CRYPTONELLOIDEA

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Superfamily CRYPTONELLOIDEA Thomson, 1926

[*nom. transl.* STEHLI, 1965, p. 762, *ex* Cryptonellinae THOMSON, 1926, p. 529]

Adult shells commonly small to medium in size; commonly ventribiconvex, elongate oval or subpentagonal in outline; smooth or plicate anteriorly; anterior margin rectimarginate, unisulcate, or sulciplicate; ventral foramen commonly permesothyrid or submesothyrid, often labiate; deltidial plates commonly conjunct; dental plates present or absent; hinge plate commonly undivided and perforate; median septum and crural plates rarely developed; adult loop variable, acuminate (centronelliform), deltiform (terebratuliform), diploform (cryptacanthiiform), or teloform (cryptonelliform). *Lower Devonian (Emsian)–Upper Triassic (Norian).*

Family CRANAENIDAE Cloud, 1942

[*nom. transl.* STEHLI, 1965, p. 754, *ex* Cranaeninae CLOUD, 1942, p. 131]

Shell moderately biconvex; ventral foramen commonly permesothyrid and labiate; pedicle collar present, loop short, deltiform (terebratuliform), undivided hinge plate extending between socket ridges without support from crural plates and typically perforate, but imperforate when plate apically sessile or median septum present. *Lower Devonian (Emsian)–Permian.*

Subfamily CRANAENINAE Cloud, 1942

[Cranaeninae CLOUD, 1942, p. 131]

Small to medium in size; commonly smooth, but may be peripherally costate; hinge plate extending as apically perforate plate between socket ridges free of valve floor, or as imperforate plate apically united with valve floor, dental plates commonly present; loop deltiform. *Lower Devonian (Emsian)–Permian (Wordian).*

Cranaena HALL & CLARKE, 1893, p. 297 [**Terebratula romingeri* HALL, 1863, p. 48; OD] [=*Eunella* HALL & CLARKE, 1893, p. 290 (type, *Terebratula sullivanti* HALL, 1867b, p. 387, OD); *Cranaenella* FENTON & FENTON, 1924, p. 129 (type, *Terebratula navicella* HALL, 1867b, p. 391, OD)]. Small to medium, smooth, subcircular to elongate; ventribiconvex; sulcus on ventral valve and corresponding fold on dorsal valve fold may be present; anterior commissure rectimarginate to slightly uniplicate; foramen permesothyrid; dental plates short; hinge plate free, perforate; muscle field well impressed; loop deltiform (terebratuliform). *Lower Devonian (Emsian)–Carboniferous (Upper Mississippian):* cosmopolitan (extra-Malvinokaffric Realm).——FIG. 1336,*1a–d. *C. romingeri* (HALL), Devonian, Michigan, USA; dorsal, lateral, posterior, and anterior views, ×2 (Cloud, 1942).——FIG. 1336,*1e–f. C. lincklaeni* (HALL), New York, USA; *e,* ventral view of dorsal interior; *f,* ventral view of nearly complete loop, ×3 (Cloud, 1942).

Anomalesia COOPER & GRANT, 1976b, p. 2,818 [**A. perplexa* COOPER & GRANT, 1976b, p. 2,819; OD]. Medium size, subpentagonal, ventribiconvex; foramen telate, anterior commissure strongly sulciplicate; dental plates divergent; hinge plate gently concave; loop short and wide. *Permian (Guadalupian):* USA (western Texas).——FIG. 1336,*2a–c. *A. perplexa,* Leonardian; *a–b,* dorsal and lateral views of holotype, USNM 153376, ×1, ×2; *c,* interior of dorsal valve, ×2 (Cooper & Grant, 1976b).

Asiacranaena KAPLUN & KRUPCHENKO, 1991, p. 142, *nom. transl.* JIN & LEE, herein, *ex Cranaena (Asiacranaena)* KAPLUN & KRUPCHENKO, 1991, p. 142 [**Cranaena (Asiacranaena) koldarensis;* OD]. Medium in size, biconvex, weakly uniplicate; hinge plate united with floor, free anteriorly, with low ridge ventrally. *Lower Devonian (Emsian):* central Kazakhstan.——FIG. 1336,*7a–b. *C. koldarensis,* ventral valve and internal mold of dorsal valve, 55/12737, ×1 (Kaplun & Krupchenko, 1991).

Costacranaena JOHNSON & PERRY, 1976, p. 631 [**C. marlenae;* OD]. Medium size; smooth posteriorly but costate peripherally; rectimarginate, crenulate; elongate; ventribiconvex; dental plates prominent, vertical; hinge plate perforate; muscle field well impressed; loop deltiform with extended anterior portion. *Middle Devonian (Eifelian):* Arctic Canada. ——FIG. 1336,*9a–f. *C. marlenae; a–d,* dorsal, ventral, lateral, and anterior views of holotype, GSC 42743, ×2; *e,* ventrioblique view of rubber replica of dental lamellae and cardinalia, ×2; *f,* reconstruction of loop, ×2 (Johnson & Perry, 1976).

Hamburgia WELLER, 1911, p. 445 [**H. typa;* M] [=*Stuartella* BELANSKI, 1928, p. 24 (type, *S. vera,*

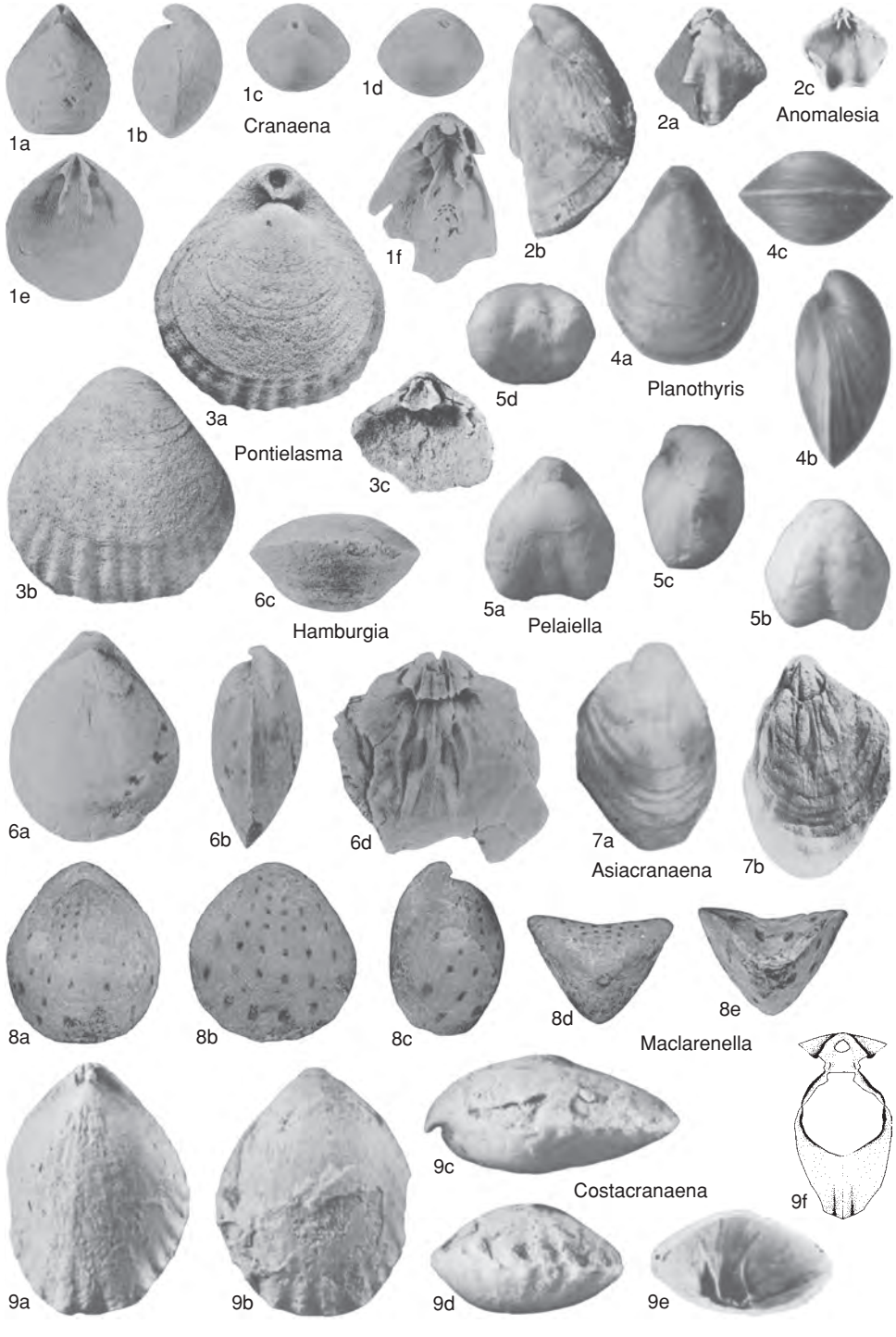

Fig. 1336. Cranaenidae (p. 2019–2021).

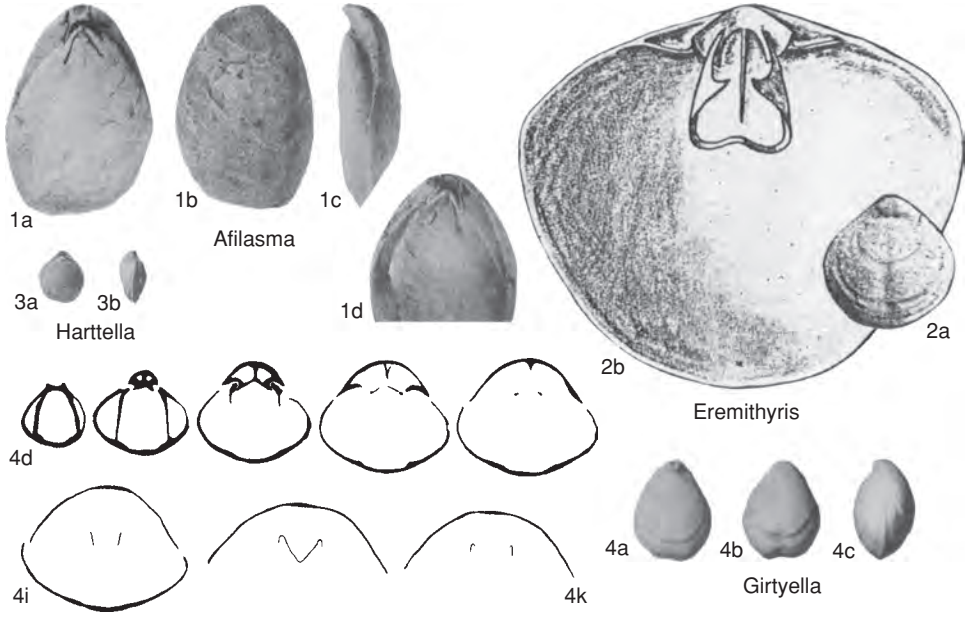

FIG. 1337. Cranaenidae (p. 2021–2022).

OD)]. Externally homeomorphous with *Cranaena,* internally similar to *Cranaena* except for apically sessile and imperforate hinge plate. *Upper Devonian–Carboniferous (Mississippian):* USA.——FIG. 1336,*6a–c. *H. typa,* Upper Devonian, Illinois; dorsal, lateral, and anterior views, ×2 (Cloud, 1942).——FIG. 1336,*6d. H.* sp., Iowa; posterior of dorsal valve interior, ×2 (Cloud, 1942).

Maclarenella STEHLI, 1955, p. 868 [**M. maculosa;* OD]. Medium size; subcircular to oval; smooth, with color markings preserved as radial rows of spots; dorsal valve triangular in cross section; ventral valve transversely concave; anterior commissure strongly uniplicate; dental plates strong; hinge plate free and perforate. *Upper Devonian (Frasnian):* Canada.——FIG. 1336,*8a–e. *M. maculosa,* Athabaska River, Alberta; dorsal, ventral, lateral, posterior, and anterior views, ×1 (Stehli, 1955).

Pelaiella MARTÍNEZ-CHACÓN, 1991, p. 84 [**P. exigua;* OD]. Small, subpentagonal; both valves sulcate, anterior commissure biplicate; no dental plates; hinge plate imperforate; fulcral plates broad; socket ridges high; loop deltiform, transverse band narrow. *Carboniferous (upper Moscovian):* Spain.——FIG. 1336,*5a–d. *P. exigua;* dorsal, ventral, lateral, and anterior views of holotype, DPO 112770, ×3 (Martínez-Chacón, 1991).

Planothyris GLUSHENKO, 1975, p. 107 [**P. idonea;* OD]. Medium size, smooth, biconvex, oval; anterior commissure rectimarginate; dental plates and pedicle collar present; hinge plate imperforate; loop deltiform with long vertical plate. *Permian (Asselian):* Ukraine (Peri-Donets Depression).——FIG. 1336,*4a–c. *P. idonea;* dorsal, lateral, and anterior views, ×3 (Glushenko, 1975).

Pontielasma WATERHOUSE & PIYASIN, 1970, p. 163 [**P. praeundatum;* OD]. Medium size, smooth; ventral sulcus shallow; anterior commissure uniplicate; costate anteriorly; foramen epithyrid; hinge plate supported by fulcral plates, imperforate and raised high above commissure plane. *Permian (Wordian):* Thailand.——FIG. 1336,*3a–c. *P. praeundatum; a–b,* dorsal and ventral views of holotype, ROM B513, ×2; *c,* internal view of incomplete dorsal valve, ×2 (Waterhouse & Piyasin, 1970).

Subfamily AFILASMATINAE new subfamily

[Afilasmatinae JIN, herein] [type genus, *Afilasma* STEHLI, 1961b, p. 460]

Smooth, with divided or undivided, inner hinge plate; pedicle collar and dental plates present. *Upper Devonian (Frasnian).*

Afilasma STEHLI, 1961b, p. 460 [**A. beecheri;* OD]. Medium size; externally homeomorphous with *Cranaena;* unfolded, cardinal plate apically perforate, extending free of valve floor between crural plates; loop not known, probably deltiform. [This genus is based on 2 specimens, both internal molds.] *Upper Devonian (Frasnian):* USA (New York).——FIG. 1337,*1a–d. *A. beecheri; a–c,* dorsal, ventral, and lateral views of holotype, YPM S-1420; *d,* latex impression of dorsal view of holotype, ×1 (Stehli, 1961b).

Subfamily GIRTYELLINAE Stehli, 1965

[Girtyellinae Stehli, 1965, p. 755]

Very small to medium in size; smooth; with or without dental plates; imperforate hinge plate supported by median septum; loop deltiform (terebratuliform). *Carboniferous (Mississippian)–Permian (Lopingian).*

Girtyella Weller, 1911, p. 442 [**Harttina indianensis* Girty, 1909, p. 293; OD]. Small to medium size; anterior commissure rectimarginate or modified by rounded plications; dental plates present. *Carboniferous (Mississippian):* North America, Europe, Australia.——Fig. 1337,*4a–k.* **G. indianensis* (Girty); *a–c,* dorsal, ventral, and lateral views, Mississippi Valley, USA, ×1 (Weller, 1914); *d–k,* serial transverse sections 0.25, 1.25, 1.75, 2.25, 2.50, 3.25, 4.25, 4.75 mm from initial section, Pella Beds, Iowa, ×2 (Campbell, 1965).

Eremithyris Bruegge, 1973, p. 197 [**E. muhlbergensis* Bruegge, 1973, p. 199; OD]. Broadly subpentagonal, greatest width at midlength; anterior commissure rectimarginate to uniplicate; beak erect; foramen mesothyrid; palintrope relatively wide; inner hinge plates supported by median septum forming septalium in apical region; crural bases arising from ventral side of hinge plate; dental plates present. *Permian (Lopingian):* Germany (Zechstein).——Fig. 1337,*2a–b.* **E. muhlbergensis; a,* dorsal view; *b,* interior of dorsal valve, ×2 (Bruegge, 1973).

Harttella Bell, 1929, p. 149 [**H. parva;* OD]. Very small, similar to *Girtyella* except in being folded and lacking dental plates. *Carboniferous (Upper Mississippian):* North America.——Fig. 1337,*3a–b.* **H. parva,* Nova Scotia; dorsal and lateral views of holotype, NMC7498, ×1 (Bell, 1929).

Family NOTOTHYRIDIDAE Licharew, 1960

[*nom. transl. et correct.* Stehli, 1965, p. 758, *ex* Notothyrinae Licharew in Licharew, Makridin, & Rzhonsnitskaya, 1960, p. 288]

Commonly small, smooth or anteriorly plicate; ventral foramen permesothyrid and labiate; ventribiconvex; anterior commissure rectimarginate to unisulcate; perforate hinge plate unsupported between inner socket ridges; loop acuminate (centronelliform) with vertical median plate and various supplemental lamellae in advanced forms; dental plates commonly absent. *Carboniferous (Bashkirian)–Permian (Changhsingian).*

Notothyris Waagen, 1882, p. 336 [375] [**Terebratula subvesicularis* Davidson, 1862, p. 27; SD Hall & Clarke, 1893, p. 275]. Small to medium size, anteriorly plicate; anterior commissure rectimarginate to slightly unisulcate; adult shells commonly with abruptly bent anteriors and broadly truncated anterior margin; hinge plate apically perforate; loop with broad descending lamellae, incipient median vertical plate. *Permian (Wordian–Changhsingian):* USA (Texas), Italy, Pakistan, southern China, Thailand.——Fig. 1338,*4a–c.* **N. subvesicularis* (Davidson), Salt Range, Pakistan; dorsal, lateral, and anterior views, approximately ×1.5 (Waagen, 1882).——Fig. 1338,*4d. N.* sp., Salt Range, Pakistan; interior of dorsal valve, ×2 (Cooper & Grant, 1976b).

Alwynia Stehli, 1961b, p. 464 [**Dielasma vesiculare* de Koninck, 1887, p. 30; OD]. Small, subpentagonal, ventral valve convex, dorsal valve planar; anterior commissure biplicate; loop deltiform but modified by close approach of main bands anteriorly and small transverse band. *Carboniferous (Visean):* Belgium, England.——Fig. 1338,*2a–f.* **A. vesiculare* (de Koninck), Isle of Man, England; *a–e,* dorsal, ventral, lateral, posterior, and anterior, ×1.5; *f,* reconstruction of loop, ×2 (Stehli, 1961b).

Chondronia Cooper & Grant, 1976b, p. 2,854 [**C. bella;* OD]. Small, elongate oval, rectimarginate to paraplicate; foramen strongly labiate, deltidial plates concealed; smooth or faintly costate near anterior commissure; loop consisting of two broad, descending lamellae, no median fold or plate. *Permian (Guadalupian):* USA (Texas).——Fig. 1338,*7a–d.* **C. bella,* Leonardian, Roadian; *a–c,* dorsal, lateral, and anterior views of holotype, USNM 153385a, ×4; *d,* interior of dorsal valve showing partly encrusted loop, ×8 (Cooper & Grant, 1976b).

Enallosia Cooper & Grant, 1976b, p. 2,859 [**E. rotundovata;* OD]. Small to medium size, oval, smooth; lateral and anterior commissures straight, pedicle collar strong; dental plates erect, stout; hinge plate imperforate; loop long with incomplete anterior end. *Permian (Guadalupian):* USA (Texas).——Fig. 1338,*6a–d.* **E. rotundovata,* Leonardian, holotype; *a–c,* dorsal, lateral, and anterior views, USNM 155136a, ×1; *d,* ventral view of incomplete loop, ×1.5 (Cooper & Grant, 1976b).

Gefonia Licharew, 1936, p. 264 [**G. cubanica;* OD]. Small, subpentagonal; anterior commissure biplicate; loop acuminate, but modified by union of main bands through transverse band anterior to midlength and their subsequent separation with rise of diverging, recurving bands that end without uniting. *Permian (Lopingian):* North Caucasus.——Fig. 1338,*9a–d.* **G. cubanica; a–c,* dorsal, ventral, and lateral views, ×1.5 (Licharew, Makridin, & Rzhonsnitskaya, 1960); *d,* reconstruction of loop, approximately ×6 (Dagys, 1972b).

Ligatella Martínez-Chacón, 1978b, p. 29 [**Notothyris (Ligatella) sarytchevae* Martínez-Chacón, 1978b, p. 29; OD]. Small, subpentagonal; anterior commissure rectimarginate, bent slightly dorsally or ventrally; both valves with median sinus bounded by strong plicae; internal characters as for *Notothyris. Carboniferous (Bashkirian):*

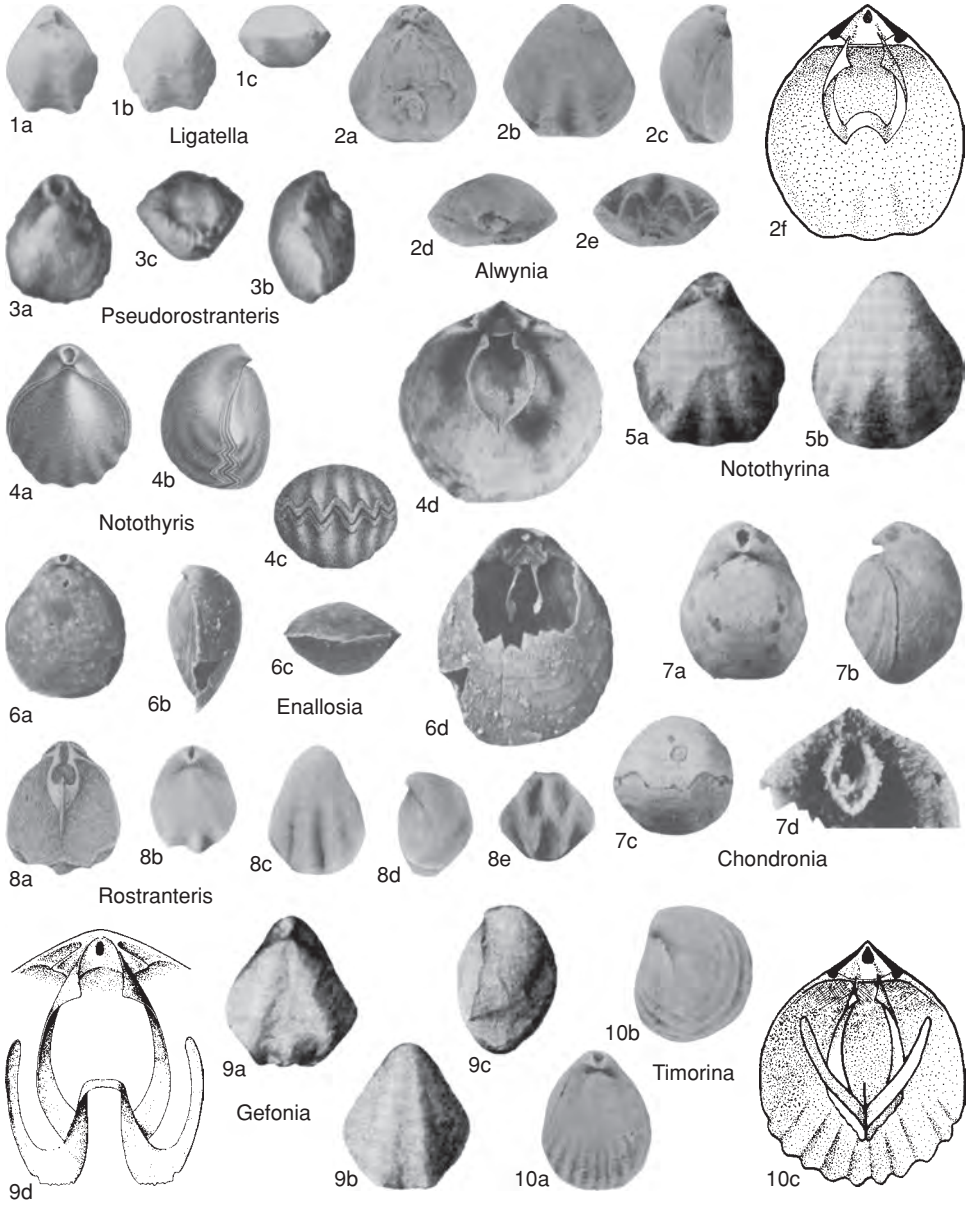

FIG. 1338. Notothyrididae (p. 2022–2024).

Spain.——FIG. 1338,*1a–c. *N. sarytchevae;* dorsal, ventral, and anterior views of holotype, DOP13438, ×3 (Martínez-Chacón, 1978b).

Notothyrina LICHAREW, 1936, p. 271, *nom. transl.* JIN & LEE, herein, *ex Notothyris (Notothyrina)* LICHAREW, 1936, p. 271 [**Notothyris (Notothyrina) pontica;* OD]. Very small, ventral valve with two strong folds each bordered by weak lateral folds; internal structures identical to *Notothyris* except for loop thickened by secondary shell material. *Permian (Lopingian):* North Caucasus (Nikitin Formation).——FIG. 1338,*5a–b. *N. pontica;* dorsal and ventral views, ×3 (Licharew, Makridin, & Rzhonsnitskaya, 1960).

Pseudorostranteris GLUSHENKO, 1975, p. 114 [**P. schebelinkaensis;* OD]. Subpentagonal, ventral valve strongly arched with flat slopes; anterior commissure uniplicate; pedicle collar well developed; outer

hinge plates thick, inner hinge plates divided, recurved ventrally; loop acuminate with high median plate. *Permian (Aselian):* Ukraine (Slavinsk Formation).——Fig. 1338,*3a–c. *P. schebelinkaensis;* dorsal, lateral, and anterior views, ×3 (Glushenko, 1975).

Rostranteris Gemmellaro, 1899, p. 104 [**Dielasma adrianense* Gemmellaro, 1894, p. 5; OD]. Small to medium size, anterior commissure commonly plicosulcate, rarely unisulcate; loop acuminate with high median plate extending anteriorly and posteriorly beyond union of main bands. *Permian (Guadalupian):* North America, Europe, Asia.——Fig. 1338,*8a. *R. adrianense* (Gemmellaro), Sicily; dorsal interior, ×2 (Stehli, 1962).——Fig. 1338,*8b–e. R. inflatum* Gemmellaro, Sicily; dorsal, ventral, lateral, and anterior views, ×1.5 (Stehli, 1962).

Timorina Stehli, 1961b, p. 465 [**Notothyris minuta* Broili, 1916, p. 69; OD; *non* Waagen, 1882; =*Timorina broili* Stehli, 1961b, p. 465]. Small, externally similar to *Notothyris* but with 2, 3, or more median plications on ventral valve raised into slight fold; loop acuminate, but with a median vertical plate modified by diverging, recurved bands that end without uniting. *Permian (Capitanian–Changhsingian):* Timor, Pakistan; USA (Texas), *Capitanian.*——Fig. 1338,*10a–c. *T. broili,* Capitanian, Timor; *a–b,* dorsal and lateral views, ×2; *c,* reconstruction of loop, ×1 (Stehli, 1961b).

Family LABAIIDAE Licharew, 1960

[*nom. correct.* Stehli, 1965, p. 755, *pro* Labaidae Licharew in Licharew, Makridin, & Rzhonsnitskaya, 1960, p. 293]

Small, smooth, commonly folded anteriorly; dental plates absent; loop modified acuminate with supplemental lamellae; hinge plate perforate; may be obscured by secondary shell thickening; crura arising from margins of socket ridges. *Permian (Lopingian).*

Labaia Licharew, 1956, p. 65 [**L. Muir-Woodae;* OD]. Elongate suboval to subrhomboidal, rectimarginate; outer hinge plate not developed; crural bases fused with socket ridges; loop acuminate with auxiliary bands developing from distal part of vertical plate. *Permian (Lopingian):* North Caucasus.——Fig. 1339,*2a–d. *L. muirwoodae; a–c,* dorsal, ventral, and lateral views, ×2 (Licharew, 1960b); *d,* reconstruction of loop, ×2 (Dagys, 1969).

