TEREBRATELLIDINA

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Suborder TEREBRATELLIDINA Muir-Wood, 1955

[*nom. correct.* Muir-Wood & Stehli, 1965, p. 730, *pro* suborder Terebratelloidea Muir-Wood, 1955, p. 79]

All long-looped terebratulides in which the loop develops by a complex ontogeny that always involves either a septal pillar or median septum. *Upper Triassic–Holocene.*

ZEILLERIOIDEA

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Superfamily ZEILLERIOIDEA Allan, 1940

[*nom. transl.* Kyansep, 1961, p. 80, *ex* Zeilleriidae Allan, 1940a, p. 269]

Small to large, outline variable, biconvex, less commonly ventribiconvex or globose, rarely dorsiconvex or planoconvex, anterior commissure variable, shell smooth, less commonly costate, or exceptionally with rugae, umbo normally small to moderate size, rarely massive, typically short, suberect to strongly incurved, with well-defined, curved beak ridges, deltidial plates conjunct, or exceptionally disjunct or forming symphytium, pedicle foramen small to large, mesothyrid to permesothyrid; pedicle collar present or absent, shell without callus, or apical only, thick umbonal callus rarely developed; teeth moderate, rarely large, dental plates present, slender to thick, unenveloped, partially enveloped, or completely enveloped in callus, variably disposed, cardinal process rarely developed (except in one family), inner socket ridges occasionally deflected dorsally or ventrally, outer hinge plates normally not demarcated from inner socket ridges, ventrally concave or convex, crural bases and loop given off dorsally or ventrally, or mesially exceptionally, hinge plates fused, inner hinge plates or crural plates present, septalium present or absent, adult loop teloform, moderate to long, slender, with no adult connection with median septum, with or without spines, descending branches, ascending branches, and transverse band typically narrow, transverse band typically posterior, loop development associated with septal pillar very early in ontogeny (except in one family), dorsal adductor scars variable; shell attached throughout life by pedicle emerging through apically resorbed delthyrium. *Lower Triassic (Induan)–Holocene.*

Family ZEILLERIIDAE Allan, 1940

[*nom. correct.* Allan, 1940a, p. 269, *pro* Zeilléridés Rollier, 1915, p. 14]

Small to medium size, rarely larger, shell smooth, exceptionally with costae developed anteriorly or rugate or capillate; umbo normally moderate size, with angular beak ridges, deltidial plates normally conjunct, pedicle foramen typically small, commonly telate; pedicle collar commonly developed, thick umbonal callus developed exceptionally; teeth large exceptionally, dental plates typically short, straight, ventrally divergent; outer hinge plates demarcated exceptionally,

commonly convex ventrally, crural plates typically forming shallow, broadly V-shaped septalium, supported by a low, bladelike, short to moderate median septum, transverse band of loop typically posterior, loop rarely smooth, spines normally numerous on descending branches, rarely forming anterior fringe, rarely occurring on both descending and ascending branches, loop development associated with septal pillar very early in ontogeny (in some genera). [Authorship and date of this family would be ROLLIER, 1915, if generally accepted by paleontologists (ICZN, 1999, *Code,* Art. II, c, iii) but ALLAN, 1940a has come to be recognized instead.] *Lower Triassic (Induan)–Holocene.*

Subfamily ZEILLERIINAE Allan, 1940

[*nom. transl.* BAKER, herein, *ex* Zeilleriidae ALLAN, 1940a, p. 269]

Large exceptionally, outline commonly subpentagonal or variant, valves commonly lobate, bilobate, or quadrilobate, biconvex, less commonly ventribiconvex or globose, anterior commissure typically rectimarginate, commonly unisulcate, umbo long exceptionally, typically with persistent beak ridges, extended exceptionally, deltidial plates, exceptionally disjunct or forming symphytium, pedicle foramen typically oval, commonly telate; dental plates unenveloped, or enveloped exceptionally, relatively strong, commonly long; cardinal process absent, or exceptionally represented by callus lobe, crural bases given off dorsally, septalium occasionally U- or W-shaped, occasionally deep, median septum commonly triangular, rarely acutely triangular, rarely long, transverse band of loop occasionally broad, with posterior projections. *Lower Triassic (Induan)–Upper Jurassic (Kimmeridgian), Lower Cretaceous (?Berriasian–?Hauterivian).*

Zeilleria BAYLE, 1878, expl. pl. 9 (no page number) [**Terebratula cornuta* J. de C. SOWERBY, 1824 in 1823–1825, p. 66; SD DOUVILLÉ, 1879, p. 275] [=*Columellithyris* TCHORSZHEVSKY & RADULOVIĆ, 1984, p. 164 (type, *C. novoselica* TCHORSZHEVSKY & RADULOVIĆ, 1984, p. 165, OD); *Sinusella* SUČIĆ-PROTIĆ, 1985, p. 26 (type, *S. laskarevi,* OD)]. Small to large, subpentagonal, bilobate or quadrilobate outline, biconvex, becoming anteriorly lobate with no posterior dorsal sulcation, umbo suberect to much incurved, beak ridges clearly delimiting palintropes, foramen permesothyrid, commonly telate; pedicle collar absent, dental plates strong, slightly inwardly concave, ventrally divergent; cardinal process exceptionally represented by callus lobe, hinge plates ventrally deflected and convex ventrally in section, septalium broadly U-shaped, commonly with anterior median groove, median septum triangular in cross section, extending about 0.3 valve length, loop almost reaching anterior, with spinose, descending branches, connection between anterior of loop and septal pillar early in ontogeny; dorsal adductor scars subcircular. [Distinction of *Columellithyris,* based on the absence of inner hinge plates and the unresorbed remnant of a septal pillar, cannot be sustained, as a septalium is clearly present and a septal pillar remnant is present in the ontogeny of *Zeilleria.* Distinction based on three specimens and resting solely on the presence of a shallow sulcus in the anterior half of the ventral valve is not valid; *Sinusella* is therefore regarded as a synonym of *Zeilleria.*] ?*Upper Triassic, Lower Jurassic–Middle Jurassic:* Europe (or cosmopolitan), *Lower Jurassic.*——FIG. 1439,*1a–d.* **Z. cornuta* (J. de C. SOWERBY), middle Lias, Somerset, England; *a–c,* dorsal, lateral, anterior views; *d,* internal mold showing adductor scars, ×1.3 (Muir-Wood, 1965b).——FIG. 1439,*1e. Z. quadrifida* (VALENCIENNES in LAMARCK), middle Lias, France; dorsal view showing quadrilobation, ×0.7 (Muir-Wood, 1965b).——FIG. 1439,*1f–uu. Z. leckenbyi* (DAVIDSON *ex* WALKER MS), lower Aalenian, Gloucestershire, England; *f,* dorsal valve interior, reconstruction, ×1.3 (Baker, 1972); *g–aa,* serial transverse sections, early juvenile shell, 0.15, 0.36, 0.45, 0.54, 0.69, 0.75, 0.87, 0.99, 1.20, 1.29, 1.59, 1.74, 1.80, 1.86, 1.92, 2.04, 2.07, 2.10, 2.46, 2.79, 3.12 mm from umbo, ×4; *bb–uu,* serial transverse sections, adult shell 1.4, 2.8, 3.5, 4.2, 4.9, 5.6, 7.0, 7.7, 9.1, 9.8, 11.2, 11.9, 12.6, 15.4, 16.1, 16.8, 19.6, 20.3, 21.0, 21.7 mm from umbo, ×0.65 (adapted from Baker, 1972).

Ajukuzella OVTSHARENKO, 1983b, p. 165–166 [**A. ajukuzensis* OVTSHARENKO, 1983b, p. 166; OD]. Rounded-square or rounded-pentagonal in outline, strongly ventribiconvex, anterior commissure rectimarginate or incipiently uniplicate, umbo small, suberect, with short, subangular beak ridges, foramen permesothyrid; poorly developed pedicle collar occasionally present; outer hinge plates very narrow, deflected ventrally, septalium broadly U-shaped with crural plates curved ventrally to form low, median ridge, median septum triangular in cross section, extending about 0.3 valve length, crural processes long, arched, loop relatively short, barely extending 0.4 valve length. *Middle Jurassic:* Tadzhikistan, Pamirs.——FIG. 1440,*4a–c.* **A. ajukuzensis,* Tadzhikistan; dorsal, lateral, anterior views, ×1 (new).

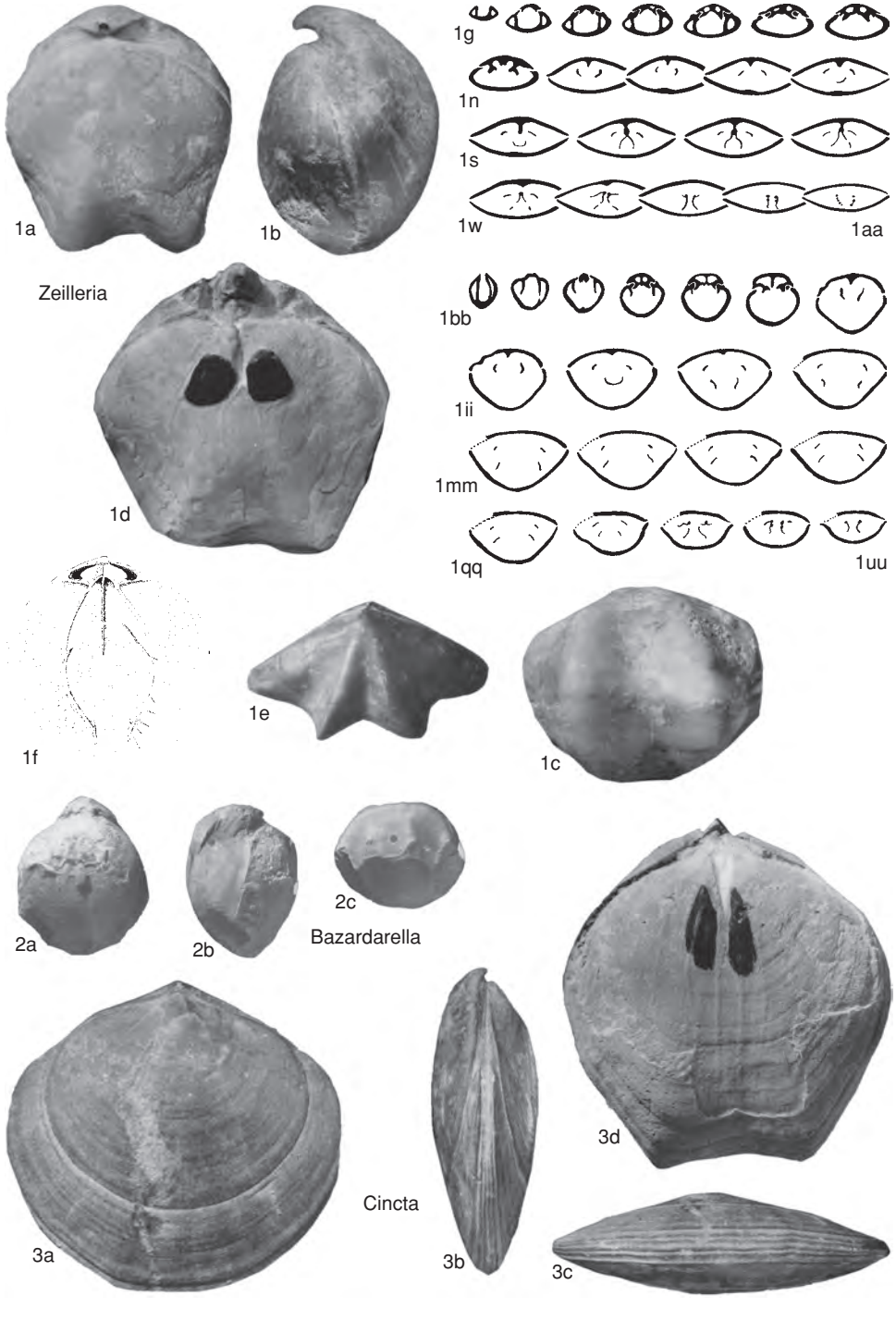

FIG. 1439. Zeilleriidae (p. 2164–2169).

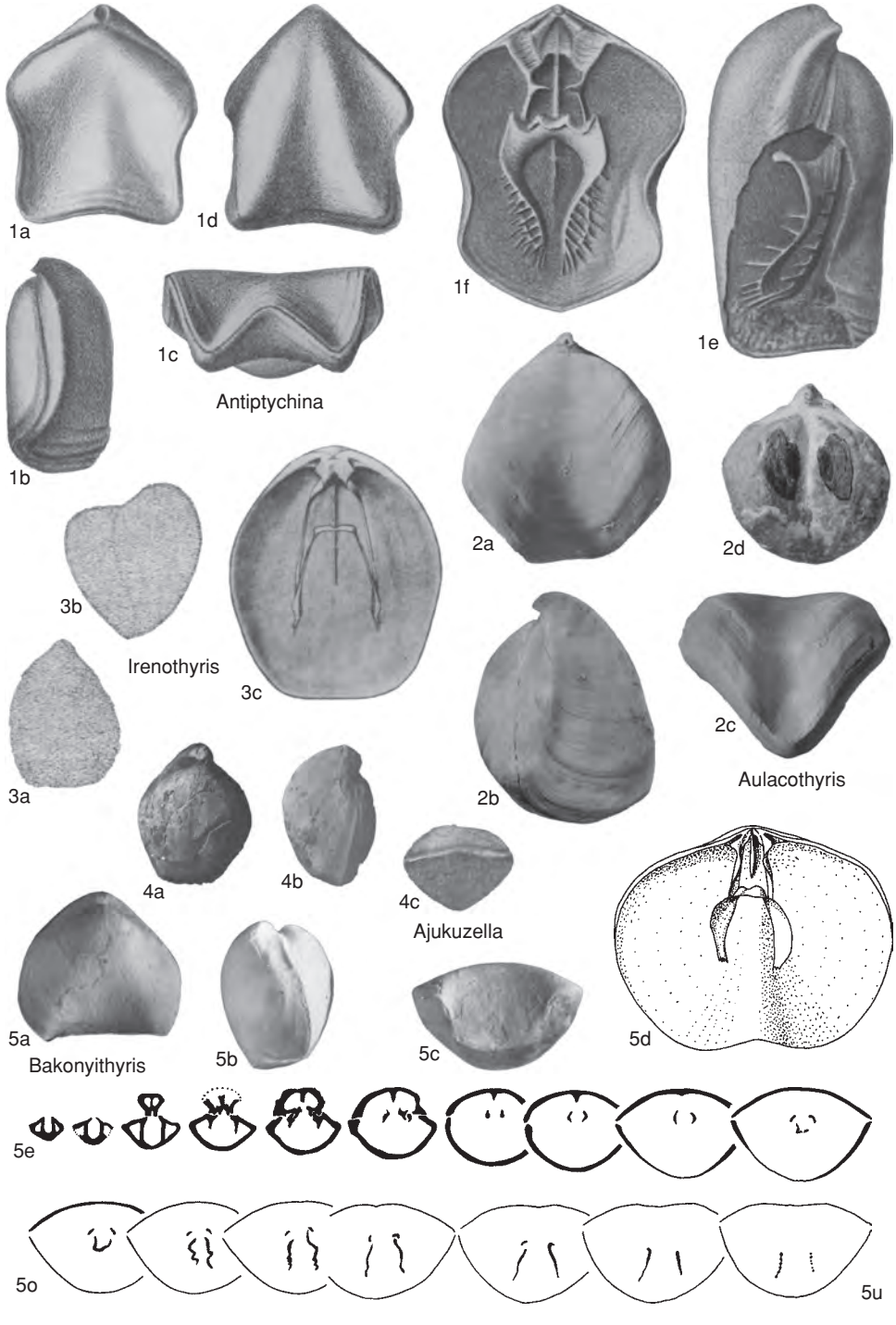

FIG. 1440. Zeilleriidae (p. 2164–2169).

Antiptychina Zittel, 1880, p. 704 [**Terebratula bivallata* Deslongchamps, 1860, p. 20 (p. 7 of separate); SD Eudes-Deslongchamps, 1884, p. 268]. Small, oblong-pentagonal to quadrilobate in outline, flatly biconvex, ventral valve carinate with median sulcus, dorsal valve sulcate with median fold, anterior commissure biplicate, umbo fine tapering, suberect with long, angular beak ridges extending to anterolateral margin, foramen elliptical, possibly epithyrid; cardinal process represented by small callus knob, septalium possibly broadly U-shaped, median septum long, bladelike or acutely triangular in cross section, extending for almost 0.75 valve length, loop with long spines on both ascending and descending branches, broad transverse band with two lateral, posteriorly projecting carinae separated from median lobe by deep concavity. [Cretaceous record relates to unnamed terebratulid homeomorph.] *Middle Jurassic (Bajocian)–Upper Jurassic (Oxfordian):* France, Germany, Czech Republic, Slovakia, Austria, *Bajocian.*——Fig. 1440,*1a–f.* **A. bivallata* (Deslongchamps), upper Bajocian, France; *a–d,* dorsal, lateral, anterior, ventral views, ×2; *e,* breached shell showing lateral view of loop, ×3; *f,* dorsal valve interior, ×2.5 (Muir-Wood, 1965b).

Aulacothyris Douvillé, 1879, p. 277 [**Terebratula resupinata* J. Sowerby, 1816 in 1815–1818, p. 116; OD]. Subpentagonal in outline, strongly ventribiconvex or concavocarinate to planoconvex, anterior commissure normally unisulcate, umbo small, flattened, incurved with palintrope strongly demarcated, pedicle foramen permesothyrid, commonly telate, interior of shell commonly with much callus thickening; pedicle collar not observed, dental plates angled, subparallel to ventrally convergent; hinge plates convex ventrally, not clearly demarcated from inner socket ridges, septalium rounded V-shaped, median septum moderately high, triangular in cross section, about 0.5 valve length, connection between anterior of loop and septal pillar early in ontogeny, dorsal adductor scars elongate-oval, anterior scars about half size of posterior scars. *?Triassic, Lower Jurassic (lower Pliensbachian)–Middle Jurassic (Aalenian), ?Upper Jurassic:* Europe, ?cosmopolitan.——Fig. 1440,*2a–d.* **A. resupinata* (J. Sowerby), Pliensbachian, Somerset, England; dorsal, lateral, anterior views, dorsal valve interior mold showing adductor scars, ×1.3 (Muir-Wood, 1965b).

Bakonyithyris Vörös, 1983, p. 22 [**Waldheimia pedemontana* Parona, 1893, p. 49; OD]. Small, subpentagonal to rounded outline, anterior commissure unisulcate, umbo small, incurved, pedicle foramen very small, mesothyrid, deltidial plates disjunct, dental plates long, parallel; crural processes incurved, septalium deep, V-shaped, median septum acutely triangular in cross section, extending barely 0.25 valve length, loop moderate, descending branches slender, ascending branches expanded, uniting with transverse band to form hoodlike structure, anterior of loop with fringe of short spines. *Lower Jurassic (Sinemurian–Pliensbachian):* Sicily, Apennines, southern Alps, West Carpathians, Hungary, Crimea, *Sinemurian.*——Fig. 1440,*5a–u.* **B. pedemontana* (Parona), Pliensbachian, Ibex Zone, Bakony Mountains, Kericser, Hungary; *a–c,* dorsal, lateral, anterior views, ×2 (Vörös, 1983); *d,* dorsal valve interior reconstruction, ×3.5; *e–u,* serial transverse sections, 0.3, 0.5, 0.7, 0.85, 1.0, 1.2, 1.5, 1.7, 2.1, 2.5, 2.7, 2.8, 3.0, 3.3, 3.7, 4.3, 4.6 mm from umbo, ×2.5 (adapted from Vörös, 1983).

Bazardarella Ovtsharenko, 1983b, p. 159–160 [**B. bazardarensis* Ovtsharenko, 1983b, p. 160; OD]. Medium size, rounded or oval, biconvex, unevenly bisulcate with folds distinctively developed anteriorly, umbo small, incurved to strongly incurved with short, subangular beak ridges; hinge teeth simple with small denticulum, dental plates inwardly concave, becoming ventrally convergent; outer hinge plates broad, ventrally convex, dorsally deflected, crural plates ventrally convex, combined effect producing septalium replaced by median ridge for most of length and whole structure with flattened, W-shaped section, lateral umbonal cavities with apical callus, crural processes short, divergent, median septum extending almost 0.5 valve length, excavated, as in *Rugitela,* to leave narrow cardinal shelf; dorsal adductor scars rather broad, parallel or slightly diverging. *Middle Jurassic:* Tadzhikistan, Pamirs.——Fig. 1439,*2a–c.* **B. bazardarensis,* Tadzhikistan; dorsal, lateral, anterior views, ×1 (new).

Calpella Owen & Rose, 1997, p. 508 [**Zeilleria aretusa* Di Stefano, 1887, p. 93; OD]. Small, subpentagonal in outline with maximum width in anterior third, equally biconvex, anterior commissure rectimarginate, anterior half of shell costate with 10 to 12 costae originating from midvalve area and radiating anteriorly, umbo short, suberect, with subangular beak ridges clearly delimiting palintropes, pedicle foramen permesothyrid, comparatively large; median septum prominent, extending slightly more than 0.5 valve length, other internal characters unknown. *Lower Jurassic (?upper Sinemurian):* Gibraltar, Sicily, Morocco.——Fig. 1441,*2a–c.* **C. aretusa* (Di Stefano), lower Lias, Gibraltar; dorsal, lateral, anterior views, ×1.5 (Owen & Rose, 1997).

Cincta Quenstedt, 1868 in 1868–1871, p. 25 [**Terebratula numismalis* Valenciennes in Lamarck, 1819, p. 249; SD Dall, 1877a, p. 20] [=*Cinctopsis* Sučić-Protić, 1985, p. 45 (type, *C. luka,* OD)]. Subcircular to pentagonal in outline, growth lines prominent, weakly biconvex, anteriorly lobate, umbo acute, suberect, beak ridges short, foramen minute mesothyrid; dental plates angled, ventrally convergent, commonly embedded in callus; hinge plates slightly ventrally inclined, septalium rounded V-shaped becoming deep U-shaped, median septum triangular in cross section, extending about 0.3 valve length, dorsal adductor scars elongate-oval, tapering posteriorly. [The characters cited for

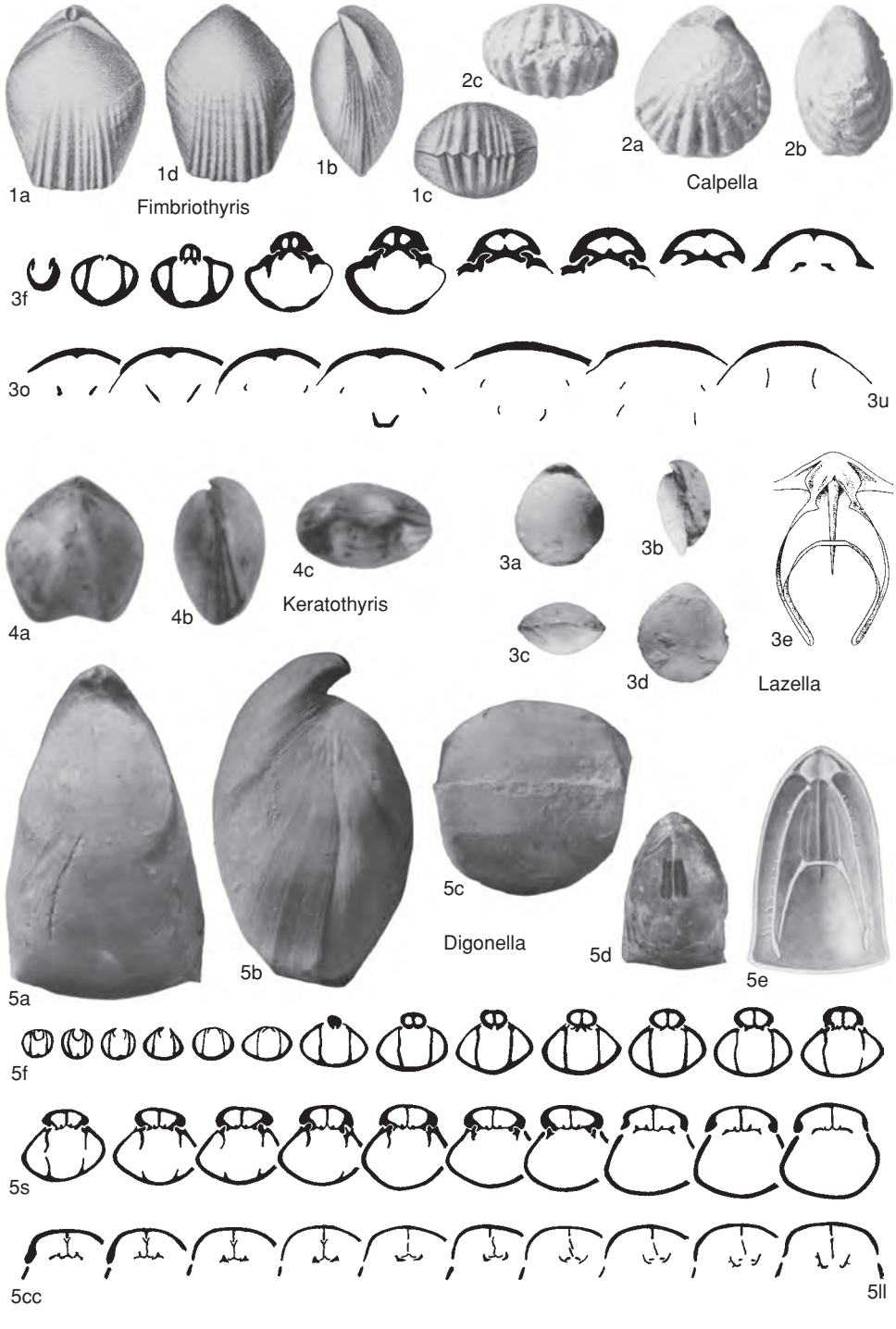

FIG. 1441. Zeilleriidae (p. 2167–2170).

distinction of *Cinctopsis* are trivial and fall well within the range of characters exhibited by other *Cincta* species. *Cinctopsis* is therefore regarded as a synonym.] *Lower Jurassic (Hettangian)–Middle Jurassic (lower Bajocian):* Europe (?cosmopolitan).——Fig. 1439, *3a–c. *C. numismalis* (Valenciennes), Pliensbachian, France; dorsal, lateral, anterior views, ×1.3 (Muir-Wood, 1965b).——Fig. 1439,*3d. C. pernumismalis* Buckman, England; internal mold showing dorsal adductor scars and vascular trunks, ×1 (Muir-Wood, 1965b).

Digonella Muir-Wood, 1934, p. 550 [**Terebratula digona* J. Sowerby, 1815 in 1812–1815, p. 217; OD]. Elongate to sac shaped in outline, greatest width anteriorly with development of angular carinae, concavocarinate posteriorly, becoming biconvex, umbo flattened, suberect with short beak ridges, foramen mesothyrid or permesothyrid, telate; pedicle collar with septum, dental plates slender, subparallel; hinge plates demarcated from inner socket ridges, slightly concave ventrally, septalium open V-shape, becoming almost flat with median groove anteriorly, median septum bladelike, slightly more than 0.5 valve length, loop with numerous long spines, transverse band with posteriorly projecting carinae; dorsal adductor scars linear, adjacent to septum. *Middle Jurassic (Bathonian):* England, France.——Fig. 1441,*5a–ll. *D. digona* (J. Sowerby), Great Oolite Series, southern England; *a–c,* dorsal, lateral, anterior views, ×2; *d,* dorsal valve interior mold showing adductor scars, ×1 (Muir-Wood, 1965b); *e,* dorsal valve interior, reconstruction, ×1.5 (Muir-Wood, 1934); *f–ll,* serial transverse sections, 1.0, 1.2, 1.3, 1.4, 1.6, 1.9. 2.9, 3.3, 3.7, 3.8, 3.9, 4.0, 4.2, 4.3, 4.5, 4.6, 4.7, 4.8, 5.0, 5.1, 5.3, 5.4, 5.5, 6.1, 6.3, 6.5, 6.7, 6.8, 6.9, 7.3, 7.5, 7.7, 7.9 mm from umbo, ×1.25 (adapted from Muir-Wood, 1934).

Eoantiptychia Xu & Liu, 1983b, p. 97 [**Antiptychia pentagona* Yang & Yin in Yang & others, 1962, p. 122; OD]. Small, pentagonal in outline, unequally biconvex, anterior commissure unisulcate initially, becoming biplicate, umbo erect or slightly incurved, palintropes small, foramen mesothyrid; pedicle collar present; inner socket ridges well developed, hinge plates narrow, crural processes high, crural plates convex distally, giving septalium open V-shape posteriorly, becoming deep, truncated V-shape anteriorly, median septum broadly triangular in cross section, approximately 0.3 valve length, loop descending branches slender, ascending elements unknown. *Middle Triassic:* China (Qinghai Province, Junzihe Formation).——Fig. 1442,*1a–e. *E. pentagona* (Yang & Yin), South Dajialian Member, southern Qilian Mountains; dorsal, lateral, anterior, ventral, posterior views, ×1 (Xu & Liu, 1983b).

Fimbriothyris Eudes-Deslongchamps, 1884, p. 273 [**Terebratula guerangeri* Deslongchamps, 1856a, p. 304; OD]. Subpentagonal in outline and laterally compressed, equally biconvex, without median fold or sulcus, umbo suberect, with long, subangular beak ridges delimiting narrow palintropes, foramen permesothyrid, telate, symphytium narrow, anterior half of shell costate medianly, costae simple, subparallel, rare on lateral slopes; dental plates long, slender, subparallel; inner socket ridges and hinge plates convex ventrally, septalium deep posteriorly, becoming broad, shallow, U-shaped, septalial plates incompletely fused, leaving small cavity below septalium, median septum bladelike, becoming acutely triangular in cross section anteriorly, extending only about 0.3 of valve length. *Lower Jurassic (upper Pliensbachian):* Europe, ?Morocco.——Fig. 1441,*1a–d. *F. guerangeri* (Deslongchamps), Sarthe, France; dorsal, lateral, anterior, ventral views, ×1 (Muir-Wood, 1965b).

Irenothyris Pojariskaja, 1966, p. 27 [**Zeilleria guldaraensis* Moisseev, 1944, p. 60; OD]. Medium size, subpentagonal, subtrigonal or rounded in outline, globose, becoming anteriorly lobate or metacarinate, anterior commissure rectimarginate, umbo acute, strongly incurved, beak ridges rounded, foramen mesothyrid to epithyrid; pedicle collar present, hinge teeth short, thick, with weakly developed denticulum; dental plates slender; outer hinge plates ventrally concave in juveniles, forming troughlike structure but in adults almost planar due to secondary thickening combined with ventrally convex crural plates to form T-shaped septalium unsupported anteriorly as in *Rugitela,* median septum thin, high, extending about 0.5 valve length, loop long, ascending elements relatively wide, dorsal adductor scars elongate, pyriform, close to septum; mantle canals parallel. *Upper Jurassic:* Russia, western Europe.——Fig. 1440,*3a–c. *I. guldaraensis* (Moisseev), Gusapski region, River Guldara, Russia; *a–b,* dorsal, lateral views, ×1 (Moisseev, 1944); *c,* dorsal valve interior, reconstruction, ×1.5 (Pojariskaja, 1966).

Keratothyris Tuluweit, 1965, p. 76 [**Terebratula cor* Lamarck, 1819, p. 249; OD] [=*Spinulothyris* Antostschenko, 1973, p. 112 (type, *S. patilensis* Antostschenko, 1973, p. 113, OD)]. Small, subpentagonal to incipiently bilobate in outline, biconvex to slightly globose, anterior commissure paraplicate to rectimarginate or weakly unisulcate, lobate, umbo broad, erect to incurved, with clearly delimited palintropes, foramen mesothyrid, commonly telate; inner socket ridges dorsally deflected, septalium open V-shaped, becoming U-shaped anteriorly, median septum moderately high, lateral umbonal cavities with thick apical callus, connection between anterior of loop and septal pillar early in ontogeny. [External and internal similarity of *Spinulothyris* to *Keratothyris,* together with coincident distribution and loss of all comparative material of *Spinulothyris,* renders *Spinulothyris* inseparable from *Keratothyris*.] *Lower Jurassic (Sinemurian–Toarcian):* France, Switzerland, *Sinemurian;* Crimea, Caucasus, Yugoslav Carpatho-Balkan arch, western Europe, *Pliensbachian;* Germany, France, *Toarcian.*——Fig. 1441,*4a–c. *K. cor* (Lamarck), Pliensbachian, Echte, northwestern Germany; dorsal, lateral, anterior views, ×1 (Tuluweit, 1965).

Kolymithyris Dagys, 1965, p. 148 [**Zeilleria kolymensis* Moisseev, 1937, p. 3; OD]. Medium size, oval in outline, umbo short, incurved, pedicle foramen minute, mesothyrid; pedicle collar absent, dental plates angled, slightly ventrally divergent, enveloped in thick umbonal callus; cardinal process massive callus structure, undivided, projecting into delthyrial cavity, anteriorly fused with inner socket ridges, outer hinge plates, and crural plates, internal structures much obscured by umbonal callus but in section, inner socket ridges deflected ventrally, septalium V-shaped, median septum low, triangular, extending about 0.25 valve length, loop long, without spines, transverse band with laterally projecting carinae. *Upper Triassic (Carnian–Norian):* northeastern Siberia; ?New Zealand, *Norian.*——Fig. 1443,*1a–bb. *K. kolymensis* (Moisseev), Norian, Kolyma River Basin, northeastern Siberia; *a–c,* dorsal, anterior, ventral views, ×1 (Dagys, 1965); *d–bb,* serial transverse sections, 0.2, 0.7, 1.0, 1.3, 1.7, 2.0, 2.3, 2.6, 2.8, 3.0, 3.2, 3.4, 3.6, 3.8, 4.1, 4.8, 5.3, 6.1, 7.0, 7.8, 9.0, 9.4, 10.3, 12.2, 17.0 mm from umbo, ×1.25 (adapted from Dagys, 1965).

Kuntella Ovtsharenko, 1991, p. 112 [**K. kuntensis;* OD]. Small to medium size, subpentagonal to elongate pentagonal in outline, anterior commissure rectimarginate to incipiently uniplicate, umbo small, suberect with short, rounded-angular beak ridges, pedicle foramen small, apparently round, apparently permesothyrid; pedicle collar not observed, dental plates very short, subparallel to slightly ventrally convergent; inner socket ridges deflected dorsally, outer hinge plates flat, septalium open U-shape initially, becoming flat anteriorly, wholly supported by median septum except for narrow, anterior cardinal shelf, median septum thin, moderately high, extending more than 0.5 valve length, loop about 0.75 valve length, transverse band moderately broad with posterior projections. *Middle Jurassic–Upper Jurassic:* Pamir.——Fig. 1443,*3a–c. *K. kuntensis,* Middle Jurassic; dorsal, lateral, and anterior views, ×1.5 (Ovtsharenko, 1991).

Lazella Radulović, 1991, p. 29 [**L. nana* Radulović, 1991, p. 30; OD]. Small, oval, anterior commissure rectimarginate to incipiently uniplicate, umbo relatively long, erect, beak ridges clearly delimiting palintropes, pedicle foramen round, mesothyrid, deltidial plates disjunct, incurved; poorly developed pedicle collar occasionally present, hinge teeth massive, dental plates slender, inner socket ridges slightly deflected dorsally, outer hinge plates demarcated from inner socket ridges, septalium very shallow, broadly U-shaped, median septum triangular in cross section, extending about 0.5 valve length, excavated, as in *Plesiothyris,* to leave narrow, cardinal shelf. *Middle Jurassic (upper Bajocian–Bathonian):* Yugoslav Carpatho-Balkan arch.——Fig. 1441,*3a–u. *L. nana,* upper Bajocian, Laz, Yugoslavia; *a–d,* dorsal, lateral, anterior, ventral views, ×1; *e,* dorsal valve interior, reconstruction, ×5 (Radulović, 1991); *f–u,* serial transverse sections, 0.3, 1.3, 1.7, 2.0, 2.3, 2.6, 2.7, 2.9, 3.4, 4.0, 4.5, 5.0, 6.4, 6.9, 8.2, 9.6 mm from umbo, ×2 (adapted from Radulović, 1991).

Mycerosia Cooper, 1989, p. 117 [**M. amygdaliformis;* OD]. Small, pentagonal in outline, maximum width in posterior third, ventribiconvex, anterior commissure rectimarginate with slight tendency to uniplication, umbo small, erect, with rounded-angular beak ridges, foramen medium size, mesothyrid, slightly telate; short pedicle collar, dental plates short; septalium flattish, with or without low median elevation, median septum thin, high, bladelike, slightly less than 0.5 valve length, crural bases given off possibly dorsally, loop extending for about four fifths of valve length, descending and ascending branches spinose, transverse band narrow laterally, wide ventrodorsally with short projections extending dorsally from junction with ascending lamellae. *Middle Jurassic (?Bathonian, Callovian)–Upper Jurassic (Kimmeridgian):* ?Egypt, *?Bathonian;* Saudi Arabia, *Callovian.*——Fig. 1444,*1a–d. *M. amygdaliformis,* Kimmeridgian, Hanifa Formation, Jebel Tuwaiq, Saudi Arabia; *a–c,* dorsal, lateral, anterior views, ×3; *d,* dorsal valve interior, showing spinose loop, ×2 (Cooper, 1989).

Obovothyris Buckman, 1927, p. 32 [**O. magnobovata;* OD]. Subpentagonal in outline with angular, anterolateral carinae, sulcocarinate posteriorly, becoming biconvex, umbo suberect to incurved, with short, subangular beak ridges, pedicle foramen permesothyrid; pedicle collar with stout septum; septalium very shallow, flatly undulating, median septum bladelike, slightly more than 0.5 valve length; dorsal adductor scars elongate-oval, tapering posteriorly. *Middle Jurassic (Bathonian):* England, France.——Fig. 1445,*1a–e. *O. magnobovata,* Lower Cornbrash, England; *a–c,* dorsal, lateral, anterior views; *d,* interior mold showing dorsal adductor scars, ×1.3 (Muir-Wood, 1965b); *e,* dorsal valve interior, reconstruction, ×1 (Muir-Wood, 1934).

Parathyridina Schuchert & LeVene, 1929b, p. 121, *nom. nov. pro Parathyris* Douvillé, 1916, p. 35, *non* Hübner, 1816 [**Parathyris plicatoides* Douvillé, 1916, p. 36; OD]. Small to medium size, shell equally biconvex to globose without prominent fold or sulcus, anterior commissure uniplicate with superimposed, alternating costation, costae few, broad, near anterior margin only; umbo short, suberect, with obscure beak ridges, foramen possibly permesothyrid, symphytium narrow, median septum prominent, clearly visible on partially worn shells, other internal characters unknown. [The presence of a strong median septum is regarded as strong evidence that *Parathyridina* is a zeilleriid resembling the Liassic *Fimbriothyris.*] *Middle Jurassic (Bajocian):* Egypt, Sinai Peninsula.——Fig. 1443,*2a–b. *P. plicatoides* (Douvillé), Egypt; dorsal, anterior views, ×1 (Muir-Wood, 1965a).

Periallus Hoover, 1979, p. 17 [**P. woodsidensis;* OD]. Small, pyriform in outline, unequally biconvex, anterior commissure rectimarginate to uniplicate or paraplicate, umbo broad, suberect with prominent beak ridges, pedicle foramen large, mesothyrid, deltidial plates disjunct; pedicle collar clearly devel-

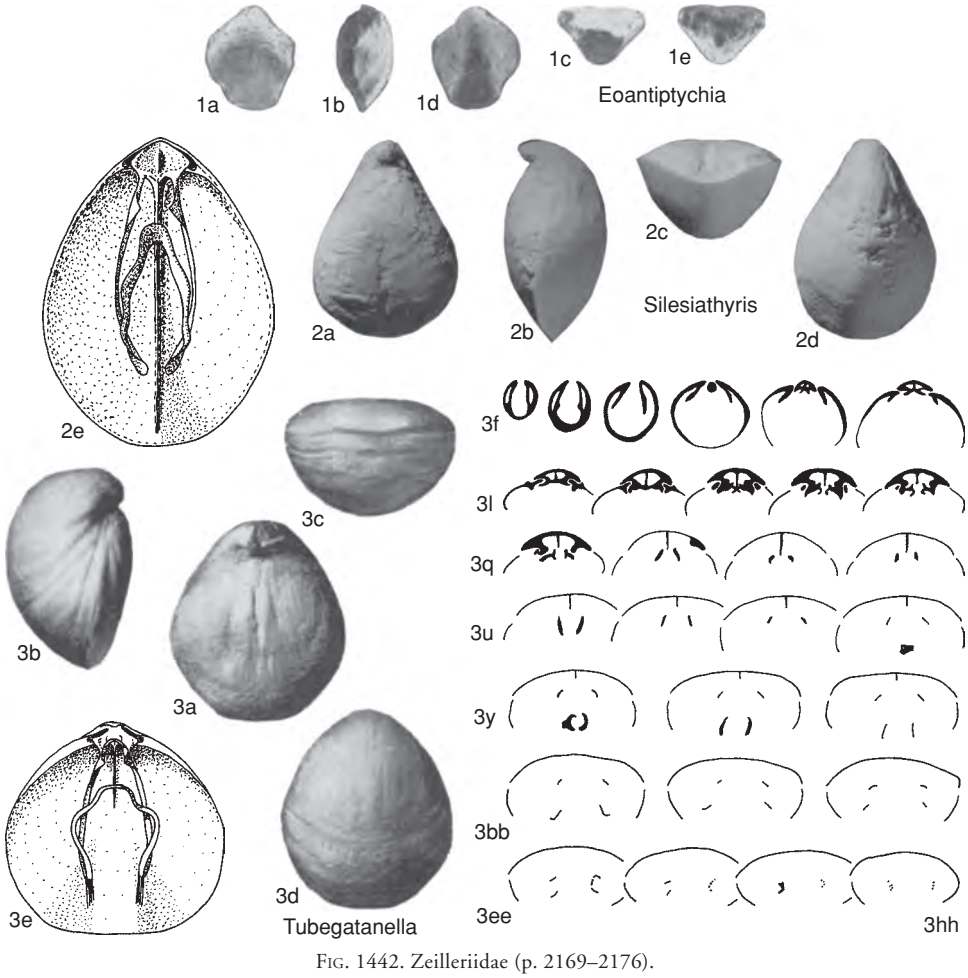

FIG. 1442. Zeilleriidae (p. 2169–2176).

oped, dental plates subparallel, hinge teeth well developed, ventral muscle scars elongate-triangular; hinge plates narrow, flat, arising at about midheight of inner socket ridges, crural bases possibly given off mesially in some specimens, crural plates variably disposed from vertical, joining valve floor, to dorsomesially directed, forming small acute septalium, median septum bladelike, approximately 0.5 valve length, loop moderate, commonly 0.6 valve length, dorsal surface of descending branches, profusely spinose, no trace of septal pillar involvement in loop development in specimens only 2.00 mm long. *Lower Triassic (Induan–Olenekian):* USA (southeastern Idaho).——FIG. 1443,*6a–g.* **P. woodsidensis,* Woodside Formation, Bear Lake; *a–c,* dorsal, lateral, anterior views, ×3; *d,* fragment of articulated valves showing pedicle collar, strong dental plates, and median septum, ×8; *e,* dorsal valve, anteroventral view showing individual in which septalial plates do not contact median septum; *f,* dorsal valve interior showing form of septalium developed; *g,* dorsal valve interior showing spinose descending branch of loop and portion of ascending branch, ×6 (Hoover, 1979).

Pirotella SUČIĆ-PROTIĆ, 1985, p. 22 [**P. petkovici;* OD]. Large, elongate oval to subpentagonal in outline, anterior commissure commonly undulating, umbo slightly incurved, with short, rounded, angular beak ridges, pedicle foramen round, small to moderate, permesothyrid; dental plates slightly inwardly concave, slightly ventrally divergent; median septum triangular in cross section, extending about 0.3 valve length, loop transverse band narrow to moderate. *Lower Jurassic (upper Pliensbachian):* Yugoslav Carpatho-Balkanids.——FIG. 1445,*2a–e.* **P. petkovici,* Stara Planina, Senokos, Serbia; *a–d,* dorsal, lateral, anterior, ventral views, ×1; *e,* dorsal valve interior, reconstruction, ×1.2 (Sučić-Protić, 1985).

Plesiothyris DOUVILLÉ, 1879, p. 275 [**Terebratula (Waldheimia) verneuili* EUDES-DESLONGCHAMPS, 1864, p. 268; OD] [=*Rhomboidella* SUČIĆ-PROTIĆ,

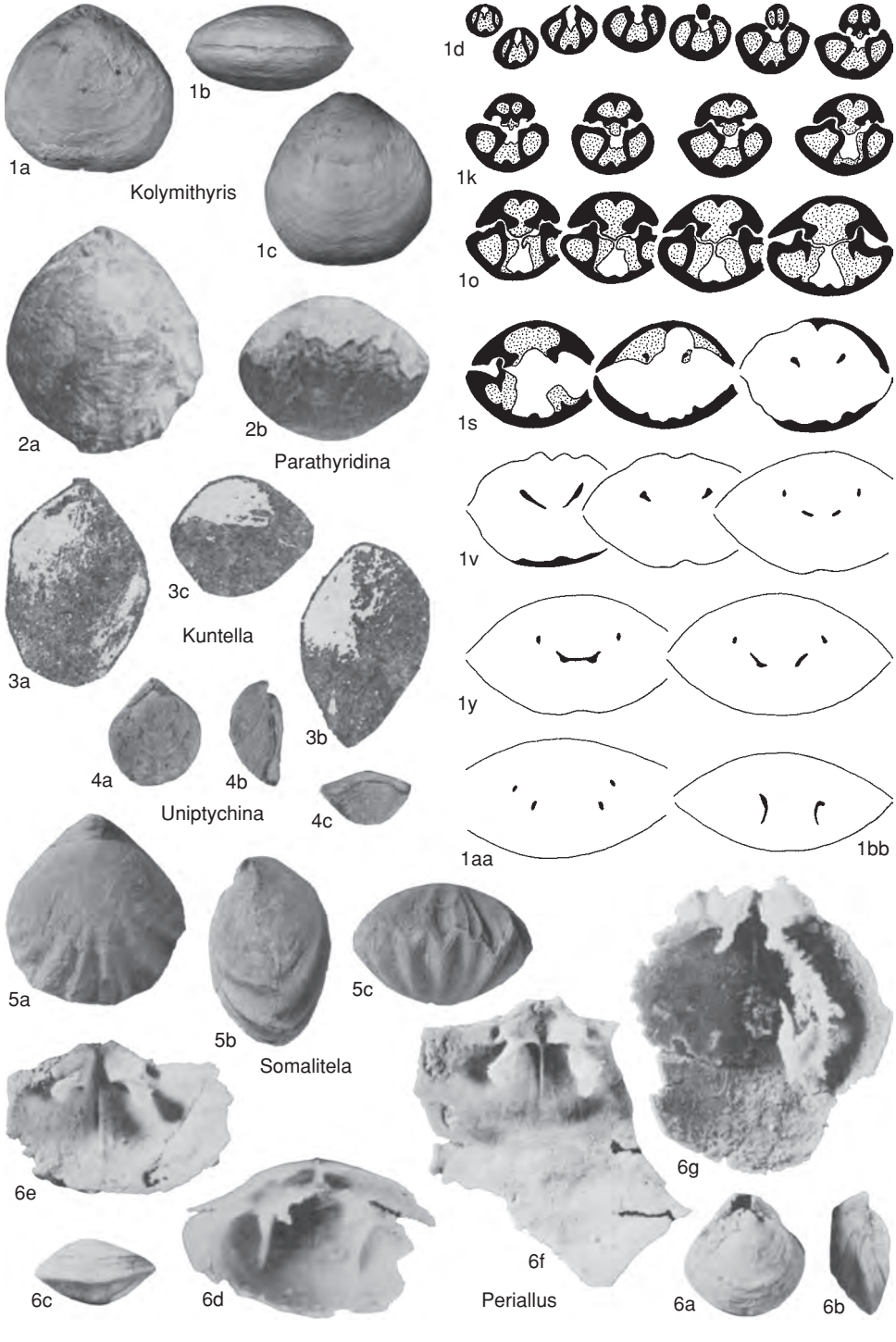

Fig. 1443. Zeilleriidae (p. 2170–2176).

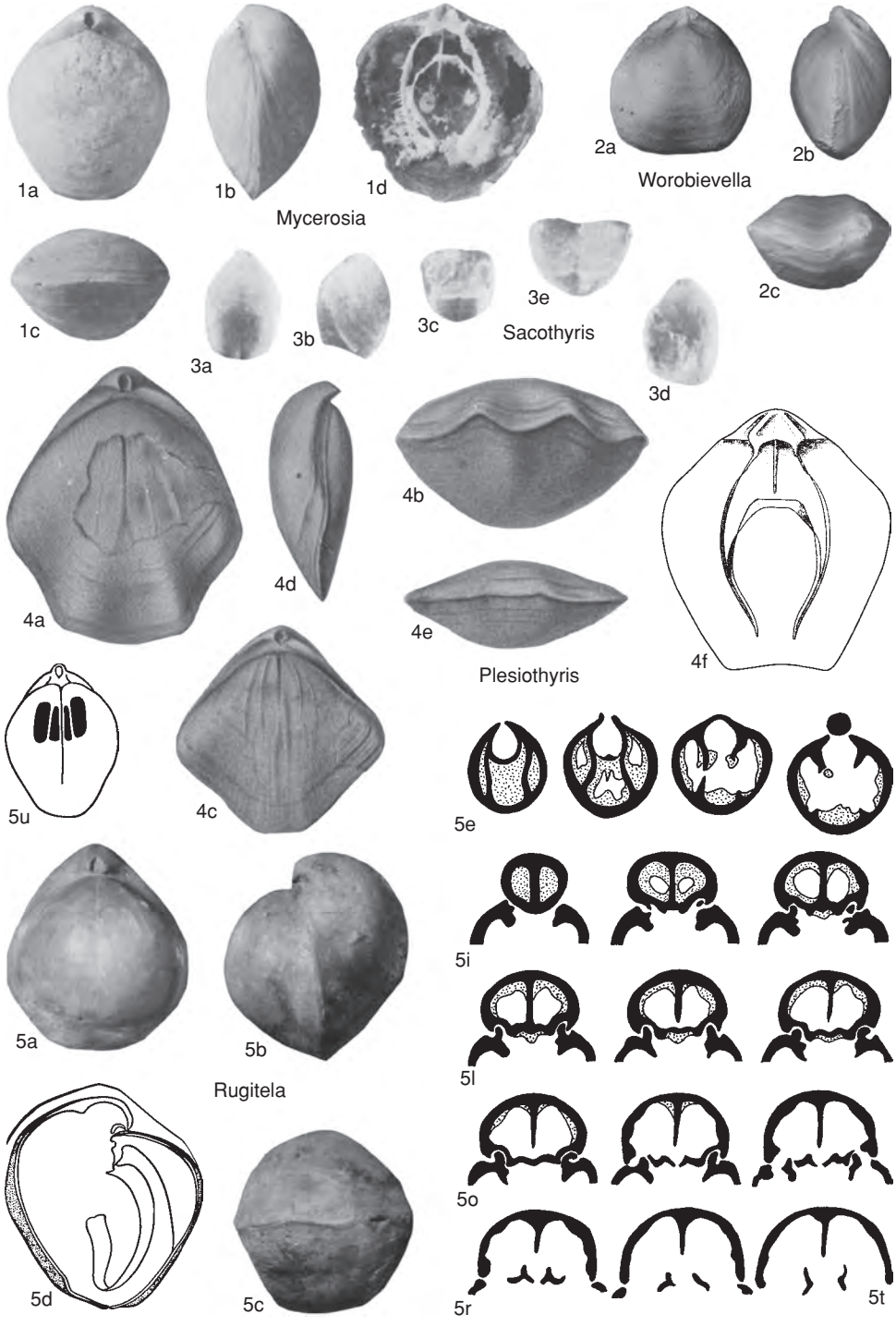

FIG. 1444. Zeilleriidae (p. 2170–2176).

1985, p. 30 (type, *R. rhombica,* OD)]. Medium size, pentagonal in outline, moderately biconvex, anteriorly bilobate or quadrilobate, anterior commissure rectimarginate or sulciplicate, umbo suberect to incurved, beak ridges long, sharply demarcating palintropes, pedicle foramen commonly telate, permesothyrid, symphytium short; dental plates long, subparallel; hinge plates flat in section, septalium V-shaped, becoming broad, open, U-shape anteriorly, median septum acutely triangular in cross section, extending about 0.3 valve length, excavated beneath anterior of septalium to leave narrow cardinal shelf, loop almost reaching anterior; dorsal adductor scars linear, apparently similar to *Digonella.* [Distinction of *Rhomboidella* is based on only four specimens; its small size and close approximation to the morphology of a juvenile *Plesiothyris,* together with the form of the median septum and similarity of the septalium to the early-formed septalium and immature loop of *Plesiothyris* is considered to render *Rhomboidella* synonymous.] *Lower Jurassic:* Spain, France, Yugoslavia.——Fig. 1444,*4a–e. *P. verneuili* (Eudes-Deslongchamps), upper Pliensbachian; *a,* dorsal view, Spain; *b,* anterior view, adult specimen, Spain; *c–d,* dorsal, lateral view, Spain; *e,* anterior view, immature specimen, Spain, ×1 (Muir-Wood, 1965b).——Fig. 1444,*4f. P. beli* Sučić-Protić, Senokos, Serbia; dorsal valve interior, reconstruction, ×1.5 (Sučić-Protić, 1985).

