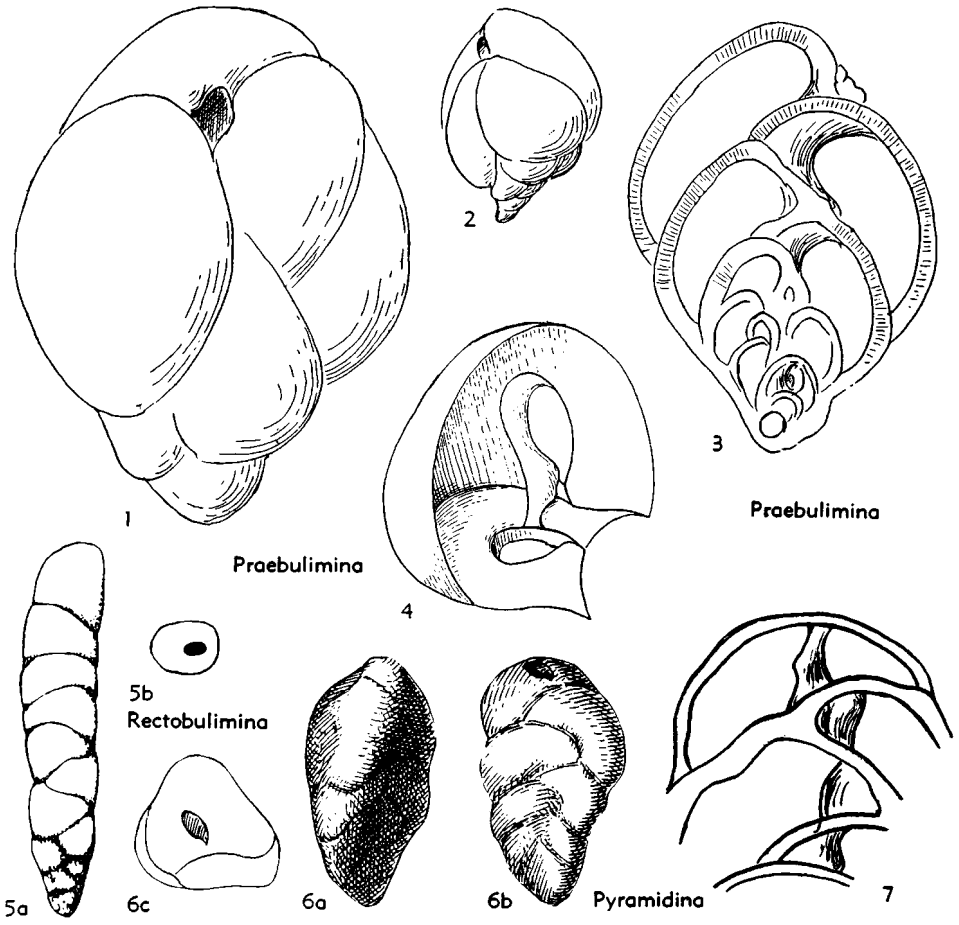

FIG. 428. Turrilinidae (Turrilininae; *1-4, Praebulimina; 5, Rectobulimina; 6,7, Pyramidina*) (p. C545-C546).

showing tooth plate in final chamber from apert. side, ×333; *4b,* successive tooth plates in optical sec. from opposite side, ×333 (*928c).

Buliminellita CUSHMAN & STAINFORTH, 1947, *526, p. 78 [**B. mirifica*; OD]. Test elongate, chambers arranged in high trochospiral coil, approximately 3 to 5 high, narrow chambers to whorl; aperture in early stage as in *Buliminella* but terminal and rounded in adult and produced on neck. *U.Eoc.-Mio.,* Ecuad.-Afr.——FIG. 426,*5. *B. mirifica,* U.Eoc., Ecuad.; *5a,b,* side, top views of holotype, ×116 (*2117).

Buliminoides CUSHMAN, 1911, *404b, p. 90 [**Bulimina williamsoniana* BRADY, 1881, *196c, p. 56; OD] [=*Elongobula* FINLAY, 1939, *717c, p. 321 (type, *E. chattonensis*)]. Test free, elongate, early chambers in low trochospiral coil, then spire increasing rapidly in height with coiling around open umbilicus, about 5 chambers to whorl, aligned oblique to axis, septal walls partially resorbed internally so that chambers open into umbilical hollow; wall calcareous, perforate radial in structure; surface smooth or with prominent longitudinal costae which cross sutures obliquely and obscure structure externally; aperture umbilical, with simple tooth plate. [As *Elongobula chattonensis* differs only in the absence of ornamentation from typical *Buliminoides,* the genus is here regarded as synonymous. The Upper Cretaceous *Elongobula creta* FINLAY apparently belongs to *Buliminella.*] *Oligo.-Rec.,* Indo-Pac.-W.trop. Atl. ——FIG. 426,*8-11. *B. williamsoniana* (BRADY), Rec., Fiji *(8),* Indon. *(9-11)*; *8a-c,* opposite sides and apert. view, ×94 (*2117); *9,* long. sec. showing tooth plates, ×210; *10,* long. sec. showing resorbed internal walls, ×150; *11,* transv. sec. showing chambers around hollow umbilical axis, ×150 (*928c).——FIG. 426,*12. *B. chattonensis* (FINLAY), L.Oligo.(Duntroon.), N.Z.; *12a-c,* opposite sides and apert. view, ×94 (*2117).

Neobulimina CUSHMAN & WICKENDEN, 1928, *541, p. 12 [**N. canadensis*; OD]. Test free, elongate,

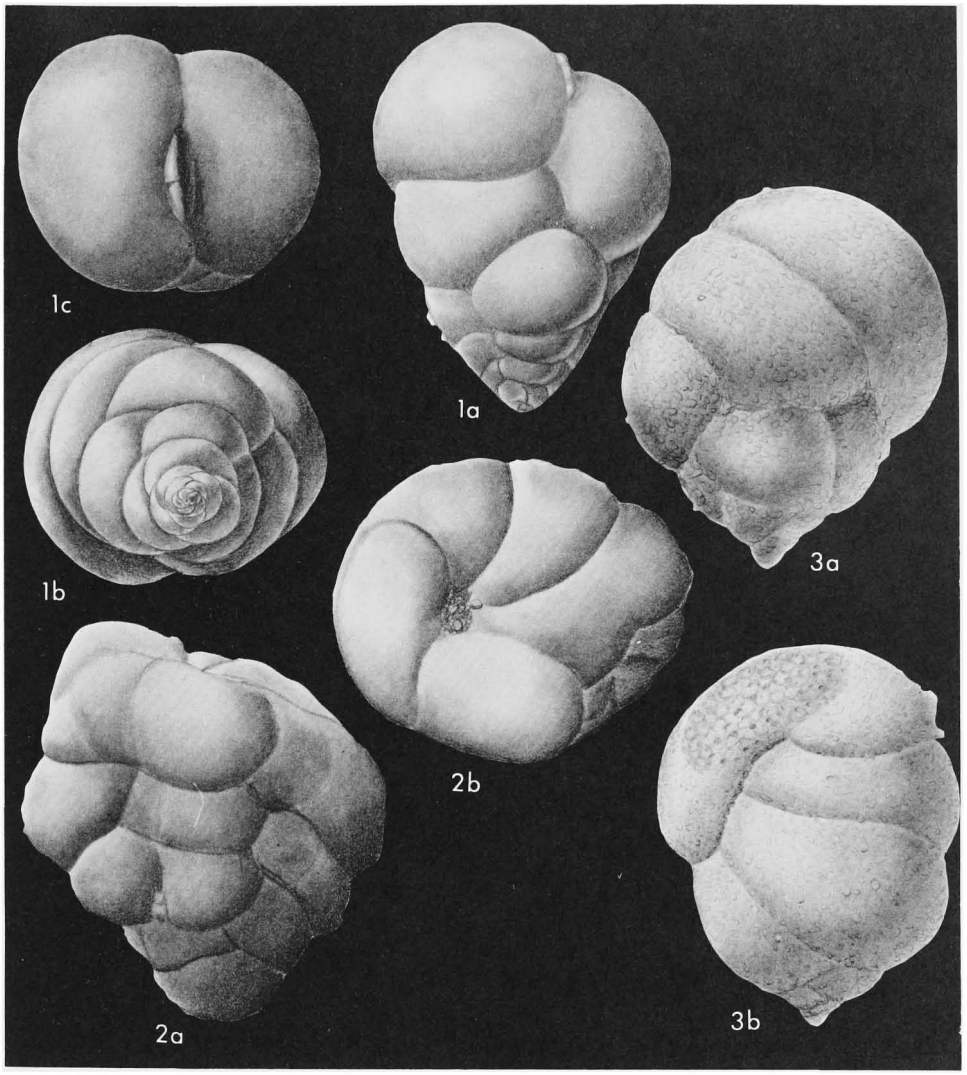

FIG. 429. Turrilinidae (Turrilininae; *1, Tosaia; 2, Quadratobuliminella; 3, Sporobuliminella*) (p. C546-C547).

early stage triserial, later biserial, not compressed; chambers inflated; aperture loop-shaped opening extending up terminal face. *L.Cret.(Alb.)-U.Cret. (Maastricht.)*, cosmop.——FIG. 426,*6,7*. **N. canadensis*, U.Cret., Can.; *6a,7a*, side views; *6b,7b*, apert. views; all ×208 (*2117).

Praebulimina HOFKER, 1953, *939, p. 27 [**Bulimina ovulum* REUSS, 1844, *1537, p. 215 (*non Bulimina ovula* D'ORBIGNY, 1839) =*Bulimina reussi* MORROW, 1934, *1319, p. 195; OD] [=*Praebulimina* HOFKER, 1951, *928c, p. 144, *935, p. 6 *(nom. nud.)*; *Praebulimina* THALMANN, 1952, *1897j, p. 979 (type, *Praebulimina* sp. HOFKER, 1951, *928c, p. 145, *nom. nud.*)]. Test flaring, inflated, chambers triserially arranged, externally similar to *Bulimina*; wall calcareous, perforate, thick and opaque in appearance; aperture loop-shaped, with simple internal tooth plate, instead of complex projecting one of *Bulimina*. *M.Jur. (Bathon.)-U.Cret.(Maastricht.)*, cosmop.——FIG. 428,*1-3*. *P. reussi* (MORROW), U.Cret.(U.Turon.), Sweden; *1*, ext. of megalospheric form, ×268; *2*, ext. of microspheric test, ×43; *3*, long. sec. of microspheric test, showing successive tooth plates, ×268 (*935).——FIG. 428,*4*. *P.* sp., U.Cret., Neth.; opened final chamber showing simple tooth-plate bordering side of apert. opening and extending to margin of previous septal foramen, ×220 (*928c).

[Although a generic description was given for *Praebuli-*

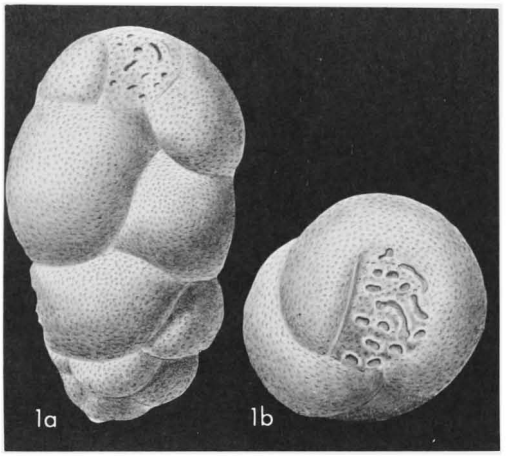

FIG. 430. Turrilinidae (Turrilininae; *1, Sporobulimina*) (p. C546).

mina in 1951 (*928c) the genus was a *nomen nudum* as no type-species was designated, though various species of *"Bulimina"* were discussed under the generic heading. Another publication in the same year (*935) discussed only *P. ovula*, but did not state it to be the type-species. THALMANN (1952, *1897j) cited the *Praebulimina* sp. figured by HOFKER (*928c) as type-species, but as this was not a valid named species, *Praebulimina* remained a *nomen nudum* until the designation by HOFKER in 1953 of *Bulimina ovulum* REUSS, 1844, as type-species. As *B. ovulum* REUSS was a homonym of *B. ovula* D'ORBIGNY, the former had been renamed by MORROW, 1934, as *B. reussi*, which is thus the valid name for the European species. HOFKER (1957, *948, p. 184, 187) recognized both *Praebulimina ovulum* (RUSS) and *P. reussi* (MORROW), including the original reference of REUSS in both synonymies, but regarding the American species as distinct from the European one. If so, the American species would require a different name, as *B. ovulum* REUSS cannot be resurrected for the European species and *B. reussi* MORROW was proposed only as a *nom. nov.* for *B. ovulum* REUSS. However, HOFKER regarded *Bulimina brevis* FRANKE [=*B. brevis* D'ORBIGNY?] as a synonym of *B. reussi* MORROW from the Niobrara formation and the *B. reussi* from the American Gulf Coast as synonymous with *B. ventricosa* BROTZEN, all species being transferred to *Praebulimina*. Many of the Cretaceous species previously placed in *Bulimina, Buliminella,* and *Reussella* should be referred to *Praebulimina* or *Pyramidina*.]

Pyramidina BROTZEN, 1948, *241, p. 62 [**Bulimina? curvisuturata* BROTZEN, 1940, *239, p. 29; OD] [=*Pyramidina* BROTZEN, 1940, *239, p. 29 *(nom. nud.)*]. Test free, flaring, subtriangular in section, chambers broad, low, triserially arranged and subangular; wall calcareous, finely perforate, surface may be somewhat nodose; aperture a high loop-shaped opening which has tendency to close at basal part, remaining only as more or less defined suture connecting subterminal aperture to base of chamber. *U.Cret.(Santon.)-Paleoc.(Dan.),* Eu.-N.Am.——FIG. 428,*6*. **P. curvisuturata* (BROTZEN), Paleoc.(U.Dan.); *6a-c,* opposite sides and apert. view, ×100 (*239).——FIG. 428,*7*. *P. cushmani* (BROTZEN), U.Cret.(L.Campan.), Ger.; apert. portion of long. sec. showing tooth plates, ×160 (*948).

[In 1940, *Bulimina? curvisuturata* was described by BROTZEN (*239) with the statement that it did not wholly agree with that genus because of a tendency to terminal development of the aperture, and that it probably should be placed in a new genus, *Pyramidina*. In the discussion he referred to this species as *"Bulimina (Pyramidina) curvisuturata,"* but also discussed *"Reussella (Pyramidina) cushmani,"* and since no type-species was designated and 2 species were discussed, the generic name proposed was invalid until 1948, when type designation was made. Although the main generic features given by BROTZEN were the subangular test shape and tendency for the loop-shaped aperture to close at the lower part, with only a suture connecting the opening to the chamber base, the same apertural characters were shown in *Praebulimina* sp. of HOFKER (*928c) from the Upper Cretaceous of the Netherlands. In the diagnosis of *Praebulimina* (*928c, p. 144) HOFKER stated that he included "those Buliminidae found in the Upper Cretaceous of Sweden (Brotzen) and the Netherlands," and cited the publication in which *Bulimina? curvisuturata* was described. In 1957 HOFKER (*948) regarded *Pyramidina* as a synonym of *Reussella,* discussing BROTZEN'S *Reussella (Pyramidina) cushmani,* but did not mention the type-species. As noted by HOFKER (*948, p. 202), the Cretaceous species are finely perforate and the tooth plate less complex, in contrast to the more coarsely perforate true *Reussella* of the Cenozoic. *Pyramidina* is therefore here recognized for the subangular finely perforate species particularly characteristic of the Upper Cretaceous, differing from the more coarsely perforate, sharply angular or keeled Cenozoic *Reussella*. It differs from *Praebulimina* in its low, broad and angular rather than rounded or inflated chambers. *Pseudouvigerina* differs in having a distinctly terminal aperture in the adult.]

Quadratobuliminella DE KLASZ, 1953, *1041, p. 435 [**Q. pyramidalis*; OD]. Test similar to *Buliminella* but quadrate in section, chambers elongate, quadriserially arranged; aperture low and umbilical as in *Buliminoides. Paleoc.(Dan.),* Bav.-Fr.——FIG. 429,*2*. **Q. pyramidalis,* Bav.; *2a,b,* side, top views, ×174 (*2117).

Rectobulimina MARIE, 1956, *1221, p. B249 [**R. carpentierae*; OD]. Test similar to *Siphogenerina* in being triserial in early stage, later biserial and finally uniserial; wall calcareous, perforate; aperture terminal, rounded to oval, flush with surface and not produced into phialine lip, presence or absence of internal tooth plates not known. [*Rectobulimina* is tentatively placed in the Turrilinidae, but information as to the internal structure is lacking.] *U.Cret.(Maastricht.),* Belg.——FIG. 428, *5*. **R. carpentierae*; *5a,b,* side, apert. views of holotype, ×77.5 (*1221).

Sporobulimina STONE, 1949, *1842, p. 82 [**S. perforata*; OD]. Test elongate, triserial, wall calcareous, perforate, primary aperture narrow elongate slit extending from base of chamber about half distance up apertural face, supplementary apertures consist of numerous irregular openings in face of chamber at one side and adjacent to primary aperture. *U.Cret.,* Peru.——FIG. 430,*1*. **S. perforata*; *1a,b,* side and apert. views of holotype, ×82 (*2117).

Sporobuliminella STONE, 1949, *1842, p. 81 [**S. stainforthi*; OD]. Test tightly coiled in low spire; with about 4 inflated chambers to whorl; primary aperture low interiomarginal opening with narrow lip, with numerous small supplementary apertures over nodose or pustulose roughly circular area or pore plate extending up terminal face from primary aperture. *U.Cret.,* Peru.——FIG. 429, *3*. **S. stainforthi*; *3a,b,* opposite sides of holotype, ×93 (*2117).

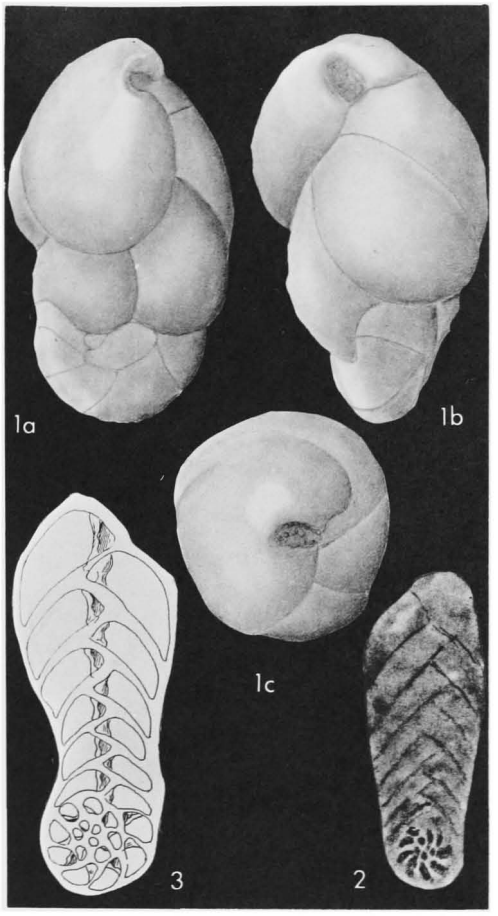

FIG. 431. Turrilinidae (Lacosteininae; *1, Lacosteina; 2,3, Spirobolivina*) (p. C547).

Tosaia TAKAYANAGI, 1953, *1862, p. 30 [**T. hanzawai*; OD]. Test free, small, flaring, early stage obscure, triserial completely or through most of development, rarely with last few chambers in biserial arrangement; wall calcareous, smooth, finely perforate, microstructure not known; aperture basal, relatively small, with a narrow bordering lip. [Originally regarded as belonging to the Heterohelicidae, *Tosaia* was later questionably referred to the Buliminidae by MONTANARO GALLITELLI (*1303). Additional information is required as to wall character and presence or absence of apertural tooth plate.] *Plio.*, Japan.——FIG. 429,*1*. **T. hanzawai*; *1a-c*, side, basal and apert. views, ×99 (*1303).

Subfamily LACOSTEININAE Sigal, 1952

[Lacosteininae SIGAL in PIVETEAU, 1952, p. 220]

Early portion planispirally coiled, later changing abruptly to elongate growth axis with 2, 3, or 4 chambers to whorl; aperture loop-shaped, in face of final chamber. *U. Cret.-U.Eoc.*

Lacosteina MARIE, 1945, *1216, p. 295 [**L. gouskovi*; OD]. Test free, elongate; early portion in planispiral coil of few chambers, later changing direction of coiling and forming high spire of about 2 volutions with 3 or 4 chambers to whorl, chambers inflated; sutures distinct, depressed; wall calcareous, finely perforate, surface smooth; aperture loop-shaped, at inner margin of final chamber. *U.Cret. (Campan.)*, Morocco-USA (Alaska-Calif.).——FIG. 431,*1*. **L. gouskovi*, Morocco; *1a-c*, side, edge, and apert. views, ×166 (*2117).

[*Lacosteina* differs from *Bulimina* and *Praebulimina* in having the early planispiral coil perpendicular to the plane of coiling of its later high-spired part of the test. MARIE (1945, *1216, p. 295) stated that the genus resembled *Bulimina* in the later stage and the Heterohelicidae in its initial stage, and accordingly suggested that *Lacosteina* represents the ancestral genus of the Buliminidae, which was therefore derived from a planispiral ancestry, rather than from the high-spired *Terebralina*, as CUSHMAN had earlier concluded. Although the ontogeny might suggest such an ancestry, the geological record does not bear out this relationship, since the earliest Buliminidae occur in the Jurassic. *Lacosteina* is apparently a specialized offshoot occurring in the Upper Cretaceous.]

Spirobolivina HOFKER, 1956, *945, p. 915 [**Bolivinopsis pulchella* CUSHMAN & STAINFORTH, 1947, *526, p. 78; OD]. Test free, elongate, with early planispiral stage of about 1.5 volutions, later biserial, compressed; wall thin, calcareous, finely perforate; aperture a loop-shaped opening, with small internal tooth plate similar to *Bolivina*, tooth plates of successive chambers differing in orientation by 180°. [*Spirobolivina* was proposed for calcareous perforate species with internal tooth plate, previously placed erroneously in *Bolivinopsis*, which is an agglutinated form.] *Paleoc.-U. Eoc.*, S.Am.-N.Am.——FIG. 431,*2,3*. **S. pulchella* (CUSHMAN & STAINFORTH), U.Eoc., S.Am. (Ecuad.); *2*, holotype, side view, ×80 (*526); *3*, long. sec., ×120 (*945).

Family SPHAEROIDINIDAE Cushman, 1927

[*nom. transl.* LOEBLICH & TAPPAN, 1961, p. 300 (*ex* subfamily Sphaeroidininae CUSHMAN, 1927)] [=Uvellina EHRENBERG, 1839, table opposite p. 120 *(partim) (nom. nud.)*]

Early portion trochospiral, later streptospiral, with chambers embracing most of preceding ones; aperture interiomarginal, with rounded tooth, or with later secondary sutural openings. *U.Cret.-Rec.*

Sphaeroidina D'ORBIGNY, 1826, *1391, p. 267 [**S. bulloides*; OD (M)] [=*Sexloculina* ČŽJŽEK, 1848, *545, p. 138 (type, *S. haueri*); *?Bolbodium* EHRENBERG, 1872, *687, p. 276 (type, *B. sphaerula*)]. Test subglobular, coiling variable, depending on fluctuation in position of aperture; chambers hemispherical, few, number depending on changes of apertural position and relative size and placement of chambers, each placed centrally about previous aperture, strongly embracing, me-

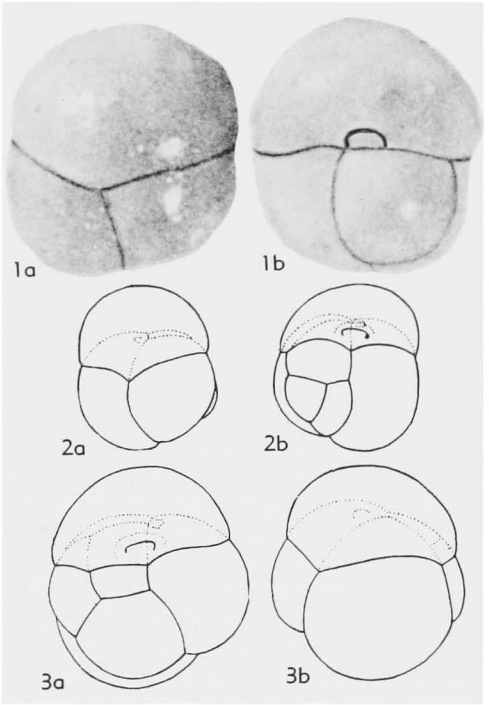

FIG. 432. Sphaeroidinidae; *1-3, Sphaeroidina* (p. C547-C548).

dian apertural planes of later chambers diverging from those of earlier ones alternating to left and right, or constantly to one side, or irregularly to right and left by angle up to 180°, commonly 90°, in latter case resulting in relatively regular spiral; wall of calcite, very finely perforate, radial in structure, surface smooth or faintly roughened near aperture, which is crescentic slit near suture and may occur above junction of 3 chambers, bordered by lip, also may have simple or bifid tooth. [Placed in the Chilostomellidae by CUSHMAN (1948, *486, p. 321), it was transferred to the Cassidulinidae by VAŠÍČEK (1956, *1983, p. 160). However, as both the Chilostomellidae and Cassidulinidae are characterized by a perforate granular wall structure, the radially built Sphaeroidininae have been elevated to a separate family by us (*1177, p. 300) and placed in the superfamily Buliminacea.] *U.Eoc.-Rec.,* cosmop.——FIG. 432, *1-3. *S. bulloides,* Rec., Italy *(1),* Mio.(Torton.), Czech.(Morav.) *(2,3); 1a,b,* opposite sides of topotype, ×73 (*530); *2a,b, 3a,b,* diagram. figures showing chamber arrangement, opposite sides seen through sides of final chamber with preceding whorl indicated by dotted lines, ×44 (*1983).

Pullenoides HOFKER, 1951, *935, p. 10 [**P. senoniensis*; OD]. Test free, subglobular, early stage trochospiral, later chambers planispiral and embracing, with tendency to biseriality; wall calcareous, very finely perforate, as in *Sphaeroidina,* opaque, surface smooth, microstructure not determined; aperture a loop-shaped opening in early stage, later with numerous, small supplementary sutural openings, no internal tooth plate. *U.Cret. (U.Senon.),* Neth.——FIG. 433,*1-3. *P. senoniensis*; *1a-c,* opposite sides and edge view, ×74 (*2117); *2,3,* horiz. and transv. secs., ×53 (*935).

Family BOLIVINITIDAE Cushman, 1927

[*nom. transl.* GLASSNER, 1936, p. 127 *(ex* subfamily Bolivinitinae CUSHMAN, 1927, p. 61)] [=Bolivininae GLAESSNER, 1937, p. 420; Bolivinidae HOFKER, 1951, p. 48]

Test biserial at least in young stage, aperture comma-shaped, parallel to compression of test, basal or terminal, with internal tooth plate. *U.Trias.-Rec.*

Bolivinita CUSHMAN, 1927, *429, p. 90 [**Textilaria quadrilatera* SCHWAGER, 1866, *1703, p. 253; OD]. Test free, compressed, broad sides flat to concave, rectangular in transverse section, 4 angles of test with strongly developed axial costae; chambers biserial throughout, gradually increasing in relative breadth, proloculus may have one or more spines; sutures straight, depressed on lateral edges, oblique and may be limbate on broader faces; wall thin, calcareous, perforate radial in structure, completely covered by minute pores and sporadic larger ones, surface of early portion may be spinose or vertically costate; aperture basal, subcircular, elliptical, perpendicular to suture and with bordering lip, tooth plate may project slightly, somewhat arched at upper surface, flaring and curved internally and may be spatulate at free lower end, those of successive chambers alternating in direction. *Mio.-Rec.,* Atl.-Pac.-Kar Nicobar-N.Z.-N. Am.-Java-Sumatra-Australia. —— FIG. 434,*1-3. *B. quadrilatera* (SCHWAGER), Rec., Philip.; *1a,b,* side, edge views of microspheric form; *2a,b,* side, edge views of megalospheric form; *3,* edge view of megalospheric form with portion of final chamber removed to show tooth plate; all ×65 (*1303).

[*Bolivinita* closely resembles *Bolivina* in chamber arrangement and apertural features, differing in its marginal keels, quadrate section, and absence of retral processes. Although regarded as a synonym of *Bolivina* by HOFKER (1951, *928c, p. 106), *Bolivinita,* as here understood, has a more restricted geologic occurrence, and therefore its retention seems to be useful. Such a taxonomic modification, with specialized morphology and limited geologic occurrence, may be afforded generic or subgeneric status by different workers, but is here regarded as of generic status.]

Altistoma DE KLASZ & RÉRAT, 1962, *1043, p. 180 [**A. scalaris*; OD]. Test biserial, strongly overlapping chambers with lobulate lower margin, sutures depressed; wall calcareous, finely perforate, surface smooth; aperture large, high symmetrical arch bordered by thickened lip, in laterally compressed apertural face. *Eoc.-L.Mio.,* W.Afr. (Gabon).——FIG. 434,*4. **A. scalaris,* L.Mio.; *4a-c,* side, edge, and apert. views of holotype, ×133 (*1043).

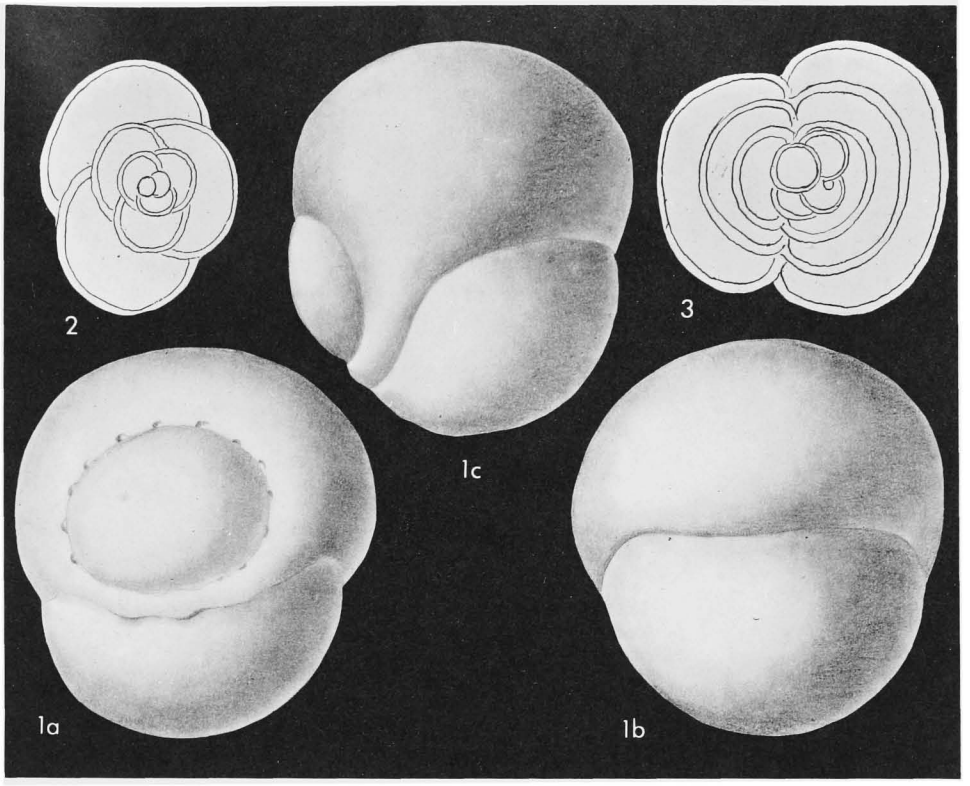

FIG. 433. Sphaeroidinidae; *1-3, Pullenoides* (p. C548).

Bolivina D'ORBIGNY, 1839, *1393, p. 60 [**B. plicata;* SD CUSHMAN, 1911, *404b, p. 31] [=*Grammostomum* EHRENBERG, 1839, *667, table opposite p. 120 (type, *G. tenue*); *Proroporus* EHRENBERG, 1844, *673, p. 75 (type, *P. lingua*); *Clidostomum* EHRENBERG, 1845, *675, p. 358 (type, *C. polystigma*); *Afrobolivina* REYMENT, 1959, *1557, p. 19 (type, *A. afra*)]. Test elongate, may be somewhat compressed; chambers broad, low, biserially arranged throughout, basal margins of chambers with retral processes or backward directed chamber overlaps; wall calcareous, perforate, radial in structure, smooth, striate, or costate and may have marginal keel; aperture a narrow, elongate loop up chamber face, one margin ending blindly or bent upward as collar, opposite border attached to one side of doubly folded internal tooth plate (U-shaped in section), attached half of tooth plate projecting inward to coalesce with free half of tooth plate of previous foramen, free half of tooth plate projecting through aperture at one extremity and bisecting it, narrowing rapidly inward, tooth plate thus being trough-shaped structure with concave portion alternately turning from one side to opposite in successive chambers. *U. Cret.-Rec.*, cosmop.——FIG. 434,*7*. **B. plicata,* Rec., Panama; *7a,b,* side, apert. views, ×99 (*2117).——FIG. 434,*8,9*. *B. afra* (REYMENT), U.Cret.(Maastricht.), Nigeria; *8a,b,* side and top views of microspheric test showing surface ribs and chamber overlaps, ×40; *9,* dissected final chamber showing rear side of tooth plate *(t)*, intercameral foramen *(f)*, lip of preceding tooth plate *(l)*, apertural depression *(d)*, crenulated terminal wall of penultimate chamber *(c)* and crenulations from interior *(cr)*, ×147 (*1557).

[Although it has been stated that *Bolivina* and *Virgulina* [=*Fursenkoina*] are intergradational (*472), *Bolivina,* as all Buliminacea, has a perforate radial wall structure, and *Fursenkoina* has a perforate granular wall structure. HOFKER (*928c), REYMENT (*1557) and others have regarded *Bolivinita* and *Bolivinoides* as synonyms of *Bolivina,* but they are here considered to be distinct, although all are biserial in chamber arrangement and possess internal tooth plates. The differing geologic ranges of these distinct morphologic types seem to indicate their generic validity. *Bolivina* is therefore restricted to include biserial species with internal tooth plates, basal aperture, radially built perforate hyaline walls, and chamber retral projections or overlaps, varying from a few broad lobes, as in the type-species, to the numerous smaller projections, as in *Afrobolivina afra.* As the so-called secondary vertical septa described for *Afrobolivina* are merely internal indentations of the wall between chamber overlaps, *Afrobolivina* is regarded as a synonym of *Bolivina.* Species without chamber overlaps, commonly keeled and strongly compressed, are placed by us in *Brizalina.*]

Bolivinoides CUSHMAN, 1927, *429, p. 89 [**Bolivina draco* MARSSON, 1878, *1228, p. 157; OD]. Test free, rhomboidal, flaring, compressed; chambers low and broad, biserially arranged throughout; septa thick, sutures oblique, obscured externally

by strong ornamentation; wall calcareous, single-layered, lamellar, finely perforate, radial in structure, interior tuberculate, exterior surface with strong longitudinal costae and tuberculate; aperture elongate, loop-shaped, basal, extending up face of final chamber with bordering lip and in-

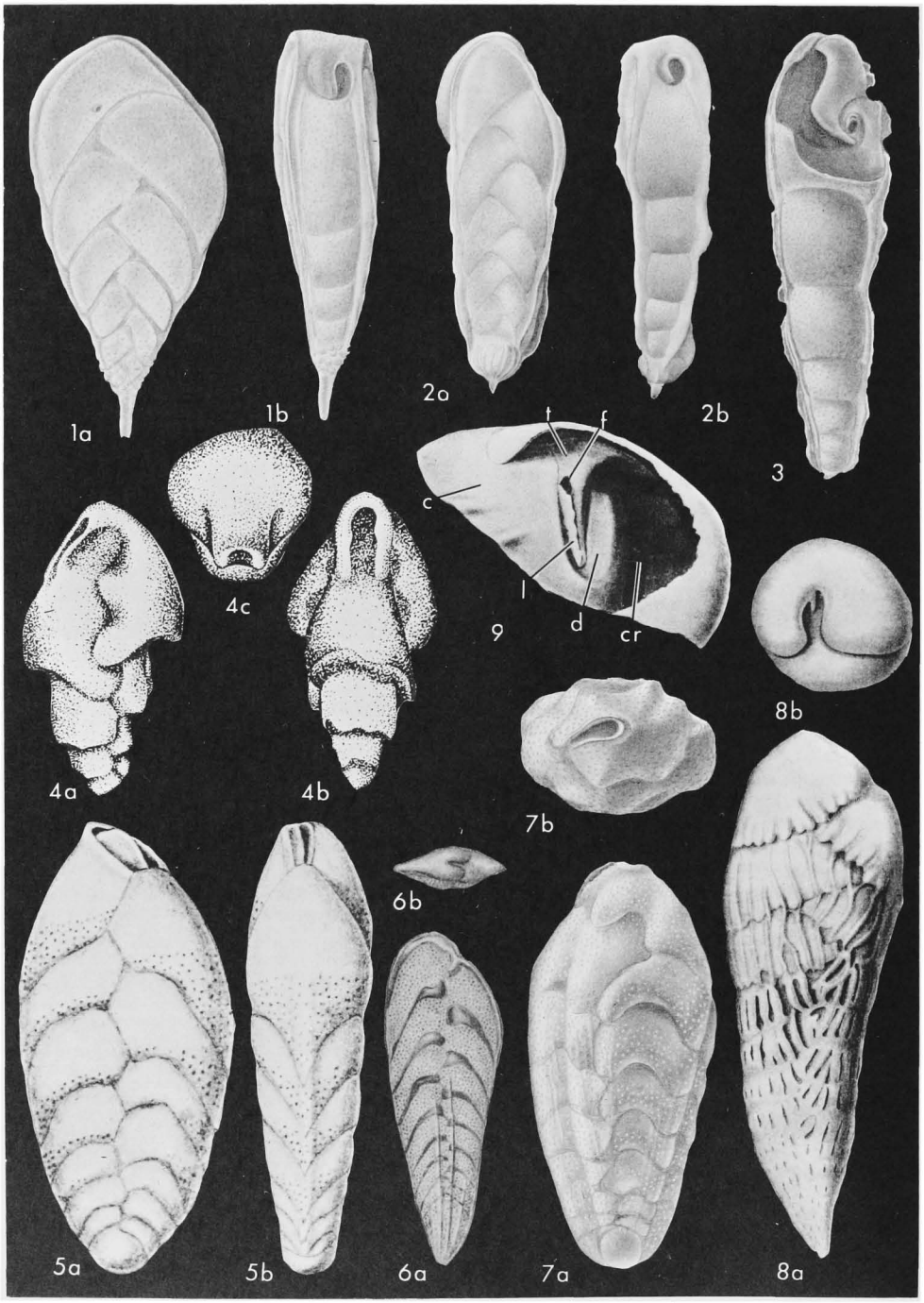

FIG. 434. Bolivinitidae; *1-3, Bolivinita; 4, Altistoma; 5,6, Brizalina; 7-9, Bolivina* (p. C548-C549, C552).

ternal tooth plate. [*Bolivinoides* may have an internal tuberculate wall, but does not show the exterior chamber overlaps or retral processes found in *Bolivina*, as here restricted. It is also char-

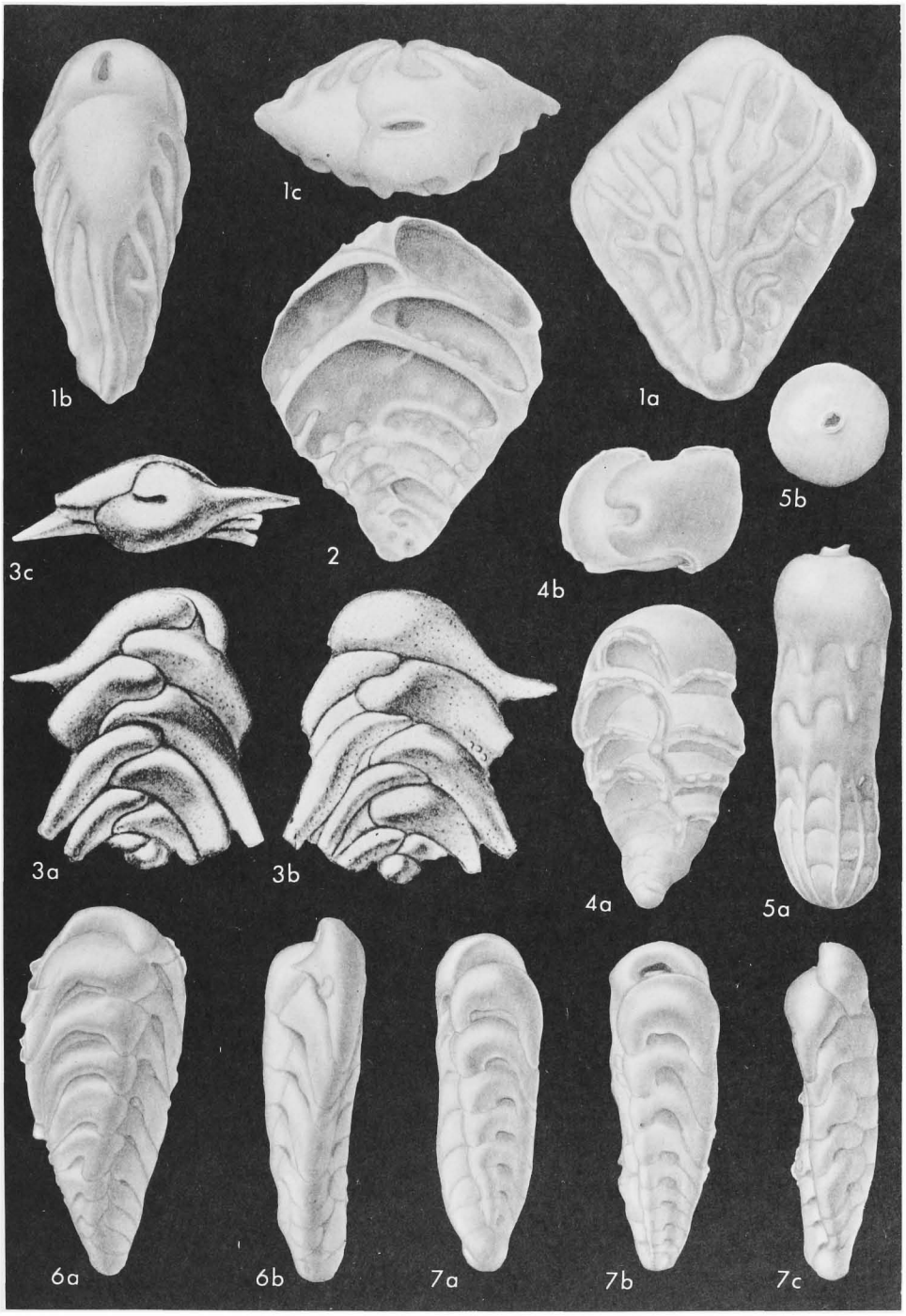

FIG. 435. Bolivinitidae; *1,2, Bolivinoides; 3, Grimsdaleinella; 4, Tappanina; 5, Unicosiphonia; 6,7, Gabonella* (p. C549-C555).

acterized by heavy longitudinal ornamentation.] *U. Cret.(U. Santon.)-Paleoc.,* Eu.-N. Am.-Carib.-S. Am.-Australia-N.Z.-Indon.——Fig. 435,*1,2*. **B. draco* (Marsson), U.Cret.(Campan.), Ger.; *1a-c,* side, edge, and top views, ×97; *2,* dissected specimen showing thick septa, internally tuberculate wall, and apert. tooth plate in later chambers, ×100 (*1303).