Family CRYPTONELLIDAE Thomson, 1926

[*nom. transl.* Stehli, 1965, p. 762, *ex* Cryptonellinae Thomson, 1926, p. 529]

Shell small to medium, smooth, rarely plicate anteriorly, foramen small, commonly mesothyrid or submesothyrid; beak ridges prominent, deltidial plates conjunct, dental plates present; pedicle collar present or absent; inner hinge plate commonly undivided, commonly perforate and generally unsupported by median septum; loop long, acuminate (centronelliform), diploform (cryptacanthiiform), or teloform (cryptonelliform). *upper Lower Devonian–Upper Triassic (Norian).*

Subfamily CRYPTONELLINAE Thomson 1926

[Cryptonellinae Thomson, 1926, p. 529]

Small to medium, commonly smooth, biconvex or dorsibiconvex, anterior commissure rectimarginate, uniplicate or sulciplicate, foramen small, telate; pedicle collar commonly absent; loop narrow ribboned with distinct ascending and descending branches developed from acuminate (centronelliform) through diploform (cryptacanthiiform) to teloform (cryptonelliform) stage. *upper Lower Devonian–Permian.*

Cryptonella Hall, 1861, p. 101 [**Terebratula rectirostra* Hall, 1860, p. 88; SD Hall & Clarke, 1894, p. 861]. Small to medium; subcircular to elongate; ventribiconvex; smooth or anteriorly faintly plicate; anterior commissure rectimarginate to sulciplicate; foramen submesothyrid; dental plates short to obsolescent; muscle field well impressed; free, perforate or imperforate hinge plate extending unsupported between socket plates; adult loop teloform (cryptonelliform). *upper Lower Devonian–Upper Devonian:* North America, South America, Europe, ?New Zealand.——Fig. 1340,*6a–c. *C. rectirostra* (Hall), Middle Devonian, New York, USA; dorsal, lateral, and anterior views of lectotype, AMNH FI 25373, ×1 (new).——Fig. 1340,*6d. C. planirostra* (Hall), Middle Devonian, New York; ventral view of loop, ×2 (Cloud, 1942).

?Booralia Campbell, 1961a, p. 449 [**B. ovata* Campbell, 1961a, p. 450; OD]. Medium in size, ovate, anterior commissure rectimarginate or slightly unisulcate; foramen mesothyrid to submesothyrid; pedicle collar long, dorsally placed, attached to deltidial plates; hinge plates deeply concave and perforate; dental plates long; loop unknown. *Carboniferous (?Moscovian):* Australia (New South Wales).——Fig. 1340,*7. *B. ovata;* dorsal view of latex cast, ×1 (Campbell, 1961a).

Dielasmella Weller, 1911, p. 446 [**Eunella compressa* Weller, 1906, p. 442; OD]. Small, subcircular to pentagonal, anterior commissure rectimarginate; foramen mesothyrid; deltidial plates disjunct; perforate hinge plate unsupported between socket

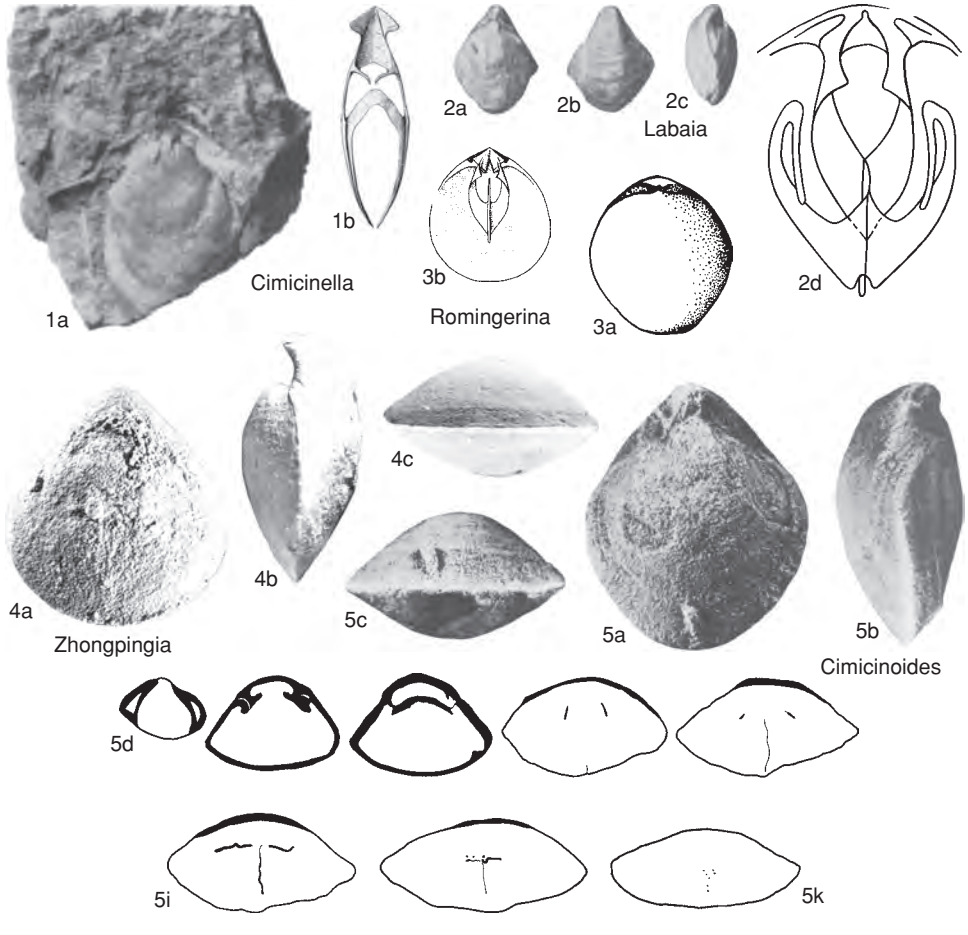

FIG. 1339. Labaiidae, Cimicinellidae, and Uncertain (p. 2024–2028).

plates; loop long, teloform. *Carboniferous (Mississippian):* USA.——FIG. 1340,*2a–c. *D. compressa* (WELLER), Mississippi Valley; *a–b,* dorsal and ventral views, ×2; *c,* interior of transparent specimen infilled with clear calcite, ×1.5 (Weller, 1914).

Gacina STEHLI, 1961b, p. 458 [**G. moorefieldensis;* M]. Medium size, elongate or subpentagonal to elliptical, dorsal valve with distinct sulcus; hinge plate free, perforate; loop long, descending lamellae uniting near midlength with a vertical plate at front. *Carboniferous (Visean):* North America, Europe. ——FIG. 1340,*3a–e. *G. moorefieldensis,* Meramecian, Oklahoma, USA; *a–d,* dorsal, ventral, lateral, and anterior views, ×1; *e,* reconstruction of loop, ×1 (Stehli, 1961b).

Heterelasma GIRTY, 1909, p. 337 [**H. shumardianum;* OD]. Small to medium, planoconvex to concavoconvex in profile, anterior commissure uniplicate to strongly sulciplicate; dental plates united on floor by callus, median ridge extending nearly to anterior margin; hinge plate generally imperforate and may be supported apically by short median septum. *Permian:* North America.——FIG. 1340,*1a–d. *H. shumardianum,* Texas, USA; dorsal, ventral, lateral, and anterior views of holotype, USNM 118584, ×1 (Cooper & Grant, 1976b).——FIG. 1340,*1e–h. H. concavum* COOPER & GRANT, Texas, USA; *e–g,* dorsal, lateral, and anterior views of holotype, USNM 153396a, ×2; *h,* interior of dorsal valve, ×3 (Cooper & Grant, 1976b).

Petriathyris LEE & JIN, herein, p. 2,254, *nom. nov. pro Petria* MENDES, 1961b, p. 21, *non* SEMENOV, 1894 [**Waldheimia coutinhoana* DERBY, 1874, p. 3; OD]. Medium size, oval to subelliptical, beak strongly recurved, with sharp beak ridges, foramen submesothyrid, symphytium complete; anterior commissure rectimarginate, dental plates subparallel; hinge plate perforate, loop extending to front of shell, recurving lamellae broad, thin and long, with lamellar spines at its extremities; median septum very short. *Carboniferous (Pennsylvanian):* Brazil

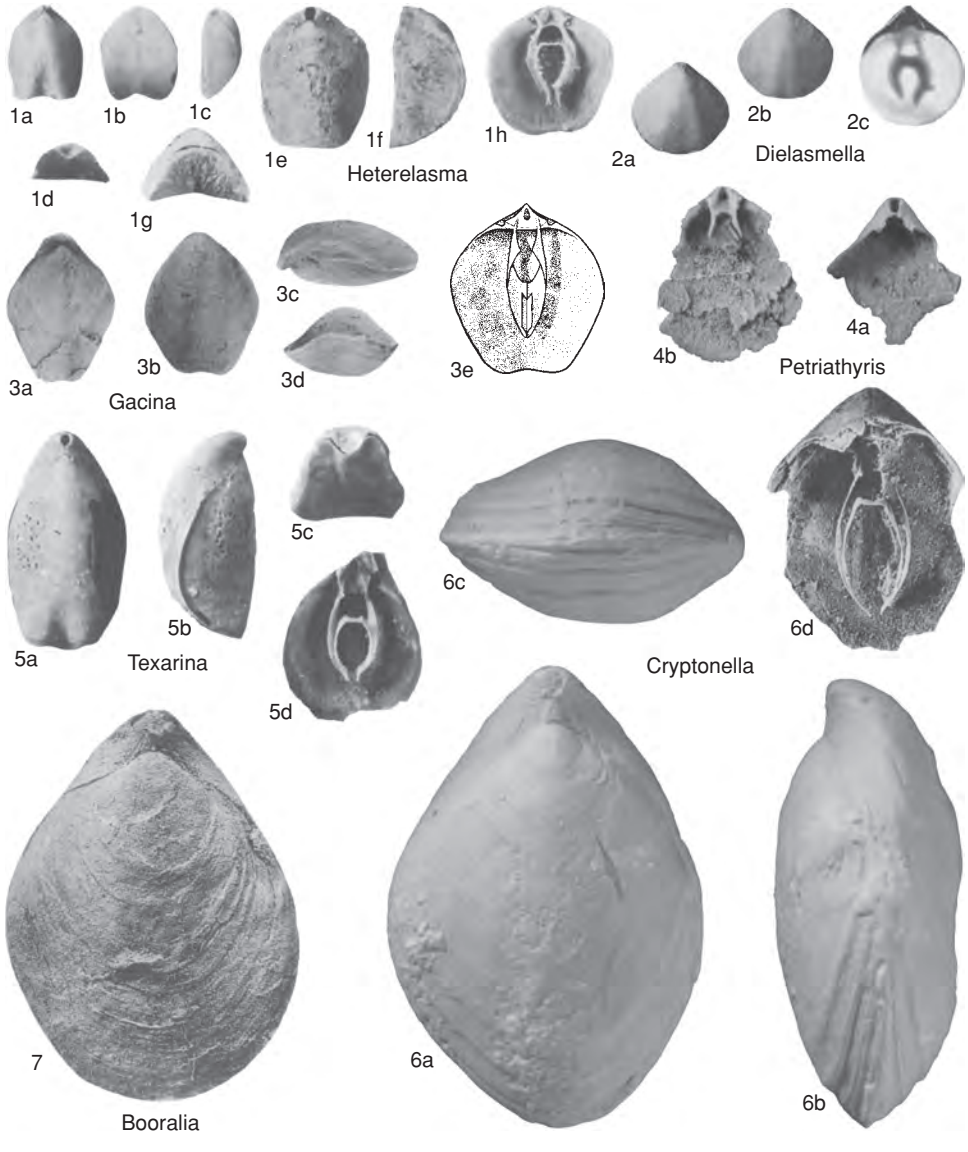

FIG. 1340. Cryptonellidae (p. 2024–2026).

(Para).——FIG. 1340,*4a–b. *P. coutinhoana* (DERBY)*; a,* interior of ventral valve, ×3; *b,* interior of dorsal valve, USNM 249883, ×3 (new).

Texarina COOPER & GRANT, 1970, p. 579, *nom. nov. pro Texasia* COOPER & GRANT, 1969, p. 17, *non* REESIDE, 1932 [**Texasia oblongata* COOPER & GRANT, 1969, p. 17; OD]. Small, elongate, beak erect, foramen nonlabiate, symphytium completely exposed; anterior commissure sulciplicate; dental plates short; median ridge poorly developed in ventral valve; loop long with spinose anterior extremities, no median septum in dorsal valve. *Permian (Wordian):* USA (Texas), Venezuela, ?Europe.——FIG. 1340,*5a–c. *T. oblongata* (COOPER & GRANT), Texas, USA; *a–c,* dorsal, lateral, and anterior views of holotype, USNM 153415, ×1 (Cooper & Grant, 1976b).——FIG. 1340,*5d. T. elongata;* interior of dorsal valve, ×3 (Cooper & Grant, 1976b).

Subfamily CRYPTACANTHIINAE Stehli, 1965

[Cryptacanthiinae Stehli, 1965, p. 752]

Commonly small, smooth, ventral valve convex, dorsal valve gently convex to concave, anterior commissure rectimarginate to unisulcate; beak erect, with sharp beak ridges; pedicle collar present; dental plates strong, hinge plates may be divided, may be perforate apically, and may be supported by small median septum; loop long, with broad-banded, hoodlike ascending lamellae and transverse ribbon developed from acuminate (centronelliform) stage through diploform (cryptacanthiiform) to teloform (cryptonelliform) stage. *Carboniferous (middle Pennsylvanian)–Upper Triassic (Norian).*

Cryptacanthia White & St. John, 1867, p. 119 [**Waldheimia? compacta* White & St. John, 1867, p. 119; OD]. Small, biconvex to concavoconvex, unisulcate; median septum usually absent or present apically, hinge plate concave to nearly flat, perforate; loop with hoodlike ascending lamellae and transverse band, descending lamellae becoming independent very late, anterior extremities of loop spinose. [No suitable illustrations of type are available.] *Carboniferous (middle Pennsylvanian)–Permian (Sakmarian):* North America, Europe, Asia.——Fig. 1341,*1a–g. C. prolifica* Cooper, upper Pennsylvanian, New Mexico; *a–d,* dorsal, ventral, lateral, and anterior views of holotype, USNM 127066, ×3; *e–g,* dorsal, ventral, and lateral views of loop, ×3 (Cooper, 1957a).

Anadyrella Dagys, 1974, p. 185 [**A. infrequens;* OD]. Small, subpentagonal, unisulcate, dorsal valve slightly flattened; beak short, incurved, foramen mesothyrid; pedicle collar distinct, dental plates short, divergent; cardinal process low, crural plates joined to floor of dorsal valve; no septum or septalium; loop long, with narrow lamellae, anteriorly spinose. *Middle Triassic (Ladinian)–Upper Triassic (Norian):* Siberia.——Fig. 1341,*4a–d. *A. infrequens,* Norian, northern Siberia; *a–c,* dorsal, lateral, and anterior views, ×1; *d,* reconstruction of loop, ×2 (Dagys, 1974).

Anaptychius Hoover, 1981, p. 106 [**A. minutus;* OD]. Small, suboval, smooth; moderately biconvex, anterior commissure rectimarginate; dental plates strong; outer hinge plates low, inner hinge plates conjunct with apical perforation; median septum absent; loop diploform (cryptacanthiiform). *Permian (Roadian–Wordian):* Venezuela.——Fig. 1341,*2a–d. *A. minutus; a–c,* dorsal, lateral, and anterior views of holotype, USNM 221552, ×3; *d,* interior of dorsal valve, ×3 (Hoover, 1981).

Glossothyropsis Girty, 1934, p. 251 [**Cryptacanthia? robusta* Girty, 1934, p. 251; OD]. Small to medium size, outline subquadrate, planoconvex to slightly concavoconvex; anterior commissure strongly unisulcate; beak ridges telate, interarea distinct; dental plates strong; cardinalia complex, with broad outer hinge plate, inner hinge plates separate in early growth stages but grow medially to form undivided inner hinge plate in adult specimens; supported by strong median septum extending anteriorly to beyond midvalve; loop long, fringed laterally by long spines, ascending lamellae and transverse band forming a broad-ribboned ring. *Permian (?Cisuralian, Wordian, ?Lopingian):* USA, *Guadalupian;* Australia, *?Permian.*——Fig. 1341,*5a–d. *G. robusta* (Girty), Capitanian, Delaware basin, western Texas, USA; *a–c,* dorsal, lateral, and anterior views, ×1; *d,* interior of dorsal valve, ×3 (Cooper & Grant, 1976b).——Fig. 1341,*5e. G. rectangulata* Cooper & Grant, Wordian, Glass Mountains, western Texas, USA; interior of dorsal valve, ×3 (Cooper & Grant, 1976b).

Obnixia Hoover, 1979, p. 11 [**Terebratula thaynesiana* Girty, 1927, p. 435; OD]. Small, smooth, outline subtrigonal to subpentagonal; ventribiconvex, anterior commissure unisulcate, beak ridges strong, foramen small, mesothyrid, deltidial plates thin, conjunct; dental plates variable, pedicle collar short; outer hinge plates narrow; inner hinge plates absent; loop long, variably spinose. *Lower Triassic:* western United States.——Fig. 1341,*3a–d. *O. thaynesiana* (Girty), California; *a–c,* dorsal, lateral, and anterior views, ×2; *d,* interior of dorsal valve, ×4 (Hoover, 1979).

Family CIMICINELLIDAE Stehli, 1965

[*nom. transl.* Jin & Lee, herein, *ex* Cimicinellinae Stehli, 1965, p. 752]

Medium size, smooth, dental plates short; hinge plate perforate, loop teloform. *Lower Devonian (Emsian)–Middle Devonian (Eifelian).*

Cimicinella Schmidt, 1946, p. 67 [**Terebratula cimex* Richter & Richter, 1918, p. 156; OD]. Elongate; ventribiconvex; rectimarginate; crural plates present. *Lower Devonian (Emsian):* Germany.——Fig. 1339,*1a–b. *C. cimex* (Richter & Richter); *a,* steinkern of dorsal valve, ×1; *b,* reconstruction of loop, ×1 (Schmidt, 1946).

?Cimicinoides Anderson, Boucot, & Johnson, 1969, p. 156 [**C. struvei;* OD]. Small; externally like *Cimicinella;* crural plates absent; acuminate loop with anterior attached to vertical plate; vertical plate and anterior band anteriorly spinose. *Middle Devonian (Eifelian):* Burma.——Fig. 1339,*5a–k. *C. struvei; a–c,* dorsal, lateral, and anterior views of holotype, BMNH BB55586, ×4; *d–k,* serial

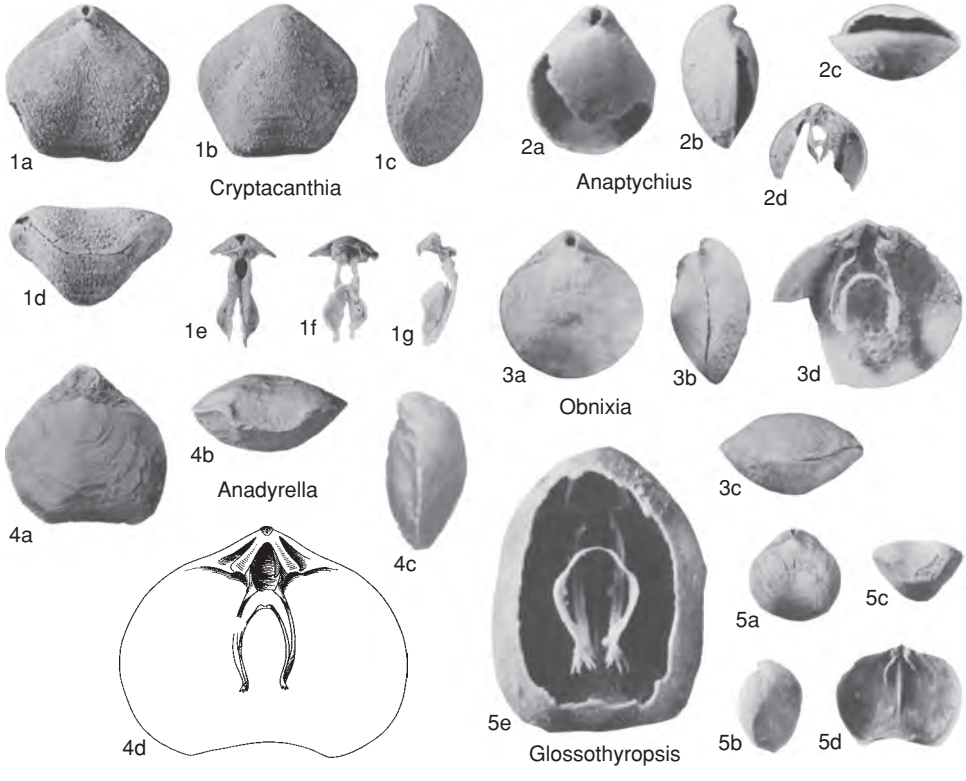

FIG. 1341. Cryptonellidae (p. 2027).

transverse sections 9.10, 8.45, 8.00, 6.69, 6.24, 5.94, 5.59, 4.99, ×4 (Anderson, Boucot, & Johnson, 1969).

Family UNCERTAIN

Romingerina HALL & CLARKE, 1893, p. 272 [**Centronella julia* WINCHELL, 1862, p. 405; OD] [=*Harttina* HALL & CLARKE, 1893, p. 292 (type, *Centronella anna* HARTT, 1868, p. 300–301, OD)]. Small, smooth, circular; ventribiconvex, ventral beak short, deltidial plates conjunct; foramen submesothyrid; small dental plates may be present; hinge plate sessile; apparently divided; crural plates seemingly absent; loop long, acuminate, with large vertical plate. *Carboniferous (Mississippian):* North America.——FIG. 1339,*3a–b.* **R. julia* (WINCHELL); *a,* composite figure, ×2; *b,* reconstruction of loop, ×2 (Stehli, 1965).

?Zhongpingia YANG, 1983, p. 35 [**Z. cimicinoidesiformis;* OD] [=*Xenocryptonella* ZHANG in ZHANG, FU, & DING, 1983, p. 148 (type, *X. intraplicata* ZHANG in ZHANG, FU, & DING, 1983, p. 424)]. Small, circular, deltidial plates present, no cardinal process; dental plates present, short crural plates and hinge plates, simple (possibly acuminate) loop. [Interior structures are imperfectly known.] *Middle Devonian (Givetian):* southern China.——FIG. 1339,*4a–c.* **Z. cimicinoidesiformis,* Jide Formation, Maanshan, Xiangzhou; holotype, ventral, lateral, and anterior views of conjoined shell, YI-IV 47297, ×5 (Yang, 1983).

DIELASMATOIDEA

JIN YU-GAN,[1] D. E. LEE,[2] SUN DONG-LI,[1] T. N. SMIRNOVA,[3] A. S. DAGYS,[4] and M. R. SANDY[5]

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Superfamily DIELASMATOIDEA Schuchert, 1913

[*nom. correct.* LEE & others, herein, *pro* Dielasmatacea STEHLI, 1965, p. 754, *nom. transl. ex* Dielasmatinae SCHUCHERT, 1913, p. 402]

Adult shells small to large; commonly biconvex, rarely planoconvex; elongate oval, subcircular, or subpentagonal in outline; commonly smooth, but may develop plicae in anterior part of shell; hinge line nonstrophic; dorsal foramen very rare; beak ridges angular or rounded; pedicle foramen commonly permesothyrid or mesothyrid, commonly medium in size and often labiate; anterior commissure highly variable, may be uniplicate, unisulcate, bisulcate, sulciplicate, or rectimarginate. Pedicle collar commonly present; teeth small, cyrtomatodont; dental plates present in some families; ventral valve without median septum. Cardinal process commonly small; median septum present or absent; outer hinge plates commonly narrow, weakly developed, may be fused with socket ridges; inner hinge plates may be absent, present and separate, or joined near union with valve floor, or to median ridge to form a septalium; crural plates may be present and joined with floor of valve, or enveloping septum to form septalium; loop normally short, acuminate (centronelliform) in juveniles to deltiform (terebratuliform) in adults, modified by fission and resorption of echmidium and insertion of transverse lamellae, or by more complex developmental stages; but in some taxa long, with descending and ascending lamellae; color banding may be present. *Upper Devonian (Frasnian)–Lower Jurassic.*

Family DIELASMATIDAE Schuchert, 1913

[*nom. transl.* SCHUCHERT & LEVENE, 1929a, p. 23, *ex* Dielasmatinae SCHUCHERT, 1913, p. 402]

Shell small to large; subrounded, elongate oval, or subpentagonal in outline; commonly biconvex; smooth to slightly plicate, anterior commissure variable, may be uniplicate, unisulcate, sulciplicate, or rectimarginate, may be geniculate; foramen commonly permesothyrid and labiate; pedicle collar present; cardinal process small, low; dental plates usually present; outer hinge plates variable, joined to socket ridges or directly to valve wall; inner hinge plates converging on valve floor, or uniting to form a septalium or forming entire plate, raised above valve floor; juvenile loop acuminate, adult loop commonly short (0.3 to 0.5 dorsal valve length), deltiform; transverse band developed through resorption of echmidium. *Carboniferous (Mississippian)–Upper Triassic, ?Lower Jurassic.*

Subfamily DIELASMATINAE Schuchert, 1913

[Dielasmatinae SCHUCHERT, 1913, p. 402]

Dental plates present; pedicle collar complete; inner hinge plates meeting on valve floor or septum. *Carboniferous (Mississippian)–Upper Triassic.*

Dielasma KING, 1859, p. 256 [**Terebratulites elongatus* SCHLOTHEIM, 1816, p. 27; OD] [=*Dielasmoides* WELLER, 1911, p. 443 (type, *D. binsinuata* WELLER, 1911, p. 444, OD)]. Small to large, smooth, elongate oval to subpentagonal in outline, generally dorsibiconvex, narrowly domed to keeled, and ventral valve flatly convex to medially concave; anterior commissure uniplicate to sulciplicate; beak ridges

rounded; foramen permesothyrid, small to large, often labiate, symphytium often hidden; pedicle collar short; fulcral plates strong, outer hinge plates vary from absent to fairly broad; inner hinge plates separate or joined near union with valve floor or to a median ridge; juvenile loop acuminate; adult loop developed by fission and resorption of echmidium and insertion of transverse band; loop 0.4 to 0.5 dorsal valve length, transverse band narrow, strongly folded medially. *Carboniferous (Upper Mississippian)–Permian:* cosmopolitan.——Fig. 1342,*1a–d.* **D. elongatum* (Schlotheim), upper Permian, Pössneck, Thuringia, Germany; *a–c,* dorsal, lateral, and anterior views of neotype, USNM 124226, ×1; *d,* calcite encrusted loop, ×1 (Stehli, 1956a).——Fig. 1342,*1e–g. D. zebratum* Cooper & Grant, Permian, western Texas, USA; *e,* dorsal view of holotype, USNM 1533426, ×1; *f–g,* juvenile and adult loops, respectively, ×2 (Cooper & Grant, 1976b).

Adygella Dagys, 1959a, p. 25 [**A. cubanica;* OD]. Small to medium, rounded to pentagonal in outline, biconvex with incipiently uniplicate, anterior commissure; beak short, incurved, beak ridges rounded, foramen small, permesothyrid; dental plates short, diverging; no cardinal process; outer hinge plates horizontal, crural bases distinct, directed ventrally; septalium deep, supported by thin, short septum; loop short (less than 0.3 dorsal valve length), transverse band low, slightly arched. *Upper Triassic:* Alps, Carpathians, northwestern Caucasus, China.——Fig. 1342,*5a–n.* **A. cubanica,* Norian, northwestern Caucasus; *a–c,* dorsal, lateral, and anterior views of holotype, ×1; *d–m,* transverse serial sections 0.4, 1.7, 1.8, 2.2, 2.7, 3.0, 3.6, 4.2, 4.5, 5.8 mm from ventral umbo, ×1; *n,* reconstruction of loop, ×2 (Dagys, 1974; courtesy of the late A. S. Dagys).