Rugitela Muir-Wood, 1936, p. 121 [**Terebratula bullata* J. de. C. Sowerby, 1823 in 1823–1825, p. 49; OD] [=*Russiella* Makridin, 1964, p. 288 (type, *Terebratula royeriana* d'Orbigny, 1845a, p. 484)]. Medium size, elongate-oval to bilobate in outline, sulcocarinate in early stages, becoming biconvex, commonly globose, anterior commissure rectimarginate, lobate, umbo suberect to incurved, with short, subangular beak ridges, pedicle foramen mesothyrid or permesothyrid, telate, shell surface with concentric rugae; pedicle collar rarely observed, dental plates angled, thickened by callus; septalium replaced by callus ridge anteriorly, inner socket ridges, hinge plates, and median callosity forming W-shaped structure, median septum long, high, bladelike or acutely triangular in cross section, extending 0.7 valve length, supporting posterior half of crural plates only, structures thickened by umbonal callus, loop possibly without spines; dorsal adductor scars elongate-oval. [The characters cited for distinction of *Russiella* are trivial and fall well within the range of characters exhibited by other *Rugitela* species. Separation based essentially on the form of the median septum is not acceptable. *Russiella* is therefore regarded as a synonym.] *Lower Jurassic (Toarcian)–Middle Jurassic (Bathonian), Lower Cretaceous (?Berriasian–?Hauterivian):* England, France; Saudi Ababia, *Toarcian.*——Fig. 1444,*5a–t. *R. bullata* (J. de C. Sowerby), Bathonian, Fullers Earth Rock, Frome, southern England; *a–c,* dorsal, lateral, anterior views; *d,* longitudinal section showing loop, ×1.3 (Muir-Wood, 1965b); *e–t,* serial transverse sections, 0.4, 2.5, 2.7, 2.9, 3.9, 4.2, 4.3, 4.5, 4.9, 5.1, 5.2, 5.3, 5.6, 5.8, 6.1, 6.5 mm from umbo, ×1.2 (adapted from Muir-Wood, 1936).——Fig. 1444,*5u. R. cadomensis* (Eudes-Deslongchamps), Fullers Earth Rock, Bath, southern England; dorsal valve interior mold, showing median septum and adductor muscle scars, ×0.7 (Muir-Wood, 1965b).

Sacothyris Ching, Sun, & Ye, 1979, p. 214 [**Aulacothyropsis sinosa* Jin & Fang, 1977, p. 64; OD]. Rounded oblong in outline, ventribiconvex, sulcocarinate, broadening anteriorly, anterior commissure unisulcate or plicosulcate, umbo incurved, beak ridges rounded, pedicle foramen mesothyrid, symphytium present; pedicle collar present, dental plates slender; septalium moderately deep, median septum very long, extending almost to anterior margin, crural processes high, loop ascending branches vertical, platelike, transverse band thin or wide, arched belt. *Upper Triassic:* Tibet, China (Qinghai, Sichuan, Yunnan Provinces).——Fig. 1444,*3a–e. *S. sinosa* (Jin & Fang), Benzilan, Yunnan Province; dorsal, lateral, anterior, ventral, anterior views of plicosulcate specimen, ×1 (Ching, Sun, & Ye, 1979).

Securina Vörös, 1983, p. 23 [**Waldheimia securiformis* Gemmellaro, 1874, p. 66; OD]. Medium size, trigonal in outline, umbo strong, incurved, beak ridges angular in both valves, extended, reaching anterolateral extremities of shell, demarcating well-developed, concave planareas, pedicle foramen mesothyrid; inner socket ridges deflected dorsally, crura of falcifer type, septalium V-shaped, median septum slender, loop almost reaching anterior, descending branches straight, divergent, ascending branches wide, uniting with wide, arched transverse band, loop apparently without spines. *Lower Jurassic (Sinemurian–Pliensbachian):* Betic Cordilleras, Saharan Atlas, Sicily, Apennines, southern Alps, northern Limestone Alps, West Carpathians, Hungary, *Sinemurian.*——Fig. 1445,*3a–r. *S. securiformis* (Gemmellaro), Sinemurian, Bakony Mountains, Urkut, Hungary; *a–c,* dorsal, lateral, anterior views, ×2 (Vörös, 1983); *d,* dorsal valve interior, reconstruction, ×2.5; *e–r,* serial transverse sections, 1.8, 2.2, 2.6, 3.5, 4.3, 5.6, 6.1, 6.3, 6.9, 7.4, 9.0, 10.5, 12.0, 13.0 mm from umbo, ×1.5 (adapted from Vörös, 1983).

Silesiathyris Brügge, 1977, p. 664 [**Terebratulites angustus* von Schlotheim, 1820, p. 285; OD]. Small, pyriform to subpentagonal in outline, ventribiconvex or concavocarinate, dorsal valve with persistent sulcus, widening anteriorly, anterior commissure unisulcate, umbo long, erect, with short, rounded-angular beak ridges, pedicle foramen elongate-oval, moderate, epithyrid; dental plates slender, very short, inwardly concave, subparallel, concealed by callus in apical region; hinge plates flat, septalium wide, posterior concavity soon replaced by median ridge, giving open W-shape anteriorly, median septum rounded-triangular in cross section, extending almost to anterior, loop ascending branches wider, transverse band broad, acutely arched posteriorly, loop apparently without spines. *lower Middle Triassic:* Poland.——Fig. 1442,*2a–e.*

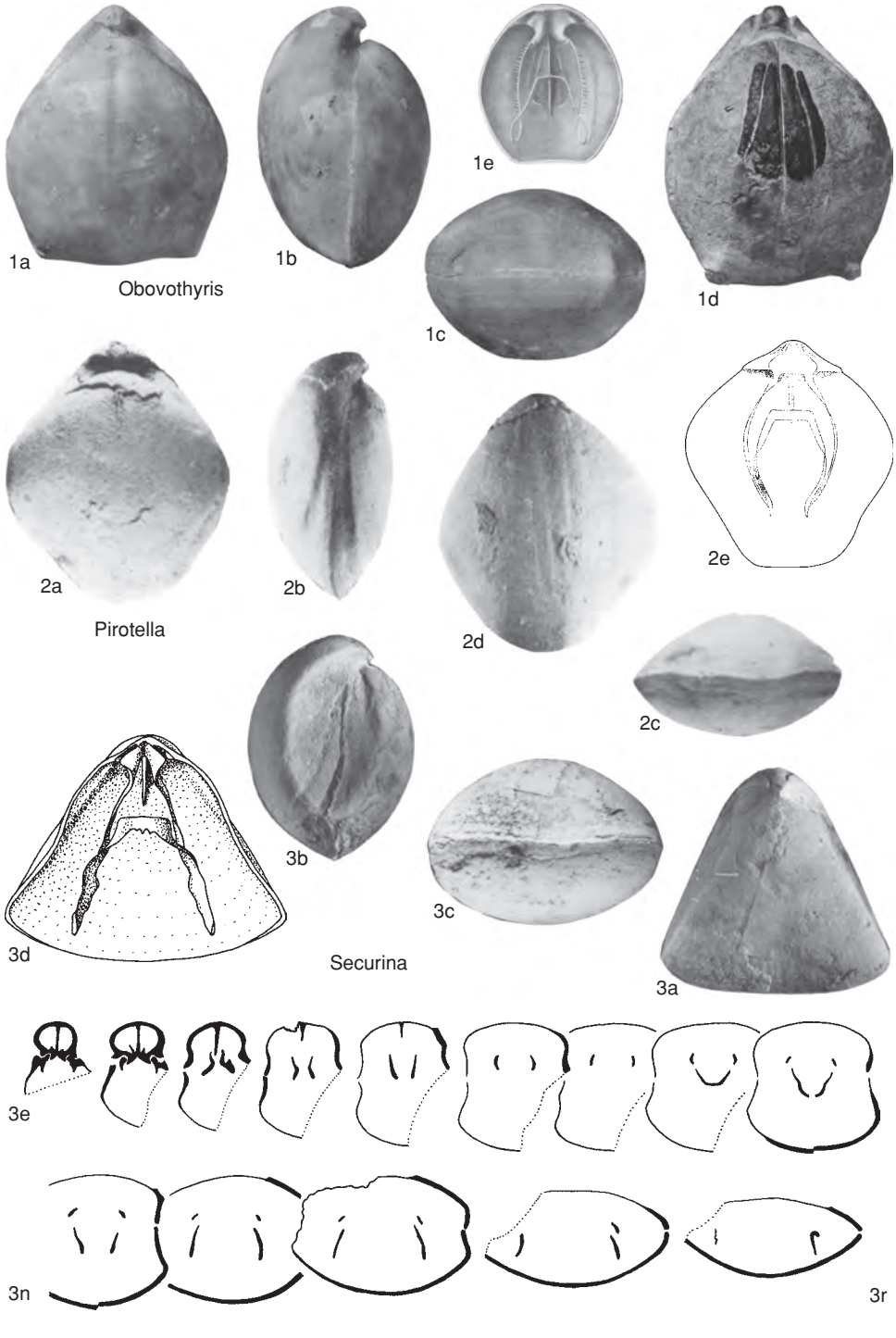

Fig. 1445. Zeilleriidae (p. 2170–2174).

**S. angusta* (von Schlotheim), Anisian, Tarnowiec, Gorny Slask; *a–d,* dorsal, lateral, anterior, ventral views, ×2.5 (Brügge, 1977); *e,* dorsal valve interior, reconstruction, ×4.25 (adapted from Brügge, 1977).

Somalitela Muir-Wood, 1935, p. 140 [**S. ambalensis;* OD]. Small, elongate-oval in outline, anterior commissure incipiently uniplicate, umbo flattened, suberect with short, rounded-angular beak ridges, pedicle foramen relatively large, permesothyrid, telate, anterior half of shell prominently costate; dental plates slightly inwardly concave, subparallel; inner hinge plates slighty concave ventrally, septalium shallow, replaced by median ridge for most of length and whole structure with flattened, W-shaped section, median septum acutely triangular in cross section, about 0.5 length of valve, supporting hinge plates posteriorly. *Upper Jurassic (?Kimmeridgian):* Somaliland.——Fig. 1443,*5a–c.* **S. ambalensis;* dorsal, lateral, anterior views, ×2 (Muir-Wood, 1965b).

Tubegatanella Prosorovskaja, 1968, p. 244 [**T. repmanae* Prosorovskaja, 1968, p. 245; OD]. Medium size, subpentagonal in outline, strongly ventribiconvex, anterior commissure usually rectimarginate, umbo massive, strongly incurved, with short, rounded-angular beak ridges, pedicle foramen very small, permesothyrid; dental plates slender; crural bases short, septalium flattening to become convex anteriorly, anterior edge of crural plates curved acutely in dorsoventral direction, median septum high, thin, approximately 0.3 valve length, loop spinose anteriorly. *Upper Jurassic (upper Oxfordian):* Tadzhikskaya.——Fig. 1442,*3a–hh.* **T. repmanae,* Gissar, Tian Shan; *a–d,* dorsal, lateral, anterior, ventral views, ×1 (Prosorovskaja, 1968); *e,* dorsal valve interior, reconstruction, ×1.2; *f–hh,* serial transverse sections, 0.6, 0.8, 1.0, 3.5, 3.9, 4.4, 4.8, 4.9, 5.0, 5.1, 5.3, 5.5, 5.8, 6.4, 6.8, 7.2, 7.8, 8.4, 9.5, 9.7, 10.3, 10.8, 11.8, 12.7, 14.0, 16.7, 17.4, 17.5, 17.8 mm from umbo, ×0.75 (adapted from Prosorovskaja, 1968).

Uniptychina Alméras & Elmi, 1998, p. 96 [**Waldheimia böhmi* Parona, 1895, p. 31; OD]. Small, subpentagonal, becoming rounded elongate with age, strongly ventribiconvex, anterior commissure essentially parasulcate with median fold flattened and sulci widely separated with complementary folds in ventral valve masked by convexity of valve, umbo small, suberect, beak ridges sharp, demarcating well-developed symphytium, foramen small, circular, mesothyrid; median septum extending approximately 0.5 valve length, other internal characters unknown. *Middle Jurassic (lower Bathonian):* France, England, Italy.——Fig. 1443,*4a–c.* **U. boehmi* (Parona), Montchaud à Saint Brés, France; dorsal, lateral, anterior views, ×1 (Alméras & Elmi, 1998).

Worobievella Dagys, 1959a, p. 33 [**W. caucasica;* OD] [=*Woroboviella* Muir-Wood, 1965b, p. 828, *nom. null.*]. Small, elongate-oval in outline, with shallow, dorsal median sulcus, anterior commissure weakly unisulcate, umbo small, incurved, pedicle foramen minute, mesothyrid; dental plates slender, inwardly concave, slightly ventrally divergent; inner socket ridges and hinge plates dorsally inclined, septalium rounded V-shaped, median septum thin, about 0.3 valve length, loop smooth, with broad, ascending branches, transverse band convex, only slightly posterior. *Upper Triassic (Norian):* northwestern Caucasus.——Fig. 1444,*2a–c.* **W. caucasica;* dorsal, lateral, anterior views, ×1.5 (Dagys, 1959a).

Subfamily VECTELLINAE new subfamily

[Vectellinae Baker, herein]
[type genus, *Vectella* Owen, 1965, p. 51]

Small to medium size, rarely medium size to large, biconvex, or exceptionally ventribiconvex, dorsiconvex or planoconvex, anterior commissure commonly folded, umbo commonly suberect, beak ridges typically short, exceptionally extended, deltidial plates exceptionally disjunct, pedicle foramen typically round, mesothyrid; dental plates normally slender, rarely long; cardinal process commonly represented by callus lobe, inner socket ridges commonly deflected ventrally or exceptionally dorsally, crural bases given off ventrally, septalium rarely flat or U-shaped, occasionally deep or exceptionally very deep, median septum commonly triangular, less commonly acutely triangular, or long, transverse band of loop exceptionally located anteriorly. *Middle Triassic–Lower Cretaceous (Albian).*

Vectella Owen, 1965, p. 51 [**Waldheimia celtica* Morris, 1854, p. 158; OD]. Elongate-oval in outline, sulcocarinate to biconvex, anterior commissure rectimarginate to uniplicate or unisulcate, umbo moderate, suberect; dental plates short, ventrally convergent, embedded in callus; cardinal process represented by apical callus, crural bases triangular, septalium deep, V-shaped, median septum thick, acutely triangular in cross section. *Lower Cretaceous (upper Aptian):* southern England.——Fig. 1446,*1a–p.* **V. celtica* (Morris), Shanklin, Isle of Wight; *a–c,* dorsal, lateral, anterior views, ×1 (Owen, 1965); *d–p,* serial transverse sections. 0.8, 1.4, 1.6, 1.9, 2.4, 2.7, 3.2, 3.5, 3.7, 4.0, 4.2, 4.9, 5.2 mm from umbo, ×1 (adapted from Owen, 1965).

Advenina Sandy, 1986a, p. 187 [**A. oweni;* OD]. Small, oval, subpentagonal or subtriangular in outline, anterior commissure rectimarginate to uniplicate, occasionally multiplicate, umbo erect, beak ridges well defined, foramen medium size; septalium V-shaped posteriorly, becoming open U-shaped to subhorizontal anteriorly, crura stout, extending rapidly into high crural processes, median septum high, bladelike, extending 0.5 or more of

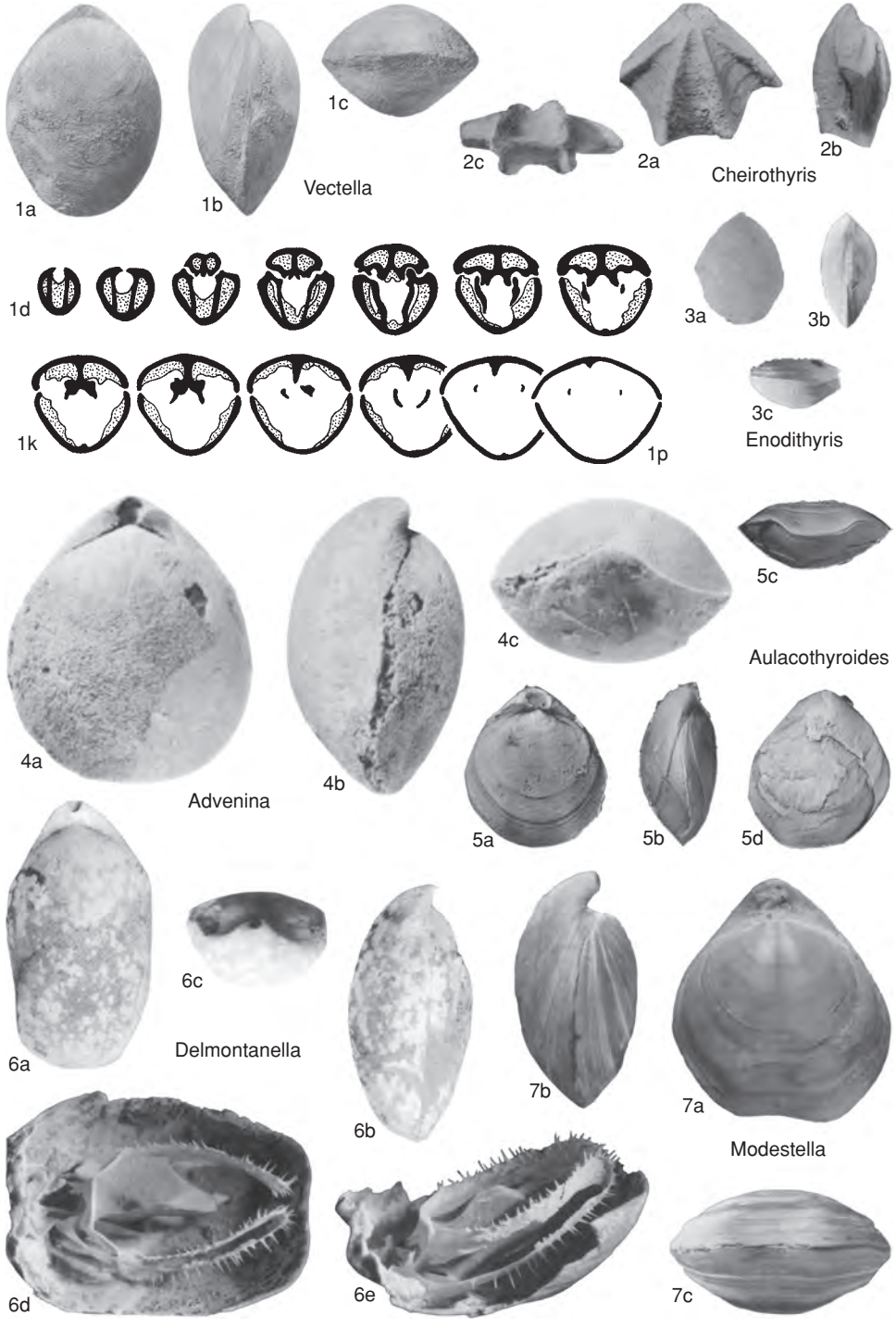

FIG. 1446. Zeilleriidae (p. 2176–2180).

valve length. *Lower Cretaceous (?Berriasian, Valanginian–Aptian):* France, Switzerland, Sardinia, *?Berriasian, Valanginian;* Crimea, Caucasus, Georgia, Kazakhstan, *Valanginian–Aptian.*——Fig. 1446,*4a–c.* **A. oweni,* lower Valanginian, Alpes de Haute Provence, France; holotype, dorsal, lateral, anterior views, BMNH BB86852, ×3 (Sandy, 1986a).

Aulacothyroides Dagys, 1965, p. 155 [**A. bulkutensis;* OD]. Small, suboval in outline, ventribiconvex, anterior commissure unisulcate to plicosulcate, umbo moderate size, short, erect, beak ridges rounded, foramen large, round, permesothyrid; pedicle collar present, dental plates short, straight, ventrally divergent; low cardinal process probably represented by apical callus development, outer hinge plates not demarcated from inner socket ridges, septalium shallow, open, V-shaped trough filled with callus medially, minor development of apical umbonal callus, median septum low, bladelike, extending about 0.6 valve length, enveloped for much of its length by extension of crural plates, loop long, descending and ascending branches spinose anteriorly. *Upper Triassic (Carnian–Norian):* Svalbard, northern Siberia, Sikhote-Alin.——Fig. 1446,*5a–d.* **A. bulkutensis,* Carnian, Rossokh River Basin, Bulkut River, northern Siberia; dorsal, lateral, anterior, ventral views, ×1.5 (Dagys, 1974).

Carpatothyris Smirnova, 1975a, p. 135 [**Terebratella repanda* Zeuschner, 1857, p. 48–49; OD]. Large, pyriform in outline, ventribiconvex, anterior commissure strongly unisulcate, both valves flattened medianly, umbo elongate, suberect with long, angular beak ridges extending to posterolateral margin, symphytium high; dental plates long, subparallel, lateral umbonal cavities small; crural plates subhorizontal, septalium poorly developed, rudimentary, median septum united with hinge plates in umbonal region only, acutely triangular in cross section, extending about 0.8 valve length, loop long, almost reaching anterior margin, with wide, ascending lamellae and broad, transverse band. *Upper Jurassic (Tithonian):* Poland (Carpathians), Czech Republic.——Fig. 1447,*3a–c.* **C. repanda* (Zeuschner), upper Tithonian, Carpathians, Poland; dorsal, lateral, ventral views, ×1 (Smirnova, 1975a).

Cheirothyris Rollier, 1919, p. 338 [**Terebratula fleuriausa* d'Orbigny, 1850 in 1849–1852, p. 25; OD] [=*Neotrigonella* Cossmann, 1910 in 1895–1921, p. 74, obj., *nom. nov. pro Trigonella* Quenstedt, 1868 in 1868–1871, p. 25, obj., *non* da Costa, 1778, *nec* Conrad, 1837, *nec* Hehl, 1842]. Pentangular in outline with four prominent carinae, flatly biconvex, anterior commissure rectimarginate, umbo suberect, broad with long beak ridges extending to lateral margin, pedicle foramen large, incomplete, deltidial plates disjunct; dental plates relatively thick, subparallel to slightly ventrally divergent; inner socket ridges convex ventrally, septalium broad, with posterior median ridge giving low W-shape, median septum triangular in cross section, extending about 0.5 valve length, loop with low-arched, transverse band. [Homeomorph with short loop, no septum or dental plates, as well as two terebratelloid homeomorphs (*Ismenia* and *Trigonellina*) exist in Upper Jurassic.] *Upper Jurassic (middle Kimmeridgian–upper Kimmeridgian):* France, Switzerland, Germany.——Fig. 1446,*2a–c.* **C. fleuriausa* (d'Orbigny), Germany; dorsal, lateral, anterior views, ×2 (Muir-Wood, 1965b).

Delmontanella Sulser, 1995, p. 725, *nom. transl.* Baker, herein, *ex Ornithella (Delmontanella)* Sulser, 1995, p. 725 [**Terebratula (Waldheimia) delmontana* Oppel, 1857, p. 607; OD]. Large, elongate oval or elongate pentagonal in outline, anterior commissure rectimarginate, commonly carinate, umbo small to moderate, suberect, palintropes slightly flattened, foramen permesothyrid; dental lamellae robust; septalium initially shallowly concave, later flattened, retaining residual concavity with some undulation anteriorly with unsupported, anterior shelf, median septum acutely triangular, extending slightly more than 0.5 valve length, loop descending and ascending branches spinose, ascending elements relatively wide, transverse band saddle shaped with paired, posterior projections; connection between anterior of loop and median septum in ontogeny. [The similarity between *Delmontanella* and *Ornithella* as indicated by external morphology is not confirmed internally. Important differences in the dental lamellae, septalium, and brachidium lead to the conclusion that *Delmontanella* should be regarded as a separate genus.] *Upper Jurassic (lower Oxfordian–middle Oxfordian):* Switzerland (northwestern Jura).——Fig. 1446,*6a–e.* **D. delmontana* (Oppel), lower middle Oxfordian, Liesberg Formation, Montfaucon; *a–c,* dorsal, lateral, posterior views, ×1; *d,* dorsal valve interior, prepared specimen; *e,* dorsal valve interior, tilted lateral view, prepared specimen, ×1.8 (Sulser, 1995).

Enodithyris Smirnova in Smirnova & Konovalov, 1986, p. 79 [**E. fluens;* OD]. Small, elongate-oval or elongate-rhomboidal in outline, anterior commissure rectimarginate to incipiently unisulcate, umbo suberect, with angular beak ridges; dental plates slightly ventrally divergent; septalium V-shaped posteriorly, acutely V-shaped anteriorly, crural bases short, inclined, crural processes widely diverging, median septum acutely triangular to triangular in cross section, extending about 0.3 valve length, loop spinose. *Lower Cretaceous:* Russia (Far East).——Fig. 1446,*3a–c.* **E. fluens;* holotype, ventral, lateral, anterior views, MGU 245/230, ×1 (Smirnova, 1990a).

Epicyrta Eudes-Deslongchamps, 1884, p. 275 [**Terebratula eugenii* von Buch in Davidson, 1850a, p. 72; OD]. Medium size, elongate-subpentagonal in outline, dorsiconvex, ventral valve depressed-convex with deep, median sulcus, anterior commissure dorsally arched, umbo suberect, flattened, beak ridges persistent in both valves, ventral beak ridges delimiting flattened

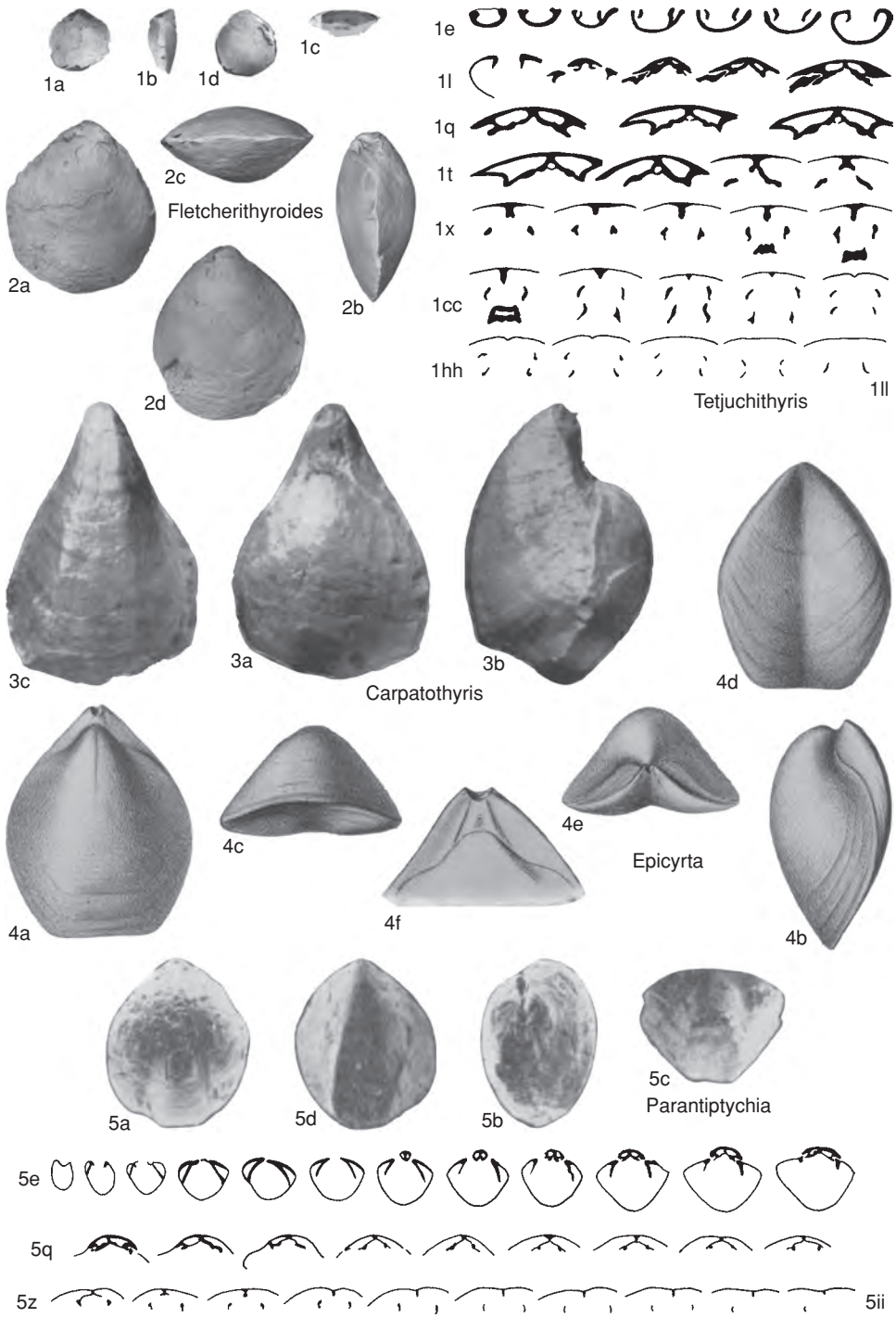

FIG. 1447. Zeilleriidae (p. 2178–2183).

palintropes, extending almost to anterolateral margin, dorsal beak ridges more rounded, pedicle foramen apical, telate, shell with rarely preserved, fine capillation; dental plates subparallel, becoming ventrally convergent; inner socket ridges ventrally deflected at high angle, hinge plates keeled, septalium deep, angular, U-shaped, median septum bladelike, high posteriorly, low anteriorly, less than 0.5 valve length, loop spines not observed. *Lower Jurassic:* Europe.——Fig. 1447,*4a–f.* **E. eugenii* (von Buch), middle Lias, France; *a–e,* dorsal, lateral, anterior, ventral, posterior views, ×1; *f,* umbo enlarged, ×2 (Muir-Wood, 1965b).

Fletcherithyroides Dagys, 1977, p. 14 [**F. gregarius* Dagys, 1977, p. 15; OD]. Medium size, oval in outline, anterior commissure rectimarginate to incipiently uniplicate, umbo small, short, suberect, beak ridges rounded, foramen small; pedicle collar unsupported, dental plates straight, becoming slightly inwardly concave anteriorly, ventrally divergent; cardinal process low, undivided, possibly callus lobe, inner socket ridges deflected ventrally, demarcated from outer hinge plates, septalium moderately deep, broad V-shaped, median septum low, bladelike, extending about 0.4 valve length, loop long, spinose anteriorly. *Middle Triassic:* northeastern Siberia.——Fig. 1447,*2a–d.* **F. gregarius,* Ladinian; dorsal, lateral, anterior, ventral views, ×1 (Dagys, 1977).

Gemerithyris Siblík, 1977, p. 203 [**Waldheimia (Aulacothyris) supina* var. *hungarica* Balogh, 1940, p. 26; OD]. Medium size, subpentagonal to elongate-oblong in outline, ventribiconvex, ventral valve sometimes carinate, strongly convex with median sulcus, dorsal valve flatter, sulcate with median fold, anterior commissure plicosulcate, umbo relatively small, erect, with rounded beak ridges, pedicle collar present; outer hinge plates separated from crural plates by massive crural bases, septalium deep, V-shaped or broadly U-shaped with anterior median groove, median septum high, almost reaching anterior margin, loop with wider, ascending branches, transverse band convex ventrally, descending branches rarely with a few short spines. *?Middle Triassic, Upper Triassic:* Czech Republic, Slovakia, Austria, Romania.——Fig. 1448,*2a–d.* **G. hungarica hungarica* (Balogh), Carnian, Silicka Brezova, Czech Republic, Slovakia; *a–c,* dorsal, lateral, anterior views, ×2.5; *d,* younger specimen, dorsal view, ×3 (Siblík, 1977).

Karpatiella Sučić-Protić, 1985, p. 27 [**K. valeriae* Sučić-Protić, 1985, p. 28; OD]. Medium size to large, elongate-oval to subpentagonal in outline, anterior commissure weakly uniplicate to weakly sulciplicate, umbo large, broad, erect with rounded-angular beak ridges, pedicle foramen moderate, dental plates long, straight to slightly inwardly concave, slightly ventrally divergent; cardinal process represented by callus knob, inner socket ridges slightly dorsally deflected, outer hinge plates demarcated, slightly concave ventrally, septalium long, slightly undulating, median septum extending about 0.25 valve length. *Lower Jurassic (upper Pliensbachian):* England, France, Czech Republic, Slovakia, Yugoslav Carpatho-Balkan arch.——Fig. 1449,*2a–e.* **K. valeriae,* Stara Planina, Senokos, Serbia; *a–d,* dorsal, lateral, anterior, ventral views; *e,* dorsal valve interior reconstruction, ×1 (Sučić-Protić, 1985).

Kedrovothyris Smirnova, 1990a, p. 119 [**K. kedrovaensis;* OD]. Medium size, rounded-pentagonal in outline, anterior commissure rectimarginate, umbo small, erect; dental plates thick, probably partially enveloped in umbonal callus; cardinal process probably represented by callus lobe, crural plates slender, median septum obtusely triangular in cross section, extending less than 0.5 valve length, loop transverse band with posterior projections. *Lower Cretaceous:* Kamchatka.——Fig. 1449,*3a–d.* **K. kedrovaensis; a–c,* dorsal, lateral, anterior views; *d,* holotype, ventral view, internal mold of conjoined valves, MGU 138/401, ×1.5 (Smirnova, 1990a).

Modestella Owen in Casey, 1961, p. 573 [**M. modesta;* OD]. Small, rounded subpentagonal in outline, shallow median sulcus between faint ridges in each valve, lobate anteriorly, anterior commissure rectimarginate, emarginated, umbo suberect, pedicle foramen large, deltidial plates concave; hinge teeth wedge shaped, dental plates thick, ventrally convergent; cardinal process commonly represented by callus lobe, hinge plates convex ventrally, septalium very deep, acutely V-shaped, median septum triangular in cross section, extending 0.5 valve length, structures commonly thickened by callus apically. *Lower Cretaceous (Albian):* England.——Fig. 1446,*7a–c.* **M. modesta,* lower Albian, Bedfordshire, southern England; dorsal, lateral, anterior views, ×3 (Casey, 1961).

Ornithella Eudes-Deslongchamps, 1884, p. 273 [**Terebratula ornithocephala* J. Sowerby, 1815 in 1812–1815, p. 227; OD] [=*Microthyridina* Schuchert & LeVene, 1929b, p. 120 (type, *Terebratulites lagenalis* von Schlotheim, 1820, p. 284), *nom. nov. pro Microthyris* Eudes-Deslongchamps, 1884, p. 274, *non* Lederer, 1863]. Elongate-oval to pentagonal in outline, lobate anteriorly, anterior commissure rectimarginate, umbo suberect to incurved with rounded beak ridges, pedicle foramen permesothyrid; pedicle collar rarely observed, dental plates inwardly concave to angled, converging ventrally, embedded in callus in adult; hinge plates slightly deflected ventrally, becoming gently undulating, septalium flattening anteriorly to become convex median ridge, median septum acutely triangular in cross section, less than 0.5 valve length, umbonal cavities commonly filled with callus, connection between anterior of loop and septal pillar early in ontogeny; dorsal adductor scars elongate, set at slight angle to septum. *Middle Jurassic (Bajocian)–Upper Jurassic (Callovian), ?Cretaceous:* Europe, *Bajocian.*——Fig. 1448,*3a–d.* **O. ornithocephala* (J. Sowerby), Bathonian, lower Cornbrash, ?Somerset, England; *a–c,* dorsal, lateral, anterior views, ×1.3 (Muir-Wood, 1965b); *d,* dorsal valve interior, reconstruction, ×1.5 (Muir-Wood,

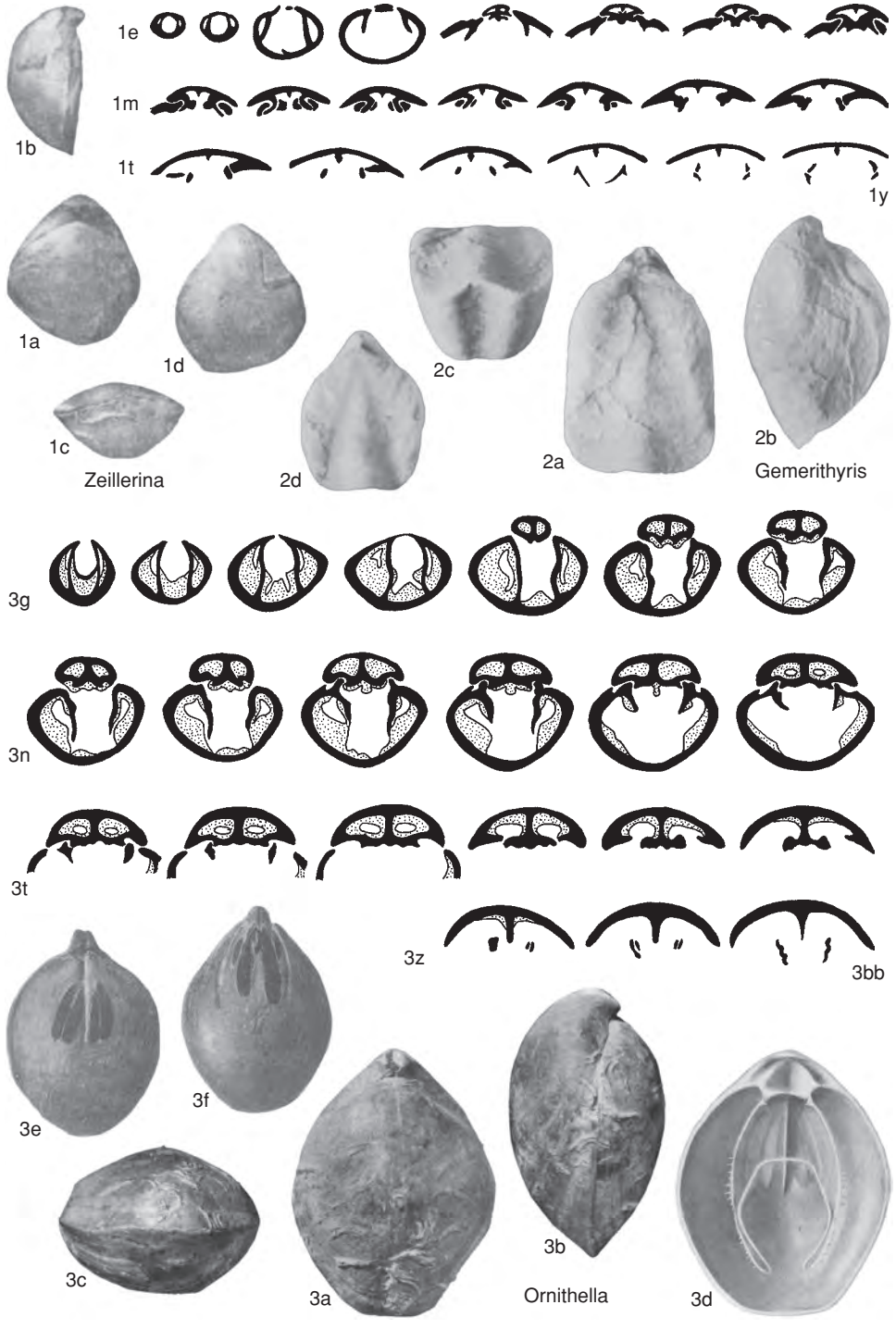

FIG. 1448. Zeilleriidae (p. 2180–2183).

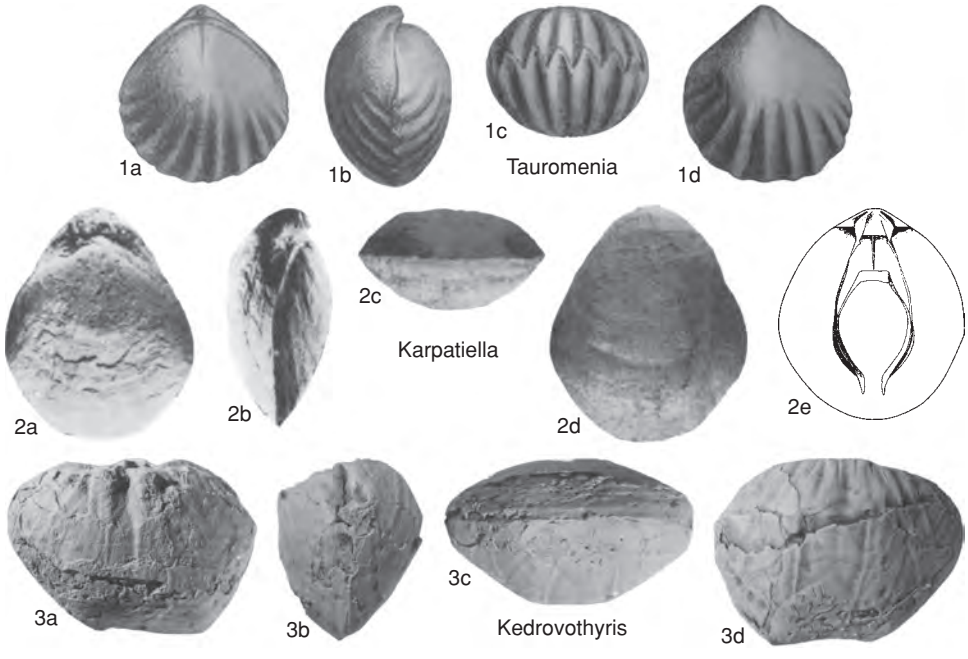

FIG. 1449. Zeilleriidae (p. 2180–2182).

1934).——FIG. 1448,*3e–bb. O. bathonica,* middle Bathonian, Fullers Earth Rock, Wiltshire, England; *e–f,* dorsal, ventral adductor scars, ×1 (Muir-Wood, 1934); *g–bb,* serial transverse sections, 1.1, 1.8, 2.4, 2.6, 3.7, 3.9, 4.0, 4.3, 4.4, 4.7, 4.9, 5.5, 5.8, 6.1, 6.3, 6.7, 6.8, 7.1, 7.2, 7.4, 7.5, 7.6 mm from umbo, ×1.25 (adapted from Muir-Wood, 1934).

Parantiptychia XU & LIU, 1983b, p. 99 (XU & LIU, 1980, p. 36, *nom. nud.*) [**Antiptychina robusta* YANG & YIN in YANG & others, 1962, p. 124; OD]. Medium to large size, broadly oval to subpentagonal in outline, anterior commissure rectimarginate early, becoming unisulcate or plicosulcate, umbo incurved with short beak ridges, pedicle foramen moderately large, possibly permesothyrid; pedicle collar present; inner socket ridges slightly deflected ventrally, hinge plates long and narrow, crural plates thin, persistent, extended as in *Aulacothyroides,* septalium commonly with anterior median ridge, septalium extending almost 0.3 valve length, median septum triangular in cross section, extending more than 0.5 valve length, loop ascending elements unknown. *Middle Triassic:* China (Qinghai Province).——FIG. 1447,*5a–d. *P. robusta* (YANG & YIN), Junzihe Formation, southern Qilian Mountains; dorsal, lateral, anterior, ventral views, ×1 (Xu & Liu, 1983b).——FIG. 1447,*5e–ii. P. sulcata* XU & LIU, Zunzihe Formation, southern Qilian Mountains; transverse serial sections, 1.0, 1.5, 1.8, 2.5, 3.0, 3.5, 3.6, 3.7, 3.9, 4.3, 4.6, 4.9, 5.2, 5.6, 5.9, 6.1, 6.3, 6.9, 7.2, 7.6, 8.0, 8.5, 8.9, 9.1, 9.3, 9.8, 10.2, 10.7, 11.1, 11.6, 11.9 mm from umbo, ×0.6 (adapted from Xu & Liu, 1983b).

Tauromenia SEGUENZA, 1885, p. 253, footnote, *non* FUCINI, 1931 [**T. polymorpha;* OD]. Small, rounded to elongate-oval or rounded-pentagonal in outline, anterior commissure rectimarginate, umbo small, erect, pedicle foramen permesothyrid, anterior half of shell prominently costate; dental plates short, other characters unknown; hinge plates slightly convex ventrally, septalium shallow, median septum less than 0.5 valve length, loop characters unknown. *Upper Triassic (?Rhaetian), Lower Jurassic (Hettangian–Sinemurian):* Italy, *?Rhaetian;* Italy, Portugal, Spain, northern Africa, *Hettangian–Sinemurian.*——FIG. 1449,*1a–d. *T. polymorpha,* Hettangian, Sicily; dorsal, lateral, anterior, ventral views, ×1 (Muir-Wood, 1965b).

Tetjuchithyris SMIRNOVA in SMIRNOVA & KONOVALOV, 1986, p. 81 [**T. flexibilis;* OD]. Small, subcircular to subtriangular in outline, anterior commissure uniplicate, umbo acute, erect; dental plates angled, widely spaced, recessive; septalium long, wide, septalial plates with outgrowth overarching septalial trough anteriorly, median septum long, thick posteriorly, becoming bladelike to acutely triangular anteriorly, extending about 0.75 valve length, loop long, almost reaching anterior margin, ascending branches widening posteriorly, uniting with broad, posteriorly arched transverse band. *Lower Cretaceous (Berriasian–Valanginian):* Russia (Far East).——FIG. 1447,*1a–ll. *T. flexibilis; a–d,* dorsal, lateral,

anterior, ventral views, ×1 (Smirnova & Konovalov, 1986); *e–ll,* serial transverse sections, 0.2, 0.4, 0.6, 0.7, 1.0, 1.2, 1.6, 1.9, 2.3, 2.5, 2.6, 2.7, 2.8, 2.85, 2.9, 3.0, 3.1, 3.25, 3.45, 3.65, 4.05, 4.15, 4.45, 4.65, 4.75, 4.95, 5.05, 5.15, 6.15, 6.45, 6.55, 8.35, 8.75 mm from umbo [there is no record of the distance of the final section], ×1.5 (adapted from Smirnova & Konovalov, 1986).

Zeillerina Kyansep, 1959, p. 119 [**Zeilleria belbekensis* Moisseev, 1934, p. 149; OD; *emend.,* Kyansep, 1961, p. 80]. Small, young specimens oval-pentagonal, adult specimens commonly strongly pentagonal in outline, ventribiconvex to planoconvex, anterior commissure incipiently uniplicate, umbo erect to slightly incurved, with subangular beak ridges; pedicle collar developed, teeth massive; cardinal process small, commonly weakly developed or absent, hinge plates slightly ventrally convex to flat, septalium poorly developed, rudimentary, median septum united with hinge plates in umbonal region only, triangular in cross section, 0.5 to 0.75 valve length, loop with short, ascending branches, sometimes with wedge-shaped spines. [The emended diagnosis of *Zeillerina belbekensis* Kyansep, 1961, p. 80, does not materially affect the diagnosis of *Zeillerina* included herein.] *Upper Jurassic (Oxfordian–Kimmeridgian):* Mediterranean region, Crimea, Poland.——Fig. 1448,*1a–y. *Z. belbekensis* (Moisseev), Kimmeridgian, southwestern Crimea; *a–d,* dorsal, lateral, anterior, ventral views, ×1 (Kyansep, 1959); *e–y,* serial transverse sections, 1.0, 1.1, 1.5, 1.9, 3.6, 4.4, 4.8, 5.3, 6.3, 6.5, 6.6, 6.9, 7.1, 7.2, 7.5, 7.6, 7.8, 8.1, 8.8, 9.5, 10.1 mm from umbo, ×1 (adapted from Kyansep, 1959).

Subfamily MACANDREVIINAE Cooper, 1973

[*nom. transl.* Baker, herein, *ex* Macandreviidae Cooper, 1973b, p. 23]

Small to medium size, biconvex, anterior commissure rectimarginate or weakly unisulcate, umbo short, broad, with beak ridges ill defined, deltidial plates disjunct, pedicle foramen moderate, round; pedicle collar well developed, sessile, impunctate, minor development of umbonal callus, dental plates slender; cardinal process absent, crural bases given off mesially, septalium absent, median septum absent, adult loop teloform, connected to septal pillar early in ontogeny. *Paleogene (Eocene)–Holocene.*

Macandrevia King, 1859, p. 261 [**Terebratula cranium* Müller, 1776, p. 249; OD] [=*Macandrewia* Bronn, 1862, p. 305, obj., improper emendation; *Frenula* Dall, 1871, p. 55 (type, *F. jeffreysi,* OD); *Waldheimiathyris* Helmcke, 1939, p. 331, obj.; *Notorygmia* Cooper, 1972, p. 13 (type, *N. abyssa,* OD)]. Subpentagonal in outline, smooth or with fine radial sculpture, umbo suberect to erect, deltidial plates rudimentary, pedicle foramen possibly permesothyrid, attrite; teeth moderate to large, dental plates short, straight, ventrally divergent, united by callus deposit closely applied to floor of valve; crural bases fused with inner socket ridges, crural plates steeply inclined to floor of valve, extended anteriorly, forming long, V-shaped trough extending about 0.5 valve length, low median ridge present early in ontogeny, but median septum absent in adult, loop extending about 0.75 valve length, smooth except for anterior fringe of short spines, ascending branches and transverse band moderately broad with short, posterior projections at union; diductor muscle scars attached to small, transverse impression over dorsal umbo; endopunctae minute, rather widely separated. [Preservation of detail in figured type material is poor. Generic characters are more clearly illustrated in the species figured herein.] *Paleogene (Eocene)–Holocene:* Antarctic Peninsula, *Eocene;* Japan, *Miocene;* Italy, *Pliocene;* Norway, Sweden, Italy, *Pleistocene;* Atlantic (10–2,900 m), Pacific (240–4,400 m), Antarctic (400–2,800 m), *Holocene.*——Fig. 1450,*2a–e. M. americana* Dall, Holocene, west entrance to Strait of Magellan, 470–562 m, Pacific, off Chile; *a–c,* dorsal, lateral, anterior views, ×1; *d,* dorsal valve interior; *e,* dorsal valve oblique interior view, ×1 (Cooper, 1973b).

Subfamily UNCERTAIN

Polyplectella Feldman, Owen, & Hirsch, 2001, p. 654 [**P. debriani;* OD]. Medium size, oval to subpentagonal, almost equally biconvex but with ventral valve more inflated anteriorly, anterior commissure uniplicate, shell mostly smooth but with polyplication developed marginally, umbo erect with distinct, mesothyrid beak ridges; median septum thin, extending about 0.6 of valve length. [Distinction is based on only two specimens and details of the loop remain unknown; inclusion in the Zeilleriidae is resting on the presence of dental lamellae.] *Middle Jurassic (Callovian):* southern Israel (Negev).——Fig. 1450,*1a–f. *P. debriani,* upper Callovian, Hamakhtesh Hagadol; *a–c,* holotype, dorsal, lateral, anterior views, NHM 1038; *d–f,* paratype, dorsal, lateral, anterior views, NHM 1037, ×1 (Feldman, Owen, & Hirsch, 2001).

Family GUSARELLIDAE Ovtsharenko, 1976

[Gusarellidae Ovtsharenko, 1976, p. 20]

Small to medium size, outline commonly oval to elongate, biconvex, shell smooth, umbo normally small, incurved, with short beak ridges; teeth moderate, dental plates not enveloped in callus, short, strong; cardinal process absent, inner socket ridges occasionally deflected ventrally, outer hinge

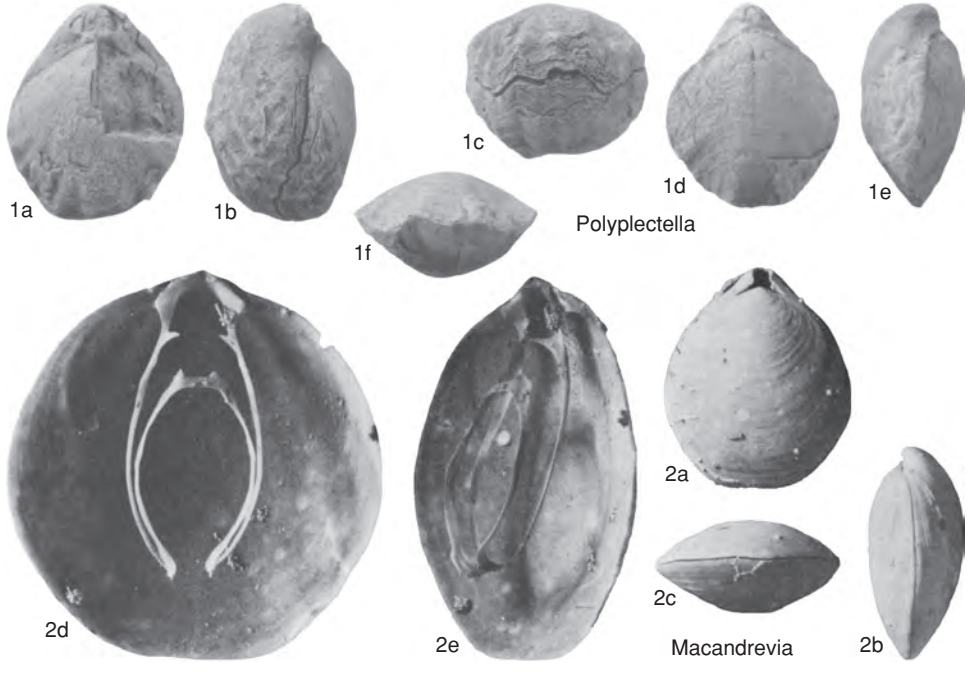

FIG. 1450. Zeilleriidae (p. 2183).

plates slightly concave ventrally, rarely undulating, crural bases given off dorsally, inner hinge plates slightly concave, ventrally forming typically U-shaped cardinal plate, minor development of apical umbonal callus, septalium absent, median septum absent, except possibly rudimentary in very early growth stages, loop smooth, rarely with few spines at union between descending and ascending branches, development of septal pillar in ontogeny not observed. *Lower Triassic (Induan)–Upper Jurassic.*

Gusarella PROSOROVSKAJA, 1962, p. 111 [**Zeilleria gusarensis* MOISSEEV, 1944, p. 58; OD] [=*Montanella* OVTSHARENKO, 1976, p. 21 (type, *Gusarella longa* PROSOROVSKAJA in PROSOROVSKAJA & POJARISSKAJA, 1968, p. 30); *Micella* OVTSHARENKO, 1976, p. 24 (type, *Gusarella makridini* POJARISSKAJA in PROSOROVSKAJA & POJARISSKAJA, 1968, p. 32); *Eousella* OVTSHARENKO, 1976, p. 26 (type, *Gusarella moisseievi* POJARISSKAJA in PROSOROVSKAJA & POJARISSKAJA, 1968, p. 35)]. Medium size, elongate-oval to elongate-pentagonal in outline, anterior commissure weakly uniplicate with tendency toward sulciplication, umbo small, broad, with rounded-angular beak ridges, pedicle foramen circular, pedicle collar absent; dental plates straight, diverging ventrally; hinge plates united to form broadly U-shaped cardinal plate becoming W-shaped anteriorly, cavity may be present between crural bases and inner hinge plates, median septum absent, or rudiment present only in earliest development stages, loop almost reaching anterior margin, commonly spinose at point of union of descending and ascending branches, delicate transverse band rather posterior, dorsal adductor scars large, oval. *Middle Jurassic–Upper Jurassic:* Crimea, Caucasus, Turkoman, *Middle Jurassic.*——FIG. 1451,*3a–jj*. **G. gusarensis* (MOISSEEV), Callovian, near Caspian Sea, western Turkoman; *a–d,* dorsal, lateral, anterior, ventral views, ×0.75 (new); *e,* dorsal valve interior reconstruction, ×0.75 (Prosorovskaja, 1962); *f–jj,* serial transverse sections, 1.9, 2.3, 3.8, 4.1, 4.7, 5.0, 5.2, 5.3, 5.5, 6.5, 6.6, 7.4, 7.9, 8.5, 8.6, 8.7, 9.6, 10.2, 10.7, 11.4, 11.9, 13.4, 14.7, 15.1, 15.8, 19.6, 21.9, 25.4, 27.8, 28.5, 29.6 mm from umbo, ×1 (adapted from Prosorovskaja, 1962).