Brizalina Costa, 1856, *392, p. 296 [**B. aenariensis*; OD (M)]. Test elongate, tapering, commonly compressed and laterally carinate, biserial throughout, lacking basal chamber lobes, crenulations or retral processes of *Bolivina* but having straight or curved, commonly limbate sutures; wall calcareous, perforate, radially built, with ornamentation consisting of variously arranged pores, longitudinal costae, carinae, and marginal or apical chamber spines; aperture loop-shaped, extending up from base of final chamber, with tooth plate as in *Bolivina. U.Trias.-Rec.,* cosmop.——Fig. 434,*5;* 436,*1*. **B. aenariensis,* Rec., Ire. (434,*5*), Plio., Italy (436,*1*); 434,*5a,b,* side and apert. views, ×75 (*472); 436,*1a,b,* holotype, side, edge views, approx. ×60 (*700).——Fig. 434,*6*. *B.* sp. cf. *B. vadescens* (Cushman), Rec., Sweden; *6a,b,* side view and edge view showing projecting tooth plate, ×140 (*924).——Fig. 436,*2*. *B. pseudopunctata* (Höglund), Rec., Sweden; *2a,* optical sec. of apert. end showing internal tooth plate in alternating arrangement; *2b,* transv. sec. of final chamber through aperture showing U-shaped sec. of tooth plate fastened at one border to chamber wall, ×500 (*924).

[*Brizalina,* as here emended, includes many species previously placed in *Bolivina* that do not show retral chamber processes or crenulations, such as are found in *Bolivina plicata*. The original description of *Brizalina* erroneously described the presence of a neck; this was on the basis of a broken specimen in which only the axis and tooth plates of the final pair of chambers were preserved. Similar preservation has been noted in many specimens of the type-species.]

Gabonella de Klasz, Marie & Meijer, 1960, *1042, p. 167 [**G. elongata* de Klasz & Meijer; OD]. Test free, elongate, biserial, chambers broad and low, plane of biseriality somewhat twisted; sutures strongly depressed, commonly with strong reentrant toward center of chamber margins; wall calcareous, finely perforate, radial in structure; aperture hook-shaped, extending upward from base of final chamber, then curving sharply to run nearly parallel to suture, with narrow bordering lip. [*Gabonella* differs from *Grimsdaleinella* in its distinctly twisted test, low hook-shaped aperture, and small tooth, instead of high comma-shaped aperture. It differs from *Bolivina* in lacking crenulated sutures or retral chamber processes and distinctive tooth plate.] *U.Cret.(Santon.-Maastricht.), ?Paleoc.(Dan.),* Afr.——Fig. 435, *6,7,* **G. elongata,* U.Cret.(Maastricht.), Gabon; *6a,b,* side and edge views showing twisted test and deeply incised sutures; *7a-c,* opposite sides and edge of specimen in which twisting results in nearly quadrate test, apert. tooth visible; all ×62 (*2117).

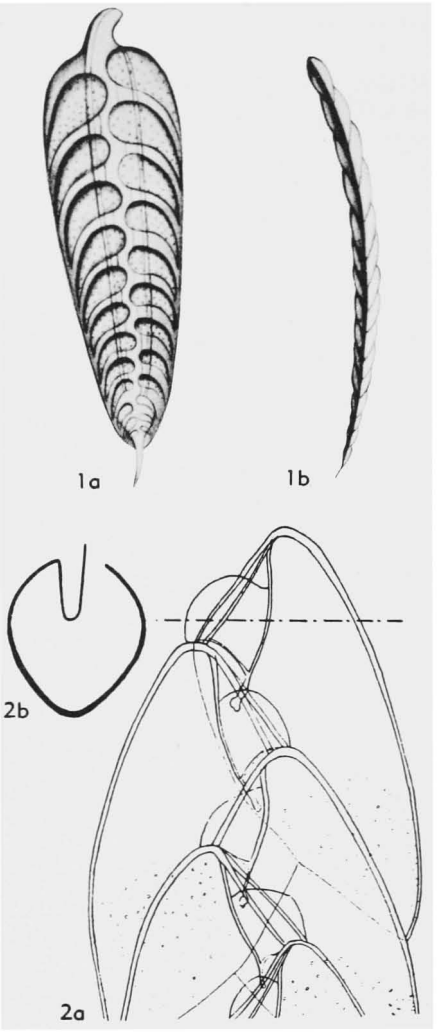

Fig. 436. Bolivinitidae; *1,2, Brizalina* (p. *C*552).

Grimsdaleinella Bolli, 1959, *162, p. 1 [**G. spinosa*; OD]. Test free, chambers biserially arranged, inflated, and laterally produced into spine-like extensions; wall calcareous, finely perforate, surface smooth, hispid or striate; aperture an asymmetrical arch or slit extending up face, presence or absence of tooth plate unknown. *U.Cret. (Turon.-Coniac.),* Trinidad.——Fig. 435,*3*. **G. spinosa*; *3a-c,* opposite sides and top view of holotype, ×73 (*162).

[Originally regarded as belonging to the Heterohelicidae, and differing from *Chiloguembelina* in having lateral spines, the genus is here judged to belong probably to

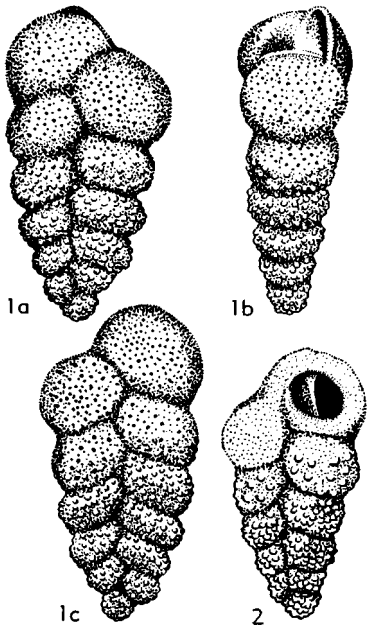

FIG. 437. Bolivinitidae; *1,2, Laterostomella* (p. C553).

the Bolivinitidae, as indicated by its loop-shaped aperture and broad low chambers, although no information is available as to the presence of an internal tooth plate. The original generic description stated "biserially arranged throughout or planispiral in early stage," but the description of the type-species of the monotypic genus stated "biserial throughout," further suggesting the possibility of a relationship with the Bolivinitidae.]

Laterostomella DE KLASZ & RÉRAT, 1962, *1043, p. 177 [**L. guembelinijormis*; OD]. Test elongate, biserial, chambers inflated; sutures depressed; wall calcareous, finely to coarsely perforate, with rugose or striate surface; aperture elongate, with bordering lip, situated in cavity at one side of apertural face, outer margin somewhat flaring and infolded to form tooth plate. *Mio.*, W.Afr.(Gabon).——FIG. 437,*1,2*. **L. guembelinijormis*, Burdigal.; *1a-c*, opposite sides and edge view of holotype; *2*, dissected specimen showing tooth plate; all ×133 (*1043).

Loxostomoides REISS, 1957, *1528a, p. 241 [**Bolivina applini* PLUMMER, 1927, *1461, p. 69 (*recte*= *B. applinae*); OD] [=*Bolivina (Loxostomoides)* REYMENT, 1959, *1557, p. 16 (obj.)]. Test free, narrow, elongate, oval in section; chambers biserial, with tendency to become uniserial in later stage; sutures with retral processes or crenulations of base of chambers; wall calcareous, perforate, radial in structure; aperture an elongate loop extending from base of chamber in early stages, becoming areal in later stages although never central and completely terminal, internal tooth plate present. *U.Cret.(Senon.)-Paleoc.*, N.Am.-Israel.——FIG. 438,*1*. **L. applinae* (PLUMMER), Paleoc. (Midway.), USA(Tex.); *1a-c*, side, edge, and apert. views, ×50 (*472).

Rectobolivina CUSHMAN, 1927, *431, p. 68 [**Sagrina bifrons* BRADY, 1881, *196c, p. 64; OD] [=*Geminaricta* CUSHMAN, 1936, *468, p. 61 (type, *Bolivinella virgata* CUSHMAN, 1929, *441, p. 33)]. Test elongate, may be slightly compressed or circular in section, in early stage biserial, later uniserial, biserial stage much reduced in megalospheric generation and may consist of only slightly eccentric second chamber; wall calcareous, finely perforate, radial in structure, surface smooth, nodose, or more commonly longitudinally costate; aperture terminal, rounded to elongate, with internal twisted tooth plate, those of successive chambers alternating in position in planes 180° apart. *M.Eoc.-Rec.*, cosmop.——FIG. 438,*2-5*. **R. bifrons* (BRADY), Rec., Pac.; *2a,b*, side and apert. views of microspheric test; *3a,b*, side and apert. views of megalospheric test, ×65 (*2117); *4*, sec. showing tooth plates; *5a,b*, side and edge views of isolated tooth plate, enlarged (*928c).——FIG. 438,*6-8*. *R. virgata* (CUSHMAN), Mio., Fr.; *6a,b*, side and apert. views of holotype with only biserial stage; *7a,b, 8a,b*, side and apert. views of hypotypes, ×102 (*2117).——FIG. 438, *9-11*. *R. raphana* (PARKER & JONES), Rec., Ind.O.; *9-11a,b*, side and apert. views of paratypes showing variation in degree of biserial development, ×55 (*2117).

[As shown by HOFKER (1951, *928c), many species previously have been placed incorrectly in *Siphogenerina, Loxostomum*, and *Bifarina* that should be assigned to *Rectobolivina*, as they are unlike the type-species of those genera. The present generic definition of *Rectobolivina* also includes the type-species of *Geminaricta*, hence the latter is a junior synonym. The type-specimens of *Uvigerina (Sagrina) raphanus* PARKER & JONES were examined by us in 1953 in the British Museum (Natural History); a lectotype was selected and is here designated (BMNH-ZF3582), together with paratypes (BMNH-ZF3581), on Recent *Chama hippopus* from the Indian Ocean. As the type-specimens of this species have up to 22 ribs and are either biserial in the early stage or uniserial throughout, they are regarded as specifically and generically distinct from *Siphogenerina costata* SCHLUMBERGER for which the species had been considered a senior synonym. *S. costata* has 5 or 6 costae, an early triserial microspheric stage, and a biserial early stage in the megalospheric form. It was also regarded as a *Rectobolivina by* HOFKER (1951, *928c, p. 62). The "double aperture" of *Geminaricta* was illustrated only on broken specimens. Complete specimens show only an elongate aperture. Probably an erroneous interpretation of the fragmentary remains of the tooth plate led to separating *Geminaricta* as a distinct genus.]

Tappanina MONTANARO GALLITELLI, 1955, *1301, p. 190 [**Bolivinita selmensis* CUSHMAN, 1933, *459, p. 58; OD]. Test biserial, flaring, sides flattened, resulting in transverse section; chambers cuneiform, apparently concave on broad sides, more or less inflated laterally, with well-developed horizontal or arched rib across chambers and along zigzag suture and lateral margins; sutures depressed, straight or arched; wall calcareous, finely perforate, surface appearing rough owing to development of ridges; aperture narrow, elongate, at base of final chamber, with tooth plate as in *Bolivina*. [*Tappanina* is characterized by its strong

horizontal carinae, narrow incised sutures, and degeneration into discontinuous thickenings of the 4 axial lamellar sutural costae which are characteristic of *Loxostomum*, but it differs in the bolivine character of the aperture.] *U.Cret.-Paleoc.*, N.Am.-Eu.——Fig. 435,*4*. **T. selmensis* (Cush-

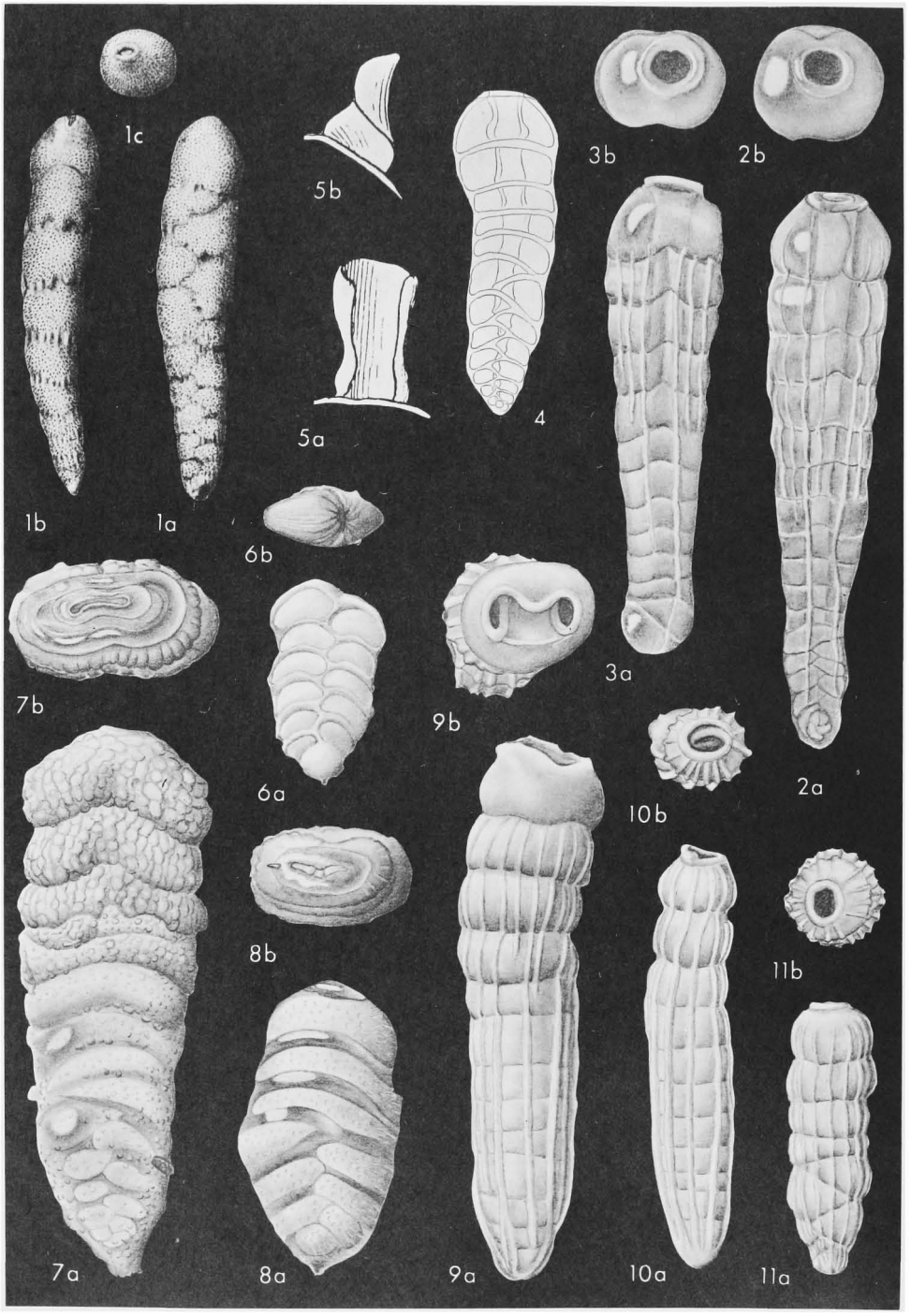

Fig. 438. Bolivinitidae; *1, Loxostomoides; 2-11, Rectobolivina* (p. C553).

MAN), U.Cret., USA(Tenn.); *4a,b,* side, apert. views of holotype, ×130 (*1302).

Unicosiphonia CUSHMAN, 1935, *465, p. 81 [**U. crenulata*; OD]. Test similar to *Rectobolivina* but chambers with basal crenulations or retral processes as in *Bolivina* and *Loxostomoides*; aperture ter-

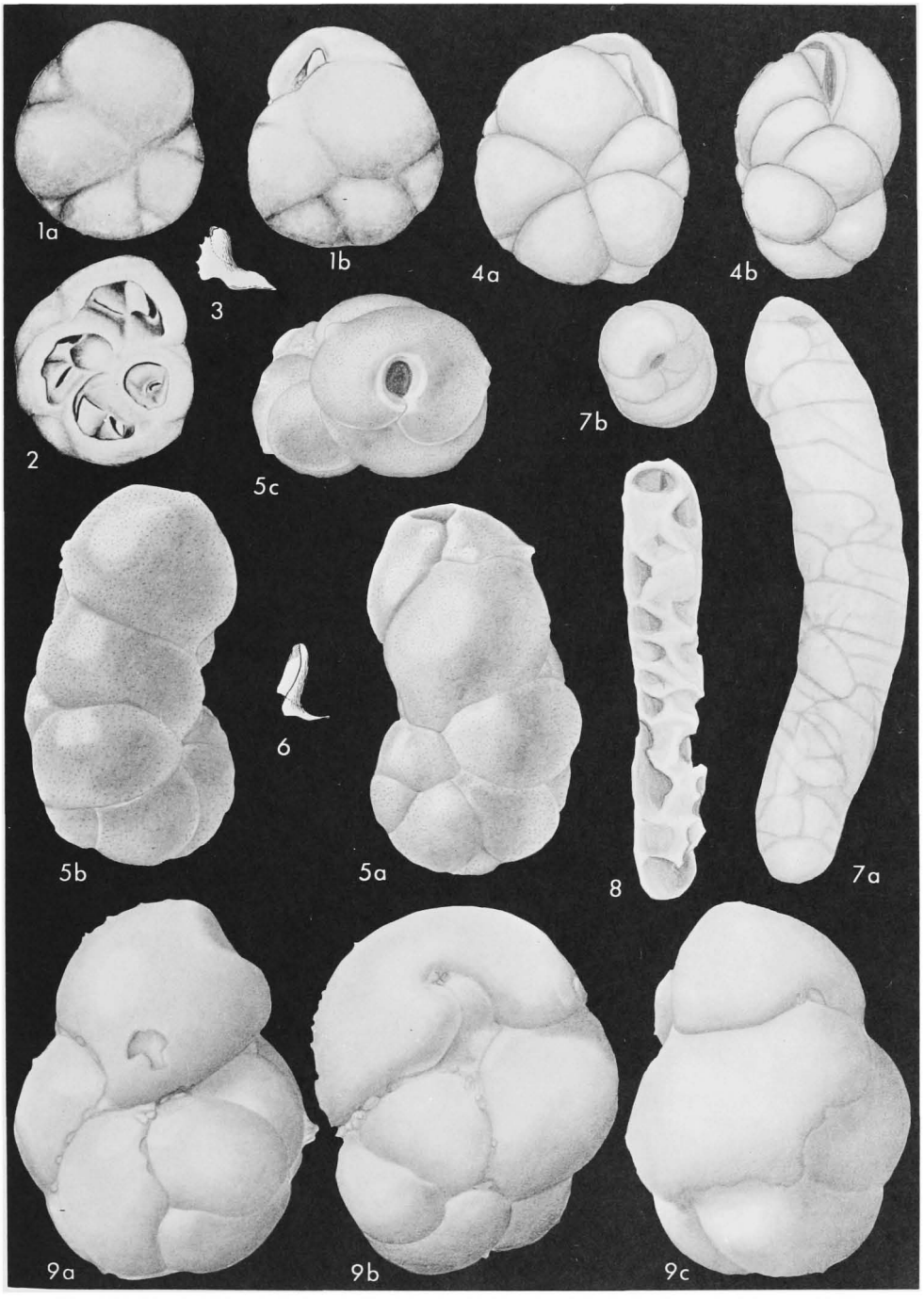

FIG. 439. Islandiellidae; *1-4, Islandiella; 5,6, Cassidulinoides; 7,8, Orthoplecta; 9, Stichocassidulina* (p. C556).

minal, rounded, with internal columellar process or tooth plate. *Tert.*, Atl.(Georges Bank).——Fig. 435,*5*. **U. crenulata*; *5a,b*, side, top views of holotype, ×64 (*2117).

Family ISLANDIELLIDAE Loeblich & Tappan, n.fam.

Test with biserially arranged enrolled chambers, at least in early stage, or derived from such, later stage may uncoil; as in Cassidulinidae, but with calcareous, perforate, radiate fibrous wall and primary aperture provided with internal tooth plate extending inward from aperture to previous foramen. *?U.Cret., Paleoc.-Rec.*

Islandiella Nørvang, 1958, *1361, p. 26 [**Cassidulina islandica* Nørvang, 1945, *1359, p. 41; OD] [=*Cassilamellina* Voloshinova, 1960, *2020, p. 59 (type, *Cassidulina californica* Cushman & Hughes, 1925, *508, p. 12)]. Test relatively large, lenticular to subglobular, periphery rounded, umbilicus closed; chambers biserially arranged and planispirally enrolled, sutures slightly depressed; wall calcareous, thick, perforate, lamellar, radiate, fibrous in microstructure, surface smooth; aperture elongate, interiomarginal opening, with internal platelike tooth extending from posterior edge of aperture to anterior corner of preceding foramen and with free margin projecting from aperture and partially closing it. [*Islandiella* differs from *Cassidulina* in having a radiate, instead of granular, wall structure and in the presence of an internal tooth plate.] *?U.Cret., Paleoc.-Rec.*, cosmop.——Fig. 439,*1-3*. **I. islandica* (Nørvang), Rec., Iceland; *1a,b*, opposite sides, showing elongate aperture and projecting tooth plate; *2*, partially dissected specimen showing free tongue of internal platelike tooth at base of open chambers; all ×33 (*1361); *3*, isolated tooth plate, enlarged (*928c).——Fig. 439,*4*. *I. californica* (Cushman & Hughes), Pleist., USA(Calif.); *4a,b*, side, edge views, ×37 (*766).

Cassidulinoides Cushman, 1927, *431, p. 84 [**Cassidulina parkeriana* Brady, 1881, *196c, p. 59; OD]. Test free, elongate, robust, early stage subglobular with chambers biserially arranged and enrolled as in *Cassidulina*, later uncoiling, but continuing biserial development; wall calcareous, perforate, radial in structure; aperture in adult loop-shaped, extending upward from base of chamber into rounded opening at its summit. *U.Eoc.-Rec.*, Atl.-Pac.-N. Am.-Australia-S. Am.-Carib.-Indon.-Japan-Eu.——Fig. 439,*5,6*. **C. parkeriana* (Brady), Rec., Falk. Is.; *5a-c*, opposite sides and top view, ×153 (*2117); *6*, isolated tooth plate, enlarged (*928c).

Orthoplecta Brady, 1884, *200, p. 355, 428 [**Cassidulina (Orthoplecta) clavata*; OD (M)] [=*Cassidulina (Orthoplecta)* Brady, 1884, *200, p. 355, 428 (obj.)]. Test free, elongate, narrow, slightly arcuate, of nearly equal diameter throughout, no regular chamber arrangement, but with spiraling internal column, which gives extremely irregular septation as it spirals and in places touches exterior wall; wall calcareous, finely perforate, radial in structure; aperture subterminal, ovate, just above sutural junction. [Although originally considered a subgenus of *Cassidulina*, *Orthoplecta* has a perforate radial rather than a granular wall structure, and is neither cassiduline nor biserial in the early stage.] *Rec.*, Pac.——Fig. 439,*7,8*. **O. clavata*; *7a,b*, side, top views of holotype; *8*, dissected hypotype, ×146 (*1166).

Stichocassidulina Stone, 1946, *1841, p. 59 [**S. thalmanni*; OD]. Test subglobular, periphery rounded; chambers inflated, biserial and enrolled as in *Islandiella*, involute; sutures depressed; wall calcareous, finely perforate, microstructure unknown; aperture large loop-shaped opening in apertural face, perpendicular to basal suture, partially covered by toothlike plate, numerous small, secondary, sutural openings also occurring along all sutures of test. [*Stichocassidulina* is here placed with *Islandiella* because of the presence of the apertural tooth. Confirmation of its placement requires information as to the wall microstructure.] *U.Eoc.*, S.Am.——Fig. 439,*9*. **S. thalmanni*, Peru; *9a-c*, opposite sides and edge view of holotype, ×80 (*2117).

Family EOUVIGERINIDAE Cushman, 1927

[*nom. transl.* Loeblich & Tappan, 1961, p. 300 (*ex* subfamily Eouvigerininae Cushman, 1927, p. 63)]——[=Stilostomellinae Finlay, 1947, p. 275]

Test biserial in young, later may become uniserial; aperture terminal, with internal siphon, and may have everted phialine lip. *L.Cret.-Rec.*

Eouvigerina Cushman, 1926, *424, p. 4 [**E. americana* (=*Loxostomum aculeatum* Ehrenberg, 1854, *680, p. 22); OD] [=*Zeauvigerina* Finlay, 1939, *717a, p. 541 (type, *Z. zelandica*)]. Test biserial throughout, but may be slightly twisted, final chamber nearly central in position; sutures depressed; wall calcareous, finely perforate, surface may be smooth, carinate or hispid; aperture terminal, with neck and phialine lip, commonly with crenulated margin, internally with thin columellar tooth plate. [Although the presence of an internal apertural tooth plate has not been demonstrated in the type-species of *Zeauvigerina*, owing to unfavorable preservation and lack of sufficient material for sectioning, it is here regarded as congeneric with *Eouvigerina* because of the similarity in chamber arrangement and apertural characters, including the crenulated phialine lip.] *L.Cret.(Alb.)-U.Eoc.*, N.Am.-N.Z.-Eu.——Fig. 440,*1-3*. **E. aculeata* (Ehrenberg),

U.Cret.(Campan.), USA (Tex.) *(1,2)*, Neth. or Ger. *(3)*; *1a,b*, side, apert. views of holotype of *E. americana*, ×162; *2*, dissected specimen showing internal tooth plate, ×162 (*1303); *3a,b*, vert. secs. through breadth and thickness showing character of tooth plates, ×106 (*948).——Fig. 440,

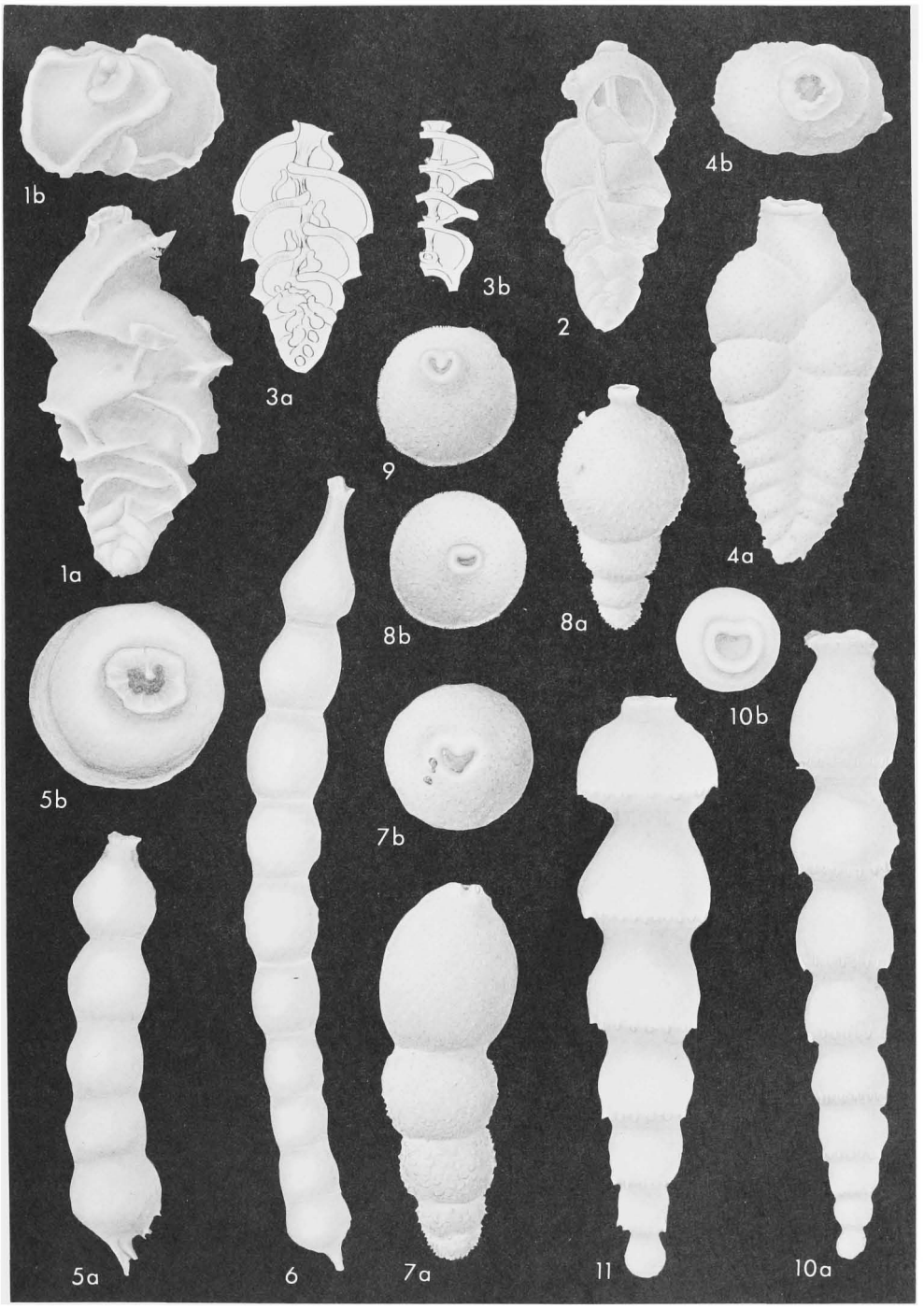

Fig. 440. Eouvigerinidae; *1-4, Eouvigerina; 5,6, Siphonodosaria; 7-11, Stilostomella* (p. C556-C559).

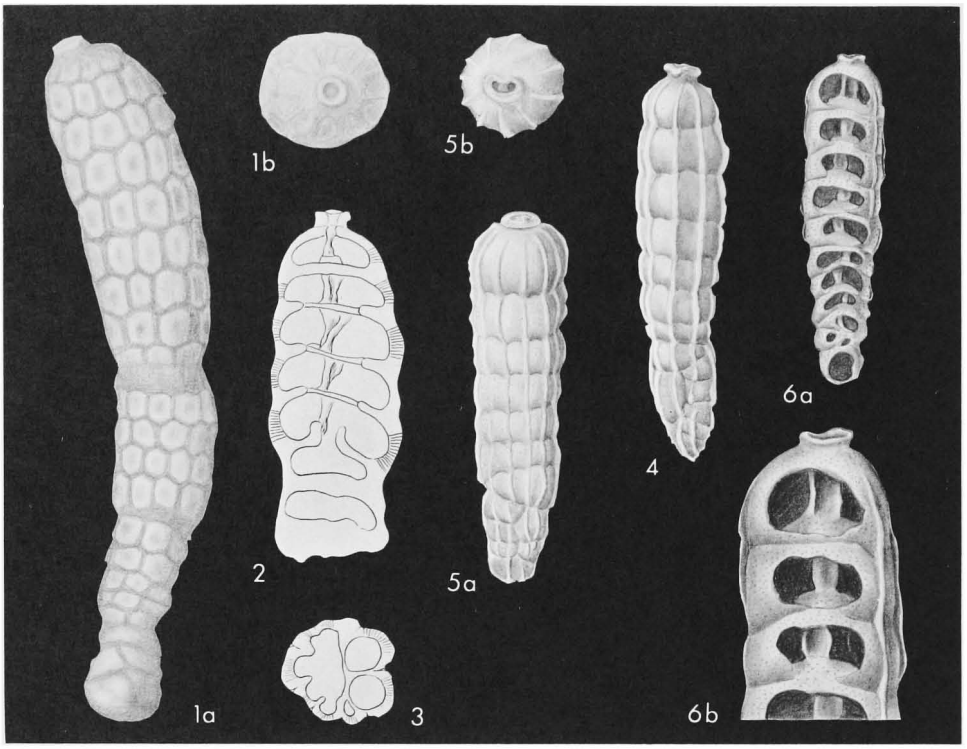

FIG. 441. Eouvigerinidae; *1-3, Millettia; 4-6, Siphogenerinoides* (p. C558).

4. E. zelandica (FINLAY), Up.M.Eoc., N.Z.; *4a,b,* side, top views of paratype, ×180 (*1303).

Millettia SCHUBERT, 1911, *1689b, p. 89 [*non* SHERBORN, 1893, *1731a, p. 206, *nom. correct. pro Milletia* WRIGHT, 1889, *2080, p. 448 *(nom. nud.)*; *non Milletia* DUNCAN, 1889] [**Sagrina? tessellata* BRADY, 1884, *200, p. 85; SD SCHUBERT, 1911, *1689a, p. 320] [=*Schubertia* A. SILVESTRI, 1912, *1772, p. 68 (*non Schubertia* GISTL, 1848) (*nom. subst. pro Millettia* SCHUBERT, 1911) (obj.)]. Test free, elongate, narrow, arcuate, very early portion biserial, later portion consisting of few elongate subcylindrical chambers. rapidly increasing in height and subdivided into chamberlets by vertical and horizontal partitions in honeycomb pattern, chamberlets arranged in regular transverse rows; wall calcareous, perforate radial in structure; surface marked into hexagonal patterns by junction of chamberlet walls with outer wall; aperture terminal, rounded with slight lip and internal tooth plate. *Rec.,* Pac.——FIG. 441, *1-3. *M. tessellata* (BRADY), Admiralty Is. *(1),* Indon. *(2,3)*; *1a,b,* side, top views of lectotype (BMNH-ZF2359), ×146 (*1166); *2,* long. sec., showing tooth plates, ×160; *3,* horiz. sec. showing vertical partitions and chamberlets, ×210 (*928c).

[HOFKER (1951, *928c, p. 67) incorrectly restricted the genus *Sagrina* to *S. tessellata,* but the type of *Sagrina* is *S. pulchella* by monotypy. Furthermore, *S. tessellata* had been made the type-species for *Millettia* and *Schubertia. Schubertia* was proposed as a replacement for *Millettia* SCHUBERT (*non* SHERBORN; *non Milletia* WRIGHT; *nec Milletia* DUNCAN), but *Schubertia* is also preoccupied by the molluscan genus *Schubertia* GISTL, 1848. Furthermore, *Millettia* SHERBORN *(nom. correct.)* and *Milletia* WRIGHT were both *nomina nuda,* hence have no standing in zoological nomenclature. *Milletia* DUNCAN, 1889, is an echinoid genus, but according to the Rules of Nomenclature (Art. 56) a difference in spelling of even one letter is sufficient to prevent generic homonymy; hence *Millettia* SCHUBERT is here reinstated.]

Siphogenerinoides CUSHMAN, 1927, *431, p. 63 [**Siphogenerina plummeri* CUSHMAN, 1926, *422, p. 18; OD]. Test elongate, biserial in early stage in both microspheric and megalospheric forms, later uniserial, with straight, nearly horizontal sutures; wall calcareous, perforate, surface with numerous longitudinal costae; aperture terminal, elliptical or reniform, with internal tooth plate of spoutlike shape, those of successive chambers with concave side facing in alternate directions, each apertural foramen except that of final chamber connecting to terminal end of tooth plate of its own chamber and also to that of succeeding chamber, convex surface of both sections being oriented toward opening. *U.Cret.-Paleoc.,* N.Am.-Afr.——FIG. 441,*4-6. *S. plummeri* (CUSHMAN), U.Cret.(Maastricht.), USA(Tex.); *4,* side view of microspheric form, ×66 (*2117); *5a,b,* side, top views of megalospheric form, ×66; *6a,b,* long. sec. showing tooth plates, ×66 and ×133 (*1303).

Siphonodosaria A. SILVESTRI, 1924, *1779, p. 18 [**Nodosaria abyssorum* BRADY, 1881, *196c, p. 63; SD (SM) CUSHMAN, 1927, *431, p. 67] [=*Sagrinnodosaria* JEDLITSCHKA, 1931, *985, p. 125 (type, *Nodosaria abyssorum* BRADY, 1881, SD LOEBLICH & TAPPAN, herein) (obj.)]. Test free, narrow, elongate, uniserial, straight to arcuate; chambers subglobular, proloculus may have basal spines; sutures constricted; wall calcareous, thick, perforate, radial in structure; aperture rounded, produced on slight neck, bordered with phialine lip, and with distinct teeth projecting into aperture. *Eoc.-Rec.*, Eu.-N.Am.-S.Am.-Carib.-Atl.-Pac. ——FIG. 440,*5,6*. **S. abyssorum* (BRADY), Rec., S.Pac.; *5a,b*, side, apert. views of lectotype, here designated (BRADY, 1884, *200, pl. 63, fig. 8) (BMNH-ZF3649), *5a*, ×22, *5b*, ×48; *6*, paratype (BMNH-ZF1926), one of unfigured syntypes, ×22 (*2117).

[GALLOWAY (1933, *762, p. 376) regarded *Nodogenerina* as a synonym of *Siphonodosaria* and STAINFORTH (1952, *1833, p. 7) also stated that "no difference is readily apparent between *Siphonodosaria* SILVESTRI and *Nodogenerina* CUSHMAN." *Siphonodosaria* is here restricted to forms with completely crenulate or dentate phialine lip, in addition to the distinct apertural tooth, whereas *Stilostomella* (including *Nodogenerina*) has a simple lip and single tooth.]

Stilostomella GUPPY, *843, p. 649 [**S. rugosa*; OD] [=*Nodogenerina* CUSHMAN, 1927, *428, p. 79 (type, *N. bradyi* =*Sagrina virgula* BRADY, 1884, *200, p. 583, *partim*)]. Test free, elongate, uniserial and rectilinear, with gradually enlarging subglobular chambers; wall calcareous, hyaline, finely perforate, surface may be spinose, or spines may be restricted to lower chamber margin; aperture terminal, may be produced on neck, with phialine lip and slight indentation at one side owing to surface reflection of internal spatulate tooth. *Cret.-Rec.*, Pac.-Atl.-Carib.-N.Z. ——FIG. 440,*7-9*. **S. rugosa*, Mio., Trinidad; *7-8a,b*, *9*, side and top views, of paratypes, ×33 (*2117).——FIG. 440,*10,11*. *S. bradyi* (CUSHMAN), Rec., Brazil(off Pernambuco); *10a,b*, side, top views of lectotype of *Sagrina virgula* BRADY (1884, *200, pl. 76, fig. 8) here designated, BMNH-ZF2363; *11*, megalospheric paratype, ×146 (*2117).

[*Stilostomella* was regarded as unrecognizable by CUSHMAN (1948, *486, p. 277) and he placed *Nodogenerina* in the Heterohelicidae. *Stilostomella* was regarded as a valid genus in the Pleurostomellidae by GALLOWAY (1933, *762, p. 384) and *Nodogenerina* was considered a synonym of *Siphonodosaria* in the Uvigerinidae. FINLAY (1947, *717e, p. 273) regarded *Nodogenerina* and *Siphonodosaria* both as junior synonyms of *Stilostomella*, placing the latter genus in the Lagenidae [=Nodosariidae] in a new subfamily Stilostomellinae. *Stilostomella* is here separated from *Siphonodosaria* in having a single tooth or indentation of the phialine lip, whereas *Siphonodosaria* has a more prominent tooth and the entire inner margin of the lip is crenulate or dentate. The prominent apertural tooth, instead of a radial or slit aperture, separates it from the Nodosariidae.]