Amygdalocosta Waterhouse, 1967, p. 101 [**A. rara;* OD]. Medium size, almond shaped, differs from *Dielasma* in possessing dorsal sulcus and anterior costae; dental plates short, subparallel; hinge plates uniting on valve floor; crura and loop unknown. *Permian (Guadalupian–Lopingian):* New Zealand.——Fig. 1342,*3a–b.* **A. rara; a,* ventral internal mold, ×2.5; *b,* dorsal internal mold of holotype, BR 844, ×2.5 (Waterhouse, 1967).

Aspidothyris Diener, 1908, p. 58 [**A. kraffti;* OD]. Small, biconvex, anterior commissure rectimarginate or incipiently uniplicate, beak incurved; dental plates strong, septum and crural plates developed; loop acuminate, about 0.5 dorsal valve length, with long, vertical plate extending dorsally and possibly ventrally. [Genus may be based on immature specimens.] *Upper Triassic (Carnian):* Himalayas.——Fig. 1342,*2a–d.* **A. kraffti; a–c,* dorsal, lateral, and anterior views; *d,* reconstructed loop, ×1 (Muir-Wood, 1965a).

Coenothyris Douvillé, 1879, p. 270 [**Terebratulites vulgaris* Schlotheim, 1820, p. 275; OD] [=*Praerhaetina* Urosevic, 1988, p. 351 (type, *P. radulovici,* OD)]. Medium to large, elongate oval to subpentagonal in outline; biconvex, usually with prominent dorsal fold, anterior commissure uniplicate or rarely bisulcate, beak suberect or incurved, beak ridges angular, foramen permesothyrid; radiating color banding often present; pedicle collar present, dental plates short, may be fused with thickened shell wall; cardinal process broad, concave; outer hinge plates subhorizontal in section; median septum high, about 0.3 dorsal valve length, septalium present; adult loop deltiform with long crural processes, 0.3 dorsal valve length, transverse band fragile, rarely preserved. *Middle Triassic–Upper Triassic:* Europe, Afghanistan, Himalayas, China, *Middle Triassic;* Yugoslavia, Bulgaria, Israel, *Upper Triassic.*——Fig. 1342,*4a–o.* **C. vulgaris* (Schlotheim), Muschelkalk; *a–c,* dorsal, lateral, and anterior views of topotype from Schlotheim's original collection, Germany, ×1 (new; courtesy of the late A. S. Dagys); *d,* dorsal valve with characteristic color banding, Lagoubran, France, ×1; *e–o,* transverse serial sections 1.2, 3.9, 4.8, 5.4, 7.0, 7.4, 7.7, 8.8, 10.8, 11.6, 16.0 mm from ventral umbo, Lagoubran, France, ×1 (Hagdorn & Sandy, 1998).

Cruratula Bittner, 1890, p. 66 [**Waldheimia eudora* Laube, 1866, p. 8; OD]. Medium size, subtriangular or pear shaped, planoconvex, dorsal valve with broad sulcus; anterior commissure unisulcate to incipiently parasulcate; beak prominent, erect to incurved, beak ridges rounded, foramen permesothyrid; dorsal septum strong, about 0.5 shell length, septalium present; loop imperfectly known. *Middle Triassic (Ladinian)–Upper Triassic (Norian):* northern Alps, southern Alps, Dinarids, ?Asia.——Fig. 1343,*1a–d.* **C. eudora* (Laube), Carnian, southern Alps; *a–c,* dorsal, lateral, and anterior views, ×1; *d,* incomplete loop, ×1 (Bittner, 1890).

Dareithyris Siblík, 1991, p. 171 [**D. vulgaris;* OD]. Medium in size, biconvex with shallow sulcus on dorsal valve, beginning at cardinal margin; anterior commissure rectimarginate or slightly unisulcate, beak erect to incurved, beak ridges angular, foramen permesothyrid; dental plates short, subparallel, cardinal process short, undivided; outer hinge plates subhorizontal in section, crural bases distinct, directed ventrally; septalium shallow, dorsal septum long, about 0.5 valve length; loop with diverging, descending lamellae, about 0.5 dorsal valve length, transverse band unknown. *Middle Triassic (Anisian):* Iran.——Fig. 1343,*2a–o.* **D. vulgaris; a–c,* dorsal, lateral, and anterior views of holotype, GBA1982/8/10, ×1; *d–o,* transverse serial sections 1.2, 2.5, 3.9, 5.1, 5.4, 7.0, 7.2, 8.3, 9.1, 10.0, 10.6, 11.0 mm from ventral umbo, ×1 (Siblík, 1991).

Dielasmina Waagen, 1882, p. 335 [**D. plicata;* OD]. Medium to large, external homeomorph of *Hemiptychina,* dorsal valve geniculated sharply near midlength; dental plates and pedicle collar well developed; cardinal process shelflike; fulcral plates high, outer hinge plates very narrow; inner hinge plates converging medially from apex of valve to form a narrow septalium; median ridge extending from anterior end of septalium to midlength; crural

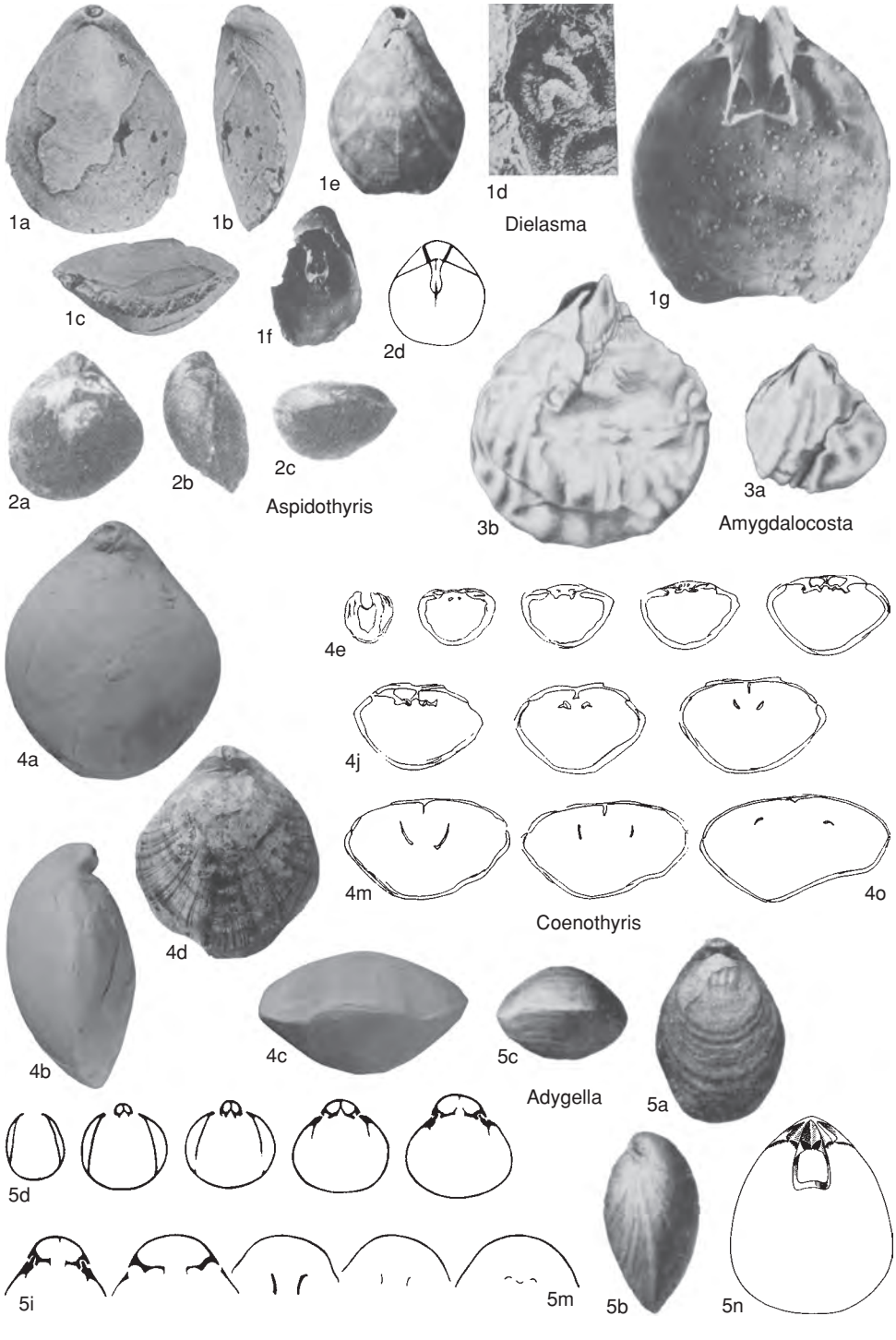

FIG. 1342. Dielasmatidae (p. 2029–2030).

processes low; descending lamellae of loop short and narrow, reaching valve midlength. *Permian (Capitanian, middle Lopingian):* Pakistan (Salt Range).——Fig. 1343,*4a–d.* **D. plicata,* Capitanian, Wuchiapingian; dorsal, ventral, lateral, and anterior views, ×1 (Waagen, 1882).——Fig. 1343,*4e. D.* sp.; interior of dorsal view with broken transverse band, USNM 489614, ×3 (new).

Dongbaella Jin & Ye in Jin & others, 1979, p. 127 [**D. planata;* OD]. Small, biconvex, anterior commissure rectimarginate; foramen hypothyrid; dental plates thin, ending behind hinge line; inner socket ridges high, outer hinge plates narrow, converging toward valve floor, united with long, inner hinge plates; loop long, descending lamellae parallel, recurving lamellae arched ventrally and connected medially by small band. *Carboniferous (Visean):* China (Qinghai).——Fig. 1343,*5a–h.* **D. planata; a,* dorsal view, ×1; *b–h,* serial transverse sections 0.8, 2.2, 3.4, 4.8, 5.1, 5.4, 5.8 mm from ventral umbo, ×1 (Jin & others, 1979).

Ectoposia Cooper & Grant, 1976b, p. 2,898 [**E. wildei;* OD]. Medium, thin shelled, elongate oval in outline, dorsibiconvex, anterior commissure broadly uniplicate, beak suberect, foramen labiate; dental plates erect; inner hinge plates well separated, uniting on valve floor; loop reaching 0.6 dorsal valve length, crura very short, crural processes long, descending lamellae connected with long, recurving band to form troughlike anterolateral branches, spinules on anterior extremities, transverse band broad. *Permian (Wordian):* USA (Texas).——Fig. 1343,*3a–c.* **E. wildei; a–b,* dorsal and lateral views of holotype, USNM 153446; *c,* interior view showing loop, ×1 (Cooper & Grant, 1976b).

Elasmata Waterhouse, 1982a, p. 349 [**E. retusus;* OD]. Large, elongate, anterior commissure slightly uniplicate; dental plates present; inner hinge plates uniting on valve floor, forming sessile septalium; low median ridge; crura rising from septalium. *Permian (Asselian):* Thailand.——Fig. 1343,*7.* **E. retusus;* dorsal internal mold of holotype, TBR 527, ×1 (Waterhouse, 1982a).

Fletcherithyris Campbell, 1965, p. 24, *nom. nov. pro Fletcherina* Stehli, 1961a, p. 452, *non* Lang, Smith, & Thomas, 1955, p. 261 [**Terebratula amygdala* Dana, 1847, p. 152; OD]. Small to medium size, folded or unfolded; when folded, dorsal valve with median sulcus flanked by folds; anterior commissure rectimarginate to sulciplicate; foramen labiate; dental plates and pedicle collar well developed; inner hinge plates uniting on floor of valve or joining to form a low median septum or septalium; loop deltiform but transverse band not preserved. *Permian (Sakmarian–Wordian):* Australia, New Zealand.——Fig. 1344,*1a–d.* **F. amygdala* (Dana), New South Wales; *a–c,* dorsal, lateral, and anterior views, ×1; *d,* latex cast of internal mold, ×1 (Stehli, 1961a).——Fig. 1344,*1e. F. reidi;* reconstruction of dorsal valve interior, ×1 (Campbell, 1965).

?Paradygella Liao & Sun, 1974, p. 352 [**P. magna;* OD]. Similar to *Adygella,* but larger with a thick pedicle collar, angular beak ridges, and a median ridge in septalium. [Serial transverse sections of type species are not available. Details of interior characters are needed to confirm the status of this genus.] *Middle Triassic (Ladinian):* China (Sichuan).

Pirithyris Sun & Ye, 1982, p. 167 [172] [**P. pius;* OD]. Small, pear shaped, biconvex; beak ridges rounded, palintrope small, delthyrium with discrete deltidium, anterior commissure unisulcate; pedicle collar present; dental plates long, slightly inclined outwardly; hinge plates merged with inner socket ridges; septalium well developed, widely V-shaped; median septum high, stout, extending nearly to anterior margin; crural bases triangular, crural processes inconspicuous; loop short, consisting of only platelike, descending branches. Differs from *Praecubanothyris* in possessing dental plates and lacking transverse band in loop. *Middle Triassic (Anisian):* China (Qinghai).——Fig. 1344,*2a–c.* **P. pius;* dorsal, lateral, and anterior views, ×1 (Sun & Ye, 1982).

Plectelasma Cooper & Grant, 1969, p. 16 [**P. kingi* Cooper & Grant, 1969, p. 17; OD]. Medium size, elongate oval; anterior margin parasulcate, surface semicostate; foramen strongly labiate, permesothyrid; dental plates strong, cardinal process thick, inner hinge plates uniting on valve floor. *Permian (Guadalupian):* USA (Texas).——Fig. 1343,*6a–e.* **P. kingi; a–d,* dorsal, ventral, lateral, and anterior views of holotype, USNM 153355a, ×2; *e,* interior of dorsal valve, ×2 (Cooper & Grant, 1976b).

Sulcatinella Dagys, 1974, p. 177 [**S. sulcata;* OD]. Small, planoconvex with flattened dorsal valve bearing broad sulcus; anterior commissure unisulcate; beak with sharp ridges, foramen small, mesothyrid; pedicle collar short, dental plates divergent. Cardinal process low but distinct; outer hinge plate horizontal in section, connected with septum by crural plates to form a septalium; loop about 0.5 dorsal valve length, with high, arcuate transverse band that is spinose anteriorly. *Middle Triassic (Anisian):* Balkans, Crimea, northwestern Caucasus.——Fig. 1345,*3a–aa.* **S. sulcata,* northwestern Caucasus; *a–c,* dorsal, lateral, and anterior views, ×2; *d,* reconstructed loop, ×2 (Dagys, 1974; courtesy of the late A. S. Dagys); *e–aa,* serial tranverse sections 0.0, 0.2, 0.3, 0.4, 0.6, 0.7, 0.9, 1.1, 1.3, 1.4, 1.5, 1.7, 1.9, 2.1, 2.3, 2.5, 2.8, 3.0, 3.4, 3.8, 4.1, 4.2, 4.4 mm from first section, ×2 (adapted from Dagys, 1974; courtesy of the late A. S. Dagys).

Tibetothyris Ching, Sun, & Rong, 1976, p. 327 [**T. depressa;* OD]. Medium size, roundly pentagonal, biconvex; anterior commissure sulciplicate to bisulcate; beak short, erect; beak ridges rounded; delthyrium open or covered by deltidial plates; foramen circular, permesothyrid; pedicle collar present; dental plates long, slightly divergent; teeth thin; cardinal process short, flattened, with fine, longitudinal grooves; inner socket ridges high, fused with short, dorsally inclined, outer hinge plates; crural plates converging on valve floor, forming

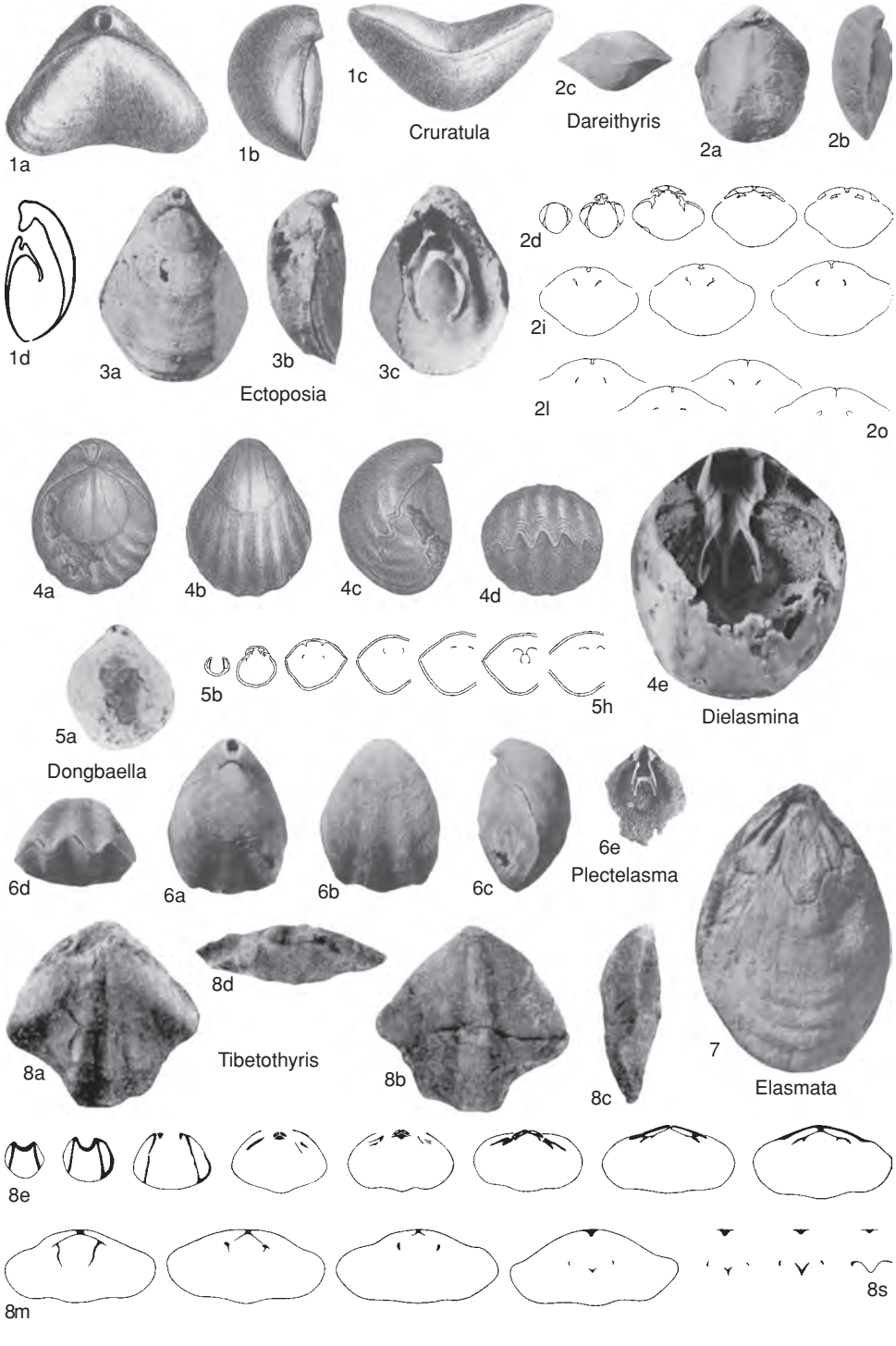

FIG. 1343. Dielasmatidae (p. 2030–2035).

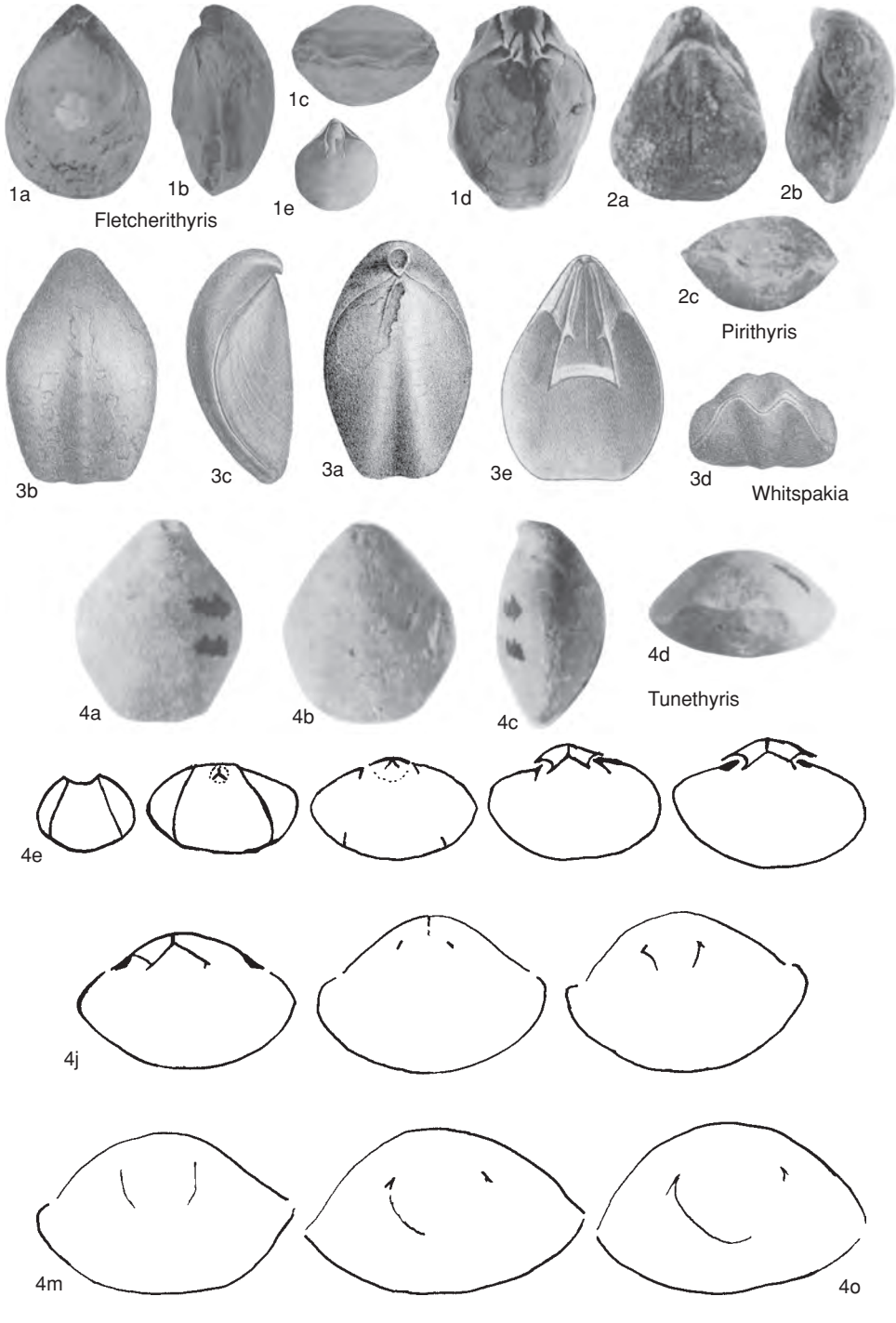

FIG. 1344. Dielasmatidae (p. 2032–2036).

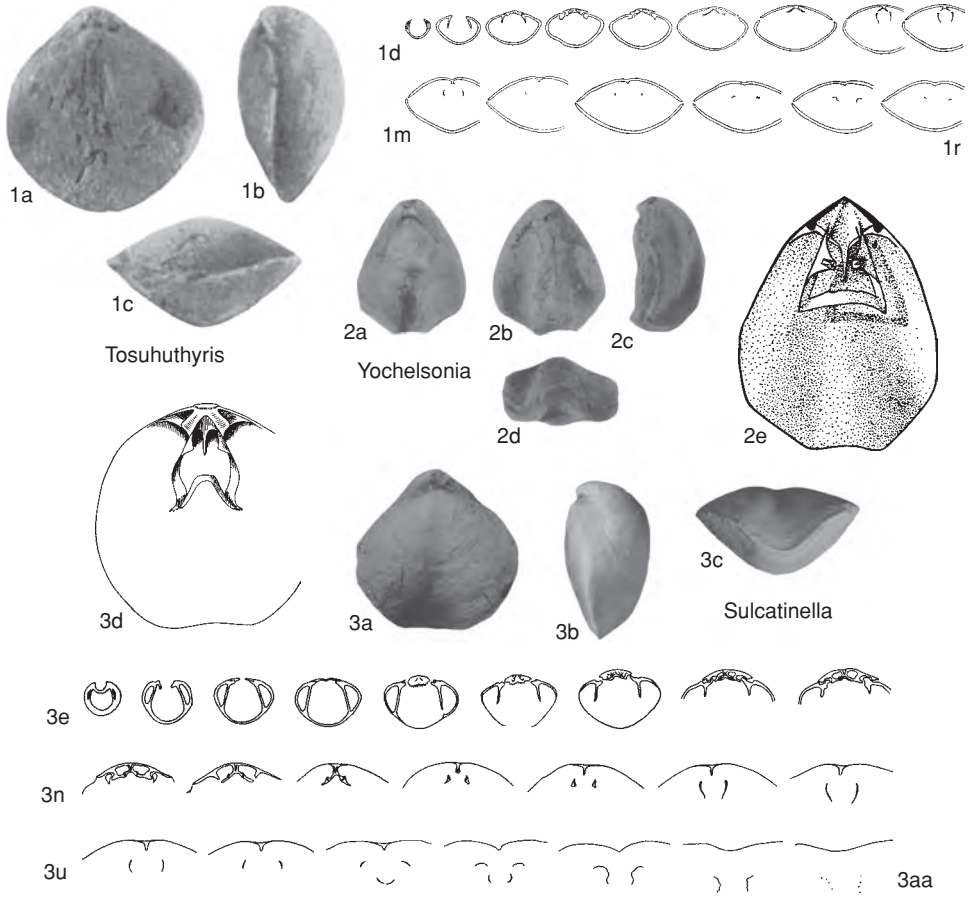

FIG. 1345. Dielasmatidae (p. 2032–2036).

wide septalium, supported by low median ridge anteriorly; crura of *Dielasma* type; crural bases long, trigonal, attached to inner end of outer hinge plates; crura very short, crural processes high; loop short, narrowly triangular, about 0.3 dorsal valve length; descending branches long, thin; plate-shaped transverse band a broad, depressed arch with narrow crest projecting posteriorly; median septum low, reaching 0.5 dorsal valve length. *Upper Triassic (Carnian–Norian):* Alps and Himalayas.——FIG. 1343,*8a–s.* **T. depressa,* Norian, Tibet, China; *a–d,* dorsal, ventral, lateral, and anterior views, ×1; *e–s,* serial transverse sections 0.5, 1.7, 2.8, 3.7, 4.6, 5.5, 7.1, 7.6, 8.7, 9.3, 10.2, 11.3, 11.5, 11.7, 11.8 mm from ventral umbo, ×1 (Ching, Sun, & Rong, 1976).

Tosuhuthyris SUN & YE, 1982, p. 166 [171] [**T. sulcus;* OD]. Small, subcircular; planoconvex to biconvex; beak short, incurved, foramen large, mesothyrid; beak ridges distinct; dorsal sulcus wide, shallow in valve anterior; pedicle collar present; dental plates discrete; outer hinge plates narrow, merged with inner socket ridges; septalium V-shaped, formed by bifurcation of median septum; median septum low, thick, 0.3 to 0.5 dorsal valve length; crural bases triangular, rising from ventral edge of hinge plates; crural processes high; loop short, about 0.3 to 0.5 dorsal valve length; only descending branches present (possible fragile transverse band not preserved). *Middle Triassic:* China (Qinghai).——FIG. 1345,*1a–r.* **T. sulcus; a–c,* dorsal, lateral, and anterior views, ×1; *d–r,* transverse serial sections 0.6, 1.3, 1.9, 2.1, 2.3, 2.8, 3.2, 3.7, 4.1, 4.7, 5.1, 5.5, 6.2, 6.5, 7.1 mm from ventral umbo, ×1 (Sun & Ye, 1982).