Paragusarella SHI, 1992, p. 158 (SHI, 1990, p. 315, *nom. nud.*) [**P. uniplicata* SHI, 1992, p. 159; OD]. Elongate-oval in outline, strongly biconvex, anterior commissure uniplicate, umbo relatively small, erect to slightly incurved with angular beak ridges, pedicle foramen possibly permesothyrid; pedicle collar present, dental plates inwardly concave, diverging ventrally; cardinal process present, inner socket ridges deflected ventrally, hinge plates united to form shallow, U-shaped, entire cardinal plate,

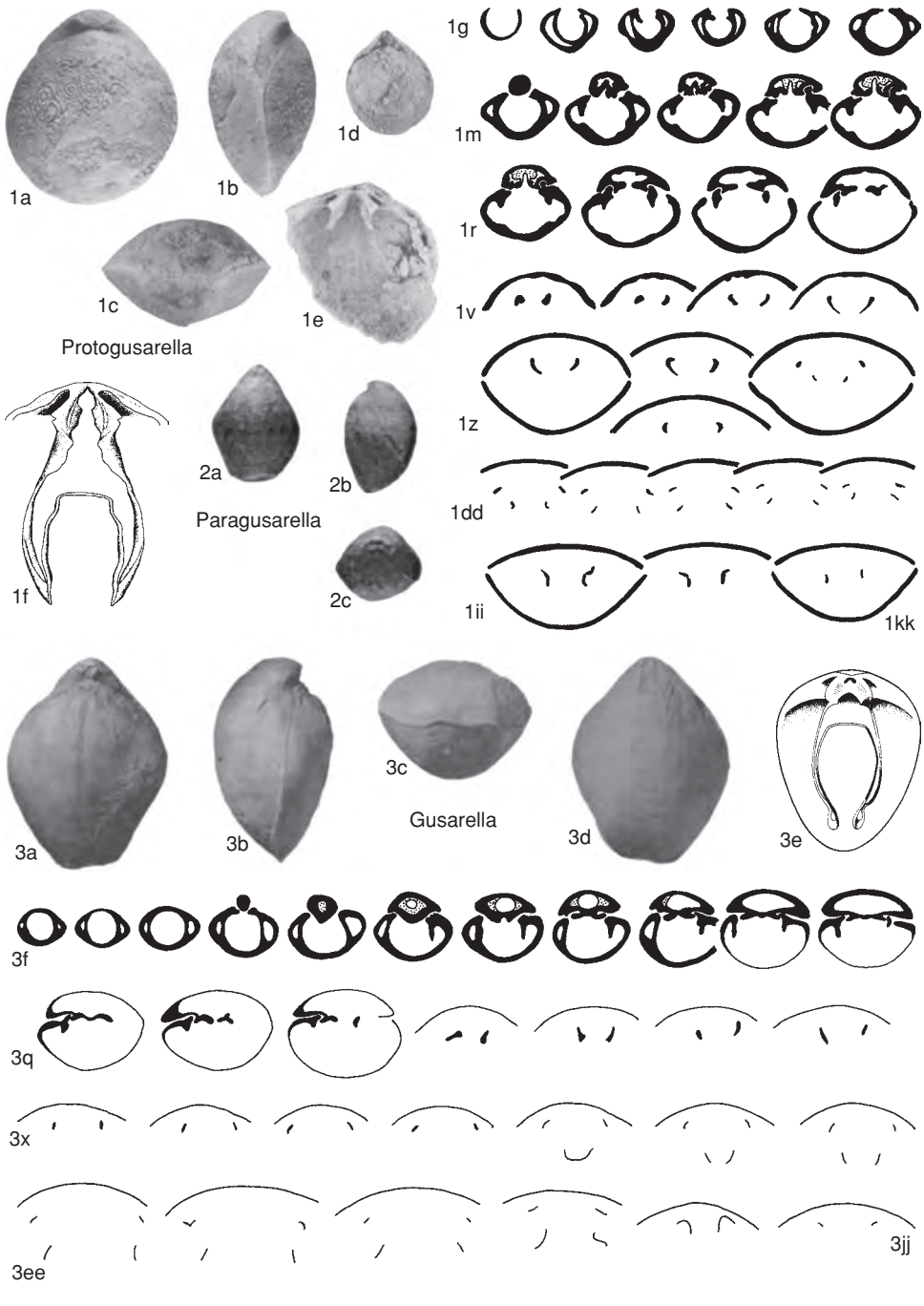

FIG. 1451. Gusarellidae (p. 2184–2186).

median septum not developed but trace of low, median ridge in early development stage, loop descending branches slender, nature of ascending elements unknown, dorsal adductor scars elongate on either side of low, indistinct myophragm. *Middle Jurassic (Callovian):* southern Tibet.——FIG. 1451,*2a–c. *P. uniplicata,* Burang; dorsal, lateral, anterior views, P31011, ×1 (Shi, 1992).

Protogusarella PERRY & CHATTERTON, 1979, p. 315 [**P. smithi;* OD]. Elongate-suboval in outline,

anterior commissure weakly unisulcate to rectimarginate, umbo moderately incurved with rounded-angular beak ridges, foramen moderately large, permesothyrid; well-developed pedicle collar, dental plates inwardly concave, subparallel; hinge plates W-shaped, crural bases strong, given off possibly dorsally, inner hinge plates converging medianly but not meeting, forming perforate, apical cardinal plate, loop delicate, ribbonlike, at least 0.75 valve length, apparently not spinose, dorsal adductor scars elongate on either side of low, indistinct myophragm. *Lower Triassic (Induan–Olenekian):* USA (Idaho, Wyoming, Utah).——Fig. 1451,*1a–kk.* **P. smithi,* Thaynes Formation, Preuss Range, southeastern Idaho; *a–c,* dorsal, lateral, anterior views; *d,* juvenile shell, dorsal view; *e,* dorsal valve interior, ×2.6; *f,* loop reconstruction, ×5 (Perry & Chatterton, 1979); *g–kk,* serial transverse sections, 0.8, 0.9, 1.0, 1.1, 1.2, 1.4, 1.5, 1.6, 1.7, 1.9, 2.0, 2.1, 2.2, 2.4, 2.6, 2.8, 3.0, 3.2, 3.6, 3.8, 4.0, 4.6, 4.8, 5.2, 5.6, 6.2, 6.6, 7.0, 7.4, 7.6, 7.8 mm from umbo, ×2.6 (adapted from Perry & Chatterton, 1979).

Family EUDESIIDAE Muir-Wood, 1965

[Eudesiidae Muir-Wood, 1965b, p. 829]

Small to large size, outline commonly oval to elongate-oval, biconvex or ventribiconvex, anterior commissure rectimarginate to uniplicate and multiplicate, shell costate, rarely costellate, umbo normally massive, typically with short, obscure to rounded beak ridges, pedicle foramen large, round, mesothyrid, rarely without pedicle collar, shell with apical or thick umbonal callus; teeth moderate, dental plates short, commonly enveloped in callus, typically straight, subparallel; cardinal process present, bilobed, trilobed, or elaborated, or exceptionally represented by callus lobe only, inner socket ridges occasionally deflected dorsally, outer hinge plates demarcated exceptionally, crural bases given off dorsally, inner hinge plates developed, typically united to form cardinal plate with anterior median ridge, giving open W-shape in cross section, septalium absent, median septum typically low and triangular in cross section, supporting cardinal plate at apex only, loop apparently smooth, transverse band variable, commonly with posterior projections. *Lower Jurassic (Toarcian)–Upper Jurassic (Kimmeridgian).*

Eudesia King, 1850, p. 144 [**Terebratula orbicularis* J. de C. Sowerby, 1826 in 1826–1829, p. 68; OD; =*T. cardium* Valenciennes in Lamarck, 1819, p. 255]. Small to medium size, elongate-oval in outline, umbo suberect to incurved, concealing deltidial plates; dental plates commonly enveloped in callus ventrally; hinge plates slightly convex ventrally, cardinal plate keeled, median septum high posteriorly, acutely triangular in cross section, extending about 0.5 valve length, loop transverse band with posteriorly directed carinae. *Middle Jurassic (?upper Bajocian, Bathonian):* Serbia, *?upper Bajocian;* Europe, Asia, Africa, *Bathonian.*——Fig. 1452,*3a–u.* **E. cardium* (Valenciennes), Bathonian, Ranville, France; *a–e,* dorsal, lateral, anterior, ventral, posterior views, ×1 (Cooper, 1989); *f–u,* serial transverse sections, distances unknown, ×1.2 (adapted from Muir-Wood, 1965b).

Apothyris Cooper, 1989, p. 101 [**A. aberrans;* OD]. Small, costellate, elongate-oval to subcircular in outline, ventribiconvex, anterior commissure commonly incipiently uniplicate, umbo broad, suberect to erect, with flattened palintropes demarcated by strong beak ridges, deltidial plates commonly excavated remnantal, costellae irregular, narrow, separated by spaces as wide as or wider than costellae, intercalation in two or three generations; pedicle collar not developed, dental plates very short, usually enveloped by callus; cardinal process small, possibly bilobed, inner socket ridges dorsally deflected, hinge plates concave ventrally, cardinal plate possibly perforate posteriorly, median septum very short, less than 0.2 valve length, supporting cardinal plate at apex, crural processes blunt, loop almost reaching anterior, ascending branches about half loop length, transverse band flattened. *Lower Jurassic (Toarcian)–Middle Jurassic (Callovian):* Saudi Arabia.——Fig. 1453,*1a–e.* **A. aberrans,* Callovian, Jebel Tuwaiq; dorsal, lateral, anterior, ventral, posterior views, ×2 (Cooper, 1989).

Flabellothyris Eudes-Deslongchamps, 1884, p. 262 [**Terebratula flabellum* Defrance, 1828a, p. 160; OD]. Small, subtrigonal to flabellate in outline, weakly biconvex, commissure commonly incipiently uniplicate, dorsal fold, if formed, occupying about 0.3 of valve width, commonly formed by three costae, umbo suberect with rounded-angular beak ridges, deltidial plates disjunct to conjunct, commonly flaring, commonly concealed; hinge plates demarcated from inner socket ridges, ventrally directed, slightly concave, median septum short, dorsal valve structures concealed by callus apically. [Specimens from the Lower Jurassic and Upper Cretaceous are homeomorphs.] *Middle Jurassic (Bathonian):* England, France, Saudi Arabia.——Fig. 1453,*2a–c.* **F. flabella* (Defrance); dorsal, lateral, anterior views, lower Bathonian, middle Dhruma Formation, Djebel Tuwaiq, Saudi Arabia, ×2 (Cooper, 1989).

Praeudesia Hegab & Tkhorzhevsky, 1991, p. 3 [**P. makridini* Hegab & Tkhorzhevsky, 1991, p. 4; OD]. Small to medium size, rounded oval to subtrigonal in outline, maximum width anterior to

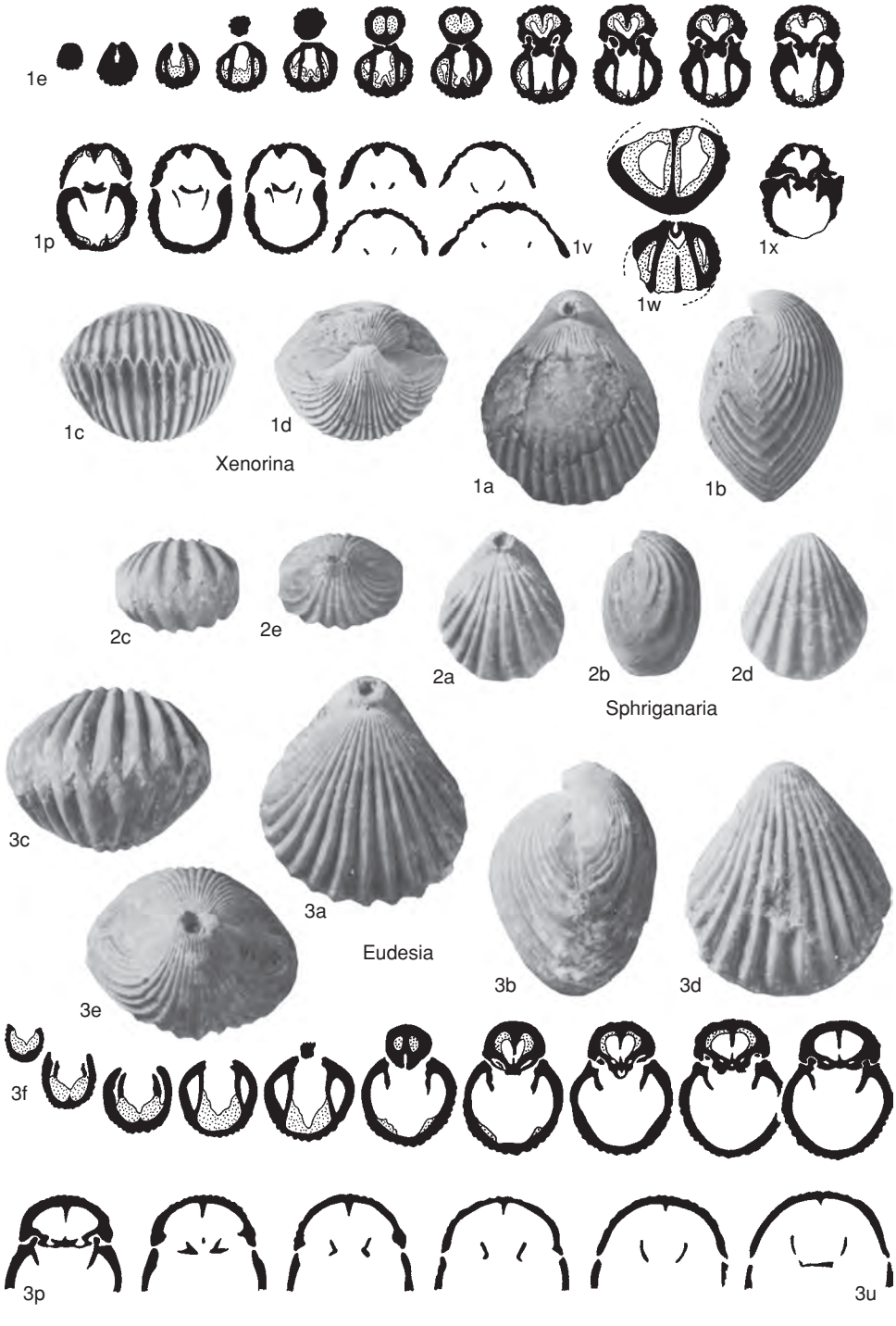

FIG. 1452. Eudesiidae (p. 2186–2188).

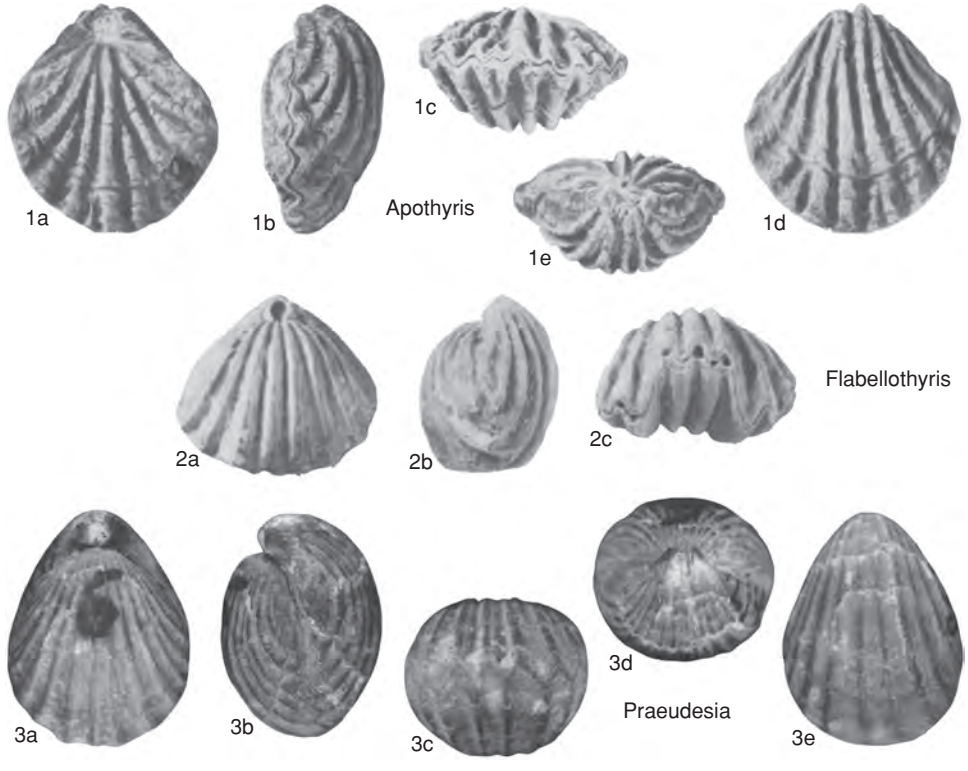

FIG. 1453. Eudesiidae (p. 2186–2188).

midvalve, shell costellate laterally, biconvex, umbo suberect to incurved, concealing short, thin symphytium, with rounded beak ridges; pedicle collar not developed, dental plates thick, partially enveloped in callus, subparallel or slightly ventrally convergent; cardinal process absent, outer hinge plates weakly developed on ventral margin of inner socket ridges, deflected dorsally, median septum very low, about 0.25 valve length, appearing anteriorly as a euseptoidum, structures much thickened and obscured by umbonal callus, loop transverse band narrow. *Middle Jurassic (upper Bathonian, ?Callovian):* Sinai.——FIG. 1453,*3a–e. *P. makridini,* Kehailia Member, Masajid Formation, Gebel Maghara, northern Sinai; dorsal, lateral, anterior, posterior, ventral views, ×1.5 (Hegab & Tkhorzhevsky, 1991).

Sphriganaria COOPER, 1989, p. 102 [**S. modesta* COOPER, 1989, p. 111; OD]. Small to medium size, costellate, oval to subtrigonal in outline, maximum width ranging from midvalve to anterior, usually slightly ventribiconvex, anterior commissure with tendency toward weak uniplication in some species, umbo straight to erect, with rounded beak ridges, pedicle foramen usually mesothyrid; pedicle collar sessile, dental plates slender, slightly inwardly concave; cardinal process absent, inner socket ridges dorsally deflected, hinge plates flat, median septum very low, about 0.5 valve length. *Middle Jurassic (Bajocian)–Upper Jurassic (Kimmeridgian):* Saudi Arabia, Sinai, Egypt.——FIG. 1452,*2a–e. *S. modesta,* Callovian, upper Dhruma Formation, Jebel Tuwaiq, Saudi Arabia; *a–e,* dorsal, lateral, anterior, ventral, posterior views, ×1 (Cooper, 1989).

Xenorina BAKER, *nom. nov.* herein (COOPER, 1989, p. 115, *nom. nud.*) [**X. ovata;* OD]. Large, oval in outline, with rounded sides and narrowly rounded anterior, ventribiconvex, umbo erect to strongly incurved, pedicle foramen ranging from moderately large to very small; dental plates fairly long, parallel, thickened by callus in adult; cardinal process bilobed, protruberant, hinge plates short, thick, convex ventrally, cardinal plate scarcely supported by short, thick, rounded triangular median septum, structures much thickened by callus in old specimens, loop with broad transverse band. *Middle Jurassic (Bathonian–Callovian):* Saudi Arabia.——FIG. 1452,*1a–x. *X. ovata,* Callovian, upper Dhruma Formation, Jebel Tuwaiq; *a–d,* dorsal, lateral, anterior, posterior views, ×1 (Cooper, 1989); *e–v,* serial transverse sections, 0.4, 1.3, 1.7, 2.3, 2.7, 3.1, 3.2, 3.6, 4.0, 4.4, 4.6, 5.1, 5.4, 5.5, 5.7, 6.5, 7.2, 7.6 mm from umbo, ×1; *w,* transverse, oblique section showing pedicle collar, ×1.5; *x,* transverse section showing well-developed cardinal process, ×1 (adapted from Cooper, 1989).

KINGENOIDEA

D. I. MacKinnon,[1] T. N. Smirnova,[2] and D. E. Lee[3]

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Superfamily KINGENOIDEA Elliott, 1948

[*nom. transl.* MacKinnon, Smirnova, & Lee, herein, *ex* Kingeninae Elliott, 1948b, p. 311]

Adult shells small to large, subcircular to subtriangular or subpentagonal, exterior smooth to granular, anterior commissure rectimarginate, unisulcate or intraplicate, foramen small to medium, deltidial plates conjunct or disjunct. Pedicle collar broad and sessile. Dental plates well developed; cardinal process a small, transversely oval myophore; outer hinge plates commonly well developed; inner hinge plates uniting to form septalium; crural bases weakly differentiated. Adult loop commonly mediovertical, may be diploform or bilacunar. Septal pillar retained throughout ontogeny, commonly developing as long, thin median septum. Septal pillar bifurcating early in ontogeny. Septal flanges not developed. Lophophore plectolophous. Mantle may be spiculate. *Middle Triassic–Holocene.*

Family KINGENIDAE Elliott, 1948

[*nom. transl.* Owen, 1970, p. 49, *ex* Kingeninae Elliott, 1948b, p. 311]

Adult loop bilacunar or mediovertical. *Upper Jurassic–Holocene.*

Subfamily KINGENINAE Elliott, 1948

[Kingeninae Elliott, 1948b, p. 311]

Adult loop bilacunar with both lateral and mediovertical connecting bands. *Upper Jurassic–Neogene (lower Miocene).*

Kingena Davidson, 1852a, p. 40 [**Terebratula lima* Defrance, 1828b, p. 156; OD] [=*Kingia* Schloenbach, 1866, p. 296, *nom. null., non* Theobald, 1910, *nec* Malloch, 1921]. Small to large, biconvex, elongate-oval to pentagonal, rectimarginate to faintly uniplicate to ligate; shell ornament granular, beak short, suberect, foramen subcircular, permesothyrid, deltidial plates disjunct. Pedicle collar sessile. Cardinal process small, transversely oval myophore; septalium broad, shallow, supported by long, thin, moderately high median septum; loop bilacunar, may be thickened. *Lower Cretaceous–Upper Cretaceous:* Europe, Australasia, India.——Fig. 1454,*3a–c. *K. lima* (Defrance), Upper Cretaceous, England; dorsal, anterior, and lateral views of exterior of neotype, NHM B79709, ×2 (Owen, 1970).——Fig. 1454,*3d–e. K. mesembrina* (Etheridge), Upper Cretaceous, Western Australia; ventral and anterior views of partially complete loop showing strong, mediovertical connecting bands, ×9 (new).

Aldingia Thomson, 1916b, p. 501 [**Terebratella furculifera* Tate, 1880, p. 161; OD]. Small to medium, smooth, elongate-oval, anterior commissure rectimarginate to unisulcate; deltidial plates commonly disjunct but conjunct in some adults; foramen submesothyrid to mesothyrid; beak short, erect. Pedicle collar sessile, hinge teeth supported by swollen bases derived from thickened dental plates. Cardinal process a sessile, transverse myophore; cardinalia thick with socket ridges flanking a solid hinge trough with large, strongly impressed adjustor scars; fused anteriorly with median septum; loop bilacunar. *Paleogene (Eocene):* Australia.——Fig. 1454,*2a–d. *A. furculifera* (Tate); *a–b,* dorsal and lateral views of exterior of lectotype, SAM.P T895H, ×1.5; *c–d,* ventral and anterior view of dorsal valve interior, ×3 (Richardson, 1973).

Dictyothyropsis Barczyk, 1969, p. 66 [**Terebratulites loricatus* Schlotheim, 1820, p. 270; OD]. Small, biconvex, pentagonal in outline; costellae fine, dichotomous; anterior commissure parasulcate; beak short, massive, erect; deltidial plates disjunct to conjunct. Pedicle foramen large, round, mesothyrid; pedicle collar present; cardinal area wide and flat; teeth and dental plates long, massive, smooth. Cardinal process small, poorly developed, fused with hinge plates and median septum; loop bilacunar with mediovertical connecting band and broad hood. *Upper Jurassic:* Europe.——Fig. 1455,*2a–e. *D. loricata* (Schlotheim), Poland; *a–d,* dorsal, ventral, lateral, and anterior views of exterior, ×2.5; *e,* detail of umbonal region, ×6 (Barczyk, 1969).——Fig. 1455,*2f–dd. D. roemeri* (Rollier), Poland; serial transverse sections 0.0, 1.4, 1.6, 2.0, 2.2, 2.5, 2.8, 3.2, 3.4, 3.6, 4.1, 4.4, 4.9, 5.1, 5.3, 5.5, 5.7, 6.0, 6.2, 6.4, 6.7, 7.1, 7.7, 8.0, 8.9 mm from first section, ×1 (adapted from Barczyk, 1969).

Laquethiris Bitner, 1996, p. 86 [**L. curiosa;* OD]. Small to medium, smooth, elongate-oval to subpentagonal, anterior commissure rectimarginate to mildly unisulcate; deltidial plates small, disjunct; foramen large, oval to subcircular, submesothyrid to mesothyrid; beak short, suberect. Pedicle collar

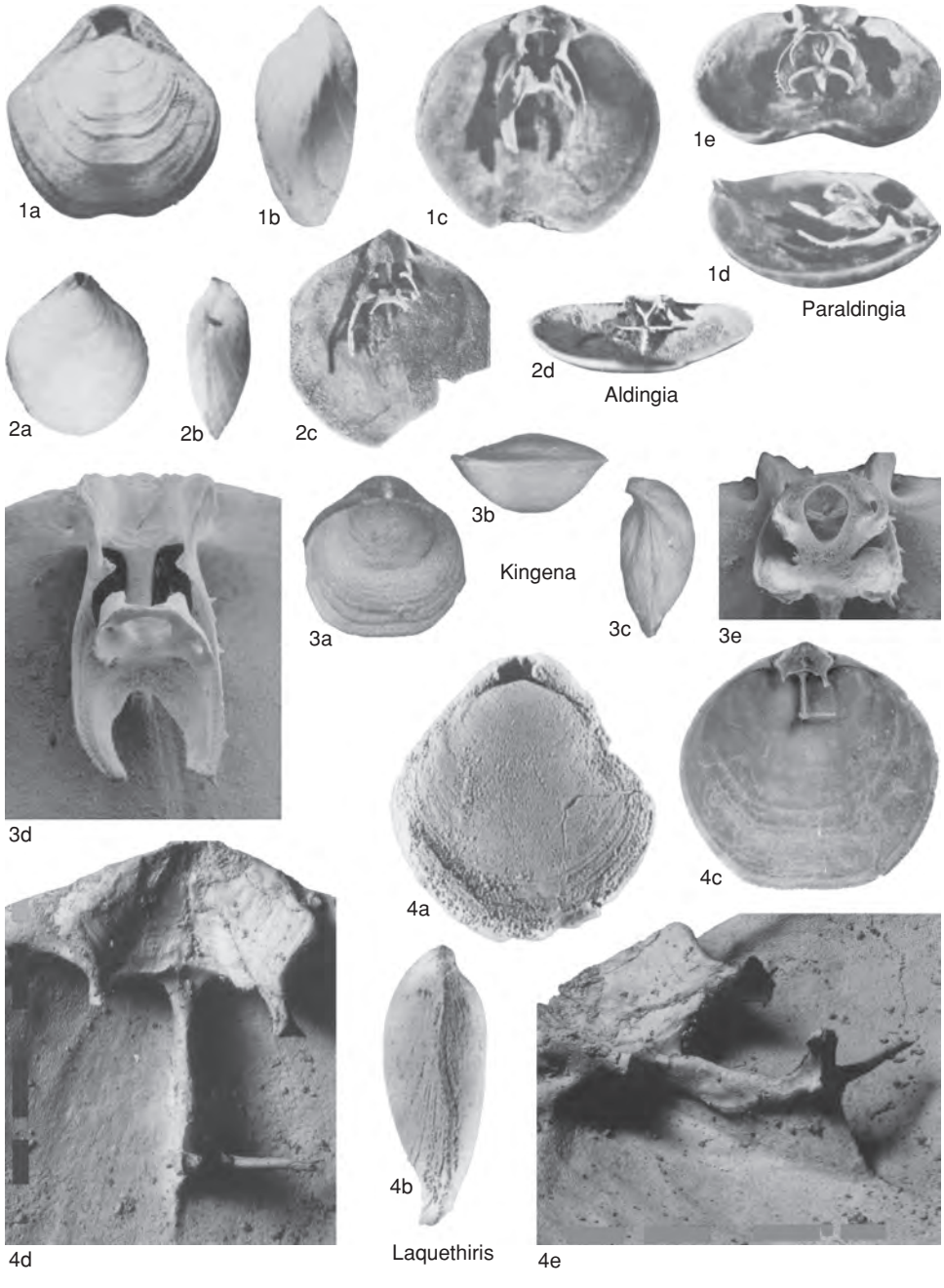

FIG. 1454. Kingenidae (p. 2189–2192).

sessile, hinge teeth small, supported by dental plates. Cardinalia lamellar, with well-developed inner and outer hinge plates separated by prominent crural bases; inner hinge plates uniting with median septum to form septalium; cardinal process an indistinct, sessile, transverse myophore; loop bilacunar, mediovertical and lateral connecting bands slender. *Paleogene (Eocene):* Antarctica, ?Australia.——FIG. 1454,*4a–e. *L. curiosa,* Antarctica; *a–b,* dorsal and lateral views of exterior of holotype,

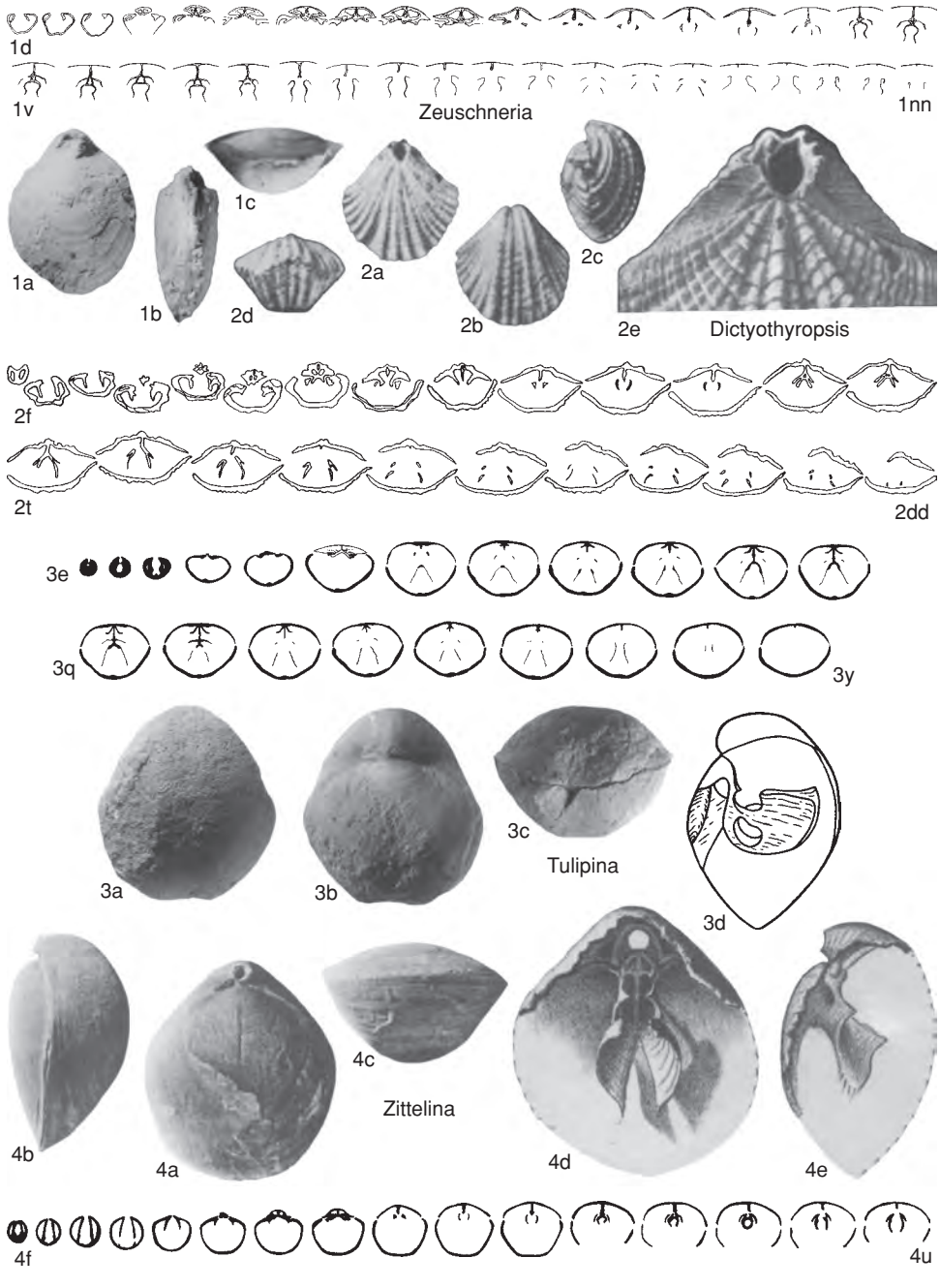

FIG. 1455. Kingenidae (p. 2189–2192).

ZPAL Bp. XXXVII/565, ×2 (Bitner, 1996); *c,* dorsal interior, ×1.5 (new); *d–e,* ventral and anterior oblique view of dorsal interior showing cardinalia and mediovertical and lateral connecting bands of loop, ×4.5, ×5 (new).

Paraldingia RICHARDSON, 1973, p. 122 [**Terebratella(?) woodsii* TATE, 1880, p. 161]. Differs from *Aldingia* in possession of discrete dental plates, unisulcation, excavate inner hinge plates, and bilacunar loop with broad and moderately thick, mediovertical and

lateral connecting bands. *Paleogene (lower Eocene)–Neogene (lower Miocene):* Chatham Islands, New Zealand, *lower Eocene;* Australia, *upper Eocene–lower Miocene.*——Fig. 1454,*1a–e.* **P. woodsii* (Tate), lower Miocene, Australia; *a–b,* dorsal and lateral views of exterior of lectotype, SAM.P T901A, ×2.5; *c–e,* ventral, lateral oblique, and anterior views of dorsal valve interior, ×3 (Richardson, 1973).

Tulipina Smirnova, 1962, p. 102 [**Zeilleria koutaisensis* de Loriol, 1896, p. 145; OD]. Small, smooth, subpentagonal, globose, anterior commissure unisulcate, beak low, strongly incurved; pedicle foramen small, mesothyrid. Dental plates short and thick; lateral umbonal cavities vestigial. Cardinal process not differentiated, crural bases massive, septalium deep and cuplike; median septum short, high, bladelike with pair of obliquely inclined flanges (possibly for dorsal adductor muscle attachment) extending from base; loop bilacunar with prominent, mediovertical connecting band; hood strongly flared, with posteromedian lacuna and broad, dorsally convex transverse band. *Lower Cretaceous:* Georgia.——Fig. 1455,*3a–y.* **T. koutaisensis* (de Loriol); *a–c,* ventral, dorsal, and anterior views, ×3 (Smirnova, 1990a); *d,* lateral view with loop reconstruction, ×3 (Muir-Wood, 1965a); *e–y,* serial transverse sections 0.0, 0.7, 0.8, 1.6, 2.2, 2.6, 3.2, 3.6, 3.8, 4.1, 4.2, 4.3, 4.6, 4.8, 5.2, 5.35, 5.6, 6.0, 6.4, 6.8, 7.6 mm from ventral umbo, ×1 (adapted from Smirnova, 1962).

Zeuschneria Smirnova, 1975a, p. 137 [**Z. imitabilis;* OD] Small, smooth, elongate oval, anterior commissure rectimarginate, beak erect, foramen mesothyrid. Dental plates short, steeply inclined, bounding small, lateral umbonal cavities. Septalium broad with gently inclined hinge plates. Loop bilacunar with broad hood and well-developed mediovertical connecting band, spinose anteriorly. *Upper Jurassic:* Poland.——Fig. 1455,*1a–nn.* **Z. imitabilis; a–c,* dorsal, lateral, and anterior views, ×3 (Smirnova, 1975a); *d–nn,* serial transverse sections 0.0, 0.3, 0.7, 1.2, 1.4, 1.7, 1.9, 2.2, 2.4, 2.6, 2.9, 3.1, 3.5, 3.7, 4.2, 4.5, 5.1, 5.3, 5.5, 5.9, 6.2, 6.4, 6.5, 6.7, 7.0, 7.1, 7.7, 7.9, 8.7, 9.2, 9.4, 9.6, 10.4, 10.5, 10.7, 11.5, 11.6 mm from ventral umbo, ×1 (adapted from Smirnova, 1975a).

Zittelina Rollier, 1919, p. 368 [**Terebratula orbis* Quenstedt, 1858, p. 639; OD]. Small, smooth, subpentagonal to subquadrate; anterior commissure rectimarginate to incipiently unisulcate; beak suberect to slightly incurved, beak ridges indistinct; foramen small, circular, permesothyrid. Pedicle collar present. Cardinalia with small, central, concave hinge platform, septum thin, loop diploform, with short descending branches fringed with long spines, and large hood with annular flutings, laterally angled and anteriorly produced into gracefully curved projections. *Upper Jurassic, ?Lower Cretaceous:* Europe, Western Asia, *Upper Jurassic;* Europe, *?Lower Cretaceous.*——Fig. 1455,*4a–u.* **Z. orbis* (Quenstedt), Upper Jurassic, Germany; *a–c,* dorsal, lateral, and anterior views of exterior, ×2 (Owen, 1970); *d–e,* ventral and lateral views of loop, ×4 (adapted from Zittel, 1870); *f–u,* serial transverse sections 0.0, 0.3, 0.7, 0.9, 1.1, 1.4, 1.7, 2.0, 2.2, 2.6, 2.8, 3.1, 3.3, 3.8, 4.0 mm from first section, ×1 (Owen, 1970).

Subfamily ECNOMIOSINAE Cooper, 1977

[*nom. transl.* MacKinnon, herein, *ex* Ecnomiosidae Cooper, 1977, p. 128]

Adult loop mediovertical. *Lower Cretaceous–Holocene.*

Ecnomiosa Cooper, 1977, p. 129 [**E. gerda* Cooper, 1977, p. 131; OD]. Medium to large, subrounded to subpentagonal, smooth, rectimarginate, beak short, suberect, attrite; foramen large, mesothyrid, deltidial plates narrow, disjunct. Teeth strong, dental plates short. Cardinal process an indistinct, sessile, transverse myophore; cardinalia having inner hinge plates attached to short median septum; adult loop mediovertical; descending branches of loop attached to median septum in early adult stages of development (bilacunar). *Holocene:* Caribbean, Japan, Indian Ocean.——Fig. 1456,*1a–f.* **E. gerda,* Caribbean; *a–d,* dorsal, lateral, posterior, and anterior views of exterior of holotype, USNM 550510a, ×1; *e–f,* ventral and lateral oblique views of dorsal interior of holotype showing mediovertical loop, ×1 (Cooper, 1977).

Belothyris Smirnova, 1960, p. 117 [**B. plana* Smirnova, 1960, p. 118; OD]. Medium, subpentagonal to elongate-oval, smooth, biconvex, ligate; anterior margin rectimarginate, beak low, incurved, deltidial plates conjunct. Dental plates gently diverging, curved, teeth massive with distinct denticulum. Hinge plates almost fused with inner socket ridges, septalium deep, broadly cup shaped, flattened anteriorly; loop mediovertical. [Possible junior synonym of *Dzirulina* Nutsubidze, 1945.] *Lower Cretaceous:* Georgia (Crimea, Caucasus, Daghestan), Western Europe.——Fig. 1456,*3a–s.* **B. plana; a–c,* dorsal, lateral, and anterior views of exterior of holotype, MGU 784/19, ×1 (Smirnova, 1990a); *d–r,* serial transverse sections 0.25, 0.40, 1.4, 1.5, 2.4, 2.7, 3.3, 4.3, 4.7, 5.0, 5.1, 5.45, 5.8, 6.5, 8.3 mm from ventral umbo, ×1 (adapted from Smirnova, 1990a); *s,* loop reconstruction, ×1.3 (adapted from Smirnova, 1960).

Dzirulina Nutsubidze, 1945, p. 188 [**Terebratula dzirulensis* Anthula, 1899, p. 70; OD]. Small to medium, subpentagonal, biconvex, smooth, or capillate near shell margin; anterior commissure rectimarginate; beak incurved, concealing symphytium, beak ridges short, angular, foramen circular, permesothyrid. Loop mediovertical. *Lower Cretaceous (Aptian–Albian):* Georgia (Caucasus), USA (California).——Fig. 1456,*4a–bb.* **D. dzirulensis* (Anthula), Albian; *a–c,* dorsal, lateral, and anterior views of exterior, ×1 (Muir-Wood, 1965a); *d,* loop reconstruction, ×1.5; *e–bb,* serial transverse sections 0.0, 0.5, 1.3, 1.9, 2.4, 2.6, 2.8, 3.3, 3.9, 4.8, 5.5, 5.6, 5.8, 5.85, 5.9, 6.0, 6.15, 6.4,

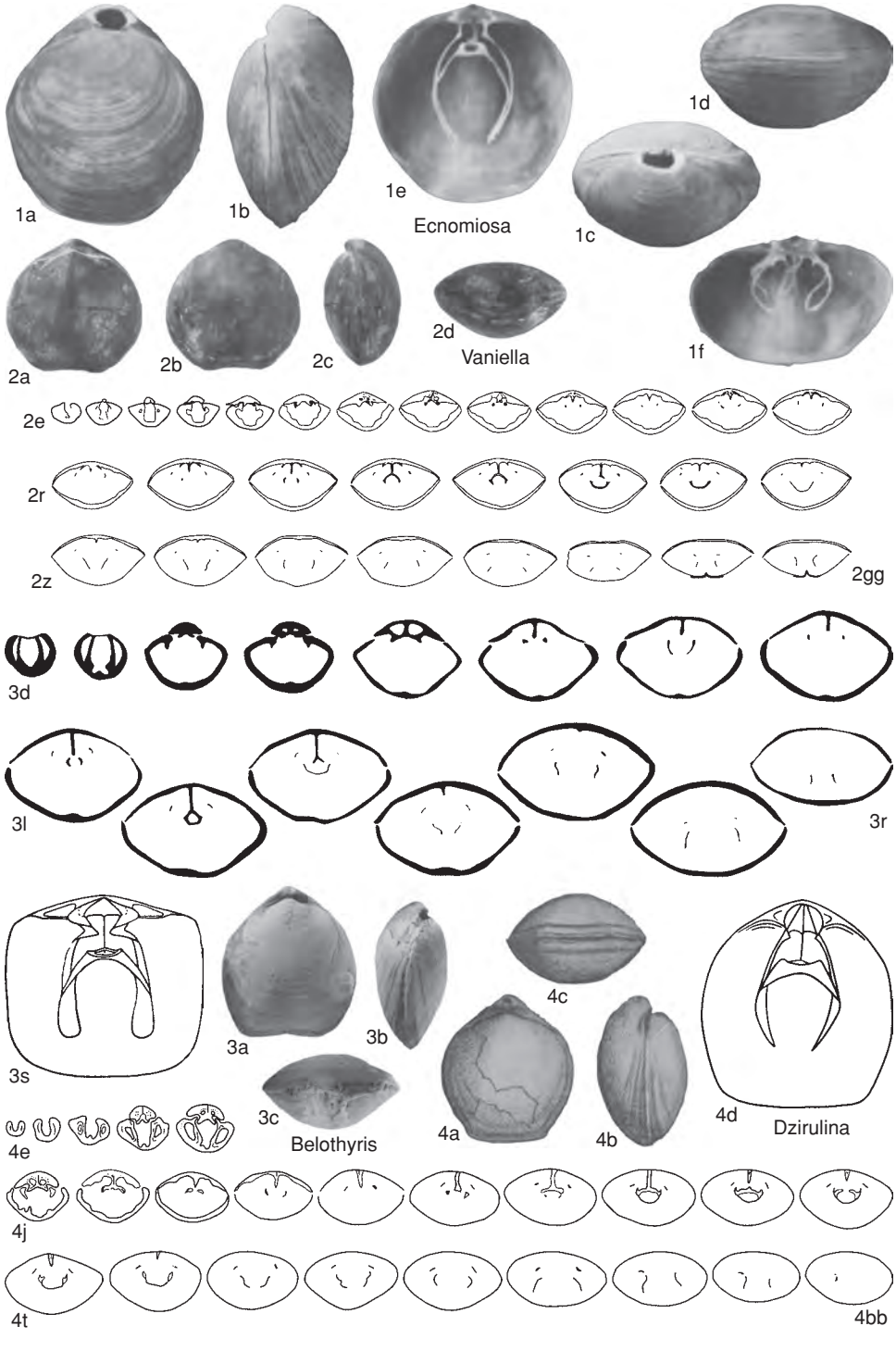

FIG. 1456. Kingenidae (p. 2192–2194).

6.7, 7.2, 8.2, 9.8, 10.9, 11.5 mm from ventral umbo, ×1 (adapted from Kvakhadze, 1972).

Vaniella Kvakhadze, 1974, p. 493 [**V. sinuata* Kvakhadze, 1974, p. 495; OD]. Subpentagonal, ventribiconvex, ligate; anterior commissure weakly unisulcate; beak short, incurved, foramen submesothyrid. Dental plates thickened, lateral beak cavities small. Cardinal process indistinct; inner socket ridges high; septalium deep, rather broad; loop mediovertical; lateral margins of muscle scars projecting above valve floor as obliquely inclined flanges. *Lower Cretaceous (Aptian):* Georgia.——Fig. 1456,*2a–gg.* **V. sinuata; a–d,* dorsal, ventral, lateral, and anterior views of holotype, GMG 329/1, ×1; *e–gg,* serial transverse sections 0.9, 1.1, 1.4, 1.7, 2.1, 2.4, 2.7, 3.0, 3.2, 3.8, 4.0, 4.2, 4.5, 5.1, 5.7, 5.9, 6.1, 6.2, 6.3, 6.5, 6.9, 7.0, 7.2, 8.0, 8.4, 9.8, 11.4, 12.0, 12.3 mm from ventral umbo, ×1 (adapted from Kvakhadze, 1972).

Family AULACOTHYROPSIDAE Dagys, 1972

[Aulacothyropsidae Dagys, 1972b, p. 53]

Smooth, biconvex, rectimarginate to unisulcate or ligate; dental plates present; adult loop generally haptoid to diploform, less commonly teloform. *Middle Triassic–Holocene.*

Subfamily AULACOTHYROPSINAE Dagys, 1972

[*nom. transl.* MacKinnon, Smirnova, & Lee, herein, *ex* Aulacothyropsidae Dagys, 1972b, p. 53]

Adult loop generally haptoid to diploform, with tendency for late detachment from septum. *Middle Triassic–Holocene.*

Aulacothyropsis Dagys, 1959b, p. 99 [**Waldheimia (Aulacothyris) reflexa* Bittner, 1890, p. 258; OD]. Small, elongate-oval, planoconvex to ventribiconvex, mildly unisulcate; beak short, erect, with distinct beak ridges; foramen minute, mesothyrid. Dental plates parallel; pedicle collar fused laterally to dental plates. Cardinal process not differentiated; septalial trough shallow, with outer hinge plates and crural bases lying in commissural plane; median septum long and thin; adult loop diploform with incipient detachment from septum; crural processes, dorsal and anterior edges of loop spinose. *Middle Triassic–Upper Triassic:* Alps, Balkans, Carpathians, Crimea, northwestern Caucasus, Pamirs, China.——Fig. 1457,*1a–ff.* **A. reflexa* (Bittner), Norian, northwestern Caucasus; *a–c,* dorsal, lateral, anterior views, ×1.5 (Dagys, 1963); *d–dd,* serial transverse sections 0.1, 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4, 1.5, 1.6, 1.8, 2.0, 2.4, 2.8, 3.1, 3.3, 3.7, 3.8, 3.9, 4.0, 4.2, 4.5, 5.1, 5.8, 7.2, 7.9, 8.0 mm from ventral umbo, ×1; *ee–ff,* loop reconstructions, ×2 (Dagys, 1974).

Camerothyris Bittner, 1890, p. 318 [**Terebratula subangusta* Münster, 1841, p. 64; SD Diener, 1920, p. 98]. Small, smooth, planoconvex to biconvex, rectimarginate to unisulcate; beak short, erect; foramen small, mesothyrid. Dental plates uniting with ventral median septum to form Y-shaped, spondylium-like structure. Cardinal process not differentiated; well-developed septalium supported by bladelike median septum; adult loop diploform but possibly detached (through resorption) from septum. *Middle Triassic–Upper Triassic:* Alps, Carpathians, northwestern Caucasus.——Fig. 1458*a–c.* **C. subangusta* (Münster), Upper Triassic, Dolomites, Italy; dorsal, ventral, anterior views, ×2 (Dagys, 1974).——Fig. 1458*d–z. C. minor* Dagys, Upper Triassic, northwestern Caucasus; *d–x,* serial transverse sections 0.2, 0.3, 0.4, 0.5, 0.7, 0.9, 0.85, 0.9, 1.0, 1.1, 1.2, 1.4, 1.5, 1.7, 1.9, 2.0, 2.2, 2.3, 2.4, 2.6, 2.8 mm from ventral umbo, ×6 (adapted from Dagys, 1974); *y–z,* loop reconstructions, ×6 (Dagys, 1974).

Coriothyris Ovtsharenko, 1983b, p. 168 [**C. corumensis* Ovtsharenko, 1983b, p. 169; OD]. Small, oval or rounded-pentagonal, ventribiconvex, mildly unisulcate; beak short, erect to incurved with distinct beak ridges; formen minute, mesothyrid. Dental plates short, bladelike, ventrally divergent. Cardinal process not differentiated; outer hinge plates short, dorsally inclined, inner hinge plates ventrally curved, uniting early in ontogeny with high median septum to form septalium; crural processes short, parallel; adult loop teloform, extending about half length of dorsal valve, descending and ascending loop branches broad. *Middle Jurassic–Upper Jurassic:* Tadzhikistan, Pamirs.——Fig. 1457,*2a–ii.* **C. corumensis,* Tadzhikistan; *a–c,* dorsal, ventral, and anterior views, ×1 (Ovtsharenko, 1983b); *d–ii,* serial transverse sections 0.2, 0.5, 0.7, 1.0, 1.3, 1.5, 1.7, 2.1, 2.2, 2.8, 2.9, 3.5, 4.0, 4.1, 4.2, 4.3, 4.5, 4.7, 5.0, 5.3, 5.8, 6.2, 6.8, 7.5, 8.5, 8.7, 9.3, 9.7, 10.0, 10.1, 10.7, 10.9 mm from ventral umbo, ×1.8 (adapted from Ovtsharenko, 1983b).