Family BULIMINIDAE Jones, 1875

[*nom. correct.* EIMER & FICKERT, 1899, p. 680 (*pro* family Buliminida JONES in GRIFFITH & HENFREY, 1875, p. 320)]——[All names cited are of family rank; dagger (†) indicates *partim*]——[=Stichostègues† D'ORBIGNY, 1826, p. 251 (*nom. neg.; nom. nud.*); =Hélicostègues† D'ORBIGNY, 1826, p. 268 (*nom. neg.; nom. nud.*); =Uvellina† EHRENBERG, 1839, table opposite p. 120 (*nom. nud.*); =Helicosorina† EHRENBERG, 1839, table opposite p. 120 (*nom. nud.*); =Equilateralidae† D'ORBIGNY in DE LA SAGRA, 1839, p. xxxvii, 11 (*nom. nud.*); =Turbinoidae† D'ORBIGNY in DE LA SAGRA, p. xxxviii, 71 (*nom. nud.*); =Aequilateralidae† D'ORBIGNY, 1846, p. 28 (*nom. nud.*); =Uvellidae† REUSS, 1860, p. 225 (*nom. nud.*)]——[=Buliminidae SCHWAGER, 1876, p. 479; =Buliminidea SCHWAGER, 1877, p. 19; = Buliminina LANKESTER, 1885, p. 847; =Buliminae DELAGE & HÉROUARD, 1896, p. 140]——[=Pavoninidae EIMER & FICKERT, 1899, p. 678; =Globobuliminidae HOFKER, 1956, p. 908; =Hyalovirgulinidae HOFKER, 1956, p. 45 (*nom. nud.*)]

Test high trochospiral, with not more than 3 chambers to whorl, may reduce to biserial; aperture a loop in apertural face, with platelike internal tooth connecting successive chambers, or aperture may be indistinct and represented only by pores in terminal chamber face. *Paleoc.-Rec.*

Subfamily BULIMININAE Jones, 1875

[*nom. correct.* BRADY, 1881, p. 44 (*pro* subfamily Buliminidae SCHWAGER, 1877, p. 19)] [=Buliminae RHUMBLER, 1895, p. 89; =Globobuliminae HOFKER, 1951, p. 248]

Test triserial throughout; aperture loop-shaped, with distinctive tooth plate. *Paleoc.-Rec.*

Bulimina D'ORBIGNY, 1826, *1391, p. 269 [**B. marginata*; SD CUSHMAN, 1911, *404b, p. 76]. Test triserial in early stage, may tend to reduce to uniserial in later portion; wall calcareous, finely to coarsely perforate, radial in structure; aperture extending up from base of apertural face, with free border that may have elevated rim and fixed border attached to internal folded tooth plate, which with fixed shank is attached to internal chamber wall below aperture, with free shank that may be dentate or smooth, flaring or enrolled and subtubular. [*Bulimina* differs from *Praebulimina* in having a tooth plate with developed border, and from *Globobulimina* in one shank of the tooth plate free, instead of both fixed, and in lacking strongly embracing chambers.] *Paleoc.-Rec.*, cosmop.——FIG. 442,*1-3*. **B. marginata*, Rec., Italy *(1)*, Rec., Sweden *(2)*; *1a,b*, side, apert. views, ×50 (*519); *2a,b*, apert. end showing tooth plate *(t)*, aperture lip *(l)*, and free shank of tooth plate *(s)*, ×105 (*924); *3*, isolated tooth plate, enlarged (*928c).

Globobulimina CUSHMAN, 1927, *431, p. 67 [**G. pacifica*; OD] [=*Bulimina (Desinobulimina)* CUSHMAN & PARKER, 1940, *518, p. 19 (type, *Bulimina auriculata* BAILEY, 1851, *65, p. 12)]. Test globular to ovate, chambers triserially arranged, strongly overlapping earlier ones; wall calcareous, thin, finely perforate, radial in structure, surface smooth; aperture loop-shaped, with tendency to become terminal, tooth plate doubly folded pillar-like trough joined to apertural border at one side, upper part with projecting fanlike tip, lower portion extending into chamber cavity as arched trough, then curving forward, free shank coalescing with free border of aperture,

lower part of tooth plate touching projected tip of tooth plate of preceding chamber. [The modified definition of the genus by HÖGLUND (*924) based on apertural features, includes *Desinobulimina.*] *Paleoc.(Dan.)-Rec.*, cosmop.——FIG. 442,*4*. **G. pacifica*, Rec., Pac.; *4a-c*, opposite

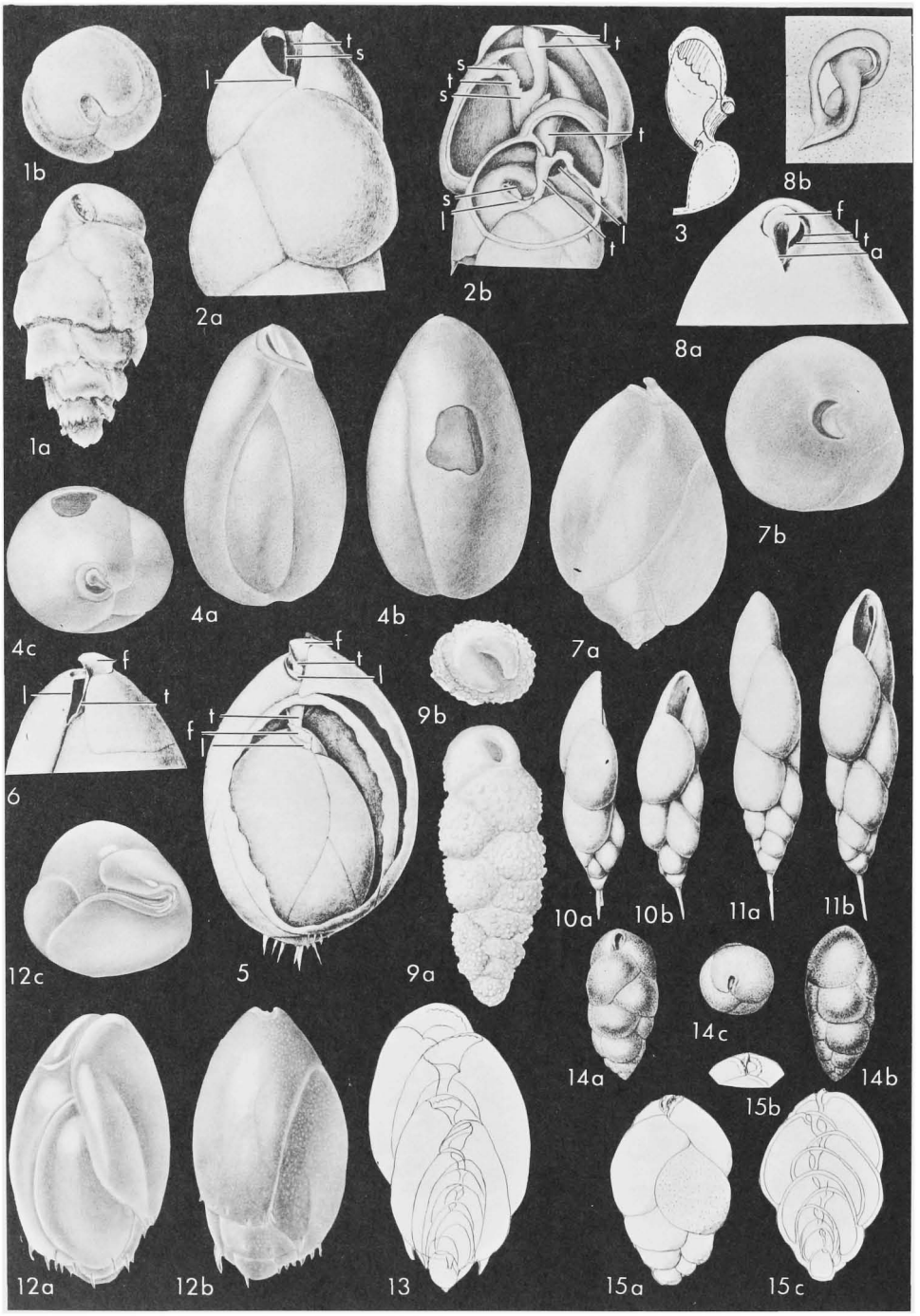

FIG. 442. Buliminidae (Bulimininae; *1-3, Bulimina; 4-8, Globobulimina; 9, Virgulopsis; 10-11, Stainforthia; 12-15, Praeglobobulimina*) (p. C559-C561).

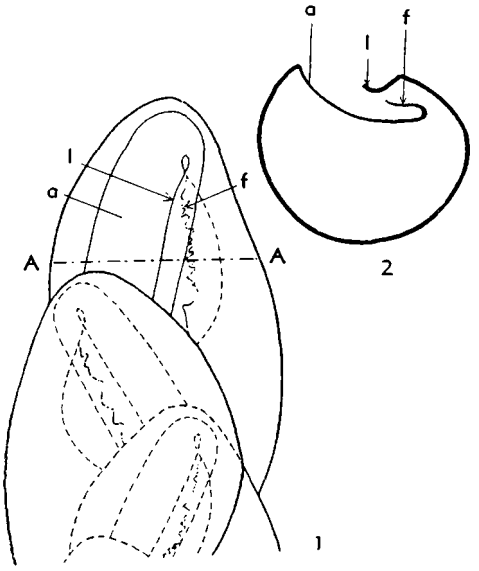

FIG. 443. Buliminidae (Bulimininae; *1,2, Stainforthia*) (p. C561).

sides and apertural views of holotype, ×56 (*2117).——FIG. 442,*5*. *G. turgida* (BAILEY), Rec., Sweden; dissected specimen showing tooth plate *(t)*, fanlike tip *(f)*, and apert. lip *(l)* in 2 successive chambers, ×70 (*924).——FIG. 442,*6*. *G.* sp., Rec., Gulf Mex.; apert. region, as in fig. *5*, ×22 (*924).——FIG. 442,*7*. *G. auriculata* (BAILEY), Rec., N.Atl.; *7a,b*, side, apert. views, ×51 (*2117).——FIG. 442,*8*. *G. auriculata gullmarensis* HÖGLUND; *8a,b*, apert. region showing tooth plate attachment *(a)* and apert. features as in fig. *5*, *8a*, ×70, *8b*, ×105 (*924).

Praeglobobulimina HOFKER, 1951, *928c, p. 248 [**Bulimina pyrula* var. *spinescens* BRADY, 1884, *200, p. 400; OD] [=*Protoglobobulimina* HOFKER, 1951, *928c, p. 252 (type, *Bulimina pupoides* D'ORBIGNY, 1846, *1395, p. 185)]. Test free, elongate, triserial with strongly overlapping chambers; wall calcareous, perforate radial in structure; aperture elongate, extending up from base of final chamber toward its apex, successive chambers connected internally by tooth plate with simple fold and fixed shank joined to anterior wall below aperture and wide free shank joined to chamber wall only at anterior end of aperture, free shank may be dentate and basal part reduced, small tip protruding through aperture. *Paleoc.-Rec.*, cosmop. ——FIG. 442,*12,13*. **P. spinescens* (BRADY), Rec., Pac.; *12a-c*, opposite sides and apert. view of topotype, ×62 (*2117); *13*, sec. showing tooth plates, ×125 (*928c).——FIG. 442,*14,15*. *P. pupoides* (D'ORBIGNY), Mio., Aus. *(14)*, Rec., Italy *(15)*; *14a-c*, opposite sides and apert. view of microspheric specimen, ×25 (*516); *15a,b*, side view and opposite side of apert. region showing tooth plate, *15c*, long. sec. showing successive tooth plates, all ×83 (*928c).

[HAYNES (1954, *886) emended the original diagnosis but incorrectly cited the type-species as *Praeglobobulimina spinescens* HOFKER. Since the type-species was designated by HOFKER as *P. spinescens* (BRADY) this cannot be changed. HOFKER regarded *Praeglobobulimina* as characterized by elongate pores, and *Protoglobobulimina* as having elongate pores with fine pores between. The apertural tooth plate has a flaring free tip in the type (and only species) originally placed in *Praeglobobulimina*, and it is straight and collar-like in *Protoglobobulimina*. As shown by HAYNES (1954, *886, p. 185) generic separations based on pore size and distribution do not agree in many cases with those based on apertural features and (p. 188) the observation that pores are of greater length (through the wall) than their diameter may result in ovate appearance when seen on the convex test surface. Thus, the feature of pore shape does not seem to be valid for generic distinction, although pore patterns may have specific value. The actual proportions of the tooth plates also are here regarded as specific rather than generic in importance, and Recent species with flaring free tip are not regarded as generically distinct from those with less complex free tip.]

Stainforthia HOFKER, 1956, *945, p. 908 [**Virgulina concava* HÖGLUND, 1947, *924, p. 257; OD]. Test narrow, elongate, early stage triserial, at least in microspheric generation, later with twisted biserial development; chambers inflated, laterally overlapping; wall calcareous, hyaline, finely perforate, radial in structure, surface smooth or longitudinally costate, may have one or more apical spines; aperture loop-shaped in face, with narrow incurved lip at one side and broad tooth plate at opposite side bending under lip and partially closing opening, tooth plate with serrated free folded portion, lower portion of tooth plate attached to preceding chamber wall. *Eoc.-Rec.*, Eu.-S.Am.——FIG. 442,*10,11*; 443,*1,2*. **S. concava* (HÖGLUND), Rec., Sweden; 442,*10a,b, 11a,b*, side and edge views, ×93; 443,*1,2*, later portion in optical sec. and cross sec. showing apert. features with narrow incurved lip at one side *(l)*, and folded tooth plate with serrate free shank *(f)*, and attached opposite border *(a)*, ×340 (*924).

Virgulopsis FINLAY, 1939, *717c, p. 321 [**V. pustulata*; OD]. Test free, elongate, early stage triserial, later biserial; wall calcareous, finely perforate, surface plicate or pustulose; aperture loop-shaped, extending up face, internal features unknown. [Details of the inner structure and character of the tooth plate are needed for accurate placement of this genus. It may prove to be a junior synonym of *Uvigerinella* or of *Neobulimina*, or a senior synonym of *Stainforthia*.] *M. Mio.*, N.Z.——FIG. 442,*9*. **V. pustulata; 9a,b*, side, apert. views, ×82 (*2117).

Subfamily PAVONININAE Eimer & Fickert, 1899

[*nom. transl.* CUSHMAN, 1927, p. 59 (*ex* family Pavoninidae EIMER & FICKERT, 1899)] [=Reussiinae CUSHMAN, 1927, p. 68 (*pro Reussia* SCHWAGER, 1877) (*non Reussia* M'COY, 1854); =Reussellinae CUSHMAN, 1933, p. 223 (*nom. subst.*)]

Test triserial in early stage, rarely biserial, later uniserial; aperture loop-shaped or re-

presented by pores on terminal chamber face. [Simple forms such as *Reussella* have an apertural tooth plate, whereas other genera show a tooth plate in early stages *(Chrysalidinella)* and a majority apparently show no tooth plates but may have sec-

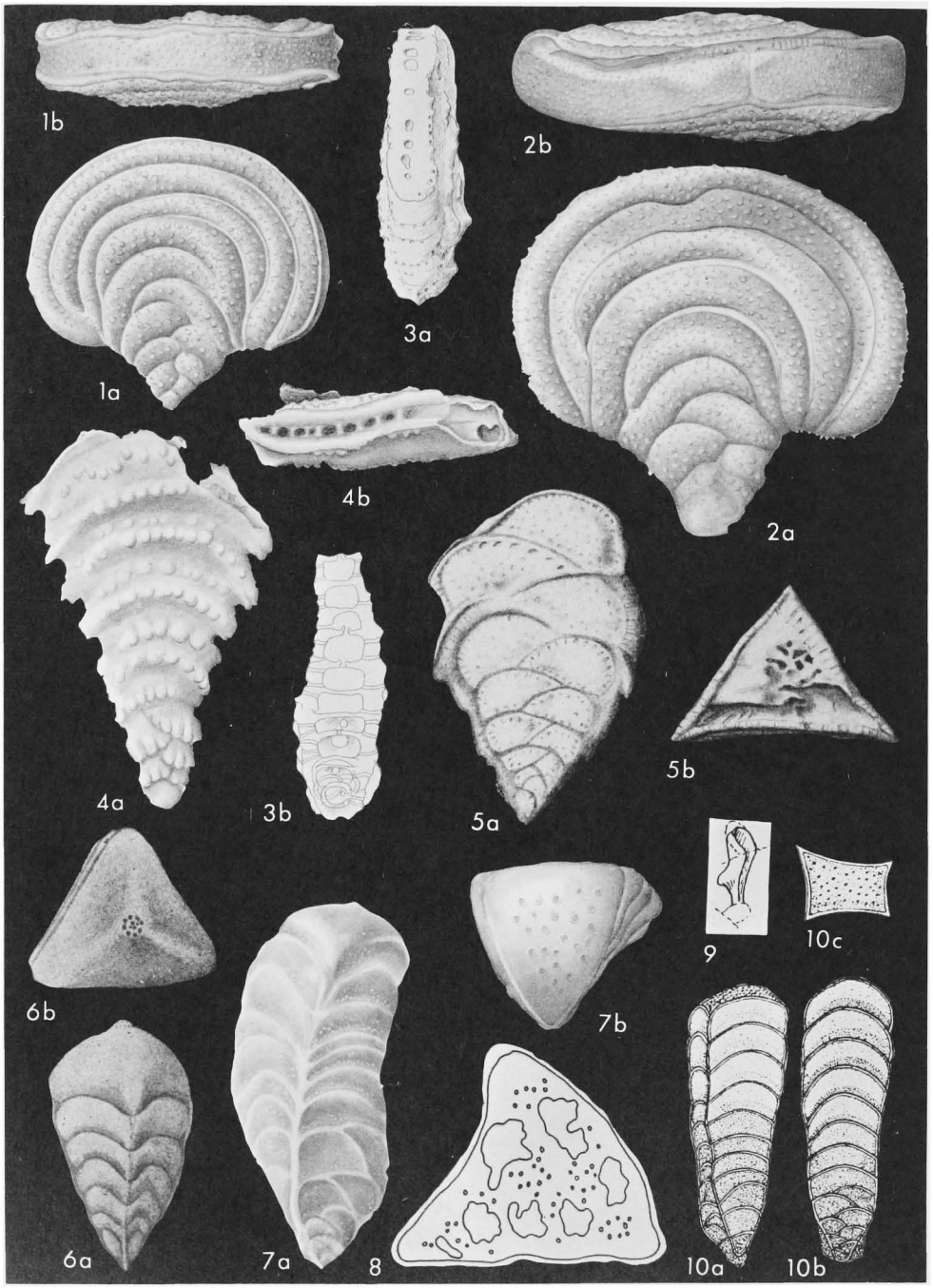

FIG. 444. Buliminidae (Pavoninae; *1-4, Pavonina; 5, Fijiella; 6, Acostina; 7-10, Chrysalidinella*) (p. C563).

ondary resorption of the terminal face to form irregular intercameral openings. Restudy of the ontogeny and internal morphology of all genera may later result in separating the forms with tooth plates (Reusellinae CUSHMAN, 1933) from the Pavoninae, but meanwhile they are retained together.] *Eoc.-Rec.*

Pavonina D'ORBIGNY, 1826, *1391, p. 260 [**P. flabelliformis*; OD (M)] [=*Bifarinella* CUSHMAN & HANZAWA, 1936, *504, p. 46 (type, *B. ryukyuensis*); *Valvopavonina* HOFKER, 1951, *928c, p. 35 (obj.)]. Test with reduced triserial stage of 3 chambers, later biserial, and finally uniserial, spreading with low broad arched chambers, strongly recurved at margins; wall calcareous, radial in structure, coarsely perforate; no distinct aperture, terminal face of final chamber merely coarsely perforate like remainder of test, large rounded openings originally reported and since mentioned by various authors not found to be present on well-preserved specimens, possibly due to secondary resorption. *Mio.-Rec.*, Pac.-Atl.-Afr.-N.Am.-Madag.——FIG. 444,*1-3*. **P. flabelliformis*, Rec., Kerimba Arch. *(1)*, Rec., Mauritius *(2,3)*; *1a,b*, side, top views, ×82; *2a,b*, side, top views, ×82 (*2117); *3a,b*, edge view, showing pores, and long. sec. of same specimen showing septal openings, large pores through walls and fine pores through one side of proloculus, and reduced triserial stage, ×80 (*928c).——FIG. 444,*4*. *P. ryukyuensis* (CUSHMAN & HANZAWA), Pleist., Ryukyu Is.; *4a,b*, side and top views of holotype, showing early biserial stage, later uniserial stage with spreading test, and large septal perforations with intervening pillars, ×48 (*2117).

[The early triserial stage mentioned has not been confirmed by us, as all specimens of the type-species observed show only a biserial stage. It is possible that ornamentation may have been mistaken for additional chambers in some reports, the wall being secondarily thickened and laminar. Nevertheless, PARR found a distinctly triserial base in *P. triformis* (*1422) and HOFKER illustrated a reduced triserial stage in *P. flabelliformis* (*928c). Well-preserved specimens of *P. flabelliformis* examined at high magnification show numerous irregularly scattered pores on the terminal face, identical in appearance to those on sides of the test, but no large regularly aligned apertural pores have been seen by us in either wet or dry or stained tests. The systematic placement has also varied, PARR (*1422) placing *Pavonina* near *Reussella* and *Chrysalidinella* in the Buliminidae, although *Pavonina* has no apertural tooth plate, and HOFKER (*928c) placing it in the Valvulinidae because of absence of a tooth plate and presence of coarse pores in the wall, although other representatives of that family are agglutinated. *Bifarinella* was placed in the Virgulininae by CUSHMAN (1937, *472), a group with perforate granular walls and apertural tooth plate, and *Pavonina* was placed in the Reussellinae, a group with perforate radial walls and apertural tooth plate. Both the holotype of *B. ryukyuensis* (in the CUSHMAN collection) and paratype are broken specimens, no terminal face being preserved. The "slitlike aperture" and everted lip consist merely of fragments of the final chamber wall. Not previously mentioned is the fact that the final septum preserved has numerous pores, with only narrow bridges remaining across the test, so that it has the identical large septal pores found in *Pavonina*, and there described as a multiple aperture. The early biserial stage and later uniserial stage both occur in most specimens and species of *Pavonina*, the less flabelliform test of *B. ryukyuensis* being here regarded as only of specific value.]

Acostina BERMÚDEZ, 1949, *124, p. 152 [**Chrysalogonium piramidale* ACOSTA, 1940, *3, p. 4; OD]. Test elongate pyramidal, triangular in section, with carinate angles, chambers uniserial throughout; aperture terminal, consisting of numerous small pores in protruding portion of terminal face. *U.Oligo.-Rec.*, Cuba-Dominican Republic.——FIG. 444,*6*. **A. piramidale* (ACOSTA), Rec., Cuba; *6a,b*, side, apert. views of holotype, ×37 (*3).

Chrysalidinella SCHUBERT, 1908, *1687, p. 242 [**Chrysalidina dimorpha* BRADY, 1881, *196c, p. 54; OD (M)] [=*Chrysalidinoides* UCHIO, 1952, *1959, p. 154 (type, *C. pacificus*)]. Test elongate, commonly pyramidal, early portion triserial and triangular, later uniserial and triangular in section or rarely quadrangular; sutures arched; wall smooth, calcareous, coarsely perforate, radial in structure; aperture basal in early stage as in *Reussella* with small tooth plates, in uniserial stage consisting of numerous scattered pores on terminal face, without tooth plates, early septa showing some larger irregular openings, probably due to resorption. *Eoc.-Rec.*, Cuba-Kerimba Arch.-Pac.-N.Am.-Carib.-Indon.——FIG. 444,*7-9*. **C. dimorpha* (BRADY), Rec., Pac. *(7)*, Rec., Sumatra *(8,9)*; *7a,b*, side, top views, ×74 (*2117); *8*, outline view of septum, showing apert. pores and secondary irregular openings due to resorption, ×80; *9*, isolated tooth plate, enlarged (*928c). ——FIG. 444,*10*. *C. pacifica* (UCHIO), Rec., Japan; *10a-c*, lat. and terminal views of holotype, ×56 (*1959).

[*Chrysalidinoides* was based on a single specimen which became quadrate in the adult, although early development was triserial and triangular. As many triangular genera have occasional aberrant quadrate specimens (e.g., *Tristix*, *Triplasia*) the present form is regarded as adventitious.]

Fijiella LOEBLICH & TAPPAN, 1962, *1185, p. 109 [**Trimosina simplex* CUSHMAN, 1929, *443, p. 158; OD]. Test triserial and triangular throughout; wall calcareous, coarsely perforate, surface smooth, lateral margins carinate and may be spinose; primary aperture a narrow elongate basal slit with terminal supplementary cribrate openings. [*Fijiella* differs from *Reussella* and *Trimosina* in having the supplementary cribrate terminal aperture, and from *Chrysalidinella* in lacking a uniserial stage.]. *Rec.*, Pac.——FIG. 444,*5*. **F. simplex* (CUSHMAN), Fiji; *5a,b*, side, apert. views, ×60 (*476).

Mimosina MILLETT, 1900, *1284e, p. 547 [**M. histrix*; SD CUSHMAN, 1927, *433, p. 190]. Test in early stage triserial, later biserial, each chamber in later stage ornamented with spine; wall calcareous, surface ornamented with very fine longitudinal ridges with fine pores between, radially built; aperture in 2 parts, one nearly terminal, second marginal and tending to be more oval in outline. *Rec.*, Malay Arch. Tropical Pac.-Kerimba Arch.-Atl.-Medit.——FIG. 445,*1,2*. **M. histrix*, Malay Arch.; *1a,b*, *2a,b*, side and top views, ×104 (*2117).

Reussella GALLOWAY, 1933, *762, p. 360 [*pro*

Reussia SCHWAGER, 1877, *1705, p. 21 (*non* M'COY, 1854)] [**Verneuilina spinulosa* REUSS, 1850, *1540, p. 374; OD]. Test triserial and triangular throughout, gradually enlarging; wall calcareous, coarsely perforate; aperture basal in final chamber, with internal tooth plate. [*Reussella* is

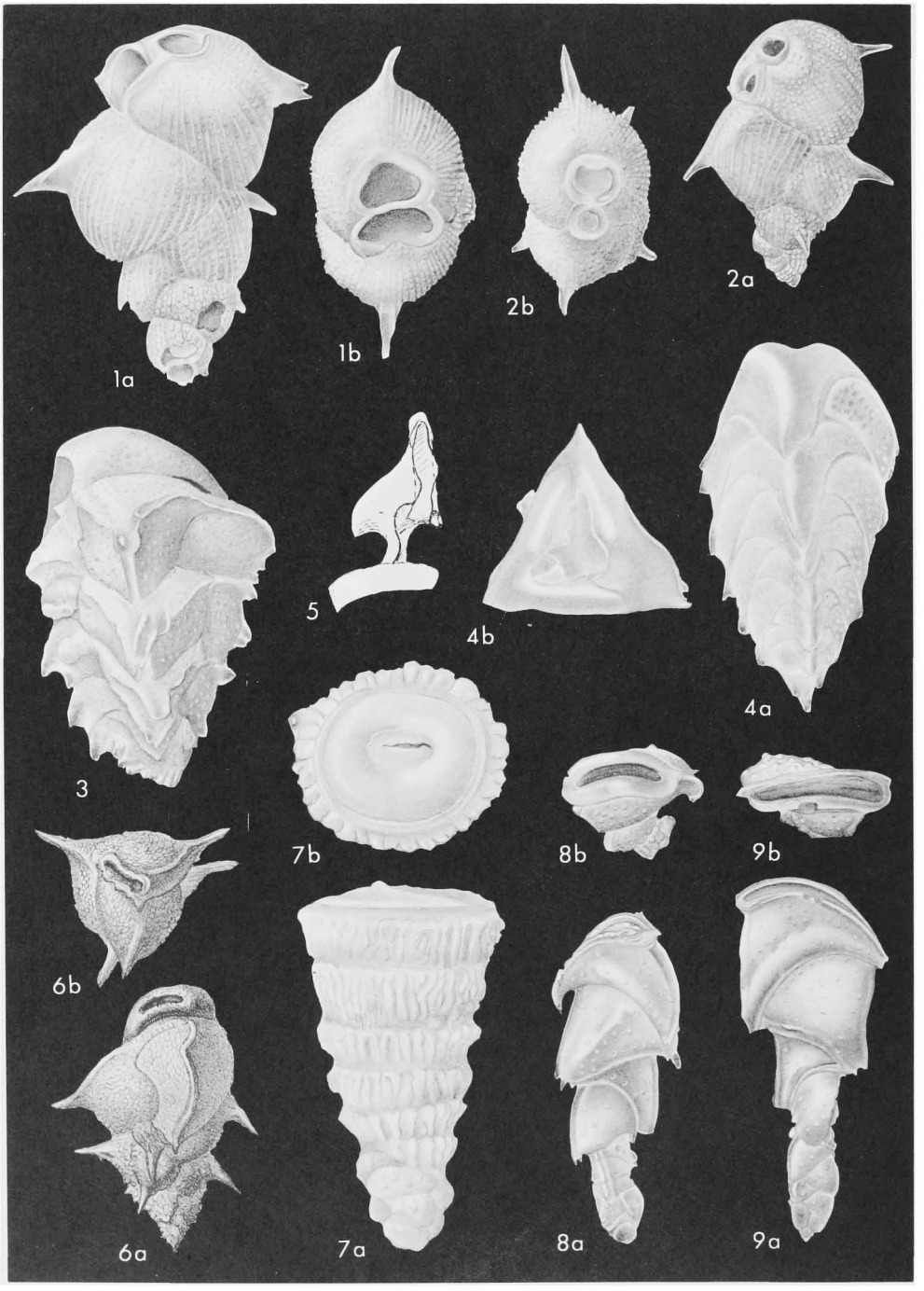

FIG. 445. Buliminidae (Pavoninae; *1,2, Mimosina; 3-5, Reussella; 6, Trimosina; 7, Tubulogenerina; 8,9, Valvobifarina*) (p. C563-C565).

restricted here to include only sharply angular species, commonly with carinate or spinose angles, coarsely perforate wall, and complex tooth plate. Upper Cretaceous species that have been previously referred to *Reussella* are here regarded as belonging to *Pyramidina,* differing in their less angular margins, finely perforate walls, and simpler tooth plate.] *M.Eoc.(Lutet.)-Rec.,* cosmop.——Fig. 445,*3-5*. **R. spinulosa* (Reuss), Mio., Aus.; *3,* side view, ×100; *4a,b,* side, apert. views, ×94 (*2117); *5,* apertural tooth plate, magnified (*928c).

Trimosina Cushman, 1927, *431, p. 64 [**T. milletti*=*Mimosina spinulosa* var. Millett, 1900, *1284e, p. 548; OD]. Test triserial, similar to *Mimosina* but without later biserial development; wall calcareous, perforate, radial in structure; aperture an elongate slit, in face of final chamber and paralleling its base. *Rec.,* Indo-Pac.——Fig. 445,*6*. **T. milletti,* Malay Arch.; *6a,b,* side, top views, ×90 (*1284e).

Tubulogenerina Cushman, 1929, *428, p. 78 [**Textularia (Bigenerina) tubulifera* Parker & Jones, 1863, *1417e, p. 94; OD]. Test elongate, early stage triserial in microspheric form, followed by short biserial stage, later chambers uniserial and compressed or rounded in section; wall calcareous perforate, surface may be distinctly nodose or longitudinally costate; aperture a narrow, elongate, crescentic slit in terminal face, with internal tooth plate. *M.Eoc.(Lutet.)-Oligo.,?Mio.,* Eu.-N.Am.-Australia.——Fig. 445,*7*. **T. tubulifera* (Parker & Jones), M.Eoc.(Lutet.), Fr.; *7a,b,* side, apert. views of topotype, ×109 (*2117).

Valvobifarina Hofker, 1951, *928c, p. 39 [**Bifarina mackinnoni* Millett, 1900, *1284d, p. 281; OD]. Test in early portion triserial, triangular in section, later changing abruptly to twisted biserial arrangement of cuneate chambers; wall ornamented with numerous calcareous knobs, each with large pore and commonly with spines at chamber margins; aperture terminal, narrow and elongate, occupying width of chamber and surrounded by everted rim. *Rec.,* Malay Arch.-Timor Sea.——Fig. 445,*8,9*. **V. mackinnoni* (Millett), Timor Sea *(8),* Macassar Straits *(9)*; *8a,b, 9a,b,* side and top views, ×74 (*2117).

[Hofker (1951, *928c, p. 42) originally placed *Valvobifarina* in the agglutinated family Valvulinidae, because of its scattered large pores and knobs of "somewhat arenaceous chalky matter." He regarded both this genus and *Bolivinitella* (=*Loxostomum*) as closely related to *Siphogaudryina.* As correctly stated by Hofker, neither *Loxostomum* nor *Valvobifarina* are related to the "Bolivininae," the former having a granular wall and lacking a tooth plate and *Valvobifarina* having a triserial, rather than biserial, early development.]

Family UVIGERINIDAE Haeckel, 1894

[*nom. correct.* Galloway & Wissler, 1927, p. 74 (*pro* family Uvigerinida Haeckel, 1894, p. 185)]——[In synonymic citations superscript numbers indicate taxonomic rank assigned by authors (¹family, ²subfamily); dagger (†) indicates *partim*]——[=¹Uvellina† Ehrenberg, 1839, table opposite p. 120 (*nom. nud.*); =²Turbinoidea† d'Orbigny in de la Sagra, 1839, p. xxxviii, 71 (*nom. nud.*); =²Angulogerininae Galloway, 1933, p. 377; =²Uvigerininae Cushman, 1913, p. 91]

Test triserial to biserial in early stage, later may become biserial or uniserial; aperture terminal, with neck and internal tooth plate connecting apertures of successive chambers. *U.Cret.-Rec.*

Uvigerina d'Orbigny, 1826, *1391, p. 268 [**U. pygmea*; SD Parker, Jones & Brady, 1865, *1419, p. 36] [=*Uvigerina (Uhligina)* Schubert, 1899, *322, p. 222 (type, *U. (U.) uhligi*) (*non Uhligina* Yabe & Hanzawa, 1922); *Aluvigerina* Hofker, 1951, *928c, p. 201 *(nom. nud.)*; *Aluvigerina* Thalmann, 1952, *1897j, p. 970 (obj.); *Miniuva* Vella, 1961, *2002, p. 480 (type, *M. minima*)]. Test elongate, triserial, rounded in section, chambers inflated, wall calcareous, perforate, surface smooth, hispid or costate; aperture terminal, rounded with nonperforate neck and may have phialine lip, internal tooth plate with distinct wing at one side. [The type-species was spelled *pigmea* in the text (*1391, p. 269) but *pygmea* on the plate explanation (*1391, pl. 12, p. 310). *Miniuva* was separated for an extremely small costate species with short neck, features here regarded as of specific value.] *Eoc.-Rec.,* cosmop.——Fig. 446, *1,2*. **U. pygmea,* Plio., Italy *(1),* Rec., Italy *(2)*; *1a,b,* side, apert. views, ×94 (*2117); *2,* sectioned specimen, showing tooth plates with wings (shaded portion), ×104 (*928c).

Clavelloides de Klasz & Rérat, 1962, *1043, p. 182 [**C. tenuistriata*; OD]. Test elongate, tapering, with broad, low, slightly enveloping, uniserially arranged chambers; sutures horizontal, slightly depressed; wall calcareous, microstructure unknown, surface longitudinally striate; aperture terminal, in slight depression, subelliptical; interior with columellar process connecting foramina of adjacent chambers. *L.Eoc.-M.Eoc.,* W.Afr.(Gabon).——Fig. 446,*3,4*. **C. tenuistriata*; *3,* ext. holotype, ×27; *4,* long. sec., ×27 (*1043).

[This genus was originally placed in the Ellipsoidinidae (=Pleurostomellidae), but differs from characteristic genera of that family in the ornate surface and very large size. It is here tentatively referred to the Uvigerinidae, though the wall microstructure is unknown. If granular, it should be placed with the Pleurostomellidae; if radial, the present position would be correct. Additional details as to the character of the columellar process or tooth plate would aid in determining the systematic position.]

Compressigerina Bermúdez, 1949, *124, p. 219 [**Uvigerina coartata* D. K. Palmer, 1941, *1410b, p. 304 (=*U. compressa* Palmer, 1941, *1410a, p. 182) (*non U. compressa* Cushman, 1925); OD]. Test free, small, with early stage triserial, later biserial with twisted axis as in *Sigmavirgulina* and finally tending to become uniserial, peripheral margins angled or keeled; wall calcareous, finely perforate, radial in structure, may have longitudinal carinae and fine spines at chamber angles; aperture terminal, ovate, produced on slight neck, with internal tooth plate. *Oligo.-Rec.,* Carib.——Fig. 446,

*6. *C. coartata* (D. K. PALMER), M.Mio., Dominican Republic; *6a-c,* side, edge, and top views, ×143 (*2117).

Euuvigerina THALMANN, 1952, *1897j, p. 974 [**Uvigerina aculeata* D'ORBIGNY, 1846, *1395, p. 191; OD] [=*Euuvigerina* HOFKER, 1951, *928c,

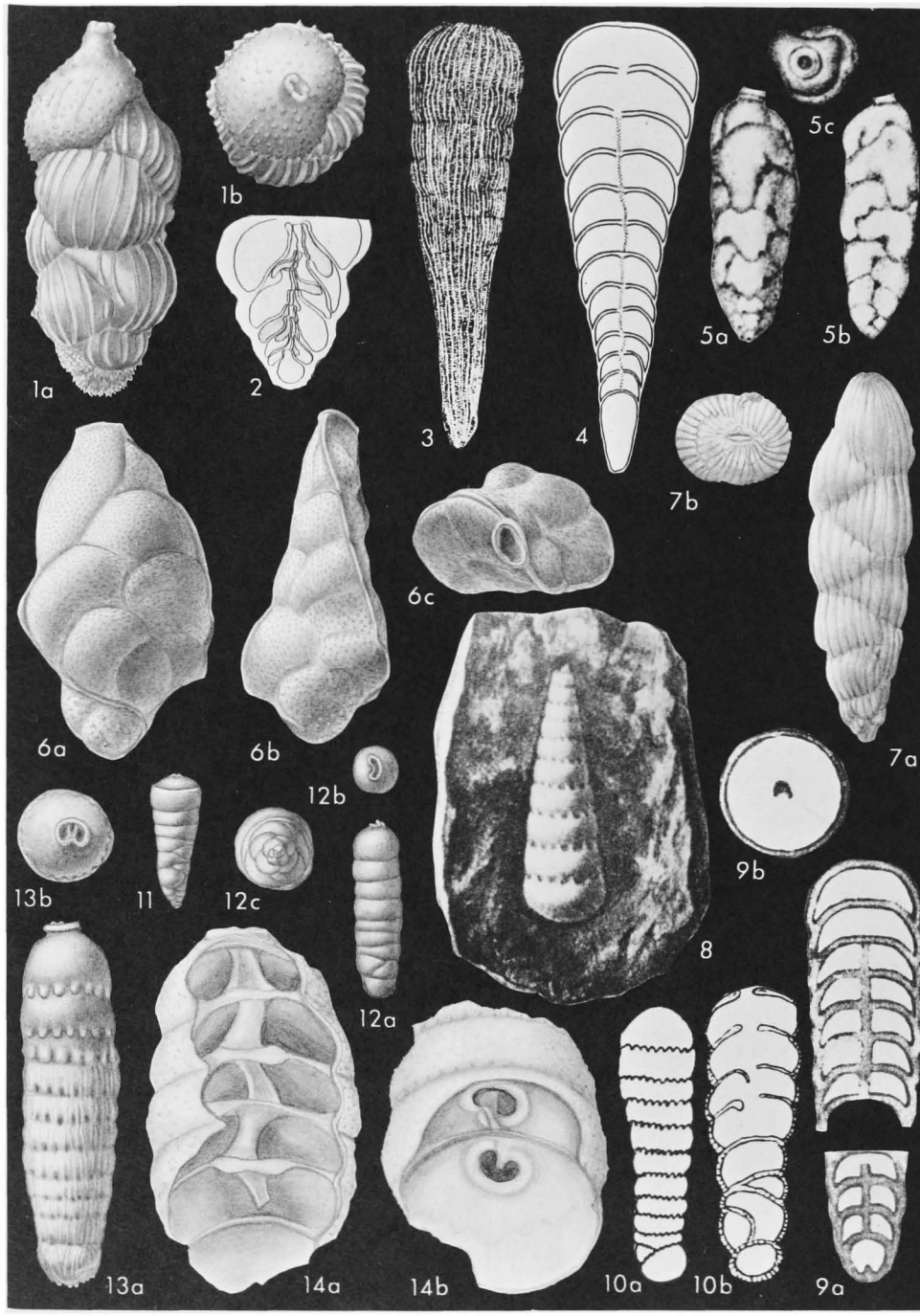

FIG. 446. Uvigerinidae; *1,2, Uvigerina; 3,4, Clavelloides; 5, Kolesnikovella; 6, Compressigerina; 7, Hopkinsina; 8-14, Orthokarstenia* (p. C565-C568).

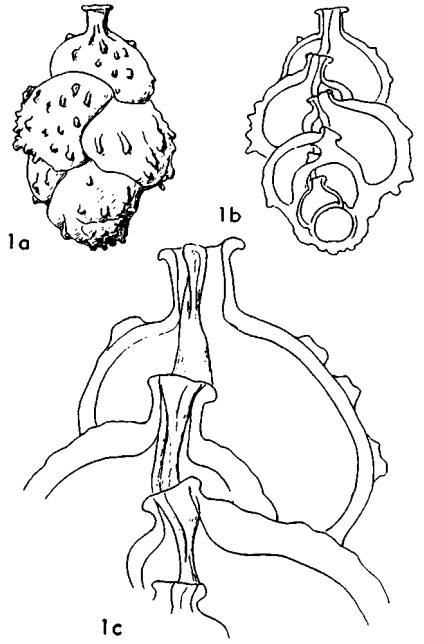

FIG. 447. Uvigerinidae; *1, Euuvigerina* (p. C566-C567).

p. 217 *(nom. nud.)*; *Hofkeruva (Hofkeruva)* VELLA, 1961, *2002, p. 473 (type, *H. (H.) mata*); *Hofkeruva (Laminiuva)* VELLA, 1961, *2002, p. 474 (type, *H. (L.) tutamoea*); *Hofkeruva (Tereuva)* VELLA, 1961, *2002, p. 475 (type, *Uvigerina paeniteres* FINLAY, 1939, *717b, p. 103); *Hofkeruva (Trigonouva)* VELLA, 1961, *2002, p. 476 (type, *H. (T.) zeacuminata*)]. Test similar in appearance to *Uvigerina,* with chambers triserially arranged, rounded in section; thick-walled and finely perforate, with surface commonly spinose and apertural neck nonperforate; with simple straight, narrow tooth plate, base of which is attached to margins of previous foramen, lacking broad wing of tooth plate of *Uvigerina. Eoc.-Rec.,* cosmop.——FIG. 447,*1.* **E. aculeata* (D'ORBIGNY), Rec., Indon.; *1a,b,* ext. and long. sec. showing simple tooth plates, ×32; *1c,* apert. area, ×153 (*928c).