Tunethyris CALZADA BADIA & others, 1994, p. 118 [**T. punica;* OD]. Medium, ovate in outline; biconvex; anterior commissure sulciplicate; foramen large, permesothyrid; pedicle collar short; inner hinge plates joining short, strong median septum to form

septalium. Differs from *Whitspakia,* which lacks a persistant median septum. *Upper Triassic (Norian):* Tunisia.——Fig. 1344,*4a–o.* **T. punica; a–d,* dorsal, ventral, lateral, and anterior views of holotype, MGSB46587.11, ×2; *e–o,* transverse serial sections 0.0, 2.4, 2.8, 3.1, 3.7, 4.3, 5.1, 5.5, 6.1, 8.5, 9.1 mm from first section, ×2 (Calzada Badia & others, 1994).

Whitspakia Stehli, 1964, p. 610, *nom. nov. pro Pakistania* Stehli, 1961b, p. 462, *non* Eames, 1952 [**Dielasma biplex* Waagen, 1882, p. 349; OD]. Medium to large, outline subpentagonal to oval; ventral sulcus variable in length, with strong median plica, anterior and lateral commissure nongeniculate; anterior commissure sulciplicate; beak erect; foramen permesothyrid; dental plates and pedicle collar well developed; cardinal process small; outer hinge plates broad; inner hinge plates uniting on valve floor and diverging anteriorly; crural processes very long, developed directly from crural bases and supported posteriorly by inner hinge plates; descending lamellae broad anteriorly; transverse band recurved. *Permian:* North America, Europe, Asia.——Fig. 1344,*3a–d.* **W. biplex* (Waagen), Salt Range, Pakistan; dorsal, ventral, lateral, and anterior views, ×1 (Waagen, 1882).——Fig. 1344,*3e. W. breviplicatum* Waagen; interior of dorsal valve, ×1 (Waagen, 1882).

Yochelsonia Stehli, 1961a, p. 454 [**Y. thomasi;* OD]. Small to medium, outline subtriangular to subpentagonal; dorsal valve longitudinally flattened to concave, with pronounced median sulcus; ventral valve with high median fold bordered by sulci; anterior commissure strongly sulciplicate, anterior and lateral commissure geniculate; beak suberect, foramen permesothyrid, nonlabiate; dental plates well developed; inner hinge plates forming short, sessile septalium; crural processes very long. *Permian (Lopingian):* Western Australia.——Fig. 1345,*2a–e.* **Y. thomasi; a–d,* dorsal, ventral, lateral, and anterior views, ×1; *e,* reconstruction of loop, approximately ×2 (Stehli, 1961a).

Subfamily CENTRONELLOIDEINAE Stehli, 1965

[Centronelloideinae Stehli, 1965, p. 758]

Small, smooth, somewhat aberrant dielasmatids with unisulcate anterior commissure and elongate ventral beak; foramen permesothyrid, deltidial plates conjunct; dental plates present, partial pedicle collar strong, cardinal process V-shaped in transverse section; cardinal plate medially sessile; adult loop deltiform but modified by spinose, anterior projections of main bands beyond transverse band. *Carboniferous (Upper Mississippian).*

Centronelloidea Weller, 1914, p. 246 [**Terebratula rowleyi* Worthen, 1884, p. 23; M]. Description as for subfamily. *Carboniferous (Upper Mississippian):* USA.——Fig. 1346,*3a–e.* **C. rowleyi* (Worthen), Missouri; *a–b,* dorsal and ventral views, ×2; *c,* loop of immature specimen, ×2; *d,* adult loop seen in transmitted light, ×2; *e,* view of reconstructed loop, approximately ×2 (Stehli, 1962).

Subfamily NUCLEATULINAE Muir-Wood, 1965

[Nucleatulinae Muir-Wood, 1965a, p. 772]

Description as for Dielasmininae but dental plates weakly developed or absent. *Lower Permian–Upper Triassic (Norian), ?Lower Jurassic.*

Nucleatula Bittner, 1888, p. 126 [**Rhynchonella retrocita* Suess, 1855b, p. 29; SD Hall & Clarke, 1894, p. 858]. Small, rounded pentagonal in outline, strongly biconvex, anterior commissure unisulcate, beak acute, incurved, beak ridges rounded, foramen minute, mesothyrid; septum not developed; loop about 0.5 valve length, acuminate, with anteroventrally directed, high vertical plate bearing spines. *Upper Triassic (Carnian, Norian):* eastern Alps.——Fig. 1346,*2a–f.* **N. retrocita* (Suess), Norian; *a–d,* dorsal, ventral, lateral, and anterior views, ×1.5 (Bittner, 1890); *e–f,* drawings of loop, ×1.5 (Bittner, 1888).

Arctothyris Dagys, 1965, p. 140 [**A. solitus;* OD]. Medium, oval in outline, biconvex, uniplicate; beak short, incurved; beak ridges rounded, foramen mesothyrid; cardinal process distinct, undivided; outer hinge plates horizontal, crural bases directed ventrally; crural plates envelop septum, forming septalium; septum low, very short; loop about 0.5 dorsal valve length. *Middle Triassic (Ladinian):* northeastern Siberia.——Fig. 1346,*1a–p.* **A. solitus; a–c,* dorsal, lateral, and anterior views, ×1; *d–p,* transverse serial sections 0.0, 0.5, 0.7, 1.0, 1.3, 1.5, 1.7, 2.0, 3.0, 4.0, 5.3, 9.1, 10.7 mm from first section, ×1 (Dagys, 1965; courtesy of the late A. S. Dagys).

Dinarella Bittner, 1892, p. 24 [**D. haueri;* OD]. Small, planoconvex, dorsal valve with anterior sulcus, anterior commissure unisulcate; beak acute, beak ridges angular, foramen small, possibly submesothyrid, dental plates weak; dorsal septum with possible septalium; loop acuminate with short, descending lamellae and long, vertical plate, directed ventrally. *Upper Triassic (Norian):* Europe (Dinarids).——Fig. 1346,*4a–e.* **D. haueri; a–d,* dorsal, ventral, lateral, and anterior views, ×2; *e,* loop, ×2 (Muir-Wood, 1965a).

Propygope Bittner, 1890, p. 210 [**Terebratula (Propygope) hagar;* OD]. Small, planoconvex to concavoconvex, dorsal valve with broad sulcus, anterior commissure unisulcate; beak suberect, foramen small, possible mesothyrid beak ridges angular;

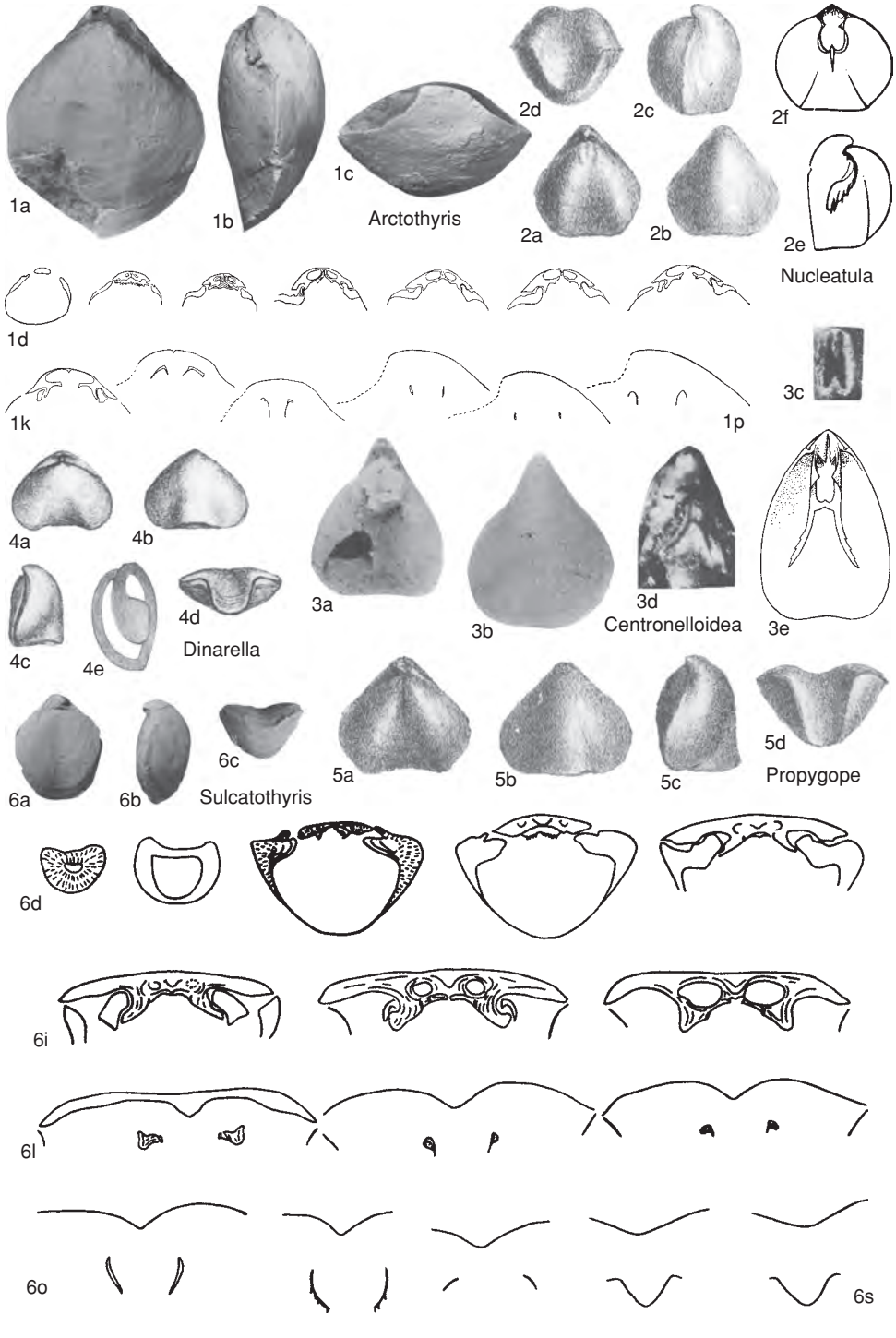

FIG. 1346. Dielasmatidae (p. 2036–2038).

no dental plates; dorsal septum strong, less than 0.5 valve length; loop almost ringlike, about 0.3 valve length. *Upper Triassic (Carnian–Norian), ?Lower Jurassic:* eastern Alps, Austria, Yugoslavia.——Fig. 1346,*5a–d. *P. hagar,* eastern Alps; *a–d,* dorsal, lateral, anterior, and ventral views, ×2 (Muir-Wood, 1965a).

Sulcatothyris Dagys, 1974, p. 176 [**S. tkhachensis;* OD] [=*Ninglangothyris* Jin & Fang, 1977, p. 60 (type, *N. subcircularis,* OD)]. Small, planoconvex, dorsal valve with sulcus beginning at cardinal margin, anterior commissure unisulcate; beak short, beak ridges rounded, foramen mesothyrid, no dental plates; cardinal process low, bilobed; septum thick, short, septalium shallow; loop about 0.3 valve length, with subparallel descending lamellae and weakly arched, transverse band. *Upper Triassic (Carnian):* Alps, Carpathians, northwestern Caucasus, China (Yunnan).——Fig. 1346,*6a–s. *S. tkhachensis,* northwestern Caucasus; *a–c,* dorsal, lateral, and anterior views, ×1; *d–s,* transverse serial sections 0.0, 0.4, 1.4, 1.6, 2.0, 2.2, 2.6, 3.0, 3.2, 3.4, 3.6, 3.9, 4.4, 4.9, 5.1, 5.4 mm from first section, ×1 (Dagys, 1974; courtesy of the late A. S. Dagys).

Family HETERELASMINIDAE Licharew, 1956

[Heterelasminidae Licharew, 1956, p. 68]

No dental plates, adult loop deltiform, crura arising directly from crural plates; inner hinge plate perforate apically, free of valve floor and supported by crural plates, or separate, but obsolete between them and socket ridges in advanced genera. *Permian.*

Heterelasmina Likharev, 1939b, p. 120 [**Hemiptychina dieneri* Gemmellaro, 1899, p. 100; OD]. Small to medium, elongate oval, straight sided; planoconvex; smooth posteriorly with a few plicae developing anteriorly; anterior commissure emarginate, uniplicate to sulciplicate; foramen permesothyrid, strongly labiate; pedicle collar present; hinge plates obsolete, crura arising from crural plates. *Permian (Guadalupian–Lopingian):* Sicily, northern Caucasus, Tajikistan, Mongolia, Pakistan, Laos.——Fig. 1347,*4a. *H. dieneri* (Gemmellaro); interior of dorsal valve, ×1 (Gemmellaro, 1899). ——Fig. 1347,*4b–e. H. genuflexa* Gemmellaro, Palermo, Sicily; *b–c,* dorsal and ventral views; *d,* lateral view; *e,* interior of dorsal valve, ×1.5 (Stehli, 1962).

Amurothyris Koczyrkevicz, 1976, p. 77 [**A. costulata;* OD]. Small, oval, anterior commissure rectimarginate, costellate, foramen permesothyrid; hinge plate obsolete, crura rising from crural plates. *Permian (Capitanian):* Russia (Primorya).——Fig. 1347,*6a–j. *A. costulata; a–c,* dorsal, lateral, and anterior views, ×1.5 (Koczyrkevicz, 1976); *d–j,* serial transverse sections 1.2, 1.8, 2.0, 2.4, 2.7, 2.9, 3.2 mm from first section, ×1 (adapted from Koczyrkevicz, 1976).

Gundarolasmina Smirnova & Grunt, 2003, p. 139 [**G. gundarensis;* OD]. Medium size, elongate oval, smooth or with single fold, anterior commissure broadly uniplicate; outer hinge plates discrete, slender, short; crural plates attached to dorsal valve for a long distance, crural outgrowths connected, loop ringlike, 0.3 dorsal valve length; descending branches connecting to crural plates. Differs from *Heterelasmina* in larger size, plications, slender beak, ringlike loop, and connected descending branches. *Permian (Roadian):* Tajikistan (Darvaz).——Fig. 1347,*2a–d. *G. gundarensis;* dorsal, lateral, and anterior views of holotype, PIN 4104/619, ×1; d, reconstruction of loop, ×2 (Smirnova & Grunt, 2003).

Mimaria Cooper & Grant, 1976b, p. 2,907 [**Dielasma lepton* Gemmellaro, 1894, p. 5; OD]. Medium size, oval to elongate triangular, ventral valve concave, dorsal valve strongly convex, beak small with strong beak ridges, foramen permesothyrid, anterior commissure sulciplicate, lateral commissure ventrally directed, hinge plates obsolete, crural bases attached directly to socket ridges, loop short, with strongly angular, delicate transverse ribbon. *Permian (Guadalupian):* Sicily.——Fig. 1347,*1a–c. *M. lepton* (Gemmellaro), Sosio Formation, Sicily; dorsal, lateral, and anterior views, ×1 (Cooper & Grant, 1976b).

Permicola Koczyrkevicz, 1976, p. 75 [**P. plicatus;* OD]. Small, oval, folded anteriorly, anterior commissure truncate or parasulcate; foramen mesothyrid; hinge plates obsolete; crural plates short, separated from descending lamellae, loop with strongly recurved band. *Permian (Capitanian):* Russia (Primorya).——Fig. 1347,*7a–n. *P. plicatus; a–c,* dorsal, lateral, and anterior views, ×2 (Koczyrkevicz, 1976); *d–n,* serial transverse sections 0.4, 0.6, 0.7, 1.25, 1.4, 1.5, 1.6, 1.8, 2.2, 2.5, 3.0 mm from first section, ×1.5 (adapted from Koczyrkevicz, 1976).

Pseudolabaia Jin & Ye in Jin & others, 1979, p. 130 [**P. curvatum;* OD]. Medium size, elongate oval, subequally biconvex, smooth; anterior commissure sulciplicate, foramen epithyrid, outer hinge plates broad and flattened; crural plates long; loop short, with highly arched and strongly recurved transverse band. *Permian (Lopingian):* southern China.—— Fig. 1347,*5a–k. *P. curvatum; a–c,* dorsal, ventral, and lateral views, ×1; *d–k,* serial transverse sections 1.9, 2.8, 3.5, 4.7, 7.1, 8.0, 9.6, 12.1 mm from ventral umbo, ×1 (Jin & others, 1979).

Qinglongia Liao, 1980, p. 270 [**Q. zhongyingensis;* OD] [=*Chuanyanella* Zhu, Zeng, & Chen in Zeng, Chen, & Chang, 1986, p. 61 (type, *C. chuanyanensis,* OD); *Zhongliangshania* Shen, He, & Zhu, 1992, p. 191 (type, *Z. zhongliangshanensis,* OD)]. Small to medium size, elongate oval, foramen permesothyrid, anterior commissure bisulcate; plicate; hinge plates divided, crural plates strong, supporting descending lamellae, transverse band of loop recurved strongly. *Permian (Changhsingian):*

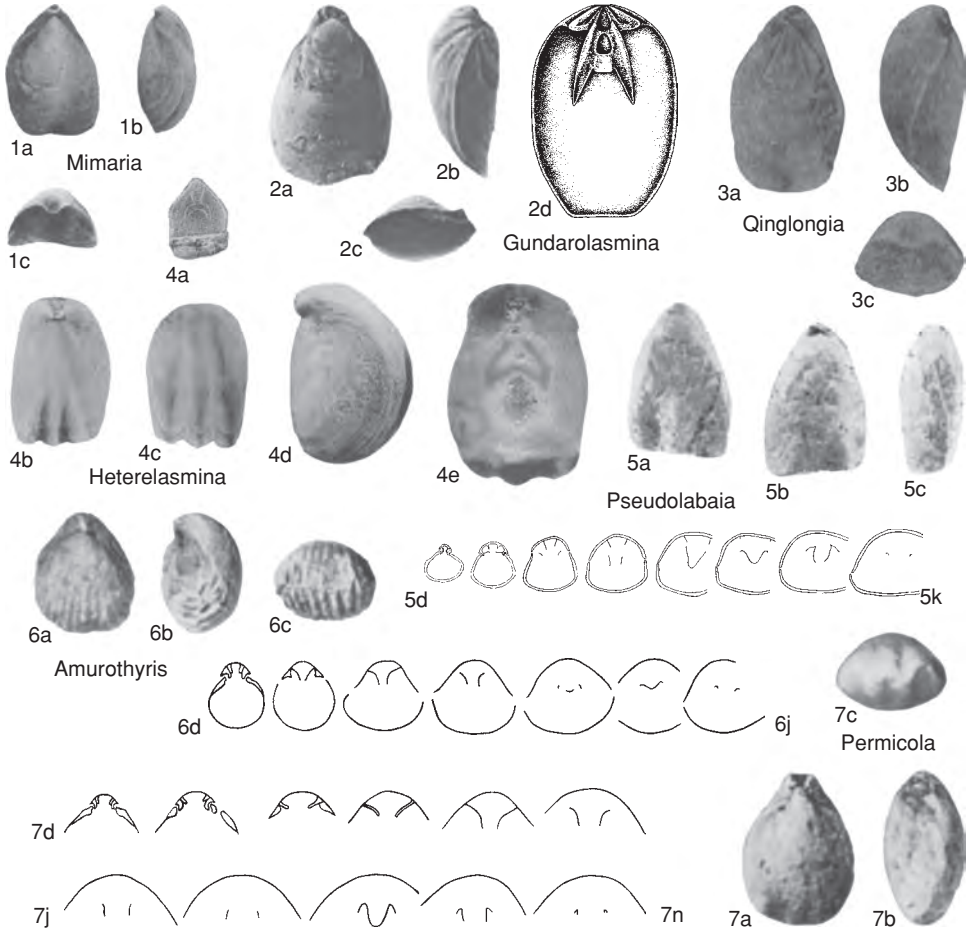

FIG. 1347. Heterelasminidae (p. 2038–2039).

southwestern China (western Guizhou Province). ——FIG. 1347,*3a–c. *Q. zhongyingensis,* Zhongying, Qinglong; dorsal, lateral, and anterior views of holotype, NIGP 43801, ×2 (Liao, 1980).

Family BEECHERIIDAE Smirnova, 2004

[Beecheriidae SMIRNOVA, 2004, p. 166] [type genus, *Beecheria* HALL & CLARKE, 1893, p. 300]

Shell smooth, dental plates present; outer hinge plates present only at early growth stages, inner hinge plates uniting to form septalium or joining separately on floor of valve, or forming entire plate raised above valve floor; crural plates attached to dorsal valve, crura developing from crural plates; loop narrow. Differs from Dielasmatidae in weakly developed, outer hinge plates, crural plates attached to floor of dorsal valve, and crura developing from crural plates. *Carboniferous (Lower Mississippian)–Permian (Lopingian).*

Beecheria HALL & CLARKE, 1893, p. 300 [**B. davidsoni;* OD]. Small to large, elongate, subspatulate; dorsibiconvex; anterior commissure uniplicate; foramen small, permesothyrid, labiate; outer hinge plates attached to valve floor and supporting crural bases, inner hinge plates convergent with valve floor or low septum, forming a shallow chamber; loop long, narrow, with broad crural processes, transverse band angularly arched and recurved. *Carboniferous (Lower Mississippian)–Permian (Lopingian):* cosmopolitan.——FIG. 1348,*1a–k. *B. davidsoni,* Windsor Series, Nova Scotia; *a,* close-up view of calcite-encrusted loop, approximately ×2 (Stehli, 1956a); *b–k,* transverse

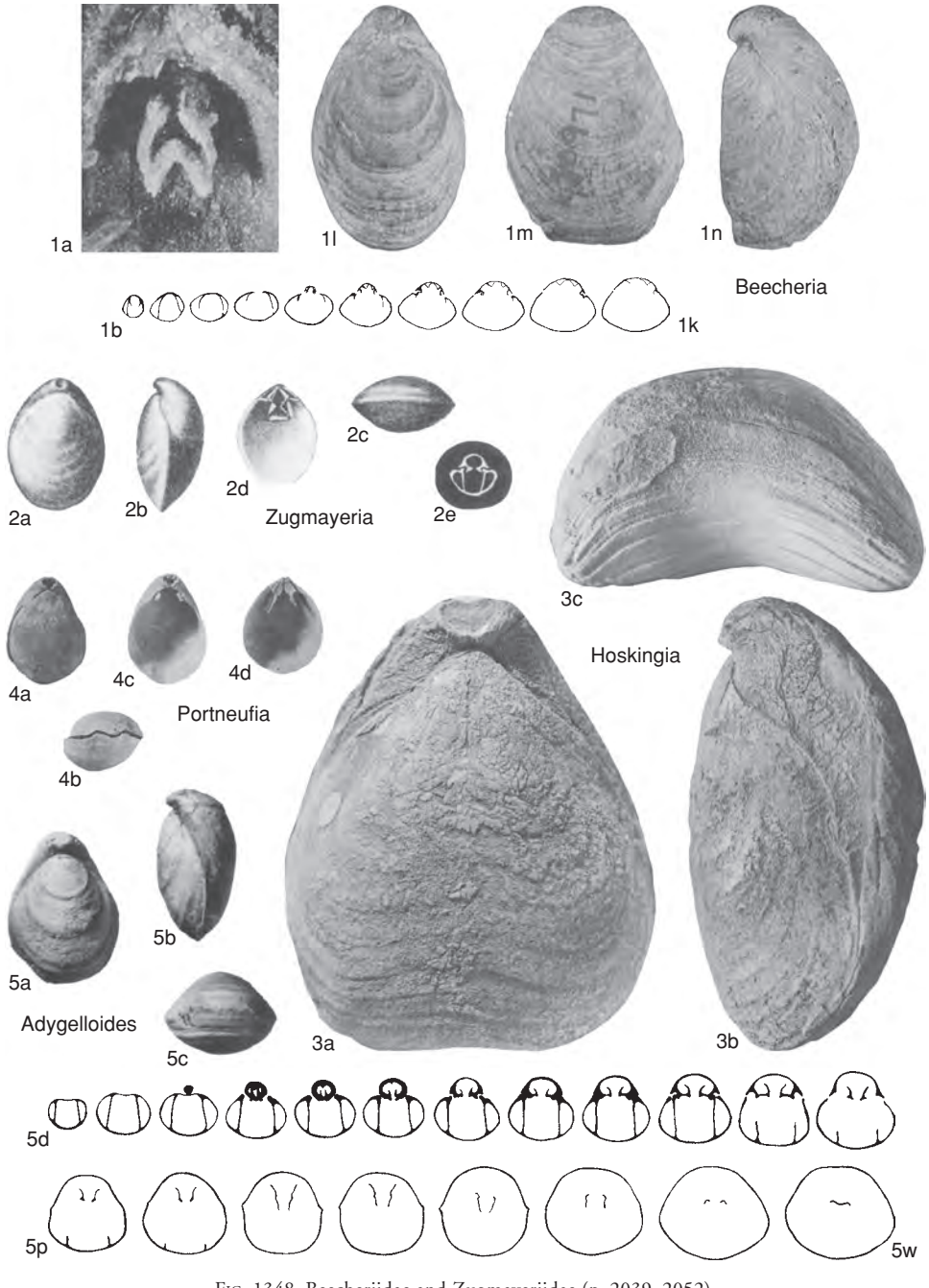

FIG. 1348. Beecheriidae and Zugmayeriidae (p. 2039–2052).

serial sections 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5 mm from first section, ×1 (Campbell, 1965).——FIG. 1348,*1l–n. B. bovidens* MORTON, Pennsylvanian, Kansas City, Missouri, USA; dorsal, ventral, and lateral views, ×1.5 (Stehli, 1956a).

Hoskingia CAMPBELL, 1965, p. 52 [**Dielasma trigonopsis* HOSKING, 1933, p. 44; OD]. Medium to very large, unisulcate to sulciplicate; deltidial plates conjunct; foramen labiate; dental plates and pedicle collar present; inner hinge plates uniting on valve

floor to form a long, sessile septalium. *Permian (Cisuralian):* Western Australia.——Fig. 1348,*3a–c. *H. trigonopsis* (Hosking); dorsal, lateral, and anterior views of lectotype, G.S.W.A. 1/4950, ×1 (Campbell, 1965).

Family GILLEDIIDAE Campbell, 1965

[Gilledíidae Campbell, 1965, p. 70]

Small to large; elongate oval to subpentagonal in outline; deltidial plates conjunct; foramen commonly permesothyrid, labiate; no dental plates; outer hinge plates attached to socket ridges or directly to valve floor; inner hinge plates absent, or small and joined directly to floor of valve along their inner edges, or broad and uniting to form a sessile septalium. *Carboniferous (Tournaisian)–Upper Triassic.*

Subfamily GILLEDIINAE Campbell, 1965

[Gilledíinae Campbell, 1965, p. 70]

Smooth or plicate. *Carboniferous (Tournaisian)–Permian (Lopingian).*

Gilledia Stehli, 1961a, p. 451 [**Terebratula cymbaeformis* Morris, 1845, p. 278; OD]. Small to large, surface sometimes ornamented with faint, wavy costae; anterior commissure uniplicate to bisulcate; pedicle collar present; outer hinges usually fused to inner socket ridges but may be joined to shell wall anteriorly; inner hinge plates discrete and joined to shell wall, crural points long. *Permian (Cisuralian):* Australia, New Zealand.——Fig. 1349,*1a–d. *G. cymbaeformis* (Morris); dorsal, ventral, lateral, and anterior views, ×1 (Stehli, 1961a).——Fig. 1349,*1e. G. homevalensis* Campbell; reconstruction of dorsal valve interior, ×1 (Campbell, 1965).