Oppeliella Tchorszhevsky, 1989a, p. 81 [**Waldheimia pinguicula* Zittel, 1870, p. 139; OD]. Small, rounded-rhomboidal or transverse-oval, anterior commissure uniplicate, beak thick, short, moderately incurved, foramen small, mesothyrid, beak ridges short, sharp; deltidial plates conjunct; dental plates thick, short, slightly convergent ventrally; inner hinge plates fused posteromedianly, forming gently convex platform in section, median septum short, adult loop diploform. *Upper Jurassic (Tithonian):* Ukraine (Carpathians).——Fig. 1459,*4a–cc.* **O. pinguicula* (Zittel); *a–d,* dorsal,

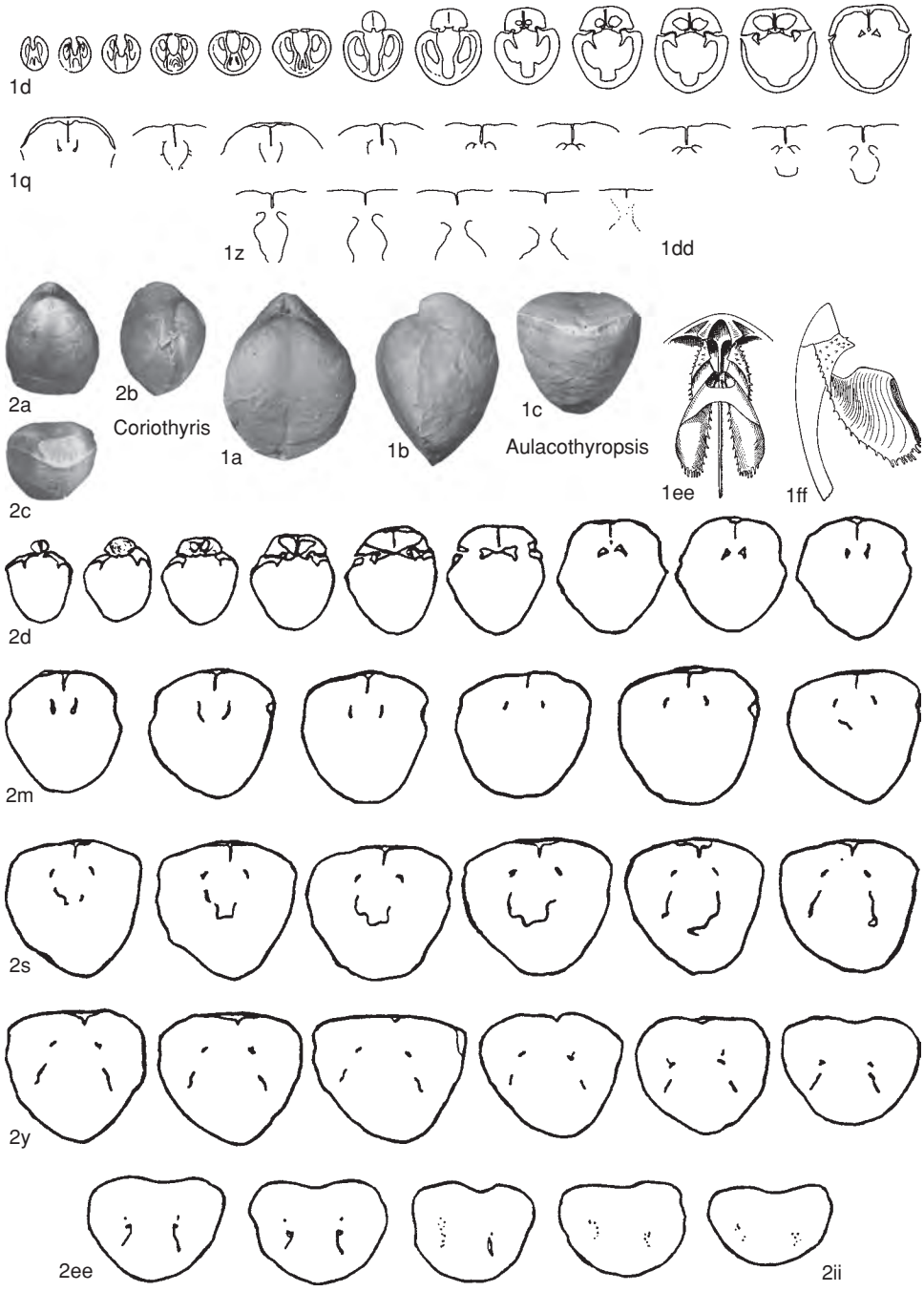

FIG. 1457. Aulacothyropsidae (p. 2194).

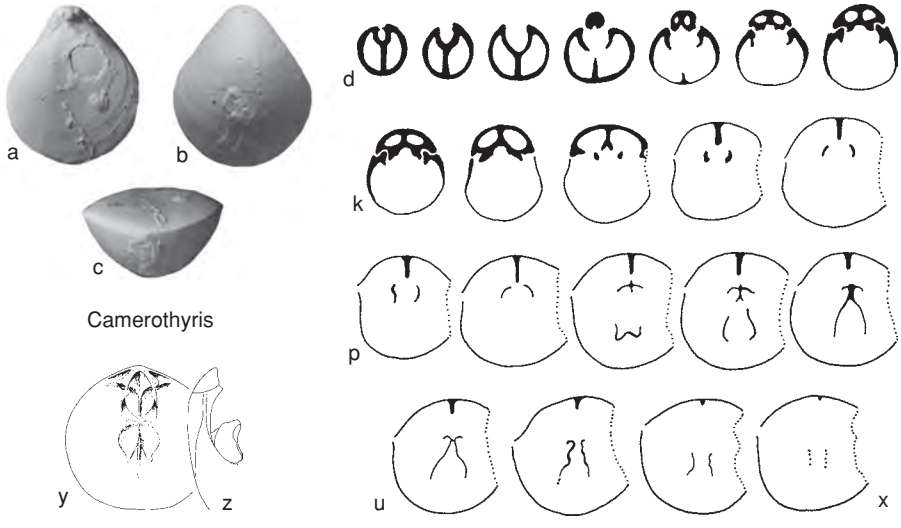

FIG. 1458. Aulacothyropsidae (p. 2194).

ventral, lateral, and anterior views of exterior, ×1 (Zittel, 1870); *e–cc,* serial transverse sections 0.0, 0.3, 0.5, 0.7, 0.85, 1.1, 1.3, 1.45, 1.65, 2.05, 2.45, 2.8, 3.15, 3.35, 3.55, 3.85, 4.15, 4.45, 4.65, 5.05, 5.25, 5.45, 6.45, 7.25, 8.45 mm from ventral umbo, ×2 (adapted from Tchorszhevsky, 1989a).

Ornatothyrella DAGYS, 1974, p. 210 [**O. ornata;* OD]. Very small, equibiconvex, ovoid outline, surface ornament of concentric rugae, anterior commissure rectimarginate, umbo short, erect, beak ridges distinct, foramen minute, mesothyrid; dental plates parallel, ventrally converging, pedicle collar absent; high dorsal median septum extending about 0.3 valve length, septalium Y-shaped. Adult loop resembling that of *Aulacothyropsis,* but less spinose and descending branches not medially united (i.e., adult loop of general diploform character but essentially teloform). *Upper Triassic (Norian):* northwestern Caucasus.——FIG. 1459,*1a–y. *O. ornata; a–d,* dorsal, ventral, lateral, and anterior views, ×2 (Dagys, 1974); *e–y,* serial transverse sections 0.0, 0.1, 0.2, 0.25, 0.35, 0.45, 0.55, 0.65, 0.75, 0.85, 1.05, 1.15, 1.25, 1.35, 1.45, 1.55, 1.65, 1.75, 1.85, 2.05, 2.65 mm from ventral umbo, approximately ×2 (adapted from Dagys, 1974).

Pseudorugitela DAGYS, 1959b, p. 100 [**Waldheimia (Aulacothyris) pulchella* BITTNER, 1890, p. 200; OD]. Small, biconvex, rounded subpentagonal in outline, surface ornament of concentric rugae, anterior commissure rectimarginate, tending to anterior ligation; umbo short, erect, beak ridges distinct, foramen minute, mesothyrid; dental plates thin, parallel, and united to pedicle collar; dorsal septalium Y-shaped, loop similar to that of *Aulacothyropsis* but spinose only anteriorly. *Upper Triassic (Carnian, Norian):* Alps, Carpathians, northwestern Caucasus, Pamirs, China.——FIG. 1459,*2a–dd. *P. pulchella* (BITTNER), Norian, Kuma River, northwestern Caucasus; *a–d,* dorsal, ventral, lateral, and anterior views, ×2 (Dagys, 1963); *e–cc,* serial transverse sections 0.0, 0.3, 0.6, 0.9, 1.3, 1.6, 1.8, 2.1, 2.3, 2.6, 3.0, 3.2, 3.5, 3.9, 4.2, 4.4, 5.0, 5.5, 5.7, 6.1, 6.5, 7.6, 8.9, 9.4, 10.3 mm from first section, ×2 (adapted from Dagys, 1959b); *dd,* loop reconstruction, ×4 (Dagys, 1974).

Smirnovina CALZADA BADIA, 1985, p. 88 [**S. smirnovae;* OD]. Small, smooth, subpentagonal, globose, anterior commissure unisulcate to plicosulcate, beak low, incurved, pedicle foramen small. Dental plates slender, subparallel; pedicle collar short, sessile. Cardinalia lamellar; inner hinge plates gently inclined and fused medianly to septum to form short septalium; median septum short, high, bladelike; loop diploform, strongly flared, with posteromedian lacuna and broad, dorsally convex, transverse band. *Lower Cretaceous:* Spain.——FIG. 1459,*3a–x. *S. smirnovae; a–d,* dorsal, ventral, lateral, and anterior views of exterior of holotype, MGSB 32.690.1, ×2 (Smirnova, 1990a); *e–x,* serial transverse sections 0.6, 1.0, 1.4, 2.3, 2.5, 2.7, 3.0, 3.4, 3.8, 4.0, 5.4, 5.9, 6.1, 6.3, 6.5, 6.7, 6.9, 8.0, 8.7, 9.3 mm from ventral umbo, ×1 (adapted from Calzada Badia, 1985).

Subfamily BABUKELLINAE new subfamily

[Babukellinae MacKinnon, Smirnova, & Lee, herein] [type genus, *Babukella* Dagys, 1974, p. 208]

Loop of adult generally haptoid to diploform, with retention of strong, mediovertical connection to septum. *Upper Triassic–Holocene.*

Babukella Dagys, 1974, p. 208 [**B. loculus;* OD]. Small, subpentagonal, ventribiconvex, strangulate, anterior commissure rectimarginate to unisulcate; beak short, attrite, with rounded beak ridges, foramen small, mesothyrid. Dental plates short. Cardinal process not differentiated; septalium distinct, dorsal median septum high, about 0.6 valve length. Loop diploform, with spinose anterior edges. *Upper Triassic:* northwestern Caucasus, Pamirs.——Fig. 1460,*5a–ff. *B. loculus,* Carnian, northwestern Caucasus; *a–d,* dorsal, ventral, lateral, and anterior views, ×2; *e–dd,* serial transverse sections 0.0, 0.1, 0.2, 0.3, 0.5, 0.7, 0.9, 1.0, 1.1, 1.2, 1.4, 1.5, 1.7, 1.9, 2.0, 2.2, 2.5, 2.7, 2.8, 2.9, 3.1, 3.3, 3.6, 3.8, 4.2, 4.5 mm from ventral umbo, ×2; *ee–ff,* loop reconstructions, ×4 (Dagys, 1974).

Fallax Atkins, 1960a, p. 72 [**F. dalliniformis;* OD]. Medium, biconvex, smooth, elongate ovate to subpentagonal, anterior commissure rectimarginate to parasulcate; beak low, erect; beak ridges rounded; deltidial plates conjunct in adults; foramen small, round, permesothyrid. Dental plates lamellar, straight; pedicle collar broad, sessile, impunctate. Cardinalia lamellar with short, well-developed septalium; inner and outer hinge plates well developed, crural bases not differentiated; cardinal process not differentiated; median septum extending anteriorly about three-quarters valve length; crura short, subparallel, crural processes short; loop diploform; lophophore and mantle finely spiculate. *Holocene:* eastern Atlantic, western and southwestern Pacific.——Fig. 1460,*4a–e. *F. dalliniformis; a–c,* dorsal, lateral, and anterior views of holotype, NHM ZB2988, ×1 (Atkins, 1960a); *d,* dorsal interior showing diploform loop; *e,* oblique view of ventral valve interior showing dental plates and muscle scars, ×2 (new).

Hynniphoria Suess, 1859 in 1858–1859, p. 44 [**H. globularis;* OD]. Small, globose, smooth, broadly uniplicate; beak low, erect to incurved, beak ridges indistinct, deltidial structures small and obscure, foramen very small. Ventral interior with dental plates and stout, apparently composite, median septal structure that projects free anteriorly as curved and thickening, blade- or scimitar-like structure, extending dorsally into shell cavity. Dorsal interior bearing stout inner socket ridges; median septum short, low, diminishing rapidly anteriorly; loop possibly diploform. [Loop and other internal features imperfectly known.] *Upper Jurassic:* central Europe.——Fig. 1460,*3a–e. *H. globularis; a–c,* dorsal, lateral, and anterior views, ×2; *d,* lateral view of shell interior, reconstruction; *e,* oblique view of loop, reconstruction, approximately ×10 (Suess, 1858 in 1858–1859).

Katchathyris Smirnova, 1975b, p. 120 [**K. privus;* OD]. Small, moderately biconvex, subcircular in outline, capillate, anterior commissure rectimarginate, beak low, slightly incurved, foramen permesothyrid; dorsal interior with broad, V-shaped septalium, septum extending for 0.3 valve length, crural processes short, loop diploform, extending about 0.75 valve length. *Lower Cretaceous:* Crimea, Ukraine.——Fig. 1461,*2a–ww. *K. privus,* Crimea; *a–d,* ventral, dorsal, lateral, and anterior views of holotype, MGU 136/440, ×2.5 (Smirnova, 1975b); *e–uu,* serial transverse sections 0.0, 0.05, 0.1, 0.15, 0.25, 0.35, 0.55, 0.75, 0.85, 0.95, 1.0, 1.05, 1.1, 1.15, 1.2, 1.3, 1.35, 1.45, 1.5, 1.55, 1.75, 1.85, 1.9, 2.1, 2.2, 2.3, 2.4, 2.45, 2.5, 2.6, 2.7, 2.75, 2.8, 2.85, 2.9, 2.95, 3.0, 3.1, 3.15, 3.2, 3.3, 3.4, 3.5 mm from ventral umbo, ×2.5 (adapted from Smirnova, 1975b); *vv–ww,* loop reconstructions, ×3 (Smirnova, 1975b).

Makridinithyris Tchorszhevsky, 1989a, p. 82 [**Terebratula wahlenbergi* Zeuschner, 1846, p. 83; OD]. Small, strongly biconvex, subtrigonal or subpentagonal in outline, beak small, trigonal, erect to moderately incurved, foramen small, mesothyrid, beak ridges short, sharp; dental plates thin, ventrally convergent, trigonal septalium; crura prefalcifer, loop slender, relatively short, diploform. *Upper Jurassic (Tithonian)–Lower Cretaceous (Berriasian):* Ukraine (Carpathians).——Fig. 1460,*1a–t. *M. wahlenbergi* (Zeuschner), Tithonian; *a–d,* dorsal, ventral, lateral, and anterior views of possible lectotype, ×1 (Zittel, 1870); *e–t,* serial transverse sections 0.0, 0.8, 1.1, 1.3, 1.5, 2.0, 2.4, 2.6, 3.1, 3.3, 3.5, 4.3, 4.6, 5.1, 5.5, 6.5 mm from ventral umbo, ×1 (adapted from Barczyk, 1971).

Septicollarina Zezina, 1981c, p. 16 [**S. hemiechinata;* OD]. Small, thin shelled, transversely oval, biconvex, anterior commissure slightly unisulcate; dorsal valve smooth; ventral valve carrying small low spines; beak straight, short, foramen permesothyrid, deltidial plates narrow, disjunct; dental plates straight, well developed; short septum in ventral valve dividing cavity beneath wide pedicle collar into two chambers; no cardinal process; inner hinge plates attached to long median septum; spicules not present; loop diploform, anteriorly spinose. *Holocene:* western Pacific (Sea of Japan).——Fig. 1460,*2a–c. *S. hemiechinata; a–b,* exterior and interior views of ventral valve, ×4; *c,* line drawing of dorsal valve interior, ×4 (Zezina, 1981c).

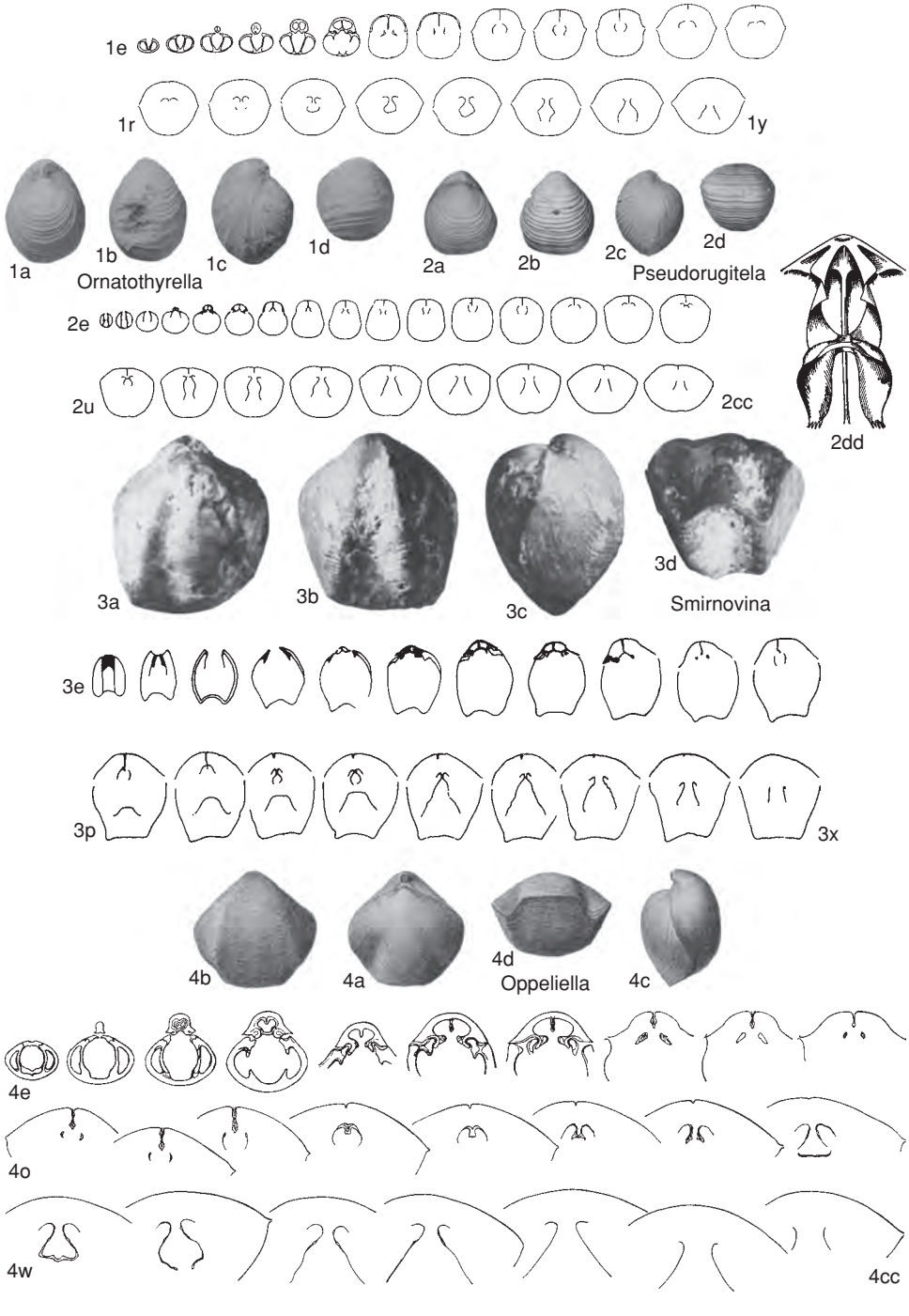

FIG. 1459. Aulacothyropsidae (p. 2194–2196).

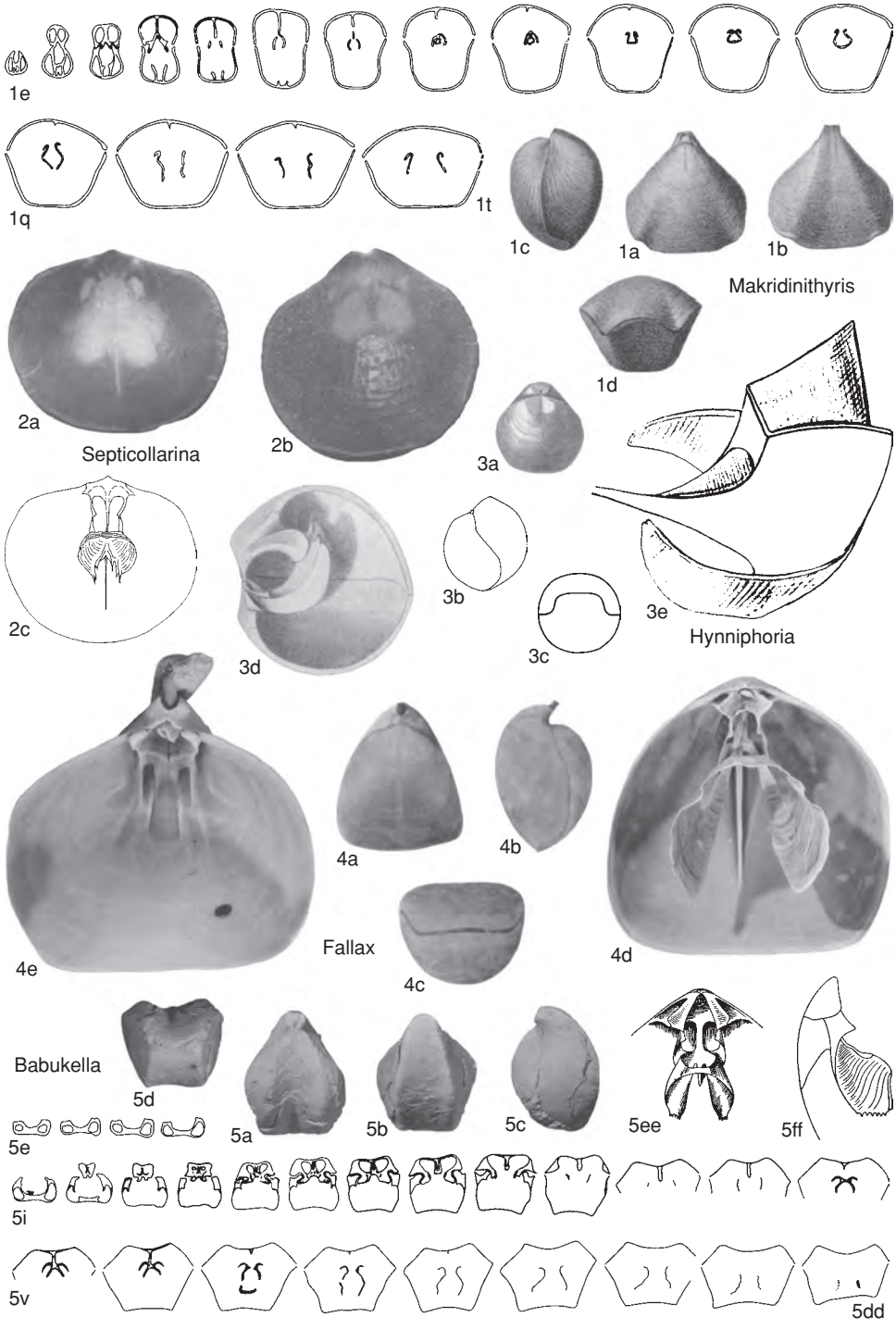

FIG. 1460. Aulacothyropsidae (p. 2197).

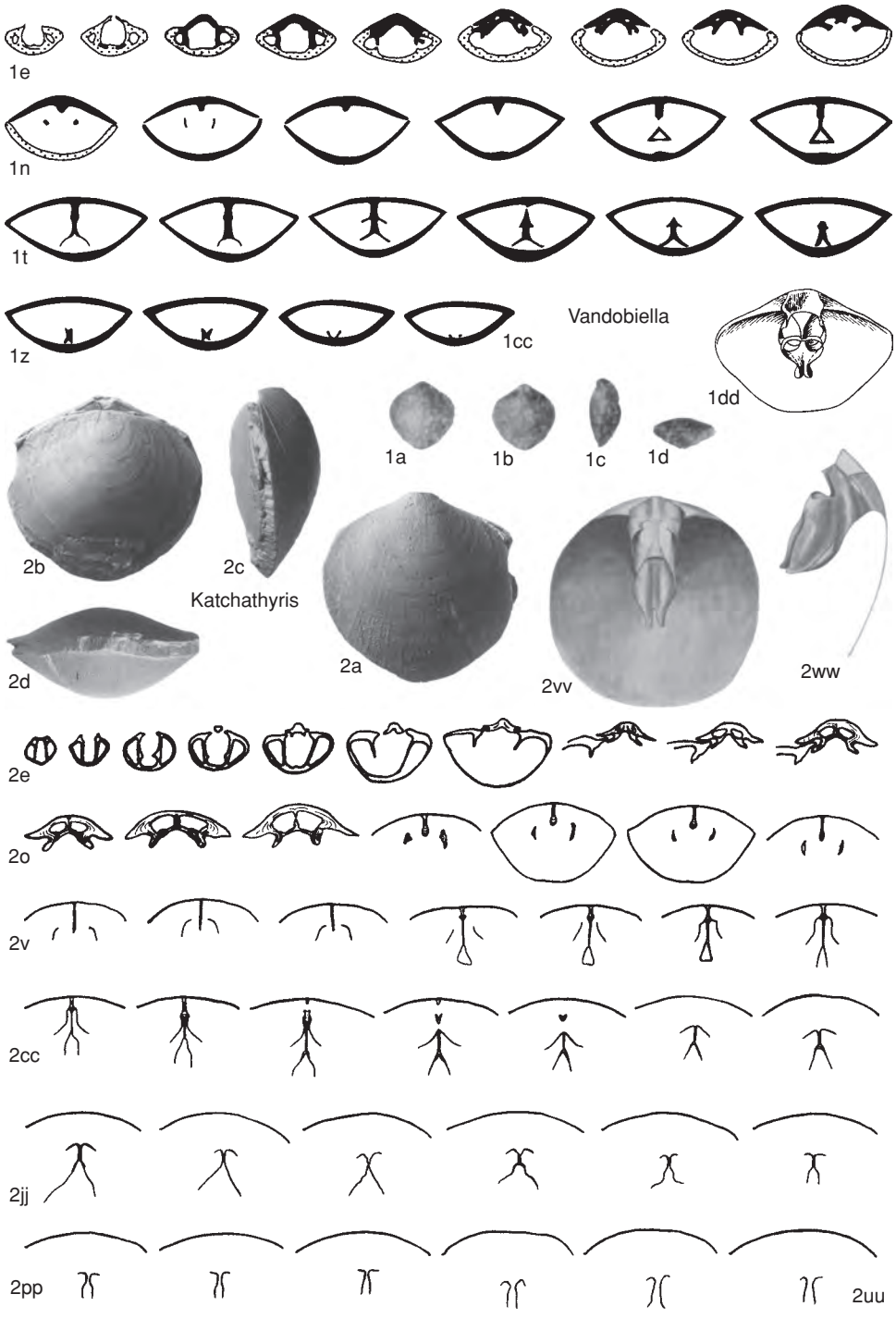

FIG. 1461. Aulacothyropsidae (p. 2197–2201).

Vandobiella POJARISKAJA, 1966, p. 22 [**V. perpusilla;* OD]. Small, planoconvex or slightly biconvex, subcircular to subrhomboidal in outline, umbo broad, erect, beak ridges sharp, foramen large, oval, submesothyrid to mesothyrid, deltidial plates disjunct. Teeth elongate, wedge shaped; dental plates short, thick; inner hinge plates converging on valve floor to form V-shaped trough; cardinal process weakly developed; well-developed median septum associated with diploform loop. *Middle Jurassic (Bathonian):* Tadzhikistan (Gissar Range).——FIG. 1461,*1a–dd. *V. perpusilla; a–d,* ventral, dorsal, lateral, and anterior views of holotype, MGRI Museum No. VI-152/9, ×1 (Pojariskaja, 1966); *e–cc,* serial transverse sections, ×2 (adapted from Pojariskaja, 1966); *dd,* loop reconstruction, ×3 (Pojariskaja, 1966).

LAQUEOIDEA

D. I. MACKINNON and D. E. LEE

[University of Canterbury; and University of Otago]

Superfamily LAQUEOIDEA Thomson, 1927

[*nom. transl.* MACKINNON & LEE, herein, *ex* Laqueinae THOMSON, 1927, p. 256]

Adult shells small to large, subcircular to transverse or elongate oval, commonly smooth, some multicostate, anterior commissure rectimarginate to unisulcate, foramen small to large, with deltidial plates conjunct, disjunct, or forming symphytium. Pedicle collar broad and sessile. Dental plates well developed; cardinal process with transversely oval myophore, which may be sessile or elevated; dorsal septal pillar or median septum present; outer hinge plates commonly well developed; inner hinge plates absent, disjunct, or united to form septalium; crural bases differentiated when septalium present. Adult loop axial, annular, haptoid, trabecular, bilacunar, bilateral, or laterovertical. Septal flanges present on septal pillar during axial, cucullate, and annular phases of loop ontogeny. Lophophore plectolophous. *Upper Triassic–Holocene.*

Family LAQUEIDAE Thomson, 1927

[*nom. transl.* COOPER, 1973a, p. 21, *ex* Laqueinae THOMSON, 1927, p. 256]

Well-developed inner and outer hinge plates separated by crural bases; septalium well developed; cardinal process weakly differentiated; adult loop axial, haptoid, or bilateral. *Upper Triassic–Holocene.*

Subfamily LAQUEINAE Thomson, 1927

[Laqueinae THOMSON, 1927, p. 256; *non* HATAI, 1965c, p. 845]

Adult loop bilateral. *Neogene (Miocene)–Holocene.*

Laqueus DALL, 1870, p. 123 [**Terebratula californiana* KÜSTER, 1844, pl. 2b,*21–23;* OD; =*Laqueus erythraeus* DALL, 1920, p. 350, SD MACKINNON & LONG, 2000, p. 89; =*L. californicus* DALL, 1870, p. 123)]. Medium to large, variably ovate, subpentagonal to ligate, biconvex, smooth; anterior commissure rectimarginate; beak low, erect, with distinct beak ridges, foramen medium, mesothyrid to permesothyrid; either symphytium or conjunct deltidial plates. Hinge teeth with ventrally recessive dental plates; pedicle collar sessile. Cardinalia with inner and outer hinge plates separated by crural

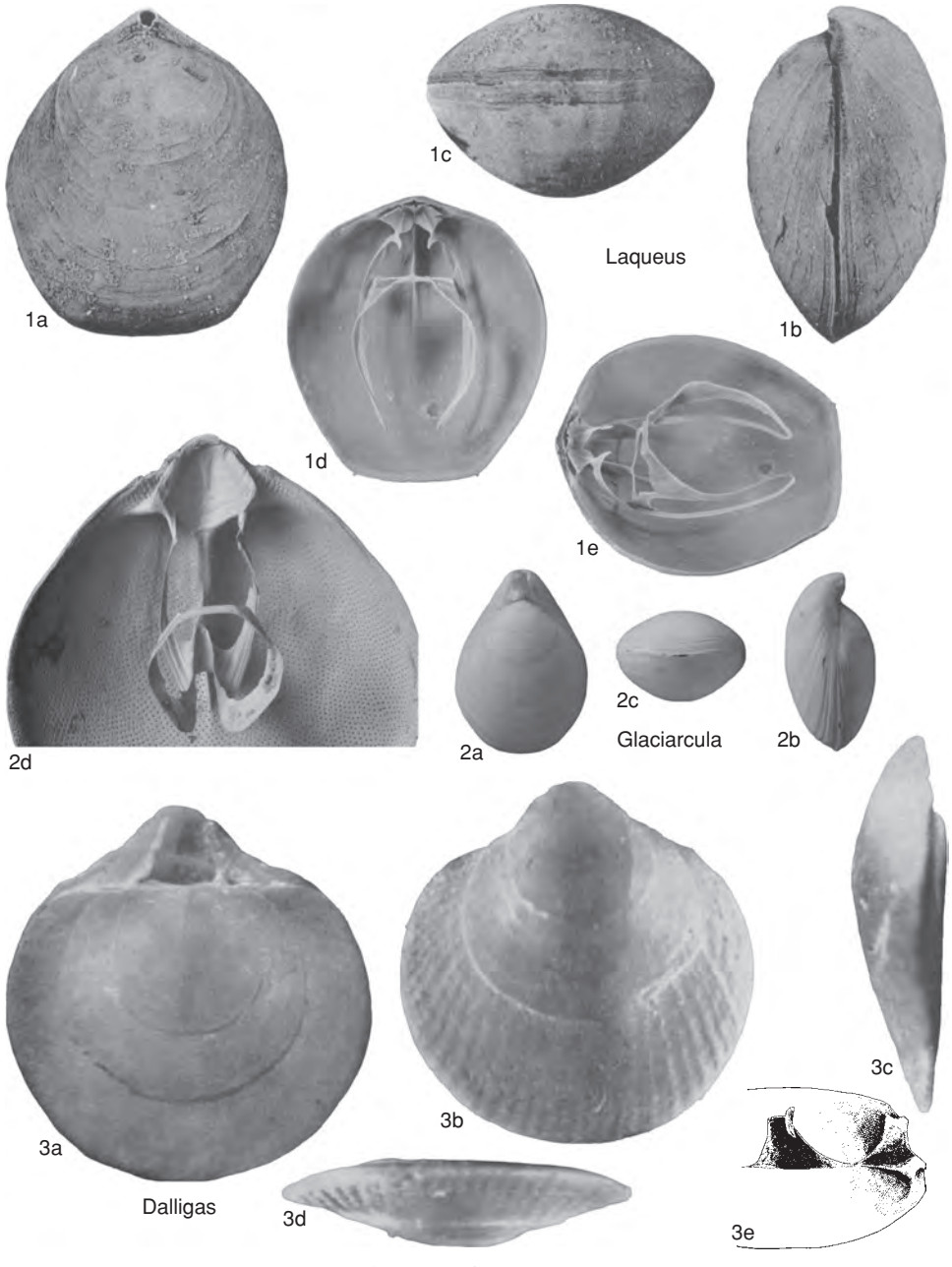

FIG. 1462. Laqueidae (p. 2201–2209).

bases; inner hinge plates uniting with median septum to form septalium; cardinal process a very short, transverse myophore; mantle canals spiculate; adult loop bilateral. [Type species now fixed (under Article 70.3 of the *Code,* ICZN, 1999) as *Laqueus erythraeus* DALL, 1920, misidentified as *Terebratula californiana* KÜSTER, 1844, in the original designation by DALL (1870).] *Neogene (Miocene)–Holocene:* circum-north Pacific Ocean from California to Japan.——FIG. 1462,*1a–e.* **L. erythraeus,* Holocene, California, USA; *a–c,* dorsal, lateral, and anterior views of holotype, USNM 19395, ×1 (Hertlein &

Grant, 1944); *d–e,* normal and lateral oblique view of dorsal interior showing loop, ×1 (new).

Subfamily PARAKINGENINAE Sun, 1981

[Parakingeninae Sun, 1981, p. 249]

Adult loop bilateral, with relatively robust lateral and vertical connecting bands forming a broad, hoodlike ring. *Lower Cretaceous–Upper Cretaceous.*

Parakingena Sun, 1981, p. 250 [**P. xizangensis;* OD]. Medium, roundly pentagonal, ventribiconvex; anterior commissure rectimarginate; beak short, erect; beak ridges angular; foramen large, subcircular, permesothyrid; deltidial plates narrow, disjunct; exterior finely pustulate with low plicae near anterior margin. Dental plates long, divergent. Cardinal process low, bilobate, inner hinge plates subhorizontal, uniting medianly and supported by bladelike median septum; loop bilacunar. [The figured specimen (possibly the holotype) and the specimen serially sectioned by Sun possess the same registration number; therefore it would appear that the holotype has been serially sectioned]. *Lower Cretaceous–Upper Cretaceous:* Tibet.——Fig. 1463,*1a–dd. *P. xizangensis,* Lower Cretaceous; *a–c,* dorsal, lateral, and anterior views, ×1 (Sun, 1981); *d–dd,* serial transverse sections 0.2, 0.9, 1.8, 2.2, 2.6, 3.0, 3.3, 3.6, 4.0, 4.4, 5.2, 5.7, 6.8, 7.0, 7.1, 7.4, 7.8, 8.1, 8.5, 9.0, 9.7, 11.0, 11.3, 12.0, 15.3, 15.5, 15.8 mm from ventral umbo, ×1 (adapted from Sun, 1981).

Colinella Owen, 1981, p. 306 [**Antiptychina? müllerriedi* Imlay, 1937, p. 568; OD] [=*Nekvasilovela* Calzada Badia, 1987, p. 321 (type, *N. magransi* Calzada Badia, 1987, p. 322)]. Subpentagonal to broadly oval, smooth, biconvex, plicosulcate; beak low, erect to incurved, attrite; beak ridges sharp; foramen medium, permesothyrid. Dental plates short, thickened, slightly convergent. Cardinal process not differentiated, septalium well developed, adult loop bilateral. *Lower Cretaceous (Valanginian–Hauterivian):* Mexico, Morocco.——Fig. 1463,*2a–hh. *C. muellerriedi* (Imlay), Mexico; *a–d,* dorsal, ventral, lateral, and anterior views of holotype, U.M. 18752, ×1 (Imlay, 1937); *e–hh,* serial transverse sections 0.6, 1.0, 1.3, 1.6, 1.8, 2.0, 2.4, 2.7, 2.9, 3.1, 3.3, 3.5, 3.7, 3.9, 4.2, 4.4, 4.6, 4.8, 5.0, 5.3, 5.5, 5.7, 5.9, 6.1, 6.3, 6.5, 6.7, 6.9, 7.2, 7.5 mm from ventral umbo, ×2 (adapted from Owen, 1981).

Langshanthyris Sun, 1987, p. 89 [100] [**L. xizangensis;* OD]. Small, transversely rhomboidal to roundly pentagonal, ventribiconvex, anterior commissure rectimarginate to parasulcate; shell smooth, occasionally with low and short plicae near anterior commissure. Beak low, erect; beak ridges subangular; foramen large, permesothyrid; deltidial plates disjunct. Dental plates long, stout; pedicle collar excavate, resting on low, bladelike, ventral median septum. Cardinal process low and lobate; loop bilateral. *Lower Cretaceous:* Tibet.——Fig. 1464,*1a–ee. *L. xizangensis; a–c,* dorsal, lateral, and anterior views of holotype, NIGP 79212, ×2 (Sun, 1987); *d–ee,* serial transverse sections 0.2, 0.6, 0.9, 1.2, 1.6, 1.9, 2.3, 2.7, 2.8, 2.9, 3.2, 3.5, 3.7, 4.0, 4.1, 4.3, 4.4, 4.8, 5.3, 5.4, 5.7, 5.9, 6.4, 6.8, 7.3, 8.9, 9.3, 9.9 mm from ventral umbo, ×1 (adapted from Sun, 1987).

Rossithyris Owen, 1980, p. 138 [**R. humpensis;* OD]. Small, oval, biconvex, rectimarginate; shell smooth; beak low, erect; foramen small, permesothyrid. Dental plates short, subparallel, supporting inwardly directed, peglike hinge teeth. Septalium Y-shaped, consisting of steeply inclined inner hinge plates fused to high, bladelike median septum; loop bilateral. *Upper Cretaceous (Campanian):* Antarctica (James Ross Island).——Fig. 1463,*3a–p. *R. humpensis; a,* dorsal view of holotype, NHM BB 76773, ×1.5 (Owen, 1980); *b–p,* serial transverse sections 1.2, 1.4, 1.6, 2.0, 2.2, 2.5, 2.7, 2.9, 3.1, 3.3, 3.5, 3.8, 4.0, 4.2, 4.5 mm from ventral umbo, ×2 (adapted from Owen, 1980).

Waconella Owen, 1970, p. 74 [**Terebratula wacoensis* Roemer, 1852, p. 81; OD]. Medium, smooth, biconvex, oval-pentagonal to elongate-oval; anterior commissure rectimarginate; beak erect, beak ridges sharp; foramen small, permesothyrid; deltidial plates conjunct. Cardinal process not differentiated; septalium well developed; median septum extending about half valve length; adult loop bilateral. *Cretaceous (Albian–Cenomanian):* USA (Texas), Mexico.——Fig. 1464,*2a–y. *W. wacoensis* (Roemer), Texas, USA; *a–c,* dorsal, lateral, and anterior views, ×2 (Owen, 1970); *d–y,* serial transverse sections 0.4, 1.4, 1.7, 2.1, 2.6, 3.0, 3.6, 4.0, 4.4, 4.7, 5.1, 5.6, 6.9, 6.3, 6.6, 7.1, 7.5, 7.9, 8.2, 8.6, 8.9, 9.3 mm from ventral umbo, ×2 (adapted from Owen, 1970).

Subfamily TEREBRATALIOPSINAE Smirnova, 1990

[Terebrataliopsinae Smirnova, 1990a, p. 108]

Shells smooth, usually unisulcate; cardinal process indistinct. *Upper Triassic–Upper Cretaceous.*

Terebrataliopsis Smirnova, 1962, p. 98 [**T. quadrata;* OD]. Small, ventribiconvex, subpentagonal in outline, ventral valve roundly carinate, commissure rectimarginate to unisulcate; beak erect, foramen small, circular, beak ridges sharp. Hinge teeth broad, denticulum present, dental plates short, ventrally divergent, pedicle collar present. Hinge plates united medially and supported by median septum that extends for 0.6 valve length, loop trabecular, spinose. *Upper Jurassic–Lower Cretaceous:* Poland, Czech Republic, *Upper Jurassic;* Crimea, Caucasus, Mangyshlak, *Lower Cretaceous.*—— Fig. 1465,*3a–mm. *T. quadrata,* Lower Cretaceous,

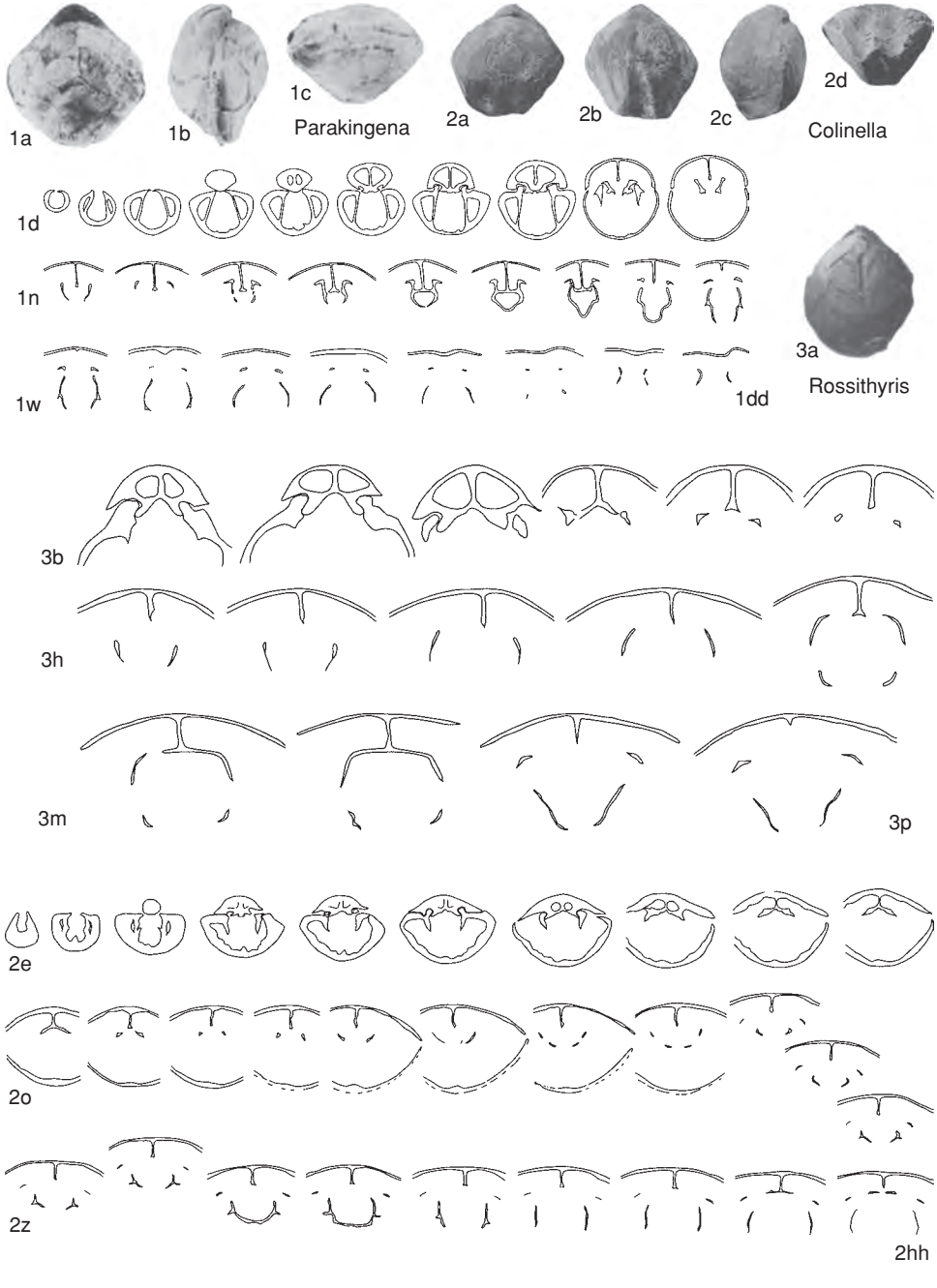

FIG. 1463. Laqueidae (p. 2203).

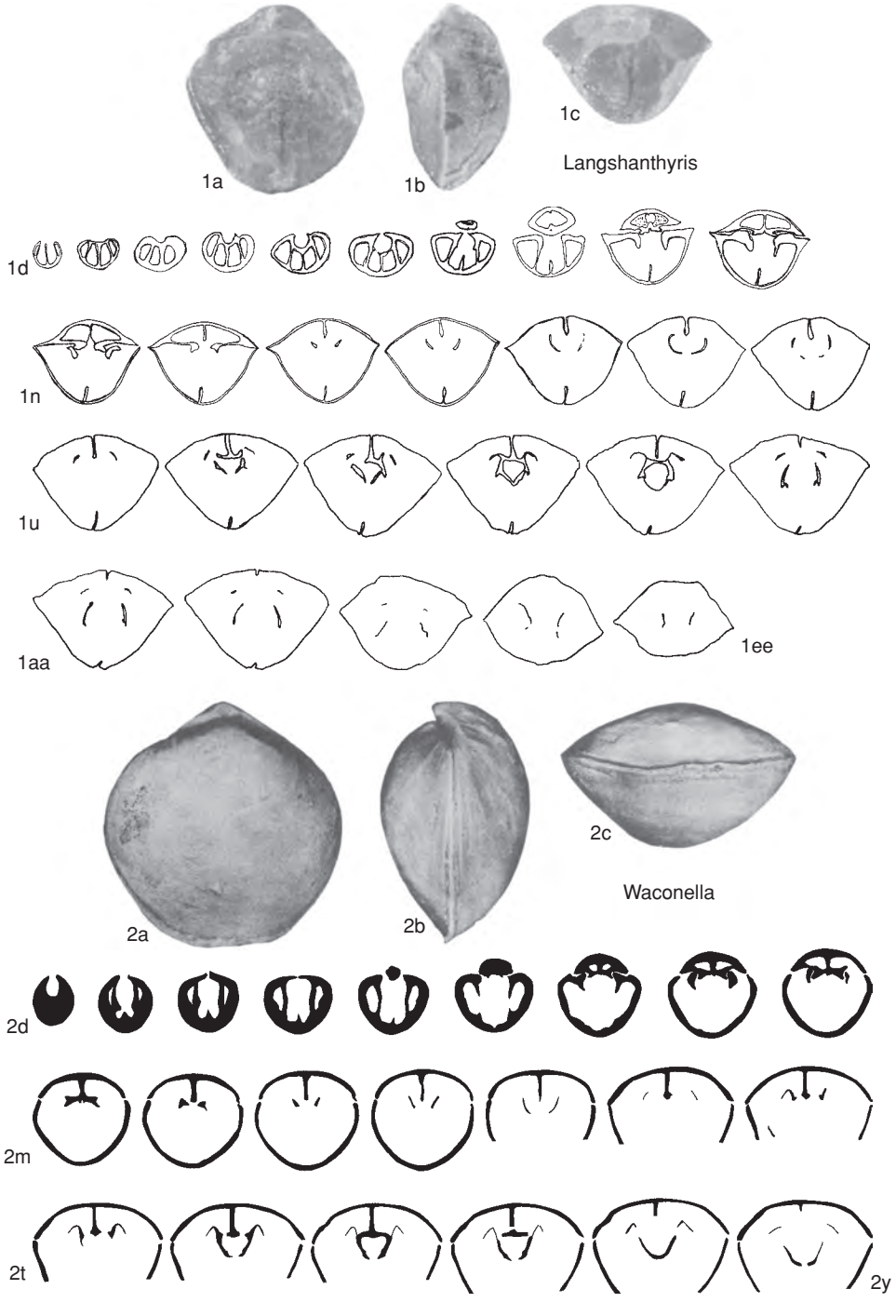

FIG. 1464. Laqueidae (p. 2203).

Crimea; *a–c,* dorsal, lateral, and anterior views, ×3 (new); *d–kk,* serial transverse sections 0.0, 0.75, 1.4, 1.9, 2.15, 2.25, 2.5, 2.65, 2.75, 2.85, 3.0, 3.25, 3.55, 3.95, 4.45, 4.65, 4.95, 5.45, 5.9, 6.1, 6.45, 6.7, 7.05, 7.35, 7.6, 7.75, 8.1, 8.7, 9.1, 9.6, 9.8, 10.5, 10.8, 11.1 mm from first section, ×1.5 (adapted from Smirnova, 1962); *ll–mm,* loop reconstructions, ×3 (Muir-Wood, 1965a).

Eodallina Elliott, 1959, p. 146 [**E. peruviana;* OD]. Small, smooth, biconvex; anterior commissure beak erect, foramen hypothyrid, apparently lacking deltidial plates. Ventral interior with short, strong dental plates; low median ridge bisecting ventral muscle scars, extending to about midvalve. Septalium well developed, dorsal median septum extending anteriorly beyond midlength; loop diploform with spinose leading edges, crural processes short, transverse band of hood narrow. *Upper Triassic:* Peru.——Fig. 1465,*1a–c. *E. peruviana; a–b,* dorsal and lateral views, ×4 ; *c,* dorsal interior, reconstruction, ×4 (Stehli, 1956c).

Hamptonina Rollier, 1919, p. 360 [**Terebratella buckmani* Moore, 1860, p. 441; OD]. Small, subpentagonal, biconvex, rectimarginate; beak short, suberect, attrite, foramen circular; deltidial plates small, disjunct. Dorsal interior with inner socket ridges enclosing concave hinge plate, cardinal process small, transverse; dorsal median septum low posteriorly, rising steeply anteriorly, loop haptoid to diploform with spinose edges, moderately long crural processes. *Middle Jurassic:* England.——Fig. 1465,*2a–d. *H. buckmani* (Moore); *a–c,* dorsal, lateral, and anterior views, ×3 (new); *d,* dorsal valve interior showing loop, reconstruction, ×4 (Elliott, 1965a).

Kafirnigania Katz, 1962, p. 138 [**K. pentangulata;* OD]. Small, elongate-subpentagonal in outline, smooth, biconvex; anterior commissure weakly uniplicate, less commonly rectimarginate; beak erect, beak ridges sharp; foramen submesothyrid; deltidial plates disjunct. Dental plates slightly convex, diverging from beak; lateral umbonal cavities deep. Well-developed, Y-shaped septalium. Loop (possibly incipiently) trabecular; haptoid and diploform juvenile loop stages also known. *Upper Cretaceous (Turonian):* Tadzhikistan Republic.——Fig. 1466,*2a–hh. *K. pentangulata; a–c,* holotype, dorsal, lateral, and anterior views, No. 4-770/1, author's collection, Kharkov State University, ×1; *d–gg,* transverse serial sections 0.3, 0.4, 0.5, 0.7, 1.0, 1.2, 1.5, 1.8, 2.0, 2.1, 2.4, 2.6, 2.7, 2.8, 3.1, 3.7, 3.9, 4.1, 4.3, 4.5, 4.7, 4.9, 5.0, 5.3, 5.7, 6.2, 6.8, 7.4, 8.0, 8.2 mm from ventral umbo, ×1 (Katz, 1962); *hh,* loop reconstruction, ×2 (adapted from Katz, 1962).

Psilothyris Cooper, 1955b, p. 10 [**P. occidentalis;* OD] [=*Tamarella* Owen, 1965, p. 57 (type, *Terebratula tamarindus* J. de C. Sowerby in Fitton, 1836, p. 338)]. Small to medium size, smooth, biconvex, ovate to subpentagonal, rectimarginate to uniplicate, umbo erect, foramen small to large, round, mesothyrid, deltidial plates disjunct to conjunct; dental plates bladelike; cardinal process small, hinge plates fused, medianly concave; median septum short, slender, extending about 0.3 valve length, hinge plates fused with septum posteriorly to form septalium but may be free of hinge plates anteriorly; loop teloform, with short crura and long crural processes. *Lower Cretaceous–Upper Cretaceous:* North America; Europe, *Lower Cretaceous.*——Fig. 1466,*1a–e. *P. occidentalis,* Lower Cretaceous, Arizona, USA; *a–d,* dorsal, lateral, anterior, and posterior views of holotype, USNM 124191, ×2 (Cooper, 1955b); *e,* posterior part of interior of conjoined valves showing dental plates, medianly fused inner hinge plates with upturned edges, crura, and partially descending loop branches, ×4 (Cooper, 1955b).

Subfamily GLACIARCULINAE new subfamily

[Glaciarculinae MacKinnon & Lee, herein] [type genus, *Glaciarcula* Elliott, 1956, p. 285]

Adult loop haptoid. *Pleistocene–Holocene.*

Glaciarcula Elliott, 1956, p. 285 [**Terebratella spitzbergensis* Davidson, 1852c, p. 78; OD]. Small, elongate-pyriform, biconvex, smooth, thin shelled, rectimarginate; ventral beak elongate, moderately incurved, suberect, attrite; foramen mesothyrid; deltidial plates long, narrow, disjunct. Hinge teeth supported by vertical, lamellar dental plates; pedicle collar long, sessile. Cardinalia with well-developed inner and outer hinge plates; inner hinge plates steeply inclined, uniting with low median septum to form septalium; cardinal process a very short, transverse myophore; septal flanges developed on juvenile septal pillar; adult loop haptoid to incipiently trabecular. *Pleistocene–Holocene:* Scandanavia, *Pleistocene;* North Atlantic, Arctic, North Pacific, *Holocene.*——Fig. 1462,*2a–d. *G. spitzbergensis* (Davidson), Holocene, North Atlantic; *a–c,* dorsal, lateral, and anterior views of holotype, ZB1518, ×3; *d,* dorsal interior showing loop and cardinalia, ×6 (new).