[VELLA (1961, *2002) subdivided the uvigerine forms on the basis of surface ornamentation into many genera and subgenera. Although distinct lineages of costate or spinose species can be demonstrated, we do not regard them to require generic separation, for which characters recognized are those of chamber arrangement and apertural position and modifications, including tooth plates. VELLA stated (*2002, p. 473) that *Hofkeruva* and its subgenera have tooth plates identical to those of *Euuvigerina aculeata;* hence, they are here regarded as congeneric.]

Hopkinsina HOWE & WALLACE, 1932, *972, p. 61 [**H. danvillensis*; OD]. Test elongate, early stage triserial, later biserial, wall calcareous, perforate, surface smooth or more commonly longitudinally striate or costate; aperture terminal, with lip or may be slightly produced on neck, apertural tooth plate not described in type-species. [Differs from *Uvigerina* in its later biserial stage, from *Uvigerinella* in its terminal aperture, and from *Trifarina* in being rounded in section and in being biserial rather than uniserial in the adult.] *Eoc.-Rec.,* N.Am.-Eu.——FIG. 446,*7.* **H. danvillensis,* U.Eoc.(Jackson.), USA(La.); *7a,b,* side, top views of topotype, ×130 (*2117).

Kolesnikovella N. K. BYKOVA, 1958, *265, p. 68 [**Tritaxia elongata* HALKYARD, 1918, *861, p. 45; OD]. Test similar to *Trifarina,* triserial in early stage with tendency to become uniserial, lower chamber margins with retral processes and sinuous margin; wall calcareous perforate; aperture terminal, rounded, produced on neck, commonly with phialine lip. *Eoc.,* W.Eu.-USSR-Cuba-USA(Calif.)-W.Indies.——FIG. 446,*5.* **K. elongata* (HALKYARD), Eoc., Fr.; *5a-c,* opposite sides and apert. view, ×97 (*861).

Orthokarstenia DIETRICH, 1935, *597, p. 80 [**Orthocerina ewaldi* KARSTEN, 1856, *1025, p. 114; OD] [=*Siphogenerita* FURRER, 1961, *757, p. 271 (type, *Siphogenerinoides clarki* CUSHMAN & CAMPBELL, 1936, *499, p. 91)]. Test free, elongate, gradually enlarging from rounded base, early stage of microspheric form triserial, then short biserial stage, megalospheric form with proloculus followed by biserial stage, adult uniserial in both generations; adult chambers subcylindrical, somewhat inflated, lower margin commonly with re-entrants, resulting in appearance of lobulate sutures, sutures distinct, straight, depressed; wall calcareous, finely perforate, surface smooth or with ornamentation of longitudinal costae or striae; aperture terminal, elliptical to reniform, with short neck and distinct lip, internally provided with a spoutlike columellar process, semicylindrical spout arising from apertural lip and extending inward with concave side toward opening, those of successive chambers discontinuous, orientation of convex side changing from 120° to 180° in successive chambers, spout may terminate in small circular opening adjacent to concave side of true aperture but is not connected to it. *U.Cret.(Turon.-Maastricht.),* N.Am.-S.Am.-Afr.——FIG. 446,*8-10.* **O. ewaldi* (KARSTEN), Turon., S.Am.(Colom.); *8,* ext., approx. ×17; *9a,b,* vert. and cross secs. showing internal semicylindrical siphon, approx. ×30 (*1025); *10a,b,* ext. and vert. sec. showing early triserial stage, approx. ×20 (*597).——FIG. 446,*11,12.* **O. clarki* (CUSHMAN & CAMPBELL), U.Cret. (Campan.), USA(Calif.); *11,* microspheric test, ×21; *12a,b,* megalospheric test, side, and apert. views, ×21; *12c,* basal view showing chamber arrangement, ×41 (*757).——FIG. 446,*13,14.* *O. whitei* (CHURCH), U.Cret.(Maastricht.), USA (Calif.); *13a,b,* side and apert. views of megalospheric test, ×21; *14a,b,* dissected test showing

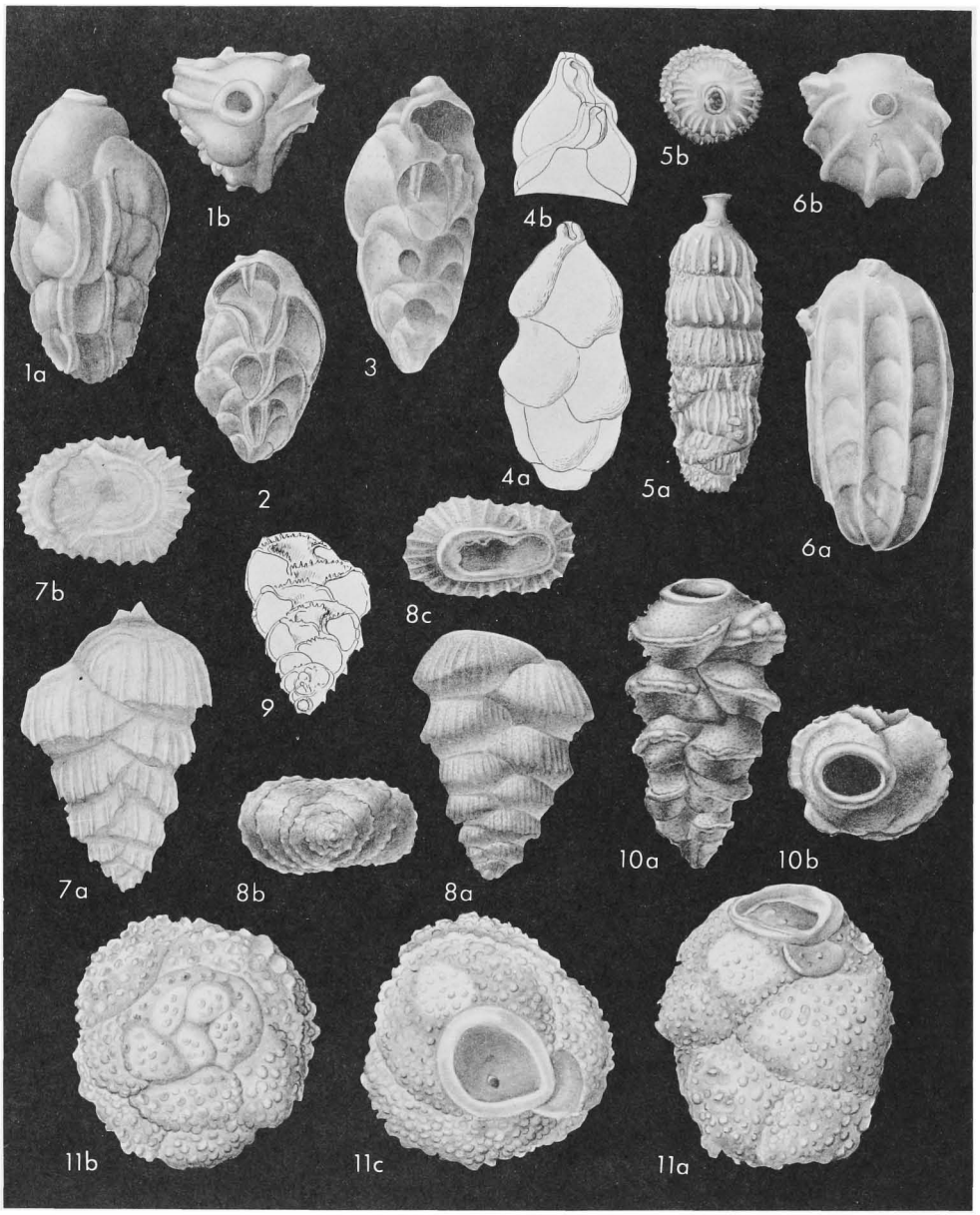

FIG. 448. Uvigerinidae; *1-4, Pseudouvigerina; 5,6, Rectuvigerina; 7-11, Sagrina* (p. C568-C569).

alternating position of internal process in successive chambers, ×48 (*757).

Pseudouvigerina CUSHMAN, 1927, *428, p. 81 [**Uvigerina cristata* MARSSON, 1878, *1228, p. 150; OD] [=*Praeuvigerina* HOFKER, 1951, *928c, p. 188 (type, *Uvigerina westfalica* FRANKE, 1912, *738, p. 280)]. Test small, triserial throughout, rounded, triangular or trihedral in section; wall calcareous, finely perforate, surface may be smooth or tuberculate, angles of test may have double vertical costae; aperture circular or subelliptical, with short neck provided internally with narrow columellar tooth plate. *U.Cret.,* Eu.-N.Am.—— FIG. 448,*1-3*. **P. cristata* (MARSSON), Maastricht., Ger.; *1a,b,* side, apert. views of topotype, U.Cret., Ger., ×111; *2,3,* acid-dissected specimens showing internal tooth plate, ×107 (*1303).—— FIG. 448,*4*. *P. westfalica* (FRANKE), U.Cret. (Senon.), Neth.; *4a,b,* side view and sec. of apert. region showing tooth plates, ×125 (*928c).

[*Pseudouvigerina* may have arisen from early *Pyramidina* and given rise to *Trifarina*. HOFKER (1957, *948, p. 220)

regarded *Pseudouvigerina* as synonymous with *Reussella*, but recognized the younger name as the valid one. *Pseudouvigerina* is here separated on the basis of its terminal aperture, whereas *Pyramidina* and *Reussella* have basal apertures.]

Rectuvigerina MATHEWS, 1945, *1234, p. 590, 598, 601 [**Siphogenerina multicostata* CUSHMAN & JARVIS, 1929, *509, p. 14; OD] [=*Rectuvigerina (Rectuvigerina)* MATHEWS, 1945, *1234, p. 590, 598, 601 (obj.); *Rectuvigerina (Transversigerina)* MATHEWS, 1945, *1234, p. 599 (type, *Siphogenerina raphanus* (PARKER & JONES) var. *transversus* CUSHMAN, 1918, *409, p. 64); *Ruatoria* VELLA, 1961, *2002, p. 480 (type, *R. ruatoria*); *Ciperozea* VELLA, 1961, *2002, p. 481 (type, *Siphogenerina ongleyi* FINLAY, 1939, *717b, p. 111)]. Similar to *Siphogenerina* but with triserial to uniserial chamber arrangement in both megalospheric and microspheric generations, whereas *Siphogenerina* has biserial to uniserial megalospheric generation. *M.Eoc.-Rec.*, cosmop.——FIG. 448,*5*. **R. multicostata* (CUSHMAN & JARVIS), Mio. (originally recorded as Eoc.), Trinidad; *5a,b,* side, apertural views of holotype, ×44 (*2117).——FIG. 448,*6*. *R. transversa* (CUSHMAN), Oligo., Panama C.Z.; *6a,b,* side, apert. views of holotype, ×49 (*2117).

[*Ruatoria* was stated to differ from *Rectuvigerina* in being smaller, with "staggered" terminal chambers and broad neck. *Ciperozea* was stated to have a more elongate triserial portion and cuneate, rather than truly rectilinear, chambers and low longitudinal ribs. Although slightly cuneate in *Ruatoria* and *Ciperozea*, these terminal chambers are nevertheless uniserial and they are regarded as synonymous with *Rectuvigerina*.]

Sagrina D'ORBIGNY in DE LA SAGRA, 1839, *1611, p. 149 [**S. pulchella*; OD (M)] [=*Sagraina* BRONN & ROEMER, 1853, *214a, p. 92 *(nom. van.)*; *Bitubulogenerina* HOWE, 1934, *970, p. 420 (type, *B. vicksburgensis*); *Tritubulogenerina* HOWE, 1939, *971, p. 69 (type, *T. mauricensis*, =*Bitubulogenerina mauricensis* HOWE, 1934, *970, p. 421)]. Test free, elongate, circular to ovate in section, triserial in early stage, later biserial; chambers commonly with angular lower margin; wall calcareous, hyaline, coarsely perforate, radial in structure, surface variously ornamented with longitudinal costae, prominent nodes; aperture elongate, bordered with distinct lip, extending up face from base of chamber beyond middle of chamber, outer portion of penultimate aperture visible also, but partially filled by tooth plate; flaring, folded tooth plate extending upward from border of previous foramen, then flaring back through chamber to attach at one side of aperture and in part forming apertural border overlapping previous chamber, entire inner margin of tooth plate serrated, forming fringed border to interior of aperture. *M.Eoc.-Rec.*, Cuba-Carib.-N.Am.-Atl. ——FIG. 448,*7-9*. **S. pulchella,* Rec., Cuba *(7)*, Atl. *(8)*, W.Indies *(9)*; *7a,b,* side, apert. views of lectotype (MNHN, Paris), ×109 (*2117); *8a-c,* side, basal, apert. views, ×107 (*2117); *9,* long. sec. of megalospheric form showing tooth plates, ×117 (*946).——FIG. 448,*10*. *S. vicksburgensis* (HOWE), Oligo., USA(Miss.); *10a,b,* side, apert. views, ×130 (*2117).——FIG. 448, *11*. *S. mauricensis* (HOWE), M.Eoc., USA(La.); *11a-c,* side, basal, and apert. views, ×227 (*2117).

[*Sagrina* described by D'ORBIGNY, 1839, was monotypic, including only *S. pulchella*. PARKER & JONES (1863, *1417e, p. 95) incorrectly emended the genus on the basis of the arenaceous *S. rugosa* D'ORBIGNY, 1840, adding that "the other *Sagrina* (*S. pulchella* d'Orb . . .) (biserial, ribbed and not sandy) is a *Uvigerina*." BRADY (1884, *200, p. 580) stated, "The generic term *Sagrina* was introduced by d'Orbigny for a biserial or Textulariform variety of *Uvigerina* with longitudinal costae." As D'ORBIGNY later also included an arenaceous species, BRADY concluded that while it would have been better to allow the name to lapse, it had been revived by PARKER & JONES for a "group of dimorphous *Uvigerinae*, usually biserial in the arrangement of their early segments and Nodosariform in their later growth, and it is to this particular set of forms that the genus is now restricted." CUSHMAN (1928, *439, p. 249) placed *Sagrina* in the synonymy of *Bolivina* but did correctly consider the type-species to be *S. pulchella*. GALLOWAY (1933, *762, p. 348) recognized *Sagrina* as a distinct genus, placing it in the Heterohelicidae. HOWE (1934, *970, p. 420) defined *Bitubulogenerina*, comparing it to the similar *Tubulogenerina*, which has a uniserial adult stage but without mention of *Sagrina*. HOFKER (1951, *928c, p. 67) incorrectly restricted *Sagrina* to *S. tesselata* (which is the type-species of *Milletia*) and placed *S. pulchella* in *Bitubulogenerina*. As *Sagrina* has priority, *Bitubulogenerina* is the junior synonym. A lectotype of *S. pulchella*, here designated and redrawn, and paratypes were selected by us from the D'ORBIGNY collection in the Muséum National d'Histoire Naturelle, Paris, France. They are Recent, off Cuba. The monotypic *Tritubulogenerina* was based on a small completely triserial form, *T. mauricensis*, which was described from the same strata and locality as *Bitubulogenerina mauricensis* HOWE, 1934, a form with early triserial stage and later biserial development. As *Tritubulogenerina mauricensis* appears merely to represent a young form or the megalospheric generation of the earlier-described species, it is a junior synonym of *Bitubulogenerina* and of *Sagrina*.]

Siphogenerina SCHLUMBERGER in MILNE-EDWARDS, 1882, *1286, p. 51 [**Siphogenerina costata* SCHLUMBERGER, 1883, *1650, p. 26; SD CUSHMAN, 1927, *433, p. 190] [=*Ellipsosiphogenerina* A. SILVESTRI, 1902, *1754, p. 101 (type, *Siphogenerina costata* SCHLUMBERGER, 1883, *1650, p. 26, SD LOEBLICH & TAPPAN, herein) (obj.); *Ellipsosiphongenerina* A. SILVESTRI, 1923, *1774, p. 265 *(nom. null.)*]. Test free, early stage biserial, later uniserial, or rarely with early triserial stage (probably microspheric); wall calcareous, hyaline, finely perforate, radial in structure, surface smooth or variously ornamented with longitudinal costae, striations or pits; aperture terminal, rounded with short neck or rim and phialine lip; apertural tooth plates projecting inward, those of successive chambers added in planes 120° apart. *Eoc.-Rec.*, cosmop.——FIG. 449,*1-4*. **S. costata,* Rec., Tahiti *(1)*, Fiji *(2,3)*, W.Indies *(4)*; *1,* holotype, ×28 (*1650); *2a,b,* side, apert. views of microspheric hypotype; *3,* side view of megalospheric hypotype; all ×32 (*476); *4,* sec. of apert. end showing tooth plates in 2 successive chambers, probably ×160 (originally stated to be ×240, but magnification of figures and measurements of specimens do not agree) (*946).

[*Siphogenerina* was originally defined (1882, *1286) without included species. A subsequent article by the same author (1883, *1650) included 3 species (*S. glabra, S. costata, S. ocracea)*, but none was designated as type-species. CUSHMAN (1913, *404c, p. 104) incorrectly designated *Uvigerina (Sagrina) raphanus* PARKER & JONES as the type-species of *Siphogenerina*, although this was not one of the 3 species originally included. Later CUSHMAN (1927, *433,

p. 190) corrected this, designating *S. costata* SCHLUMBERGER as the type-species, although stating that it was a synonym of *S. raphanus*. MATHEWS (1945, *1234, p. 589) cited the type as *S. costata* and regarded it as specifically distinct from *S. raphanus*. BANDY & BURNSIDE (1951, *76, p. 14) stated that CUSHMAN was in error in designating *S. costata* as type and that *S. glabra* as the first species included should be the type. However, any of the 3 species de-

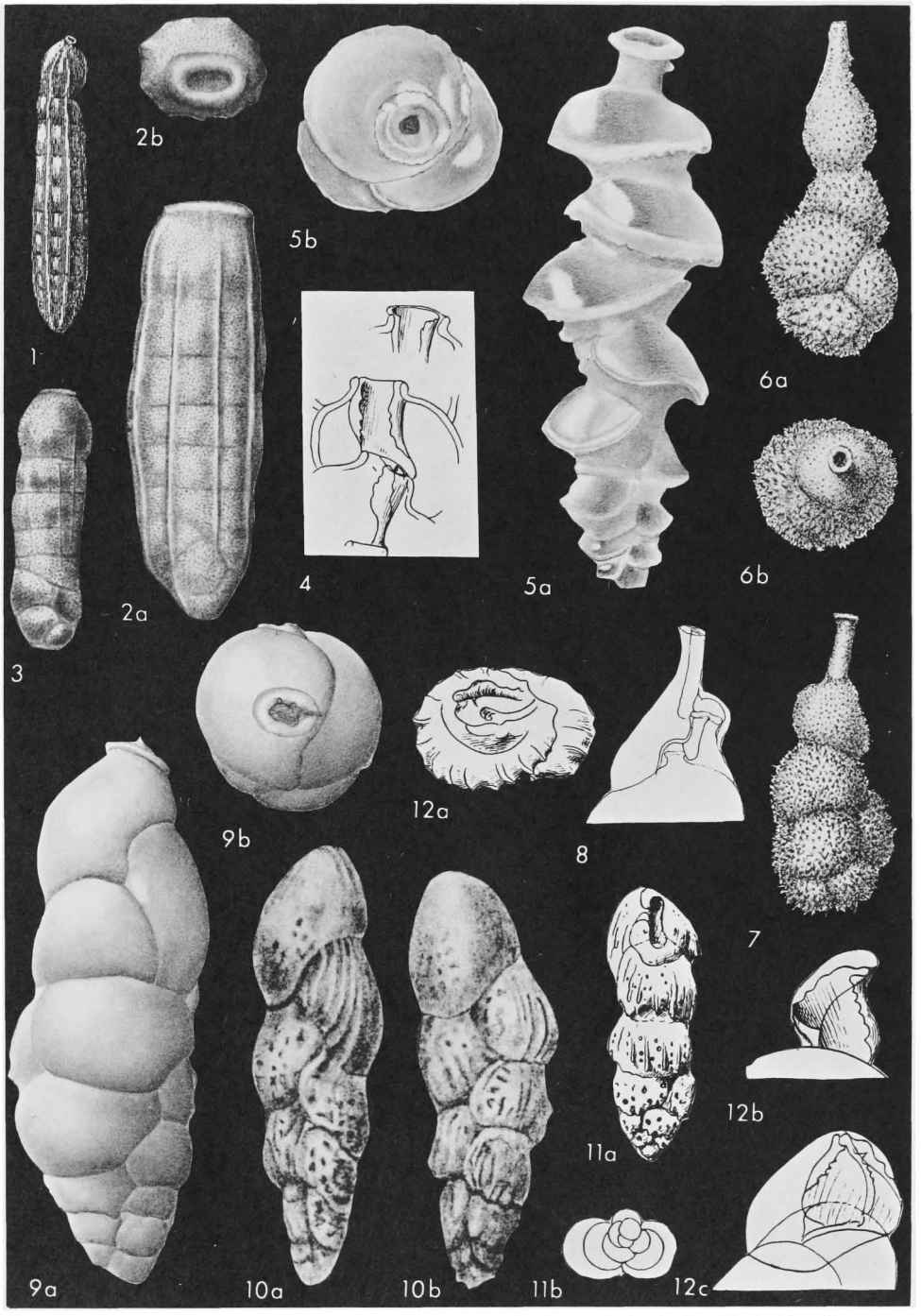

FIG. 449. Uvigerinidae; *1-4, Siphogenerina; 5-8, Siphouvigerina; 9, Uvigerinella; 10-12, Virgulinopsis* (p. C569-C572).

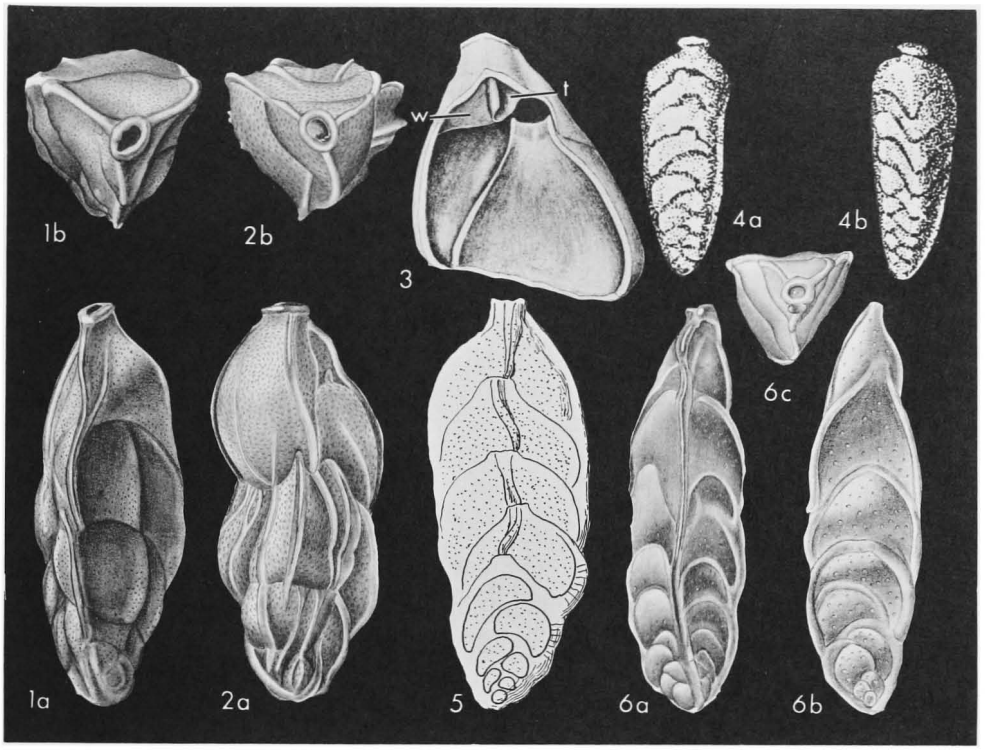

FIG. 450. Uvigerinidae; *1-6, Trifarina* (p. C571-C572).

scribed in 1883 was available for designation as type. BANDY (1952, *72, p. 17) later agreed with CUSHMAN that *S. costata* was a synonym of *S. raphanus* and stated that the latter was therefore the type-species. The type area given for *S. costata* by SCHLUMBERGER was Tahiti and New Caledonia. BANDY stated (1952, *72, p. 18) that some specimens of *S. costata* from Tahiti have a triserial early stage and others have a biserial early stage. We examined the types of *S. raphanus* in the British Museum (Natural History), and regard it as distinct from *S. costata*. *Siphogenerina* is here regarded as including only species which are triserial in the microspheric early stage and biserial in the megalospheric stage. As *S. raphanus* is biserial to uniserial in the microspheric form and only uniserial in the megalospheric stage it has been transferred to *Rectobolivina*.]

Siphouvigerina PARR, 1950, *1429, p. 342 [**Uvigerina porrecta* BRADY var. *fimbriata* SIDEBOTTOM, 1918, *1741, p. 147; OD] [=*Neouvigerina* HOFKER, 1950, *932, p. 67 *(nom. nud.)*; *Neouvigerina* HOFKER, 1951, *928c, p. 206 *(nom. nud.)*; *Neouvigerina* THALMANN, 1952, *1897j, p. 977 (type, *Uvigerina asperula* var. *ampullacea* BRADY, 1884, *200, p. 579)]. Test elongate, chambers triserial and closely appressed in the early stage, later tending to uniseriality, with chambers loosely attached and sutures deeply incised; wall calcareous, surface hispid or with granulations which may coalesce into costae; aperture terminal, rounded, with perforate neck and phialine lip, tooth plate straight and simple, attached to outer margin of previous foramen. *Oligo.-Rec.* cosmop.——FIG. 449,*5*. **S. fimbriata* (SIDEBOTTOM), Rec., Australia; *5a,b,* side, top views, ×185 (*2117).——FIG. 449,*6-8*. *S. ampullacea* (BRADY), Rec., S.Atl. *(6,7)*, Sumatra *(8)*; *6a,b,* side, apert. views, ×64; *7,* side view, ×64 (*200); *8,* optical sec. of terminal portion showing tooth plates, approx. ×100 (*928c).

Trifarina CUSHMAN, 1923, *411d, p. 99 [**T. bradyi*; OD] [=*Angulogerina* CUSHMAN, 1927, *431, p. 69 (type, *Uvigerina angulosa* WILLIAMSON, 1858, *2065, p. 67); *Candela* N. K. BYKOVA, in N. K. BYKOVA *et al.*, 1958, *265, p. 70 (type, *Trifarina labrum* SUBBOTINA, 1953, *1846, p. 247 (*non Candela* HERRMANNSEN, 1846); *Dymia* N. K. BYKOVA, 1962, *264, p. 22 (*nom. subst. pro Candela* N. K. BYKOVA, 1958, *non* HERRMANNSEN, 1846); *Norcottia* VELLA, 1961, *2002, p. 478 (type, *Hopkinsina mioindex* FINLAY, 1947, *717e, p. 282)]. Test free, elongate, triangular in section; chambers triserially arranged, early ones closely appressed, later ones more loosely appressed and tending to become uniserial; wall calcareous, finely perforate, radial in structure, commonly with longitudinal costae; aperture terminal, ovate, on short neck with thickened rim, tooth plate with wing at dorsal side. *Eoc.-Rec.,* cosmop.——FIG. 450,*1-3*. *T. angulosa* (WILLIAMSON), Rec., Br.I.; *1a,b,* side, apert. views of paratype, ×83 (*2117); *2a,b,* side, apert. views, ×99 (*2117); *3,* apert. end dissected to show tooth plate *(t)* and its wing *(w)*, ×123 (*924).——FIG. 450,*4*. *T. labrum* (SUBBOTINA), U.Eoc., Ukraine; *4a,b,* opposite sides of holotype, ×96 (*1509).——FIG. 450,*5,6*. **T. bradyi,* Rec., Indon. *(5)*, Atl. *(6)*;

5, long. sec. showing tooth plates, ×160 (*928c); *6a-c,* opposite sides and apert. view of paratype, ×94 (*2117).

[*Trifarina* differs from *Uvigerina* in being angular in section and in the tendency to become uniserial in the adult. The synonymy of *Angulogerina* with *Trifarina* was shown by HOFKER (1956, *946, p. 77), although he recognized the junior name as valid. The original types of *Uvigerina angulosa* WILLIAMSON were studied by us in the British Museum (Natural History), and a lectotype here designated (BMNH-ZF3576) with paratypes (BMNH-ZF3575) (all *ex* 96.8.13.32, WILLIAMSON collection, Recent. off Great Britain). *Norcottia* was proposed to include a finely costate Miocene species, as VELLA utilized surface ornamentation for generic separation. In chamber arrangement and other features it resembles *Trifarina*; hence *Norcottia* is here considered a synonym of *Trifarina.*]

Uvigerinella CUSHMAN, 1926, *426, p. 58 [**Uvigerina (Uvigerinella) californica*; OD] [=*Uvigerina (Uvigerinella)* CUSHMAN, 1926, *426, p. 58 (obj.)]. Test similar to *Uvigerina,* triserial; wall calcareous, perforate, surface smooth or longitudinally costate; aperture slitlike, extending up face of final chamber, rather than terminal in position, and may have elevated rim or collar, but without neck and phialine lip, character of tooth plate not described in type-species. [Additional study is needed of the type-species of this and other genera. Possibly *Virgulopsis* or *Virgulinopsis* may be synonyms of the present genus, but evidence for determining this is insufficient as yet.]. *Eoc.-Rec.,* N.Am.-W.Indies.——FIG. 449, *9. *U. californica,* Mio., USA(Calif.); *9a,b,* side, apert. views of paratype, ×97 (*2117).

Virgulinopsis HOFKER, 1956, *946, p. 47 [**Bolivina cubana* BERMUDEZ, 1935, *117, p. 196; OD]. Test with short triserial early stage, later biserial; wall calcareous, finely perforate, surface commonly striate or costate, apertural face poreless; aperture elongate, nearly terminal in position, with flaring tooth plate, attached portion folded, and irregularly lobed, free folded part narrow, with fimbriate margin, occurring in an excavation of upper apertural margin. *Rec.,* Carib.——FIG. 449, *10-12. *V. cubana* (BERMUDEZ), Cuba; *10a,b,* opposite sides, ×120 (*472); *11a,b,* edge view showing aperture and basal view showing triserial base, ×160 (*946); *12a,* top view showing aperture, ×210; *12b,c,* views of tooth plate, one showing chamber outline, ×210 (*946).

[*Virgulinopsis* differs from *Bolivina* in its early triserial development, and from *Stainforthia* in its coarser perforations, longitudinal ornamentation, and more highly developed tooth plate. It is possibly intermediate between *Stainforthia* and *Sagrina.* The magnifications here given are corrected, as the figures given by HOFKER (*946) apparently were reduced to two-thirds the size stated in the figure explanations.]

Superfamily DISCORBACEA Ehrenberg, 1838

[*nom. correct.* LOEBLICH & TAPPAN, herein (*pro* Discorbidea SMOUT, 1954, p. 81)]——[In synonymic citations superscript numbers indicate taxonomic rank assigned by authors (¹superfamily, ²family group); dagger (†) indicates *partim*]——[=¹Orthoklinostegia† EIMER & FICKERT, 1899, p. 685 (*nom. nud.*); =²Rotaliaridia† RHUMBLER in KÜKENTHAL & KRUMBACH, 1923, p. 88; =¹Discorbidea SMOUT, 1954, p. 81; =¹Monolamellidea REISS, 1957, p. 128 (*nom. nud.*)]——[=Asterigerinacea LOEBLICH & TAPPAN, 1961, p. 302]

Test trochospiral or derived from such; wall of radial laminated calcite, perforate, noncanaliculate, single walls and septa; aperture interiomarginal or areal, or derived from such. *M.Trias.-Rec.*

Family DISCORBIDAE Ehrenberg, 1838

[*nom. correct.* GLAESSNER, 1945, p. 145 (*pro* Discorbina EHRENBERG, 1838, p. 200)]——[All names cited are of family rank; dagger (†) indicates *partim*]——[=Polystomat LATREILLE, 1825, p. 161 (*nom. nud.*); =Cristacea†, and Cristacés† DE BLAINVILLE, 1825, p. 383 (*nom. nud.*); =Hélicostègues† D'ORBIGNY, 1826, p. 268 (*nom. nud.*); =Uvellina† EHRENBERG, 1839, table opposite p. 120 (*nom. nud.*); =Turbinoidae† D'ORBIGNY in DE LA SAGRA, 1839, p. xxxviii, 71 (*nom. nud.*); =Valvulineriidae BROTZEN, 1942, p. 16; =Laticarinidae HOFKER, 1951, p. 307; =Valvulineridae HOFKER, 1951, p. 484; =Marginolamellidae† HOFKER, 1951, p. 485 (*nom. nud.*); =Discorbididae POKORNÝ, 1954, p. 215 (*nom. van.*); =Conorbinidae HOFKER, 1954, p. 167; =Discorbinidae HOFKER, 1954, p. 167; =Pseudoparrellidae SUBBOTINA in RAUZER-CHERNOUSOVA & FURSENKO, 1959, p. 272; =Discorbiidae HORNIBROOK, 1961, p. 97 (*nom. van.*)]

Test free, trochospiral; chambers simple; wall calcareous, perforate, radial in structure, monolamellid; aperture basal or areal. *M.Trias.-Rec.*

Subfamily DISCORBINAE Ehrenberg, 1838

[*nom. correct.* GALLOWAY, 1933, p. 285 (*pro* subfamily Discorbisinae CUSHMAN, 1927, p. 75; *nom. transl. ex* family Discorbina EHRENBERG, 1838)] [=Discorbininae SCHUBERT, 1921, p. 156; =Pseudoparellinae VOLOSHINOVA in VOLOSHINOVA & DAIN, 1952, p. 81; =Discorbinellinae SIGAL in PIVETEAU, 1952, p. 228; =Discorbidinae POKORNÝ, 1954, p. 215 (*nom. van.*); =Discorbiinae HORNIBROOK, 1961, p. 97 (*nom. van.*)]

Test free, trochospiral, low- to high-spired, umbilical region open; aperture basal, umbilical. *M.Trias.-Rec.*

Discorbis LAMARCK, 1804, *1085a, p. 182 [**Discorbites vesicularis*; OD (M)] [=*Discorbites* LAMARCK, 1804, *1085a, p. 182 (obj.); *Discorbitus* RAFINESQUE, 1815, *1496, p. 140 (*nom. van.*); Les Discorbes D'ORBIGNY, 1826, *1391, p. 274 (*nom. neg.*); Les Trochulines D'ORBIGNY, 1826, *1391, p. 274 (*nom. neg.*); *Trochulina* D'ORBIGNY in EHRENBERG, 1839, *667, chart following p. 120 (type, *Rotalia turbo* D'ORBIGNY, 1826, *1391, p. 274); *Cyclodiscus* EHRENBERG, 1839, *667, chart opposite p. 120 (*nom. subst. pro Discorbis* LAMARCK, 1804) (obj.); *Allotheca* EHRENBERG, 1843, *672, p. 407 (type, *A. megathyra*); *Asterospira* EHRENBERG, 1858, *683, p. 11 (type, *A. isoderma*); *Discorbina* PARKER & JONES in CARPENTER, PARKER & JONES, 1862, *281, p. 200, 203 (type, *Rotalia turbo* D'ORBIGNY, 1826, *1391, p. 274); *Rotorbinella* BANDY, 1944, *69, p. 372 (type, *R. colliculus*); *Biapertorbis* POKORNÝ, 1956, *1477, p. 262 (type, *B. biaperturata*)]. Test free, trochospiral, plano-convex, flattened on umbilical side, periphery angled; all chambers visible on umbonate spiral side, only chambers of final whorl visible on umbilical side, with a flap extending from basal portion of each chamber toward umbilical region, opening extending along proximal side of each radial umbilical flap, connecting through cavity beneath flaps to interior of cham-

bers themselves; primary aperture an interiomarginal, extraumbilical arch, secondary sutural openings at opposite side of chamber flap remaining open as later chambers are formed; biflagellate gametes occur. *Eoc.-Rec.*, Eu.-N.Am.-Pac.-N.Z.-Australia-Atl.——Fig. 451,*1-3*. **D. vesicularis*,

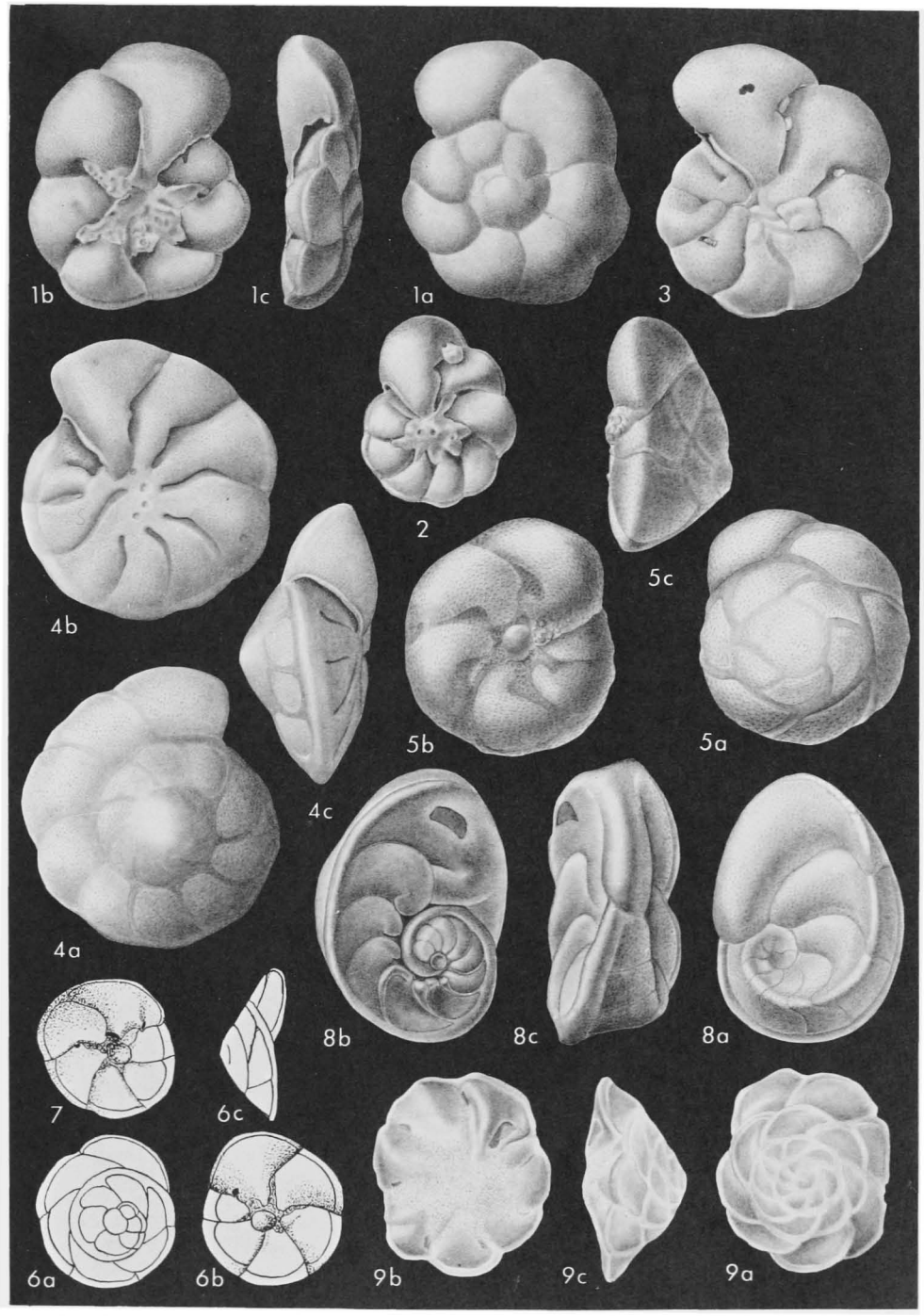

Fig. 451. Discorbidae (Discorbinae; *1-7, Discorbis; 8, Bronnimannia; 9, Buccella*) (p. C572-C575).

M.Eoc.(Lutet.), Fr.; *1a-c,* opposite sides and edge view of well-preserved topotype, showing flange-like umbilical flaps with openings at each extremity, ×17; *2,* umbilical side of smaller topotype, with less well-preserved flaps coalescing centrally and with a few central perforations, ×17; *3,* umbilical side of somewhat abraded topotype, umbilical flaps being destroyed and secondary apertures showing as sutural slits, ×25 (*2117). ——FIG. 451,*4. D. turbo* (D'ORBIGNY), M.Eoc. (Lutet.), Fr.; *4a-c,* opposite sides and edge view of specimen compared with and nearly identical to lectotype in Paris, ×28 (*2117).——FIG. 451, *5. D. colliculus* (BANDY), Eoc., USA(Ore.); *5a-c,* opposite sides and edge view, ×74 (*2117).—— FIG. 451,*6,7. D. biaperturata* (POKORNÝ), U.Eoc., Czech.; *6a-c,* opposite sides and edge view of paratype, ×85; *7,* umbilical view of holotype, ×85 (*1477).