Aneuthelasma Cooper & Grant, 1976b, p. 2,906 [**A. amygdalinum;* OD]. Small, elongate oval, profile lenticular, anterior commissure rectimarginate to slightly uniplicate, beak erect with prominent ridges, foramen circular, slightly labiate, deltidial plates conjunct, visible; pedicle collar present; no cardinal process, inner plates nearly erect, loop narrow, reaching 0.5 valve length, with subparallel, descending branches and broadly bowed, transverse ribbon. *Permian (Capitanian):* USA (Texas).——Fig. 1350,*1a–c. *A. amygdalinum; a–b,* dorsal and lateral views of holotype, USNM 153374a, ×2; *c,* interior of dorsal valve, ×2 (Cooper & Grant, 1976b).

Balanoconcha Campbell, 1957, p. 86 [**B. elliptica;* OD]. Medium size, external homeomorph of *Dielasma,* but without dental plates. *Carboniferous (Tournaisian):* eastern Australia.——Fig. 1350,*3a–c. *B. elliptica;* dorsal, ventral, and anterior views of holotype, U.N.E. F. 2825, ×1 (Campbell, 1957).

Camarelasma Cooper & Grant, 1976b, p. 2,900 [**C. neali;* OD]. Small, elongate oval, dorsibiconvex, rectimarginate to gently uniplicate, beak strongly labiate, deltidial plates conjunct, concealed under beak lip, inner hinge plates attached to median septum and forming a shallow chamber, loop narrow with subparallel sides, extending about 0.5 dorsal valve length. *Permian (Artinskian):* USA (Texas).——Fig. 1349,*3a–e. *C. neali,* Leonardian; *a–c,* dorsal, lateral, and anterior views of holotype, USNM 153381c, ×2; *d,* ventral valve interior, ×2; *e,* dorsal valve interior, ×2 (Cooper & Grant, 1976b).

Lowenstamia Stehli, 1961b, p. 460 [**L. texana;* OD]. Small, smooth, biconvex, elongate oval; sulcus well marked on anterior part of ventral valve, anterior margin uniplicate; beak strong, with permesothyrid labiate foramen; outer hinge plates small to obsolete, inner hinge plates short, separate, and becoming free of valve floor anteriorly; crural bases troughlike. *Permian (Asselian–Sakmarian):* USA (Texas).——Fig. 1349,*4a–d. *L. texana,* Wolfcampian; *a–c,* dorsal, ventral, and lateral views, ×2; *d,* reconstruction of dorsal valve interior, C.I.T. 5965, approximately ×2 (Stehli, 1961b).

Maorielasma Waterhouse, 1964, p. 175 [**M. imperatum;* OD]. Large, anterior commissure rectimarginate or weakly uniplicate; pedicle collar thick, outer hinge plates narrow; inner hinge plates broad, converging on valve floor to form a V-shaped, sessile, long septalium. *Permian (Guadalupian–Lopingian):* New Zealand, Australia.——Fig. 1349,*2a–b. *M. imperatum,* New Zealand; dorsal and lateral views of internal mold, NZGS BR896, ×1 (Waterhouse, 1964).——Fig. 1349,*2c–d. M. globosum,* Queensland; dorsal and lateral views, ×1 (Campbell, 1965).

Pyandzhelasma Smirnova & Grunt, 2002, p. 41 [**Hemiptychina juresanensiformis* Likharev, 2002, p. 41; OD]. Medium to large, biconvex, rounded pentagonal or ovate with a narrow ventral sulcus; pedicle collar present; outer hinge plates wide, steeply inclined; septal plates attached to valve floor, septalium deep, supporting hinge plates throughout its length; crural bases indistinct; crural processes well developed; loop narrow, transverse band widely trapezoidal. *Permian (Roadian):* northern Pamirs, Tajikistan.——Fig. 1349,*5a–v. *P. juresanensiformis* (Licharev); *a–c,* dorsal, lateral, and anterior views of holotype, TsNIGR 23/340, ×1; *d–t,* transverse serial sections 0.5, 1.3, 1.9, 2.8, 3.9, 4.4, 4.8, 6.1, 6.8, 8.3, 8.5, 8.9, 9.9, 10.4, 12.2, 12.4, 12.7 mm from ventral umbo, ×1; *u–v,* reconstructions of dorsal valve interior, ×2 (Smirnova & Grunt, 2002).

Tacinia Glushenko, 1975, p. 116 [**T. modesta* Glushenko, 1975, p. 117; OD]. Medium size, moderately biconvex, anterior commissure parasulcate, with two short folds on ventral valve; crural bases crescentic, outer hinge plates short, inner hinge plates grooved, attached to median septum; loop deltiform. *Permian (Cisuralian):* Ukraine (Donetz basin).——Fig. 1350,*2a–c. *T. modesta;* dorsal, ventral, and lateral views, ×2 (Glushenko, 1975).

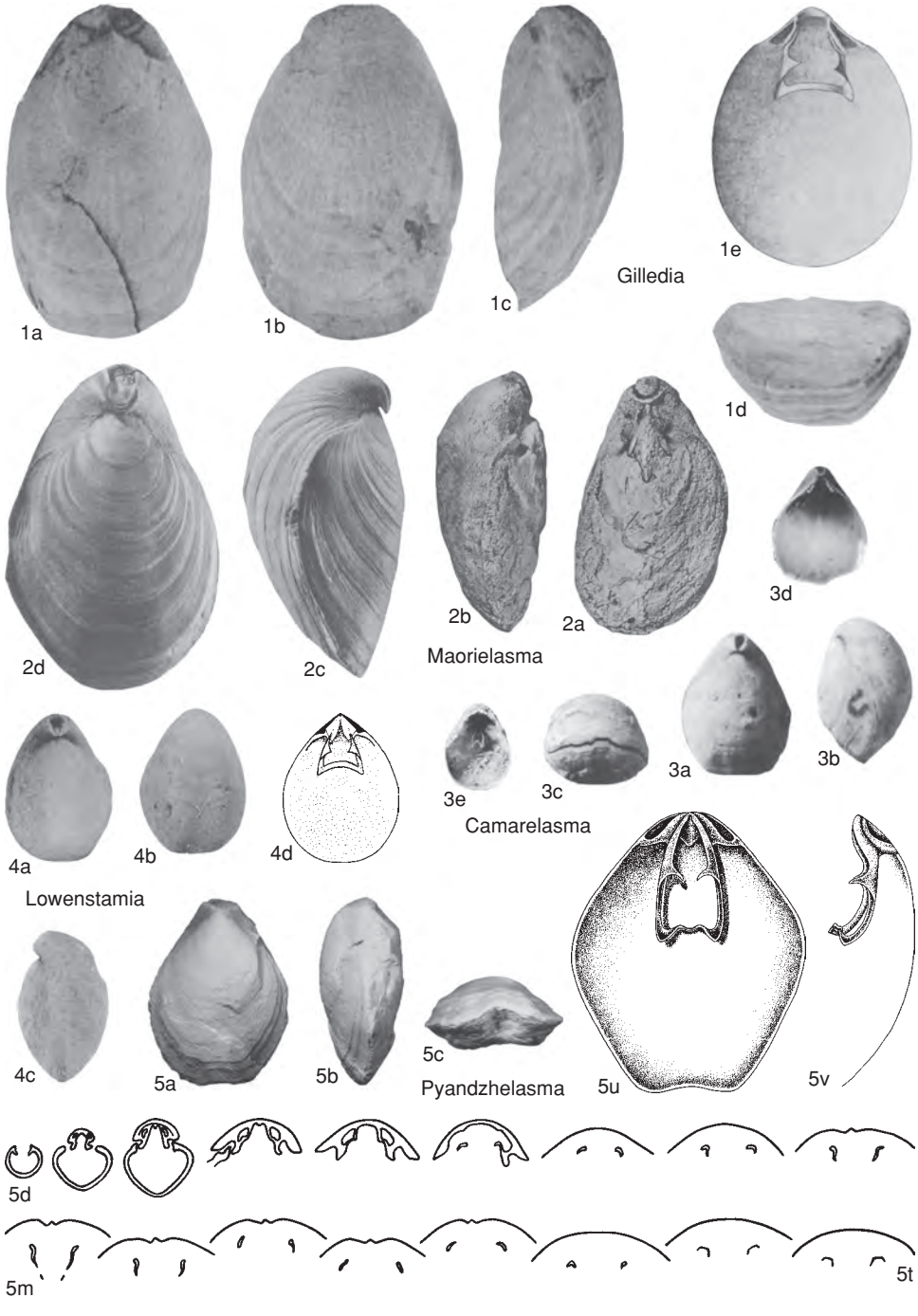

FIG. 1349. Gillediidae (p. 2041).

Subfamily HEMIPTYCHININAE Campbell, 1965

[Hemiptychininae Campbell, 1965, p. 103]

Anterior margins commonly multiplicate. *Permian (Guadalupian)–Upper Triassic.*

Hemiptychina Waagen, 1882, p. 335 [**Terebratula himalayensis* Davidson, 1862, p. 27; OD] [=*Morrisina* Grabau, 1931c, p. 97 (type, *Hemiptychina sparsiplicata* Waagen, 1882, p. 366); *Jisuina* Grabau, 1931c, p. 105 (type, *J. elegantula* Grabau, 1931c, p. 106, OD)]. Medium size, biconvex to subglobular; dorsal valve and some ventral valves geniculate anteriorly; anterior commissure rectimarginate; strongly plicate anteriorly; cardinal process shelflike, fulcral plates broad, conjunct with narrow, outer hinge plates, or directly connected with crural bases; inner hinge plates short, joining valve floor independently along their inner edges; crura short, conjunct with outer hinge plates; descending lamellae narrow; transverse band gently bent to V-shaped. *Permian (Guadalupian–Lopingian):* Asia.——Fig. 1351,*1a–e.* **H. himalayensis* (Davidson), Salt Range, Pakistan; *a–d,* dorsal, ventral, lateral, and anterior views, ×1; *e,* interior of dorsal valve, approximately ×1.5 (Waagen, 1882).

Costoconcha Jin, Sun, & Ye in Jin & others, 1979, p. 193 [**C. zigaensis;* OD]. Medium size, oval to enlongate oval; biconvex; anterior commissure rectimarginate to slightly uniplicate; surface smooth posteriorly, with ornament of short, angular, or round costae anteriorly; beak incurved, foramen epithyrid; delthyrium covered by thick henidium; pedicle collar developed; dental plates absent; cardinal process gently arched, platelike; hinge plates divided; crural plates oblique, fused with valve floor or joining median septum to form septalium; loop short, deltiform, about 0.4 shell length; transverse band arched ventrally. *Upper Triassic:* China (Tibet, Qinghai, Sichuan).——Fig. 1351,*7a–m.* **C. zigaensis,* Tibet; *a–d,* dorsal, ventral, lateral, and anterior views, ×1 (Jin & others, 1979); *e–m,* serial transverse sections 2.95, 3.50, 4.05, 5.25, 5.95, 7.95, 9.05, 11.05, 11.65 mm from ventral umbo, ×1 (adapted from Jin & others, 1979).

Latiflexa Koczyrkevicz, 1984, p. 14 [**L. pentagona* Koczyrkevicz, 1984, p. 15; OD]. Small to medium, outline subpentagonal; ventral valve geniculate; folded anteriorly, parasulcate anterior commissure; foramen epithyrid; outer hinge plates oblique, crura supported by separate inner hinge plates; loop short, with thin, transverse band. *Permian (Capitanian):* Russia (Primorya).——Fig. 1351,*2a–c.* **L. pentagona;* dorsal, lateral, and anterior views, ×1.5 (Koczyrkevicz, 1984).

Mongolina Grabau, 1931c, p. 102 [**M. subdieneri;* OD]. Small, biconvex, strongly plicate anteriorly; septal plates joining valve floor, loop deltiform. *Permian (Guadalupian):* Mongolia.——Fig. 1351,*4a–o.* **M. subdieneri; a–c,* dorsal, lateral, and anterior views, ×2 (Stehli, 1962); *d–o,* transverse serial sections 0.0, 1.1, 1.8, 2.1, 3.0, 3.7, 3.9, 5.1, 5.6, 6.7, 8.4, 8.7 mm from first section (Smirnova & Grunt, 2001).

Parahemiptychina Chen & others, 1986, p. 77 [**P. hemiptyca;* OD]. Small to medium, oval to subtriangular to subpentagonal in outline, ventribiconvex, smooth in early stages but becoming strongly plicate anteriorly; anterior commissure rectimarginate to weakly unisulcate, foramen permesothyrid, no cardinal process, hinge plates discrete, crural plates inclined and reaching floor of valve; median ridge absent or raised in wide, deep septalium; loop short, transverse band with high arch. *Upper Triassic:* China (Tibet, Sichuan).——Fig. 1351,*5a–j.* **P. hemiptyca; a–d,* dorsal, ventral, lateral, and anterior views of holotype, SC245, ×1; *e–j,* serial transverse sections 1.5, 2.6, 4.0, 5.9, 8.5,

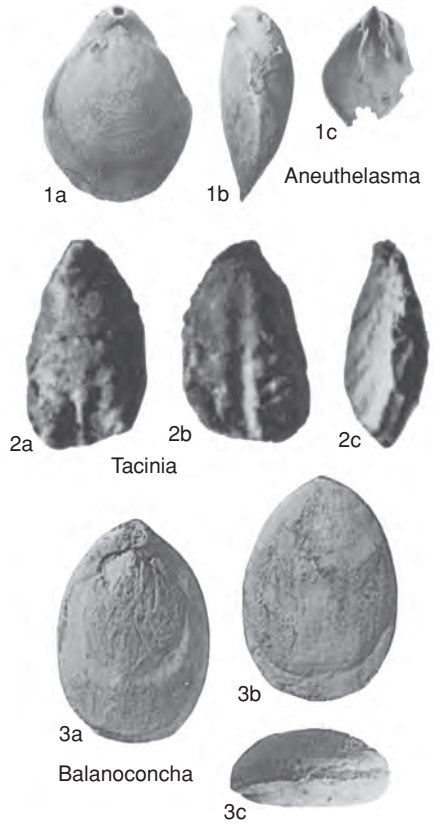

Fig. 1350. Gillediidae (p. 2041).

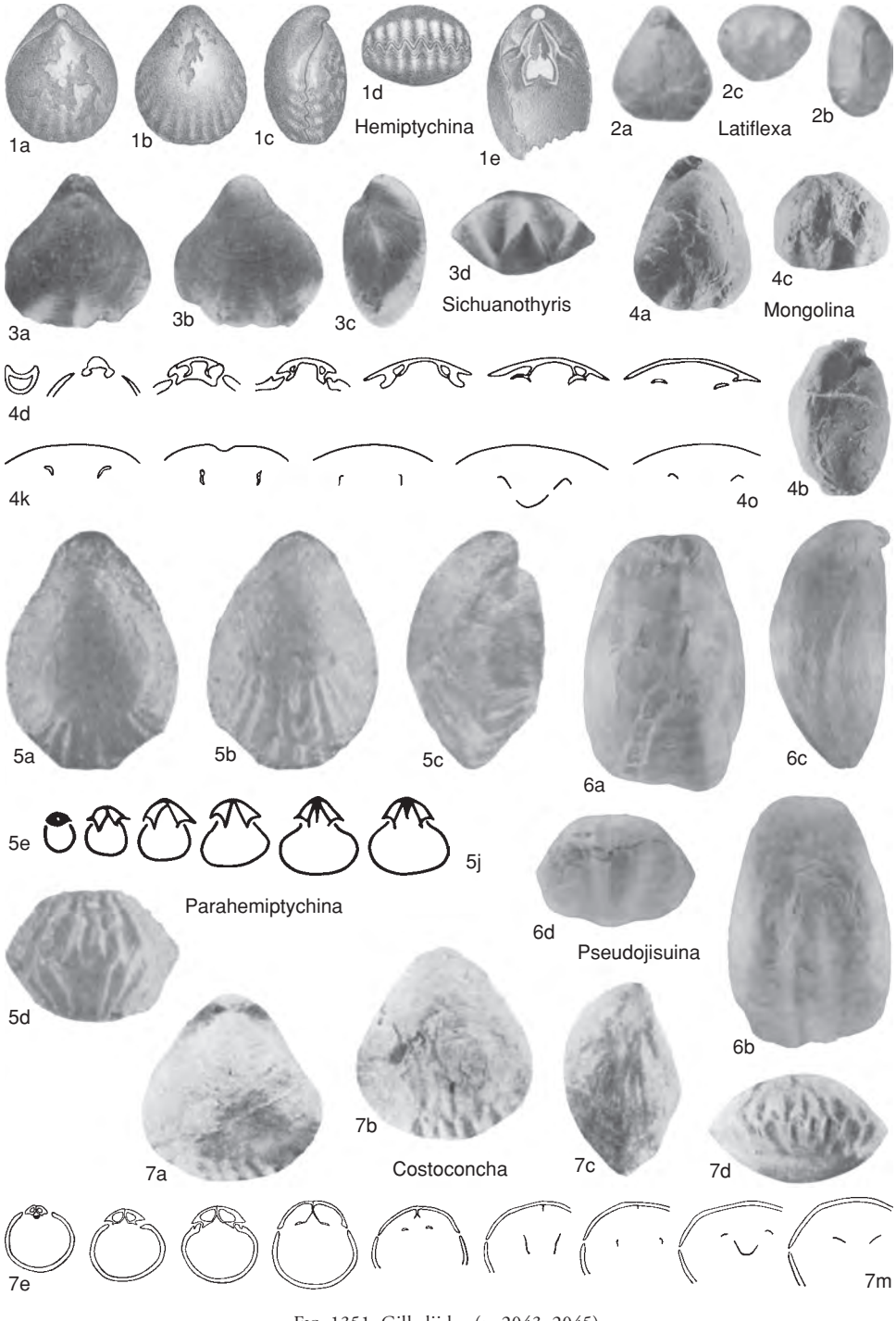

FIG. 1351. Gillediidae (p. 2043–2045).

11.7 mm from ventral umbo, ×1 (Chen & others, 1986).

Pseudojisuina Liang, 1990, p. 416 [493] [**P. lengwuensis* Liang, 1990, p. 417; OD] [=*Lengwuella* Liang, 1990, p. 419 (type, *L. spadeformis,* OD); *Phyllolasma* Liang, 1990, p. 426 (type, *P. lamina,* OD)]. Medium to large; elongate oval; anterior commissure rectimarginate to sulciplicate; lateral commissure moderately sinuate; pedicle collar strong; outer hinge plates wide, joined to inner socket ridges; inner hinge plates forming short, sessile septalium; crura short; crural processes long; loop with high, V-shaped, transverse band. *Permian (Guadalupian–Lopingian):* southern China.——Fig. 1351,*6a–d. *P. lengwuensis;* dorsal, ventral, lateral, and anterior views, ×1 (Liang, 1990).

Sichuanothyris Shen, He, & Zhu, 1992, p. 191 [*?*Notothyris dapaichongensis* Liao & Meng, 1986, p. 89; OD]. Medium to large, elongate oval; foramen epithyrid, sulcus on anterior half of ventral valve, bounded by parallel plicae; inner hinge plates converging medially on floor. *Permian (Changhsingian):* southern China.——Fig. 1351,*3a–d. *S. dapaichongensis* (Liao & Meng); dorsal, ventral, lateral, and anterior views, ×1.5 (Liao & Meng, 1986).

Family PSEUDODIELASMATIDAE Cooper & Grant, 1976

[Pseudodielasmatidae Cooper & Grant, 1976b, p. 2,910]

Medium to small, commonly elongate oval; smooth or with anterior plication, foramen commonly mesothyrid, nonlabiate; no dental plates; outer hinge plates weakly developed or absent; no inner hinge plates; no crural plates or median septum; crural bases attached to socket plates; loop short with reduced crural processes; adult loop deltiform with complex developmental stages. *Carboniferous (Middle Pennsylvanian)–Permian.*

Pseudodielasma Brill, 1940, p. 317 [**P. perplexa;* OD]. Small, elliptical to oval, dorsibiconvex, sulcus bounded by low plicae in dorsal valve, anterior commissure paraplicate to biplicate; beak suberect, foramen circular, deltidial plates visible; folds arising near anterior; pedicle collar well developed; loop short (about 0.4 dorsal valve length); crural processes weak, transverse band with median angulation projecting anteriorly. *Permian (Wordian–Capitanian):* USA (Texas), Australia.——Fig. 1352,*1a–c. *P. perplexa,* Wordian, Texas; *a–b,* dorsal and anterior views of holotype, YPM 15278, ×3; *c,* close-up of loop, ×10 (Brill, 1940).——Fig. 1352,*1d–e. P. ovatum* Cooper & Grant, Wordian, Texas; interiors of ventral and dorsal valves, ×3 (Cooper & Grant, 1976b).

Fredericksolasma Smirnova, 2001a, p. 37 [**Hemiptychina pseudoelongata* var. *lata* Likharev, 1939b, p. 119; OD]. Small to medium, rounded or elongate oval, biconvex; rarely with shallow ventral sulcus; anterior commissure uniplicate; no cardinal process; outer hinge plate divided, narrow; socket ridges high; loop deltiform, short (less than 0.3 dorsal valve length); transverse band widely trapezoidal or rounded triangular. *Permian (Roadian):* Tajikistan, Pakistan, Austria.——Fig. 1353*a–nn. *F. lata* (Licharew), Tajikistan; *a–c,* dorsal, lateral, and anterior views, ×1; *d–t,* transverse serial sections of juvenile shell (length 5.5 mm), 0.0, 0.1, 0.2, 0.4, 0.6, 0.7, 0.8, 0.9, 1.1, 1.13, 1.18, 2.23, 2.3, 2.4, 2.5, 2.6, 2.7 mm from first section, ×1; *u–jj,* transverse serial sections of adult shell (length 14.5 mm), 0.0, 1.3, 2.1, 2.5, 2.8, 3.3, 3.6, 4.0, 4.2, 4.6, 5.0, 5.4, 6.0, 6.3, 6.6, 6.8 mm from first section, ×1; *kk–nn,* reconstructions of adult and juvenile loops, respectively, ×2 (Smirnova, 2001a).

Levenolasma Smirnova & Grunt, 2003, p. 138 [**L. concava;* OD]. Medium to large, elongate oval to subpentagonal in outline, ventral valve flat with elongate sulcus; anterior commissure uniplicate with a few small folds; outer hinge plates discrete, parallel to floor of dorsal valve; crural processes join to form high transverse band of short loop. *Permian (Roadian):* Sicily, Tajikistan (North Pamirs).——Fig. 1352,*5a–f. *L. concava,* Tajikistan; *a–d,* dorsal, ventral, lateral, and anterior views of holotype, PIN 4101/283b, ×1; *e–f,* reconstructions of loop and cardinalia, ×2 (Smirnova & Grunt, 2003).

?Marinurnula Waterhouse, 1964, p. 177 [**M. rugulata;* OD]. Medium size, elongate, nonplicate, anterior commissure uniplicate; cardinal process slightly striate; hinge plates diverging anteriorly; loop unknown. *Permian:* New Zealand, Australia.——Fig. 1352,*2a–b. *M. rugulata;* dorsal and lateral views of internal mold of holotype, GS4651[BR900], ×1 (Waterhouse, 1964).

Oligothyrina Cooper, 1956, p. 525 [**O. alleni;* OD]. Small, biconvex, anterior commissure weakly to strongly intraplicate; folds arising anterior to midlength; transverse band not projecting anteriorly. *Carboniferous (Middle Pennsylvanian)–Permian (Guadalupian):* USA.——Fig. 1352,*4a–d. *O. alleni; a–c,* dorsal, lateral, and anterior views of holotype, USNM 124409a, ×3; *d,* interior of dorsal valve, ×3 (Cooper, 1956).

Pleurelasma Cooper & Grant, 1976b, p. 2,922 [**P. costatum* Cooper & Grant, 1976b, p. 2,923; OD]. Medium size, oval, anterior commissure rectimarginate to slightly unisulcate; anterior multicostate; pedicle collar small; crural bases attached to strong socket ridges and attached to valve floor; loop triangular with median, angulated transverse ribbon. *Permian (Capitanian):* USA (Texas).——Fig. 1352,*3a–d. *P. costatum; a–c,* dorsal, lateral,

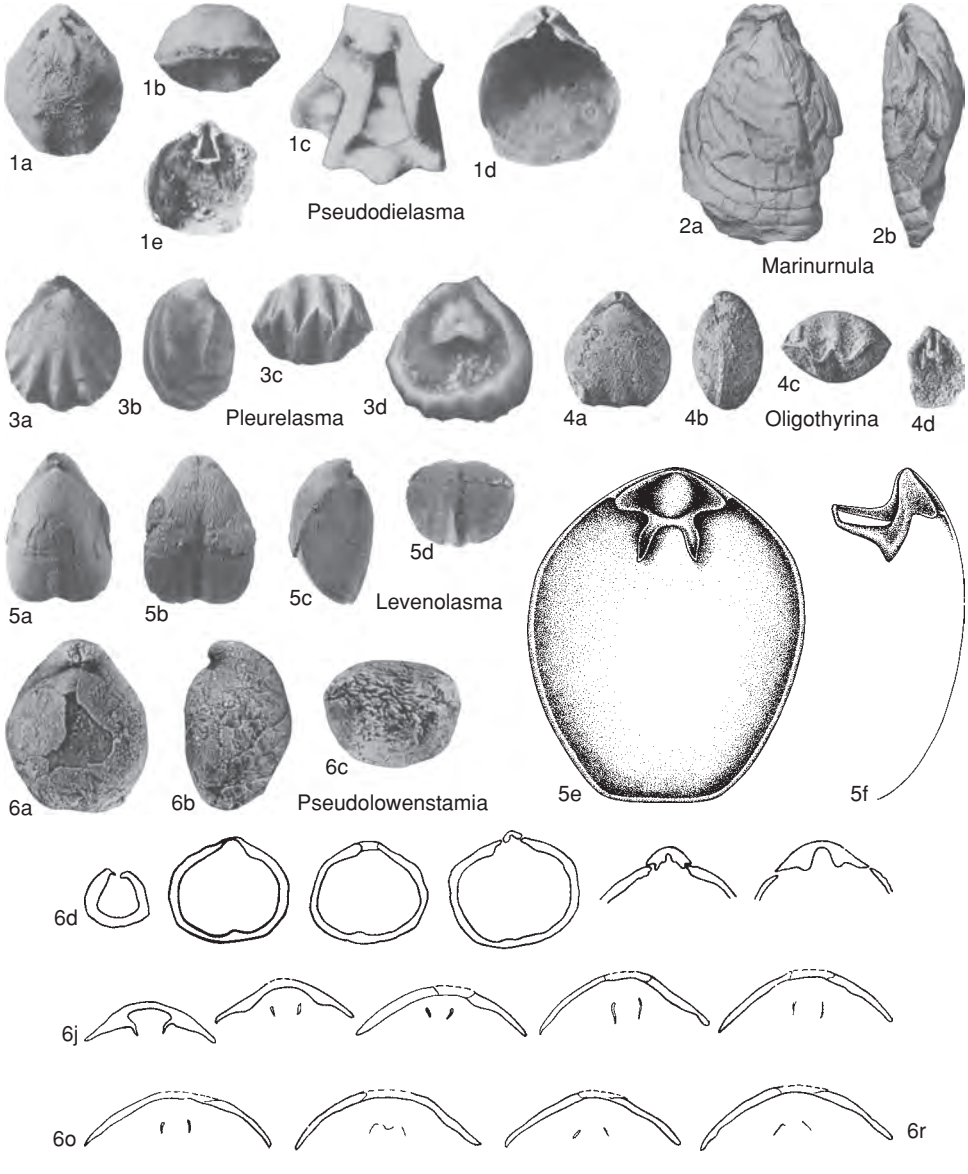

FIG. 1352. Pseudodielasmatidae (p. 2045–2046).

and anterior views, ×2; *d,* interior of dorsal valve, ×2 (Cooper & Grant, 1976b).