Subfamily DALLIGADINAE new subfamily

[Dalligadinae MacKinnon & Lee, herein] [type genus, *Dalligas* Steinich, 1968b, p. 336]

Shells minute to small; adult loop axial with septal flanges. *Upper Cretaceous (Maastrichtian).*

Dalligas Steinich, 1968b, p. 336 [**D. nobilis;* OD]. Minute to small, thin shelled, elongate-oval to subcircular, weakly capillate, hinge line straight, anterior commissure rectimarginate; beak erect, foramen large, hypothyrid. Cardinal process not differentiated; cardinalia consisting of sessile septalium, crura absent; loop axial with laterally directed septal flanges on posteroventral edge of

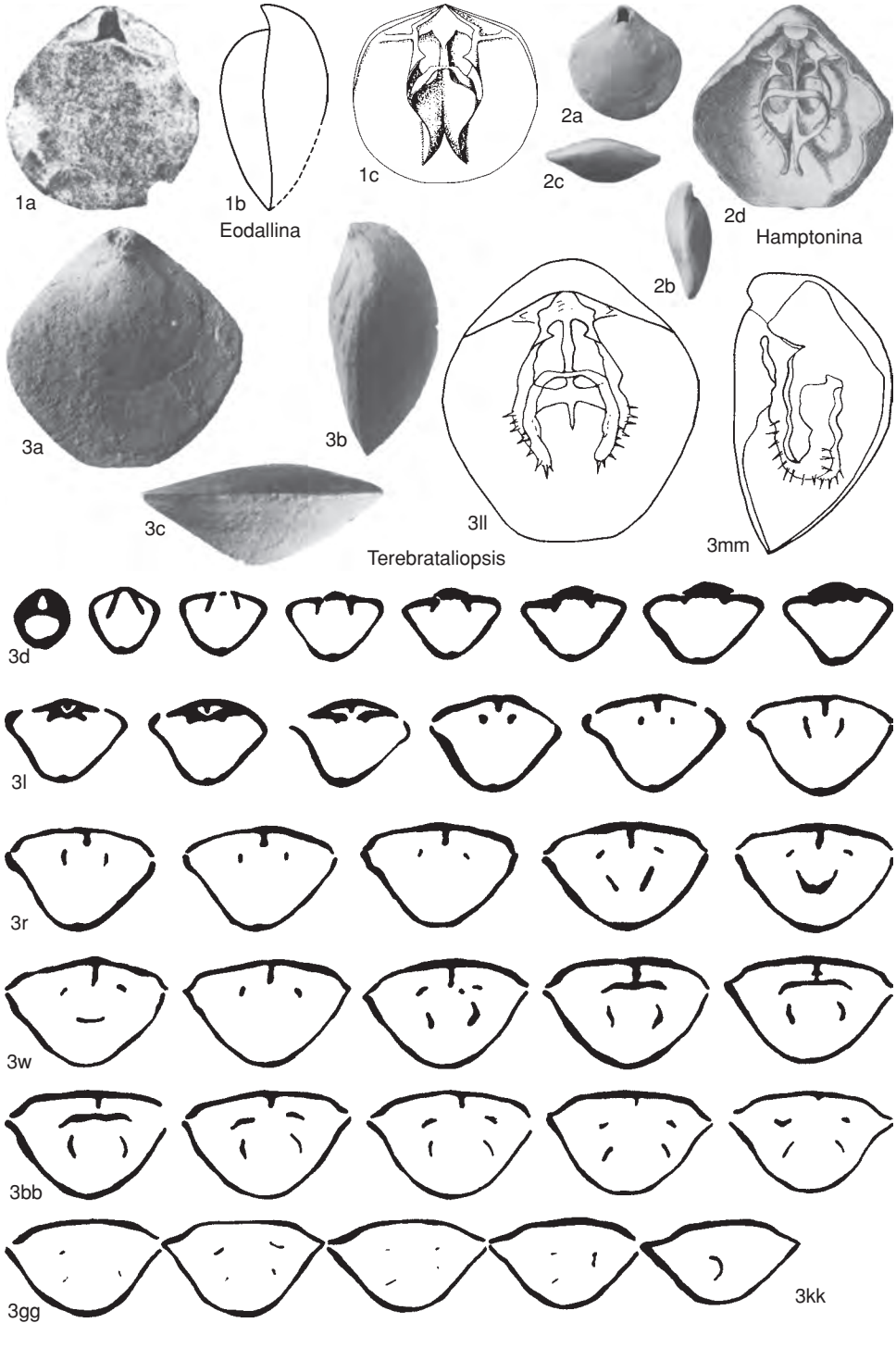

FIG. 1465. Laqueidae (p. 2203–2206).

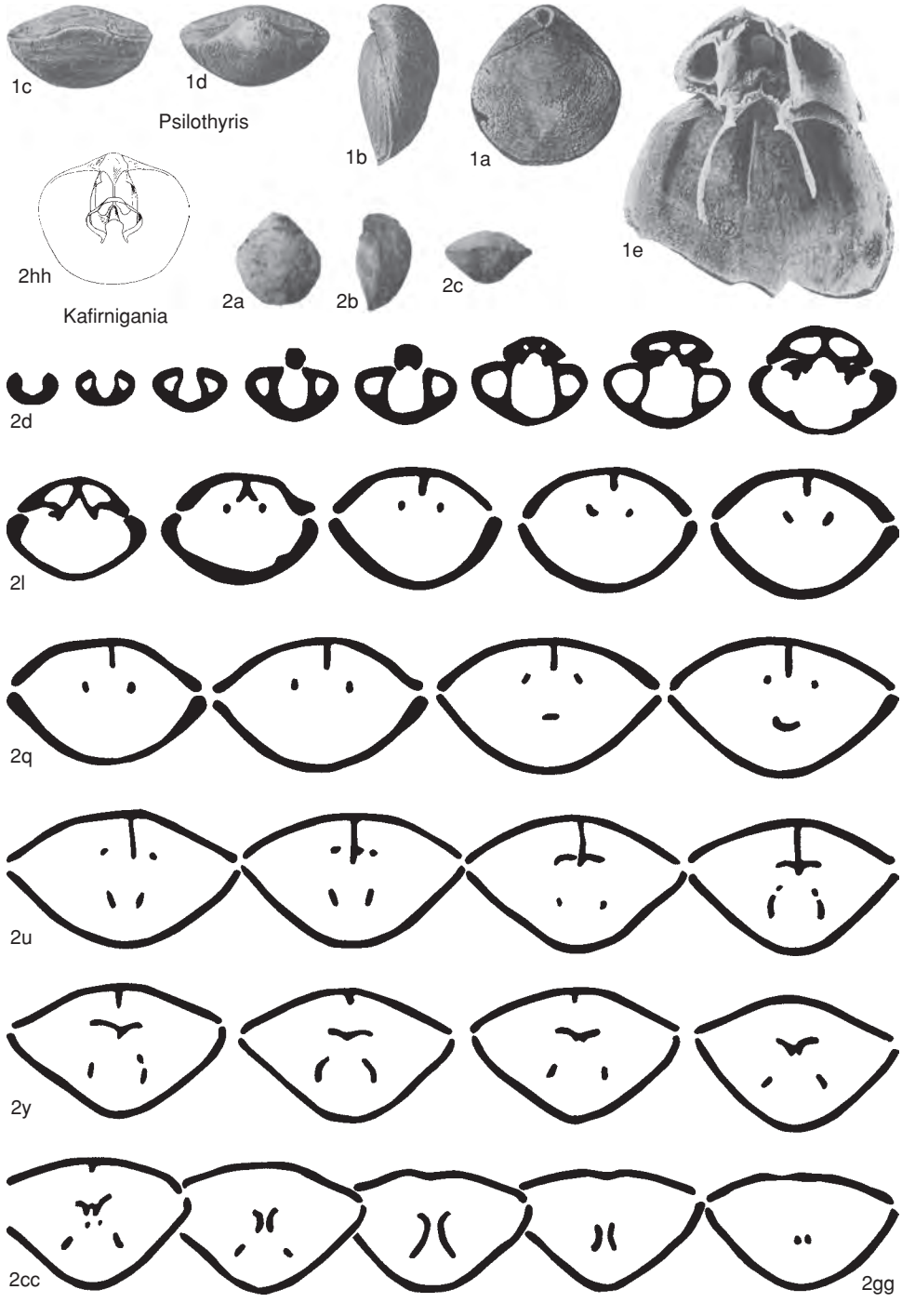

FIG. 1466. Laqueidae (p. 2206).

high septal pillar. Lophophore spiculate. *Upper Cretaceous (Maastrichtian):* Western Europe.——Fig. 1462,*3a–e. *D. nobilis,* Germany; *a–d,* dorsal, ventral, lateral, and anterior views, ×10 (Steinich, 1968); *e,* lateral oblique view of dorsal interior, ×10 (Steinich, 1968b).

Family FRENULINIDAE Hatai, 1938

[*nom. transl.* MacKinnon & Lee, herein, *ex* Frenulininae Hatai, 1938, p. 109]

Outer hinge plates and crural bases well developed; inner hinge plates not differentiated or rudimentary; septalium not developed; cardinal process moderately to strongly developed; adult loop annular, bilacunar, bilateral, or laterovertical; septal pillar nonbifurcate. *Neogene (Miocene)–Holocene.*

Subfamily FRENULININAE Hatai, 1938

[Frenulininae Hatai, 1938, p. 109]

Inner hinge plates rudimentary; adult loop bilacunar or bilateral. *Neogene (Miocene)–Holocene.*

Frenulina Dall, 1895, p. 724 [**Anomia sanguinolenta* Gmelin, 1792, p. 3,347; OD]. Small, biconvex, smooth, commonly reddish-orange with white mottling, unisulcate, beak suberect, foramen submesothyrid; deltidial plates commonly disjunct, occasionally conjunct. Hinge teeth with ventrally recessive dental plates; pedicle collar sessile. Cardinalia divergent from apex with inner socket ridges rather strong, united on their inner sides to crural bases; inner hinge plates rudimentary and not united medianly; cardinal process small, striated myophore; loop bilacunar to incipiently bilateral. *Neogene (Pliocene)–Holocene:* Okinawa, Ryukyu Islands, *Pliocene–Pleistocene;* Pacific, Indian Oceans, *Holocene.*——Fig. 1467,*1a–d. *F. sanguinolenta* (Gmelin), Holocene; *a–c,* dorsal, lateral, and anterior views, Hawaiian Islands, ×3 (new); *d,* dorsal interior showing loop, Philippines, ×5 (new).

Jolonica Dall, 1920, p. 366 [**Campages (Jolonica) hedleyi* Dall, 1920, p. 366; OD] [=*Compsoria* Cooper, 1973a, p. 23 (type, *C. suffusa,* OD); *Kamoica* Hatai, 1936, p. 313 (type, *Jolonica (Kamoica) iduensis* Hatai, 1936, p. 313, OD)]. Medium, smooth, ovate to subpentagonal, rectimarginate to weakly unisulcate; beak low, suberect, attrite; foramen mesothyrid to permesothyrid, deltidial plates conjunct. Dental plates recessive with narrow, lateral umbonal cavities; pedicle collar long, sessile. Cardinalia very similar to *Frenulina* but with prominent, upstanding cardinal process; strong inner socket ridges, flattened ventrally, fused to stout crural bases; inner hinge plates and septalium absent; median septum prominent, diminishing posteriorly. Loop bilacunar with median lacuna of hood occupied by calcareous plate. *Neogene (Miocene)–Holocene:* Japan (Okinawa, Ryukyu Islands), *Miocene–Pleistocene;* western Pacific (South Japan, Philippines to 640 m), western Indian Ocean (off Mozambique to 132 m), *Holocene.*——Fig. 1467,*2a–g. *J. hedleyi,* Holocene, off Jolo, Philippines; *a–d,* dorsal, anterior, lateral, and posterior views of holotype, USNM 111059, ×1; *e–f,* ventral and lateral views of dorsal interior of holotype showing loop, ×2; *g,* tilted view of ventral interior of holotype showing dental plates, ×2 (Cooper, 1957b).

Subfamily PICTOTHYRIDINAE Yabe & Hatai, 1941

[*nom. correct.* Hatai, 1965c, p. 846, *pro* Pictothyrinae Yabe & Hatai, 1941, p. 494]

No inner hinge plates; adult loop laterovertical. *Neogene (Pliocene)–Holocene.*

Pictothyris Thomson, 1927, p. 260 [**Anomia picta* Dillwyn, 1817, p. 295; OD]. Medium, ovate, biconvex, rectimarginate to faintly unisulcate, smooth; shell commonly reddish and variegated; beak suberect; foramen medium size, mesothyrid, attrite; deltidial plates conjunct. Hinge teeth strong, dental plates short, recessive; pedicle collar broad, sessile. Cardinal process prominent, upstanding, with distal, impressed, bilobed myophore; median septum low, thick; adult loop laterovertical. *Neogene (Pliocene)–Holocene:* Japan (Formosa, Ryukyu Islands, 40–160 m).——Fig. 1467,*3a–e. *P. picta* (Dillwyn), Holocene, Japan; *a–c,* dorsal, lateral, and anterior views, ×1; *d–e,* dorsal and ventral interiors, ×2 (Cooper, 1957b).

Kikaithyris Yabe & Hatai, 1941, p. 495 [**Pictothyris hanzawai* Yabe, 1932, p. 196; OD]. Medium, ovate to subpentagonal, biconvex; beak low, erect; beak ridges strong; deltidial plates conjunct; foramen small to minute, mesothyrid. Hinge teeth strong, dental plates thickened and almost obscured; diductor scars elongate, narrow. Cardinalia resembling *Pictothyris* but more robust; inner socket ridges swollen, cardinal process upstanding with distal, bilobed myophore; dorsal median septum low and thick. Adult loop laterovertical. *Neogene (Pliocene)–Pleistocene:* Japan (Ryukyu Islands), Taiwan.——Fig. 1467,*4a–e. *K. hanzawai* (Yabe), Ryukyu Islands; *a–c,* dorsal, lateral, and anterior views, ×1; *d–e,* dorsal and ventral interiors, ×2 (Cooper, 1957b).

Subfamily SHIMODAIINAE new subfamily

[Shimodaiinae MacKinnon & Lee, herein] [type genus, *Shimodaia* MacKinnon, Saito, & Endo, 1997, p. 226]

Shells small, adult loop annular. *Holocene.*

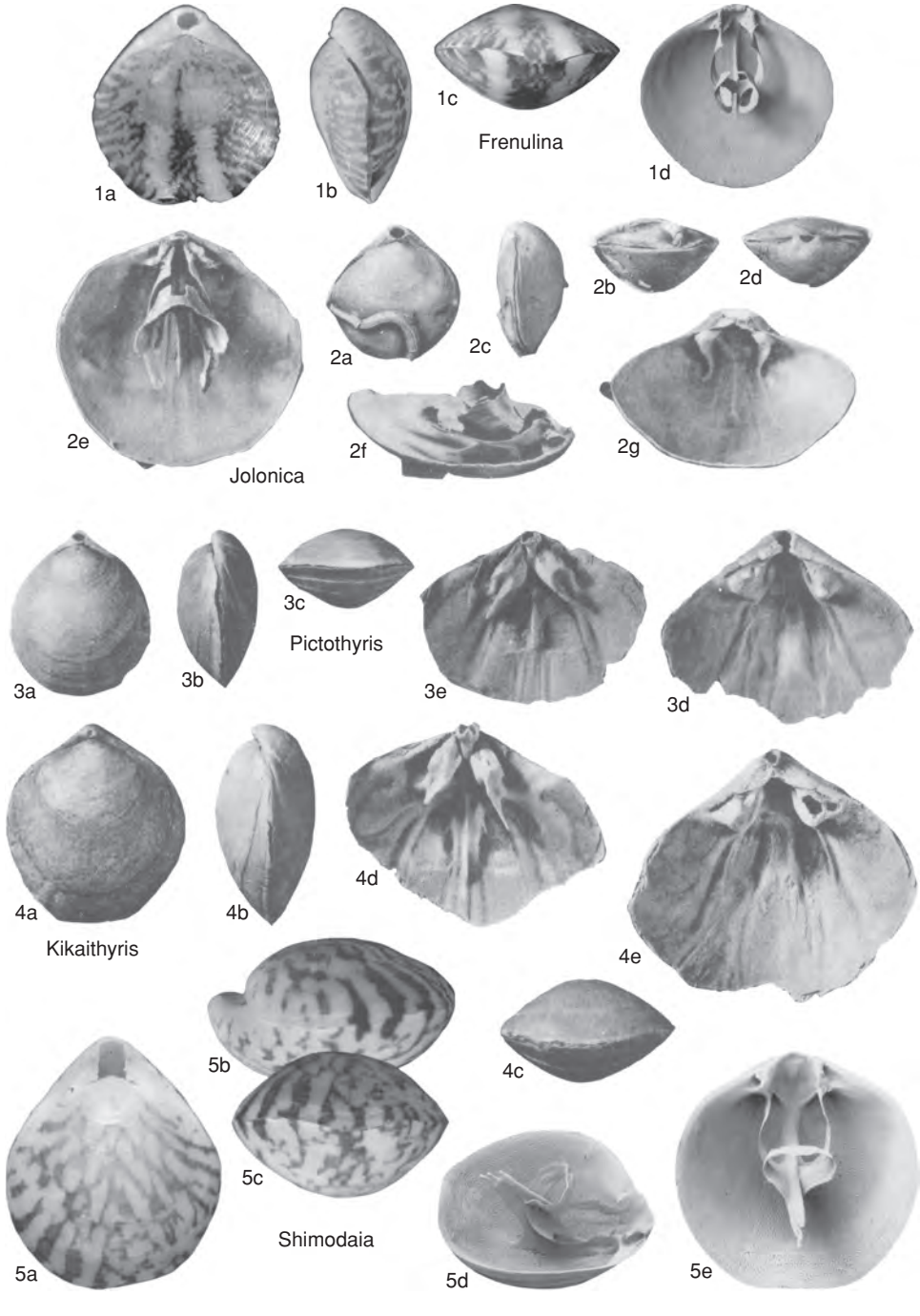

FIG. 1467. Frenulinidae (p. 2209–2211).

Shimodaia MacKinnon, Saito, & Endo, 1997, p. 226 [**S. pterygiota;* OD]. Small, red to white color markings, ovate, commissure rectimarginate; beak erect, attrite; foramen submesothyrid; deltidial plates disjunct. Dental plates recessive, pedicle collar long, sessile. Cardinal process inconspicuous; septal pillar arising (in adults) about midvalve, very long and narrow, strongly inclined anteroventrally, sometimes spinose distally, extending posteriorly as low ridge; hinge trough with incipient inner hinge plates; adult loop annular with descending branches attached to septal pillar and ascending branches commonly incomplete; juvenile axial loop phase with well-developed septal flanges. *Holocene:* Japan, South China Sea.——Fig. 1467,*5a–e.* **S. pterygiota; a–c,* dorsal, lateral, and anterior views of holotype, UMUT RB27390, ×5; *d–e,* two views of dorsal interior, ×5 (MacKinnon, Saito, & Endo, 1997).

Family TEREBRATALIIDAE Richardson, 1975

[*nom. transl.* Zezina, 1985, p. 171, *ex* Terebrataliinae Richardson, 1975b, p. 310]

Inner hinge plates or septalium absent or rudimentary; adult loop diploform, trabecular, rarely teloform. *Upper Jurassic–Holocene.*

Subfamily TEREBRATALIINAE Richardson, 1975

[Terbrataliinae Richardson, 1975b, p. 310]

Shells smooth to multicostate, small to large, commonly transversely oval, foramen large, beak short, strongly attrite. Adult loop commonly trabecular. *Upper Cretaceous (Maastrichtian)–Holocene.*

Terebratalia Beecher, 1893, p. 377 [**Terebratula transversa* G. B. Sowerby, 1846, p. 94; OD; =*Magasella radiata* Dall, 1877b, p. 49] [=*Pacifithyris* Hatai, 1938, p. 98 (type, *Terebratalia xanthica* Dall, 1920, p. 346, OD)]. Medium to large, outline extremely variable from subcircular to transversely oval, mildly unisulcate, ornamentation highly variable from smooth to costate; beak short, suberect, strongly attrite, beak ridges sharp, foramen large, mesothyrid, deltidial plates disjunct. Pedicle collar short, dental plates ventrally recessive, lateral umbonal cavities narrow and tending to infill with secondary shell. Cardinal process transverse-oval myophore; cardinalia strong with some median shell thickening, dorsal adjustor scars impressed on thickened inner socket ridges, crura fairly long, slender, roughly circular in cross section; loop trabecular with very slender, lateral connecting bands extending from low median septum. *Paleogene (Eocene)–Holocene:* Mexico (Baja California), *Eocene;* western North America, ?Japan, *Oligocene;* western North America, Japan, *Miocene–Pleistocene;* North Pacific (10–1,750 m), *Holocene.*——Fig. 1468,*1a–d.* **T. transversa* (Sowerby), Holocene, Vancouver Island, Canada; *a–c,* dorsal, lateral, and anterior views; *d,* dorsal interior, loop missing, ×1 (new).

Coptothyris Jackson, 1918a, p. 479 [**Terebratula grayi* Davidson, 1852c, p. 76; OD; =*Magasella adamsi* Davidson, 1871, p. 307] [=*Pereudesia* Dall, 1920, p. 360, obj., *nom. nov. pro Thomsonia* Jackson, 1916, p. 22, *non* Signoret, 1879, *nec* Konow, 1884; =*Cacata* Strand, 1928, p. 38, obj., *nom. nov. pro Thomsonia* Jackson, 1916, p. 22, *non* Signoret, 1879, *nec* Konow, 1884]. Medium to large, biconvex, subquadrate to transversely oval, rectimarginate to mildly uniplicate, multicostate; beak suberect, attrite, foramen large, mesothyrid to permesothyrid; deltidial plates conjunct in adults. Pedicle collar short, hinge teeth strong, dental plates ventrally recessive with very reduced, lateral umbonal cavities. Cardinalia as in *Terebratalia,* median septum very low, loop teloform. *Neogene (Miocene)–Holocene:* Japan, Korea.——Fig. 1468,*4a–d.* **C. grayi* (Davidson), Holocene, Korea Strait; *a–c,* dorsal, lateral, and anterior views, ×1; *d,* dorsal interior showing cardinalia, teloform loop missing, ×2 (new).

Dallinella Thomson, 1915c, p. 75 [**Terebratalia obsoleta* Beecher, 1893, p. 382, 392; OD; =*Terebratella occidentalis obsoleta* Dall, 1891b, p. 186]. Medium to large, biconvex, subquadrate to transversely oval, multiplicate with wide, subdued, median uniplication; beak erect, attrite, foramen large, mesothyrid to permesothyrid; deltidial plates conjunct in adults. Pedicle collar short, hinge teeth strong, dental plates ventrally recessive with very reduced, lateral umbonal cavities. Cardinalia as in *Terebratalia,* crural processes attenuated, anteriorly projecting. Loop trabecular. *Neogene (Miocene)–Holocene:* northeastern Pacific (100–220 m).——Fig. 1468,*5a–d.* **D. obsoleta* (Dall), Holocene; *a–c,* dorsal, lateral, and anterior views, ×1; *d,* dorsal interior showing cardinalia, trabecular loop missing, ×2 (new).

Diestothyris Thomson, 1916b, p. 504 [**Terebratula frontalis* Middendorff, 1849, p. 518; OD] [=*Diestothyris (Tisimania)* Hatai, 1938, p. 203 (type, *Diestothyris tisimana* Nomura & Hatai, 1936, p. 131)]. Small to medium, smooth; anterior commissure rectimarginate to weakly unisulcate; beak short, suberect, strongly attrite; foramen large, submesothyrid; deltidial plates very narrow. Pedicle collar well developed, thin, ventrally recessive dental plates, with small, deep, lateral umbonal cavities. Cardinal process subtriangular myophore; cardinalia strong, socket ridges strong, disjunct inner hinge plates with deeply impressed dorsal adjustor scars, fused posteriorly to cardinal process;

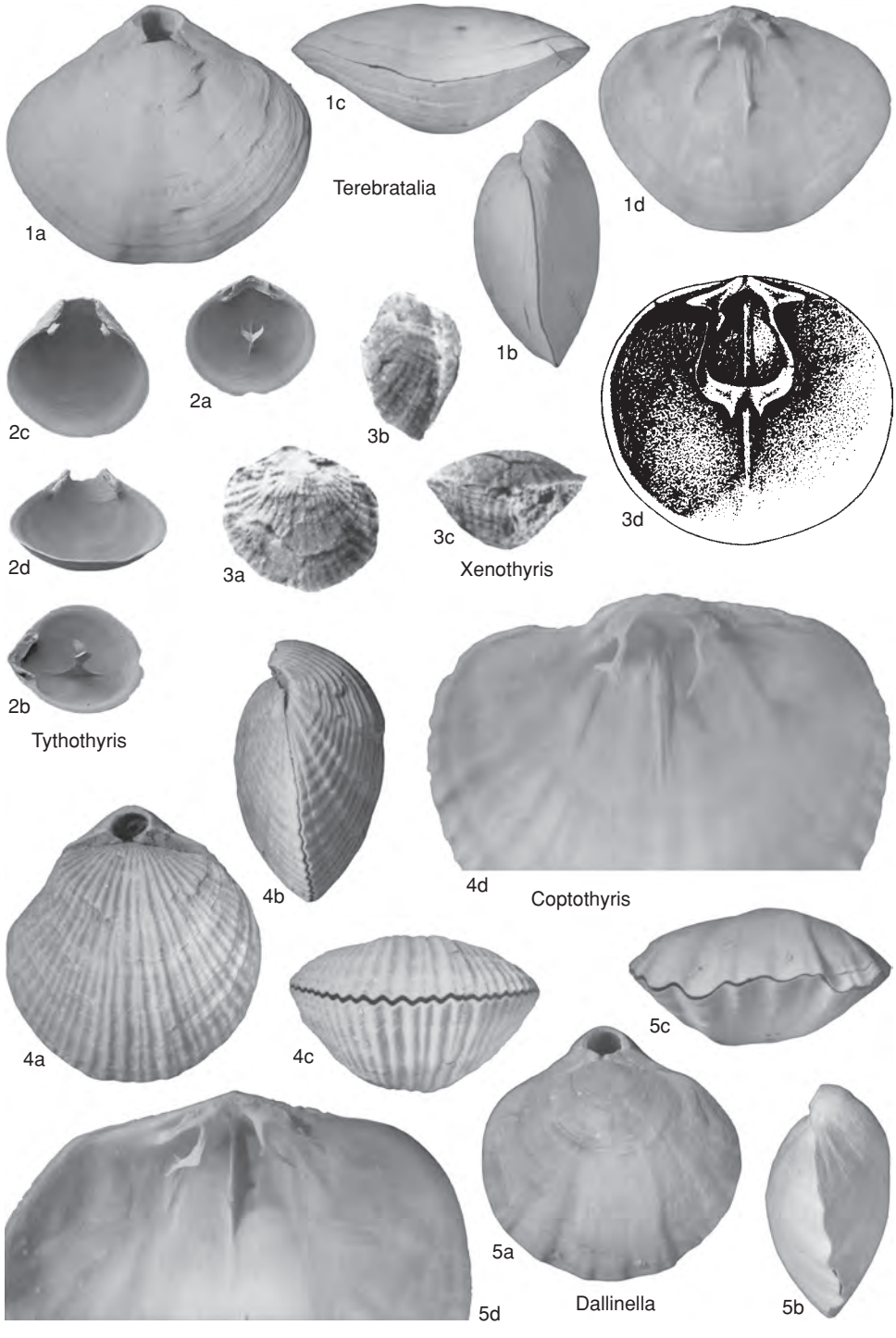

FIG. 1468. Terebrataliidae (p. 2211–2213).

septal pillar located anterior of midvalve; loop trabecular, slender. [*Tisimania* was erected as a subgenus of *Diestothyris* by HATAI (1938)]. *Neogene (Miocene)–Holocene:* North America, *Miocene–Pleistocene;* Kamchatka, Japan, *Pliocene;* North Pacific (Okhotsk Sea, Japan Sea), *Holocene.*——FIG. 1469*a–d.* **D. frontalis* (MIDDENDORFF), Holocene, North Pacific; *a,* dorsal view, ×1.5; *b–c,* lateral and anterior views, ×2 (new); *d,* dorsal interior showing loop, reconstruction, ×3 (Davidson, 1887).

Tythothyris ZEZINA, 1979, p. 223 [**T. rosimarginata;* OD]. Small, smooth, biconvex, rectimarginate to weakly sulcate; similar to juvenile *Diestothyris* but crura and descending loop branches not developed; septal pillar with ventrally curved, ascending lamellae that do not unite, with small, posteriorly directed flanges at apices of ascending lamellae. *Holocene:* Okhotsk Sea, Kurile Islands.——FIG. 1468,*2a–d.* **T. rosimarginata; a–b,* ventral and lateral oblique views of dorsal interior; *c–d,* dorsal and anterior oblique views of ventral interior, ×5 (new).

Xenothyris CHING, RONG, & SUN, 1976, p. 337 [**X. tuilaensis;* OD]. Small, subcircular; hinge line straight, ventribiconvex, multiplicate; anterior commissure rectimarginate to uniplicate; beak short, suberect; foramen semicircular, without deltidial plates. No ventral septum; dental plates short, highly divergent. Cardinal process low, flattened; narrow outer hinge plates present between divergent inner socket ridges, and crural bases as in *Terebratalia;* loop imperfectly known, possibly trabecular; dorsal median septum long, low posteriorly, high at midvalve, and forming a low ridge anteriorly. *Upper Cretaceous (Maastrichtian):* Tibet.——FIG. 1468,*3a–d.* **X. tuilaensis; a–c,* dorsal, lateral, and anterior views, ×1; *d,* reconstruction of dorsal interior showing possibly incomplete loop, ×4 (Ching, Rong, & Sun, 1976).

Subfamily GEMMARCULINAE Elliott, 1947

[Gemmarculinae ELLIOTT, 1947, p. 145]

Costate, cardinal process large, fused with cardinalia; accessory structures present on all stages of trabecular loop. *Upper Jurassic–Upper Cretaceous.*

Gemmarcula ELLIOTT, 1947, p. 145 [**G. aurea;* OD; =*Terebratula truncata* J. DE C. SOWERBY, 1826 in 1826–1829, p. 21, *non Anomia truncata* LINNAEUS, 1767, p. 1,152] [=*Trifidarcula* ELLIOTT, 1959, p. 147 (type, *Terebratella trifida* MEYER, 1864, p. 167, OD)]. Small to medium, biconvex, strophic, ovate to subquadrate, costate, rectimarginate to parasulcate, umbo short, suberect, attrite; foramen large, submesothyrid; symphytium present. Dental plates short, ventrally divergent; pedicle collar present. Cardinalia strong, buttressed by median septum, cardinal process transverse and countersunk in shallow hinge trough; adult loop trabecular, with small flanges extending laterally from transverse band, loop ontogeny similar to *Terebratalia. Lower Cretaceous–Upper Cretaceous:* Europe; North America, *Upper Cretaceous.*——FIG. 1470,*1a–d.* **G. aurea,* Lower Cretaceous, England; *a–c,* dorsal, lateral, anterior views of holotype, BMNH BB 9251, ×2 (new); *d,* dorsal valve interior, ×6.5 (Muir-Wood, 1965a).

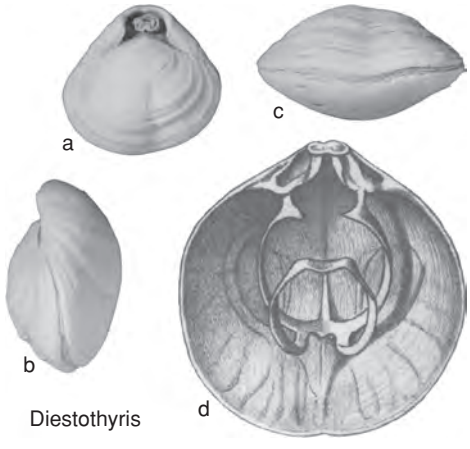

FIG. 1469. Terebrataliidae (p. 2211–2213).

Arenaciarcula ELLIOTT, 1959, p. 147 [**Terebratella fittoni* MEYER, 1864, p. 250; OD]. Small, ovate, costate, commissure uniplicate to parasulcate; beak erect, beak ridges sharp; foramen mesothyrid, deltidial plates conjunct. Dental plates fused to side of valve. Septalium with raised inner socket ridges, crural bases, and median septal ridge; cardinal process consisting of medianly bifid myophore. Adult loop possibly trabecular. *Cretaceous (Aptian–Cenomanian):* England, France, Belgium, Poland, Denmark, Germany, Austria, Russia, Turkmenistan.——FIG. 1470,*5a–m.* **A. fittoni* (MEYER), Aptian, England; *a–c,* dorsal, lateral, and anterior views of exterior, ×2; *d–m,* serial transverse sections 1.1, 1.4, 1.9, 2.2, 2.6, 2.9, 3.2, 3.6, 3.9, 4.3 mm from ventral umbo, ×2 (Owen, 1977).——FIG. 1470,*5n. A. beaumonti* (D'ARCHIAC), Cenomanian, Belgium; dorsal interior, ×2 (Owen, 1977).

Choristothyris COOPER, 1942, p. 233 [**Terebratula plicata* SAY, 1820, p. 43; OD]. Small, subcircular, multicostate to plicate, sulcate, shell thick, beak suberect to erect, foramen large, submesothyrid, deltidial plates small, disjunct. Hinge teeth large, with deep fossettes in supporting callus, ventral muscle area large, flabellate, divided by low, stout median ridge. Cardinalia strong, inner socket ridges strong and high; hinge plate small, concave, cardinal process massive, trilobed; median septum high, thin, reaching to center of valve, crural processes long, slender, loop trabecular. *Upper Cretaceous:* North America.——FIG. 1470,*2a–c.* **C. plicata* (SAY), New Jersey, USA; *a,* dorsal exterior, ×1; *b–c,* dorsal valve interior, interior showing calcite-encrusted loop, ×2 (Muir-Wood, 1965a).

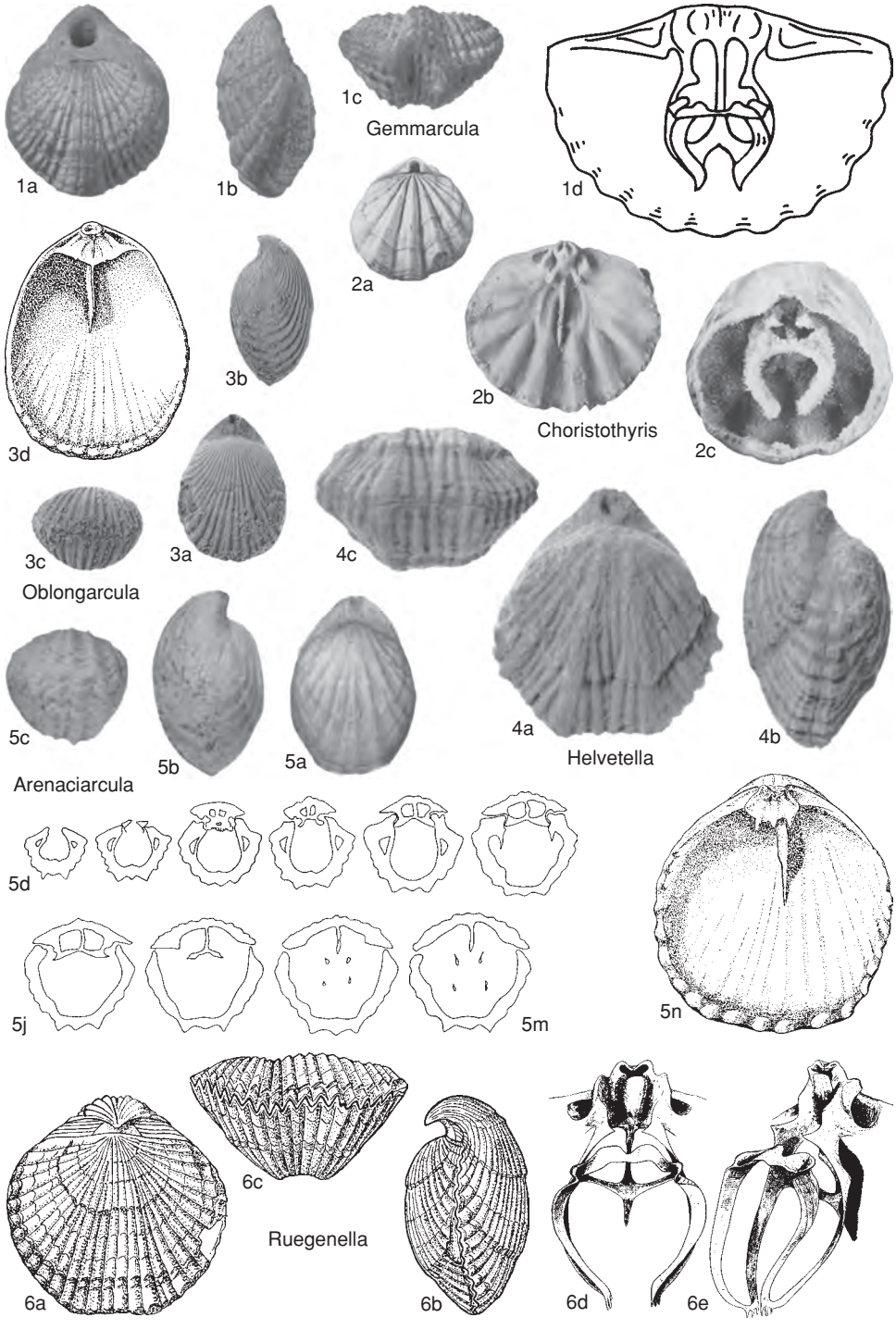

FIG. 1470. Terebrataliidae (p. 2213–2215).

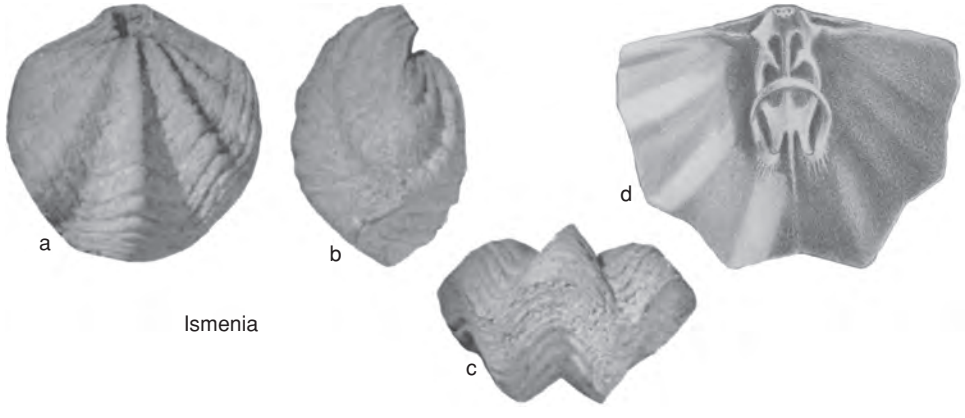

FIG. 1471. Terebrataliidae (p. 2215).

Helvetella OWEN, 1977, p. 221 [**Terebratula (Terebratella) arzierensis* DE LORIOL, 1864, p. 441; OD]. Medium, biconvex, pentagonal, costae strong, rounded; uniplicate to parasulcate; umbo massive, beak suberect; foramen large, circular, mesothyrid; symphytium short, broad; cardinal area extensive, slightly concave, beak ridges distinct. Cardinal process not developed, hinge plates short, triangular, ventrally deflected; loop trabecular. *Lower Cretaceous (Valanginian):* Switzerland, Spain.——FIG. 1470,*4a–c*. **H. arzierensis* (DE LORIEL), Arzier, Vaud, Switzerland; dorsal, lateral, and anterior views, ×2 (Owen, 1977).

Ismenia KING, 1850, p. 142 [**Terebratulites pectunculoides* VON SCHLOTHEIM, 1820, p. 271; OD]. Small, transverse, biconvex, with about 5 prominent plicae on each valve, beak low, suberect, attrite, foramen large, rounded, deltidial plates small; hinge line nearly strophic. Inner socket ridges prominent, inner hinge plates buttressed by median septum to form small septalium, cardinal process transverse, loop trabecular, anteriorly spinose. *Upper Jurassic–Lower Cretaceous:* Europe, Russia.——FIG. 1471*a–d*. **I. pectunculoides* (VON SCHLOTHEIM), Germany; *a–c,* dorsal, lateral, and anterior views, ×2 (Owen, 1977); *d,* dorsal interior showing loop, reconstructed, ×3 (Muir-Wood, 1965a).

Oblongarcula ELLIOTT, 1959, p. 147 [**Terebratula oblonga* J. DE C. SOWERBY, 1829 in 1826–1829, p. 68; OD]. Medium, elongate oval to subpentagonal, biconvex, costate to costellate, anterior commissure rectimarginate to incipiently unisulcate, shell thin; beak suberect, foramen mesothyrid, deltidial plates conjunct, beak ridges well defined, pedicle collar well developed. Teeth strong, dental plates thin with narrow, lateral umbonal cavities. Cardinalia thin, platelike; cardinal process a raised, transverse myophore; sockets narrow, inner socket ridges enclosing septalium; median septum thin, supporting septalium beneath and extending anteriorly to half of valve length; crura delicate. Adult loop possibly teloform. *Lower Cretaceous (Hauterivian–Aptian):* England, Germany, France.——FIG. 1470,*3a–d*. **O. oblonga* (J. DE C. SOWERBY), Aptian, Berkshire, England; *a–c,* dorsal, lateral, and anterior views, ×1; *d,* dorsal valve interior, ×2 (Owen, 1977).

Ruegenella OWEN, 1977, p. 224 [**Terebratula humboldti* HAGENOW, 1842, p. 539; OD]. Small to medium size, subquadrate to oval, costae rounded; anterior commissure rectimarginate to parasulcate; beak acuminate, incurved; foramen small, circular, mesothyrid; symphytium well exposed; beak ridges sharp, interarea extensive. Cardinal process massive, bilobed; hinge plates thickened, fused; median septum low. Adult loop trabecular. *Upper Cretaceous (Maastrichtian):* Belgium, Germany.——FIG. 1470,*6a–e*. * *R. humboldti* (HAGENOW), Rügen, Germany; *a–c,* dorsal, lateral, and anterior views, ×2 (Owen, 1977); *d–e,* views of dorsal valve interior showing trabecular loop, ×4 (Steinich, 1965).

Subfamily TRIGONOSEMINAE Elliott, 1965

[Trigonoseminae ELLIOTT, 1965b, p. 851]

Shell costellate, sulcate; cardinal process robust, loop trabecular to teloform. *Cretaceous.*

Trigonosemus KÖNIG, 1825, p. 3 [**T. elegans;* OD] [=*Delthyridea* M'COY, 1844, p. 150 (type, *Delthyridaea McCoy* KING, 1850, p. 141, OD); *Fissirostra* D'ORBIGNY, 1847 in 1847–1851, p. 269 (type, *Terebratula recurva* DEFRANCE, 1828b, p. 133); *Fissurirostra* D'ORBIGNY, 1850 in 1849–1852, p. 132, *nom. null., errore pro Fissirostra*]. Medium to large, unequally biconvex to planoconvex; strophic, beak high, incurved, acutely pointed; unisulcate, shell thick, costate, interarea high, smooth, concave; foramen small, circular, permesothyrid; symphytium high and narrow. Ventral valve posteriorly thickened, teeth heavy, dental plates thick, lateral umbonal cavities vestigial. Cardinalia dominated by massive cardinal process with swollen base; dorsal diductor muscle scars deeply sunken;

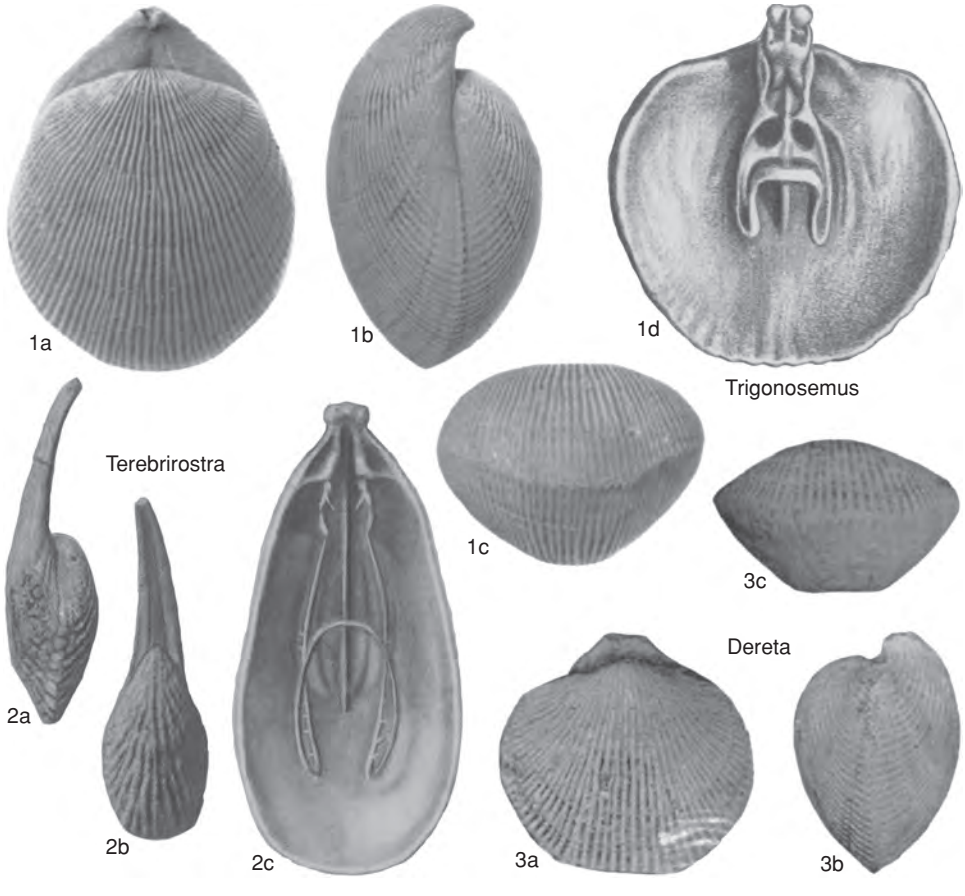

FIG. 1472. Terebrataliidae (p. 2215–2216).

median septum thick, extending anteriorly to just over half valve length; loop narrow, rather small, trabecular. *Upper Cretaceous:* France, Belgium, Holland, England, Turkmenia.——FIG. 1472,*1a–d. *T. elegans,* Maastrichtian, Ciply, Belgium; *a–c,* dorsal, lateral, and anterior views, ×2 (Owen, 1977); *d,* dorsal valve interior, ×4 (Muir-Wood, 1965a).

Dereta ELLIOTT, 1959, p. 147 [**Terebratula pectita* J. SOWERBY, 1816 in 1815–1818, p. 83; OD]. Medium to large, subcircular, strongly biconvex, costate, anterior commissure unisulcate; foramen round to oval, mesothyrid; beak suberect, beak ridges angular; lateral areas smooth, bordering symphytium. Pedicle collar present; median ridge in ventral umbonal area; dental lamellae strong. Cardinal platform small, thick; cardinal process high, narrow, pillarlike; hinge plates fused anteriorly and supported by high median septum; adult loop possibly trabecular. *Cretaceous (Albian–Cenomanian):* Europe.——FIG. 1472,*3a–c. *D. pectita* (SOWERBY), England; dorsal valve, lateral, and anterior views, ×2 (Owen, 1977).

Terebrirostra D'ORBIGNY, 1847 in 1847–1851, p. 269 [**Terebratula lyra* J. SOWERBY, 1816 in 1815–1818, p. 83; OD] [=*Lyra* CUMBERLAND in J. SOWERBY, 1816 in 1815–1818, p. 84, *nom. nud.*]. Medium, biconvex, ornament of wavy radial costellae, dorsal valve elongate-oval to subtrigonal in outline, ventral valve very elongate, suberect beak; anterior commissure rectimarginate or slightly unisulcate; beak ridges angular, deltidial plates conjunct. Dental plates extending whole length of umbo, anteriorly curved and uniting with lateral margin. Cardinalia with large, triangular sockets; central hinge trough deep; cardinal process large, trilobed; median septum long, thin, extending anteriorly from cardinalia; adult loop teloform, long, thin. *Cretaceous:* Western Europe.——FIG. 1472,*2a–b. *T. lyra* (SOWERBY), England; lateral and dorsal views of exterior, ×1.5 (adapted from Muir-Wood, 1934).——FIG. 1472,*2c. T. incurvirostrum* LAMPLUGH & WALKER, England; dorsal valve interior, ×2.5 (adapted from Muir-Wood, 1934).

MEGATHYRIDOIDEA

D. E. Lee,[1] D. I. MacKinnon,[2] and T. N. Smirnova[3]

[[1]University of Otago; [2]University of Canterbury; and [3]Moscow State University]

Superfamily MEGATHYRIDOIDEA Dall, 1870

[*nom. transl.* MacKinnon & Smirnova, 1995, p. 671, *ex* Megathyrididae Hatai & Elliott, 1965, p. 830, *nom. correct. pro* Megathyridae Allan, 1940a, p. 269, *nom. transl. ex* Megathyrinae Dall, 1870, p. 100]

Adult shells commonly small in size, outline subquadrate, commonly multiplicate with wide hinge line and well-developed interareas; beak attrite, foramen large. Pedicle collar long, wide, elevated; short, low, ventral median septum commonly present; dental plates rarely present. Cardinal process or myophore inconspicuous; high, narrow dorsal median septum commonly present, rarely bifurcate distally; outer hinge plates absent; conjunct inner hinge plates forming low septalium may be present; loop axial, consisting of a pair of laterally arcuate, ribbonlike descending branches derived solely from short crura and commonly fused to valve floor; distal extremities of loop converging on high, triangular median septum; no ascending loop elements; lophophore schizolophous or ptycholophous; one species reportedly weakly spiculate. *Lower Cretaceous–Holocene.*

Family MEGATHYRIDIDAE Dall, 1870

[*nom. correct.* Hatai & Elliott, 1965, p. 830, *pro* Megathyridae Allan, 1940a, p. 269, *nom. transl. ex* Megathyrinae Dall, 1870, p. 100]

Loop axial, composed of descending branches only; lophophore trocholophous to ptycholophous; posterior margin strophic or nearly so; dental plates absent. *Upper Cretaceous (Campanian)–Holocene.*

Megathiris d'Orbigny, 1847, p. 269, *nom. nov. pro Argiope* Deslongchamps, 1842, p. ix, *non* Audouin in Savigny, 1827 [**Anomia detruncata* Gmelin, 1790, p. 3,347; OD] [=*Megathyris* Bronn, 1848, p. 244, *nom. van.; Argyope* Davidson, 1850a, p. 65, obj., *non* Savigny, 1826]. Small, broadly transverse, hinge line straight; ventribiconvex, multiplicate, anterior commissure rectimarginate to slightly uniplicate; beak short, attrite; foramen hypothyrid, deltidial plates disjunct. Hinge teeth small, elongate; pedicle collar supported by long, narrow median septum and 2 subdued lateral septa extending almost to anterior margin. Cardinal process small, transverse, grooved; cardinalia with low hinge platform uniting 2 prominent socket ridges; crura short, widely separated, crural processes prominent, horizontal, pointed; median septum very long, narrow, high; flanked in anterior part of shell by 2 lateral septa reaching to near middle of dorsal valve; loop of 2 slender, arcuate descending branches free only near crura, attached to base of crura, valve floor, and anterior extremities of lateral septa and median septum; lophophore attached to dorsal mantle, ptycholophous; rarely weakly spiculate. *Upper Cretaceous (Campanian)–Holocene:* England, France, Belgium, *Campanian–Maastrichtian;* Italy, *Eocene;* Germany, *Oligocene;* Italy, Poland, *Miocene;* Europe, *Pliocene;* Mediterranean, Channel Islands, Portugal, Madeira, Algeria, France, Italy, Greece, Israel, Ghana (3–260 m), *Holocene.*——Fig. 1473,*3a–e.* **M. detruncata* (Gmelin), Holocene, Mediterranean; *a–b,* dorsal and ventral valve views; *c,* interior of dorsal valve, ×5.4 (Muir-Wood, 1965a); *d–e,* interior of dorsal and ventral valves, ×12 (Logan, 1979).

Argyrotheca Dall, 1900, p. 44 [**Terebratula cuneata* Risso, 1826, p. 388; OD] [=*Cistella* Gray, 1853, p. 114, obj., *non* Gistl, 1848; *Cistellarcula* Elliott, 1954, p. 726 (type, *C. wrigleyi,* OD)]. Small, commonly transversely ovate with wide hinge line but outline variable; ventribiconvex, smooth to more commonly multiplicate; beak short, subtruncate; foramen large, commonly hypothyrid; deltidial plates narrow. Pedicle collar well developed, supported by long, narrow, median septum. Cardinal process short, transversely elongate, buttressed by long, high, thick median septum; crura widely separate, short, prominent, pointed; loop long, formed of 2 slender, arcuate descending branches attached to base of crura, valve floor, and anterior end of median septum; short septal flanges present in adult stages; lophophore large, schizolophous, spicules not observed. [*Argyrotheca* may include species that should be assigned to several different genera.] *Upper Cretaceous (Maastrichtian)–Holocene:* Belgium, *Maastrichtian;* cosmopolitan, *Eocene–Miocene;* England, Italy, *Pliocene;* Atlantic (60–1,280 m), Caribbean, Pacific (160 m), Mediterranean (3–400 m), *Holocene.*——Fig. 1473,*2a–e.* **A. cuneata* (Risso), Holocene, Mediterranean; *a,* dorsal valve view, ×15; *b,* ventral valve view, ×13; *c,* dorsal valve interior of juvenile, ×20; *d–e,* dorsal and ventral valve interiors, ×20 (Logan, 1979).