[Many dissimilar forms have been placed in *Discorbis,* as, unfortunately, no characteristic illustrations were available for the type-species until approximately 1950. The original figure given by LAMARCK was extremely diagrammatic, the vesicular portion of the umbilical side being indicated only by the slightly angled sutures. CUSHMAN (1927, *432, pl. 24, fig. 1a-c) illustrated a topotype specimen; although the spiral and edge views given are recognizable, the drawing of the umbilical side does not show the "alar projections" referred to in the discussion. Y. LE CALVEZ (1949, *1112, pl. 3, figs. 36-38) has illustrated the central vesicular area much better. The preservation and degree of abrasion of the specimens cause a considerable degree of variation in the lateral extent of these projections, from narrow radial projections to approximately continuous flaps which almost overlap. Most texts have copied either the original figures of *Discorbis* or the misleading illustrations of CUSHMAN just cited; others have illustrated different species, some of which are not even congeneric with the type-species. Many unrelated forms thus have been placed in *Discorbis,* some of them completely lacking essential features of the genus. For these reasons, during the last 15 years there has been a great proliferation of generic names proposed for various discorbine species. Many of these are currently recognized, whereas others are here regarded as synonyms of one genus or another. In some instances the same species has been cited as type or placed within 3 or 4 different generic taxa. The species *Rotalia* (Trochuline) *turbo* D'ORBIGNY, 1826, has been designated as the type-species of *Trochulina* D'ORBIGNY, 1839, by subsequent monotypy, BASSET (1885, *101, p. 162); also it has been defined as the type-species of *Discorbina* PARKER & JONES, 1862, was included by BROTZEN (1936, *237, p. 141) in *Conorbina* but by HOFKER at various times in *Discopulvinulina* (1951, *928c) and *Rotorbinella* (1954, *942, p. 34). *Trochulina* was named by D'ORBIGNY in EHRENBERG, 1839, but no species were cited, although 3 species had been mentioned by D'ORBIGNY in 1826 (*1391, p. 274) under the French vernacular subgeneric term "Les Trochulines." Two were *nomina nuda* but the third, *Rotalia* (Trochuline) *turbo,* was valid. The latter name was first used in combination with the Latin subgeneric name *Trochulina* by BASSETT, 1885, thus automatically becoming the type of *Trochulina* by subsequent monotypy. This type designation thus validated the generic name *Trochulina,* which therefore takes precedence over the later name *Discorbina* PARKER & JONES, 1862. HORNIBROOK & VELLA (1954, *960, p. 26) discussed the genus *Discorbina* (type, *Rotalia turbo*) and considered *Rotorbinella* BANDY, 1944, to be a synonym, stating (p. 27), "The main diagnostic features of *Rotorbinella* are the prominent umbilical plug and channeled ventral sutures, characters that are strongly indicated in d'Orbigny's figure of *Rotalia (Trochuline) turbo.* Specimens of what we believe to be *Rotalia turbo,* from the Paris Basin Lutetian, are very close to *Discorbis finlayi* Dorreen, 1948, which Bermúdez regards as a typical *Rotorbinella. Rotorbinella* is thus a synonym of *Discorbina,* and moreover is not far removed from *Discorbis* in the strict sense." HOFKER (1951, *928c) included *R. turbo* in his new genus *Discopulvinulina* but later (1954, *942, p. 34) stated that *turbo* should be placed in *Rotorbinella,* adding, "*Rotorbinella turbo* (d'Orbigny) does not occur in the Lutetian of the Paris Basin, as Hornibrook and Vella believe; the species which they had at hand must have been *Rotorbinella perovalis* (Terquem) . . . ." He also stated that perhaps the species should be called *Conorbina turbo.* Apparently D'ORBIGNY did not illustrate *R. turbo,* but included it in his modèles (No. 73). A figure of this was given by PARKER, JONES & BRADY (1865, *1419, pl. 2, fig. 68). However, this figure does not agree with D'ORBIGNY's specimens. Commonly D'ORBIGNY's models, and his illustrations as well, were not intended to portray a type-specimen exactly, but instead were a composite, much-generalized illustration which sometimes combined features of more than a single species. This fact makes reference to his type-specimens absolutely imperative, and the only reliable basis for systematic work. In 1954, we examined the D'ORBIGNY types in the Muséum National d'Histoire Naturelle in Paris, among them several specimens of *Rotalia turbo,* the type-specimens of which are from the Paris Basin Lutetian. HOFKER was thus mistaken in stating that *R. turbo* does not occur in the Lutetian of the Paris Basin. One of D'ORBIGNY's original specimens of *R. turbo* is here designated as lectotype and this specimen is now so labeled on a separate slide in the Museum in Paris. The specimen of *R. turbo* here figured is from the Lutetian at the classic locality of Chaussey, Seine-et-Oise, France, and was compared to the lectotype in Paris, and found to be identical in all features. It is a true *Discorbis.* Of the genera to which *R. turbo* has been referred, *Conorbina* is regarded as a valid genus, on the basis of its type-species; *Discopulvinulina* is a synonym of *Discorbinella;* and *Trochulina, Discorbina,* and *Rotorbinella* are regarded as synonyms of *Discorbis.* In addition, *Biapertorbis* is regarded as a synonym of *Discorbis,* the type-species showing the umbilical flap separating the 2 apertures characteristic of *Discorbis,* and an umbilical "plug" like that found in some species of *Discorbis* but varying considerably in the degree of development.]

Aboudaragina NAKKADY, 1955, *1345, p. 261 [**A. eponidelliformis*; OD]. Test trochospiral, ventrally umbilicate; wall calcareous, finely perforate, microstructure and lamellar character unknown; aperture a large, rounded, interiomarginal equatorial opening in depressed terminal face. [This genus and type-species are known only from the original publication, in which the figures are generalized, and at least the spiral view apparently incorrect, as it does not show a trochospiral coil, but concentric whorls.] *M.Jur.,* Egypt.——FIG. 452,*1. *A. eponidelliformis,* U.Dogger(Bathon.); *1a-c,* opposite sides and edge view of holotype, ×54 (*700).

Bronnimannia BERMÚDEZ, 1952, *127, p. 39 [**Discorbis palmerae* BERMÚDEZ, 1935, *117, p. 207; OD]. Test free, auriculate in outline, planispiral, evolute on both sides, plano-convex to nearly biconcave, umbilical region open on apertural side, closed on opposite side with sharp, acute-angled peripheral ridge and truncate peripheral margin sloping sharply to marginal keel; umbilical flap near aperture of each chamber, those of earlier chambers of final whorl remaining visible; sutures arched on apertural side and curved backward at periphery, sigmoid on opposite side, curving backward from umbonal area, abruptly angled at sharp dorsal angle, and curving again to peripheral keel; wall coarsely perforate on umbonal, ridged side, finely perforate on apertural side; aperture opening beneath umbilical chamber flaps and connecting laterally along spiral suture to openings of earlier chambers of final whorl. [*Bronnimannia* differs from *Planulinoides* in having a slitlike aperture beneath the ventral umbilical chamber flaps, whereas in *Planulinoides* the aperture is peripheral and consists of an oblique ovate open-

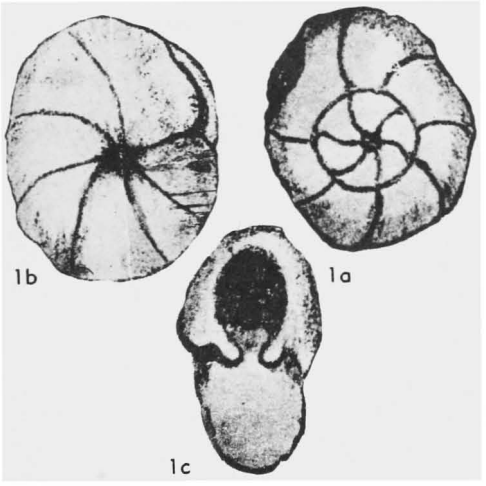

FIG. 452. Discorbidae (Discorbinae; *1, Aboudaragina*) (p. C574).

ing surrounded by a lip, in addition to the ventral openings beneath rudimentary umbilical flaps.] *Rec.,* Gulf Mex.-Atl.-Pac.——FIG. 451,*8*. **B. palmerae* (BERMÚDEZ), Cuba (Bahia de Matanzas); lectotype, here designated (Coll. U.S.N.M.) from original syntypes of BERMÚDEZ; *8a-c,* opposite sides and edge view, ×78 (*2117).

Buccella ANDERSEN, 1952, *17, p. 143 [**Eponides hannai* PHLEGER & F. L. PARKER, 1951, *1455, p. 21; OD]. Test trochospiral, planoconvex to biconvex, periphery keeled; umbilical region and inner part of last whorl of chambers partially obscured by granular or pustulose coating on umbilical side; primary aperture interiomarginal, midway between umbilicus and periphery, supplementary sutural apertures at posterior margin of each chamber, near periphery on umbilical side. *Oligo.-Rec.,* N. Am.-Atl.-Pac.-Carib.-Japan-Eu.-S.Am.——FIG. 451, *9*. **B. hannai* (PHLEGER & F. L. PARKER), Rec., Gulf Mex.; *9a-c,* opposite sides and edge view of holotype, ×80 (*17).

Conorbina BROTZEN, 1936, *237, p.141 [**C.marginata*; OD]. Test plano-convex, trochospiral; chambers crescentic, increasing in breadth as added, so that final whorl has relatively few; sutures oblique and curved on spiral side, nearly radial on opposite side; aperture a low slit at base of final chamber, in slight re-entrant of chamber margin, near periphery on umbilical side. [*Conorbina* differs from *Glabratella* in lacking open umbilicus with surrounding radial ornamentation, and in having a suturally placed aperture.] *L.Cret.(Alb.)-U. Cret.(Senon.),* Eu.-N.Am.——FIG. 453,*1*. **C. marginata,* L.Senon., Sweden; *1a-c,* opposite sides and edge view, ×190 (*2117).

Diplotremina KRISTAN-TOLLMAN, 1960, *1059, p. 64 [**D. astrofimbriata*; OD]. Test free, trochospiral, margin of large open umbilicus deeply lobed; chambers increasing gradually in size; wall calcareous, perforate, microstructure and lamellar character unknown; primary aperture interiomarginal, about midway between umbilicus and periphery, umbilical chamber flap separating it from secondary umbilical opening, both apertures with crenulated margins. *M.Trias.,* Aus.——FIG. 454,*1*. **D. astrofimbriata*; *1a-c,* opposite sides and edge view of holotype, ×125 (*1059).

Discorbinella CUSHMAN & MARTIN, 1935, *512, p. 89 [**D. montereyensis*; OD] [=*Discopulvinulina* HOFKER, 1951, *936, p. 359 (type, *Rosalina bertheloti* D'ORBIGNY in BARKER-WEBB & BERTHELOT, 1839, *86, p. 135)]. Test free, plano-convex, compressed to scalelike, spiral side convex, nearly involute, only small portion of earlier whorls visible centrally, opposite side flattened to slightly concave, umbilicate, but nearly involute, with very little of previous coil visible at center, periphery carinate; aperture an interiomarginal arch, nearly peripheral on umbilical side, with supplementary opening at opposite margin of umbilical chamber flap; gametes biflagellate (in *D. bertheloti*). *Rec.,* Atl.-Pac.-Gulf Mex.——FIG. 453,*2*. **D. montereyensis,* USA(Calif., Monterey Bay); *2a-c,* opposite sides and edge of holotype, ×115 (*2117).——FIG. 453,*3*. *D. bertheloti* (D'ORBIGNY), Gulf Mex.; *3a-c,* opposite sides and edge view, ×68 (*2117).

[*Discorbinella* differs from *Discorbis* in its spiral side being only partially evolute, in having very simple umbilical chamber flaps, and in having a nearly peripheral primary aperture. HOFKER (1951, *936, p. 359; *928c, p. 448) proposed the name *Discopulvinulina* to include a variety of forms previously placed in *Discorbis, Discorbina, Pulvinulina, Rotalia, Cibicidoides,* and *Rosalina*. If species originally included by HOFKER under *Discopulvinulina* were in reality congeneric, his proposed name would be preoccupied by no less than six other valid generic names. However, on the basis of the type-species of these genera, *Discopulvinulina* is distinct from those, but a junior synonym of *Discorbinella*. D'ORBIGNY recorded *Rosalina bertheloti* (type-species of *Discopulvinulina*) from the Canary Islands, in marine sands at Teneriffe. Our figured specimen from the Gulf of Mexico is one of the hypotypes originally figured by FLINT (1899, *723, pl. 72, fig. 4).]

Discorbitura BANDY, 1949, *70, p. 99 [**D. dignata*; OD]. Test free, trochospiral, concavo-convex, all chambers visible on convex spiral side; only last whorl visible on flat to concave umbilical side, periphery keeled; chambers with slight re-entrant at their irregular posterior margin on umbilical side, sufficiently pronounced as to nearly subdivide chamber into peripheral and umbilical lobe, and may have series of grooves branching out from sutures, umbilical region may be filled with nodes and pustules; sutures somewhat thickened on spiral side, depressed on opposite side: aperture peripheral, round areal opening at short distance above base of final chamber face, secondary openings which may be filled appear beneath posterior umbilical margin of chambers, rarely one or more of these remaining open after later chambers are added. *Oligo.,* N.Am.——FIG. 453,*4*. **D. dignata,* USA(Ala.); *4a-c,* opposite sides and edge views, ×139 (*2117).

[The secondary apertures on the umbilical side were not mentioned in the original description, nor was the in-

folding of the posterior chamber margins, although BANDY stated (*70, p. 99) that the sutures were "usually channeled with re-entrants." The holotype, paratypes, and metatypes have been examined by us and when examined at a sufficiently high magnification, all specimens show the features described above. *Discorbitura* resembles *Discorbinella*, but differs in having an areal aperture, less distinct umbilical supplementary apertures, in being involute rather than partially evolute on the umbilical side, and in possessing umbilical nodes and branching sutural grooves.]

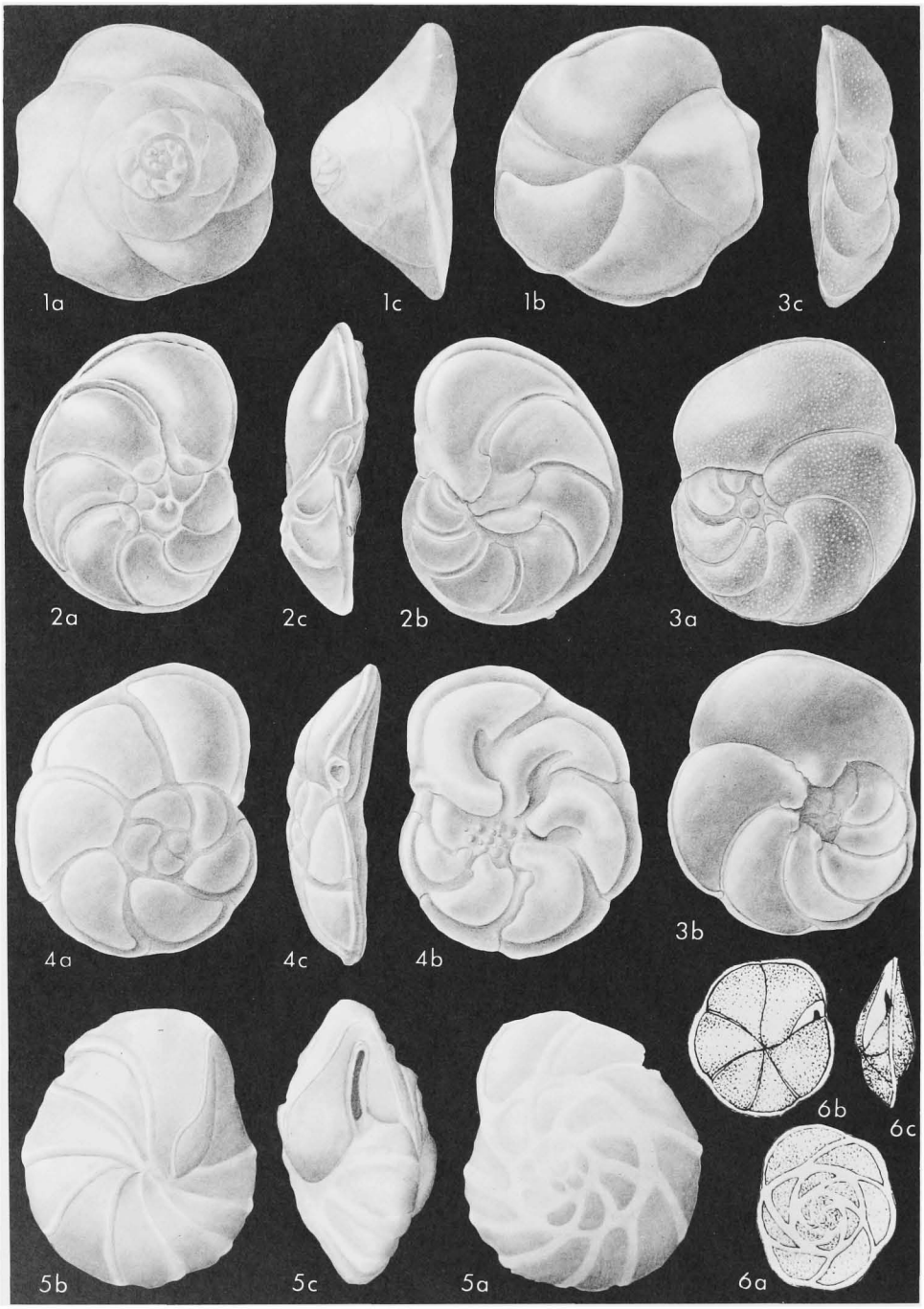

FIG. 453. Discorbidae (Discorbinae; *1, Conorbina; 2,3, Discorbinella; 4, Discorbitura; 5,6, Epistominella*) (p. C575-C576, C578).

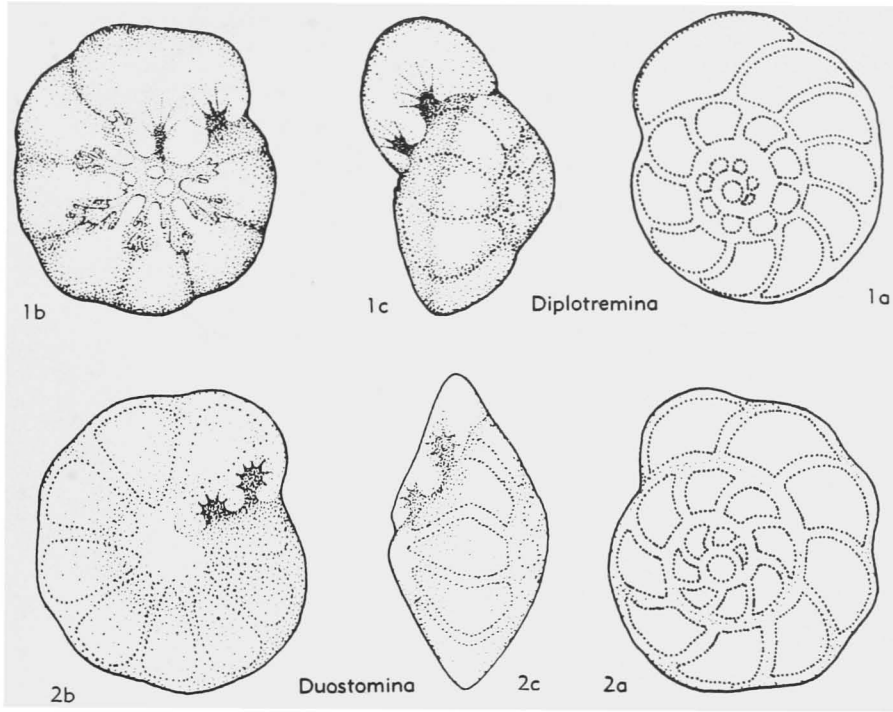

FIG. 454. Discorbidae (Discorbinae; *1, Diplotremina; 2, Duostomina*) (p. C575, C577).

Duostomina KRISTAN-TOLLMANN, 1960, *1059, p. 68 [**D. biconvexa*; OD]. Test free, trochospiral, chambers enlarging gradually, wall calcareous, perforate, microstructure and lamellar character unknown; similar to *Diplotremina* but with closed umbilicus and both apertures and intervening flap at forward margin of final chamber, instead of one being umbilical in position. *M.Trias.*, Aus.——FIG. 454,*2*. **D. biconvexa; 2a-c,* opposite sides and edge view of holotype, ×125 (*1059).

Earlmyersia RHUMBLER, 1938, *1576, p. 209 [*"*Pulvinulina punctulata* (D'ORBIGNY)", HERON-ALLEN & EARLAND, 1913, *909, p. 134 (*non Rotalia punctulata* D'ORBIGNY, 1826) (=*Earlmyersia punctulata liliputana* RHUMBLER, 1938); OD]. Test trochospiral, plano-convex to concavo-convex, all whorls visible on spiral side and most of final 2 whorls visible on umbilical side, sutures thickened, strongly curved; wall calcareous, finely perforate, radial in structure, umbilical side with fine papillae; aperture obscure, an interiomarginal slit midway between periphery and umbilicus; growth or reproductive cysts may occur, during which agglutinated material temporarily covers protoplasm. *Rec.*, Ire.-Helgoland.——FIG. 455,*1-3*. **E. liliputana,* Helgoland *(1),* W.Ire.(Clare Is.) *(2,3)*; *1a-c,* opposite sides and edge view, ×200 (*1576); *2,3,* spiral and umbilical sides of different specimens, ×120 (*909).

[The original definition of *Earlmyersia* stressed the flattened test, finely perforate wall, and the presence of pustulose ornamentation on the umbilical side. Both the descriptions by HERON-ALLEN & EARLAND and by RHUMBLER also mentioned specimens attached by the umbilical surface and surrounded by agglutinated material, comparable to the growth and reproductive cysts such as have been described for other Discorbinae. The type-species seems close to *Discorbinella* but as described, it differs in the apertural characters. *Discorbinella* has a primary peripheral interiomarginal aperture, a distinct umbilical chamber flap and a smaller opening behind this flap. A restudy of the type-species of *Earlmyersia* would show whether these features are also present therein, but meanwhile the genus is recognized tentatively as originally described. The type-species for *Earlmyersia* was originally designated by RHUMBLER (*1576, p. 209) as *"Pulvinulina punctulata* (d'Orb.) bei Heron-Allen und Earland in: Proc. roy. irish Acad., V. 31, Pt. 64, 1913, p. 134, T 4, fig. 20, 21." On the following page RHUMBLER (*1576, p. 210) described the specimens of HERON-ALLEN & EARLAND as *"Earlymersia punctulata* (D'ORBIGNY) forma: *liliputana* nom. nov.!," and the above reference, plate and figures again were cited. Taxa proposed as *forma* remain available if proposed before 1961 [ICZN Art. 17(9)], hence the type-species is *"P. punctulata* (D'ORBIGNY)" HERON-ALLEN & EARLAND, 1913 (*non Rotalia punctulata* D'ORBIGNY, 1826) =*Earlmyersia punctulata liliputana* RHUMBLER, 1938.]

Eoeponidella WICKENDEN, 1949, *2060, p. 81 [**E. linki*; OD (M)] [=*Heminwayina* BERMÚDEZ, 1951, *126, p. 325 (type, *Discorbis multisectus* GALLOWAY & HEMINWAY, 1941, *764, p. 384)]. Test free, plano-convex to nearly biconvex, umbilical side may be slightly depressed centrally, all chambers visible on convex spiral side, only final whorl visible on umbilical side where each chamber has supplementary chamber along its forward

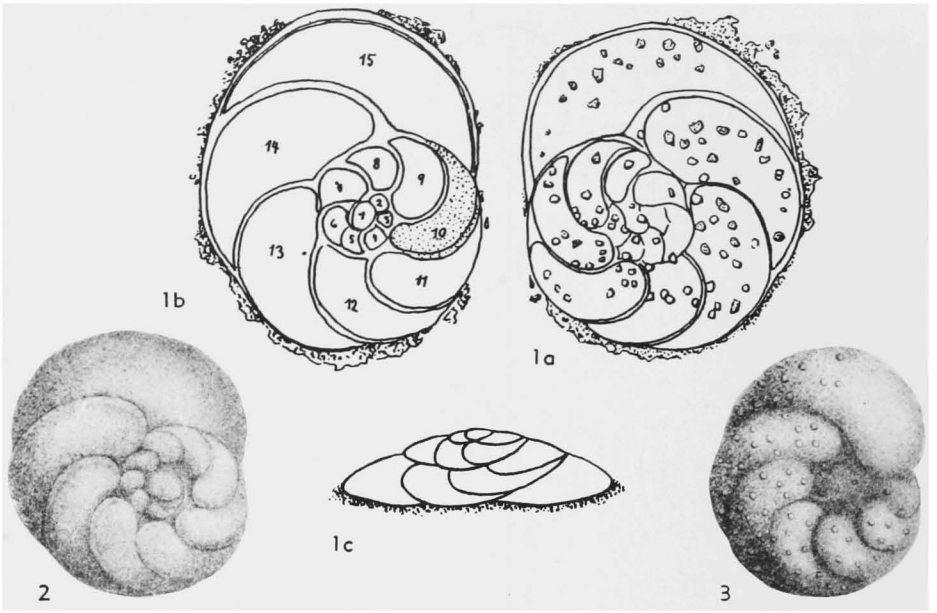

FIG. 455. Discorbidae (Discorbinae; *1-3, Earlmyersia*) (p. C577).

margin near umbilical region, supplementary chambers apparently formed after main chamber; wall calcareous, rather coarsely perforate, microstructure not known; primary aperture a broad high interiomarginal umbilical arch, but in specimens possessing final supplementary chamber against final chamber, only smaller aperture remains near proximal chamber margin. [The large open-arched aperture leading into the umbilical area, coarsely perforate test, and simple radial chambers, place *Discorbis multisectus* GALLOWAY & HEMINWAY, the type-species of *Heminwayina,* in the genus *Eoeponidella.*] *U.Cret.-Oligo.,* N.Am.-Carib. ——FIG. 456,*1*. **E. linki,* U.Cret., Can.(Sask.); *1a-c,* opposite sides and edge view, ×242 (*2117). ——FIG. 456,*2*. *E. multisecta* (GALLOWAY & HEMINWAY), Mio., Puerto Rico; *2a-c,* opposite sides and edge view of holotype, ×93 (*764).

Epistominella HUSEZIMA & MARUHASI, 1944, *974, p. 397 [**E. pulchella*; OD] [=*Pulvinulinella* CUSHMAN, 1926, *426, p. 62 (type, *P. subperuviana*) (*non Pulvinulinella* EIMER & FICKERT, 1899); *Pseudoparrella* CUSHMAN & TEN DAM, 1948, *502, p. 49 (type, *Pulvinulinella subperuviana* CUSHMAN, 1926, *426, p. 63)]. Test trochospiral; all chambers visible on spiral side, only those of last whorl visible on umbilical side; sutures oblique on spiral side, nearly radial on umbilical side; wall calcareous, perforate, radial in structure and monolamellid; aperture an elongate vertical slit in face, near and parallel to peripheral keel. *U.Cret.-Rec.,* Japan-N. Am.-Pac. - Gulf Mex.-Eu. —— FIG. 453,*6*. **E. pulchella,* Plio., Japan; *6a-c,* opposite sides and edge views, ×70 (*52b).——FIG. 453, *5*. *E. subperuviana* (CUSHMAN), Mio., USA (Calif.); *5a-c,* opposite sides and edge view of holotype, ×125 (*2117).

Eurycheilostoma LOEBLICH & TAPPAN, 1957, *1172, p. 228 [**E. altispira*; OD]. Test free, trochospiral, high-spired, umbilical side excavated, earliest whorl with 4 to 6 chambers, which increase in breadth as added, so that in adults only 3 or 4 chambers occur in each whorl, final chamber occupying most of umbilical side, extending around both sides of open umbilicus, final whorl may abruptly attain greater diameter, resulting in flaring test; aperture a broad arch at inner margin of last chamber, opening into umbilicus, and partially covered by broad umbilical flap which may have serrate margin. [*Eurycheilostoma* differs from *Neoconorbina* in being high-spired, rather than low, scalelike, and in having a rounded periphery. The apertural characters are similar, the broad umbilical flap with apertural re-entrants at the extremities occurring in both genera.] *L.Cret.,* N.Am.——FIG. 456,*3*. **E. altispira,* Alb., USA(Tex.); *3a-c,* opposite sides and edge view of holotype, ×192 (*1172).

Gavelinopsis HOFKER, 1951, *928c, p. 485 [**Discorbina praegeri* HERON-ALLEN & EARLAND, 1913, *909, p. 122; OD] [=*Gavelinopsis* HOFKER, 1951, *936, p. 359 *(nom. nud.)*]. Test free, planoconvex or biconvex, periphery keeled, all chambers visible on convex spiral side, only those of final whorl visible from flat to slightly convex umbilical side, which has prominent umbilical plug; sutures curving backward at periphery on spiral side, nearly radial on umbilical side; wall

calcareous, hyaline, finely perforate; aperture a low interiomarginal slit at short distance from periphery on umbilical side, with slight lip above. *Rec.*, Atl.-Pac.——Fig. 456,*4*. **G. praegeri* (Heron-Allen & Earland), Ire.; *4a-c*, opposite sides and edge view, ×111 (*2117).

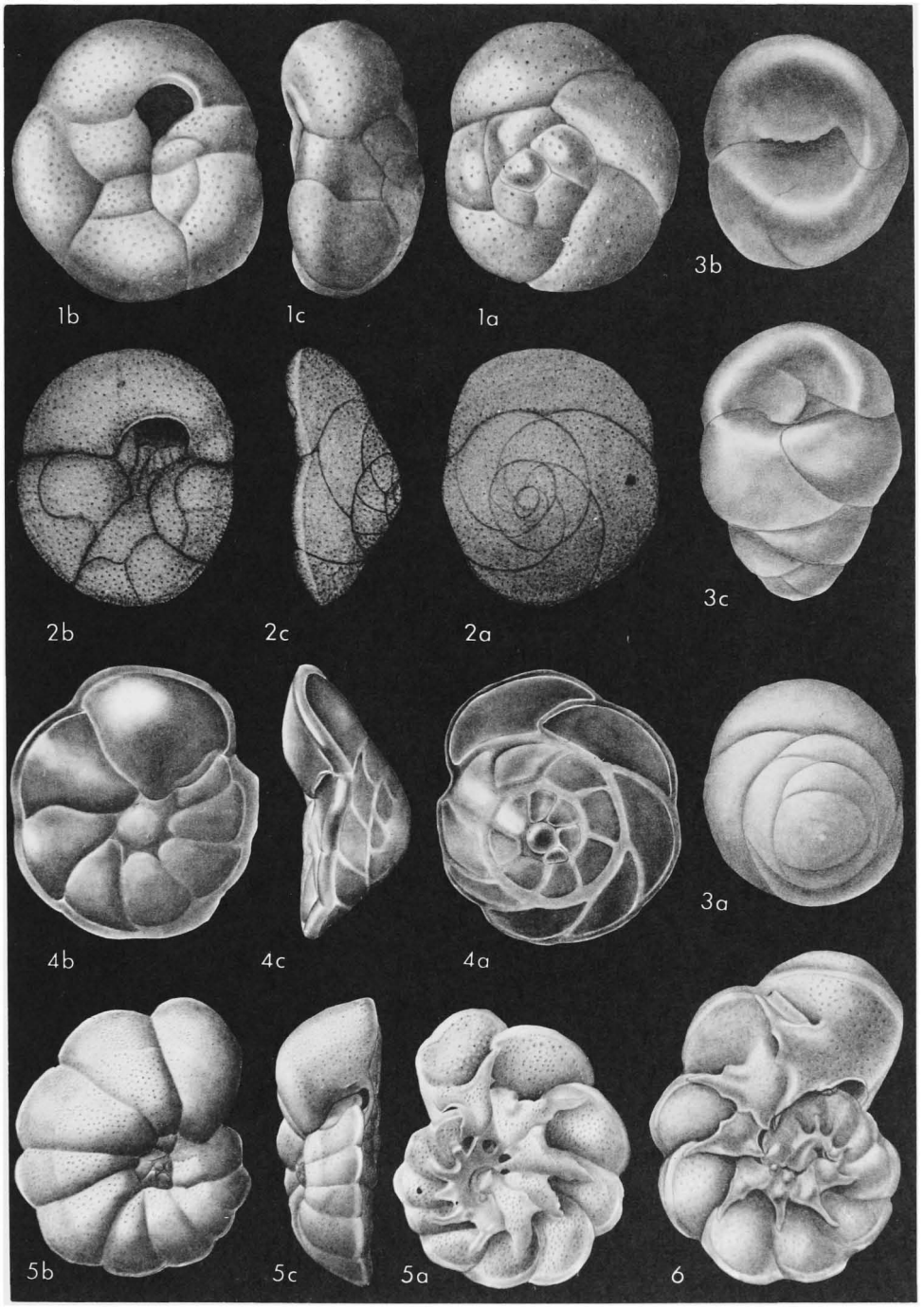

Fig. 456. Discorbidae (Discorbinae; *1,2, Eoeponidella; 3, Eurycheilostoma; 4, Gavelinopsis; 5,6, Lamellodiscorbis*) (p. C577-C580).

[*Gavelinopsis* differs from *Conorbina* in having a distinct umbilical plug and in having a more ovate aperture bordered by a distinct lip. It differs from *Discorbis* in having an umbilical plug, instead of an umbilicus covered only by the highly developed umbilical chamber flaps of *Discorbis*. HOFKER (*936, p. 359) introduced this generic name citing *Gavelinopsis atlantica* HOFKER as type, but no description was given and the species was a *nomen nudum*. Later (*928c, p. 485) the genus was described and *Gavelinopsis praegeri* (HERON-ALLEN & EARLAND) (=*Discorbina praegeri* HERON-ALLEN & EARLAND, 1913) was cited as type. In this paper HOFKER again referred to the undescribed *Gavelinopsis atlantica* as occurring in the West Indies. BERMÚDEZ (1952, *127, p. 150) considered that HOFKER referred to the same species by both names, but *G. atlantica* was described by HOFKER (1956, *946, p. 212) as a new species from off Frederiksted, Santa Cruz. It is probably not congeneric, having prominent umbilical flaps and should be placed in *Rosalina*. Neither genus is considered by us to be related to the gavelinellids or anomalinids.]

Helenina SAUNDERS, 1961, *1634, p. 148 [**Pseudoeponides anderseni* WARREN, 1957, *2039, p. 39; OD] [=*Helenia* SAUNDERS, 1957, *1632, p. 374 (obj.) (*non* WALCOTT, 1889)]. Test free, trochospiral, biconvex, periphery rounded; chambers numerous, all visible from spiral side, only those of final whorl visible on umbilical side, final chamber with umbilical flap; sutures depressed, radial on umbilical side, curved to sinuate on spiral side with sutural slits on both spiral and umbilical sides, opening into chambers; wall calcareous, finely perforate; aperture an interiomarginal slit, extending from umbilicus across peripheral margin onto spiral side where it follows suture line 0.5 to 0.7 of distance to periphery, additional sutural slit occurring on umbilical side, extending from umbilical flap of chamber toward periphery. *Rec.*, N.Am.-W.Indies(Trinidad).——FIG. 457,*1*. **H. anderseni* (WARREN), Trinidad; *1a-c*, opposite sides and edge views, ×118 (*1632).

[Differs from *Pseudoeponides* in having the supplementary slits sutural in position, whereas those of *Pseudoeponides* are nearly perpendicular to the sutures on the umbilical side and those of the spiral side are areal in position in the chamber walls. *Epistomaria* resembles *Helenina* in possessing sutural slits on both spiral and umbilical sides but differs in having supplementary chamberlets on the umbilical side, which also are bordered with slits, and an areal aperture in the face of the final chamber in addition to the interiomarginal aperture.]

Lamellodiscorbis BERMÚDEZ, 1952, *127, p. 39 [**Discorbina dimidiata* JONES & PARKER in CARPENTER, PARKER & JONES, 1862, *281, p. 201; OD]. Test free, plano-convex, periphery sharply angled and keeled, with inflated chambers around umbonal boss on spiral side, umbilical surface flattened, somewhat evolute, with alar projections on inner part of proximal margins of chambers, with opening on their umbilical side and leaving opening both in front of and behind flaps just before they attach to test at their outer ends, flaps usually coalescing at their inner margins so as to form continuous ring or spiral around open umbilicus; sutures depressed on both sides, somewhat limbate on umbilical side; wall calcareous, coarsely perforate, spiral side commonly with secondary coating that covers inner two-thirds of chambers and partially fills pores; aperture an arch at periphery, extending short distance past keel on spiral side and about one-third of distance to umbilicus on opposite side, although it may merge with opening under chamber flaps so that a definite umbilical exent cannot be delineated, aperture bordered above by narrow lip. *Rec.*, Australia.——FIG. 456,*5,6*. **L. dimidiata* (JONES & PARKER); *5a-c*, opposite sides and edge view of paratype; *6*, umbilical side of larger paratype showing well-developed alar projections and apertures, ×26 (*2117).

[Differs from *Discorbis* in its evolute umbilical side and relatively involute spiral side, in having a distinct open umbilicus, umbonal plug on the spiral side, and in extension of the aperture somewhat onto the spiral side. The type-species superficially resembles *Discorbis vesicularis* LAMARCK and, in fact, the description on the plate legend of PARKER & JONES (1865, *1418, p. 422) stated that it was "merely *D. vesicularis* modified by being sharp-edged, and flat, and even scooped on the under face (opposite to that which is flat in *Truncatulina*)." All whorls are visible spirally in *D. vesicularis* and only the final whorl visible on the umbilical side, the opposite being true in *Lamellodiscorbis dimidiata*. The chamber flaps are also better developed and are perforate to a greater extent in the present species. The illustrations given by BERMÚDEZ (1952, *127, pl. 4, figs. 4a-c) are not of this species, or genus, but as noted by HORNIBROOK & VELLA (1954, *960, p. 27) are a copy of the figures of "*Discorbina vesicularis* (Lamarck)" given by BRADY (1884, *200, pl. 87, figs. 2a-c), whose figures show the convex evolute dorsal side and involute, somewhat flattened ventral side, typical of *Discorbis*, although it is not *D. vesicularis* LAMARCK. ¶In 1953, we studied the types of JONES & PARKER in the British Museum (Natural History). As no holotype had been selected for *D. dimidiata*, one of the original specimens is here designated as lectotype (BMNH-ZF 3651), the remainder of the syntypes becoming paratypes (BMNH-ZF 3650). All are from Recent sponge sands near Melbourne, Australia. The generic description and comparisons here given are based upon these original specimens of JONES & PARKER.]

Laticarinina GALLOWAY & WISSLER, 1927, *767, p. 193 [*pro Carinina* GALLOWAY & WISSLER, 1927, *766, p. 51 (*non* HUBRECHT, 1887)] [**Pulvinulina repanda* var. *menardii* subvar. *pauperata* PARKER & JONES, 1865, *1418, p. 395; OD] [=*Parvicarinina* FINLAY, 1940, *717d, p. 467 (type, *Truncatulina tenuimargo* var. *alto-camerata* HERON-ALLEN & EARLAND, 1922, *911, p. 209)]. Test free, planispiral, broad peripheral keel may show growth lines; chambers saddle-shaped, anterior margin of keel forming separation between 2 lobes of next-developed chamber, lobes larger on one side and closely appressed, final chambers may be irregular in outline and rarely small, irregularly placed, supplementary chambers may appear on side where lobes are larger, lobes small and less closely appressed on opposite side, interconnected by small tubular necks, final chamber commonly with broad attachment flange somewhat loosely attached at posterior umbilical margin, leaving opening beneath which connects to chamber interior, wide scarlike whitish area may occur around final 2 or 3 chambers on side with larger lobes; wall calcareous, finely perforate, keel apparently imperforate, although small irregularly spaced lines, "bubbles," and tubules may appear, possibly due to parasitic organisms; peripheral aperture at one side of keel, low slit perpendicular to periphery may be slightly produced in large specimens, this peripheral aperture being absent in some specimens and entire forward margin tightly

closed, with supplementary openings beneath posterior umbilical margin of smaller lobes of later chambers suggesting apertures beneath umbilical chamber flaps. *Paleoc.-Rec.*, Atl.-Pac.-Carib.-N.Z. Afr.-Eu.——Fig. 457,*2,3*. **L. pauperata* (Parker & Jones), Rec., Carib.; *2*, apert. or umbilical side; *3a,b*, opposite sides of another specimen, ×19 (*2117).——Fig. 457,*4*. *L. altocamerata* (Heron-

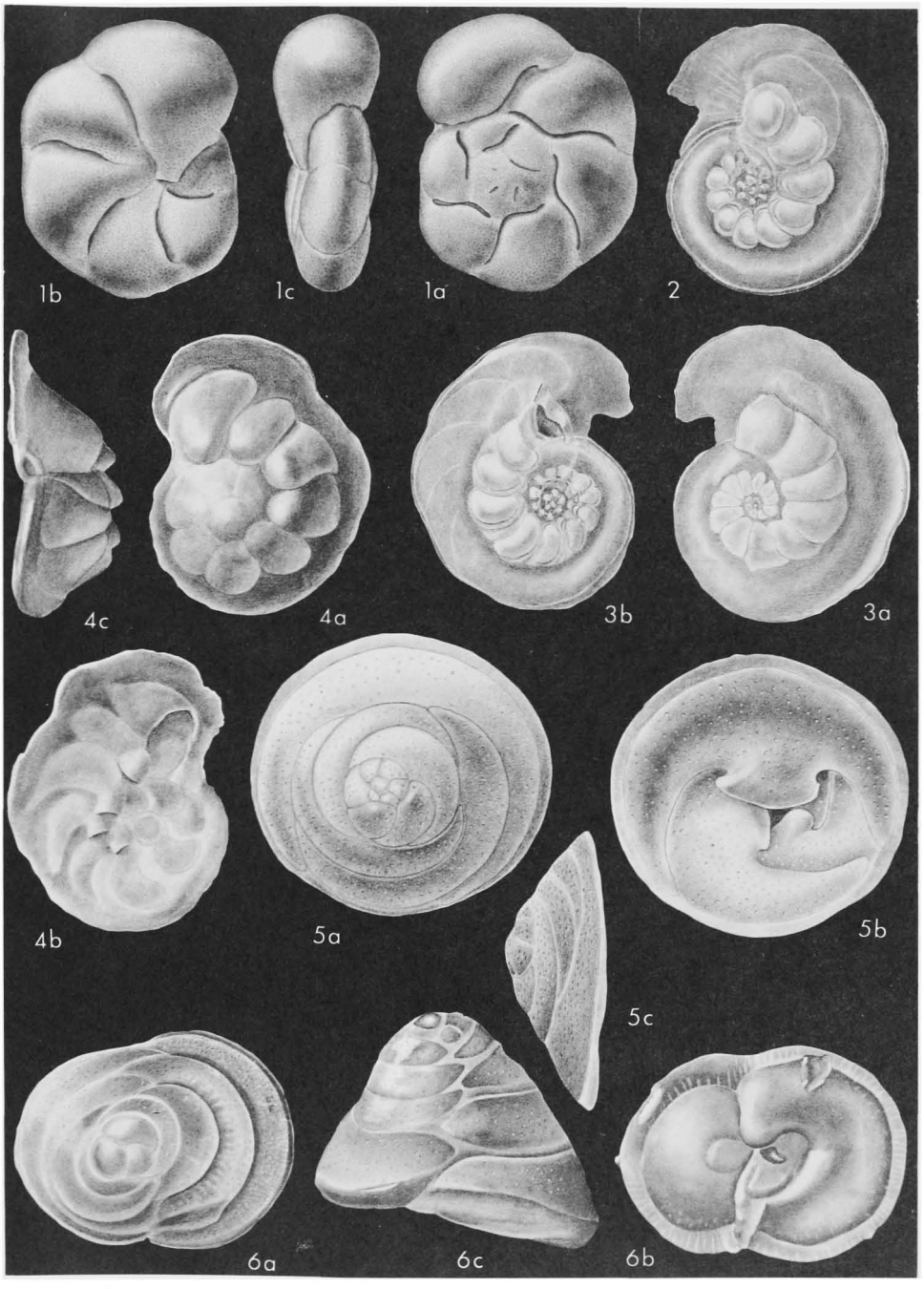

Fig. 457. Discorbidae (Discorbinae; *1, Helenina; 2-4, Laticarinina; 5, Neoconorbina; 6, Patellinella*) (p. *C*580-*C*582).