Pseudolowenstamia SUN, 1991b, p. 258 [**P. xizangensis;* OD]. Small, oval to subpentagonal, ventribiconvex; smooth; beak incurved, erect; foramen permesothyrid, symphytium present; anterior commissure rectimarginate to slightly uniplicate, no pedicle collar; crural bases attached to socket ridge, loop short, narrow. Differs from *Lowenstamia* in lacking hinge plates. *Permian (Cisuralian):* China (Tibet).——FIG. 1352,*6a–r.* **P. xizangensis; a–c,* dorsal, lateral, and anterior views, ×2; *d–r,* transverse serial sections 0.2, 1.6, 2.2, 2.6, 3.1, 3.5, 3.7, 3.8, 4.0, 4.4, 4.5, 4.6, 4.8, 5.0, 5.2 mm from ventral umbo, ×3 (Sun, 1991).

Family ANGUSTOTHYRIDIDAE Dagys, 1972

[Angustothyrididae DAGYS, 1972b, p. 51]

Small to large in size, biconvex or planoconvex; smooth or plicate anteriorly; no dental plates; foramen mesothyrid or per-

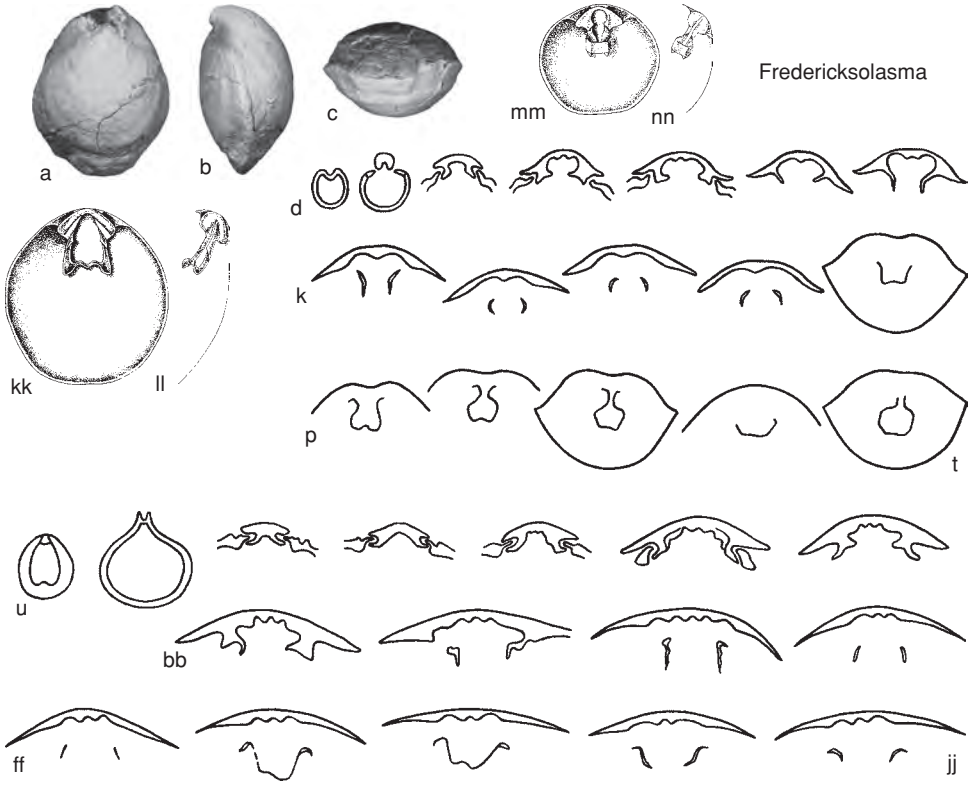

FIG. 1353. Pseudodielasmatidae (p. 2045).

mesothyrid; septum commonly developed; adult loop deltiform, usually with long flanges; transverse band derived from secondary elements developing from ventral part of vertical plate; during ontogeny loop passing through acuminate and possibly haptoid growth stages. *Permian (Capitanian)–Upper Triassic, ?Lower Jurassic.*

Angustothyris DAGYS, 1972b, p. 53 [**Waldheimia angustaeformis* BOECKH, 1873, p. 160; OD]. Small, unisulcate, biconvex with slightly flattened dorsal valve; beak short with rounded ridges, foramen mesothyrid; pedicle collar distinct; narrow outer hinge plates joined to high inner socket ridges; crural bases indistinct; no cardinal process; crural plates supported by thin septum forming septalium; loop about 0.5 dorsal valve length, with high, arched transverse band. *Middle Triassic (Anisian):* Alps, Carpathians, Balkans, Crimea, northwestern Caucasus.——FIG. 1354,*1a–t.* **A. angustaeformis* (BOECKH), northwestern Caucasus; *a–c,* dorsal, lateral, and anterior views, ×2 (Dagys, 1972b); *d–h,* reconstructions of loop stages of juvenile specimens, ×5; *i–t,* serial transverse sections 0.0, 0.7, 1.2, 1.6, 1.85, 2.1, 2.3, 2.8, 3.6, 4.3, 4.7, 5.1 mm from first section, ×2 (Popiel-Barczyk & Senkowiczowa, 1983).

Caucasothyris DAGYS, 1974, p. 192 [**C. angustiplicatus;* OD]. Small, plicosulcate, planoconvex, anterior commissure parasulcate; beak short, with rounded ridges, foramen mesothyrid; pedicle collar short; cardinal process low, laminated; short crural plates lie in commissural plane and join septum without forming septalium; septum high, long (up to 0.6 dorsal valve length); loop about 0.5 dorsal valve length, with high, arched transverse band. *Upper Triassic (Norian):* northwestern Caucasus.——FIG. 1355,*3a–d.* **C. angustiplicatus; a–c,* dorsal, ventral, and anterior views, ×2; *d,* reconstruction of loop, ×2.5 (Dagys, 1974).

Cubanothyris DAGYS, 1959a, p. 35 [**C. elegans* DAGYS, 1959a, p. 36; OD]. Small to medium size, thick shelled, biconvex, anterior commissure rectimarginate; beak thick, incurved, with rounded ridges, foramen mesothyrid; pedicle collar present; outer hinge plates narrow, septalium deep, septum short; loop acuminate, with vertical plate expanding ventrally. *Upper Triassic (Norian–Rhaetian):* Crimea, northwestern Caucasus, Pamir.——FIG.

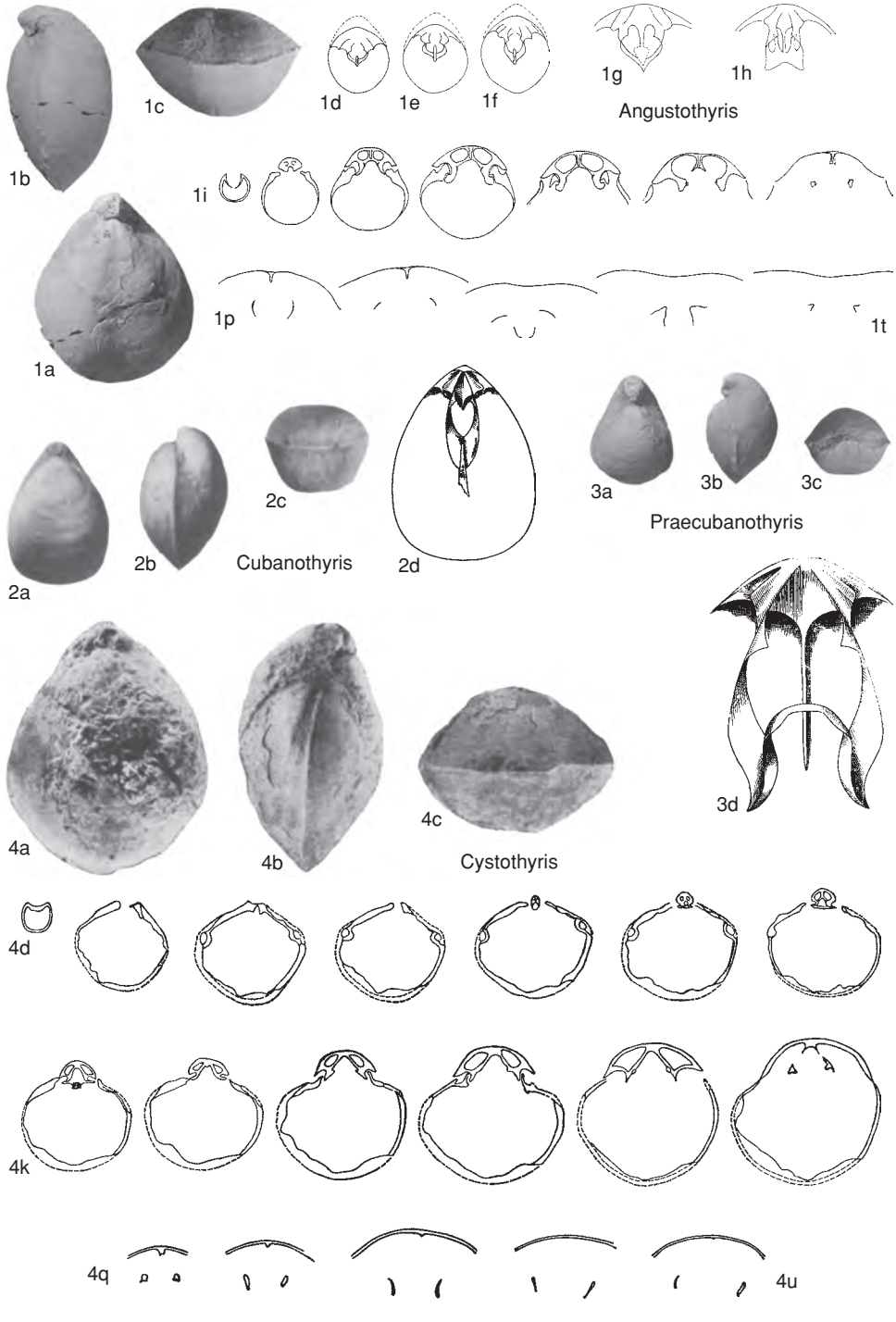

FIG. 1354. Angustothyrididae (p. 2047–2050).

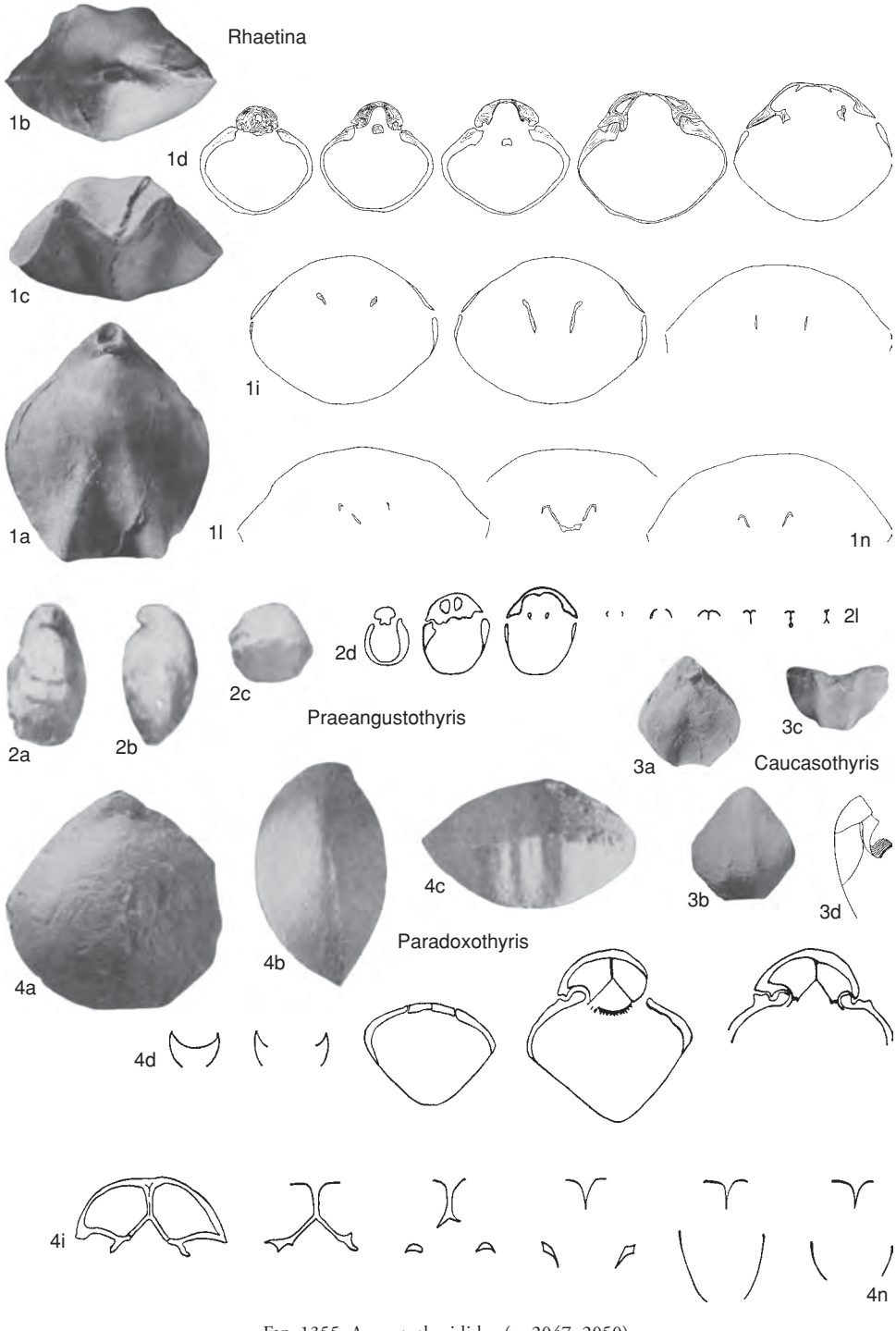

FIG. 1355. Angustothyrididae (p. 2047–2050).

1354,*2a–d.* **C. elegans,* northwestern Caucasus; *a–c,* dorsal, lateral, and anterior views, ×1 (Dagys, 1959a); *d,* reconstructed loop, ×2 (Dagys, 1974).

Cystothyris Sun Dong-Li, 1981, p. 223 [**C. zigaensis;* OD]. Large, oval, biconvex, beak short, erect, projecting over dorsal beak; beak ridges rounded, anterior commissure rectimarginate; foramen large, epithyrid, delthyridium concealed; pedicle collar short, dental plates retrograde, very short, resembling cystiform sacs in beak ridges; teeth thin; cardinal process arched with comblike surface; outer hinge plates very short, fused with inner socket ridges and crural plates, oblique and attached to valve floor or septum; inner socket ridges high, crural bases carinate, close to inner socket ridges and projecting ventrally; crura of *Rhaetina* type; loop short. Differs from *Rhaetina* in possession of cystiform sacs. *Upper Triassic:* China (Tibet).——Fig. 1354,*4a–u.* **C. zigaensis; a–c,* dorsal, lateral, and anterior views, ×1; *d–u,* serial transverse sections 0.7, 2.8, 3.4, 3.9, 4.0, 4.1, 4.3, 4.4, 4.7, 5.6, 6.5, 7.0, 7.3, 8.0, 9.3, 10.0, 10.7, 11.0 mm from ventral umbo, ×1 (Sun Dong-Li, 1981).

Paradoxothyris Xu, 1978, p. 302 [**P. cyclis;* OD] [=*Arcosarina* Jin, Sun, & Ye in Jin & others, 1979, p. 185 (type, *A. foliacea,* OD)]. Medium to large, circular, oval or subpentagonal in outline, biconvex; anterior commissure rectimarginate, uniplicate or sulciplicate; smooth, or with short plicae anteriorly; beak short, erect, beak ridges subangular, foramen mesothyrid or permesothyrid; delthyrium covered with deltidial plates or symphytium; pedicle collar present, cardinal process high and arched, or globular with comblike surface; hinge plates narrow, divided; inner socket ridges high, crural plates long, converging on septum; septalium wide and deep, septum about 0.5 dorsal valve length; crural bases trigonal, attaching ventrally to inner ends of outer hinge plates; crura short, crural processes high; loop short, narrowly trigonal, about 0.3 valve length; transverse band high and roundly arched. *Upper Triassic:* China (Tibet, Guizhou).——Fig. 1355,*4a–n.* **P. cyclis; a–c,* dorsal, lateral, and anterior views, ×1; *d–n,* serial transverse sections 0.0, 0.6, 0.8, 1.8, 2.0, 2.2, 2.6, 3.0, 4.1, 4.4, 4.6 mm from initial section, ×1 (Xu, 1978).

Praeangustothyris Koczyrkevicz, 1984, p. 18 [**P. faticana* Koczyrkevicz, 1984, p. 19; OD]. Small, elongate, anterior commissure rectimarginate or unisulcate; foramen mesothyrid; rudimentary dental plates present; hinge plates supported by septum, forming shallow, short septalium; loop acuminate, about 0.5 length of dorsal valve length. *Permian (Capitanian):* Russia (Primorya).——Fig. 1355,*2a–l.* **P. faticana; a–c,* dorsal, lateral, and anterior views, ×3 (Koczyrkevicz, 1984); *d–l,* serial transverse sections 0.0, 0.9, 1.25, 1.4, 1.85, 2.0, 2.3, 2.5, 2.65 mm from initial section, ×1 (adapted from Koczyrkevicz, 1984).

Praecubanothyris Dagys, 1974, p. 187 [**P. obtusus;* OD]. Small, biconvex, thick shelled; anterior commissure uniplicate; beak prominent, ridges rounded; foramen permesothyrid; pedicle collar present, outer hinge plates narrow, septalium deep, septum low, long; crural processes short; loop long (up to 0.6 dorsal valve length), with high, arched transverse band. *Middle Triassic (Anisian):* Alps, northwestern Caucasus, Pamir.——Fig. 1354,*3a–d.* **P. obtusus,* northwestern Caucasus; *a–c,* dorsal, lateral, and anterior views, ×1; *d,* reconstructed loop, ×2 (Dagys, 1974).

Rhaetina Waagen, 1882, p. 334 [**Terebratula gregaria* Suess, 1854, p. 42; OD] [=*Rhaetinopsis* Yang & Xu, 1966, p. 80 (type, *R. ovata*); *Sanqiaothyris* Yang & Yu, 1966, p. 83 (type, *S. elliptica*)]. Medium to large in size, smooth to biplicate, anterior commissure rectimarginate to sulciplicate; beak short, suberect, beak ridges rounded; foramen permesothyrid; cardinal process low; outer hinge plates inclined, crural plates usually connected to floor of dorsal valve without forming septalium; septum low or absent; loop short, arched (about 0.3 dorsal valve length), with moderately arched transverse band. *?Lower Triassic, Upper Triassic, ?Lower Jurassic:* North America (Idaho), *?Lower Triassic;* Alps, Balkans, Carpathians, Crimea, northwestern Caucasus, Iran, Afghanistan, Vietnam, China, USA (Nevada), *Upper Triassic;* northern Alps, *?Lower Jurassic.*——Fig. 1355,*1a–n.* **R. gregaria* (Suess), Rhaetian, eastern Alps; *a–c,* dorsal, anterior, and posterior views, ×1; *d–n,* serial transverse sections 3.35, 3.5, 3.8, 4.9, 5.5, 6.5, 6.9, 8.1, 8.9, 9.3, 9.5 mm from ventral umbo, ×2 (Pearson, 1977).

Family ANTEZEILLERIDAE Xu & Liu, 1983

[Antezeilleridae Xu & Liu, 1983b, p. 104]

Smooth, biconvex, anterior commissure rectimarginate, dental plates diverging laterally, no septum, loop short. *Triassic.*

Antezeilleria Xu & Liu, 1983b, p. 104 [**A. subrotata;* OD]. Medium; subcircular, foramen small, mesothyrid; hinge plates narrow, discrete; inner socket ridges high, crural plates reaching valve floor, septum absent, loop short, with flanges. *Lower Triassic:* China (Qinghai).——Fig. 1356,*3a–s.* **A. subrotata; a–c,* dorsal, lateral, and anterior views, ×1; *d–s,* serial transverse sections 0.2, 0.4, 0.8, 0.9, 1.1, 1.3, 1.5, 1.6, 1.75, 1.9, 2.2, 2.3, 2.5, 2.7, 2.8, 3.0 mm from ventral umbo, ×1 (Xu & Liu, 1983b).

Emeithyris Xu, 1978, p. 301 [**E. longmendongensis;* OD]. Medium, elongate oval, beak short, suberect; foramen epithyrid, delthyrium open; pedicle collar strongly developed; outer hinge plates very short, merging with inner socket ridges; crural plates subparallel, reaching valve floor; septum absent, crura thin; crural processes moderately high; descending branches of loop slender, transverse band unknown. [Serial transverse sections incomplete.]

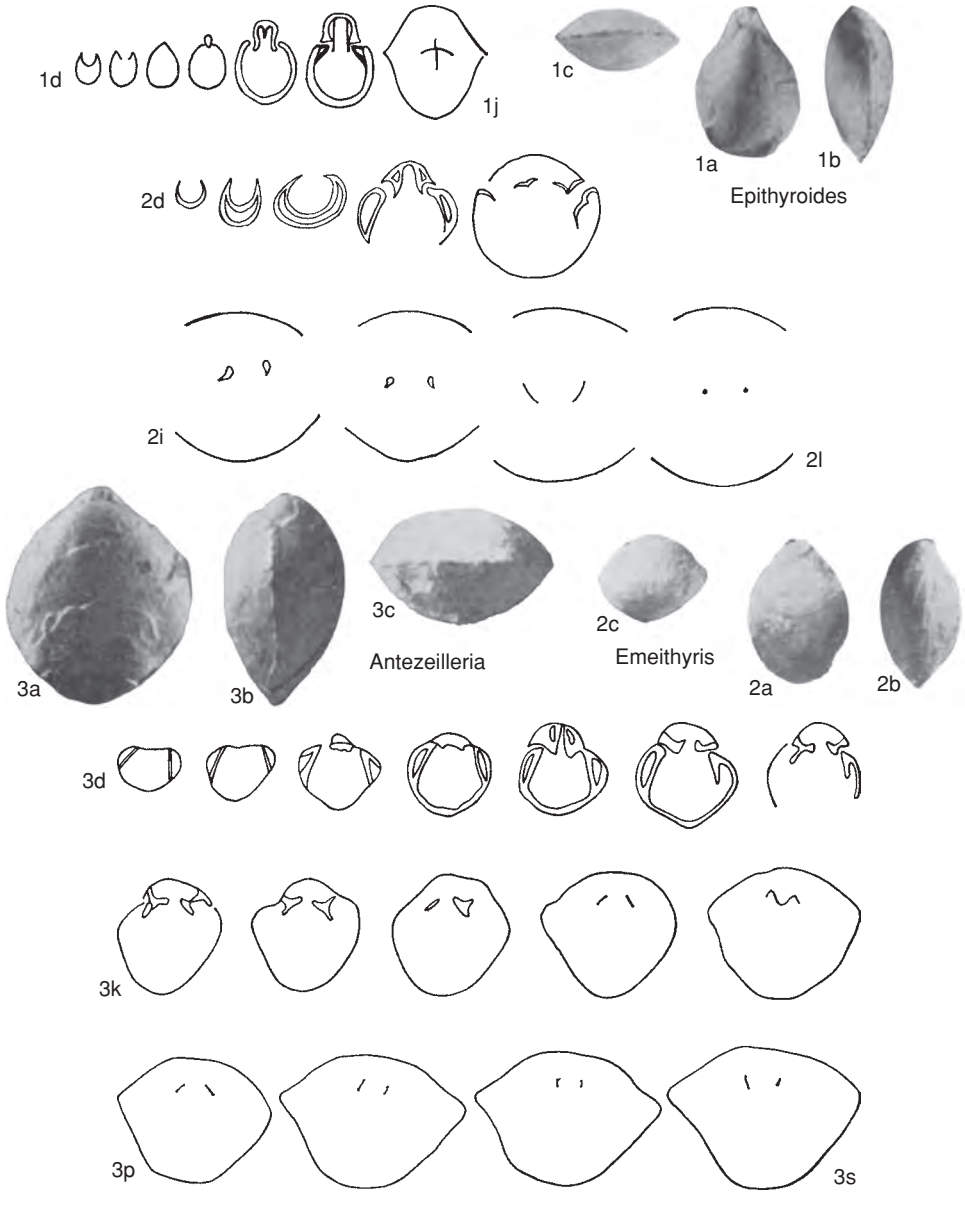

FIG. 1356. Antezeilleridae (p. 2050–2052).

Middle Triassic: China (Sichuan).——FIG. 1356,*2a–l. *E. longmendongensis; a–c,* dorsal, lateral, and anterior views, ×1; *d–l,* serial transverse sections 0.0, 0.3, 0.8, 1.9, 3.2, 4.05, 4.3, 4.45, 6.05 mm from initial section, ×1 (Xu, 1978).

?Epithyroides XU Qing-Jie, 1978, p. 306 [**E. zhonghuaensis;* OD]. Small, elongate oval; beak strongly incurved, beak ridges rounded; foramen elliptical, epithyrid; pedicle collar long; dental plates possibly retrograde, very short, divergent, beak cavities small, narrow; no cardinal process, hinge plates obscure, fused with high, inner socket ridges, and short crural plates extending vertically to valve floor; loop possibly acuminate (centronelliform),

with high vertical plate, 0.3 valve length; dorsal median ridge short, low. Differs from *Cubanothyris,* which lacks dental plates and has a wide, deep septalium. [The status of this genus is uncertain, as serial transverse sections are incomplete.] *Upper Triassic:* China (Tibet).——Fig. 1356,*1a–j. *E. zhonghuaensis; a–c,* dorsal, lateral, and anterior views, ×1; *d–j,* serial transverse sections 0.0, 0.2, 0.7, 1.3, 1.45, 1.6, 5.2 mm from initial section, ×1 (Xu Qing-jie, 1978).

Family ZUGMAYERIIDAE Dagys, 1963

[*nom. correct.* Pearson, 1977, p. 35, *pro* Zugmayeridae Dagys, 1963, p. 71]

Shell small, elongate, biconvex, dental plates present; no septum or septalium; crural plates rudimentary or absent; loop short, with low transverse band. *Lower Triassic–Upper Triassic (Rhaetian).*

Zugmayeria Waagen, 1882, p. 334 [**Terebratula rhaetica* Zugmayer, 1880, p. 13; OD]. Anterior commissure rectimarginate or incipiently uniplicate, beak tapering, suberect, beak ridges obscure; dental plates subparallel; loop short, about 0.3 dorsal valve length, descending lamellae slightly diverging, transverse band almost flat. *Upper Triassic (Rhaetian):* eastern Alps.——Fig. 1348,*2a–e. *Z. rhaetica* (Zugmayer); *a–c,* dorsal, lateral, and anterior views, ×2; *d,* loop, ×2; *e,* transverse section, ×2 (Muir-Wood, 1965a).

Adygelloides Dagys, 1959a, p. 28 [**A. labensis;* OD]. Anterior commissure uniplicate; beak short, incurved, beak ridges rounded, foramen small, oval, permesothyrid; dental plates long, parallel, pedicle collar lacking; cardinal process low, crural bases distinct; crura falcifer, supported by dorsally directed plates, not reaching valve floor; loop short, with subparallel descending lamellae, transverse band slightly arched. *Upper Triassic (Rhaetian):* northwestern Caucasus.——Fig. 1348,*5a–w. *A. labensis; a–c,* dorsal, lateral, and anterior views, ×1; *d–w,* serial transverse sections 0.0, 0.9, 1.2, 1.5, 1.6, 1.7, 1.9, 2.0, 2.1, 2.5, 2.7, 2.8, 2.9, 3.1, 3.3, 3.5, 3.8, 4.3, 4.4, 4.9 mm from first section, ×1 (Muir-Wood, 1965a).