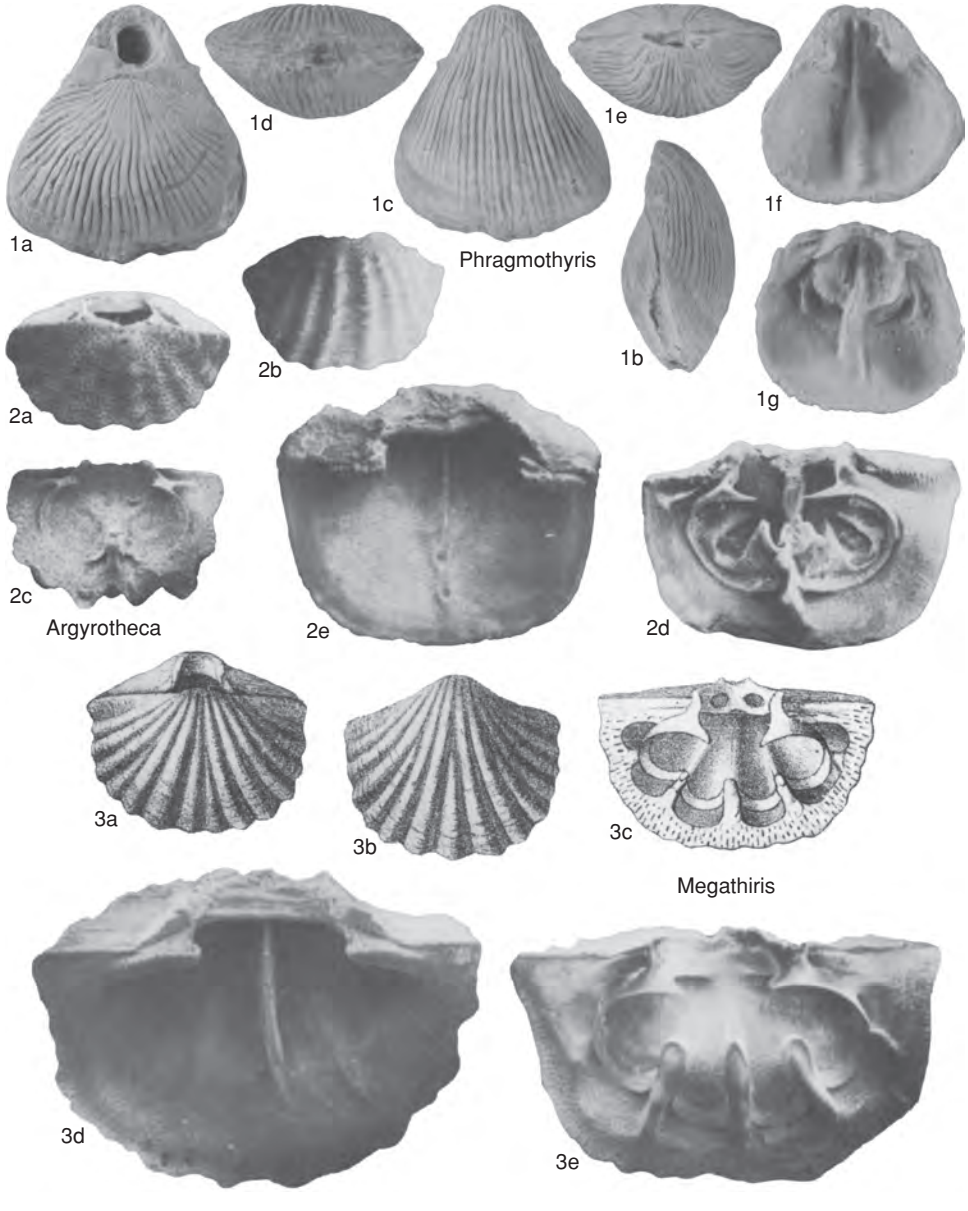

FIG. 1473. Megathyrididae (p. 2217–2221).

Bronnothyris POPIEL-BARCZYK & SMIRNOVA, 1978, p. 134 [**Terebratula bronnii* ROEMER, 1841, p. 41; OD]. Small, semicircular to subpentagonal in outline; wider than long; biconvex to planoconvex; plicate, with 6 to 10 broad, low costae; beak erect, foramen large, trigonal, deltidial plates narrow, disjunct. Pedicle collar well developed, ventral septum thin, short. Cardinal process low, broad; hinge plates broad, circular, concave; dorsal septum high, long, reaching from cardinalia to anterior margin; short septal flanges extending ventrally from dorsal septum. *Upper Cretaceous (upper Campanian)–Paleogene (lower Danian):* Germany, Denmark, Poland, England, The Netherlands, *upper Campanian–Maastrichtian;* Denmark, *lower Danian.*——FIG. 1474*a–o.* **B. bronnii* (ROEMER), lower Maastrichtian, Kronsmoor, northwestern Germany; *a,* dorsal valve view, ×10; *b,* dorsal valve

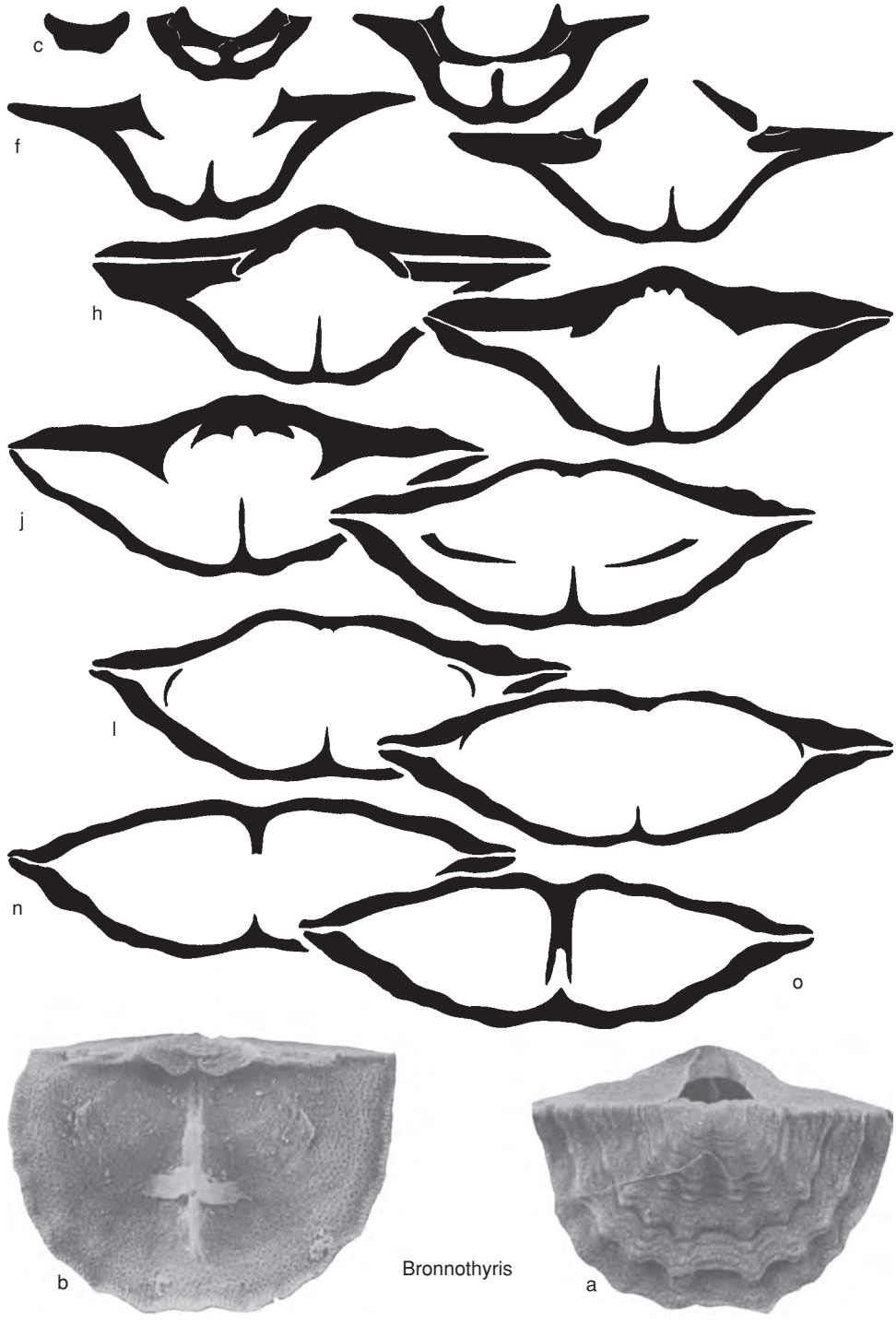

FIG. 1474. Megathyrididae (p. 2218–2220).

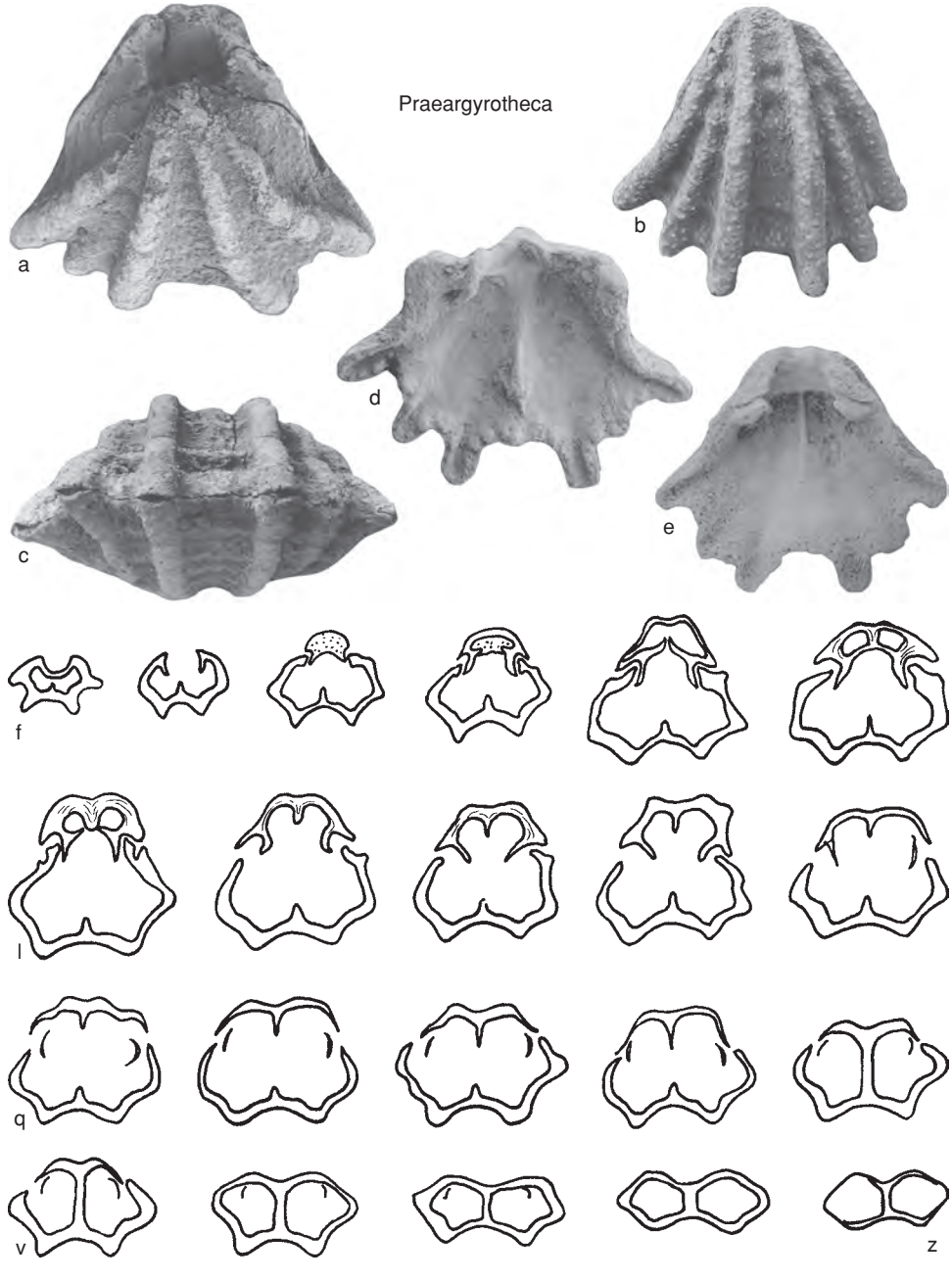

FIG. 1475. Praeargyrothecidae (p. 2221–2222).

interior, ×15 (Johansen & Surlyk, 1990); *c–o,* serial transverse sections 0.1, 0.3, 0.5, 0.7, 0.8, 0.85, 0.9, 1.1, 1.2, 1.35, 1.5, 1.75, 1.8 mm from ventral umbo, ×18 (Steinich, 1966).

Phragmothyris COOPER, 1955a, p. 65 [**P. cubensis;* OD]. Small to medium size; ventribiconvex, commissure rectimarginate to sulcate, multicostellate; foramen large, submegathyrid, symphytium rarely complete. Hinge teeth large, median ridge extending from beak nearly to anterior margin. Dorsal valve with wide, deep sockets bounded by elevated socket ridges; adductor scars on elevated platform

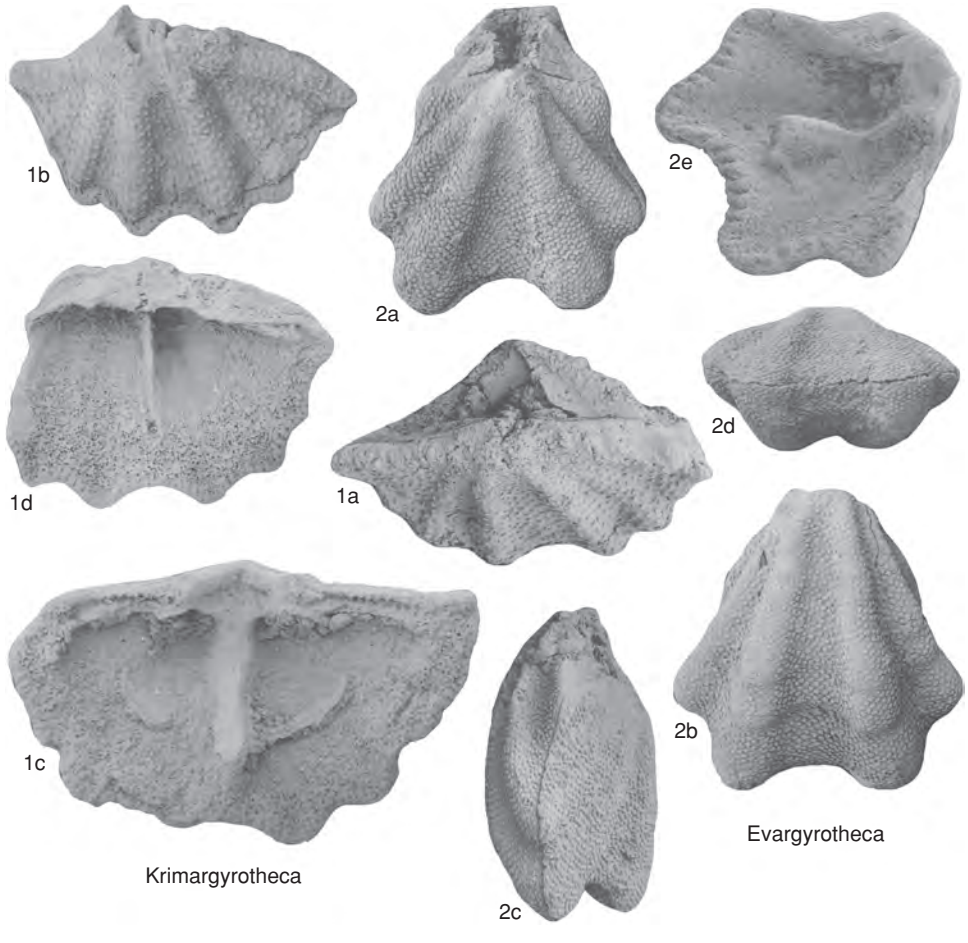

FIG. 1476. Praeargyrothecidae (p. 2222).

with median septum rising above it; loop consisting of broad ribbon extending around muscle platform, and uniting with valve floor beneath it. *Paleogene (Eocene)–Oligocene:* Cuba.——FIG. 1473,*1a–g.* **P. cubensis;* Eocene, Camaguey Province; *a,* holotype, dorsal valve, ×3; *b–e,* lateral, ventral valve, anterior, posterior views, ×3; *f–g,* ventral valve interior, dorsal valve interior, ×3 (Muir-Wood, 1965a).

Family PRAEARGYROTHECIDAE MacKinnon & Smirnova, 1995

[Praeargyrothecidae MACKINNON & SMIRNOVA, 1995, p. 671]

Small to minute, generally strongly plicate, with conspicuous granular microornament; ventral medium septum well developed; dental plates present in young stages, obscured by later shell thickening in adult forms; inner hinge plates and low median septum united to form low dorsal septalium; loop axial, consisting of only two gently curved, descending lamellae that unite anteriorly on high, triangular median septum. *Lower Cretaceous.*

Praeargyrotheca SMIRNOVA in SMIRNOVA, ZEZINA, & POPIEL-BARCZYK, 1983, p. 52 [**Argyrotheca hexaplicata* SMIRNOVA, 1972, p. 108; OD] [=*Smirnovaena* NEKVASILOVÁ, 1985, p. 101 (type, *S. quadricostata,* OD)]. Shell small, biconvex, with 4 to 10 prominent, dorsoventrally opposed high, keeled plicae in each valve; with commonly flat-topped, granular microornament not coincident with endopunctae; anterior commissure rectimarginate; foramen large, hypothyrid to submesothyrid; deltidial plates disjunct; interior margin of both valves crenulated. Dental plates and lateral umbonal cavities visible in early growth stages, commonly obscured by secondary shell thickening

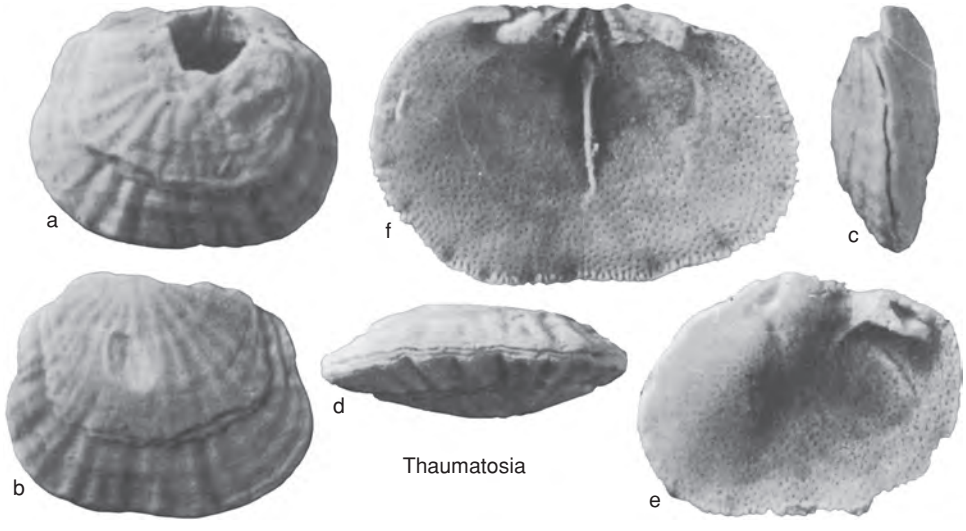

FIG. 1477. Thaumatosiidae (p. 2222).

in adults. Cardinal process not differentiated but small, transverse myophore may be visible; prominent trapezoidal median septum extending about 0.8 distance to anterior margin, tapering posteriorly to unite with a pair of inclined, partially excavate inner hinge plates to form septalium; septalium well demarcated from high inner socket ridges; descending branches of loop consisting of pair of arcuate ribbons that unite with dorsal valve floor and median septum just anterior of midvalve. *Lower Cretaceous:* Ukraine (Crimea).——FIG. 1475*a–z.* **P. hexaplicata* (SMIRNOVA), Berriasian; *a,* posterodorsal valve view; *b,* ventral valve view; *c,* anterior view; *d,* dorsal valve interior; *e,* ventral valve interior, ×20 (MacKinnon & Smirnova, 1995); *f–z,* serial transverse sections 0.0, 0.1, 0.2, 0.3, 0.4, 0.6, 0.7, 0.8, 0.9, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2.1, 2.3, 2.4 mm from ventral umbo, ×5 (adapted from Smirnova, 1972).

Evargyrotheca MACKINNON & SMIRNOVA, 1995, p. 676 [**Argyrotheca alta* SMIRNOVA, 1972, p. 110; OD]. Minute, subpentagonal, hinge line narrow; ventribiconvex; commonly with 4 dorsoventrally opposed, rounded plicae; anterior commissure rectimarginate; microornament of triangular granules coincident with endopunctae; beak high, apsacline; foramen large, mesothyrid, deltidial plates disjunct. Interior as for *Praeargyrotheca. Lower Cretaceous:* Ukraine (Crimea).——FIG. 1476,*2a–e.* **E. alta* (SMIRNOVA), Berriasian; *a,* dorsal view; *b,* ventral view; *c,* dorsolateral view; *d,* anterior view; *e,* oblique view of dorsal valve interior, ×20 (MacKinnon & Smirnova, 1995).

Krimargyrotheca MACKINNON & SMIRNOVA, 1995, p. 676 [**Argyrotheca concinna* SMIRNOVA, 1972, p. 107; OD]. Minute, hinge line wide; ventribiconvex; commonly with 6 to 9 dorsoventrally opposed, rounded plicae; microornament of rounded granular mounds in granular groundmass; beak high, apsacline; foramen large, deltidial plates disjunct. Interior as for *Praeargyrotheca. Lower Cretaceous (Berriasian):* Crimea.——FIG. 1476,*1a–d.* **K. concinna* (SMIRNOVA); *a,* posterodorsal view; *b,* ventral valve view; *c,* dorsal valve interior; *d,* ventral valve interior, ×20 (MacKinnon & Smirnova, 1995).

Family THAUMATOSIIDAE Cooper, 1973

[Thaumatosiidae COOPER, 1973a, p. 15]

Minute, foramen amphithyrid; without loop, septum, or other calcareous supports; lophophore schizolophous. *Holocene.*

Thaumatosia COOPER, 1973a, p. 15 [**T. anomala;* OD]. Minute, quadrate to subcircular in outline with wide hinge line; costellate; anterior commissure rectimarginate to unisulcate; foramen large, amphithyrid. Teeth small, unsupported, with pedicle groove at apex; ventral median septum narrow, long. Dorsal valve sockets broad, deep; socket ridges erect, short, thick; no loop or other brachial support. *Holocene:* Andaman Sea, off Thailand (40–77 m).——FIG. 1477*a–f.* **T. anomala; a–d,* holotype, dorsal, ventral, lateral, and anterior views, USNM 550347c, ×10; *e–f,* dorsal and ventral valve interiors, ×20 (Cooper, 1973b).

BOUCHARDIOIDEA

D. I. MacKinnon and D. E. Lee

[University of Canterbury; and University of Otago]

Superfamily BOUCHARDIOIDEA Allan, 1940

[*nom. transl.* MacKinnon & Lee, herein, *ex* Bouchardiinae Allan, 1940a, p. 270]

Adult shells small to medium size, smooth, ovate to elongate-oval with pronounced ventral carina, anterior commissure unisulcate; beak commonly straight; hinge teeth strong, with swollen bases grooved for reception of socket ridges; cardinal process and inner socket ridges commonly fused to form a solid hinge platform that may bear a prominent, inverted, V-shaped scar reflecting deep impression of posterodorsal extremities of diductor muscles; crura vestigial to absent; septal pillar high, with truncated distal extremity touching ventral valve; brachidial supports, when present, arising solely from septal pillar, consisting of either a pair of septal flanges or more elaborate, posteroventrally directed lamellae with medially directed extremities that do not unite to form complete ring; lophophore plectolophous; not spiculate. *Lower Cretaceous–Holocene.*

Family BOUCHARDIIDAE Allan, 1940

[*nom. transl.* MacKinnon & Lee, herein, *ex* Bouchardiinae Allan, 1940a, p. 270]

Diagnosis as for superfamily. *Lower Cretaceous–Holocene.*

Bouchardia Davidson, 1850a, p. 62 [**Anomia rosea* Mawe, 1823, p. 65; OD] [=*Pachyrhynchus* King, 1850, p. 70, obj., *non* Wagler, 1822, *nec* Germar, 1824]. Small to medium size, very thick shelled posteriorly; beak nearly straight, foramen permesothyrid; symphytium slightly concave. Ventral valve with low septal ridge. High inner socket ridges enclosing massive hinge platform with inverted, V-shaped, diductor muscle grooves; crura absent; paired brachidial lamellae curving posteroventrally from high septal pillar, but not uniting distally. *Upper Cretaceous (?Maastrichtian), Paleogene (Paleocene)–Holocene:* South America (0–150 m); *upper Eocene–Oligocene,* Antarctica (Seymour Island).——Fig. 1478,*1a–f.* **B. rosea* (Mawe), Holocene, Brazil; *a–d,* dorsal, ventral, lateral, and anterior views, ×2; *e,* ventral valve interior; *f,* dorsal valve interior, ×4 (Brunton, 1996).

Australiarcula Elliott, 1960b, p. 26 [**A. artesiana;* OD]. Small, ovate; beak straight, foramen medium, permesothyrid, attrite; symphytium slightly concave, beak ridges sharp. Cardinal process small, bilobed myophore, posteriorly inserted on cardinal platform; septal pillar high anteriorly, with curved, posteriorly directed, brachidial lamellae situated close to elevated margins of deeply inserted adductor muscle scars on valve floor; crura reduced to a pair of minute, inwardly curving projections located high in anterior wall of cardinal platform. [There is no evidence to support the loop reconstruction of Elliott, 1960b.] *Lower Cretaceous:* South Australia.——Fig. 1478,*4a–c.* **A. artesiana; a–b,* dorsal and anterior views, ×2 (Muir-Wood, 1965a); *c,* dorsal valve interior, reconstructed, ×2 (adapted from Elliott, 1960b).

Bouchardiella Doello-Jurado, 1922, p. 200 [**Bouchardia patagonica* Ihering, 1903a, p. 210; OD]. Small, ventribiconvex, elongate-oval, thick shelled; beak short, straight, foramen permesothyrid, attrite; symphytium flat to concave. Ventral valve greatly thickened, bearing prominent grooves to accommodate inner socket ridges. Cardinal process small, bilobed myophore, posteriorly inserted on cardinal platform, socket ridges prominent; septal pillar high anteriorly and bearing 2 short, posteriorly inclined flanges. *Upper Cretaceous–Paleogene:* Australia, South America.——Fig. 1478,*2a.* **B. patagonica* (Ihering), Paleogene, Argentina; dorsal view of holotype, ×2 (Ihering, 1903a).——Fig. 1478,*2b–e. B. cretacea* (Etheridge), Western Australia; *b,* dorsal view, ×6; *c,* dorsal valve interior, ×7; *d,* ventral valve interior, ×6; *e,* oblique anterior view of conjoined valves showing septal pillar and septal flange abutting ventral valve, ×10 (new).

Malleia Thomson, 1927, p. 283 [**Terebratella portlandica* Chapman, 1913, p. 187; OD]. Small, planoconvex; beak short, foramen hypothyrid, deltidial plates narrow, disjunct. Hinge teeth strong, transversely striated, with deeply grooved, swollen bases. Massive inner socket ridges united posteromedianly, bearing deep, inverted, V- or Y-shaped diductor muscle pits and enclosing a prominent posteromedian trough that probably served as a dorsal adjustor muscle attachment site; crura absent; elongate adductor muscle scars enclosing septal pillar; septal pillar high with incomplete ascending and rudimentary descending lamellae. *Paleogene (Oligocene)–Neogene (Pliocene):* Australia.——Fig. 1478,*3a–d.* **M. portlandica* (Chapman), Oligocene–Miocene; *a–b,* holotype, dorsal and anterior views, NMVP 12460, ×4 (Richardson, 1973); *c,*

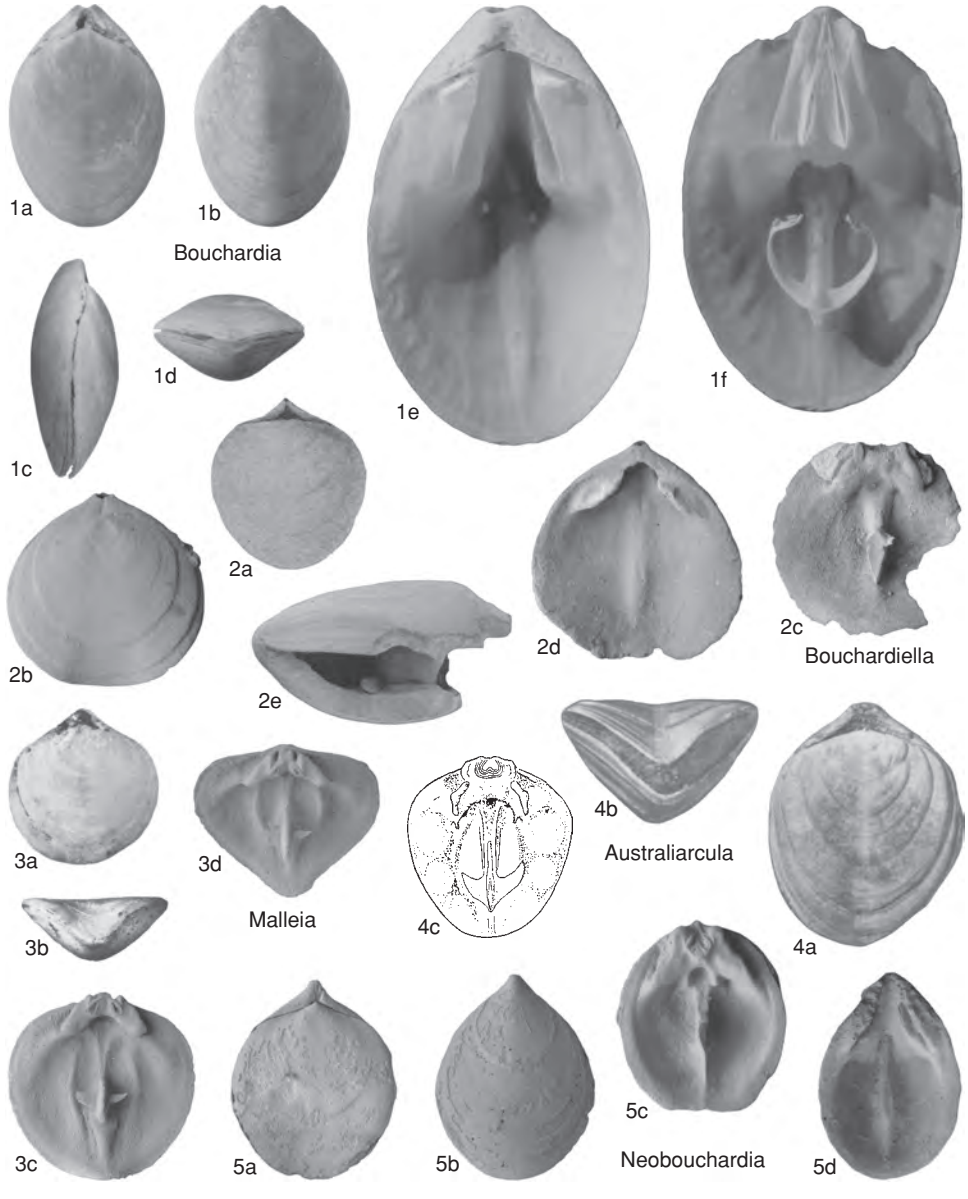

FIG. 1478. Bouchardiidae (p. 2223–2224).

dorsal valve interior showing septal lamellae, ×5; *d,* posterior oblique view of dorsal valve interior, ×5 (new).

Neobouchardia THOMSON, 1927, p. 270 [**Bouchardia minima* THOMSON, 1918b, p. 260; OD]. Small, thick shelled; beak straight to suberect; foramen minute, permesothyrid, beak ridges sharp; symphytium slightly concave. Ventral valve greatly thickened, bearing prominent grooves to accommodate inner socket ridges. Cardinalia greatly thickened, inner socket ridges fused medially, supporting posteriorly a variably swollen, bosslike cardinal process bearing paired, inverted, Y-shaped diductor scars; crura vestigial; septal pillar very high, brachidial lamellae absent. *Paleogene (Oligocene)–Neogene (Pliocene):* New Zealand; Australia, *Oligocene–Miocene.*——FIG. 1478,*5a–d.* **N. minima* (THOMSON), Miocene, New Zealand; *a–b,* dorsal and ventral views; *c,* dorsal valve interior; *d,* ventral valve interior with damaged beak, ×6 (new).

PLATIDIOIDEA

D. I. MacKinnon and D. E. Lee

[University of Canterbury; and University of Otago]

Superfamily PLATIDIOIDEA Thomson, 1927

[*nom. transl.* MacKinnon & Lee, herein, *ex* Platidiinae Thomson, 1927, p. 215]

Adult shell small, planoconvex, convexoplane or slightly biconvex; outline subcircular or ovate, smooth, capillate or spinose; anterior commissure rectimarginate; foramen relatively large, amphithyrid or hypothyrid. Dental plates weak or absent; pedicle collar short, sessile. Cardinal process weak or absent; hinge plates not developed, septal pillar may be present; crura, when present, long and slender, extending directly from inner socket ridges; descending branches or high triangular septal pillar may be developed; posterolaterally directed septal flanges may project from distal end of pillar; lophophore and mantle strongly spiculate; adult lophophore schizolophous or zygolophous. *Upper Cretaceous–Holocene.*

Family PLATIDIIDAE Thomson, 1927

[*nom. transl.* Allan, 1940a, p. 269, *ex* Platidiinae Thomson, 1927, p. 215]

Diagnosis as for superfamily. *Upper Cretaceous–Holocene.*

Subfamily PLATIDIINAE Thomson, 1927

[Platidiinae Thomson, 1927, p. 215]

Generally planoconvex shells, foramen amphithyrid; septal pillar, when present, high and triangular (axial loop phase); septal flanges at apex; crura and descending branches not always developed; mantle, body wall, lophophore, and tentacles strongly spiculate; lophophore schizolophous or zygolophous. Setae very long. *Upper Cretaceous–Holocene.*

Platidia Costa, 1852 (Jan.), p. 47 [**Orthis anomioides* Scacchi & Philippi, 1844, p. 69; OD] [=*Morrisia* Davidson, 1852d (May), p. 371, obj.]. Small, subcircular to subquadrate in outline, planoconvex, thin shelled, semitransparent; smooth, or with radiating lines or spinules on ventral valve; hinge line wide, foramen large, amphithyrid; deltidial plates very narrow, disjunct. Pedicle collar short, sessile; hinge teeth with narrow dental plates and grooved, swollen bases; short ventral myophragm. Cardinal process absent; inner socket ridges strong; outer socket ridges narrow; no hinge plates; septal pillar located directly anterior to large amphithyrid pedicle embayment, bladelike and leaning anteriorly proximally but posteriorly deflected distally and terminating in a pair of posteriorly directed, U-shaped septal flanges; crura long and slender with short processes, descending branches strongly arcuate, uniting medianly with lateral flanks of U-shaped septal flanges. Lophophore zygolophous. *Paleogene (Danian)–Holocene:* Denmark, *Danian;* North America, *Eocene;* Germany, Italy, *Oligocene;* Italy, Poland, *Miocene;* Italy, *Pliocene;* North America, *Pleistocene;* cosmopolitan: Mediterranean (180–400 m), eastern Atlantic (50–1,340 m), western Atlantic, Caribbean (170–1,290 m), eastern Pacific (100–400 m), western Pacific (130 m), Indian Ocean (90–1,500 m), *Holocene.*——Fig. 1479,*3a–i.* **P. anomioides* (Scacchi & Philippi), Holocene, Caribbean; *a–c,* dorsal, ventral, and lateral views, ×5; *d,* interior of ventral valve, ×10; *e–h,* ventral, anterior, and 2 laterally tilted views of dorsal valve interior, ×10; *i,* bilobed lophophore, ×10 (Cooper, 1977).

Aemula Steinich, 1968a, p. 193 [**A. inusitata;* OD]. Shell small (up to 8 mm in length), thin, oval to irregular subcircular, may be wider than long, planoconvex; dorsal valve smooth, ventral valve may carry fine spines; beak short, suberect, foramen large, amphithyrid, irregular in outline, deltidial plates narrow. Pedicle collar short, teeth small, dental plates slender. Hinge plates weakly developed, crura absent, septal pillar triangular with small, divergent septal flanges on apex; lophophore schizolophous to zygolophous. Differs from *Platidia* in lacking both crura and descending branches. *Upper Cretaceous (Santonian)–Paleogene (Danian):* northwestern Germany, *Santonian–Maastrichtian;* England, *Campanian;* Denmark, Germany, Poland, *Maastrichtian–lower Danian.* ——Fig. 1479,*1a–c.* **A. inusitata,* Maastrichtian, Hvidskud, Mon, Denmark; *a–b,* dorsal and ventral views, ×10 (Surlyk, 1974); *c,* dorsal valve interior, ×10 (Steinich, 1968a).

Amphithyris Thomson, 1918a, p. 20 [**A. buckmani;* OD]. Small (up to 5 mm wide), broadly suborbicular, planoconvex, smooth or with faint capillae on ventral valve, hinge line nearly straight; beak apicate, foramen amphithyrid. Hinge teeth without

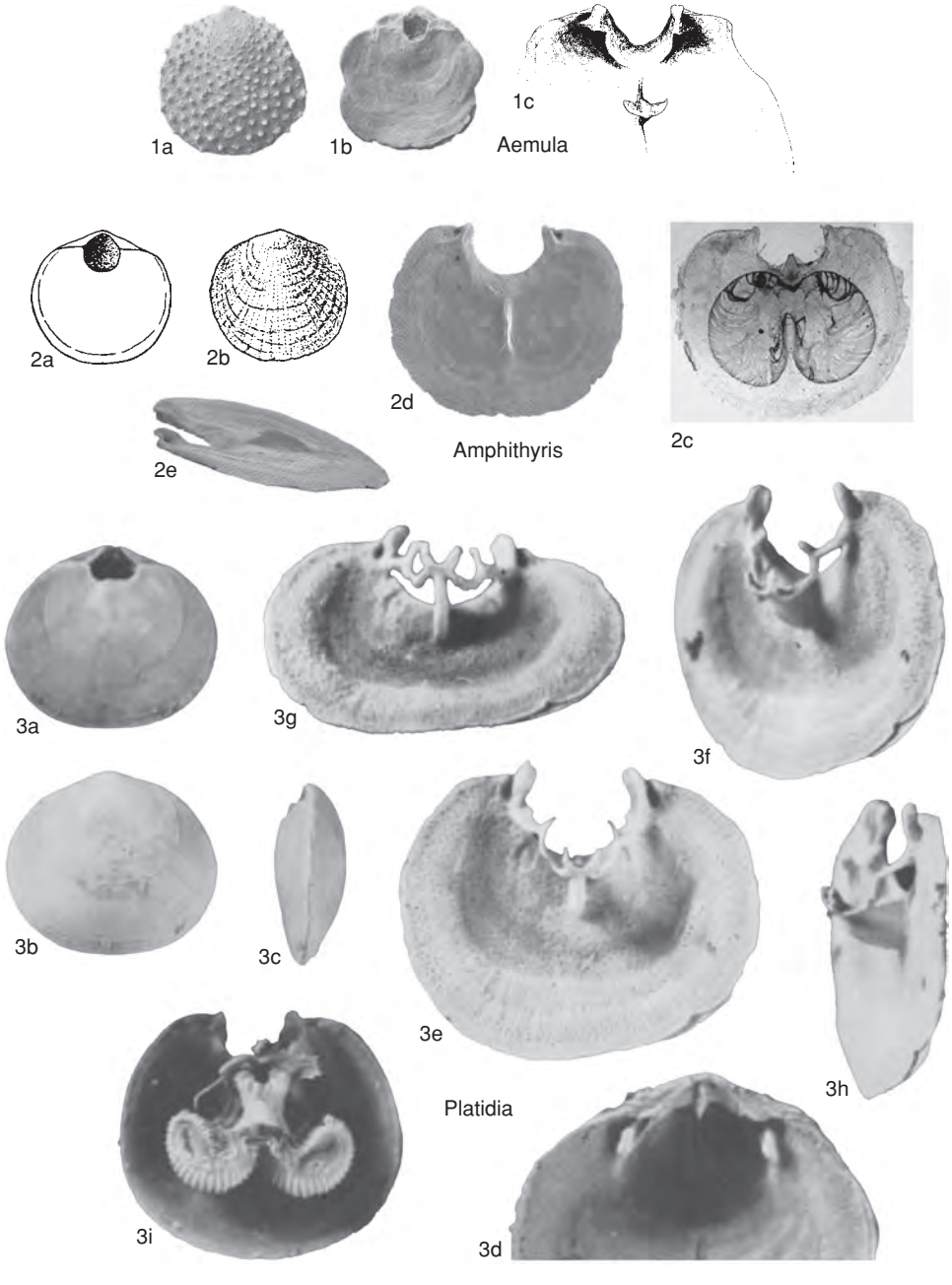

FIG. 1479. Platidiidae (p. 2225–2226).

dental plates or swollen bases. Cardinalia consisting of socket ridges only; dorsal median septum low, triangular in lateral view; lophophore schizolophous, supported by spicules. *Holocene:* New Zealand, Ross Sea, South Orkney Islands (74–641 m).——FIG. 1479,*2a–e. *A. buckmani,* holotype, NMNZ Br 80; *a–b,* line drawings of ventral and dorsal valve exteriors, ×6 (Thomson, 1927); *c,* schizolophous lophophore; *d–e,* dorsal and oblique views of dorsal valve interior with lophophore removed, ×6 (new).

Annuloplatidia ZEZINA, 1981b, p. 144 [**A. indopacifica;* OD]. Small (up to 4.7 mm wide), smooth, planoconvex to concavoconvex; foramen amphi-

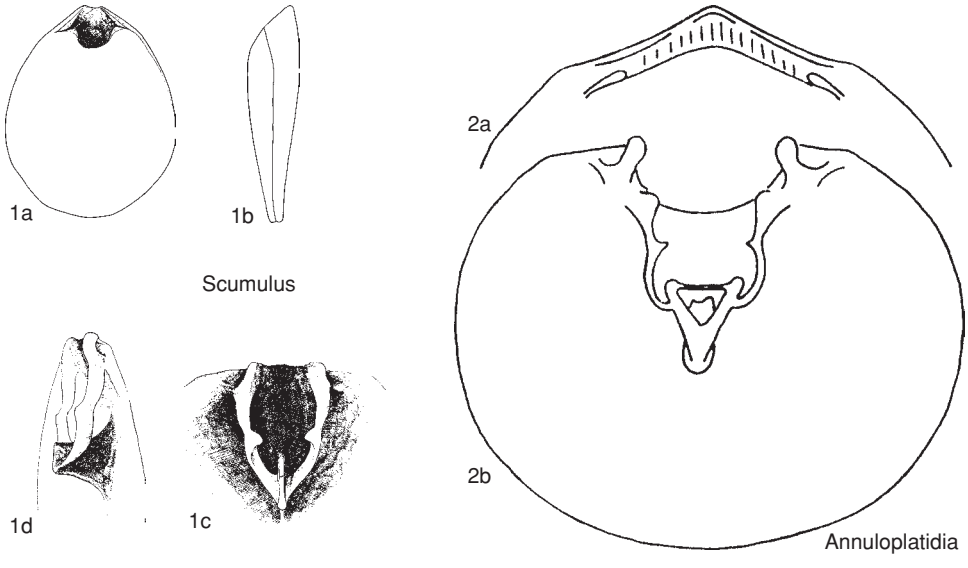

FIG. 1480. Platidiidae (p. 2226–2227).

thyrid; pedicle collar sessile; deltidial plates rudimentary. Crura projecting anteriorly from inner socket ridges; transverse band connecting distal extremities of divergent septal flanges on apex of septal pillar to form a triangular ring; descending branches as in *Platidia;* lophophore zygolophous. Differs from *Platidia* in presence of transverse band in brachidium. *Neogene (Pliocene)–Holocene:* USA (California), *Pliocene;* Indian Ocean, central Pacific, North Atlantic (370–5,240 m), *Holocene.*——FIG. 1480,*2a–b. *A. indopacifica,* Holocene, Pacific; *a,* beak of ventral valve; *b,* dorsal valve interior, ×18 (Zezina, 1981b).

Scumulus STEINICH, 1968a, p. 199 [**S. inopinatus;* OD]. Small, smooth, thin shelled, outline subtriangular to elongate-oval; flattened biconvex, short, straight beak; foramen large, amphithyrid in juveniles to hypothyrid in adults. Pedicle collar distinct. Brachidium represented by descending branches that extend between crura and narrow, high, subtriangular septal pillar with truncated apex; lophophore strongly spiculate. *Upper Cretaceous:* England, *upper Campanian;* Denmark, *Maastrichtian.*——FIG. 1480,*1a–d. *S. inopinatus,* Maastrichtian, Denmark; *a–b,* dorsal and lateral view of small specimen; *c,* dorsal valve interior; *d,* lateral view of brachidium, ×20 (Steinich, 1968a).

Subfamily PHANEROPORINAE Zezina, 1981

[*nom. transl.* MACKINNON & LEE, herein, *pro* Phaneroporidae ZEZINA, 1981c, p. 17]

Shell small, slightly biconvex, foramen hypothyrid; dental plates recessive. Inner socket ridges strong; crura long, slender, and flattened distally; descending branches when present uniting with high, triangular septal pillar (axial loop phase); adult lophophore zygolophous and heavily spiculate. *Holocene.*

Phaneropora ZEZINA, 1981c, p. 18 [**P. galatheae;* OD]. Small, subcircular, smooth, gently biconvex, anterior commissure rectimarginate; beak ridges slightly tuberculate; foramen large, hypothyrid, deltidial plates very narrow, disjunct, pedicle collar short; hinge teeth with small recessive dental plates. No cardinal process; high inner socket ridges with long crura that are anteromedially convergent; septal pillar platelike at its base with high, narrow distal extremity (axial loop phase), descending branches absent; lophophore zygolophous and heavily spiculate. *Holocene*: Great Australian Bight, Southwestern Pacific, Indonesia (Arafura Sea), 390–755 m. ——FIG. 1481,*2a–f. *P. galatheae; a–b,* holotype, dorsal and lateral views, Great Australian Bight, 1,320–1,340 m, ZMUC-BRA-1, ×8 (Zezina, 1981c); *c–d,* ventral and lateral views of dorsal interior, ×20; *e,* ventral valve interior, ×20; *f,* detail of beak region, off Tasmania, 755 m, ×40 (new).

Leptothyrella MUIR-WOOD 1965c, p. 855, *nom. nov. pro Leptothyris* MUIR-WOOD, 1959, *non* CONRAD in KERR, 1875, p. 20 [**Leptothyris ignota* MUIR-WOOD, 1959, p. 308; OD]. Very similar to *Phaneropora* but lacking beak ridge tubercles and with narrow descending loop branches extending between crura and distal extension of high, septal pillar; lophophore zygolophous. *Holocene*: Indian Ocean (off Zanzibar), Gulf of Aden, North Atlantic (2,000–

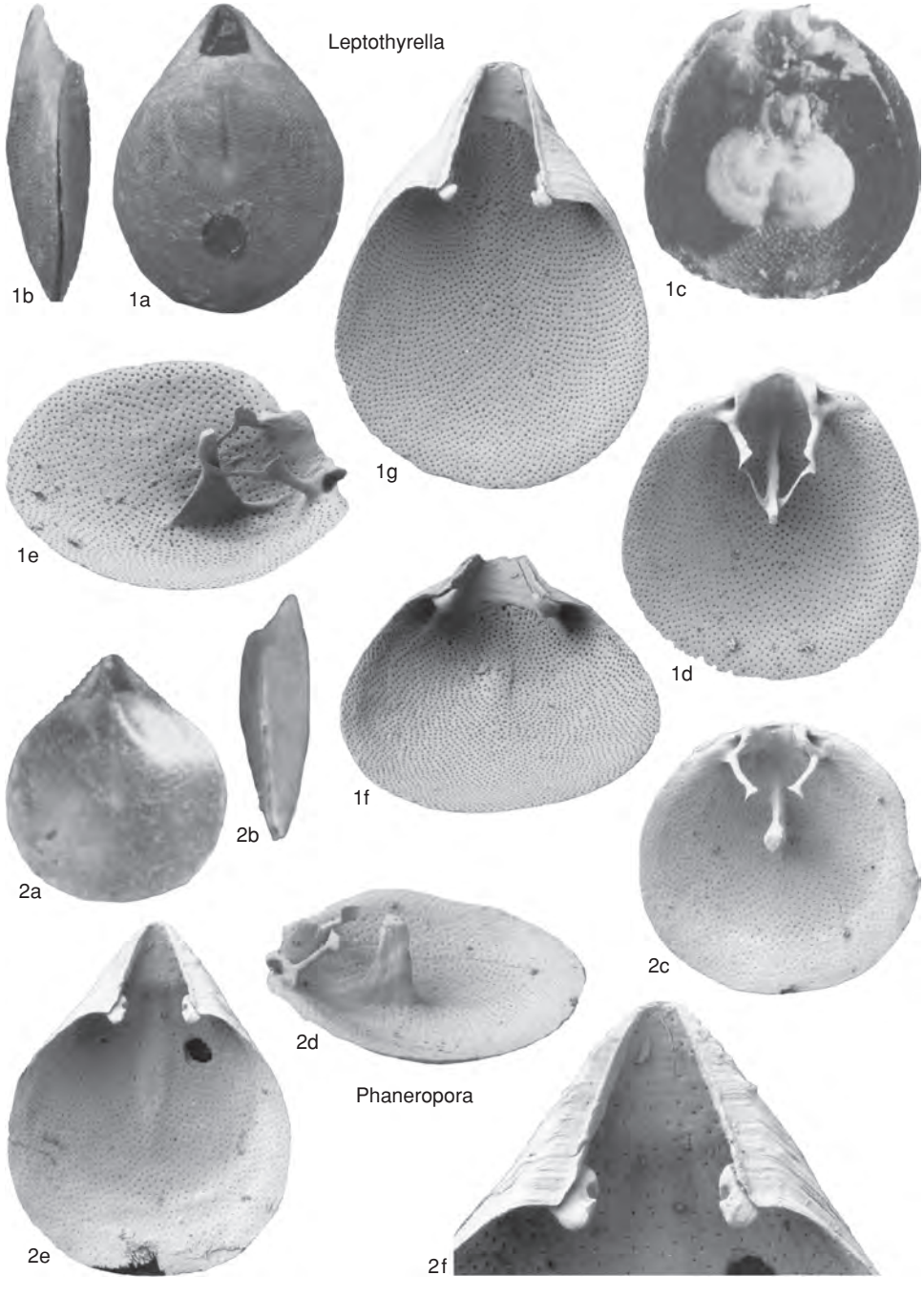

FIG. 1481. Platidiidae (p. 2227–2228).

4,737 m).——FIG. 1481,*1a–c. *L. ignota; a–b,* dorsal and lateral views, Gulf of Aden, ×7; *c,* dorsal interior, holotype NHM ZB 1555, off Zanzibar, ×12 (Muir-Wood, 1965c).——FIG. 1481, *1d–g. L. incerta* (DAVIDSON), Gulf of Gascoigne, Atlantic; *d–e,* ventral and lateral views of dorsal interior, ×20; *f–g,* dorsal and anterior oblique views of ventral interior, ×20 (new).

TEREBRATELLOIDEA

D. I. MacKinnon and D. E. Lee

[University of Canterbury; and University of Otago]

Superfamily TEREBRATELLOIDEA King, 1850

[*nom. transl.* Allan, 1940a, p. 269, *ex* Terebratellidae King, 1850, p. 245]

Adult shells small to large, generally biconvex, subcircular to elongate oval, commonly smooth, some multicostate; anterior commissure rectimarginate to unisulcate, rarely biplicate; ventral umbo commonly attrite, foramen small to large, mesothyrid to permesothyrid, with delthyrium restricted by deltidial plates (either disjunct or conjunct), or by a symphytium. Dental plates absent; pedicle collar short, sessile. Cardinalia lamellar or variably thickened. Cardinal process with transversely oval myophore that may have swollen, anterior boss; septal pillar retained throughout ontogeny, commonly developing as a median septum; hinge plates commonly uniting with septum to form septalium. Anteroventral edge of septal pillar bladelike and nonbifurcate throughout ontogeny; septal flanges not developed. Adult loop commonly teloform, but may be annular, haptoid, diploform, or trabecular; nonspiculate. *Paleogene–Holocene.*

Family TEREBRATELLIDAE King, 1850

[Terebratellidae King, 1850, p. 245]

Loop passing through some or all of axial, cucullate, annular, haptoid, trabecular, and teloform phases; inner hinge plates uniting with median septum to form septalium; posterior shell thickening developed in some taxa. *Paleogene–Holocene.*

Subfamily TEREBRATELLINAE King, 1850

[*nom. transl.* Davidson, 1886, p. 4, *ex* Terebratellidae King, 1850, p. 245]

Smooth or multicostate; deltidial plates disjunct or conjunct in adults. Cardinalia commonly lamellar with excavate, inner hinge plates meeting on medium septum to form septalium; posterior shell thickening extensive in adult growth stages of some genera; adult loop commonly trabecular but also may be annular, haptoid, or teloform. *Paleogene–Holocene.*

Terebratella d'Orbigny, 1847, p. 269 [**Terebratula chilensis* Broderip, 1833b, p. 141; OD; =*Anomia dorsata* Gmelin, 1792, p. 3,348; *Terebratula flexuosa* P. P. King, 1835, p. 337; *Terebratula patagonica* Gould, 1850, p. 347] [=*Waltonia* Davidson, 1850d, p. 474 (type, *W. valenciennesii*); *Magasella* Dall, 1870, p. 134 (type, *Terebratella evansii* Davidson, 1852c, p. 77). Medium to large, transversely ovate, unisulcate, costate to strongly multicostate; beak erect to suberect, attrite, foramen medium to large, submesothyrid to mesothyrid, deltidial plates commonly conjunct. Cardinalia weakly to moderately thickened, hinge plates excavate, moderately to steeply inclined, meeting on low median septum to form septalium; adult loop trabecular, lophophore plectolophous. *Paleogene (Oligocene)–Holocene:* South America, New Zealand.——Fig. 1482,*1a–f.* **T. dorsata* (Gmelin), Holocene, Strait of Magellan; *a–d,* dorsal, ventral, anterior, and lateral views, ×1; *e,* ventral interior, ×1; *f,* dorsal interior showing brachidium, ×1 (Fischer & Oehlert, 1892).