ALLEN & EARLAND), L.Mio., N.Z.; *4a-c,* opposite sides and edge view, showing peripheral and umbilical apertural openings, ×73 (*2117).

[BERMÚDEZ (1952, *127, p. 40) cited the type-species of *Parvicarinina* as *P. alatocamerata* (HERON-ALLEN & EARLAND, =*Truncatulina tenuimargo* var. *alato-camerata* HERON-ALLEN & EARLAND). This species was described as *alto-camerata* and was so designated by FINLAY. The umbilical openings described above are found in the type-species of both *Laticarinina* and *Parvicarinina,* although not previously reported for *Laticarinina.* We have examined the original types of PARKER & JONES in the British Museum (Natural History) and isolated a lectotype that is here designated (BMNH-ZF 3574 *ex* 94.4.3.319) for *Pulvinulina repanda* var. *menardii* subvar. *pauperata* PARKER & JONES. FINLAY (1940, *717d, p. 467) had regarded *Laticarinina* as having only the peripheral aperture and *Parvicarinina* as having only the umbilical openings. However, the type-species of *Laticarinina* has both types of apertures well developed. Furthermore, the type-species of *Parvicarinina* also has the forward peripheral aperture; hence, *Parvicarinina* is regarded as a junior synonym.——¶CUSHMAN & TODD (1941, *527, p. 105) regarded *Laticarinina* as closely related to *Cibicides,* stating that "the aperture in the adult is on the dorsal side on the inner margin of the last-formed chamber, low and elongate, similar to that in many species of *Cibicides.*" The genus was placed in the Anomalinidae by CUSHMAN (1948, *486, p. 334). The aperture is unlike that of *Cibicides,* however, and the test is not coarsely perforate, nor perforate granular in structure, as in the Anomalinidae. GALLOWAY placed the genus in the Nonionidae, stating (1933, *762, p. 264), "*Laticarinina* evolved from *Nonion* by developing a peripheral flange. Free specimens are planispiral and symmetrical, but attached specimens are distorted and on that account bear some slight resemblance to the Rotaliidae." However, none of the Nonionidae show umbilical flaps with supplementary openings, and the Nonionidae have a perforate granular wall structure, whereas that of *Laticarinina* is perforate radial.——¶BERMÚDEZ (1952, *127, p. 18) placed *Parvicarinina* in the subfamily Discorbisinae [=Discorbinae], family Rotaliidae, and placed *Laticarinina* in the subfamily *Planulininae* (*127, p. 21), family Anomalinidae. *Planulina* has radial perforate walls, as does *Laticarinina,* but the apertural characters are quite distinct. As *Parvicarinina* is a synonym of *Laticarina,* "both" must be placed in the same family.]

Neoconorbina HOFKER, 1951, *936, p. 357 [**Rosalina orbicularis* TERQUEM, 1876, *1888, p. 75 (*non Rosalina orbicularis* D'ORBIGNY, 1850) (=*Discorbina terquemi* RZEHAK, 1888, *1602, p. 228); OD]. Test free, trochospiral, conical, concavo-convex, periphery acutely angled and carinate; early chambers subglobular, increasing very rapidly in breadth on spiral side and very little in height as added, so that final chamber occupies much of periphery and is much broader than high, chambers on umbilical side with distinct flap at midline and apertural re-entrant on either side; wall calcareous, of calcite, by X-ray powder diffraction film; aperture in forward re-entrant of chamber on umbilical side, covered by succeeding chambers to remain as intercameral opening, supplementary aperture occurring in other re-entrant of final chamber, those of earlier chambers of final whorl remaining open. *Rec.,* Atl.O.-Pac.O.——FIG. 457, *5. *N. terquemi* (RZEHAK), Atl.; *5a-c,* opposite sides and edge view, ×111 (*2117).

[HOFKER described *Neoconorbina* with *N. orbicularis* (TERQUEM) (=*Rosalina orbicularis* TERQUEM, 1876) designated as type-species (*936, p. 357). The Siboga monograph (*928c) was mentioned (*936, p. 360) as being in press. *Neoconorbina* was described in detail in the Siboga paper (1951, *928c, p. 433) but in it HOFKER stated, "The type of the species [*sic*] is *Neoconorbina pacifica* Hofker." Undoubtedly THALMANN (1952, *1897j, p. 977) considered the Siboga paper as the original reference for the genus and therefore erroneously listed *Neoconorbina pacifica* HOFKER as the type-species. The genus was defined and the type-species fixed by original designation and monotypy, however, in the earlier paper cited above. BERMÚDEZ (1952, *127, p. 34) regarded *Neoconorbina* as a synonym of *Rosalina* D'ORBIGNY. However, *Rosalina* differs from *Neoconorbina* in the presence of sutural slits, which are the remnants of earlier apertures. *Neoconorbina* also has a conical form, lunate chambers, and an overlapping final chamber on the umbilical side. It differs from *Conorboides* in having 2 distinct apertures, one at each side of the umbilical flap.]

Patellinella CUSHMAN, 1928, *436, p. 5 [**Textularia inconspicua* BRADY, 1884, *200, p. 357; OD]. Test free, conical, trochoid, plano-convex, earliest whorl may have more than 2 chambers, test later biserial, all whorls visible dorsally, only final pair visible ventrally; wall calcareous, finely perforate, radial in structure; aperture ventral, broad arch opening into umbilicus, not covered by next following chamber. *Rec.,* S.Pac.O.(Tasm.).——FIG. 457,*6. **P. inconspicua* (BRADY); *6a-c,* opposite sides and edge view, ×183 (*2117).

[Differs from *Patellinoides* in having more than 2 chambers in the early whorl, not a simple spiraling tube, and in having a less complex apertural region. WOOD (1949, *2073, p. 250) noted that the type of *Patellinella inconspicua* shows a perforate radial wall structure, whereas *Spirillina, Patellina,* and *Patellinoides* all have a test composed of a single crystal of calcite. This has been verified by us. Furthermore, the absence of an early undivided spire in the present genus, such as is found in the Patellininae, substantiates their separation shown by COLLINS (1958, *375, p. 400), who placed *Patellinella* in the "Discorbisinae." HOFKER (1951, *936, p. 358) described *Discobolivina* as including the earlier genera "*Patellina, Patellinoides,* etc.," citing *Discobolivina corrugata* (WILLIAMSON) (=*Patellina corrugata* WILLIAMSON) as type-species. In the Siboga monograph (1951, *928c, p. 422) HOFKER also included *Patellinella* in *Discobolivina,* giving the generic description as an original description in this publication without citing a type-species.——¶THALMANN (1952, *1897j, p. 973) stated that HOFKER had not designated a type-species for *Discobolivina,* hence he selected *Patellinoides conica* HERON-ALLEN & EARLAND. As HOFKER'S designation of *Patellina corrugata* WILLIAMSON as type was earlier, the designation by THALMANN was invalid and *Discobolivina* is a junior objective (isogenotypic) synonym of *Patellina.* HOFKER'S discussion and figures of "*Discobolivina inconspicua* (Brady)" are of the species BRADY described as *Textularia jugosa,* and specimens belonging to BRADY'S species *inconspicua* are included by HOFKER under *Discobolivina conica.* As BRADY well described and figured the 2 species, it is impossible to alter the names applied to them.——¶The species *Textularia jugosa* does not belong to *Patellinella;* hence HOFKER'S discussion of this form, although under the name *inconspicua,* has no bearing on the present genus. *Textularia jugosa* shows an open umbilical region into which open the apertures of final pair of chambers, and in *Patellinella* the apertures of the two final chambers are distinctly separated. Typical *Patellinella* is not characterized by a strongly ornamented test, as in *T. jugosa* BRADY.]

Pijpersia THALMANN, 1954, *1904, p. 153 [*pro Ruttenia* PIJPERS, 1933, *1457, p. 30 (*non* RODHAIN, 1924)] [**Bonairea coronaeformis* PIJPERS, 1933, *1456, p. 72; OD] [=*Bonairea* PIJPERS, 1933, *1456, p. 72 (obj.) (*non* BURRINGTON BAKER, 1924); *Pseudoruttenia* Y. LE CALVEZ, 1959, *1115, p. 92 (type, *P. diadematoides*)]. Test free, trochospiral, spiral side ornamented by tubercles and keels, umbilical side flat to concave and may show radial grooves; chambers inflated to angular, strongly overlapping on umbilical side; wall microstructure unknown; aperture umbilical, with broad umbilical flap. [Similar to *Glabratella* in the commonly ornamented spiral side and radially ornamented umbilical side, but differs in having a prominent umbilical flap, similar to *Conorboides.*] *Eoc.,* W.Indies(Bonaire-Trinidad)-

C.Am.(Panama)-Eu.——Fig. 458,*1*. **P. coronaeformis* (Pijpers), Eoc.,Bonaire; *1a-c*, opposite sides and back edge (not apert.) view of topotype, ×163 (*2117).——Fig. 458,*2*. *P. diadematoides* (Y. Le Calvez), Cuis., Fr.; *2a-c*, opposite sides and edge view of holotype, ×90 (*1115).

Planodiscorbis Bermúdez, 1952, *127, p. 40 [**Discorbina rarescens* Brady, 1884, *200, p. 651, OD].

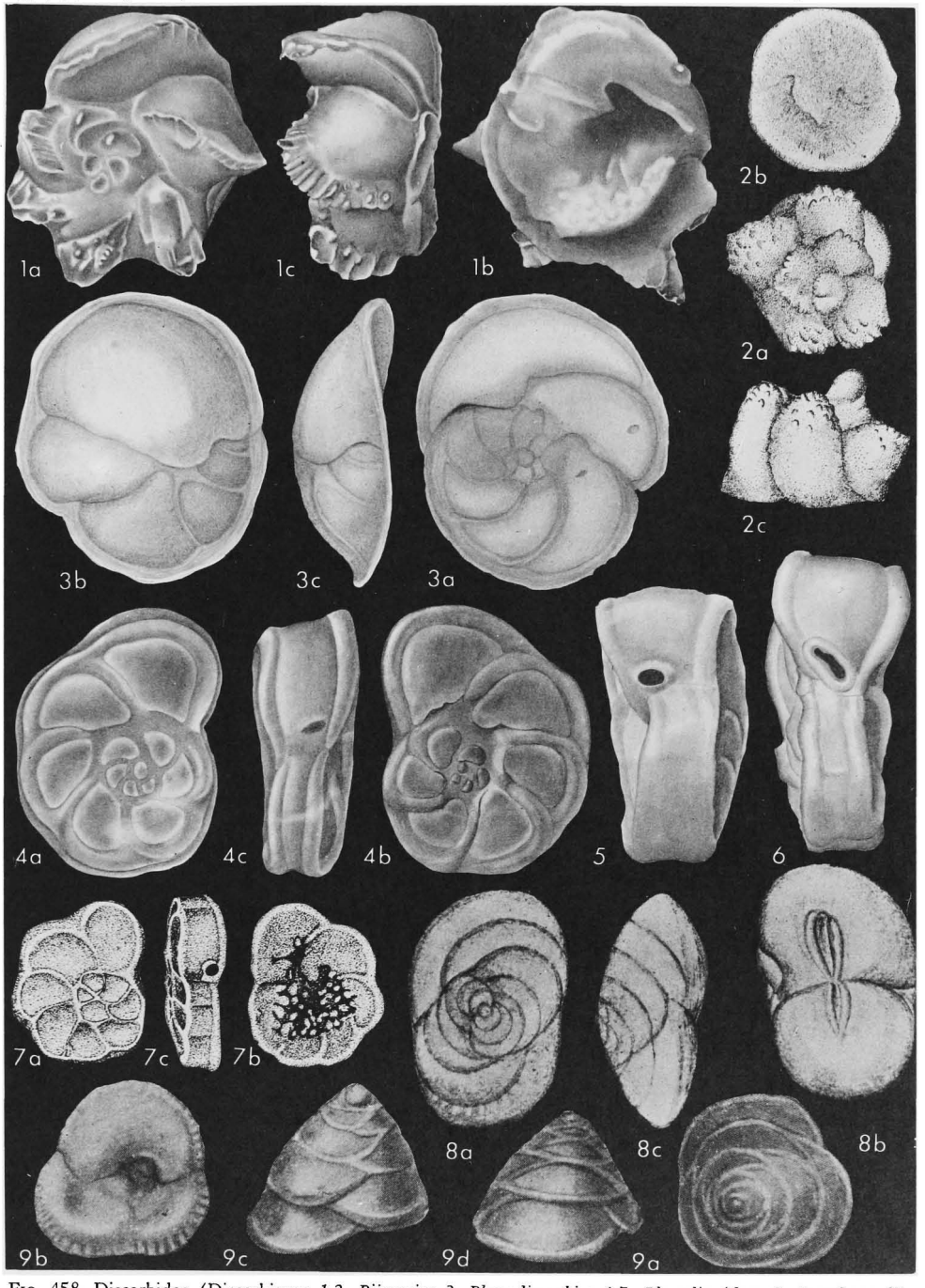

Fig. 458. Discorbidae (Discorbinae; *1,2, Pijpersia; 3, Planodiscorbis; 4-7, Planulinoides; 8, Pseudopatellinella; 9, Pseudopatellinoides*) (p. C582-C584).

Test free or possibly attached during life, planoconvex or concavo-convex, with spiral side flattened or concave and all chambers visible, umbilical side convex with only chambers of final whorl visible around closed umbilicus, periphery angled with broad keel, chambers increasing rapidly in size, final chamber occupying much of umbilical side; aperture a small arch in slight re-entrant at basal margin of final chamber on flattened spiral side, about halfway between periphery and umbilical region. *Rec.,* Pac.O.——Fig. 458,*3*. **P. rarescens* (Brady); *3a-c,* opposite sides and edge view of lectotype, ×79 (*2117).

[*Planodiscorbis* is very similar in character to *Discorbinella,* but is completely involute on the umbilical side, rather than partially evolute on both sides. It differs from *Discorbis* in having the spiral side flattened, possessing the aperture, with the umbilical side convex and involute. In *Discorbis* the umbilical side is flat and involute and contains the aperture, and the spiral side is evolute. *Planodiscorbis* also lacks the characteristic umbilical alar extensions of the chambers found in *Discorbis.*——¶Brady's types of *Discorbina rarescens* in the British Museum (Natural History) were examined by us and we here designate as lectotype the specimen figured by Brady (1884, *200, pl. 90, fig. 2) (BMNH-ZF3648, from *Challenger* station 185, off Raine Island, Torres Straits, at a depth of 155 fathoms). The remaining original syntypes are now designated as paratypes (BMNH-ZF1414).]

Planulinoides Parr, 1941, *1424, p. 305 [**Discorbina biconcava* Jones & Parker in Carpenter, Parker & Jones, 1862, *281, p. 201; OD] [=*Discotruncana* Shirai, 1960, *1734, p. 539 (type, *D. japonica*)]. Test free, biconcave, nearly planispiral, evolute, with broad truncate double-keeled periphery, evolute on spiral side, partially evolute on opposite side; primary areal aperture peripheral and somewhat oblique toward umbilical side and surrounded by lip, supplementary apertures on umbilical side at inner margin of chambers, under rudimentary umbilical flap. *Plio.-Rec.,* Australia-Japan.——Fig. 458,*4-6*. **P. biconcava* (Jones & Parker), Rec., Victoria; *4a-c,* opposite sides and edge view; *5,6,* edge views of additional specimens showing variation in peripheral aperture, ×115 (*2117).——Fig. 458,*7*. *P. japonica* (Shirai), Plio., Japan; *7a-c,* opposite sides and edge view, ×47 (*1734).

[Parr originally stated that "the aperture is peripheral instead of being situated on the under surface, as in *Discorbis*." Apparently the openings on the umbilical side were not observed, although they are shown in the figures of Parker & Jones (1865, *1418, pl. 19, fig. 10b) and Brady (1884, *200, pl. 91, fig. 2b). *Planulinoides* was considered to be a synonym of *Discorbinella* Cushman & Martin by Cushman (1948, *486, p. 288) but it differs in being biconcave, bicarinate, and in having a truncate periphery, whereas *Discorbinella* is plano-convex, with a single keel, and more prominent umbilical flaps. *Planulinoides* differs from *Bronnimannia* Bermúdez in having a peripheral aperture and a double keel. A lectotype for *Discorbina biconcava* Jones & Parker was isolated by us in 1953 and is here designated (BMNH-ZF3646, with paratype ZF3645), both from Recent shore sand, Melbourne, Australia.]

Pseudopatellinella Takayanagi, 1960, *1863, p. 121 [**P. cretacea*; OD]. Test free, trochospiral, spiral side convex and evolute, umbilical side flattened; early chambers subglobular, rapidly increasing in breadth and becoming crescentic in spiral view, with only 2 chambers to whorl; wall calcareous, perforate, microstructure and lamellar character unknown, inner surface of wall undulating, but without septula; aperture a narrow slit on umbilical side, extending up center of chamber face. [Although superficially resembling *Patellina,* this genus does not have the nonseptate coiled stage such as is characteristic of the Spirillinidae.] *U.Cret.,* Japan.——Fig. 458,*8*. **P. cretacea*; *8a-c,* opposite sides and edge view of holotype, ×140 (*1863).

Pseudopatellinoides Krasheninnikov, 1958, *1051, p. 241 [**P. primus*; OD]. Test free, small, conical, trochospirally coiled with highly convex spiral side and flattened, centrally umbilicate opposite side, periphery angled and carinate; chambers few, commonly 3 to whorl, broad, low, semilunate, and all visible on spiral side, only 3 of last whorl visible on umbilical side where each occupies approximately one-third of test; sutures strongly oblique, thickened and flush on spiral side, radial, curved and depressed on umbilical side; wall calcareous, hyaline, finely perforate, radial in structure; aperture an interiomarginal, umbilical slit or slight arch, which does not extend to periphery. [*Pseudopatellinoides* differs from *Patellinella* in having 3 chambers to whorl throughout development.] *Mio.(U.Torton.),* USSR.——Fig. 458,*9*. **P. primus*; *9a-d,* spiral, umbilical, and edge views, ×100 (*1051).

Rosalina d'Orbigny, 1826, *1391, p. 271 [**R. globularis*; SD Galloway & Wissler, 1927, *766, p. 62] [=*Turbinolina* d'Orbigny in de la Sagra, 1839, *1611, p. 89 (type, *Rosalina globularis* d'Orbigny, 1826, *1391, p. 271; SD Loeblich & Tappan, herein); *Semirosalina* Hornibrook, 1961, *959, p. 103 (type, *S. inflata*)]. Test planoconvex, free or attached by flattened umbilical surface, all chambers visible from convex spiral side, only those of final whorl visible around open umbilicus on umbilical side; aperture a low interiomarginal arch at base of final chamber near periphery on umbilical side, with broad chamber flap just beneath aperture extending into open umbilicus, secondary sutural opening at opposite side of flap, those of previous chambers also remaining open. *Rec.,* Atl.O.-Pac.O.-Antarctic.——Fig. 459,*1*. **R. globularis,* Antarctic(Ross Sea); *1a-c,* opposite sides and edge view, ×74 (*2117).——Fig. 460,*1*. *R. inflata* (Hornibrook), L.Mio., N.Z.; *1a-c,* opposite sides and edge view of holotype, ×100 (*959).

[Cushman (1948, *486, p. 286) & Galloway (1933, *762, p. 286) considered *Rosalina* a synonym of *Discorbis*. Bermúdez (1952, *127, p. 34) considered it a valid genus but placed *Neoconorbina* Hofker in the synonymy of *Rosalina*. All 3 are here considered to be distinct, *Rosalina* being intermediate, but lacking the pronounced ventral chamber flaps and closed umbilicus of *Discorbis* and differing from *Neoconorbina* in the presence of sutural slits which are remnants of earlier apertures. It differs from *Conorbina* in having an open umbilicus and a more extensive aperture nearer the umbilicus, with the proximal portions of earlier apertures remaining as sutural secondary openings. No definite locality was given in the original reference, the species being merely noted to occur on all ocean coasts. The specimen here figured was compared by us with

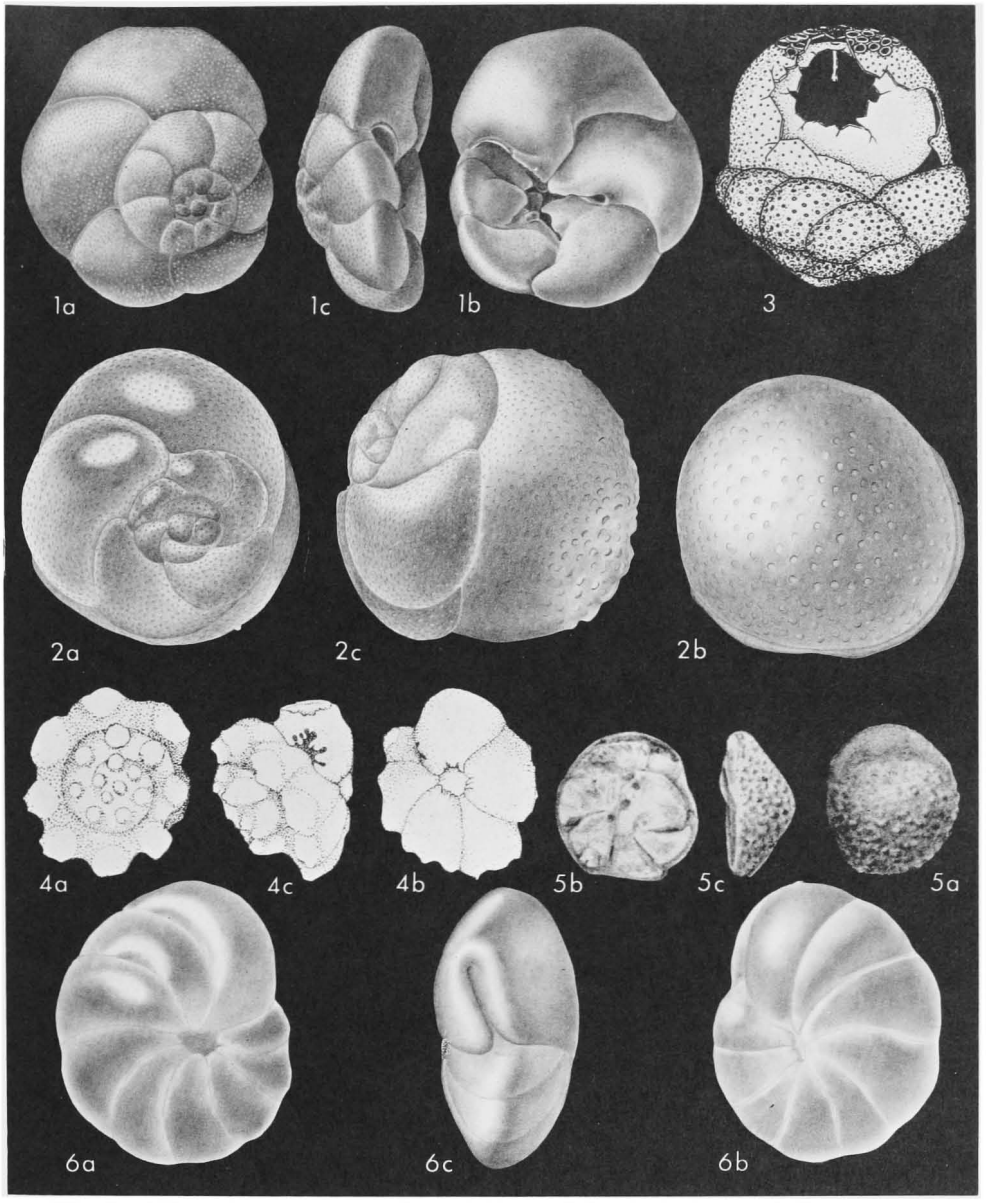

FIG. 459. Discorbidae (Discorbinae; *1, Rosalina; 2,3, Tretomphalus; 4, Variostoma; 5, Vernonina; 6, Stetsonia*) (p. C584-C586).

D'ORBIGNY'S type-specimen in the Muséum National d'Histoire Naturelle, Paris, France.]

Stetsonia F. L. PARKER, 1954, *1414, p. 534 [**S. minuta*; OD]. Test small, lenticular, slightly trochospiral but involute on both sides, periphery narrowly rounded, chambers increasing gradually in size, low and broad; sutures radial, curved, slightly depressed; wall thin, calcareous, finely perforate, radial in structure, lamellar character not described; aperture an elongate slit extending from base of final chamber in equatorial position up face in slightly diagonal line on umbilical side, with narrow lip. *Rec.*, Gulf Mex. ——FIG. 459,*6*. **S. minuta*; *6a-c*, opposite sides and edge view, ×325 (*2117).

Tretomphalus MÖBIUS, 1880, *1293, p. 67, 99 [**Rosalina bulloides* D'ORBIGNY in DE LA SAGRA, 1839, *1611, p. 98; OD (M)]. Test with early benthonic stage similar to *Discorbis*, reproductive cycle with alternation of generations, asexually

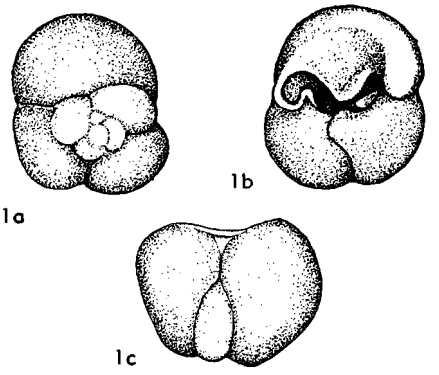

FIG. 460. Discorbidae (Discorbinae; *1, Rosalina*) (p. C584).

produced megalospheric individuals becoming encysted before development of gametes, developing large globular float chamber over umbilical region, small entosolenian tube extending inward from distal surface of float, through which ectoplasm may protrude, large gas bubble then developing within float chamber, added buoyancy allowing test to float to surface after breaking free from growth cyst, commonly 2 or more pelagic parent individuals then approaching closely by means of extended pseudopodia so as to insure fusion of maximum number of gametes, equally biflagellate gametes escaping through areal pores, those from different parent individuals fusing in pairs to form benthonic microspheric tests which in turn give rise asexually to megalospheric generation; test calcareous, with pseudochitinous inner membrane, wall microstructure unknown (if monolamellid, as in *Discorbis,* it is the only pelagic one); aperture umbilical, as in *Discorbis* in benthonic stage, and consisting of areal pores on pelagic float chamber. *Rec.,* Australia-Medit.-Gulf Mex.-tropical and subtropical Atl.O.-Pac.O.-Ind.O.-Medit. Sea-Red Sea. ——FIG. 459,*2*; 461,*1*. **T. bulloides* (D'ORBIGNY), Rec., USA(Fla.), (459,*2*), Rec., USA(Calif.) (461, *1*); 459,*2a-c,* opposite sides and edge view of hypotype, ×135 (*2117); 461,*1a,* sectioned decalcified specimen showing large central gas bubble, internal tube of float chamber, and gametes *in situ,* ×300; 461,*1b,* biflagellate gametes below and left, fused gametes at right and zygote in center, ×2,000 (*1341).——FIG. 459,*3*. *T. myersi* CUSHMAN, Rec., USA(Calif.); side view of dissected specimen showing perforated float chamber exposing internal float with entosolenian tube, ×170 (*1341).

Variostoma KRISTAN-TOLLMANN, 1960, *1059, p. 55 [**V. spinosum*; OD]. Test free, trochospiral, may be high-spired; all chambers visible on spiral side, opposite side involute, deeply umbilicate, with lobulate umbilical margin; wall calcareous-perforate, granular in structure, lamellar character unknown; aperture interiomarginal, extraumbilical, with lobulate margin. *M.Trias.,* Eu. (Aus.).——FIG. 459,*4*. **V. spinosum*; *4a-c,* opposite sides and edge view of paratype, ×25 (*1059).

Vernonina PURI, 1957, *1488, p. 124 [**V. tuberculata*; OD]. Test trochospiral, hemispherical, with convex spiral side, covered with numerous rounded granules, flattened umbilical side with central plug or granules; sutures oblique but obscured by surface ornamentation on spiral side, radial and depressed on umbilical side; wall calcareous, perforate, microstructure and lamellar character not described; aperture interiomarginal, on umbilical side about half distance between umbilicus and periphery. *U.Eoc.,* USA(Fla.).—— FIG. 459,*5*. **V. tuberculata*; *5a-c,* opposite sides and edge view of paratype, ×40 (*1488).

Subfamily BAGGININAE Cushman, 1927

[Baggininae CUSHMAN, 1927, p. 77]——[Dagger (†) indicates *partim*]——[=Praerotalininae† HOFKER, 1933, p. 125 (*nom. nud.*); =Cancrisinae CHAPMAN, PARR & COLLINS, 1934, p. 567; =Valvulineriinae BROTZEN, 1942, p. 17; =Cancrininae SIGAL in PIVETEAU, 1952, p. 228 (*nom. van.*)]

Test free, trochospiral, umbilical area closed, with clear thin imperforate area adjacent to umbilicus; aperture basal. *L. Cret.-Rec.*

Baggina CUSHMAN, 1926, *426, p. 63 [**B. californica*; OD]. Test free, subglobular, trochospiral, chambers few, rapidly enlarging and somewhat overlapping on spiral side, with closed umbilicus on opposite side; wall calcareous, perforate, radial in structure; aperture a broad umbilical opening below clear, nonperforate lunate area in face of final chamber. [*Baggina* differs from *Cancris* in having an open aperture without a lip, and in being somewhat involute on the spiral side.] *Cret.-Rec.,* cosmop.——FIG. 462,*1*. **B. californica,* Mio., USA(Calif.); *1a-c,* opposite sides and edge view of paratype, ×56 (*2117).

Cancris DE MONTFORT, 1808, *1305, p. 267 [**C. auriculatus* (=*Nautilus auriculus* FICHTEL & MOLL, 1798, *716, p. 108); OD] [=*Carcris* DESHAYES, 1830, *590, p. 191 (*nom. null.*); *Pulvinulinella* EIMER & FICKERT, 1899, *692, p. 628 (obj.) (*non* CUSHMAN, 1926)]. Test free, trochospiral, biconvex, commonly elongate and auriculate in shape, spiral side evolute, opposite side may have slightly open umbilicus; chambers rapidly enlarging, relatively low and broad; wall calcareous, perforate, radial in structure, may have peripheral keel; aperture on umbilical side, broad apertural lip extending over opening and projecting into umbilicus. [*Cancris* differs from *Baggina* in being more elongate, evolute on the spiral side, keeled, and in having an open umbilicus and an apertural lip. It resembles *Baggina* in having a broad nonperforate area above the aperture.] *Eoc.-Rec.,* cosmop.——FIG. 462,*3*. **C. auriculus* (FICHTEL & MOLL), Plio., Italy; *3a-c,* opposite sides and edge view, ×45 (*2117).

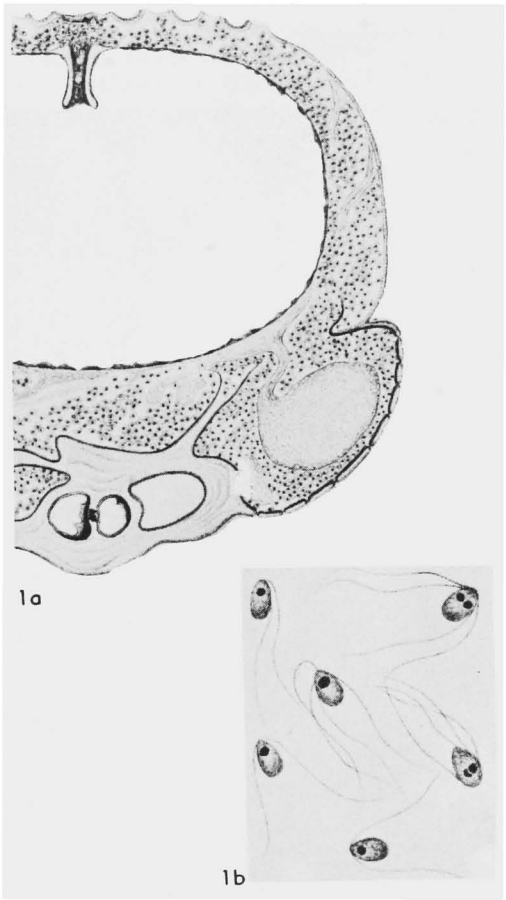

FIG. 461. Discorbidae (Discorbinae; *1, Tretomphalus*) (p. C585-C586).

Physalidia HERON-ALLEN & EARLAND, 1928, *913, p. 288 [**P. simplex*; SD GALLOWAY, 1933, *762, p. 337]. Test free, ovate or reniform in outline, composed of few (2 to 4) subglobular chambers arranged in apposition; wall calcareous, hyaline, radial in structure, very thin, coarsely perforate, with perforations produced into very thin tubules, lamellar character unknown; wall imperforate for short distance just beneath aperture on chamber opposite; aperture slitlike, at base of final chamber near its junction with earlier chambers, with slight lip on upper border. [Although previously placed with the Pegidiidae, the imperforate region near the aperture and lack of a distinct canal system and thickened lamellar wall suggest that *Physalidia* does not belong with the Rotaliacea. No specimens were available for sectioning, hence the present placement is tentative.] *Rec.*, Pac.O. ——FIG. 462,*2*. **P. simplex*, S.Pac.O.(Cook Is.); *2a,b*, side, edge views of holotype, ×79 (*2117).

Rugidia HERON-ALLEN & EARLAND, 1928, *913, p. 289 [**Sphaeroidina corticata* HERON-ALLEN & EARLAND, 1915, *910b, p. 681; OD]. Test free, small, consisting of 4 subglobular chambers arranged in apposed pairs, all visible externally, perhaps representing much reduced trochospiral coiling; wall calcareous; perforate, radial in structure, surface covered with numerous irregular knobs and ridges, presenting extremely rugose appearance, lamellar character unknown; aperture consisting of large pores between pairs of chambers on umbilical side, separated by pillar-like extensions from final chamber. *Rec.*, SE.Afr. (Moz.).——FIG. 462,*4*. **R. corticata* (HERON-ALLEN & EARLAND); *4a-c*, opposite sides and edge view of lectotype, ×79 (*2117).

[*Rugidia* differs from *Physalidia* in having a rugose exterior and multiple apertural openings between pillars along margins of the final chamber. A lectotype was selected by us at the British Museum (Natural History), and is here designated (BMNH-ZF3623, *910b, pl. 51, fig. 14) with paratypes (BMNH-ZF3621) from Kerimba Station 11, Manangoroshi to Lurio Points, Kerimba Archipelago, off Mozambique.]

Valvulineria CUSHMAN, 1926, *426, p. 59 [**V. californica*; OD] [=*Rotamorphina* FINLAY, 1939, *717c, p. 325 (type, *R. cushmani* FINLAY, 1939, *717c, p. 325 (*non Valvulineria cushmani* CORYELL & EMBICH, 1937) (=*Valvulineria teuriensis* LOEBLICH & TAPPAN, *nom. nov.*, herein)]. Test free, trochospiral, umbilicate, periphery rounded; chambers increasing gradually in size; sutures radial, thickened; wall calcareous, finely perforate, radial in structure, monolamellid, surface smooth; aperture interiomarginal, extraumbilical-umbilical, with broad thin apertural flap projecting over the umbilicus. *L.Cret. (Alb.)-Rec.*, cosmop.——FIG. 462,*5-7*; 463. **V. californica*, Mio., USA(Calif.); 462,*5a-c*, opposite sides and edge view; 462,*6,7*, umbilical sides showing more extensive umbilical flaps; all ×49 (*2117); 463, horiz. sec. showing monolamellar radial structure, ×100 (*1529).——FIG. 462,*8*. *V. teuriensis* LOEBLICH & TAPPAN, *nom. nov.*, U. Cret.(Teurian), N.Z.; *8a-c*, opposite sides and edge view, ×44 (*2117).

Family GLABRATELLIDAE Loeblich & Tappan, n.fam.

Test trochospiral, low to high-spired, umbilical side flattened; wall calcareous; hyaline, perforate, radial in structure; aperture umbilical in position; in Recent forms reproduction plastogamic, with specimens attaching in pairs by umbilical surfaces, gametes triflagellate; habitat commonly littoral. [The genera here included are distinct from the Discorbidae in having an umbilical aperture, flattened to concave and radially striate or grooved umbilical side and a plastogamic reproductive cycle with triflagellate rather than biflagellate gametes.] *Eoc.-Rec.*

Glabratella DORREEN, 1948, *610, p. 294 [*G. crassa*; OD] [=*Conorbella* HOFKER, 1951, *928c, p. 448, 466 (type, *Discorbina pulvinata* BRADY, 1884, *200, p. 650); *Pileolina* BERMÚDEZ, 1952, *127, p. 38 (type, *Valvulina pileolus* D'ORBIGNY, 1839, *1393, p. 47)]. Test hemispherical, all

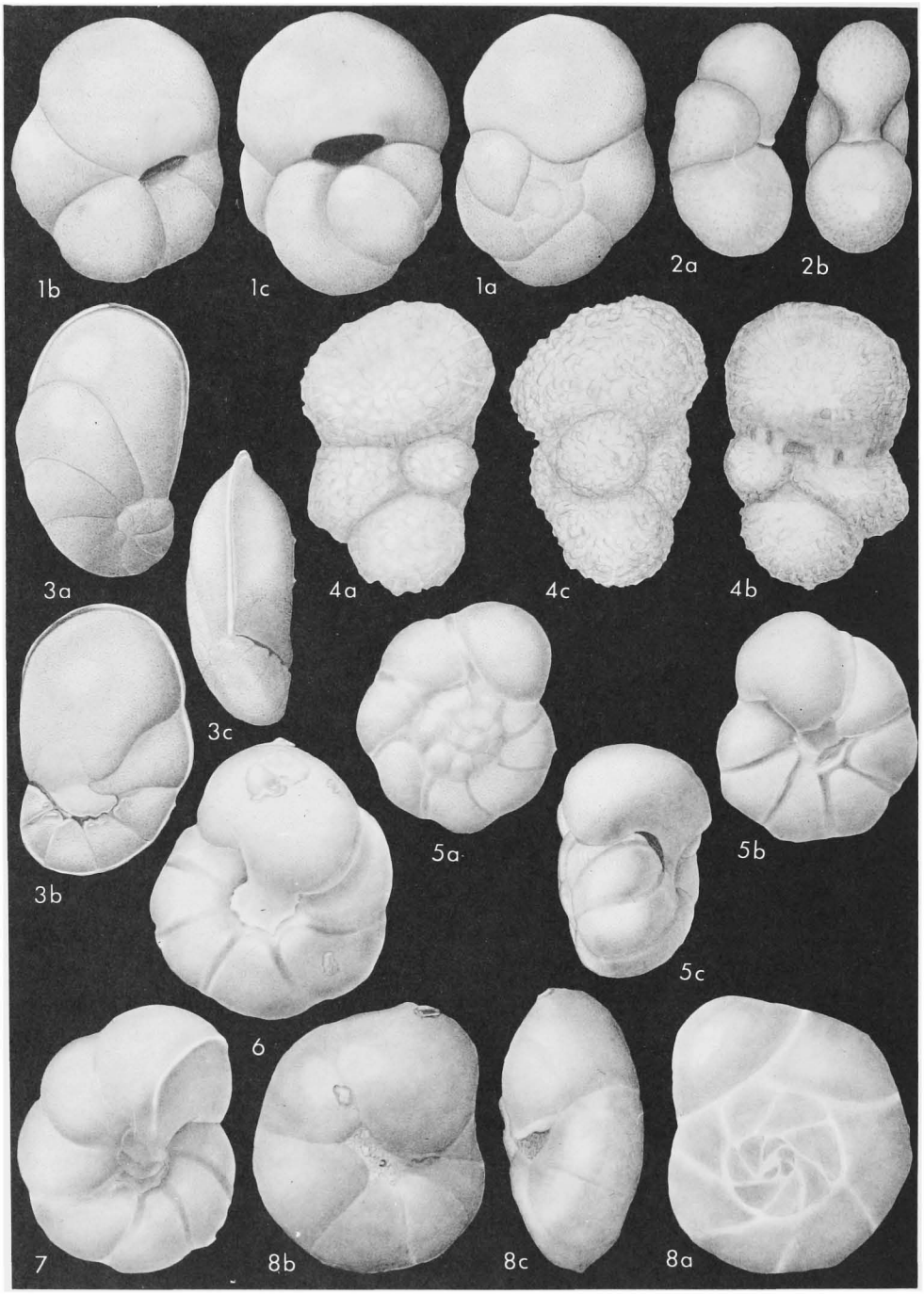

FIG. 462. Discorbidae (Baggininae; *1, Baggina; 2, Physalidia; 3, Cancris; 4, Rugidia; 5-8, Valvulineria*) (p. C586-C587).