Portneufia Hoover, 1979, p. 7 [**P. episulcata;* OD]. Small, elongate oval, smooth, anterior commissure episulcate to sulciplicate; foramen mesothyrid to permesothyrid, delthyrium closed by small, short, disjunct deltidial plates; pedicle collar present, dental plates short; inner hinge plates present, variable; crura falcifer, deep crural bases may be supported by crural plates; loop with long, slender, descending and ascending lamellae, anterior part of loop unknown. *Lower Triassic:* USA (Idaho).——Fig. 1348,*4a–d. *P. episulcata; a–b,* dorsal and anterior view of holotype, USNM 242051, ×1; *c–d,* interior views of ventral and dorsal valves, ×1 (Hoover, 1979).

Family JUVAVELLIDAE Bittner, 1896

[*nom. transl.* Lee & others, herein, *pro* Juvavellinae Muir-Wood, 1965a, p. 770, *nom. correct. ex* Juvavellinen Bittner, 1896, p. 132]

Small, smooth, biconvex; no dental plates or septum; loop acuminate (centronelliform) in adult. *Upper Triassic (Norian)–Lower Jurassic.*

Juvavella Bittner, 1888, p. 127 [**J. suessi;* OD] [=*Juvavellina* Bittner, 1896, p. 132 (type, *J. kittli*)]. Subtrigonal, with shallow ventral sulcus, anterior commissure rectimarginate or incipiently uniplicate; loop short, about 0.25 dorsal valve length, with small vertical plate directed ventrally. *Upper Triassic (Norian):* eastern Alps.——Fig. 1357,*1a–e. *J. suessi; a–d,* dorsal, ventral, lateral, and anterior views, ×1; *e,* loop reconstruction, ×1 (Muir-Wood, 1965a).

Slavinithyris Tchorszhevsky, 1986, p. 115 [**S. kamyshani;* OD]. Subpentagonal, anterior commissure rectimarginate; beak high, loop short (about 0.25 dorsal valve length), acuminate. Differs from *Wittenburgella* in absence of outer hinge plates and rectimarginate commissure, and from *Juvavella* in absence of ventral sulcus, and in strongly developed vertical plate and spinous loop. *Lower Jurassic:* Carpathian Mountains.——Fig. 1357,*4a–y. *S. kamyshani; a–c,* dorsal, lateral, and anterior views of holotype, KhGU 10/9131, ×4; *d–y,* serial transverse sections 0.0, 0.1, 0.25, 0.45, 0.6, 0.7, 0.8, 0.9, 1.05, 1.3, 1.45, 1.65, 1.85, 2.05, 2.35, 2.55, 2.75, 2.95, 3.25, 3.45, 3.7, 3.9 mm from first section, ×8 (Tchorszhevsky, 1986).

Wittenburgella Dagys, 1959a, p. 30 [**W. minuta;* OD]. Subpentagonal, anterior commissure slightly unisulcate; beak short, incurved; foramen mesothyrid; hinge plates divided, concave ventrally, becoming U-shaped; loop acuminate, 0.5 dorsal valve length, with high median plate extending dorsoventrally. *Upper Triassic (Norian):* northwestern Caucasus.——Fig. 1357,*3a–d. *W. minuta; a–c,* dorsal, lateral, and anterior views of holotype, ×2 (Muir-Wood, 1965a); *d,* reconstruction of loop, ×2 (Dagys, 1974).

Family UNCERTAIN

Pseudoharttina Likharev, 1934, p. 212 [**P. ovalis;* OD]. Small to medium size, anterior commissure rectimarginate; valves variably convex; hinge plates obsolete; crura arising from socket ridges; dorsal median septum present; all internal structures except loop much thickened; dental plates present but ankylosed to valve wall. *Permian:* Asia, North America (Alaska), Spitzbergen.——Fig. 1357,*2a–b. *P. ovalis;* dorsal and ventral views, ×1 (Stehli, 1962).——Fig. 1357,*2c–g. *P. plica* (Krotov), Spitzbergen; *c–d,* exterior and interior of dorsal valve, ×1; *e–g,* exterior and interior views of dorsal valves, USNM 134721, ×1 (new).

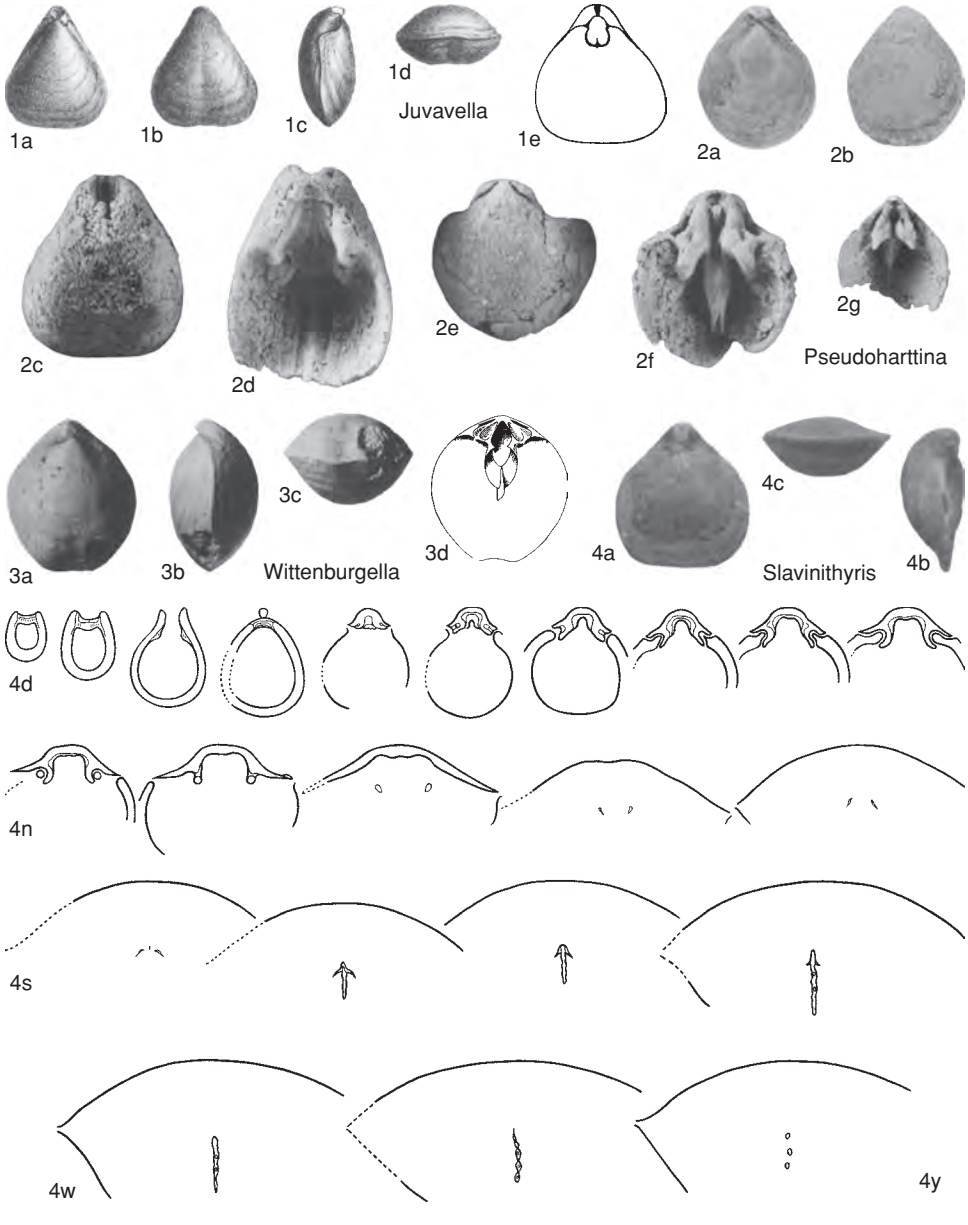

FIG. 1357. Juvavellidae and Uncertain (p. 2052).

TEREBRATULOIDEA

D. E. Lee and T. N. Smirnova

[University of Otago; and Moscow State University]

Superfamily TEREBRATULOIDEA Gray, 1840

[*nom. transl.* Schuchert & LeVene, 1929a, p. 22, *ex* Terebratulidae Gray, 1840, p. 143] [*non* Waagen, 1883, as suborder]

Small to very large, outline rounded, subpentagonal, trigonal or elongate-oval, usually biconvex, anterior commissure rectimarginate, uniplicate, paraplicate, or bisulcate, rarely unisulcate; foramen variable, usually medium to large; modified by deltidial plates, deltidium, or symphytium. No dental plates. No dorsal medium septum. Cardinal process commonly present, variable in size. Loop deltiform, loop development simple (loop growing from crura that meet in transverse band) loop short (varying from 0.2 to 0.4 dorsal valve length); loop generally attached to socket ridges by outer hinge plates, variable in length and width, occasionally absent; inner hinge plates rare; crural bases narrow or broad, attached to socket ridges directly or to dorsal or ventral edge of outer hinge plates. Crural processes vary from bluntly angular to needle sharp, forming focal point in loop; length of descending lamellae variable; transverse band variably arched, horizontal, or posteroventrally directed, narrow or broad. Lophophore plectolophe or modified plectolophe. Spicules present in Holocene species. *?Upper Jurassic, Lower Cretaceous (Berriasian)–Holocene.*

Family TEREBRATULIDAE Gray, 1840

[Terebratulidae Gray, 1840, p. 143]

Small to very large, commonly ventribiconvex; commonly rectimarginate, uniplicate, or sulciplicate; rarely unisulcate; commonly smooth, rarely faintly capillate, rarely peripherally costate or plicate; deltidial plates commonly conjunct, forming symphytium that may be visible or partly concealed; pedicle collar commonly short, excavate; teeth small; cardinal process usually small, transverse; loop variable, usually short (0.25 to 0.35 dorsal valve length), subtriangular; crural processes variable in position, inner hinge plates rarely developed, outer hinge plates usually concave, more rarely flat or absent, variably attached, most commonly to dorsal edge of crural base; transverse band variable; spicules commonly present in Holocene species; lophophore plectolophous. *Paleogene (Paleocene)–Holocene.*

Subfamily TEREBRATULINAE Gray, 1840

[*nom. transl.* Waagen, 1882, p. 330, *ex* Terebratulidae Gray, 1840, p. 143] [=Apletosiinae Cooper, 1983, p. 37]

Anterior commissure rectimarginate, uniplicate or sulciplicate; loop triangular, short to moderately long, crural processes usually anterior of midloop, may be very long, transverse band narrow to broad, anterolateral extremities of loop usually subangular, inner hinge plates rarely developed. *Paleogene (Paleocene)–Holocene.*

Terebratula Müller, 1776, p. 249 [**Anomia terebratula* Linnaeus, 1758, p. 703; SD Lamarck, 1799, p. 89; ICZN plenary powers, 2000, p. 187, Opinion 1,959]. Medium to very large, subpentagonal to broadly oval; smooth; anterior commissure rectimarginate to uniplicate or sulciplicate; beak short, erect; foramen large, mesothyrid to permesothyrid; symphytium partly visible; pedicle collar short; cardinal process variable from a flat semiellipse to a thickened, raised plate or boss; outer hinge plates very narrow or absent, separated from socket ridges by deep trough; no inner hinge plates; loop short, broadly triangular; transverse band narrow, forming a low arch. *Neogene (Miocene–Pleistocene):* Malta, Spain, Poland, Hungary, *Miocene;* Italy, Sicily, Malta, Spain, Algeria, *Pliocene;* Italy, *Pleistocene.*——Fig. 1358,*4a–c.* **T. terebratula* (Linnaeus), Pliocene, Italy; dorsal, lateral, and anterior views of neotype, NHM BG152, ×1 (Lee, Brunton, & others, 2001).——Fig. 1358,*4d–g. T. ampulla* Brocchi, Pliocene, Italy;

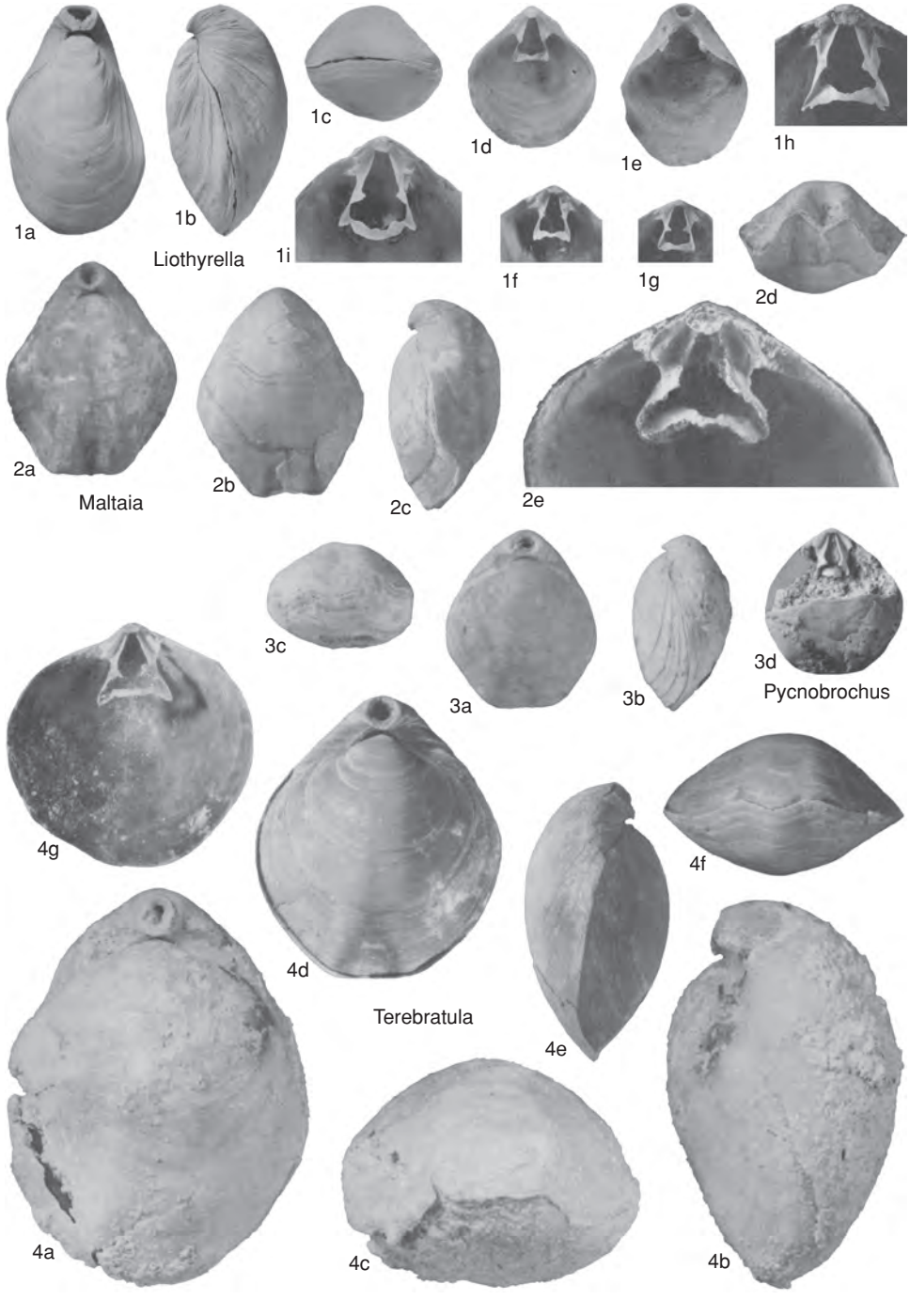

Fig. 1358. Terebratulidae (p. 2054–2057).

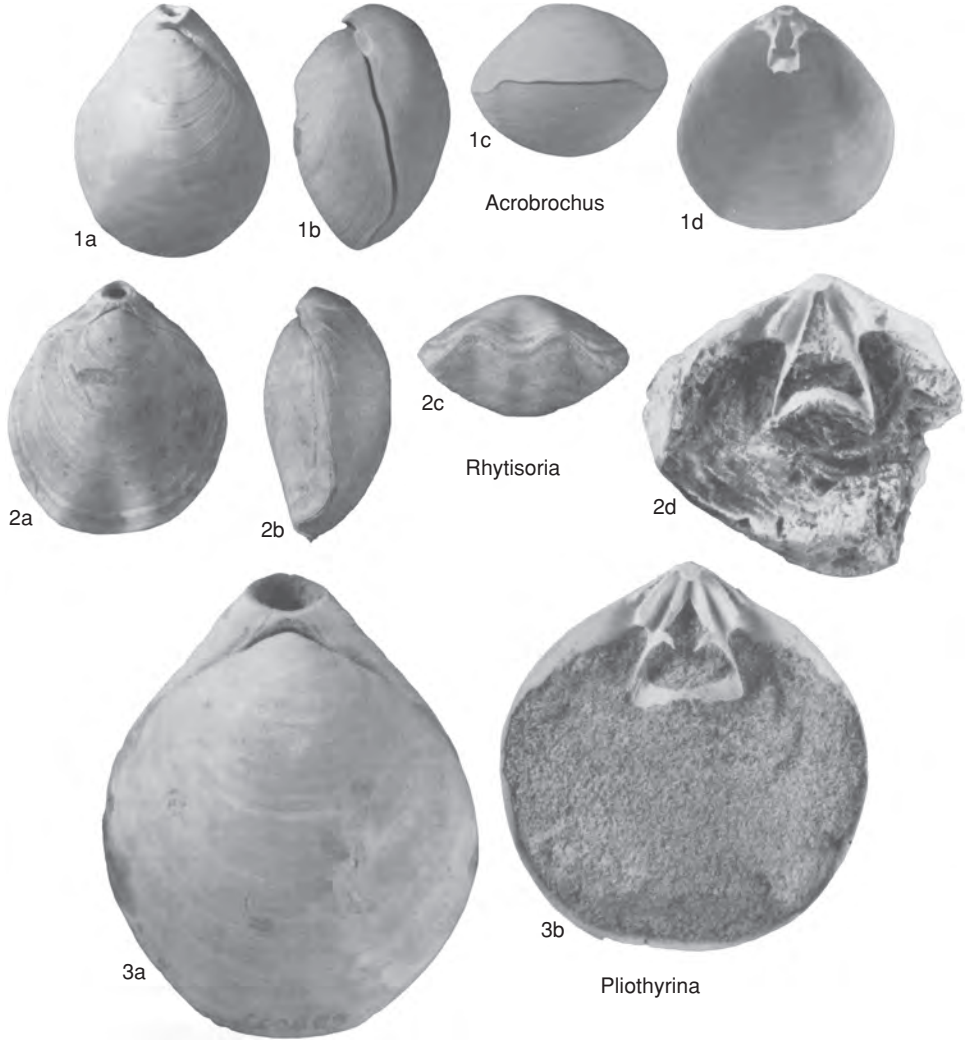

FIG. 1359. Terebratulidae (p. 2056–2057).

d–f, dorsal, lateral, and anterior views, ×1; *g,* dorsal valve interior, ×1 (Cooper, 1983).

Acrobrochus COOPER, 1983, p. 248 [**Liothyrella? vema* COOPER, 1973b, p. 17; OD]. Medium to large, oval to subpentagonal; anterior commissure rectimarginate to uniplicate, smooth; beak suberect, short, labiate; foramen moderately large, permesothyrid; symphytium partly visible; pedicle collar short, excavate; cardinal process is a transverse semiellipse; outer hinge plates taper onto posteroventral edges of crural processes; loop narrow with broad, transverse band. *Paleogene (Eocene)–Holocene:* Australia, *Eocene–Miocene;* New Zealand, *Oligocene–Miocene;* eastern Pacific Ocean off South America, Antarctic Ocean, *Holocene.*——FIG. 1359,*1a–d. *A. vema* (COOPER), Holocene, off southern Argentina; *a–c,* dorsal, lateral, and anterior views, ×1; *d,* interior of dorsal valve of holotype, USNM 550480a, ×1 (Cooper, 1983).

Liothyrella THOMSON, 1916a, p. 44 [**Terebratula uva* BRODERIP, 1833a, p. 124; OD] [=*Dolichosina* COOPER, 1983, p. 228 (type, *Terebratula oamarutica* BOEHM, 1904, p. 149); *Mimorina* COOPER, 1983, p. 232 (type, *M. ziczac,* OD, =*Liothyrella skinneri* ALLAN, 1932a, p. 8). Large to very large, elongate oval to subcircular; ventribiconvex, anterior commissure usually rectimarginate, occasionally broadly uniplicate; smooth or with faint, radial or zigzag capillae; beak usually short, suberect; foramen usually large, submesothyrid, labiate; symphytium wholly or partly visible; pedicle collar short, teeth triangular, narrow; low myophragm may be present;

cardinal process transverse semiellipse; outer hinge plates variable in width and length; attached near dorsal edge of crural bases; loop variable; usually widely triangular, crural processes located near socket openings, transverse band relatively narrow, variable; spicules abundant. *Paleogene (Eocene)–Holocene:* Australia, *Eocene–lower Miocene, Holocene;* New Zealand, *Eocene–Holocene;* Antarctic Peninsula, *Eocene–Miocene;* eastern Pacific Ocean off Central and South America, Falkland Islands, southern Indian Ocean, sub-Antarctic Ocean, *Holocene.*——Fig. 1358,*1a–e.* **L. uva* (Broderip), Holocene; *a–c,* dorsal, lateral, and anterior views of holotype, off Mexico, BMNH ZB1352, ×1.2; *d,* dorsal valve interior with loop, Falkland Islands; *e,* ventral valve interior, Falkland Islands, ×1.2 (Muir-Wood, 1965a).——Fig. 1358,*1f–i. L. neozelanica* Thomson, Holocene, New Zealand; variation in loops of 4 specimens from single locality, ×1 (Cooper, 1983).

Maltaia Cooper, 1983, p. 231 [**M. maltensis;* OD]. Similar to *Terebratula,* but subpentagonal in outline with strongly sulciplicate anterior commissure; loop wide with protuberant tranverse band. *Neogene (Miocene):* Malta.——Fig. 1358,*2a–e.* **M. maltensis; a–d,* dorsal, ventral, lateral, and anterior views, ×1; *e,* interior of dorsal valve of holotype, USNM 551164c, ×2 (Cooper, 1983).

Pliothyrina Roy, 1980, p. 2 [**Terebratula sowerbyana* Nyst, 1845, p. 335; OD] [=*Apletosia* Cooper, 1983, p. 226 (type, *Terebratula maxima* Charlesworth, 1837, p. 92)]. Large to very large, subpentagonal to oval, anterior commissure rectimarginate, becoming moderately sulciplicate in adults; smooth; beak suberect, truncated, labiate; foramen large, mesothyrid to submesothyrid; symphytium short; pedicle collar short, excavate; cardinal process large, subcircular, depressed medially; outer hinge plates very narrow or absent; inner hinge plates small to prominent, disjunct or coalescing; crural bases separated from socket ridges by a marked trough; loop widely triangular; crural processes very long, slender, curved anteromedially; transverse band strongly folded, narrow medially. *Paleogene (Oligocene)–Neogene (Pliocene):* Belgium, England, Germany.——Fig. 1359,*3a–b.* **P. sowerbyana* (Nyst), Miocene, Belgium; *a,* dorsal view; *b,* interior of dorsal valve, ×1 (Cooper, 1983).

Pycnobrochus Cooper, 1983, p. 238 [**Liothyrella pulchra* Thomson, 1918c, p. 118; OD]. Differs from *Liothyrella* in sulciplicate anterior commissure and stout, compact loop. *Paleogene (Eocene):* New Zealand.——Fig. 1358,*3a–d.* **P. pulchra* (Thomson); *a–c,* dorsal, lateral, and anterior views, ×1; *d,* interior view of dorsal valve, ×1 (Cooper, 1983).

Rhytisoria Cooper, 1983, p. 239 [**R. alabamensis;* OD]. Large, subcircular, smooth; anterior commissure sulciplicate; foramen submesothyrid, symphytium visible; crural bases broad, elevated, forming ridge along inner edge of narrow, outer hinge plates, and deep trough adjacent to socket ridges; loop triangular, wide posteriorly with broadly arched, narrow transverse band. Differs from *Oleneothyris* in position of crural processes, shorter terminal points, and angular transverse band. *Paleogene (Paleocene):* USA (Alabama).——Fig. 1359,*2a–d.* **R. alabamensis; a–c,* dorsal, lateral, and anterior views of holotype, USNM 549392a; *d,* interior of dorsal valve, ×1 (Cooper, 1983).

Subfamily GRYPHINAE Sahni, 1929

[Gryphinae Sahni, 1929, p. 8]

Medium to large, smooth, rectimarginate to broadly uniplicate; loop short, transverse band broad, crura narrow, outer hinge plate flattish, attached ventrally, crural processes anterior of midloop. *Paleogene (Eocene)–Holocene.*

Gryphus Megerle von Mühlfeldt, 1811, p. 64, *non Gryphus* Brisson, 1760, *nom. null.* (see Dall, 1920, p. 310) [**Anomia vitrea* Born, 1778, p. 104; M] [=*Liothyrina* Oehlert, 1887b, p. 1,316, obj. (see Thomson, 1927, p. 193), *nom. nov. pro Liothyris* Douvillé, 1879, p. 265, *non* Conrad, 1875]. Elongate oval in outline; ventribiconvex; foramen small to medium, epithyrid; symphytium partially visible; pedicle collar short; cardinal process small, slightly concave, variable; outer hinge plates slightly concave, narrowly triangular; crural bases narrow and flush with inner margin of outer hinge plates; crural processes scooplike in side view; loop short, about 0.25 valve length, variable; descending branches slightly diverging; transverse band broad, gently arched. *Paleogene (Eocene)–Holocene:* Caribbean; Mediterranean, eastern Atlantic, *Miocene–Holocene.*——Fig. 1360,*3a–e.* **G. vitreus* (Born), Holocene, Mediterranean; *a–c,* dorsal, lateral, and anterior views, ×1 (Muir-Wood, 1965a); *d–e,* interiors of ventral and dorsal valves respectively, ×1 (Logan, 1979).