Aerothyris Allan, 1939, p. 245 [**Magellania macquariensis* Thomson, 1918a, p. 30; OD]. Medium size, variably ovate, weakly to moderately unisulcate, smooth; beak suberect, attrite, foramen medium to large, mesothyrid, deltidial plates commonly disjunct, rarely conjunct in some adults. Cardinalia moderately thickened; outer hinge plates prominent and gently inclined; inner hinge plates more steeply inclined, uniting medianly to form septalium; cardinal process prominent, consisting of striated transverse myophore; crura with prominent crural processes; median septum bladelike; adult loop teloform. *Holocene:* Macquarie Island, Antipodes Island.——Fig. 1483,*1a–e.* **A. macquariensis* (Thomson), Macquarie Island; *a–d,* dorsal, lateral, anterior, and posterior views, ×1; *e,* interior of dorsal valve, ×1 (Foster, 1974).

Aneboconcha Cooper, 1973b, p. 28 [**A. obscura;* OD]. Small, smooth, elongate oval, gently unisulcate, beak suberect, foramen large, submesothyrid; deltidial plates disjunct. Cardinal process consisting of transversely oval myophore; socket ridges and outer hinge plates narrow, crural bases narrow, inner hinge plates well developed, uniting with bladelike median septum to form

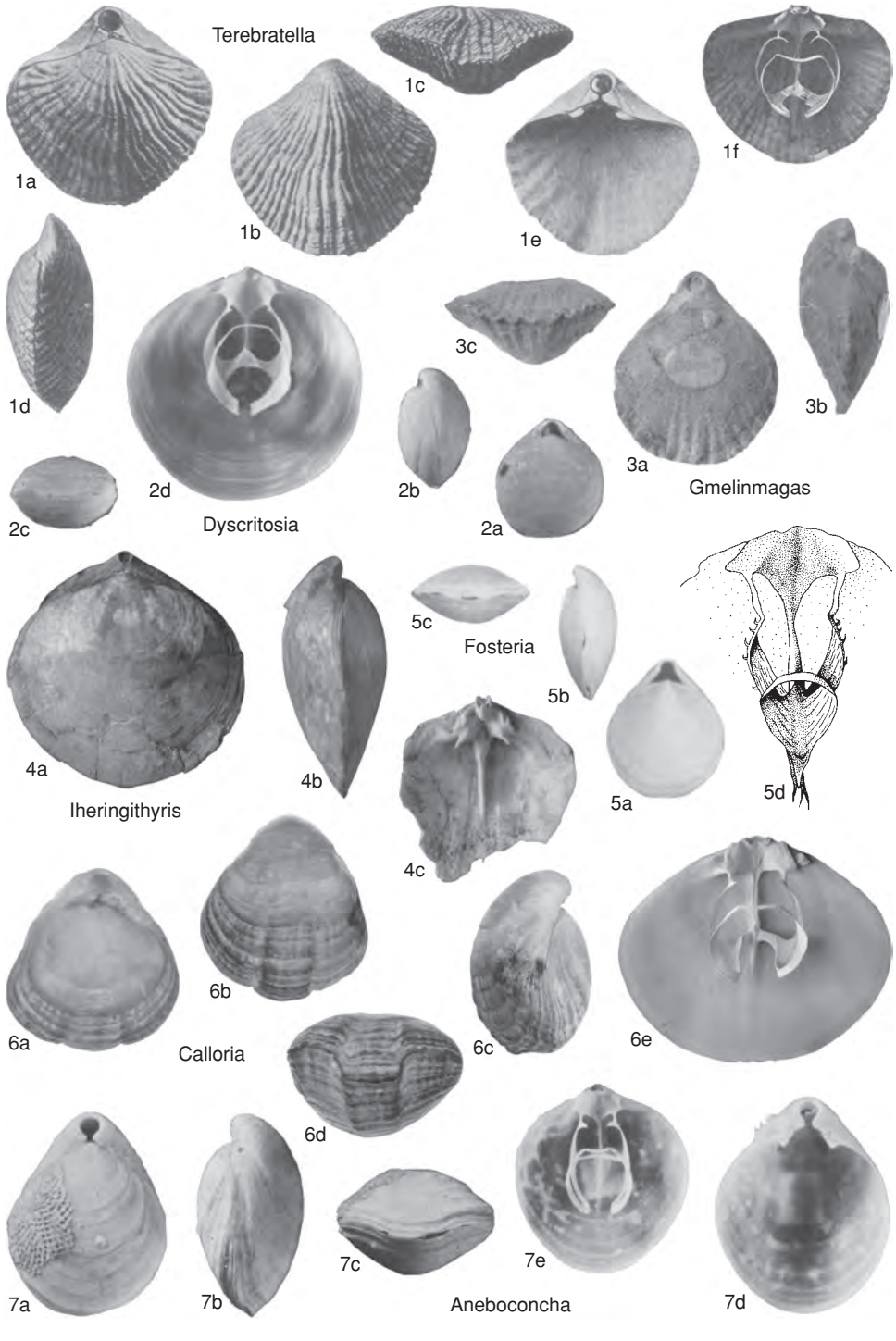

FIG. 1482. Terebratellidae (p. 2229–2231).

septalium; loop trabecular. *Holocene:* South Atlantic.——Fig. 1482,*7a–e.* **A. obscura,* South Shetland Islands; *a–c,* dorsal, lateral, and anterior views; *d–e,* interior of ventral and dorsal valves, ×2 (Cooper, 1973b).

Calloria Cooper & Lee, 1993, p. 267 [**Terebratula inconspicua* G. B. Sowerby, 1846, p. 92; OD; =*Terebratula rubicunda* G. B. Sowerby, 1846, p. 93]. Shell red, small to medium, smooth, or secondarily anteriorly costate, moderately to strongly unisulcate, beak short, attrite, foramen large, submesothyrid; deltidial plates commonly disjunct but sporadically conjunct in gerontic specimens. Cardinal process a transverse myophore lacking any anterior swelling; inner hinge plates meeting low median septum to form septalium, loop trabecular. *Neogene (Pliocene)–Holocene:* New Zealand.——Fig. 1482,*6a–e.* **C. inconspicua* (G. B. Sowerby), Holocene; *a–d,* lectotype, dorsal, ventral, lateral, and anterior views, ZB 595, ×1 (Cooper & Lee, 1993); *e,* dorsal interior, ×4 (new).

Dyscritosia Cooper, 1982, p. 22 [**D. secreta;* OD]. Small to medium, smooth, subcircular, biconvex, rectimarginate; beak low, attrite, erect; foramen medium, submesothyrid; deltidial plates narrow, disjunct. Cardinalia similar to *Aneboconcha.* Adult loop trabecular. *Holocene:* USA (southern Georgia).——Fig. 1482,*2a–d.* **D. secreta; a–c,* holotype, dorsal, lateral, and anterior views, USNM 551169a, ×1; *d,* dorsal interior, ×2 (Cooper, 1982).

Fosteria Zezina, 1980, p. 26 [**Magellania? spinosa* Foster, 1974, p. 142; OD]. Small, smooth, rectimarginate to unisulcate, foramen large, submesothyrid; beak suberect, attrite; deltidial plates very narrow, disjunct. Cardinalia lamellar, lacking clearly defined cardinal process; inner hinge plates broad, steeply inclined, uniting with low posterior trail of median septum to form septalium; septal pillar high, spinose anteriorly; loop annular, descending branches with several curved spines. *Holocene:* Antarctic and South Atlantic (311–1,226 m).——Fig. 1482,*5a–d.* **F. spinosa* (Foster), Ross Sea; *a–c,* holotype, dorsal, lateral, and anterior views, USNM 550269A, ×4; *d,* line drawing of dorsal valve interior, ×12 (Foster, 1974).

Gmelinmagas de Mariñelarena, 1964, p. 267 [**G. plicata;* OD; =*Terebratella dorsata* Ortmann, 1902, p. 74, *non Anomia dorsata* Gmelin, 1792, p. 3,348]. Medium, ventribiconvex, subpentagonal, unisulcate, coarsely costate anteriorly but smooth posteriorly; beak suberect, attrite, foramen relatively large, mesothyrid, deltidial plates conjunct. Cardinal process high, transverse, hinge plates excavate, moderately inclined, meeting on low septum to form septalium; loop trabecular. *Paleogene–Neogene:* Patagonia.——Fig. 1482,*3a–c.* **G. plicata,* Miocene; dorsal, lateral, and anterior views, ×1 (new).

Gyrothyris Thomson, 1918a, p. 23 [**G. mawsoni;* OD]. Medium, transversely ovate to elongate oval; finely multicostate, anterior commissure weakly unisulcate; beak suberect to erect, foramen small, mesothyrid, attrite; deltidial plates usually conjunct, concave, almost hidden. Cardinalia thickened; cardinal process transversely oval myophore, median septum uniting posteriorly with narrow septalium; adult loop typically trabecular but occasionally teloform. *Holocene:* off southern New Zealand and Macquarie Islands.——Fig. 1483,*2a–e.* **G. mawsoni,* Macquarie Island; *a–c,* dorsal, lateral, and anterior views, ×1; *d–e,* ventral and dorsal valve interiors, ×1 (Foster, 1974).

Iheringithyris Levy, 1961, p. 84 [**Magellania ameghinoi* Ihering, 1903b, p. 326; OD]. Medium to large, smooth, biconvex, circular, rectimarginate; beak low, suberect, foramen small, mesothyrid, deltidial plates conjunct, beak ridges sharp. Cardinalia thickened; crural bases swollen, diverging at about 45° from median plane and enclosing narrow, partially infilled septalium; cardinal process well differentiated, consisting of posterior, rather sunken myophore with upturned lateral margins and anterior bosslike swelling; inner socket ridges with submarginal thickening; median septum relatively low and bladelike, extending about 0.6 valve length; loop teloform. *Neogene (Miocene):* Patagonia.——Fig. 1482,*4a–c.* **I. ameghinoi* (Ihering); *a–b,* dorsal and lateral views, ×1; *c,* interior of dorsal valve, ×1 (new).

Magadina Thomson, 1915a, p. 399 [**M. browni;* OD]. Small, smooth, biconvex to planoconvex, ventrally carinate, unisulcate. Beak suberect, foramen permesothyrid, deltidial plates conjunct. Hinge teeth strong with grooved, swollen bases. Cardinal process a transverse myophore, lacking anterior swelling; swollen inner socket ridges tending to fuse anteriorly to enclose a short, deep hinge trough; septal pillar high; incomplete annular loop. *Paleogene (Oligocene)–Neogene (Miocene):* New Zealand; Australia, *Miocene.*——Fig. 1483,*3a–f.* **M. browni,* Miocene, New Zealand; *a–d,* holotype, dorsal, lateral, anterior, and posterior views, NMNZ Br46, ×2; *e–f,* dorsal and oblique views of dorsal valve interior, ×4 (new).

Magella Thomson, 1915a, p. 396 [**M. carinata;* OD; =*Terebratella kakanuiensis* Thomson, 1908, p. 102, *non* Hutton, 1905, p. 479]. Small, smooth, unisulcate; beak suberect, foramen submesothyrid, deltidial plates disjunct. Cardinalia strongly resembling those of *Calloria,* but adult loop phase haptoid to incipiently trabecular. *Paleogene (Eocene–Oligocene):* New Zealand.——Fig. 1483,*4a–e.* **M. carinata,* Oligocene; *a,* dorsal view, ×2; *b–c,* lateral and anterior views, ×1; *d,* dorsal valve interior, ×2; *e,* oblique view of loop, ×3 (new).

Neothyris Douvillé, 1879, p. 274 [**Terebratula lenticularis* Deshayes, 1839, p. 359; OD]. Large, smooth, weakly unisulcate, beak erect to incurved, foramen small, mesothyrid, attrite; deltidial plates conjunct. Strong posterior shell thickening in adults. Cardinalia thickened, crural bases fused with socket ridges; median septum short, high, bifurcating posteriorly to form wide hinge trough, almost filled by large, swollen boss of cardinal process; crura rather short, crural processes prominent; adult

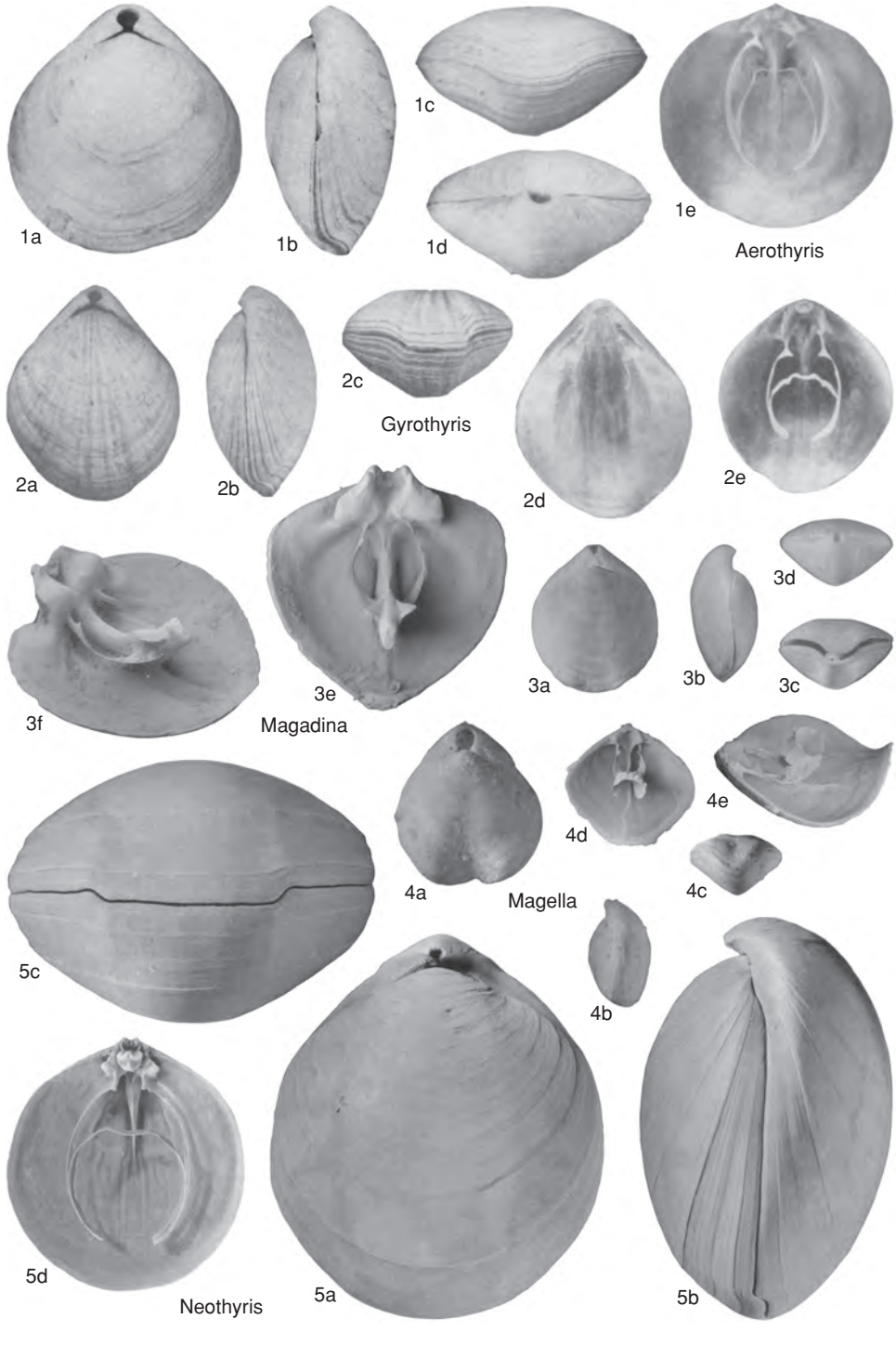

FIG. 1483. Terebratellidae (p. 2229–2233).

loop teloform, lophophore plectolophous. *Neogene (Miocene)–Holocene:* New Zealand.——Fig. 1483,*5a–d.* **N. lenticularis* (Deshayes), Holocene; *a–c,* dorsal, lateral, and anterior views; *d,* dorsal interior showing loop, ×1 (new).

Pachymagas Ihering, 1903b, p. 332 [**Terebratella (Pachymagas) tehuelcha* Ihering, 1903b, p. 332; OD]. Medium to large, smooth, unisulcate, beak suberect to erect; foramen large, mesothyrid, attrite; deltidial plates conjunct; posterior shell thickening moderately to very strongly developed. Hinge teeth strong. Cardinalia thickened; median septum bifurcating posteriorly to form wide hinge trough, almost completely filled by very swollen boss of cardinal process; loop trabecular. *Paleogene (Oligocene)–Neogene (Pliocene):* South America; New Zealand, *Oligocene–Miocene.*——Fig. 1484,*4a–c.* **P. tehuelcha,* Pliocene, Patagonia; *a–b,* lectotype, dorsal and lateral views of exterior, MACN 4990, ×1; *c,* dorsal interior, loop not preserved, ×1 (new).

Praemagadina MacKinnon in MacKinnon, Beus, & Lee, 1993, p. 338 [**P. campbelli;* OD]. Small, smooth, unisulcate, beak suberect, foramen submesothyrid, deltidial plates disjunct; both valves thickened posteriorly. Hinge teeth strong with grooved swollen bases; inner socket ridges robust, enclosing sessile hinge trough bearing large pedicle adjustor muscle scars; septal pillar high, anteriorly inclined; adult loop incomplete haptoid. *Paleogene (Oligocene):* New Zealand.——Fig. 1484,*3a–e.* **P. campbelli; a–c,* holotype, dorsal, lateral, and anterior views, OU 40741, ×3; *d–e,* dorsal valve interior, normal and oblique views, ×6 (MacKinnon, Beus, & Lee, 1993).

Syntomaria Cooper, 1982, p. 20 [**S. curiosa;* OD]. Small, smooth but with prominent growth lines, elongate oval, narrowly biconvex, rectimarginate; beak suberect, attrite, foramen wide, deltidial plates narrow, disjunct. Cardinal process a well-developed transverse myophore; inner hinge plates excavate, uniting on valve floor; septal pillar high, anteriorly inclined, and narrow. Loop annular to incipiently haptoid; descending branches occasionally incomplete. *Holocene:* South Sandwich Islands, South Atlantic.——Fig. 1484,*1a–d.* **S. curiosa; a–c,* holotype, dorsal, lateral, and anterior views, USNM 551173a, ×5; *d,* dorsal valve interior, ×7 (Cooper, 1982).

Waiparia Thomson, 1920, p. 380 [**Pachymagas abnormis* Thomson, 1917, p. 412; OD]. Medium to large, smooth, unisulcate; beak erect, attrite, foramen submesothyrid to mesothyrid, deltidial plates conjunct. Cardinal process with transversely oval myophore and small, pyramidal anterior boss; cardinalia thickened, inner hinge plates well developed, uniting on short median septum to form septalium; loop trabecular. *Paleogene (Oligocene)–Neogene (Miocene):* New Zealand.——Fig. 1484,*2a–d.* **W. abnormis* (Thomson), Miocene; *a–c,* holotype, dorsal, lateral, and anterior views, NMNZ Br113, ×1.5; *d,* dorsal interior, loop not preserved, ×3.5 (new).

Subfamily ADNATIDINAE new subfamily

[Adnatidinae MacKinnon & Lee, herein] [type genus, *Adnatida* Richardson, 1991, p. 38]

Small, smooth, unisulcate, crura vestigial, loop incomplete annular to incomplete haptoid. *Paleogene (Eocene).*

Adnatida Richardson, 1991, p. 38 [**Magasella deformis* Tate, 1880, p. 165; OD]. Small, smooth, strongly unisulcate, ventrally carinate, beak erect to slightly incurved, foramen small, mesothyrid to submesothyrid; deltidial plates conjunct and downwardly convergent along median line; beak ridges well developed. Cardinalia massively thickened; cardinal process small, sessile, transversely oval myophore; small pedicle adjustor muscle pits inserted just anteriorly of cardinal process, tending to become infilled by secondary shell in gerontic specimens; massive median swelling between very strong inner socket ridges; septal pillar very high; loop annular to haptoid. *Paleogene (Eocene):* Australia.——Fig. 1485,*3a–f.* **A. deformis* (Tate); *a–c,* dorsal, lateral, and anterior views, ×3.5 (Richardson, 1991); *d,* ventral interior; *e–f,* normal and lateral views of dorsal interior, ×4 (new).

Subfamily ANAKINETICINAE Richardson, 1991

[Anakineticinae Richardson, 1991, p. 30]

Small to medium, smooth, unisulcate, ventrally carinate; high septal pillar almost touching ventral valve floor; hinge trough may become completely infilled with secondary shell, forming prominent cardinal platform with posterior pits for dorsal adjustor muscle attachment; loop annular to trabecular. *Paleogene (Oligocene)–Holocene.*

Anakinetica Richardson, 1987, p. 38 [**Terebratella(?) cumingii* Davidson, 1852d, p. 368; OD]. Small to medium, ovate, biconvex; beak large, suberect to straight; symphytium wide, flat; cardinal margin straight or nearly straight. Substantial posterior shell thickening in both valves; pedicle canal long and narrow; crura short; loop annular to trabecular. *Paleogene (Oligocene)–Holocene:* Australia.——Fig. 1485,*2a–e.* **A. cumingii* (Davidson); *a–d,* dorsal, lateral, posterior, and anterior views, ×2; *e,* dorsal interior, ×3 (Richardson, 1987).

Parakinetica Richardson, 1987, p. 39 [**P. stewarti;* OD]. Small, planoconvex; beak small, straight; deltidial plates disjunct; loop annular. *Holocene:* Australia.——Fig. 1485,*1a–f.* **P. stewarti,* Bass Strait; *a–d,* dorsal, lateral, posterior, and anterior views; *e–f,* dorsal and ventral interiors, ×5 (Richardson, 1987).

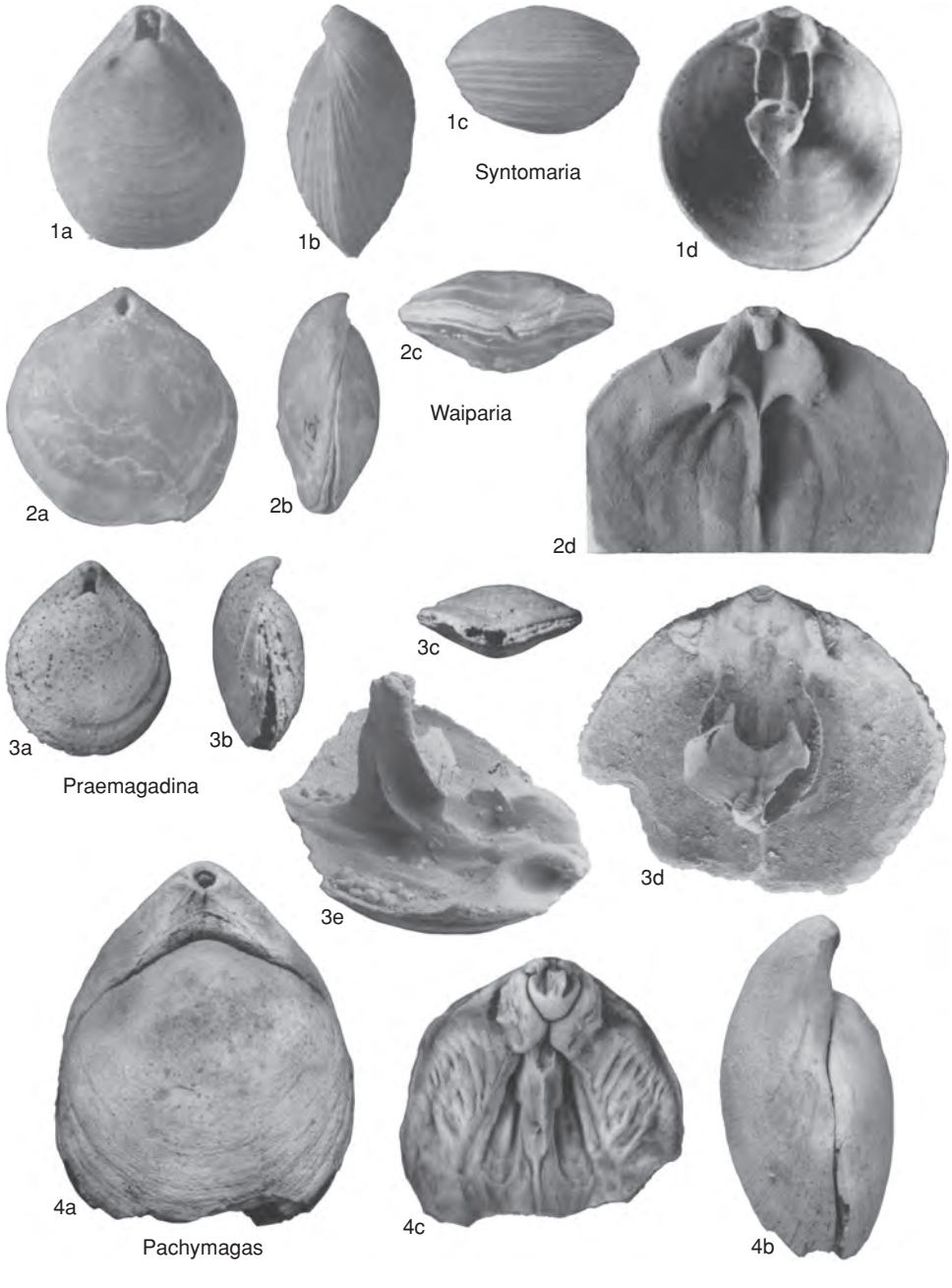

FIG. 1484. Terebratellidae (p. 2233).

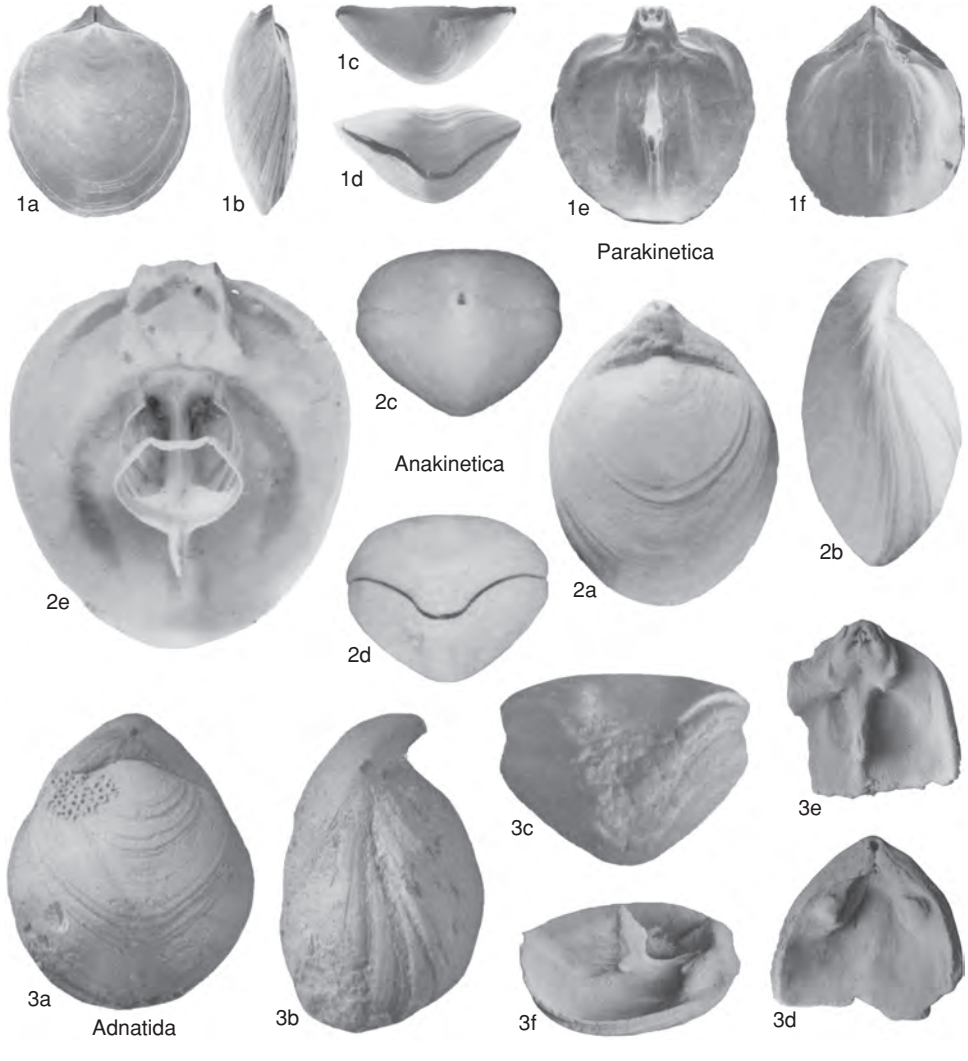

FIG. 1485. Terebratellidae (p. 2233).

Subfamily MAGELLANIINAE Beecher, 1893

[Magellaniinae BEECHER, 1893, p. 391]

Small to large, smooth to multiplicate, biconvex, with suberect to incurved beak, mesothyrid to permesothyrid foramen; symphytium well developed; cardinalia commonly lamellar with excavate inner hinge plates meeting on medium septum to form septalium; posterior shell thickening extensive in adult growth stages of some genera. Adult loop commonly teloform. *Paleogene (Eocene)–Holocene.*

Magellania BAYLE, 1880, p. 240, *nom. nov. pro Waldheimia* KING, 1850, p. 81, *non* BRULLÉ, 1846 [**Terebratula australis* QUOY & GAIMARD, 1834, p. 551; OD; = *Terebratula flavescens* LAMARCK, 1819, p.

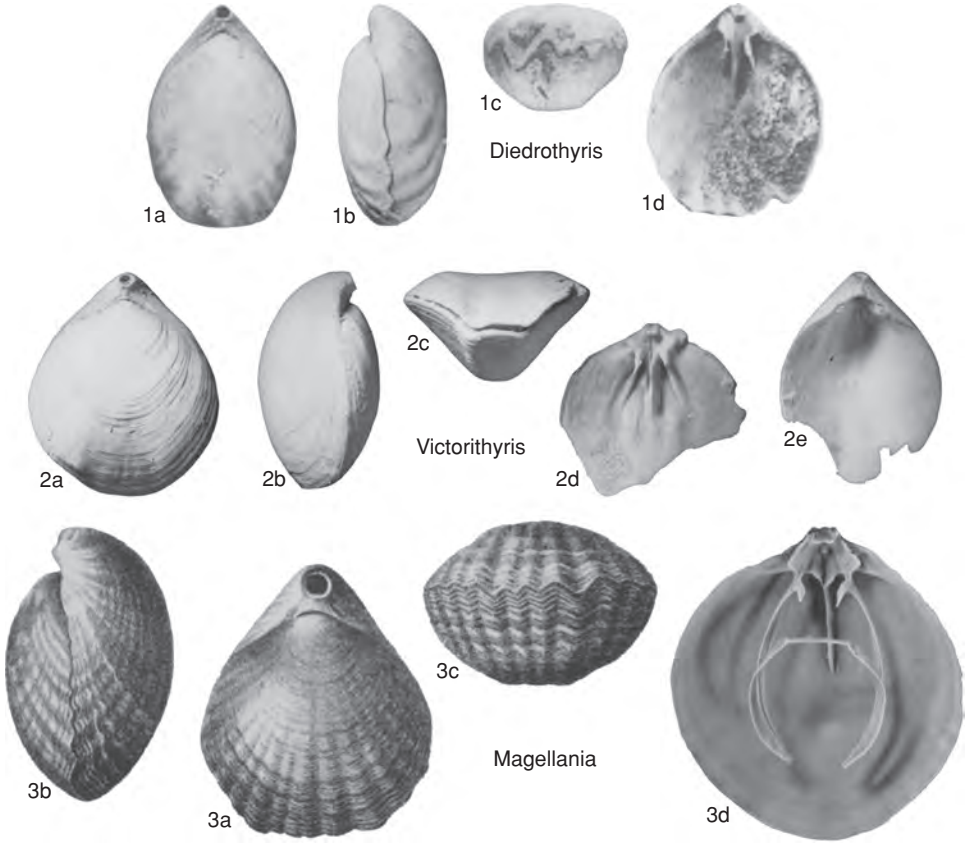

FIG. 1486. Terebratellidae (p. 2235–2236).

246]. Medium to large, ovate, smooth as juvenile, becoming costate, unisulcate; beak suberect to erect; foramen large, mesothyrid, attrite; symphytium moderately high. Cardinalia lamellar with wide inner hinge plates and narrow outer hinge plates divided by narrow crural bases, hinge plates excavate, meeting on medium septum to form septalium; cardinal process a transverse myophore; crura short, crural processes prominent; loop teloform, lophophore plectolophous. *Neogene (?Miocene), Holocene:* Australia, Antarctica, South America.——FIG. 1486,*3a–d. *M. flavescens* (LAMARCK), Holocene, Australia; *a–c,* dorsal, lateral, and anterior views, ×1 (Davidson, 1886); *d,* dorsal valve interior, ×1.5 (new).

Diedrothyris RICHARDSON, 1980, p. 48 [**Waldheimia (?) johnstoniana* TATE, 1880, p. 151; OD]. Medium, smooth, becoming multiplicate in adult, rectimarginate to unisulcate to intraplicate; beak suberect, foramen medium in size, mesothyrid. Cardinalia with crural bases separating excavate inner and outer hinge plates; inner hinge plates moderately inclined, uniting with bladelike median septum to form septalium; cardinal process consisting of upwardly projecting subquadrate myophore; loop teloform. *Paleogene (Eocene)–Neogene (Miocene):* Australia.——FIG. 1486,*1a–d. *D. johnstoniana* (TATE), upper Eocene, Aldinga, South Australia; *a–c,* dorsal, lateral, and anterior views, ×1.6; *d,* interior of dorsal valve, ×2 (Richardson, 1980).

Victorithyris ALLAN, 1940b, p. 289 [**V. peterboroughensis;* OD]. Medium to large, smooth to variably costate, unisulcate to intraplicate, beak suberect to erect, foramen small, mesothyrid; symphytium convex with median ridge. Cardinalia thickened, with fused socket ridges and stout crural bases; thickened inner hinge plates meeting on short, thick median septum to form septalium; loop teloform. *Paleogene (Eocene)–Neogene (Miocene):* Australia.——FIG. 1486,*2a–e. *V. peterboroughensis,* Miocene, Victoria; *a–c,* dorsal, lateral, and anterior views; *d–e,* dorsal and ventral interiors, ×1 (new).

Subfamily STETHOTHYRIDINAE MacKinnon, 1993

[Stethothyridinae MacKinnon in MacKinnon, Beus, & Lee, 1993, p. 342]

Smooth to marginally plicate, commonly unisulcate but may be intraplicate or paraplicate; biconvex with suberect to incurved beak, mesothyrid to permesothyrid foramen, symphytium present; inner socket ridge, outer hinge plate area wide to very wide and commonly swollen; crura originating close to median plane and diverging at acute angle from just anterior of cardinal process; dorsal median septum bladelike, merging posteriorly with very narrow, commonly parallel-sided septalium that is often obscured in adults by secondary infilling of cavities or extreme thickening of crural bases; loop teloform. *Paleogene (Eocene)–Neogene (Miocene).*

Stethothyris Thomson, 1918a, p. 23 [**S. uttleyi;* OD]. Small to medium, subcircular to elongate-oval, smooth, biconvex, unisulcate; beak suberect; foramen small, mesothyrid; symphytium wide with superficial grooves and ridges. Pedicle cavity reduced by posterior valve thickening; hinge teeth small, strong, with swollen bases grooved to accommodate socket ridges. Cardinal process with swollen anterior lobe, and posterior myophore with lateral, upturned flanges that project beyond umbo; cardinalia swollen; extremely narrow, largely infilled septalium uniting posteromedianly with crural bases; pedicle adjustor attachment sites restricted and posteriorly located, forming prominent excavations leading to isolation of cardinal process from remainder of thickened inner socket ridge, hinge plate, crural base complex; loop teloform. *Paleogene (Eocene–Oligocene):* New Zealand.——Fig. 1487,*3a–e. *S. uttleyi,* Eocene: *a–c,* holotype, dorsal, lateral, and anterior views, NMNZ Br1270, ×1; *d–e,* detail of ventral and dorsal valve interiors, ×4 (new).

Aliquantula Richardson, 1991, p. 42 [**Waldheimia(?) insolita* Tate, 1880, p. 151; OD]. Medium, subcircular to elongate oval, smooth, biconvex, rectimarginate; beak suberect to slightly incurved, foramen very small, mesothyrid; beak ridges sharp, symphytium wide with superficial grooves and ridges. Pedicle cavity restricted by posterior shell thickening; teeth large, swollen bases grooved to accommodate socket ridges. Cardinal process small with small anterior lobe and upturned lateral margins; inner socket ridges and crural bases greatly swollen, restricting septalial trough; loop teloform. *Paleogene (Eocene–Oligocene):* Australia.——Fig. 1488,*4a–d. *A. insolita* (Tate), Eocene, South Australia; *a–b,* dorsal and lateral views, ×1.5; *c,* detail of pedicle foramen; *d,* closeup of cardinalia, ×5 (new).

Austrothyris Allan, 1939, p. 238 [**Waldheimia gambierensis* Etheridge, 1876, p. 19; OD; = *W. grandis* Tenison-Woods, 1865, p. 2]. Large, elongate subpentagonal, smooth, or marginally multiplicate, with intraplicate anterior commissure; beak prominent, suberect, truncated obliquely by a large, mesothyrid, attrite foramen; beak ridges rounded; symphytium high with median ridge. Cardinalia rather slender; cardinal process upwardly projecting, consisting of subquadrate myophore with mildly swollen anterior boss; low, bladelike median septum extending to midvalve; crura long and slender; crural bases low and well differentiated from stout, steeply inclined inner socket ridges; inner hinge plates fused to crural bases, steeply inclined and meeting low on sides of median septum; inner hinge plates extremely narrow anteriorly and broadening posteriorly; loop teloform. *Paleogene (Oligocene)–Neogene (Miocene):* Australia.——Fig. 1487,*2a–e. *A. grandis* (Tenison-Woods); *a–c,* dorsal, lateral, and anterior views; *d,* dorsal interior, ×1; *e,* detail of cardinalia, ×2 (new).

Cudmorella Allan, 1939, p. 242 [**C. tatei;* OD]. Shell medium to large, smooth, biconvex, intraplicate, beak erect, foramen mesothyrid and moderately large, symphytium low, with median ridge. Hinge teeth strong, with swollen bases. Cardinalia moderately thickened; inner socket ridges and stout crural bases separated by deep groove, crura short, thick; cardinal process small, subtriangular with prominent anterior boss; median septum thick, bifurcating posteriorly to form V-shaped hinge trough; adductor scars deeply impressed on either side of septum; loop teloform. *Neogene (Miocene):* Australia.——Fig. 1488,*1a–d. *C. tatei; a–c,* dorsal, lateral, and anterior views, ×0.5; *d,* dorsal interior, ×1 (new).

Elderra Richardson, 1991, p. 38 [**E. toorlooensis;* OD]. Medium, ovate, smooth, biconvex, unisulcate, beak suberect, beak ridges sharp; symphytium with median ridge. Cardinal process with small, transverse myophore and slight median swelling; small, earlike projections adjacent to myophore; crural bases and inner socket ridges thickened and swollen but not uniting medianly; loop teloform. *Neogene (Miocene):* Australia.——Fig. 1488,*2a–d. *E. toorlooensis,* Victoria; *a–c,* dorsal, lateral, and anterior views, ×1.5; *d,* dorsal interior, ×3.5 (new).

Epacrothyris Hiller & MacKinnon, 2000, p. 68 [**Waldheimia pectoralis* Tate, 1880, p. 157; OD]. Large, smooth, strongly biconvex, elongate oval to subpentagonal, unisulcate to intraplicate; beak narrow, erect to incurved; foramen small, mesothyrid to permesothyrid; beak ridges moderately developed, symphytium flat to concave. Inner socket ridges, outer hinge plates, and crural bases well developed and fused; cardinal process large, cuplike; median septum high, uniting posteriorly with very

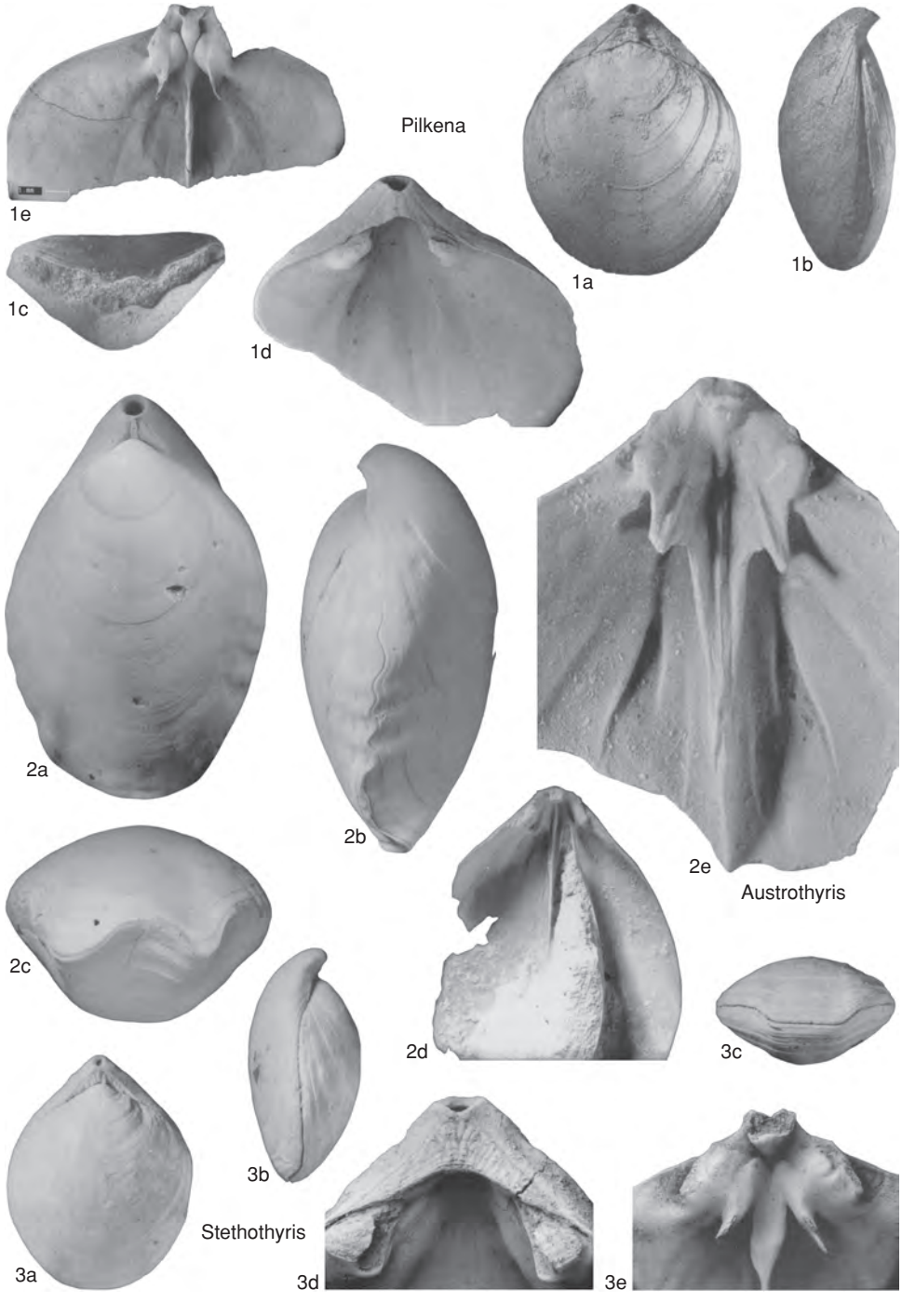

FIG. 1487. Terebratellidae (p. 2237–2240).

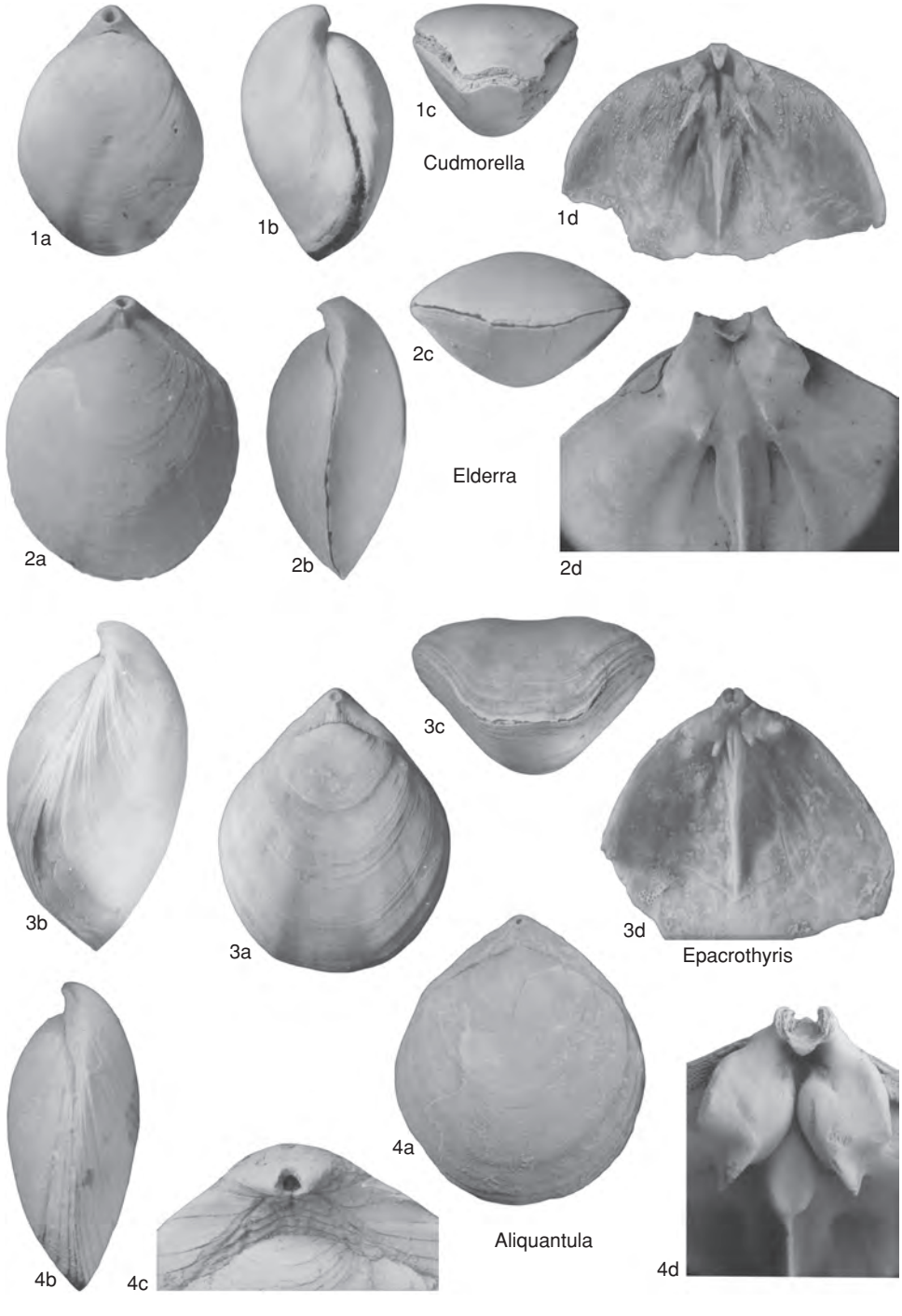

FIG. 1488. Terebratellidae (p. 2237–2240).

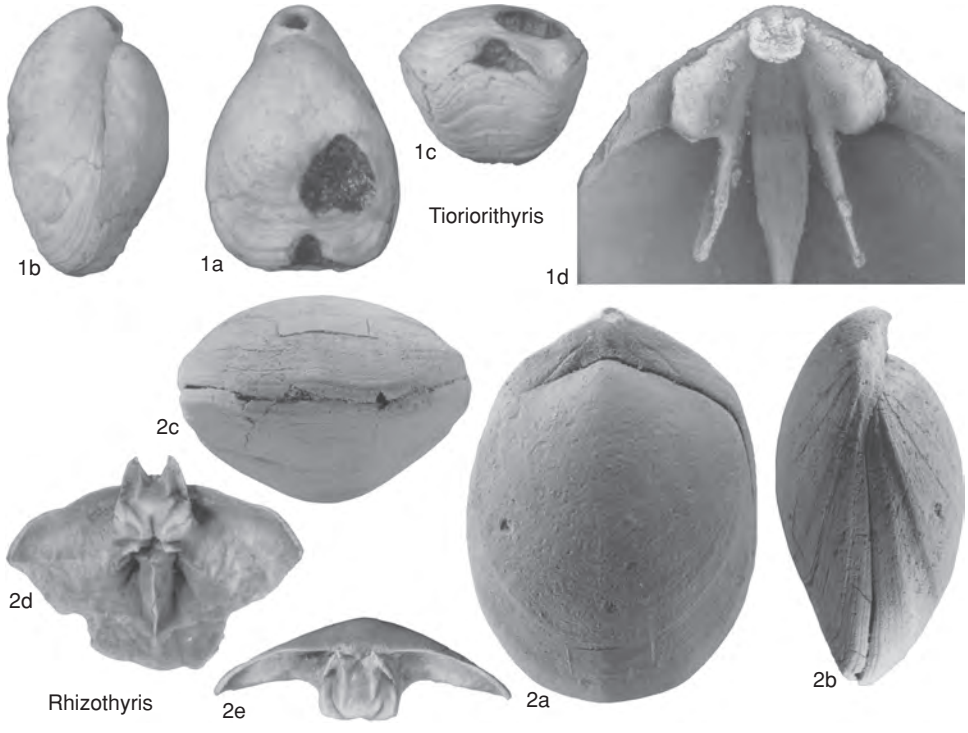

FIG. 1489. Terebratellidae (p. 2240).

narrow septalium; loop teloform. *Paleogene (Eocene)–Neogene (Miocene):* Australia; New Zealand, *Eocene–Oligocene.*——FIG. 1488,*3a–d. *E. pectoralis* (TATE); *a–c,* dorsal, lateral, and anterior views, ×1; *d,* dorsal interior, loop not preserved, ×2 (new).

Pilkena RICHARDSON, 1991, p. 42 [**P. compressa;* OD]. Smooth, medium, ovate, unisulcate, beak suberect, beak ridges sharp, ventral valve carinate; symphytium with low median ridge. Cardinal process consisting of transverse myophore with prominent anterior swelling that may occupy entire hinge trough; crural bases swollen; median septum short, thick, with bladelike ventral edge; loop teloform. *Paleogene (Oligocene):* Australia.——FIG. 1487,*1a–e. *P. compressa,* Victoria; *a–c,* dorsal, lateral, and anterior views, ×1.5 (Richardson, 1991); *d–e,* ventral and dorsal interior, ×3 (new).

Rhizothyris THOMSON, 1915a, p. 399 [**Bouchardia rhizoida* HUTTON, 1905, p. 480; OD]. Medium to large, biconvex, rectimarginate to unisulcate, elongate-oval, smooth; beak suberect; foramen small to medium, permesothyrid; symphytium wide, often with median ridge. Hinge teeth strong, pedicle cavity restricted by posterior shell thickening. Cardinalia very swollen and fused to form a massive hinge platform; distinctive cardinal process bearing two earlike, posterior projections, each bearing a deep, dorsal, pedicle, adjustor muscle pit; posterior bifurcation of median septum forming very narrow septalium commonly obscured by shell thickening; loop teloform. *Paleogene (Oligocene)–Neogene (Miocene):* New Zealand.——FIG. 1489,*2a–c. *R. rhizoida* (HUTTON), Miocene; dorsal, lateral, and anterior views, ×1 (Bowen & Campbell, 1973). ——FIG. 1489,*2d–e. R. labiata* ALLAN; normal and posterior views of dorsal interiors, ×1 (new).

Tioriorithyris HILLER & MACKINNON, 2000, p. 74 [**Campages chathamensis* ALLAN, 1932b, p. 14; OD]. Small to medium, subtriangular to subpentagonal, smooth, biconvex, parasulcate; beak suberect, attrite; foramen large, mesothyrid; symphytium low, gently convex; beak ridges not developed. Crural bases prominent, diverging from immediately anterior of linguiform, elevated cardinal process, and enclosing a narrow, elongate, nearly flat septalium; loop teloform. *Paleogene (Paleocene–Eocene):* New Zealand (Chatham Islands).——FIG. 1489,*1a–d. *T. chathamensis* (ALLAN); *a–c,* holotype, dorsal, lateral, and anterior views, UCM 1436, ×2; *d,* detail of dorsal interior, ×5 (Hiller & MacKinnon, 2000).