FIG. 463. Discorbidae (Baggininae; *Valvulineria*) (p. C587).

chambers visible from convex spiral side, only those of final whorl visible on flattened umbilical side, periphery rounded; schizont forms generally larger and flatter, gamont more high-spired; chambers relatively few, enlarging rapidly as added, sutures arcuate on spiral side, radial on opposite side; wall calcareous, hyaline, perforate, spiral surface generally ornamented with pustules, umbilical side with radial ornamentation, consisting of fine grooves or tiny, radially arranged pustules; aperture a small rounded opening restricted to open umbilicus; sexual reproduction plastogamic, with 2 specimens attaching by their umbilical surfaces, gametes triflagellate, habitat of plastogamic forms always littoral. *U.Eoc.-Rec.,* N.Z.-Pac.O.-Atl.-Australia-E.Afr.(Kerimba Arch.)-Medit. Sea-Eu.——FIG. 464,*1. *G. crassa,* U.Eoc., N.Z.; *1a-c,* opposite sides and edge view of paratype, ×119 (*2117).——FIG. 464,*2. G. pulvinata* (BRADY), Rec., S.Australia; *2a-c,* opposite sides and edge view, ×188 (*2117).——FIG. 464,*3. *G. pileolus* (D'ORBIGNY), Rec., S.Am.(Chile); *3a-c,* opposite sides and edge view, enlarged (*127).——FIG. 465. *G. mediterranensis* (D'ORBIGNY), Rec., Medit.; living triflagellate gamete, ×1500 (*1109).

[*Glabratella* resembles *Discorbis* in having a flat, involute umbilical side and convex, evolute spiral side, but differs in lacking the umbilical alar extensions of the chambers, in having the typical umbilical radial ornamentation, and in having as an aperture only the open umbilical area. It differs from *Angulodiscorbis* in being low-spired, and in having relatively few chambers in each whorl, and in having the open umbilical aperture, instead of a sutural aperture at the base of the final chamber. *Glabratella* was defined by DORREEN with *G. crassa* as type, but also included in the genus was *Discorbina pulvinata* BRADY, which HOFKER later (1951, *928c) selected as type-species of *Conorbella* without reference to the prior *Glabratella.*——¶BERMÚDEZ (1952, *127, p. 36, 37) recognized both genera, considering *Glabratella* to have a central umbilical aperture and *Conorbella* to have a slitlike interiomarginal aperture. However, the sutural aperture described by HOFKER and cited by BERMÚDEZ for *Conorbella* is lacking in the type-species, hence species showing this feature should be separated, possibly placed in *Angulodiscorbis* which HOFKER and BERMÚDEZ had considered to be a synonym of *Conorbella. Discorbina pulvinata* is very similar to *G. crassa* except in minor features of ornamentation and degree of convexity, which we regard as only of specific importance, hence *Conorbella,* as based on the type-species, is classed as a synonym of *Glabratella,* as it had been by HORNIBROOK & VELLA (1954, *960, p. 25). *Pileolina* is also regarded as a synonym.——¶J. LE CALVEZ (1952, *1110) studied some plastogamic species of *"Discorbis" (=Glabratella)* and noted that they have triflagellate gametes, and that the schizont generation is commonly larger and flatter than the gamont, the 2 generations commonly having been given distinct specific names. Synonymies of many of these were noted by LE CALVEZ. *Discorbina pulvinata* BRADY (type-species of *Conorbella* and also originally included in *Glabratella*), *Valvulina pileolus* D'ORBIGNY (type-species of *Pileolina*) and *Discorbis patelliformis* and *D. opercularis* (included later in *Conorbella* by BERMÚDEZ and HOFKER) all were among the plastogamic species studied by LE CALVEZ. These similarities in reproductive habits substantiate the congeneric status of *Glabratella, Conorbella* and *Pileolina* and their separation from *Discorbis.*]

Angulodiscorbis UCHIO, 1953, *1960, p. 156 [**A. quadrangularis*; OD]. Test free, spiral side extremely high-spired, with all chambers visible, and may be somewhat angular in section, opposite side flat to convex, umbilicate, with only chambers of final whorl visible; chambers numerous, crescentic, broad, low, with considerable overlap; spiral surface commonly with vertical ornamentation, resulting in angular test, or with vertical ribs or very fine striae, with pores of wall aligned in fine striae, ornamentation of umbilical side also with many fine radial striae; aperture a low slit at base of final chamber. *Rec.,* Pac.O.——FIG. 466,*1. *A. quadrangularis,* Ifaluk Atoll; *1a-c,* spiral, umbilical, and edge views, ×148 (*2117).

[As had been noted for nearly all similar conical, high-spired species, pairs of specimens are frequently found attached by their umbilical surfaces, which are resorbed by these plastogamic species during the reproductive process. Other specimens may later become detached, and with much of the ventral surface dissolved, appear to have an oversized umbilicus. HOFKER (1951, 928c, p. 466) considered some of the high-spired species to belong to *Conorbella* and BERMÚDEZ (1952, *127, p. 37) considered *Angulodiscorbis* a synonym of *Conorbella.* On the basis of their type-species, *Conorbella* is here regarded as a synonym of *Glabratella,* and *Angulodiscorbis* is available for the high-spired rotaliiform species with a slitlike aperture at base of the final chamber.]

Bueningia FINLAY, 1939, *717b, p. 122 [**B. creeki*; OD] [=*Ruttenella* KEYZER, 1953, *1031, p. 279 (type, *R. butonensis*) (*non Ruttenella* VAN DEN BOLD, 1946); *Lamarckinita* KEYZER, 1955, *1032, p. 119 (*nom. subst. pro Ruttenella* KEYZER, 1953 *non* VAN DEN BOLD, 1946)]. Test small, inflated, both sides involute, umbilical side flattened, with distinct peripheral keel and deep umbilicus, opposite side convex; wall calcareous, finely perforate except for keel, microstructure and lamellar character unknown; aperture umbilical, with small apertural lip. *L.Mio.-Plio.,* N.Z.-W.Indies(Indon.).——FIG. 464,*5. *B. butonensis* (KEYZER), Mio.-Plio., Indon.; *5a,b,* opposite sides, ×111 (*2117).——FIG. 464,*6. *B. creeki,* L.Mio., N.Z.; *6a-c,* opposite sides and edge view, ×115 (*2117).

Heronallenia CHAPMAN & PARR, 1931, *324, p. 236

[**Discorbina wilsoni* HERON-ALLEN & EARLAND, 1922, *911, p. 206; OD]. Test trochospiral, compressed, plano-convex, periphery carinate but rounded; chambers increasing rapidly in breadth as added, in few whorls, umbilical side with broad open umbilicus; sutures thickened on spiral side; wall calcareous; finely perforate, radial in structure, lamellar character unknown, surface

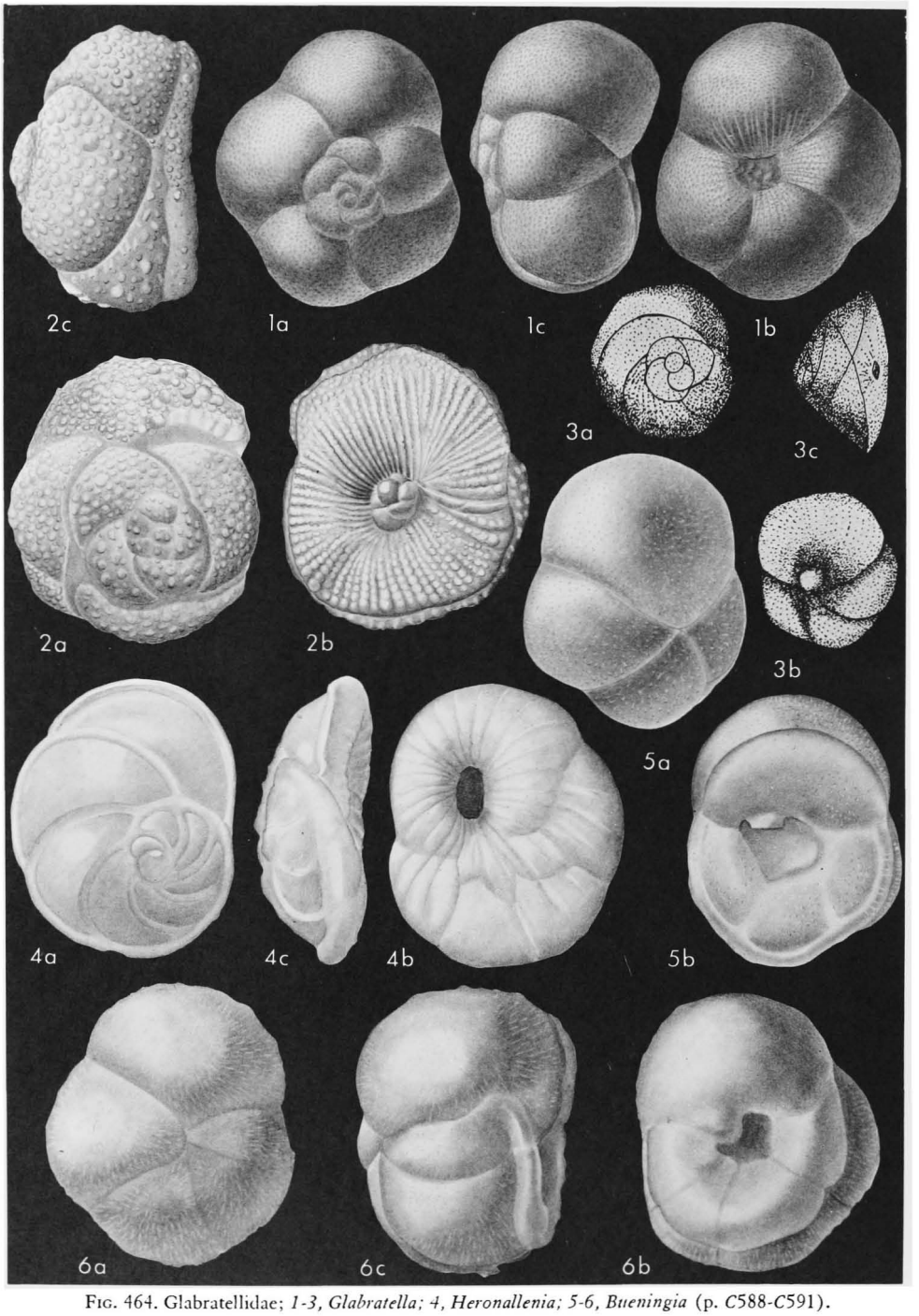

FIG. 464. Glabratellidae; *1-3, Glabratella; 4, Heronallenia; 5-6, Bueningia* (p. C588-C591).

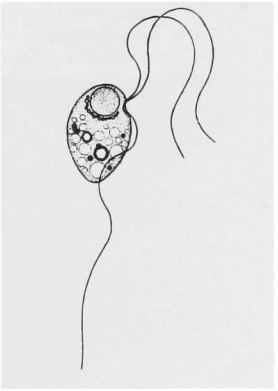

FIG. 465. Glabratellidae; *Glabratella* (p. C588-C589).

radially grooved; aperture a large ovate opening into umbilicus. *Eoc.-Rec.,* Antarctic-Australia-N. Am.-Carib.——FIG. 464,*4*. **H. wilsoni* (HERON-ALLEN & EARLAND), Rec., Antarctic; *4a-c,* opposite sides and edge view, ×93 (*2117).

Schackoinella WEINHANDL, 1958, *2043, p. 141 [**S. sarmatica*; OD]. Test trochospiral, with inflated chambers, open umbilicus and single thick spine projecting from each chamber on spiral side; wall finely perforate, microstructure and lamellar character not described; aperture apparently basal and umbilical in position. [*Schackoinella* was defined as belonging to the Hantkeninidae, but it differs from that group in having a trochospiral coil. No information is available as to the lamellar character of the type-species, but the general appearance strongly suggests its placement with the Glabratellidae. Additional study is needed of its internal characters.] *Mio.(Sarmat.),* Eu.(Aus.).——FIG. 467,*1*. **S. sarmatica*; *1a-c,* opposite sides and edge view, ×68 (*2043).

Family SIPHONINIDAE Cushman, 1927

[*non. transl.* N. K. BYKOVA, VASILENKO, VOLOSHINOVA, MYATLYUK & SUBBOTINA in RAUZER-CHERNOUSOVA & FURSENKO, 1959, p. 270 (*ex* subfamily Siphoninae CUSHMAN, 1927, p. 77)]

Test trochospiral or may become uncoiled or biserial, periphery commonly with fimbriate keel; aperture oval, bordered by distinct lip and projecting on neck. *Eoc.-Rec.*

Siphonina REUSS, 1850, *1540, p. 372 [**S. fimbriata,* =*Rotalina reticulata* CŽJŽEK, 1848, *545, p. 145; OD (M)]. Test free, biconvex, trochospiral, lenticular, periphery wih fimbriate keel, umbilicus closed; wall calcareous, coarsely perforate, radial in structure, monolamellar, surface may be ornamented with radial striae or pustules; sutures oblique on spiral side, radial on umbilical side; aperture areal, elliptical, nearly equatorial, with short neck and phialine lip. *Eoc.-Rec.,* Eu.-N.Am.-Carib.-Australia-Pac.O.-Atl.O.-S.Am.-Afr.——FIG. 468,*1*. **S. reticulata* (CŽJŽEK), Mio., Eu.(Aus.); *1a-c,* opposite sides and edge view of holotype of *S. fimbriata* REUSS, approx. ×47 (*1540).

Siphonides FERAY, 1941, *714, p. 174 [**S. biserialis;* OD]. Test free, tiny, early stage as in *Siphonina,* later chambers uncoiled and biserially arranged, periphery with fimbriate keel; aperture subterminal, with neck and phialine lip. *M.Eoc.,* USA (Tex.).——FIG. 468,*7*. **S. biserialis*; *7a-c,* opposite sides and edge view of topotype, ×218 (*2117).

Siphoninella CUSHMAN, 1927, *431, p. 77 [**Truncatulina soluta* BRADY, 1884, *200, p. 670; OD]. Test similar to *Siphonina* in early stage, later chambers uncoiling and rectilinear; aperture terminal with neck and phialine lip. *M.Eoc.-Rec.,* Carib.-N.Am.——FIG. 468,*2*. **S. soluta* (BRADY), Rec., W.Indies; *2a-c,* opposite sides and edge view, ×100 (*200).

Siphoninoides CUSHMAN, 1927, *431, p. 77 [**Planorbulina echinata* BRADY, 1879, *196b, p. 283; OD]. Test subglobular, irregularly trochospiral, few chambers to whorl, involute; wall calcareous, coarsely perforate, surface commonly spinose or tuberculate; aperture circular, with neck and phialine lip. *Mio.-Rec.,* Australia-Pac.O.-Ind.O.——FIG. 468,*3-6*. **S. echinata* (BRADY), Rec., W.Pac.O.(Admiralty Is.) *(3,4),* Hawaii *(5,6)*; *3,4,* side and edge views of different speci-

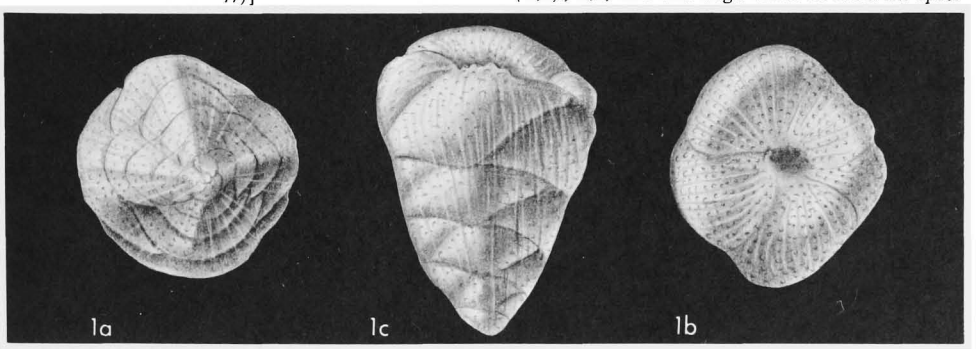

FIG. 466. Glabratellidae; *1, Angulodiscorbis* (p. C589).

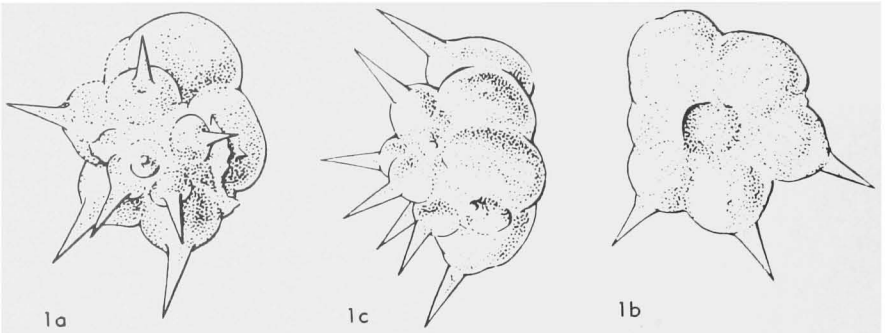

FIG. 467. Glabratellidae; *1, Schackoinella* (p. C591).

mens, ×100; *5,6,* apert. view and optical sec. showing chamber arrangement, ×100 (*200).

ASTERIGERINIDAE

By R. W. BARKER

[Shell Development Company, Houston, Texas]

Family ASTERIGERINIDAE d'Orbigny, 1839

[Asterigerinidae D'ORBIGNY in DE LA SAGRA, 1839, p. xxxix, 116] [=Helicotrochina AGASSIZ, 1844, p. 2 *(nom. nud.) (partim)*; Asterigerinida COPELAND, 1956, p. 187 *(nom. van.)*]

Test free, simple, calcareous, unequally biconvex, dorsal side usually more elevated; numerous chambers arranged in flat turbinoid spiral, with oblique sutures; dorsal chambers all visible in simple spiral, those on ventral side with less oblique sutures and alternating with small secondary chambers arranged in rosette form around umbilical plug; surface smooth; primary chambers showing slit aperture on inner side of ventral face of last chamber, secondary chambers with loop-shaped aperture leading into primaries, growth of these two series thus alternating; no canal system (*241, *553, *762, *1392). [Warm, shallow water; probably linked to *Discorbis* and perhaps to the Ceratobuliminidae, according to BROTZEN.] *Cret.-Rec.*

Asterigerina D'ORBIGNY in DE LA SAGRA, 1839, *1611, p. 117 [**A. carinata*; SD CUSHMAN, 1927, *433, p. 190]. Test simple, 3 to 5 whorls visible dorsally; ventrally secondary chamberlets form star-shaped rosette around umbilical plug. *Cret.-Rec.,* cosmop.——FIG. 469,*2*. **A. carinata,* Rec., W. Indies(Barbados); *2a-c,* dorsal., lat., vent. sides, ×60 (*2110).

Asterigerinata BERMÚDEZ, 1949, *124, p. 266 [**A. dominicana*; OD]. Differs from *Asterigerina* in having more convex dorsal side and ventral side almost flat; aperture shorter and more elliptical; test approaching *Discorbis* in general form, vitreous, compressed, secondary chambers smaller and more globular than in *Asterigerina* (*124). *Oligo.-Rec.,* cosmop.——FIG. 469,*1*. **A. dominicana,* U.Oligo., W.Indies(Santo Domingo); *1a-c,* dorsal, lat., vent. sides of topotype, ×55 (*2110).

Asterigerinella BANDY, 1949, *70, p. 118 [**A. gallowayi*; OD]. Similar to *Asterigerina* but planispiral, tending to become evolute; spire visible on both sides; periphery lobulate or carinate; chambers numerous, closely appressed and enlarging gradually; surface smooth or papillate (*70). *Eoc.,* N.Am.——FIG. 470,*1*. **A. gallowayi,* U. Eoc., USA(Miss.); *1a-c,* dorsal, lat., vent. sides, ×30 (*2110).

Asterigerinoides BERMÚDEZ, 1952, *127, p. 61 [**Discorbina gürichi* FRANKE, 1912, *739, p. 29; OD]. Many-chambered trochoidal test similar to *Asterigerina* but possessing prominent spheroidal umbo on ventral side; differs from *Asterigerinata* in having more numerous chambers and long, narrow, slitlike aperture on inner edge of last chamber (*127). *Oligo.,* Eu.(Fr.-Belg.-Ger.-Neth.)-N.Am.(USA).——FIG. 471,*1*. **A. guerichi* (FRANKE), Neth.; *1a-c,* vent., lat., dorsal sides, enlarged (*557, *127).

Family EPISTOMARIIDAE Hofker, 1954

[Epistomariidae HOFKER, 1954, p. 166]

Test trochospiral, supplementary chamberlets on umbilical side; interiomarginal primary aperture, and supplementary sutural and areal apertures. *U.Cret.-Rec.*

Epistomaria GALLOWAY, 1933, *762, p. 286 [*pro Epistomella* CUSHMAN, 1928, *436, p. 6 (*non* ZITTEL, 1878)] [**Discorbina rimosa* PARKER & JONES in CARPENTER, PARKER & JONES, 1862, *281, p. 205); OD]. Test free, trochospiral, biconvex, early whorls visible on spiral side, chambers enlarging rapidly as added, with complex system of internal partitions junction of which with outer wall give appearance of supplementary chamberlets around umbilicus and occupy much of umbilical side; sutures depressed; radial, curved; wall calcareous, perforate, but wall microstructure

and lamellar character unknown; primary aperture a low interiomarginal slit, extending from periphery nearly to umbilicus, second aperture in face of final chamber, and series of slitlike accessory apertures paralleling peripheral margin, one at suture formed by attachment of internal plate

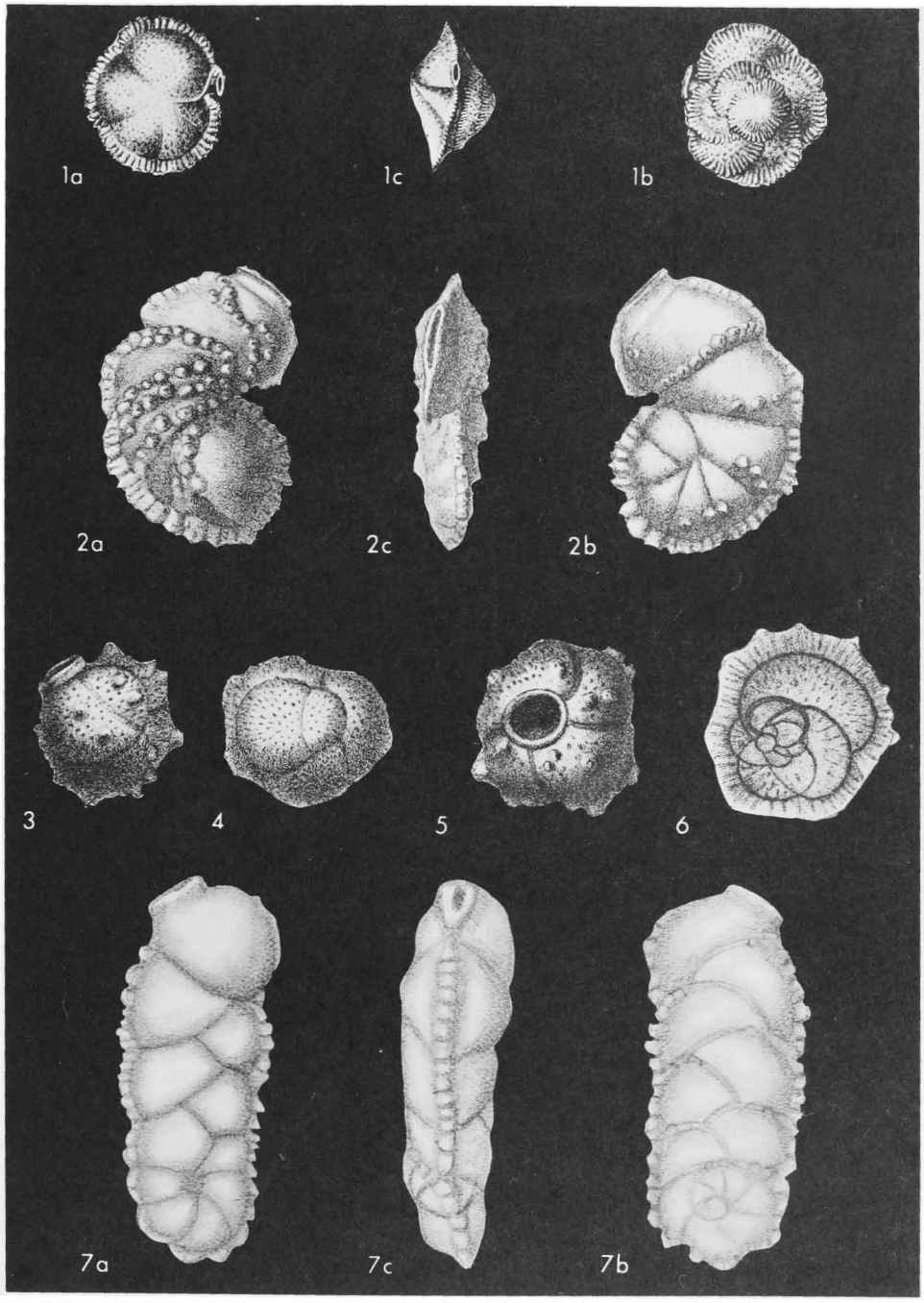

FIG. 468. Siphoninidae; *1, Siphonina; 2, Siphoninella; 3-6, Siphoninoides; 7, Siphonides* (p. C591-C592).

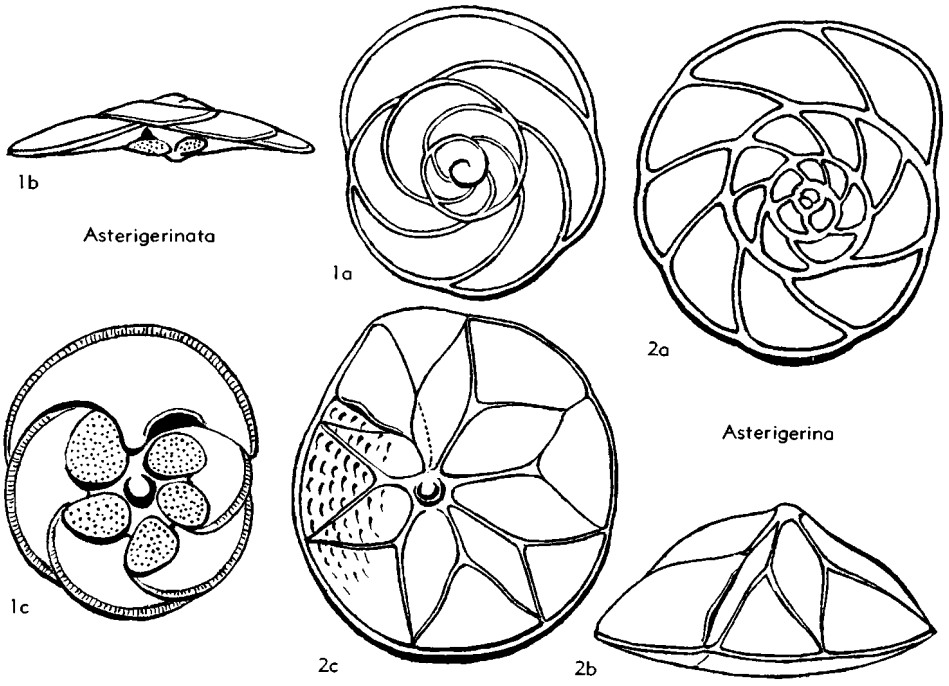

FIG. 469. Asterigerinidae; *1, Asterigerinata; 2, Asterigerina* (p. C592).

on each chamber on umbilical side, and additional supplementary apertures along sutures on both spiral and umbilical sides. [A lectotype for *Discorbina rimosa* PARKER & JONES was selected and isolated in the British Museum (Natural History) by us and is here designated (BMNH-P41670), also paratypes (BMNH-P41669), from the Eocene, Hauteville, France.] *Eoc.*, Eu.——FIG. 472,*1-3*. **E. rimosa* (PARKER & JONES); M. Eoc.(Lutet.), Fr. *(1,2)*, USSR(Ukraine) *(3)*; *1a-c*, opposite sides and edge view of paratype, ×40; *2*, edge view of another paratype, ×40 (*2117); *3*, sec. showing internal partitions, ×33 (*1509).

Elphidioides CUSHMAN, 1945, *482, p. 7 [**E. americanus*; OD]. Test free, trochospiral, biconvex, all whorls visible from spiral side, umbilical side involute with umbilicus covered by extension of final chamber, periphery rounded; chambers numerous, gradually increasing in size; sutures radial, nearly straight, slightly depressed, with sutural pores and retral processes; wall calcareous, coarsely perforate, microstructure and lamellar character unknown; aperture an interiomarginal slit, midway between periphery and umbilicus on umbilical side, with supplementary, curved, slitlike, oblique areal opening. *U.Eoc. (Jackson.)*, USA(Ga.).——FIG. 472,*4,5*. **E. americanus*; *4a-c*, opposite sides and edge view of paratype; *5*, edge view of additional paratype; all ×111 (*2117).

Epistomaroides UCHIO, 1952, *1959, p. 158 [**Discorbina polystomelloides* PARKER & JONES, 1865, *1418, p. 421; OD] [=*Epistomarioides* THALMANN, 1953, *1897k, p. 866 (*nom. null. pro Epistomaroides* UCHIO, 1952)]. Test free, trochospiral but nearly equally biconvex, all whorls visible on spiral side, umbilical side with supplementary chambers formed by transverse internal partition as in *Eponidella* and *Epistomaria*; sutures deeply incised with shell material bridging them as in Elphidiidae; wall calcareous, thin, coarsely perforate, surface with granulose ornamentation which forms network of ridges in very large specimens and extending over sutures as sutural bars; microstructure and lamellar character unknown; primary aperture a low interiomarginal arch extending from peripheral margin to umbilicus, opening into supplementary chambers present at edge of sutural incision, internal extension from secondary chamberlets opening into areal aperture on final chamber. [A lectotype for *Discorbina polystomelloides* PARKER & JONES was chosen by us and is here designated (BMNH-ZF3603) with paratypes (BMNH-ZF3602) all from "Juke's No. 2, at 14 fathoms, north of Sir C. Hardy's inside reefs, northeast coast of Australia."] *Rec.*, Australia-N.Guinea-Japan-E.Afr.(Kerimba Arch.).——FIG. 473,*1-3*. **E. polystomelloides* (PARKER & JONES); Australia (Lord Howe Is.) *(1,2)*, Kerimba Arch *(3)*; *1a-c*, opposite sides showing incised sutures and bars, and edge view showing basal and areal apertures,

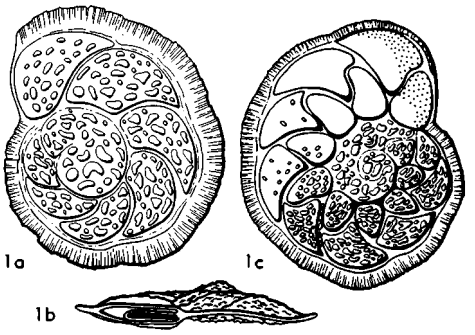

FIG. 470. Asterigerinidae; *1, Asterigerinella* (p. C592).

×23 (*2117); *2a-c,* opposite sides and edge view of larger specimen with more prominent network of ornamentation and sutural bridges, ×26 (*2117); *3a,* optical sec. of specimen in balsam, spiral side with primary chambers shown in outline, secondary chambers shaded; *3b,* same from umbilical side, showing extensions to apert. openings, ×23 (*910a).

Eponidella CUSHMAN & HEDBERG, 1935, *506, p. 13 [**E. libertadensis*; OD] [=*Paranonion* LOGUE & HAAS, 1943, *1189, p. 177 (type, *P. venezuelanum*)]. Test free, trochospiral but nearly biconvex, supplementary umbilical series of chambers appearing to be result of transverse chamber partition that extends from aperture across umbilical side of chambers and attaches to previous septum, but not reaching inner wall of spiral side of test; wall calcareous, coarsely perforate, with pseudochitinous inner layer, that of supplementary portion being thinner walled; lamellar character and microstructure unknown; aperture interiomarginal, extending in loop up peripheral apertural face, lower portion closed secondarily so that intercameral foramina consist only of areal openings. *Mio.-Rec.,* S. Am. (Venez.)-USA-Carib.——FIG. 472,*6,7. *E. libertadensis,* Mio., Venez.; *6a-c,* opposite sides and edge view, ×168 (*2117); *7a-d,* edge views of holotype and paratypes showing septal foramen and fragments of internal partition, ×100 (*506).——FIG. 472,*8,9. E. venezuelana* (LOGUE & HAAS), U.Mio., Venez.; *8a-d,* edge views showing apertural development for comparison with *E. libertadensis,* ×100 (*1189); *9a-c,* opposite sides and edge view of holotype, ×122 (*2117).

[*Eponidella* appears closely related to *Palmerinella* but has less complex apertural and septal foramina. Details of the wall structure and internal features of the secondary partitions need additional study. *Paranonion* is a synonym of *Eponidella,* but its type-species does not show the suture of the internal partition as well as *E. libertadensis.* This may be a result of a difference in preservation, however.]

Nuttallides FINLAY, 1939, *717a, p. 520 [**Eponides trumpyi* NUTTALL, 1930, *1371, p. 287; OD]. Test trochospiral, lenticular, with poreless peripheral keel; chambers broad, low; sutures oblique on spiral side, radial and gently curved on umbilical side; umbilicus closed by poreless umbonal boss; internal plate extending diagonally from septal foramen toward peripheral apertural notch but not connecting to opposite wall so as to form supplementary chamberlets; wall calcareous, perforate, radial in structure, septa monolamellid, imperforate; aperture interiomarginal, extending from umbilical boss nearly to peripheral keel, with small notch parallel to plane of coiling. *Eoc.,* Mex.-N.Z.——FIG. 473,*7,8. *N. trumpyi* (NUTTALL), Mex.; *7a-c,* opposite sides and edge view of lectotype, here designated (USNM CUSHMAN Coll. 59492), ×65 (*2117); *8,* interior of final chamber showing internal plate and marginal notch, enlarged (*108).

[The internal partitions in *Nuttallides* were described by BELFORD (1958, *108, p. 93, who regarded the genus as belonging to the Epistominidae, but possibly intermediate between *Alabamina* and *Epistomina.* As *Alabamina* has a granular, rather than radiate, wall structure, and *Epistomina* has an aragonite, rather than calcite, test, *Nuttallides* is not regarded as close to either of these genera.]

Nuttallinella BELFORD, 1959, *109, p. 20 [*pro Nuttallina* BELFORD, 1958, *108, p. 96 (*non* DALL,

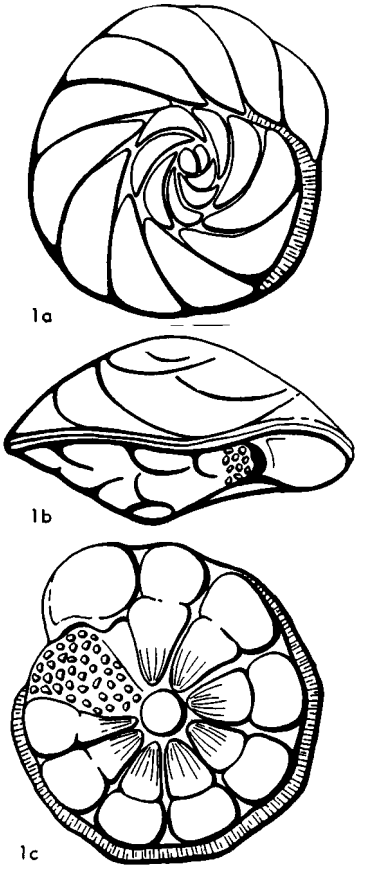

FIG. 471. Asterigerinidae; *1, Asterigerinoides* (p. C592).

1871)] [**Nuttallina coronula* BELFORD, 1958, *108, p. 97; OD]. Test trochospiral, plano-convex, with flattened spiral side, periphery with broad flangelike imperforate keel; all chambers visible from spiral side; umbilical side with small open umbilicus; sutures radial, straight to sinuate; wall

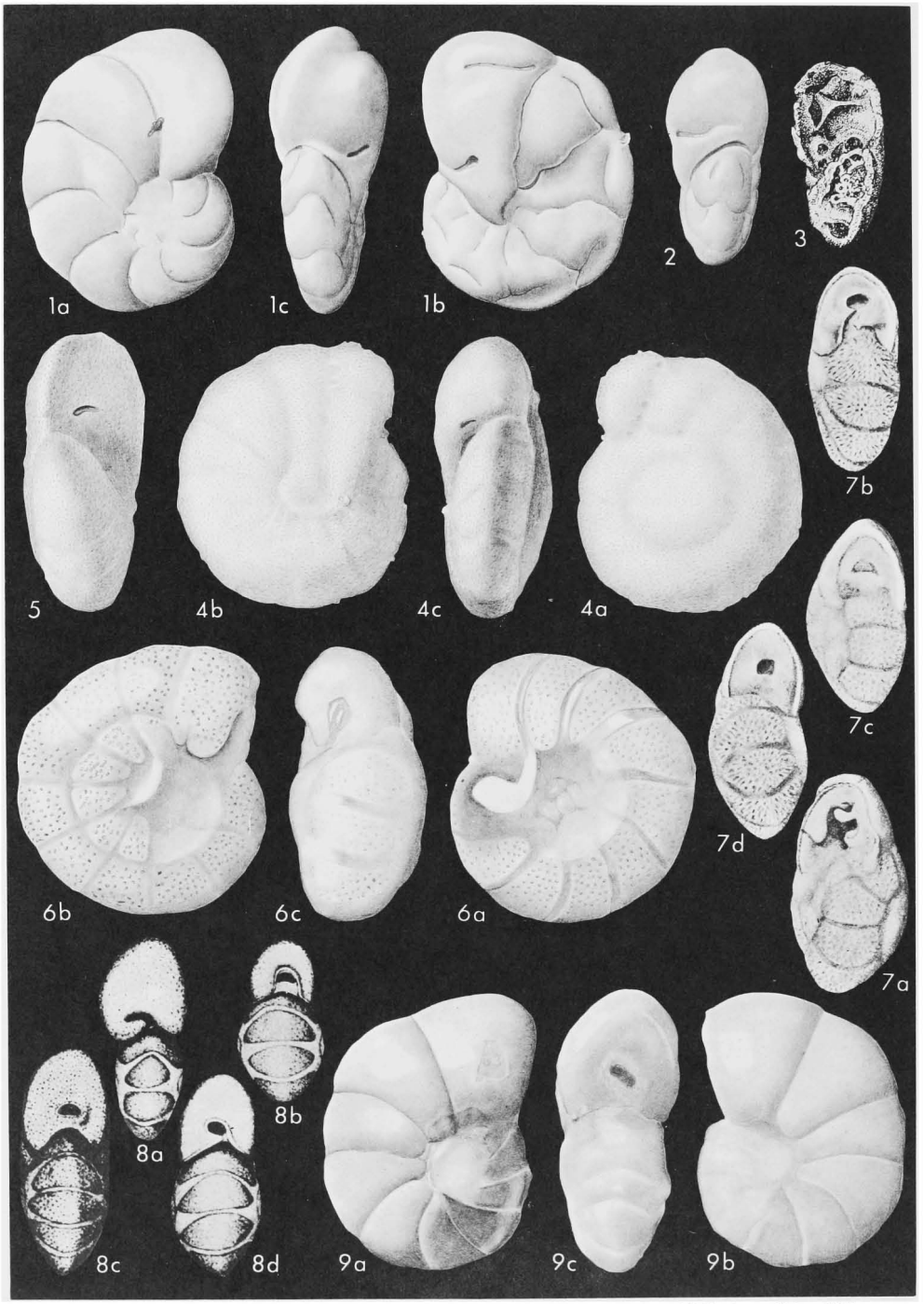

FIG. 472. Epistomariidae; *1-3, Epistomaria; 4,5, Elphidioides; 6-9, Eponidella* (p. C592-C595).

calcareous, perforate, radial in structure, septal walls single, monolamellid, imperforate; aperture elongate, interiomarginal on umbilical side, with narrow lip, and may have small flap over umbilicus, internal tooth plate extending diagonally across chamber from near periphery back to pre-

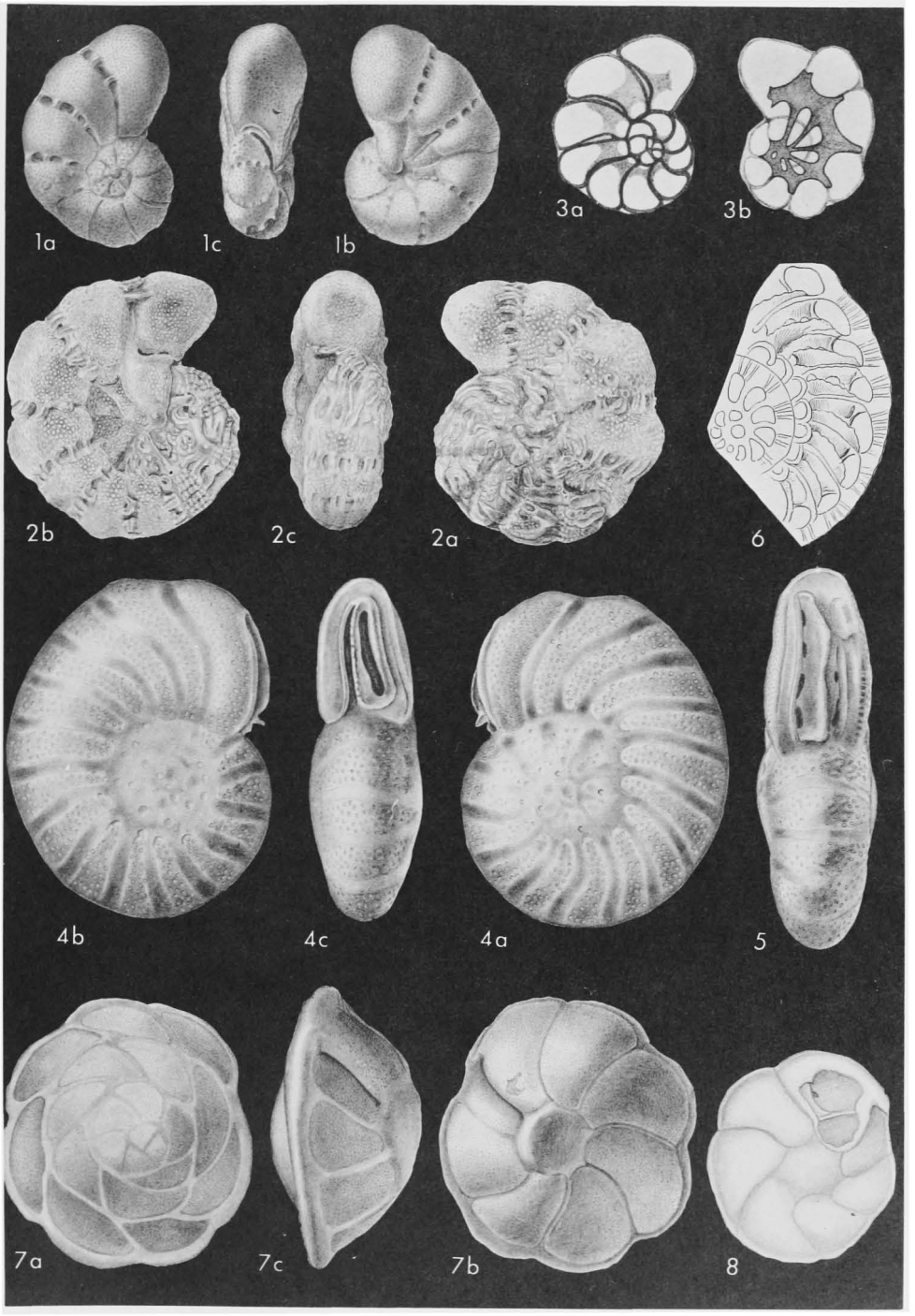

FIG. 473. Epistomariidae; *1-3, Epistomaroides; 4-6, Palmerinella; 7,8, Nuttallides* (p. C594-C595, C598).

vious septal foramen, as in *Nuttallides,* but tooth plate of *Nuttallinella* has strongly folded upper edge. [Differs from *Nuttallides* in having an open umbilicus, a more extensive aperture, which extends to the umbilicus, and folded upper margin of the tooth plate.] *U.Cret.(U.Santon.-U. Campan.),* Australia.——FIG. 474,*2-4*. **N. coronula* (BELFORD), Santon., W.Australia; *2a-c,* opposite sides and edge view of holotype, ×66; *3,* axial section showing tooth plate in final chamber at right, ×72 (*108); *4,* paratype with dissected penultimate chamber showing tooth plate, enlarged (*108).

Palmerinella BERMÚDEZ, 1934, *116, p. 83 [**P. palmerae*; OD]. Test free, discoidal, adult nearly planispiral and evolute, with low, broad chambers and small secondary chambers at umbilical margin of primary chambers on umbilical side, central portion of both sides of test with clear secondary shell material which may also obscure secondary chamberlets; secondary shell material pierced by few large pores; sutures gently curved; wall calcareous, coarsely perforate; microstructure and lamellar character unknown; aperture a broad open arch in terminal face with narrow raised bordering lip that extends somewhat to umbilical side in final chamber, this portion of earlier apertures being covered by secondary chamberlets; vertical internal partition subdividing aperture, curving at lower border to form continuous S-shaped ridge and leaving 2 elongate slits open in final chamber, these being closed by secondary plate in earlier chambers, plate containing vertical row of large perforations. [The asymmetrical aperture suggests that the nearly planispiral development is modified from a trochospiral ancestry.] *Rec.,* Carib.-N.Am.(USA).——FIG. 473, *4-6*. **P. palmerae,* Cuba; *4a-c,* opposite sides and edge view of lectotype showing aperture; *5,* edge view of paratype with broken final chamber showing septal partition and pores, ×90 (*1632); *6,* equat. sec. showing internal partitions and chamberlets, ×80 (*949).

Pseudoeponides UCHIO in KAWAI *et al.*, 1950, *1027, p. 190 and UCHIO, 1951, *1957, p. 38 [**P. japonica*; OD] [=*Epistomaria (Epistomariella)* KUWANO, 1950, *1071, p. 315 (type, *E. (E.) miurensis,* =*P. japonicus* UCHIO, 1950)]. Test free, lenticular, trochospiral, chambers numerous, broad, semilunar in outline, with strongly oblique sutures on spiral side but nearly radial on umbilical side; wall calcareous, very finely perforate, wall microstructure and lamellar character not described; aperture a low interiomarginal opening midway between umbilicus and periphery, supplementary slitlike openings parallel to spiral suture near mid-point of each chamber on spiral side at junction of spiral and septal sutures, surrounded by poreless area of chamber wall, additional hook-shaped supplementary slits at posterior margin of each chamber on umbilical side extending perpendicularly from near mid-point of previous suture and curving toward the anterior margin, thus suggesting presence of internal tooth plate, which extends vertically through chamber to attach at supplementary opening on spiral side. *Plio.-Rec.,* Japan-Neth.-Carib.——FIG. 474,*5,6*. **P. japonicus,* Plio., Japan; *5a-c,* opposite sides and edge view of paratype, ×148 (*2117); *6a,* axial sec. showing tooth plates extending from aperture on umbilical side through test to attach to wall of spiral side proximal to supplementary openings; *6b,* partial sec. showing tooth plates, ground from umbilical side through center of test so as to cut final whorl of chambers; both ×107 (*950).

[*Pseudoeponides* was stated by UCHIO (1951, *1957) to be related to *Mississippina* or *Epistomina,* because of the supplementary apertures. KUWANO (1950, *1071) considered it to be a subgenus of *Epistomaria*. Later UCHIO (1953, *1960) included *Rotalina umbonata* REUSS in *Pseudoeponides,* regarded the genus as related to *Eponides,* and placed it in the "Rotaliinae." HOFKER (1958, *950) and REISS (1960, *1533) regarded *Pseudoeponides* as a true rotaliid genus (double septa), related to *Ammonia*. HOFKER (1956, *945) considered *P. japonica* to have a "very highly developed toothplate and toothplate foramina at the dorsal side of each chamber." *Epistomina* has an aragonitic wall, the Rotaliinae are characterized by double septa and a canal system, *Eponides,* including *Rotalina umbonata* (=*Eponides*) is bilamellid, without supplementary openings and tooth plate.]

Torresina PARR, 1947, *1427, p. 129 [**T. haddoni*; OD]. Test free, trochospiral, compressed, chambers increasing gradually in size, few to whorl, chamber interior divided by secondary partitions projecting inward from peripheral margin; wall calcareous, perforate, microstructure and lamellar character unknown; aperture peripheral, short slit in plane of coiling and inclined toward umbilical side, second opening interiomarginal on umbilical side, and may have an umbilical chamber flap, as in *Discorbinella. U.Tert.-Rec.,* Australia.——FIG. 474,*1*. **T. haddoni,* Rec., Torres Straits; *1a-c,* opposite sides and edge view of topotype, ×133 (*2117).

Superfamily SPIRILLINACEA Reuss, 1862

[*nom. correct*. LOEBLICH & TAPPAN, 1961, p. 317 (*pro* superfamily Spirillinoidea CHAPMAN, PARR & COLLINS, 1934, p. 554, and superfamily Spirillinidea POKORNÝ, 1958, p. 311)] [=family group Archi-Monothalamidia RHUMBLER in KÜKENTHAL & KRUMBACH, 1923, p. 85 *(partim)*]

Test planispiral to conical, simple forms with proloculus followed by enrolled tubular second chamber, nonseptate or with septa in later stages, advanced forms with septa throughout, becoming biserial, later may develop annular chambers; wall perforate, calcareous, may consist optically of single crystal of calcite; amoeboid gametes in plastogamic reproductive cycle; quadrinucleate. *?Trias.,Jur.-Rec.*

Family SPIRILLINIDAE Reuss, 1862

[*nom. correct*. RHUMBLER, 1895, p. 85 (*pro* family Spirillinidea REUSS, 1862, p. 364)]——[All names cited of family

rank]——[=Spirillinina LANKESTER, 1885, p. 847; =Spirillinida HAECKEL, 1894, p. 185; =Spirillinae DELAGE & HÉROUARD, 1896, p. 144]

Proloculus followed by nonseptate enrolled tubular second chamber which may be septate in later stages, becoming biserial and may develop annular chambers; wall

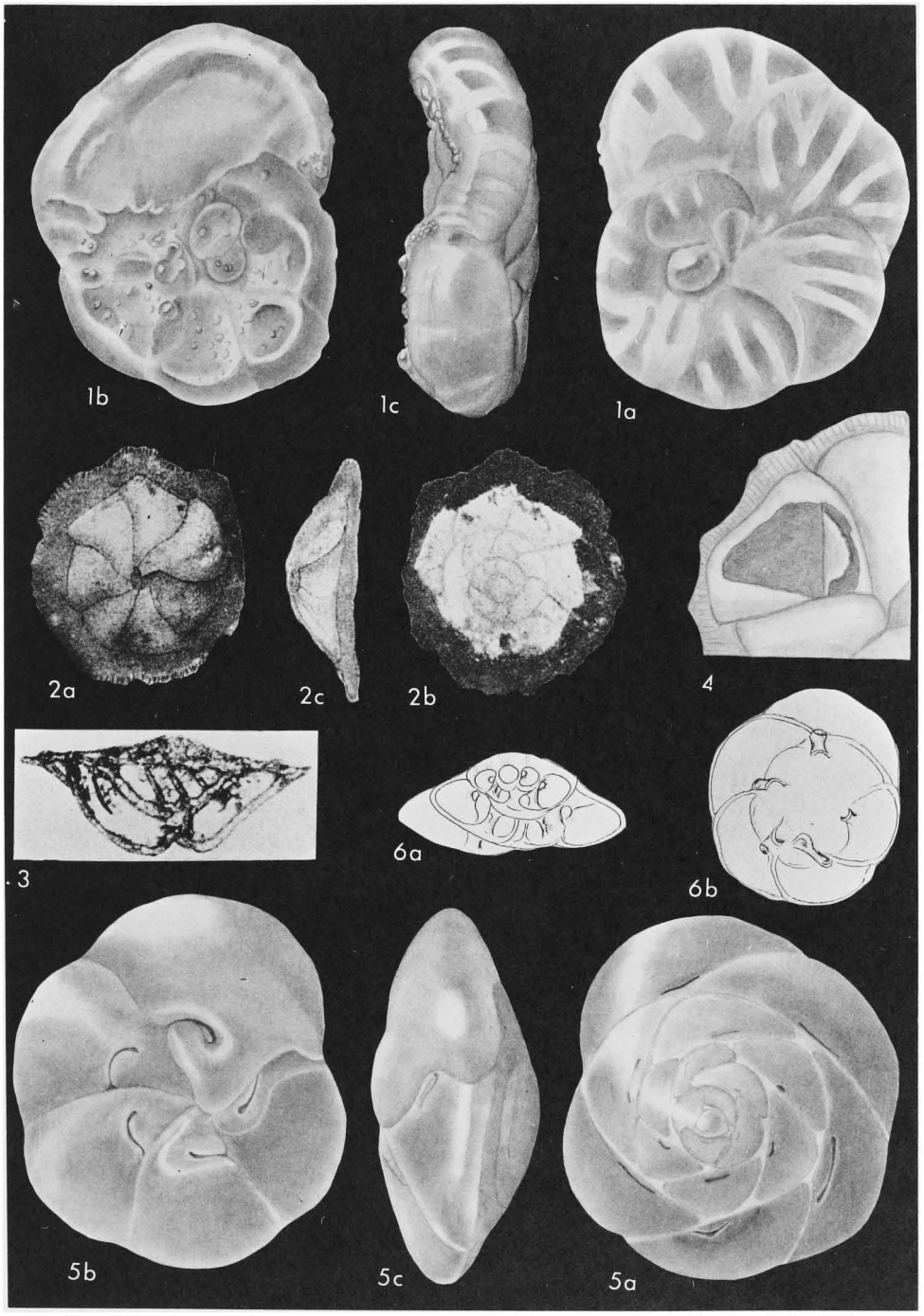

FIG. 474. Epistomariidae; *1, Torresina; 2-4, Nuttallinella; 5,6, Pseudoeponides* (p. C595-C598).

consisting optically of single crystal of calcite. *?Trias.,Jur.-Rec.*

Subfamily SPIRILLININAE Reuss, 1862

[*nom. transl.* Brady, 1884, p. 72 (*ex* family Spirillinidea Reuss, 1862)]——[All names cited of subfamily rank]——[=Arspirillinia Rhumbler, 1913, p. 388 (*nom. van.*); =Turrispirillininae Cushman, 1927, p. 73; =Terebralininae Cushman, 1927, p. 65]

Test with proloculus and enrolled tubular, nonseptate second chamber only; aperture simple, single, at open end of tube. *?Trias.,Jur.-Rec.*

Spirillina Ehrenberg, 1843, *672, p. 402 [**S. vivipara*; OD (M)] [=*Mychostomina* Berthelin, 1881, *134, p. 557 (type, *Spirillina vivipara revertens* Rhumbler, 1906, *1571, p. 32, SD Galloway, 1933, *762, p. 88); *Arspirillinum* Rhumbler, 1913, *1572b, p. 388 (*nom. van.*)]. Test free, planispiral, or with one side slightly concave, proloculus followed by closely appressed, spirally wound, undivided tubular second chamber, proloculus of "megalospheric" generation (agamont) smaller than that of "microspheric" generation; wall calcareous, hyaline, composed of single crystal of calcite (more rarely 2 or 3), deposited over pseudochitinous membrane, finely to coarsely perforate, although, according to Sollas (*1811, p. 207), the wall has "pseudopores" rather than true perforations, commonly with one side more coarsely perforate than the opposite; aperture terminal, peripheral, somewhat crescentic where final whorl lies against previous whorl, or final portion of tubular chamber may be somewhat turned inward to one side of periphery and directed toward umbilicus. *?Trias.,Jur.-Rec.*, cosmop.——Fig. 475,*1,2*. **S. vivipara*, Rec., soft muddy white sand at 10 fathoms, Dry Tortugas, Fla. (Station 23), between Middle Ground and White Shoal *(1)*, Gulf Mex. *(2)*; *1a-c*, opposite sides and edge view of neotype (Cushman Coll. 10186, U.S. Natl. Mus.), here designated, ×150; *2*, hypotype showing mychostomine appearance of agamont form, ×150 (*2117).——Fig. 475, *3,4*. *S. revertens* Rhumbler, Rec., W.Pac.O. (Caroline Is.); *3a-c*, opposite sides and edge view of hypotype with incurved chamber (agamont); *4a,b*, opposite sides of typical spirilline form (gamont); all ×148 (*2117).

[Ehrenberg's types, originally in Berlin, were reportedly destroyed during the last war. As was noted by Wood (1949, p. 245) the type-species of *Spirillina*, as generally understood, has a test composed of a single crystal of calcite, but Ehrenberg's original description stated that acid had no effect on the shell. Cushman (1931, *451, p. 4) stated: "Ehrenberg originally described this species from off the Coast of Mexico, near Vera Cruz. I examined the type in the Ehrenberg collection in Berlin and the drawing given by Ehrenberg . . . is an excellent one of the type specimen. The species is a fairly common one in the West Indian region . . . ." Cushman stated of his own illustrated specimens: "The figures given show the typical form and appearance of this species in the West Indian region from which it was described." As Ehrenberg stated that the test was insoluble in acid, this would imply that he was concerned with a siliceous or agglutinated form, such as *Ammodiscus*. However, no noncalcareous species of similar appearance is known from the type area. As Cushman's types were from the same general area, Gulf of Mexico, as the original of Ehrenberg and as he had seen the original types (now lost) and stated that his specimens were typical, we are here designating as neotype the specimen illustrated by Cushman (1931, *451, pl. 1, figs. 4*a-c*), here refigured. The original description was probably in error in stating that the test is not soluble in acid and by designating a neotype upon which to base the emended generic definition, the nomenclature can be stabilized.——¶*Mychostomina* Berthelin, 1881, was defined without citation of species, and *Spirillina vivipara* var. *revertens* Rhumbler, 1906, was designated as type-species by Galloway, 1933 (subsequent monotypy). Cushman in his various classifications of the foraminifers (1933, 1940, 1948) considered *Mychostomina* as a synonym of *Spirillina*, whereas Galloway (1933, *762, p. 88) stated that *Turrispirillina* Cushman may be a synonym of *Mychostomina*. Bermúdez (1952, *127, p. 18) recognized all three genera. We have examined specimens of *Spirillina revertens* from the Caroline Islands. In this species only slight overlap of the umbilical region by the distal end of the tubular chamber is seen and even this is difficult to determine in some specimens. In addition, very similar specimens of a typical planispiral *Spirillina* are assocated with *S. revertens*.——¶Myers (1936, *1337, p. 123), in his study of living cultures of *Spirillina vivipara* and their ontogenetic development and reproduction, stated, "In the final stage of the agamont test the distal end of the spiral chamber is usually turned inward, so that the aperture is directed toward the umbilicus." Thus, the agamont (sexually produced) generation may show the "generic" character of *Mychostomina*, with a recurved distal end of the spiral chamber, and the gamont test would show the typical *Spirillina*-like planispiral coil. Phleger & Parker (1951, pl. 13, figs. 3a, b) also figured a specimen of *Spirillina vivipara* from the Gulf of Mexico which shows the recurved distal end of the spiral chamber. We have here refigured it for comparison with the 2 forms of the type-species of *Mychostomina*. The genus *Gyrammina* Eimer & Fickert, 1899, with its type-species, *Trochammina annularis* Brady, 1876, was placed in the synonymy of *Spirillina* by Galloway (1933, *762, p. 85).——¶The types of this species in the Brady collection in the British Museum (Natural History) in London were examined by us and the species found to be unrecognizable on the basis of the type material. *S. vivipara* is one of the best-known species of all foraminifers and many details have been published as to its morphological characters (Myers, 1936, *1337, p. 123), shell composition (Wood, 1949, *2073, p. 245), ontogenetic development, reproductive process (Myers, 1936, *1337, p. 125), cytology (Myers, 1936, *1337, p. 126), and ecology (Myers, 1936, *1337, p. 122). It has been widely recorded from Recent oceans.]

Alanwoodia Loeblich & Tappan, 1955, *1166, p. 26 [**Patellina campanaeformis* Brady, 1884, *200, p. 634; OD]. Test free, conical, high-spired, ventrally flattened or slightly excavated, consisting of proloculus and long, undivided, broad and low tubular chamber in high, open conical spire, central area being filled with clear or laminated calcite, tiny pores around exterior spiral suture, wall calcareous, test composed of single calcite crystal; aperture ventral, at open end of spiraling tube. *Rec.*, Pac.O.——Fig. 476,*1,2*. **A. campanaeformis* (Brady); *1*, long. sec. of holotype showing clear central filling; *2a-c*, opposite sides and edge of paratype; all ×146 (*1166).

Conicospirillina Cushman, 1927, *431, p. 73 [**Spirillina trochoides* Berthelin, 1879, *132, p. 37; OD]. Test free, conical, consisting of proloculus and undivided tubular spiraling second chamber, spiral side convex and evolute, umbilical side concave and nearly completely involute, final whorl nearly or completely overlapping all previous whorls, rarely leaving small open umbilicus; aperture at open end of tube on umbilical side. [Differs from *Spirillina* in being ventrally involute and in being conical in form. It differs

from *Turrispirillina* in its involute ventral side with the final whorl occupying the entire ventral side.] *Jur.-Rec.*, Eu.-Atl.O.-Pac.O.——Fig. 475,5.

**C. trochoides* (Berthelin), L.Jur.(L.Pliensbach.), Eu.(Fr.); *5a-c*, opposite sides and edge view of topotype, ×257 (*2117).

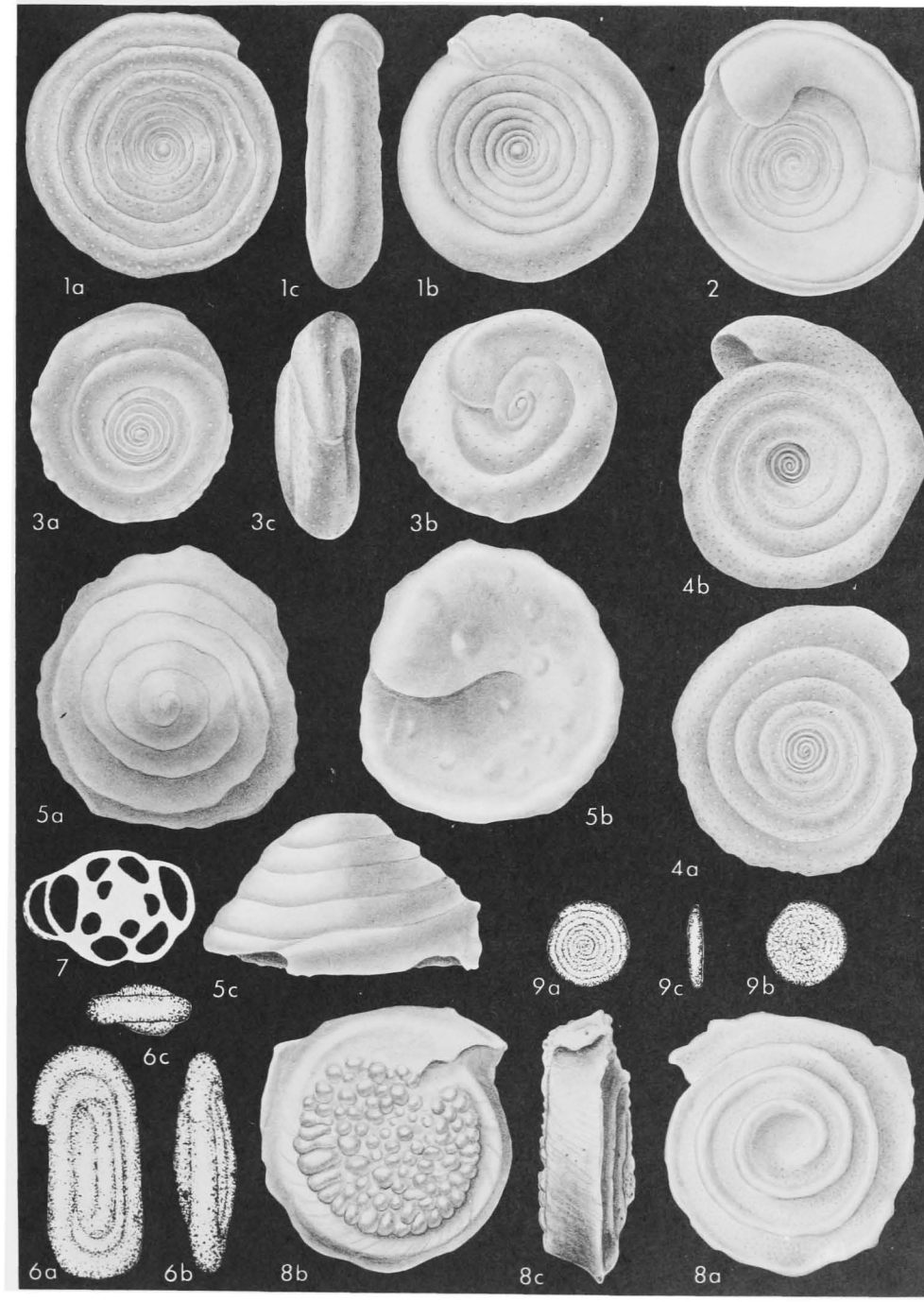

Fig. 475. Spirillinidae (Spirillininae; *1-4, Spirillina; 5, Conicospirillina; 6,7, Miliospirella; 8,9, Planispirillina*) (p. C600-C602).

Miliospirella Grigelis in N. K. Bykova *et al.*, 1958, *265, p. 75 [**M. lithuanica*; OD]. Test with proloculus followed by enrolled nonseptate tubular second chamber with plane of coiling changing regularly, so that successive whorls are approximately 120° apart, giving pseudotriloculine appearance; wall calcareous, coarsely perforate; aperture simple, at open end of tube. [Differs from *Spirillina* in its pseudotriloculine coiling, from *Triloculina* in its nonseptate tube, simple aperture, and perforate wall, and from *Agathammina* in its perforate wall.] *M.Jur.(U.Callov.),* Eu.(Lith.).——Fig. 475,*6,7*. **M. lithuanica*; *6a-c,* side, edge, and top views of holotype, ×120; *7,* sec. showing arrangement of successive whorls of nonsegmented tube, ×240 (*265).

Planispirillina Bermúdez, 1952, *127, p. 26 [**Spirillina limbata* Brady var. *papillosa* Cushman, 1915, *404e, p. 6; OD] [=*Trochospirillina* Mityanina, 1957, *1290, p. 230 (type, *T. granulosa*)]. Test free, planispiral, periphery rounded to truncate, all whorls visible on spiral side, all whorls except last obscured on ventral side by secondary accumulation of nodes and pustules of clear calcite which completely fill central region; wall calcareous, hyaline, coarsely perforate dorsally, finely perforate ventrally; aperture at open end of tube. *Jur.-Rec.,* Pac.O.-Eu.-Medit. Sea-Australia. ——Fig. 475,*8*. **P. papillosa* (Cushman), Rec., Pac.; *8a-c,* opposite sides and edge view of holotype, ×75 (*2117).——Fig. 475,*9*. *P. granulosa* (Mityanina), U.Jur.(L.Oxford.), Belorussian SSR; *9a-c,* spiral, umbilical, and edge views of type-specimen(s), ×44 (*1290).

[*Planispirillina* differs from *Spirillina* in the presence of secondary granules on its umbilical side. The original figures of *Trochospirillina granulosa* (*1290) seem to refer to a single specimen but either they represent different specimens or one figure is reversed, as the aperture is shown to the left in both figures.]

Sejunctella Loeblich & Tappan, 1957, *1172, p. 228 [**S. earlandi*; OD]. Test free, planispiral, discoidal, may have peripheral keel; globular to ovate proloculus followed by loosely wound, spiral, undivided, tubular second chamber that does not lie in contact with previous whorl but is separated from it by solid platelike area; wall calcareous, finely perforate, chamber wall and peripheral keel, when present, formed of single calcite crystal but intercalary plate between coils of tubular chamber not composed of single crystal but of secondary granular calcite; aperture a rounded opening at end of tubular chamber. *Rec.,* Atl.O.——Fig. 477,*4*. **S. earlandi;* side view of holotype, showing fimbriate peripheral keel and intercalary plate between whorls, composed of keels of earlier whorls with addition of secondary granular calcite, ×253 (*1172).

[Differs from *Spirillina* in the presence of its platelike intercalation between the planispiral whorls, a condition considered to be generically important, not only on external appearance but also because it differs in structure, being composed of granular calcite instead of a single crystal, as is the remainder of the test. The type-species has a peripheral keel on the final whorl, but this may be lacking in other species.]

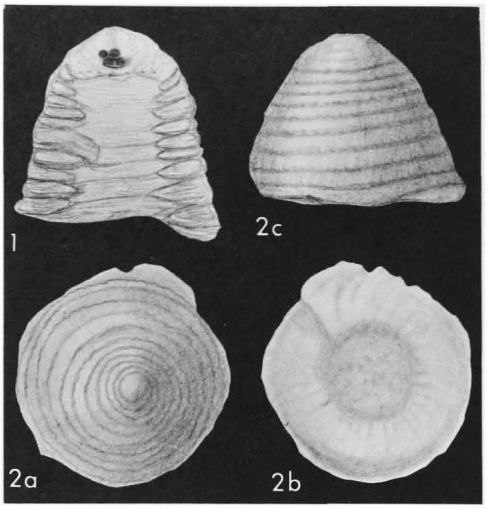

Fig. 476. Spirillinidae (Spirillininae; *1,2, Alanwoodia*) (p. *C*600).

Terebralina Terquem, 1866, *1887, p. 471, 473 [*pro Spirigerina* Terquem, 1866, *1886, p. 454 (*non* d'Orbigny, 1847)] [**Spirigerina antiqua* Terquem, 1866, *1886, p. 353, 454, =*Terebralina regularis* Terquem, 1866, *1887, p. 473; OD (M)]. Test consisting of proloculus and undivided tubular second chamber in high trochospiral coil; wall calcareous, perforate; aperture at open end of tubular chamber. [Although previously placed in the Buliminidae, *Terebralina* is here placed in the Spirillinidae because of its nonseptate coil, simple aperture, and absence of tooth plate. It differs from *Turrispirillina* in being extremely high-spired.] *L.Jur.(Lias.),* Eu.(Fr.).——Fig. 477, *5*. **T. antiqua* (Terquem); side view, ×66 (*519).

Turrispirillina Cushman, 1927, *431, p. 73 [**Spirillina conoidea* Paalzow, 1917, *1403, p. 217; OD] [=*Turrispirrillina* Neave, 1940, *1348d, p. 594 *(nom. null.)*]. Test free, conical, consisting of proloculus and spirally wound tubular second chamber, which forms hollow cone, all coils visible dorsally and ventrally; wall calcareous, finely perforate, dorsal surface somewhat roughened; aperture at open end of tube on ventral side of test. [Differs from *Spirillina* in its hollow conical spire rather than being planispiral.] *Jur.-Rec.,* Eu.-N.Am.-Australia-Antarctic. ——Fig. 477,*1*. **T. conoidea* (Paalzow), U.Jur., Eu.(Ger.); *1a-c,* opposite sides and edge view of topotype, ×90 (*2117).

Subfamily PATELLININAE Rhumbler, 1906

[Patellininae Rhumbler, 1906, p. 35] [=Arpatellinia Rhumbler, 1913, p. 390 *(nom. van.)*]

Proloculus and trochospirally coiled nonseptate chamber in early stage, followed by septate stage with 2 chambers to whorl, or chambers annular; aperture umbilical. *L. Cret.-Rec.*

Patellina WILLIAMSON, 1858, *2065, p. 46 [**P. corrugata*; OD (M)] [=*Arpatellum* RHUMBLER, 1913, *1572b, p. 391 *(nom. van.)*; *Discobolivina* HOFKER, 1951, *936, p. 358 (obj.)]. Test free, conical, spiral side elevated and evolute, umbilical side flat and involute, elliptical proloculus fol-

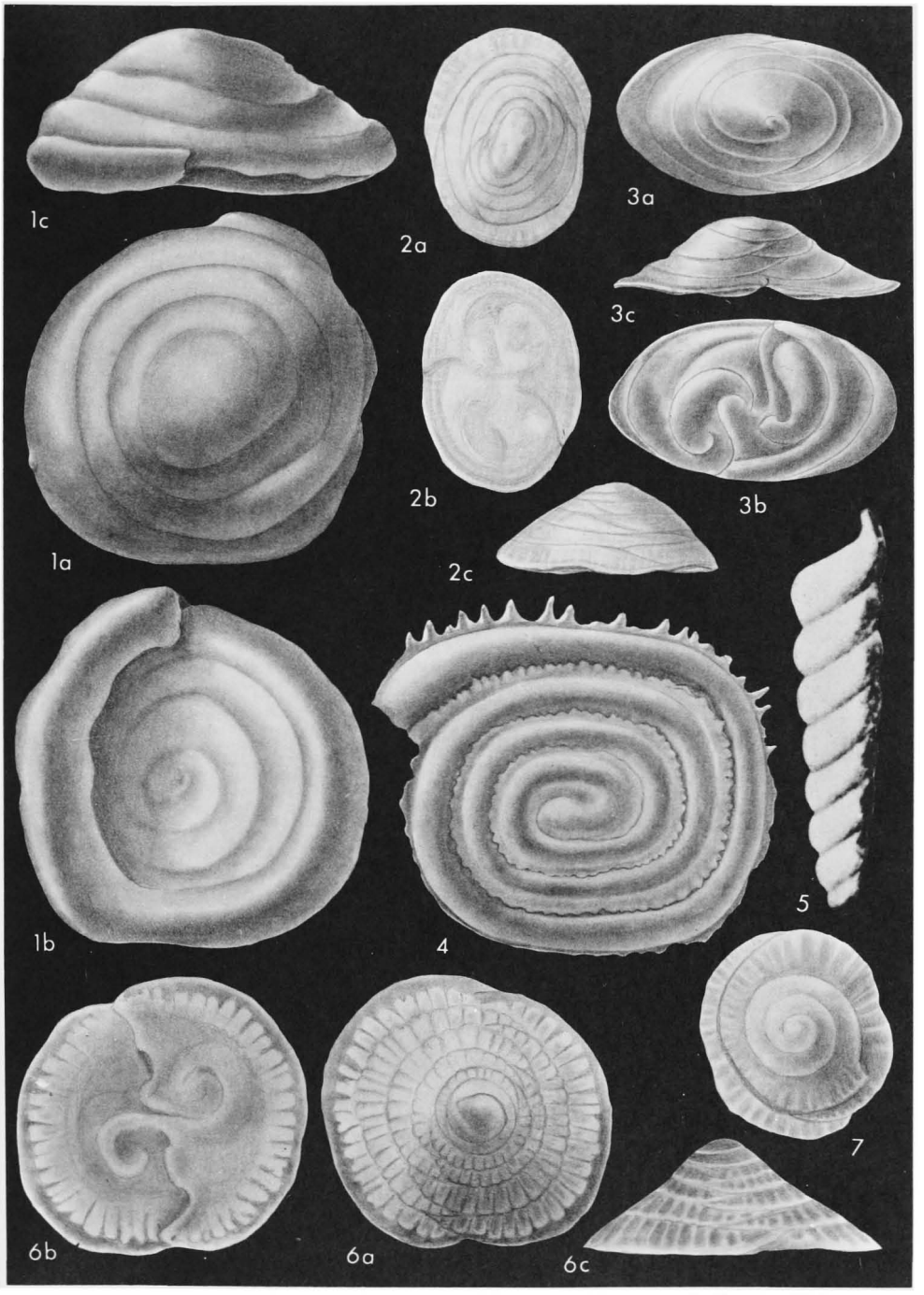

FIG. 477. Spirillinidae (Spirillininae; *1, Turrispirillina; 4, Sejunctella; 5, Terebralina;* Patellininae; *2,3, Patellinoides; 6,7, Patellina*) (p. C602-C604).

lowed by spirally wound tubular undivided second chamber of 1 to 3 whorls in microspheric form, proloculus continuous with spiral tube in megalospheric test, smaller in size that that of microspheric generation, later stage with 2 broad, low chambers to each whorl, primary chambers divided by numerous incomplete secondary transverse septa and commonly with intercalated shorter third series, these transverse septa giving typical cancellated appearance to test but extending only approximately width of chambers, as seen from the spiral side, not reaching across umbilical portion of chambers; wall calcareous, built as single calcite crystal, finely perforate; aperture a low arch under exterior margin of scroll-like median septum of final chamber at center of test, median septa of entire test arranged above each other to form columella. *L.Cret.-Rec.*, cosmop.——FIG. 477,*6,7*, **P. corrugata*, Rec., Can. *(6)*, Greenl. *(7)*; *6a-c*, opposite sides and edge view of microspheric hypotype; *7*, megalospheric hypotype; all ×100 (*1162).

[HOFKER (1951, *936, p. 358) stated "that all species known as *Patellina* and *Patellinoides* do not show in the initial part a spiral without septa, but that in contrary all genera and species observed show a more or less highly developed conorbine initial part, with fine, only in a clarifier visible, septa." He also added (*928c, p. 422) "that those records which mention an undivided first part of the test, are erroneous ones, or that this character is due to the insufficient state of fossilization."——¶However, the exacting and detailed work on Recent living specimens of *Patellina corrugata* by MYERS (1935, *1336, pl. 13, fig. 18), definitely showed the presence of an undivided spire, and nuclear characters in camera lucida drawings of decalcified cytological preparations. MYERS also noted that the microspheric tests had a distinct proloculus, followed by an undivided spiral, whereas the megalospheric test showed no separation of the proloculus from the spirally wound tubular chamber. The proloculus of the microspheric generation of *Patellina* was also shown by MYERS (1935, *1335, p. 399) to be larger than that of the megalospheric generation, so that "the terms megalospheric and microspheric, when applied to the dimorphic tests of this species, are not descriptive of the relative diameters of the initial chambers of these two stages . . . . The diameter of a megalospheric test having a given number of semilunar chambers is larger than that of a microspheric test having a similar number of chambers because of the larger diameter of the spiral stage of the megalospheric test . . . [p. 402]. The diameter of the initial chamber of a megalospheric test is influenced by the diameter of the nucleus involved, and may or may not depend on the amount of cytoplasm that surrounds the nucleus." MYERS also studied the internal features of the test (*1335, p. 395, fig. 7, and p. 397) and the columella which forms the S-shaped ventral structure considered as a tooth plate by HOFKER (probably this is the "previously unmentioned" feature HOFKER considered a basis for his genus *Discobolivina*) and discussed the morphology of the secondary septa (not mentioned by HOFKER).——¶HOFKER (1951, *928c, p. 422) stated that the wall was without pores, but MYERS (1935, *1335, p. 396) had shown the presence of a row of pores even in the microspheric proloculus of *P. corrugata* and several rows of pores in the dorsal wall of the chamberlets in later chambers. The conorbine initial stage in *Patellina*, reported by HOFKER (1951, *936, p. 358) does not occur in *P. corrugata*, as MYERS showed in cytological preparations. We have also examined this species in reflected light at magnifications higher than X200, by transmitted light with anise oil as a clarifier, and in oil immersion at X400, and no conorbine early portions were found, only a spiral nonseptate coil. Only the genus *Patellinella* has this early conorbine stage, and it lacks the secondary septa of *Patellina*. WILLIAMSON originally described *Patellina corrugata* from Arran, Skye, Shetland, Brixham, and Fowey, all from the British Isles, and from Hunde Island, in Davis Straits, Arctic Canada. He did not cite a holotype, and since all localities are represented on a single slide preserved in the British Museum (Natural History), London, England, it is impossible to state which is the type locality.]

Patellinoides CUSHMAN, 1933, *461, p. 236 [**P. conica* HERON-ALLEN & EARLAND, 1932, *916, p. 408; OD] [=*Patellinoides* HERON-ALLEN & EARLAND, 1932, *916, p. 407 *(nom. nud.)*]. Test free, tiny, conical, plano-convex, somewhat ovate in outline, trochoid, all chambers visible dorsally, only final pair visible ventrally; proloculus followed by simple undivided spiral tubular chamber of 1 or 2 volutions, then followed by chambers arranged biserially around internal S-shaped columella, as in *Patellina*, but lacking radial secondary septa which form partial chamberlets in *Patellina*; wall calcareous, perforate, composed of single calcite crystal, light reflections from fine pores sometimes giving radial pattern to exterior of test but no true internal secondary partitions present; aperture ventral, small arch near umbilicus. *Rec.*, N.Atl.O.-S.Atl.O.——FIG. 477,*2,3*. **P. conica* (HERON-ALLEN & EARLAND), S.Atl.; *2a-c*, opposite sides and edge view of lectotype (here designated) (BMNH-ZF3568 from R.R.S. *William Scoresby* station WS 408, lat. 53°50′00″ S., long. 62°10′00″ W., Falk. Is., at 454 m.), ×200; *3a-c*, opposite sides and edge view of hypotype, ×187 (*2117).

[*Patellinoides* was named by HERON-ALLEN & EARLAND (1932, *916, p. 407) as a new genus including *P. conica*, n. sp., and *P. depressa*, n. sp., neither of which was designated as type-species for the genus. Thus, it was a *nomen nudum*, with no status of availability or validity (Zool. Code, 1961, Art. 13(b)). The genus was validated when the type-species was designated by CUSHMAN (1933, *461, p. 236), who also gave a description and figure for this genus; CUSHMAN must be considered the author of the genus, therefore. The species names *conica* and *depressa* published by HERON-ALLEN & EARLAND in 1932 comply with the Rules in being accompanied by adequate "indications," and they are not *nomina nuda* because given in combination with an invalid generic name; their availability for designation of the specific taxa described is not affected by the status of *Patellinoides* as a *nomen nudum* in the original publication (Zool. Code, 1961, Art. 11(g)(ii), Art. 17(3)). In assigning these species to *Patellinoides* CUSHMAN, the names of the authors HERON-ALLEN & EARLAND need to be enclosed by parentheses, just as if they had used the generic name *Patellina* with *conica* and *depressa*.]

Family ROTALIELLIDAE Loeblich & Tappan, n.fam.

Test trochospiral, consisting of few crescentic to subglobular chambers; wall calcareous, finely perforate, radial in structure, monolamellar; aperture central on umbilical side; quadrinucleate, sexual reproduction with amoeboid gametes. [Because of the similarity in the reproductive cycle, with the amoeboid gametes and the quadrinucleate agamont form, this family is placed in the Spirillinacea.] *Rec.*

Rotaliella GRELL, 1954, *818, p. 269 [**R. heterocaryotica*; OD]. Test tiny, to 60μ diam., free, trochospiral, chambers inflated, subglobular to crescentic, 3 to whorl, increasing rapidly in size, proloculus followed by small hourglass-shaped