Subfamily UNCERTAIN

Chathamithyris ALLAN, 1932b, p. 15 [**C. traversi;* OD]. Small, smooth, elongate oval, strongly biconvex, rectimarginate to gently unisulcate, beak

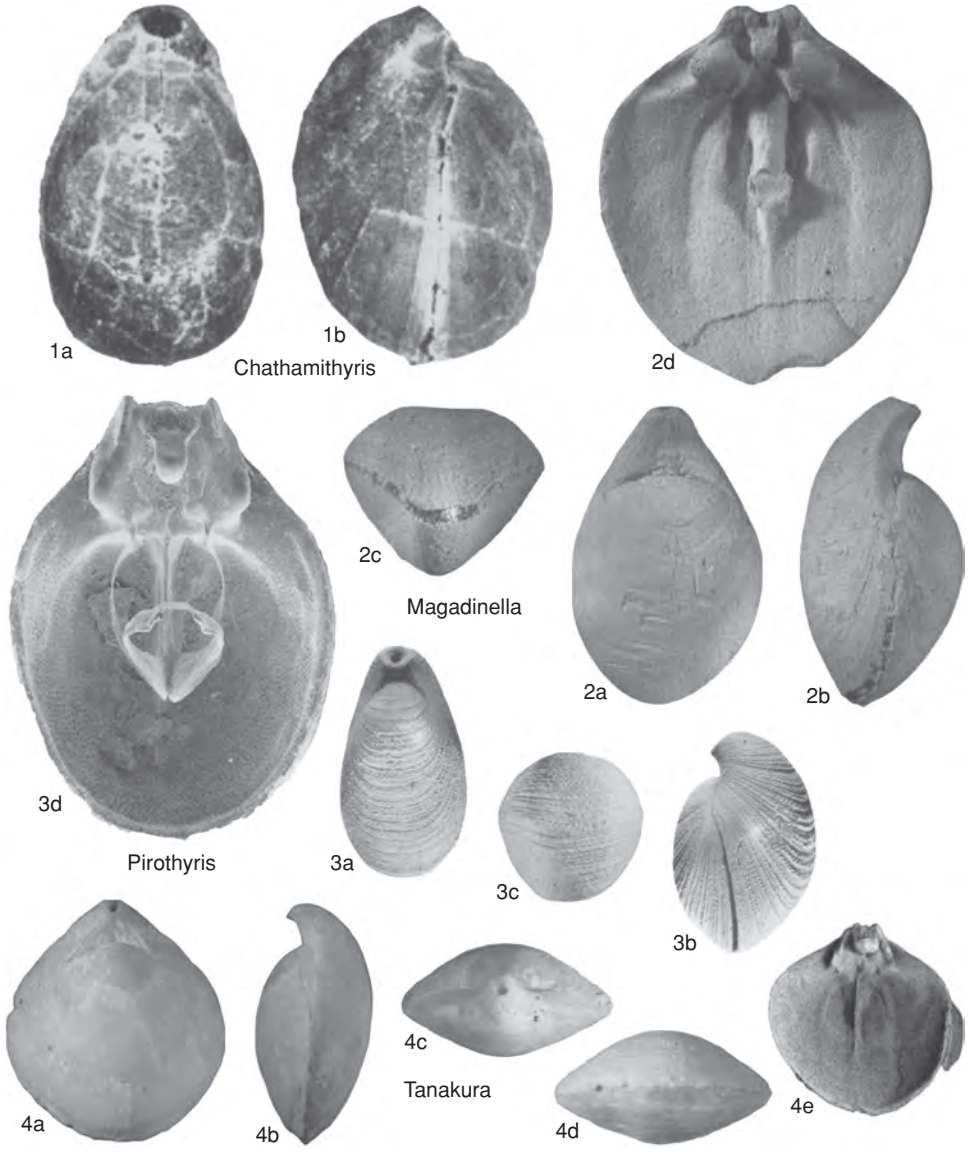

FIG. 1490. Terebratellidae (p. 2240–2242).

suberect, foramen large, mesothyrid, symphytium low. Cardinalia lamellar, septalium with gently inclined, equidimensional, inner and outer hinge plates separated by indistinct crural bases; cardinal process with ovate myophore, crura short; loop teloform. *Paleogene (Paleocene):* New Zealand (Chatham Islands).——FIG. 1490,*1a–b.* **C. traversi;* holotype, dorsal and lateral views, UCM 1439, ×4.6 (Muir-Wood, 1965a).

Magadinella THOMSON, 1915a, p. 400 [**Magasella woodsiana* TATE, 1880, p. 163; OD]. Medium, smooth, pyriform to ovate, unisulcate; beak erect to nearly straight; symphytium wide. Strong posterior shell thickening; cardinalia strongly developed with anterior parts of outer hinge plates massively swollen; cardinal process with swollen anterior boss; dorsal pedicle adjustor muscle attachment sites forming restricted hinge trough, deeply impressed adjacent to cardinal process; loop haptoid to teloform. *Paleogene (Oligocene)–Holocene:* Australia.——FIG. 1490,*2a–d.* **M. woodsiana* (TATE), Oligocene–Miocene; *a–c,* dorsal, lateral, and anterior views, ×2; *d,* dorsal interior, ×3 (Richardson, 1991).

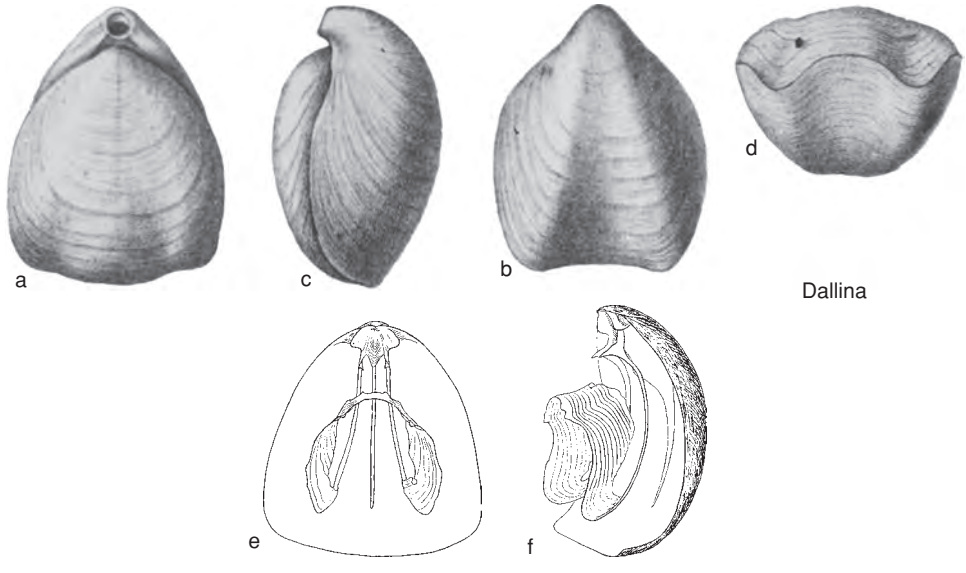

FIG. 1491. Dallinidae (p. 2242–2243).

Pirothyris THOMSON, 1927, p. 280 [**Magasella vercoi* BLOCHMANN, 1910, p. 91; OD]. Small, smooth, elongate oval, strongly biconvex, rectimarginate to slightly parasulcate, beak suberect, symphytium present. Cardinalia thickened, inner socket ridges massive; cardinal process with ovate myophore and prominent anterior boss occupying about half of hinge trough, crura short; loop haptoid. *Holocene:* Australia.——FIG. 1490,*3a–d.* **P. vercoi* (BLOCHMANN); *a–c,* dorsal, lateral, and anterior views of exterior, ×4; *d,* dorsal interior, ×10 (Richardson, 1987).

Tanakura HATAI, 1936, p. 322 [**Magasella fibula* HAYASAKA, 1921, p. 1; OD; *non* REEVE, 1861, p. 180; =*Tanakura tanakura* HATAI, 1936, p. 322]. Small to medium, smooth, subovate, rectimarginate; beak high, suberect; foramen small, permesothyrid to almost epithyrid; symphytium wide and concave with prominent median groove. Hinge teeth strong, bases swollen and grooved for reception of socket ridges; ventral muscle scars elongate and deeply impressed. Cardinalia with strong shell thickening; cardinal process a transverse myophore with massive, anterior, boss filling and dorsally fused to hinge trough; median septum bladelike, thickened posteriorly and extending anteriorly to about midvalve. Loop probably teloform. *Neogene (Miocene):* Japan.——FIG. 1490,*4a–e.* **T. tanakura* (HATAI); *a–d,* dorsal, lateral, posterior, and anterior views, ×2; *e,* dorsal valve interior, ×2 (new).

Family DALLINIDAE Beecher, 1893

[*nom. transl.* ALLAN, 1940a, p. 270, *ex* Dallininae BEECHER, 1893, p. 391]

Small to large, biconvex, smooth, rectimarginate, unisulcate, or intraplicate; beak attrite, foramen mesothyrid, symphytium generally present; adult loop commonly diploform, but occasionally trabecular, bilateral, or teloform. [Examination of early growth stages of *Dallina septigera* (LOVÉN), the type species of the nominate genus, confirms that dental plates are absent in juvenile as well as adult stages of that species. Taxa bearing dental plates previously assigned to the superfamily Dallinoidea are now assigned to the superfamilies Kingenoidea or Laqueoidea as defined herein.] *Paleogene (Oligocene)–Holocene.*

Subfamily DALLININAE Beecher, 1893

[Dallininae BEECHER, 1893, p. 391]

Adult loop teloform. *Neogene (Miocene)–Holocene.*

Dallina BEECHER, 1893, p. 382 [**Terebratula septigera* LOVÉN, 1846, p. 29; OD]. Small to large, triangular to subquadrangular in outline; rectimarginate to paraplicate; beak erect, without beak ridges; foramen small to large, mesothyrid, attrite, symphytium concave. Hinge teeth small, weak; pedicle collar very short. Cardinalia lamellar with excavate inner and outer hinge plates separated by narrow crural bases; inner hinge plates converging on median septum to form V-shaped septalium; cardinal process not differentiated; median septum low anteriorly, extending beyond midvalve; adult

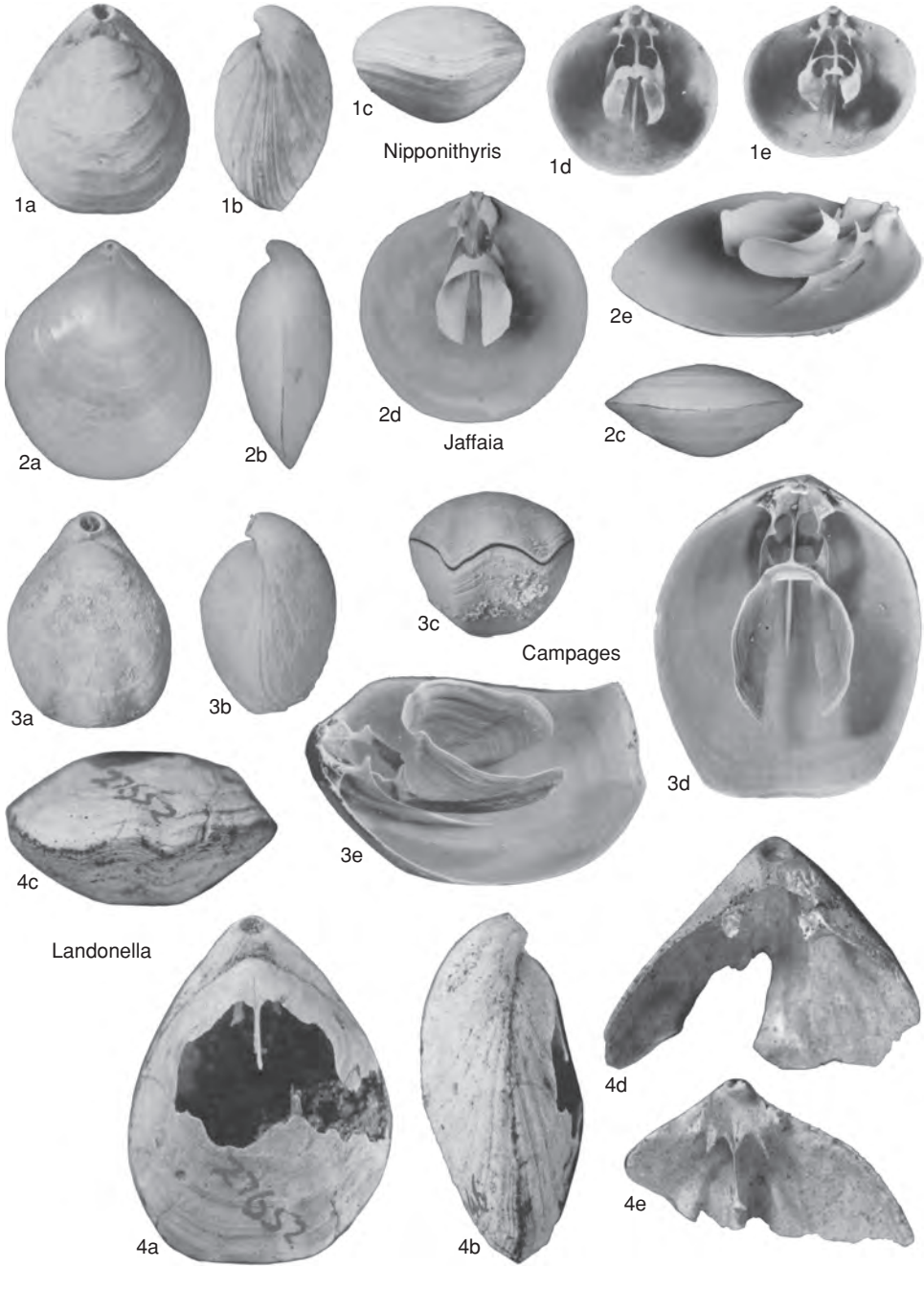

FIG. 1492. Dallinidae (p. 2244).

loop teloform. *Neogene (Miocene)–Holocene:* Italy, Japan, *Miocene–Pliocene;* Italy, Japan, Norway, *Pleistocene;* Atlantic Ocean (40–2,338 m), Pacific Ocean (23–402 m), Pacific-Antarctic Ridge (915–1,153 m), *Holocene*.——FIG. 1491*a–f.* **D. septigera* (LOVÉN), Holocene, North Atlantic; *a–d,* dorsal, ventral, lateral, and anterior views, ×1 (Muir-Wood, 1965a); *e–f,* ventral and oblique lateral views of dorsal interior showing loop, ×1 (Atkins, 1960b).

Subfamily NIPPONITHYRIDINAE Hatai, 1938

[*nom. correct.* Hatai, 1965b, p. 842, *pro* Nipponithyrinae Hatai, 1938, p. 110]

Adult loop commonly diploform, rarely bilateral or trabecular. *Paleogene (Oligocene)–Holocene.*

Nipponithyris Yabe & Hatai, 1934, p. 588 [**N. nipponensis;* OD] [=*Miyakothyris* Hatai, 1938, p. 237 (type, *Nipponithyris subovata* Hatai, 1936, p. 321, OD); *Isumithyris* Hatai, 1948, p. 498 (type, *I. kazusaensis,* OD); *Dicrosia* Cooper, 1978, p. 12 (type, *Abyssothyris fijiensis* Elliott, 1960a, p. 526, OD)]. Small to medium, rounded pentagonal, rectimarginate to strongly unisulcate, beak erect to suberect, foramen small, mesothyrid, deltidial plates conjunct, both valves thickened posteriorly. Hinge teeth stout, ventral muscle scars deeply impressed, partly lodged in narrow delthyrial cavity. Cardinal process small, semielliptical to triangular, confined to apex; inner socket ridges strong, sockets deep; inner hinge plates forming a V-shaped trough, median septum extending anteriorly as low ridge well past midvalve; loop diploform to trabecular. *Neogene (Miocene)–Holocene:* Japan, Pacific Ocean, Indian Ocean.——Fig. 1492,*1a–e. *N. nipponensis,* Holocene, Japan; *a–c,* dorsal, lateral, and anterior views, ×2; *d–e,* ventral and anterior oblique views of dorsal interior, ×2 (Cooper, 1973a).

Campages Hedley, 1905, p. 43 [**C. furcifera;* OD] [=*Japanithyris* Thomson, 1927, p. 251 (type, *Terebratella mariae* Adams, 1860, p. 412)]. Small to medium, subtriangular in outline; rectimarginate to intraplicate, beak short, suberect to erect; foramen large, mesothyrid, symphytium narrow, beak ridges not developed. Hinge teeth small, weak, pedicle collar very short. Lamellar inner hinge plates fused to median septum to form septalium, crural bases and outer hinge plates well developed; cardinal process spoon shaped, roughened, myophore facing posteriorly; adult loop diploform to trabecular. *Neogene (Miocene)–Holocene:* Japan; off eastern Australia, western Pacific (140–1,400 m), Indian Ocean, *Holocene.*——Fig. 1492,*3a–e. *C. furcifera,* Holocene, Moreton Bay, Australia; *a–c,* dorsal, lateral, and anterior views, ×1; *d–e,* ventral and lateral oblique views of dorsal interior, ×2 (new).

Jaffaia Thomson, 1927, p. 254 [**Magasella jaffaensis* Blochmann, 1910, p. 92; OD]. Small to medium; subcircular, biconvex, weakly unisulcate, beak suberect, foramen small, mesothyrid, deltidial plates conjunct but resembling symphytium, beak ridges present. Hinge teeth strong, grooved; pedicle cavity partially restricted by shell thickening. Cardinalia moderately thickened, crural bases and socket ridges united; cardinal process a transverse myophore with small, triangular, anterior boss; hinge plates uniting to form septalium supported on median septum; crura and crural processes short; loop diploform. *Holocene:* Australia.——Fig. 1492,*2a–e. *J. jaffaensis* (Blochmann); *a–c,* dorsal, lateral, and anterior views, ×2; *d–e,* normal and oblique views of dorsal valve interior, ×3 (new).

Landonella MacKinnon in MacKinnon, Beus, & Lee, 1993, p. 337 [**L. laqueiformis;* OD]. Medium, ovate to subpentagonal, rectimarginate to intraplicate; beak suberect, attrite; foramen medium to large, mesothyrid; symphytium convex with median ridge. Hinge teeth small; cardinal process prominent; broad, excavate hinge plates fused to high, bladelike median septum; adult loop bilateral, ascending lamellae and transverse band broad, laterovertical connecting band slender. *Paleogene (Oligocene):* New Zealand.——Fig. 1492,*4a–e. *L. laqueiformis; a–c,* holotype, dorsal, lateral, and anterior views, UCM RSA27652; *d,* ventral interior; *e,* oblique view of cardinalia, ×2 (new).

KRAUSSINOIDEA

D. E. Lee and D. I. MacKinnon

[University of Otago; and University of Canterbury]

Superfamily KRAUSSINOIDEA Dall, 1870

[*nom. transl.* Lee & MacKinnon, herein, *ex* Kraussininae Dall, 1870, p. 137]

Adult shells small to medium size; commonly biconvex, may be planoconvex; commonly costate; anterior commissure rectimarginate or unisulcate; beak strongly attrite; foramen usually large, deltidial plates disjunct. Pedicle collar short, sessile; dental plates absent; ventral and dorsal valve interior commonly tuberculate. Cardinal process small, inconspicuous; inner socket ridges prominent and widely divergent; with or without undifferentiated hinge plates; crura and descending lamellae present or absent; septal flanges expanding greatly during ontogeny to form strongly bifurcate septal pillar with or without slender distal extensions that may or may not unite to form a ring; lophophore zygolophous or plectolophous; mantle moderately to strongly spiculate. *Neogene (Miocene)–Holocene.*

Family KRAUSSINIDAE Dall, 1870

[*nom. transl.* Allan, 1940a, p. 269, *ex* Kraussininae Dall, 1870, p. 137] [=Mühlfeldtiinae Oehlert, 1887b, p. 1,314]

Diagnosis as for superfamily. *Neogene (Miocene)–Holocene.*

Kraussina Davidson in Suess, 1859, p. 210, *nom. nov. pro Kraussia* Davidson, 1852d, p. 369, *non* Dana, 1852 [**Anomia rubra* Pallas, 1776, p. 182; SD Davidson, 1853, p. 69]. Small to medium size, transversely oval in outline; ventribiconvex; anterior commissure rectimarginate to unisulcate; multicostate or rarely smooth; hinge line broad, nearly straight; beak strongly attrite. Cardinal process low, short, wide; socket ridges widely divergent, enclosing a pair of large, thickened, dorsal pedicle adjustor scars; crura and descending lamellae not developed; adult brachidium consisting of bifurcate septal pillar from distal tips of which may extend slender, curved, ventromedially directed processes; spicules very small. *Neogene (Pliocene)–Holocene:* South Africa (Namaqualand), *Pliocene–Pleistocene;* Indian Ocean (off southern Africa, 20–300 m), *Holocene.*——Fig. 1493,*1a–h.* * *K. rubra* (Pallas), Holocene, off southern Africa; *a–e,* dorsal, ventral, lateral, posterior, and anterior views, ×1; *f–h,* posterior, ventral, and anterior views of dorsal valve interior, ×1 (Cooper, 1973b).

Megerlia King, 1850, p. 145 [**Anomia truncata* Linnaeus, 1767, p. 1,152; OD; not preoccupied by *Megerlea* Robineau-Desvoidy, 1830] [=*Mühlfeldtia* Bayle, 1880, p. 240, obj.; *Pantellaria* Dall, 1919, p. 251 (type, *Terebratula monstruosa* Scacchi, 1836, p. 8)]. Medium size, usually wider than long, biconvex to concavoconvex; anterior commissure unisulcate; capillate, striae slightly nodulose; foramen large, submesothyrid to amphithyrid; beak suberect, subtruncate, usually abraded; deltidial plates disjunct. Valve interiors radially tuberculate; ventral valve with small median septum extending under but not supporting pedicle collar. No cardinal process; crural bases attached to inner sides of widely divergent socket ridges that are excavate below; loop bifurcate with distal extensions forming complete ring, descending branches extending from cardinalia to ring; lophophore plectolophous; spicules common in mantle and arms. *Neogene (Miocene)–Holocene:* Italy, France, *Miocene–Pliocene;* Gibraltar, Algeria, *Pliocene–Holocene;* Mediterranean, eastern Atlantic, including Ivory Coast (12–1,430 m), off South Africa, Australia (New South Wales), Barbados, Florida Straits, Venezuela, *Holocene.*——Fig. 1493,*2a–g.* **M. truncata* (Linnaeus), Holocene, Marseille, Mediterranean; *a–e,* dorsal, ventral, lateral, posterior, and anterior views, ×1; *f,* interior of dorsal valve; *g,* interior of ventral valve, ×1.2 (Logan, 1979).

Megerlina Eudes-Deslongchamps, 1884, p. 243 [**Kraussia lamarckiana* Davidson, 1852c, p. 80; OD]. Small, subpentagonal in outline, ventribiconvex; anterior commissure unisulcate, finely costellate; beak suberect, attrite; foramen submesothyrid, deltidial plates disjunct; valve interiors radially tuberculate. Pedicle collar anteriorly excavate. Cardinal process weak, acutely triangular; inner socket ridges defining deep sockets and enclosing a pair of prominent, nonexcavate, pedicle adjustor scars; crura not developed, descending lamellae extending posteriorly as curved flanges from lateral flanks of bifurcate septal pillar but not reaching cardinalia; septal pillar tapers posteriorly as low, thick median septum; spicules stouter than in *Kraussina. Neogene–Holocene:* Tasmania, *Neogene;* Australia (New South Wales), South Africa (40–90 m), *Holocene.*——Fig. 1493,*3a–f.* **M. lamarckiana* (Davidson), Holocene, South Australia; *a–c,* dorsal, lateral, and anterior views, ×5, *d,* interior of ventral

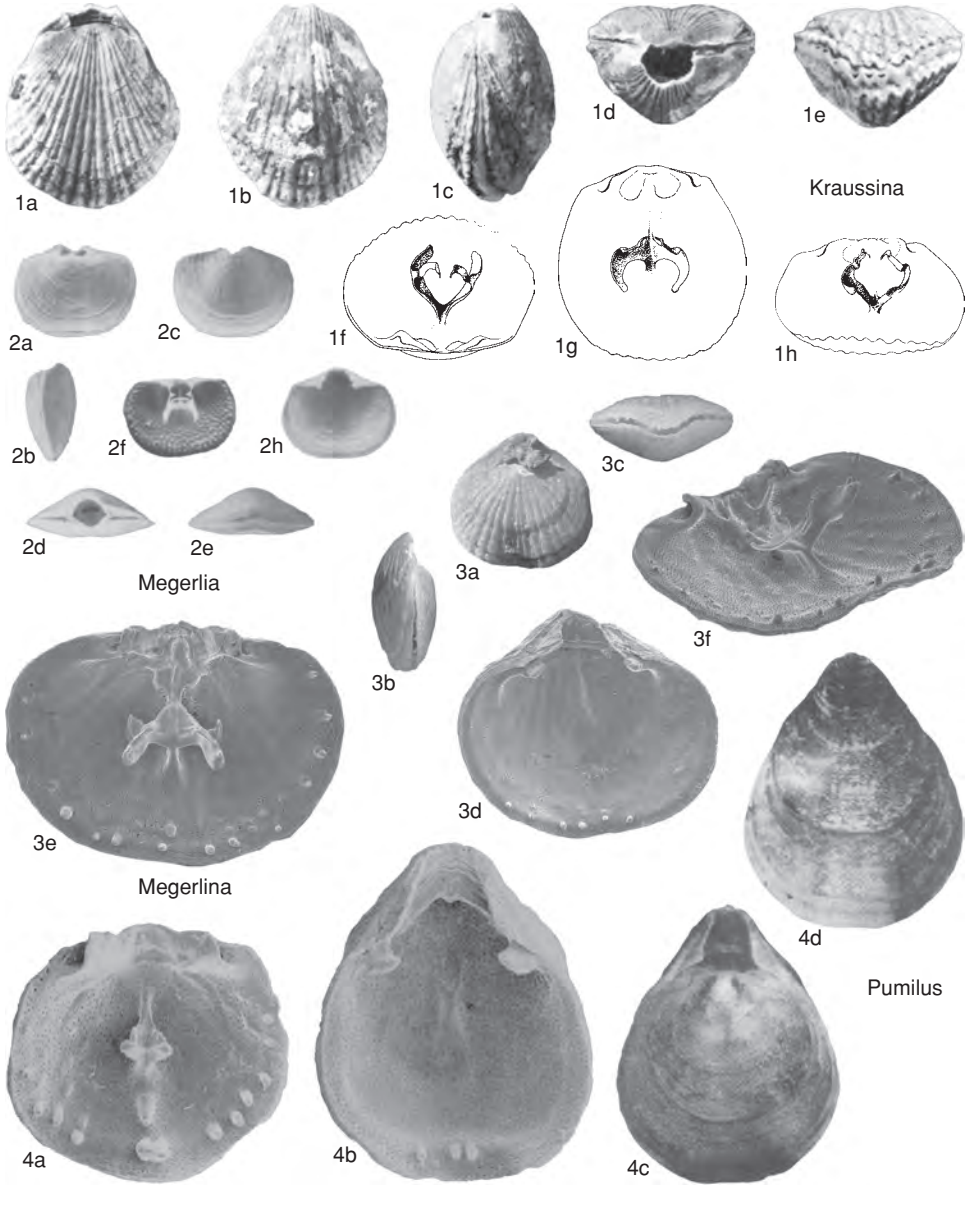

FIG. 1493. Kraussinidae (p. 2245–2246).

valve, ×6; *e,* interior of dorsal valve; *f,* oblique view of dorsal valve interior, ×6 (new).

Pumilus ATKINS, 1958, p. 560 [**P. antiquatus;* OD]. Small, subpentagonal to oval in outline; smooth, anterior commissure unisulcate; beak suberect, attrite; foramen hypothyrid, deltidial plates narrow, disjunct. Pedicle collar well developed, excavate anteriorly. Dorsal diductor attachment a low, narrow, posteromedian strip; crura and descending lamellae not developed; adult brachidium consisting of bifurcate septal pillar from distal tips of which may extend slender, curved, pointed, ventromedially directed processes. Submarginal rim of dorsal valve prominently tuberculate, ventral valve less so; spicules present, adult lophophore schizolophous. *Holocene:* New Zealand.——FIG. 1493,*4a–d. *P. antiquatus; a–b,* dorsal and ventral valve interiors, ×13 (new); *c–d,* dorsal and ventral views of exterior, ×9 (Atkins, 1958).

UNCERTAIN

D. I. MacKinnon
[University of Canterbury]

Suborder UNCERTAIN
Superfamily GWYNIOIDEA
new superfamily

[Gwynioidea MacKinnon, herein] [type genus, *Gwynia* King, 1859, p. 258]

Shell smooth, minute, subcircular to subquadrate, mildly strophic, plano- to biconvex, rectimarginate, foramen large, amphithyrid, dorsal umbo larger than ventral. Teeth peglike; dental plates absent; pedicle collar weakly developed. Dental sockets strong, with well-developed inner and outer socket ridges. Trocholophous or schizolophous lophophore supported by a pair of symmetrically disposed, bladelike, arcuate, submarginal ridges fused to valve floor. *Middle Jurassic–Holocene.*

Gwynia King, 1859, p. 258 [**Terebratula capsula* Jeffreys, 1859, p. 43; OD]. Biconvex, notothyrium triangular, wider and larger than delthyrium. Ventral interarea narrow, triangular, apsacline; delthyrium bounded by 2 small, oval teeth. Dorsal valve interior with a pair of well-developed, arcuate, submarginal ridges extending from stout inner socket ridges; dorsal interarea anacline; cardinal process not differentiated. *Pleistocene–Holocene:* Norway, *Pleistocene (postglacial);* eastern Atlantic, Adriatic (Croatia), *Holocene.*——Fig. 1494,*1a–f.* **G. capsula* (Jeffreys), Holocene, United Kingdom; *a–d,* ventral, dorsal, posterior, and lateral views, ×50; *e–f,* ventral and dorsal interiors, ×55 (Logan, MacKinnon, & Phorson, 1997).

Zellania Moore, 1855, p. 111 [**Z. davidsoni;* OD]. Adult shells shield shaped in outline; juveniles biconvex, adults more planoconvex with convexity retained in ventral valve. Probable schizolophous lophophore supported by a pair of well-developed, arcuate submarginal ridges and a hollow median septum. Ventral valve interior with ancillary median septum and ancillary lateral ridges. *Middle Jurassic:* United Kingdom.——Fig. 1494,*2a–f.* **Z. davidsoni; a–d,* dorsal, lateral, anterior, and posterior views, ×30 (Baker, 1970b); *e–f,* sketches of dorsal and ventral interiors, approximately ×40 (adapted from Baker, 1970b).

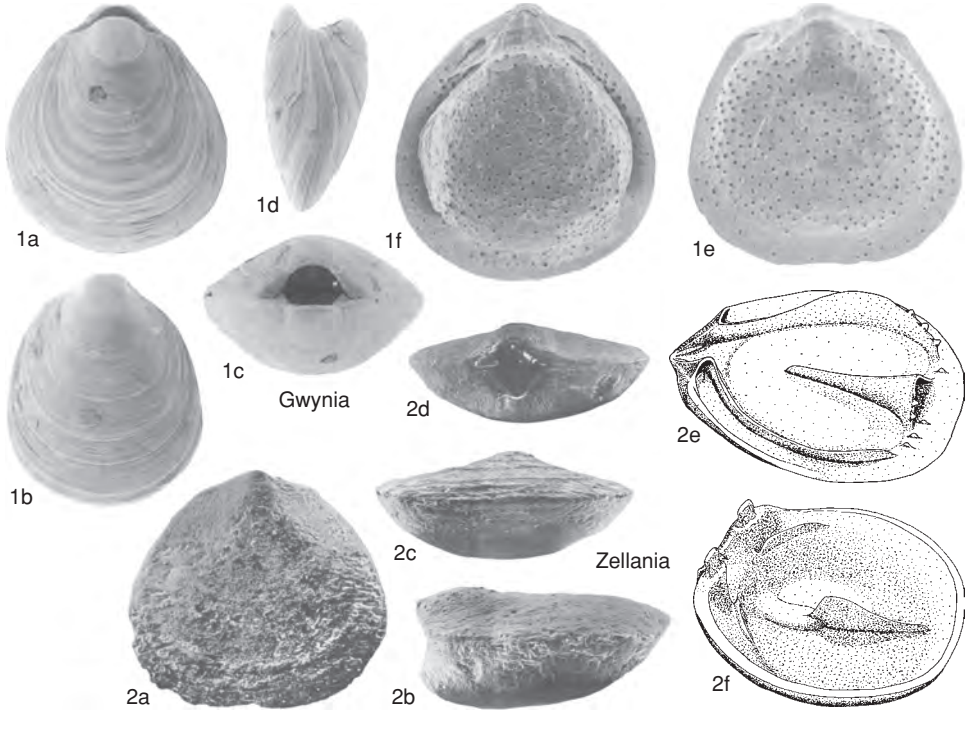

Fig. 1494. Uncertain (p. 2247).

UNCERTAIN

JIN YU-GAN and D. E. LEE

[Nanjing Institute of Geology and Palaeontology; and University of Otago]

Superfamily UNCERTAIN
Family OBOLORUGIDAE Zhang, 1983

[Obolorugidae ZHANG in ZHANG, FU, & DING, 1983, p. 425]

Punctate; small, elongate oval to circular, ventribiconvex, apical foramen, ornament of concentric wrinkles, dorsal hinge plate with posterior foramen; thin short dental lamellae; simple short loop. *Middle Devonian (Givetian).*

Obolorugia ZHANG in ZHANG, FU, & DING, 1983, p. 425 [**O. lixianensis;* OD]. Beak acutely elongated with apical foramen; rectimarginate; loop extending to midlength of dorsal valve. *Middle Devonian (Givetian):* China (southern Gansu).——FIG. 1495*a–l.* **O. lixianensis; a–d,* dorsal, ventral, lateral, and anterior views of holotype; *e–l,* transverse serial sections, ×3 (Zhang, Fu, & Ding, 1983).

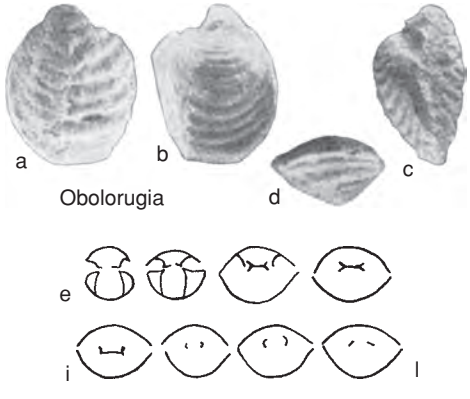

FIG. 1495. Obolorugidae (p. 2248).

UNCERTAIN

P. G. BAKER

[University of Derby]

Superfamily and Family UNCERTAIN

Parasulcatinella XU & LIU, 1983b, p. 96 (XU & LIU, 1980, p. 37, *nom. nud.*) [**P. obesus;* OD]. Small, rounded rhomboidal in outline, unequally biconvex, ventral valve strongly convex, bow shaped with sides steeply sloping, fold extending from beak to anterior margin, dorsal valve weakly convex with wide, shallow sulcus appearing posteriorly with small plication at anterior margin, anterior commissure plicosulcate, beak sharp, incurved, beak ridges angular, delimiting well-developed palintrope, delthyrium narrow, without deltidial plates; pedicle collar absent, dental plates thin, straight, ventrally divergent; cardinal process absent, hinge plates not demarcated from well-developed, inner socket ridges, septalium broadly V-shaped, median septum low, thick, very short, crural plates divergent on floor of valve anteriorly, loop short with wide, ascending lamellae. [This genus is probably dielasmatoid, similar to *Sulcatinella.*] *Middle Triassic:* China (Qilian Province, Junzihe Formation).——FIG. 1496,*1a–m.* **P. obesus,* southern Qilian Mountains, Qingai; *a–d,* dorsal, lateral, anterior, ventral views, ×1 (Xu & Liu, 1983b); *e–m,* serial transverse sections, 0.5, 0.7, 0.9, 1.0, 1.4, 1.9, 2.3, 2.5, 2.7 mm from umbo, ×1.25 (adapted from Xu & Liu, 1983b).

Triseptothyris XU, 1978, p. 314 [**T. yanjinensis;* OD]. Small, semioval to elliptical in outline, biconvex, smooth, anterior commissure rectimarginate, umbo erect, beak ridges subangular, clearly delimiting palintrope, foramen moderate, oval, permesothyrid; pedicle collar present, dental plates slender, short, straight, ventrally divergent; cardinal process absent, inner socket ridges deflected dorsally, demarcated from outer hinge plates, crural bases given off possibly ventrally, septalium wide, open U-shape, moderately deep, supported by low, thick, bladelike median septum and two lateral septa, length of median septum and form of loop unknown. [The cardinalia of this genus is vaguely zeilleriid but unusual supporting structure for septalium and lack of knowledge of loop preclude assignment to suprageneric taxon.] *Middle Triassic:* southwestern China (Liekoupo Formation, Yunnan Province).——FIG. 1496,*2a–h.* **T. yanjinensis,* Yanjin County; *a–d,* dorsal, lateral, anterior, ventral views, ×1.5 (Xu, 1978); *e–h,* serial transverse sections, 0.2, 0.6, 0.8, 1.5 mm from umbo, ×2 (adapted from Xu, 1978).

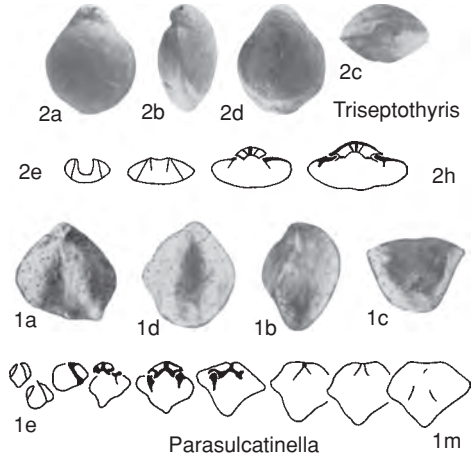

FIG. 1496. Uncertain (p. 2249).

UNCERTAIN

JIN YU-GAN

[Nanjing Institute of Geology and Palaeontology]

Superfamily UNCERTAIN

Rugosothyris ZHANG, 1987a, p. 151 [**R. dangduoensis;* OD]. Small, pentagonal, ventribiconvex, ventral beak elongate with apical foramen, curved and overhanging dorsal beak; bisulcate; few coarse, low plicae, generally only two; ornament of 8–10 evenly spaced, concentric wrinkles; thin, short dental plates; posteriorly foramenate hinge plate; punctate; simple short loop. *Middle Devonian (Givetian):* China (southern Gansu).——FIG. 1497*a–i.* **R. dangduoensis; a–d,* holotype, ventral, dorsal, lateral, and anterior views, XI-B337, ×2; *e–i,* serial transverse sections 0.4, 0.8, 1.2, 1.8, 2.5 mm from ventral umbo, ×2 (Zhang, 1987a).

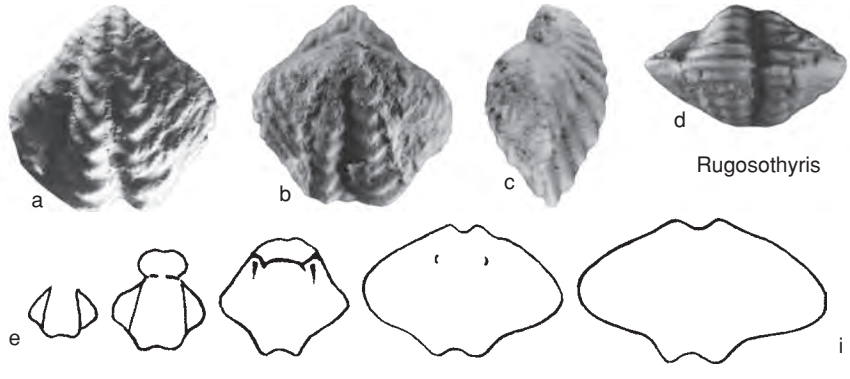

FIG. 1497. Uncertain (p. 2250).

UNCERTAIN

D. I. MacKinnon

[University of Canterbury]

Order UNCERTAIN
Superfamily CADOMELLOIDEA Schuchert, 1893

[*nom. correct.* Harper & others, 1993, p. 450, *pro* Cadomellacea Muir-Wood, 1955, p. 90, *nom. transl. ex* Cadomellinae Schuchert, 1893, p. 153, *non* Munier-Chalmas ms]

Micromorphic, subquadrate, very mildly concavoconvex shells, with very narrow mantle cavity. Pedicle foramen hypothyrid, with very narrow, subtriangular deltidial plates. Beak ridges and hinge line well developed, ventral interareas very low and wide. Prominent adductor muscle scars flanked by a pair of rodlike crura; brachidium (if any) unknown; tuberculate submarginal rim well developed on valve interiors. [The superfamily Cadomelloidea, as currently constituted, is a monospecific taxon. The only other species up to now attributed to the genus *Cadomella, C. davidsoni* (Eudes-Deslongchamps), is reassigned herein to the genus *Koninckodonta* Bittner (MacKinnon, 2002, p. 1604). The apparent absence of a spiral brachidium precludes placement into the Koninckinidina. The shell ultrastructure of *Cadomella* precludes placement into the Strophomenida.] *Lower Jurassic (Pliensbachian–Toarcian).*

Cadomella Oehlert, 1887b, p. 1,285, *non* Munier-Chalmas ms [**Leptaena moorei* Davidson in Davidson & Morris, 1847, p. 251; OD]. Very small, subquadrate, with wide hinge line and low interareas; ornamentation of subdued capillae and impersistent growth lamellae. Teeth strong, extending subparallel to hinge line; umbonal region almost completely infilled with secondary callus with surface opposing cardinal process forming bilobed platform; thickened submarginal rim of ventral valve bearing numerous depressions that appear to accommodate corresponding tuberculation in the dorsal valve. Cardinal process prominent, bilobed, flanked by pair of transverse hinge sockets; short, pronglike, anteroventrally directed crura defining posterolateral margins of adductor muscle scars; dorsal adductor muscle scars large and very prominent, bounded by raised margins that meet medianly to form hollow, triangular median ridge; dorsal valve submarginal ridge strongly tuberculate. *Lower Jurassic (Pliensbachian–Toarcian):* France, England.——Fig. 1498*a–d.* **C. moorei* (Davidson), Ilminster, England; *a–b,* dorsal, ventral exterior, ×8; *c,* dorsal interior, ×18, *d,* ventral interior, ×13.5 (new).

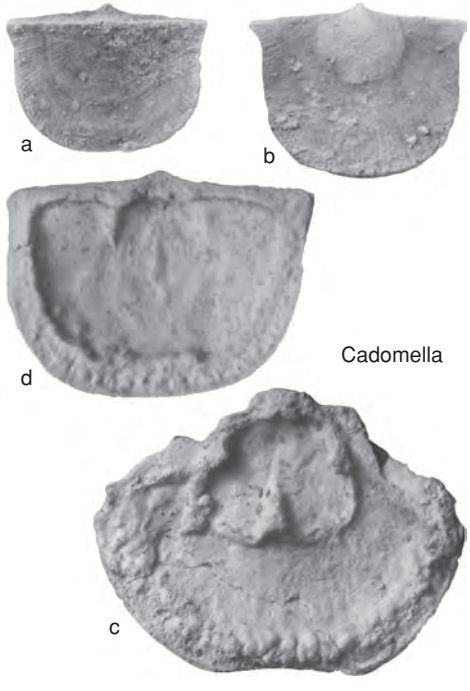

Fig. 1498. Uncertain (p. 2251).

UNCERTAIN

JIN YU-GAN and D. E. LEE

[Nanjing Institute of Geology and Palaeontology; and University of Otago]

Order UNCERTAIN
Family MONGOLELLIDAE
Alekseeva, 1976

[Mongolellidae ALEKSEEVA, 1976, p. 346]

Small, costate, ventribiconvex with ventral beak incurved over dorsal beak; cardinal process massive, elongate; ventral spondylium-like structure supported by massive median septumlike structure, both features covered with thick secondary material, dental lamellae probably absent so that massive hinge teeth and associated secondary material probably form the walls of spondylium. *Lower Devonian.*

Mongolella ALEKSEEVA, 1976, p. 347 [**M. altaica;* OD]. Description as for family. *Lower Devonian:* Mongolia.——FIG. 1499,*1a–g. *M. altaica; a–d,* dorsal, ventral, lateral, and anterior views of holotype, PIN 3406/50, ×3; *e,* lateral view, ×5; *f,* posterior part of shell interior, ×3; *g,* line drawing of cardinalia, ×5 (Alekseeva, Mendbayar, & Erlanger, 1981).

Order UNCERTAIN
Family UNCERTAIN

Microbilobata JIN & CHATTERTON, 1996, p. 47 [**M. avalanchensis;* OD]. Very small; possibly punctate; subtriangular to subpentagonal in outline; slightly ventribiconvex, smooth posteriorly, bisulcate anteriorly with median plica in ventral sulcus and two plicae in dorsal sulcus, delthyrium narrow, with no deltidial plates; interarea not developed; long, acuminate loop; other internal features unknown. *middle Silurian:* Canada.——FIG. 1499,*2a–e. *M. avalanchensis; a–c,* dorsal, lateral, and anterior views of holotype, UA10897, ×20; *d,* silicified shell with ventral valve removed to show acuminate loop, ×20; *e,* drawing to show possible crural and loop structures in *d,* ×20 (Jin & Chatterton, 1996).

NOMINA DUBIA

Phyllonia SU, 1980, p. 327 [**Etymothyris? dichopleura* SU, 1976, p. 227; OD]. As illustrated this taxon appears to be more like a bivalve than a brachiopod.

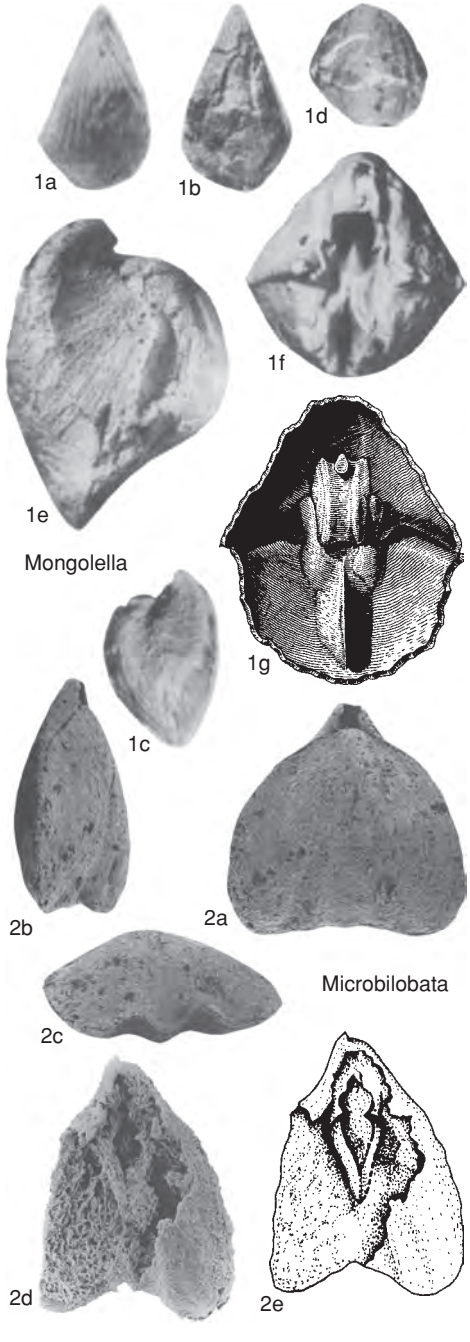

FIG. 1499. Mongolellidae and Uncertain (p. 2252).

UNCERTAIN

ALWYN WILLIAMS and C. HOWARD C. BRUNTON

[deceased, formerly of The University of Glasgow; and formerly of The Natural History Museum, London]

?Class STROPHOMENATA
Order UNCERTAIN
Family LIOSOMENIIDAE
Liang, 1990

[Liosomeniidae LIANG, 1990, p. 110]

Large, smooth, convexoconcave, ovate with flattened posterolateral margins and very short hinge line; ventral interarea small, orthocline, with convex pseudodeltidium, dorsal interarea obsolete; ventral interior without dental plates or myophragm, muscle scar flabellate; dorsal interior with bladelike cardinal process; pseudopunctate. *Permian (Capitanian).*

Liosomena LIANG, 1990, p. 110 [457] [**L. obscura;* OD]. Characters as for family. [This species has been described as a pseudopunctate orthotetoid; but the smooth surface of the shell and the bladelike cardinal process immediately preclude its assignment to the Orthotetidina. More and better-preserved specimens of the species will have to be collected and described before even its general affinities can be determined.] *Permian (Capitanian):* China (Zhejiang).

NOMENCLATORIAL NOTE

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PETRIATHYRIS, NEW NAME FOR THE GENUS *PETRIA* MENDES, 1961 (BRACHIOPODA, TEREBRATULIDA) PREOCCUPIED BY *PETRIA* SEMENOV, 1894 (ARTHROPODA, COLEOPTERA)

During preparation of the manuscript for volume 5 of the revised brachiopod *Treatise on Invertebrate Paleontology,* it was realized that the cryptonelloid brachiopod genus name *Petria* Mendes, 1961, p. 21, is preoccupied by a coleopteran genus published by Semenov, 1894, p. 363 (see p. 2,025 herein). According to Article 60 of ICZN rules (1999) we here propose the name *Petriathyris* as replacement name for *Petria* Mendes, 1961. The type species for *Petriathyris* is *Waldheimia coutinhoana* Derby, 1874, p. 3.

ACKNOWLEDGMENTS

We would like to thank Jill Hardesty for her advice on this matter.

REFERENCES

ICZN (International Commission on Zoological Nomenclature), 1999. International Code of Zoological Nomenclature, 4th ed. The International Trust for Zoological Nomenclature. London. xxix + 306 p.

Lawrence, J. F. 1971. The taxonomic position of the genus *Petria* Semenow (Coleoptera; Alleculidae). Breviora 380:1–9.

Mendes, J. C. 1961. Notas Suplementares sobre os Braquiopodes Carboniferos da Amazonia. Sociedade Brasileira de Geologia, Boletim (Sao Paulo), 10(1):5–24.

———. 1972. Braquiopodes e moluscos neocarboniferos da Amazonia (Formacao Itaituba). Academia Brasileira de Ciencias, Anais (supplement) 44:243–246.

Semenov, A. P. 1894. De Coleopterorum familia nova. Mélanges Biologiques tirés du Bulletin de l'Académie Impériale des Sciences de St-Petersbourg 13:359–366.

NOMENCLATORIAL NOTE

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[University of Otago; and University of Kharkov]

DESLONGCHAMPSITHYRIS, NEW NAME FOR THE GENUS *DESLONGCHAMPSIA* TCHORSZHEVSKY, 1988 (BRACHIOPODA, TEREBRATULIDA) PREOCCUPIED BY *DESLONGCHAMPSIA* MORRIS & LYCETT, 1851 (MOLLUSCA, ARCHAEOGASTROPODA)

During preparation of the manuscript for volume 5 of the revised brachiopod *Treatise on Invertebrate Paleontology*, it was realized that the cancellothyridoid brachiopod genus name *Deslongchampsia* Tchorszhevsky, 1988, p. 33, is preoccupied by a molluscan genus published by Morris and Lycett, 1851, p. 94 (see p. 2,152 herein; Knight & others, 1960, p. 233). According to Article 60 of the code of the ICZN (1999), we here propose the name *Deslongchampsithyris* as replacement name for *Deslongchampsia* Tchorszhevsky, 1988, not *Deslongchampsia* Morris & Lycett 1851, nor *Deslongchampsia* Roché, 1939 (Mollusca: Ammonoidea; Arkell, Kummel, & Wright, 1957, p. 290). The type species for *Deslongchampsithyris* is *Deslongchampsia moiseevi* Tchorszhevsky, 1988, p. 33, =*Terebratella liaisina* Moisseev, 1934, p. 156, *non* Deslongchamps, 1863, *nec* Rau, 1902.

ACKNOWLEDGMENTS

We would like to thank Jill Hardesty for her advice on this matter.

REFERENCES

Arkell, W. J., B. Kummel, & C. W. Wright. 1957. Mesozoic Ammonoidea. *In* R. C. Moore, ed., Treatise on Invertebrate Paleontology. Part L, Mollusca 4. Geological Society of America and University of Kansas Press. New York and Lawrence. xxii + 490 p., 558 fig.

ICZN (International Commission on Zoological Nomenclature). 1999. International Code of Zoological Nomenclature, 4th ed. The International Trust for Zoological Nomenclature. London. xxix + 306 p.

Knight, J. B., L. R. Cox, A. M. Keen, R. L. Batten, E. L. Yochelson, & R. Robertson. 1960. Systematic descriptions [Archaeogastropoda]. *In* R. C. Moore, ed., Treatise on Invertebrate Paleontology. Part I, Mollusca 1. Geological Society of America and University of Kansas Press. New York and Lawrence. xxiii + 351 p., 216 fig.

Lee, D.E., T. N. Smirnova, & Sun Dong-li. 2006. Cancellothyridoidea: Chlidonophoridae. *In* R. L. Kaesler, ed., Treatise on Invertebrate Paleontology. Part H, Brachiopoda (Revised), vol. 5. The Geological Society of America and The Paleontological Institute. Boulder and Lawrence. p. 2,151–2,156, fig. 1,432,*3a–t.*

Morris, J., & J. Lycett. 1851. A monograph of the Mollusca from the Great Oolite chiefly from Minchinhampton and the coast of Yorkshire, Part 1, Univalves. Monograph of the Palaeontographical Society London. 130 p., 15 pl.

Roché, P. 1939. Aalénien et Bajocien du Maconnais et de quelques regions voisines. Laboratoire de Géologie de la Faculté des Sciences de l'Université de Lyon, Travaux 35(Mémoire 29):1–355, pl. 1–13.