Subfamily PLICATORIINAE Cooper, 1983

[Plicatoriinae Cooper, 1983, p. 38]

Large, elongate oval, rectimarginate, uniplicate or sulciplicate; smooth or peripherally costate; symphytium visible; pedicle collar short; loop long, with long, outer hinge plates attached dorsally to crural bases; inner hinge plates may be developed; crural processes anterior of midloop, transverse band broad. *Paleogene (Eocene).*

Plicatoria Cooper, 1983, p. 236 [**Terebratula wilmingtonensis* Lyell & Sowerby in Lyell, 1845, p. 431; OD] [=*Embolosia* Cooper, 1983, p. 229 (type, *E. sphenoidea*)]. Biconvex; ornament and folding highly variable; anterior commissure rectimarginate

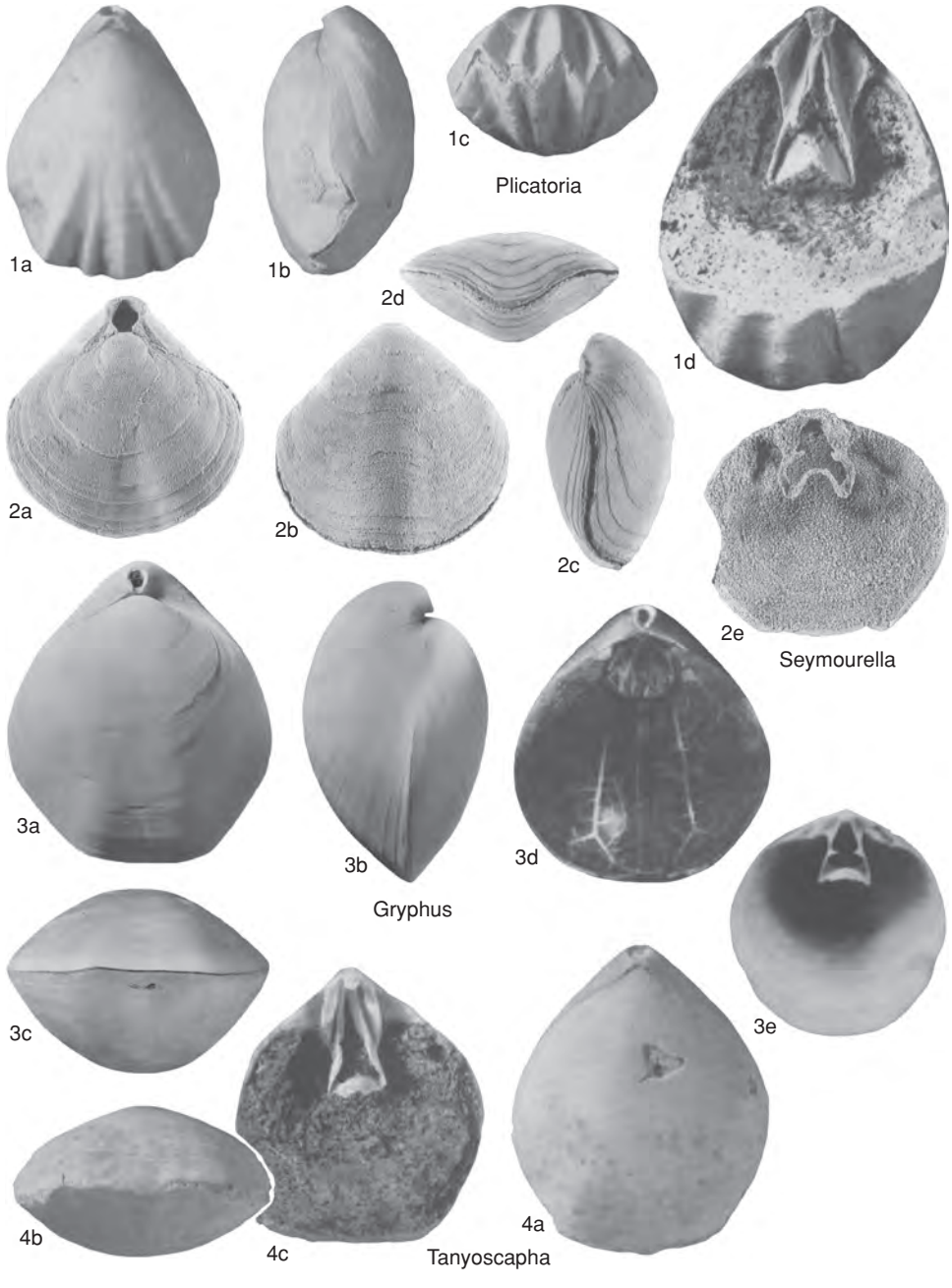

FIG. 1360. Terebratulidae (p. 2057–2059).

to strongly uniplicate; posterior of shell smooth; anterior third to half of shell variably costate to sulciplicate; beak suberect; foramen large, epithyrid to submesothyrid; teeth long, slender; dorsal valve with faint myophragm; cardinal process small, ellipsoidal; outer hinge plates wide, very long; inner hinge plates variable; loop long, triangular; crural processes overhanging broad transverse band. *Paleogene (Eocene):* USA (North Carolina).——FIG. 1360,*1a–d. *P. wilmingtonensis* (LYELL & SOWERBY);

a–c, dorsal, lateral, and anterior views, ×1; *d,* interior of dorsal valve, ×2 (Cooper, 1983).

Tanyoscapha Cooper, 1983, p. 241 [**T. sigmanae;* OD]. Ventribiconvex, smooth; uniplicate; beak suberect, foramen large, submesothyrid; teeth narrow; cardinal process small, outer hinge plates wide, very long; crural processes short, located close to broad, horizontal transverse band; loop as for *Plicatoria. Paleogene (Eocene):* USA (North Carolina).——Fig. 1360,*4a–c. *T. sigmanae; a–b,* dorsal and anterior views of holotype, USNM 550911a; *c,* dorsal valve interior, ×1 (Cooper, 1983).

Subfamily SEYMOURELLINAE Bitner, 1996

[*nom. correct.* Lee & Smirnova, herein, *pro* Seymourinae Bitner, 1996, p. 78]

Medium size, smooth, unisulcate, deltidial plates disjunct, loop short, wide anteriorly, with strongly arched transverse band. *Paleogene (Eocene–Oligocene).*

Seymourella Bitner, 1996, p. 78 [**S. oweni;* OD]. Subpentagonal, ventribiconvex, beak large, suberect, foramen large, submesothyrid to mesothyrid; deltidial plates small, triangular, disjunct; pedicle collar very short, cardinal process a transverse depression along posterior margin; outer hinge plates triangular, wide; no inner hinge plates; crural processes long, needlelike, directed ventrally; loop short (0.3 dorsal valve length), very wide anteriorly, with thin, strongly arched transverse band. *Paleogene (Eocene–Oligocene):* Antarctic Peninsula (Seymour Island).——Fig. 1360,*2a–e. *S. oweni; a–d,* dorsal, ventral, lateral, and anterior views of holotype, ZPAL Bp.XXXVII/140; *e,* interior of dorsal valve, ×1 (Bitner, 1997).

Subfamily TICHOSININAE Cooper, 1983

[Tichosininae Cooper, 1983, p. 37]

Small to large, smooth, ventribiconvex; anterior commissure rectimarginate to uniplicate; beak labiate; outer hinge plates attached to crural bases dorsally; crural processes anterior to midloop; crural props rare; no inner hinge plates; loop short with nearly parallel sides; transverse band usually broad, nearly horizontal to slightly arched medially; anterolateral extremities of loop rounded to angular. *Paleogene (Oligocene)–Holocene.*

Tichosina Cooper, 1977, p. 61 [**T. floridensis* Cooper, 1977, p. 73; OD] [=*Eurysina* Cooper, 1983, p. 259 (type, *Tichosina ovata* Cooper, 1977, p. 79)]. Small to large, subtriangular to ovate in outline; anterior commissure rectimarginate to widely uniplicate; beak suberect, foramen small to large, mesothyrid to permesothyrid; symphytium partially visible; pedicle collar short, teeth narrow; cardinal process elliptical; outer hinge plates variable, concave, with broad, flattish crural bases extending to apex and walling off outer hinge plates, which are attached to dorsal edge of crural base distally; loop small, narrow; crural processes blunt, generally overhanging posterior of broad, medially folded transverse band. *Paleogene (Oligocene)–Holocene:* Caribbean Sea, Gulf of Mexico.——Fig. 1361,*2a–d. *T. floridensis,* Holocene, off Florida, Gulf of Mexico; *a–c,* dorsal, lateral, and anterior views, ×1; *d,* interior of dorsal valve, ×2 (Cooper, 1983).

Arctosia Cooper, 1983, p. 250 [**Terebratula arctica* Friele, 1878, p. 221; OD]. Small, rectimarginate, foramen small, permesothyrid; pedicle collar long, excavate, tubular; outer hinge plates long, narrow, deeply concave; loop short, wide, with subparallel sides; transverse band narrow, nearly horizontal. *Holocene:* off Greenland.——Fig. 1361,*1a–d. *A. arctica* (Friele); *a–c,* dorsal, lateral, and anterior views, ×1; *d,* dorsal valve interior, ×3 (Cooper, 1983).

Dolichozygus Cooper, 1983, p. 253 [**Terebratula stearnsi* Dall & Pilsbry, 1891, p. 165; OD]. Large, elongate subtriangular, uniplicate; beak narrow, long, suberect; foramen large, submesothyrid; symphytium visible; pedicle collar long, excavate; outer hinge plates long, loop short, with subparallel sides; transverse band folded, very broad. *Neogene (Pliocene)–Holocene:* Japan.——Fig. 1361,*5a–d. **D. stearnsi* (Dall & Pilsbry), Holocene, Sagami Bay; *a–c,* dorsal, lateral, and anterior views; *d,* dorsal valve interior, ×1 (Cooper, 1983).

Dysedrosia Cooper, 1983, p. 256 [**Gryphus borneoensis* Dall, 1920, p. 314; OD]. Large, oval; anterior commissure broadly uniplicate; beak truncated; foramen medium, mesothyrid; pedicle collar short, teeth small; cardinal process small, shelflike; outer hinge plates wide, concave; crural bases broad; loop parallel sided, transverse band broad. *Holocene:* off Borneo.——Fig. 1361,*4a–d. **D. borneoensis* (Dall); *a–c,* dorsal, lateral, and anterior views of holotype, USNM 229297a; *d,* interior of dorsal valve of holotype, ×1 (Cooper, 1983).

Erymnia Cooper, 1977, p. 92 [**E. muralifera;* OD]. Medium size, rounded oval; anterior commissure rectimarginate to uniplicate; beak suberect, truncated; foramen small, submesothyrid, symphytium partially visible; pedicle collar short, excavate; cardinal process small, semicircular; outer hinge plates short, gently concave, attached to top of broad crural bases; crural bases attached to valve floor by two nearly vertical plates; loop small, narrow. *Holocene:* Caribbean Sea.——Fig. 1361,*3a–e. **E. muralifera; a–c,* dorsal, lateral, and anterior views of holotype, USNM 550520; *d,* interior of dorsal valve, ×1; *e,* closeup, oblique view of loop of holotype, ×2 (Cooper, 1977).

Zygonaria Cooper, 1983, p. 275 [**Gryphus joloensis* Dall, 1920, p. 313; OD]. Small to medium, rounded oval; rectimarginate; beak short, erect; foramen medium, mesothyrid; pedicle collar well

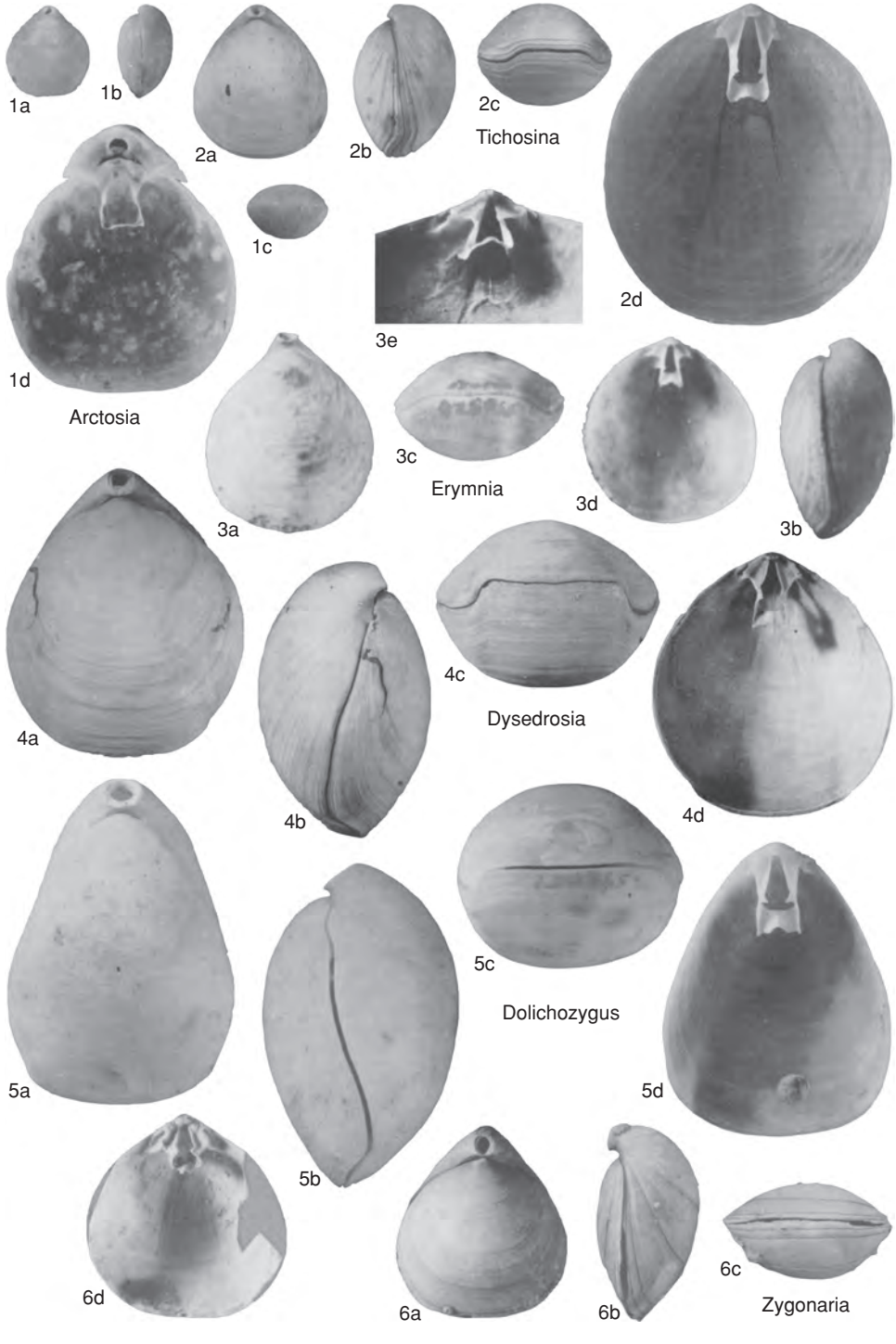

FIG. 1361. Terebratulidae (p. 2059–2061).

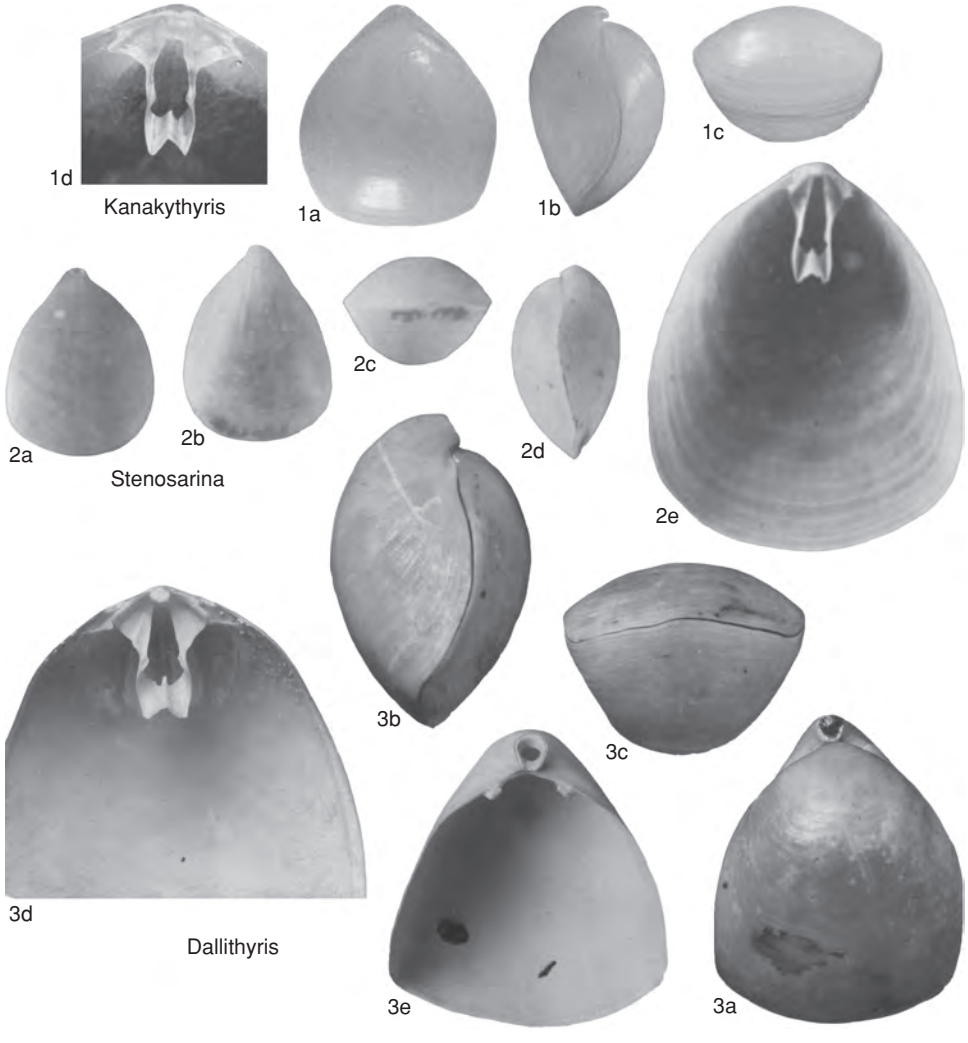

FIG. 1362. Terebratulidae (p. 2061–2062).

developed, teeth large; cardinal process large, semicircular; loop anteriorly rounded and narrowed. *Holocene:* Philippines, Japan.——FIG. 1361,*6a–d.* **Z. joloensis* (DALL), Philippines; *a–c,* dorsal, lateral, and anterior views, ×2; *d,* interior of dorsal valve of holotype, USNM 111062a, ×2 (Cooper, 1983).

Subfamily DALLITHYRIDINAE Katz & Popov, 1974

[Dallithyridinae KATZ & POPOV, 1974a, p. 29; *emend.,* LEE & SMIRNOVA, herein]

Medium to large, smooth, strongly biconvex or ventribiconvex; symphytium partially visible; pedicle collar short, teeth very small; crural bases broad, blunt; loop small, narrow; transverse band broad, with strong median fold. *Paleogene (?Eocene); Neogene (Pliocene)–Holocene.*

Dallithyris MUIR-WOOD, 1959, p. 302 [**D. murrayi;* OD] [=*Epacrosina* COOPER, 1983, p. 256 (type, *Liothyrina fulva* BLOCHMANN, 1906, p. 698)]. Medium to large, subtrigonal to subpentagonal; ventribiconvex, anterior commissure rectimarginate to broadly uniplicate; beak suberect, short, labiate; foramen large, submesothyrid; symphytium short; cardinal process small semiellipse; outer hinge plates broadly triangular, crural bases poorly defined; loop narrow, variable. *Paleogene (?Eocene); Neogene*

(Pliocene)–Holocene: Pacific (Eua, Fiji), *?Eocene, Pliocene–Pleistocene;* Indian Ocean, Pacific Ocean, off South Australia and Tasmania, *Holocene.*——Fig. 1362,*3a–e.* **D. murrayi,* Maldive Islands, Indian Ocean, Holocene; *a–c,* dorsal, lateral, and anterior views of holotype, BMNH ZB1570, ×1; *d,* interior of dorsal valve, ×2; *e,* interior of ventral valve, ×1 (Muir-Wood, 1965a).

Kanakythyris Laurin, 1997, p. 441 [**K. pachyrhynchos;* OD]. Medium size, strongly biconvex, subcircular to subpentagonal in outline, anterior commissure unisulcate; beak incurved, foramen very small. *Holocene:* southwestern Pacific (New Caledonia).——Fig. 1362,*1a–d.* **K. pachyrhynchos; a–c,* dorsal, lateral, and anterior views of holotype, ×1; *d,* closeup of loop of juvenile specimen, ×2 (Laurin, 1997).

Stenosarina Cooper, 1977, p. 95 [**S. angustata;* OD] [=*Stenobrochus* Cooper, 1983, p. 269 (type, *S. crosnieri*)]. Medium size; elongate triangular in outline; ventribiconvex; anterior commissure rectimarginate; beak suberect, labiate; foramen small, mesothyrid to permesothyrid; pedicle collar short, excavate; teeth small, narrow; cardinal process small, ellipsoidal; outer hinge plates narrow, long, tapering; crural bases elevated along inner margins of outer hinge plates. *Pliocene–Holocene:* Sicily, *Pliocene;* Gulf of Mexico, Caribbean, eastern Atlantic, southwestern Pacific (New Caledonia), Indian Ocean (Madagascar), *Holocene.*——Fig. 1362,*2a–e.* **S. angustata,* Holocene, Gulf of Mexico; *a–d,* dorsal, ventral, lateral, and anterior views of holotype, USNM 550594, ×1; *e,* interior of dorsal valve of holotype, ×2 (Cooper, 1977).

Family SELLITHYRIDIDAE Muir-Wood, 1965

[*nom. transl.* Lee & Smirnova, herein, *ex* Sellithyridinae Muir-Wood, 1965a, p. 793]

Small to large, subpentagonal, oval or subcircular in outline; smooth or finely capillate, rarely costate; biconvex or ventribiconvex, cardinal process commonly small, anterior commissure highly variable, rectimarginate, unisulcate, uniplicate, sulciplicate, or bisulcate; outer hinge plates dorsally attached to crural bases; inner hinge plates may be present; loop short; crural processes near or anterior to midloop, transverse band narrow to moderately broad. *?Upper Jurassic, Lower Cretaceous (Berriasian)–Paleogene (Eocene).*

Subfamily SELLITHYRIDINAE Muir-Wood, 1965

[Sellithyridinae Muir-Wood, 1965a, p. 793]

Medium to small, commonly smooth, subpentagonal to oval in outline, rarely faintly capillate or costate, beak generally short, foramen mesothyrid or permesothyrid; no inner hinge plates; outer hinge plates narrow, concave in section; loop triangular, transverse band narrow, with high arch. *Lower Cretaceous (Berriasian)–Upper Cretaceous (Turonian).*

Sellithyris Middlemiss, 1959, p. 113 [**Terebratula sella* J. de C. Sowerby, 1823 in 1823–1825, p. 53; OD]. Small to medium, subpentagonal in outline, anterior commissure strongly sulciplicate, shell may be faintly capillate; beak short, erect, foramen large, marginate, mesothyrid to permesothyrid; cardinal process semiellipse; outer hinge plates wide, concave, forming deep, U-shaped troughs between socket ridges and crural bases; no inner hinge plates; loop wide, triangular; transverse band narrow, strongly arched and protuberant. *Cretaceous (Berriasian–Turonian):* Ukraine, Kazakstan, Caucasus, Georgia, *Berriasian–Hauterivian;* Mexico, *Hauterivian;* England, France, Belgium, Germany, Spain, Switzerland, Sardinia, Egypt, Turkmenia, Tibet, *Aptian–Turonian.*——Fig. 1363,*1a–t.* **S. sella* (J. de C. Sowerby), Aptian, Isle of Wight, England; *a–c,* dorsal, lateral, and anterior views, ×1; *d,* dorsal valve interior, ×1 (Cooper, 1983); *e–t,* serial transverse sections 3.6, 3.8, 4.2, 4.6, 5.0, 5.2, 5.4, 5.5, 5.6, 6.0, 6.8, 7.4, 8.0, 9.2, 9.8, 10.0 mm from ventral umbo, ×1 (Middlemiss, 1959).

Boubeithyris Cox & Middlemiss, 1978, p. 419 [**Terebratula boubei* d'Archiac, 1847, p. 320; OD]. Oval pentagonal in outline, biconvex, foramen large, circular, mesothyrid, anterior commissure rectimarginate to sulciplicate to bisulcate; hinge plates thin, concave, transverse band highly arched. *Cretaceous (?Hauterivian; Barremian–Cenomanian):* England, Belgium, France, Germany, Poland, Morocco.——Fig. 1364,*3a–d.* **B. boubei* (d'Archiac), Cenomanian, Belgium; *a–c,* dorsal, lateral, and anterior views of neotype, IRScNB M.T.C.10154, ×1 (Cox & Middlemiss, 1978); *d,* dorsal valve interior, ×1 (Cooper, 1983).

Glosseudesia Lobatscheva, 1974, p. 146 [**Terebratula semistriata* Defrance, 1828b, p. 156; OD; *non Glosseudesia semistriata* Lobatscheva, 1974; =*Luppovithyris ovalis* Lobatscheva, 1990] [=*Costithyris* Middlemiss, 1981, p. 702, obj.]. Subcircular to oval, costate; rectimarginate to bisulcate; beak suberect, foramen mesothyrid; hinge plates concave, becoming cuneate, not strongly differentiated from inner socket ridges; loop lamellae narrow and thin, transverse band high arched and slightly trapezoidal. [Lobatscheva (1974) described a new genus, *Glosseudesia,* based upon a Neocomian, long-looped brachiopod from Turkmenia. Unfortunately, she designated the short-looped species, *Terebratula semistriata* Defrance, 1828b, as type species of this new genus. In 1990, Lobatscheva redescribed the long-looped Turkmenian species as *Luppovithyris ovalis.* "The

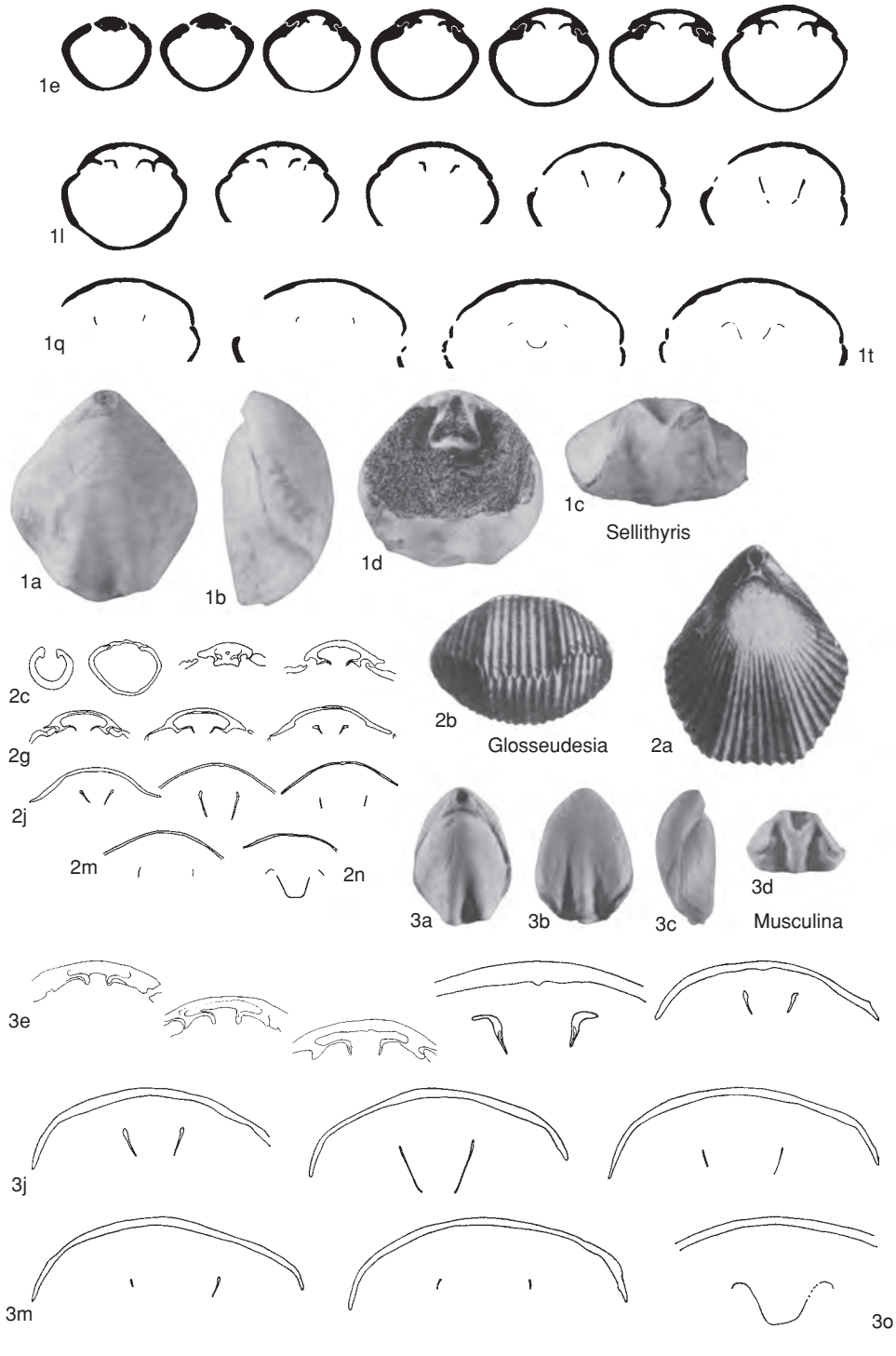

FIG. 1363. Sellithyrididae (p. 2062–2065).

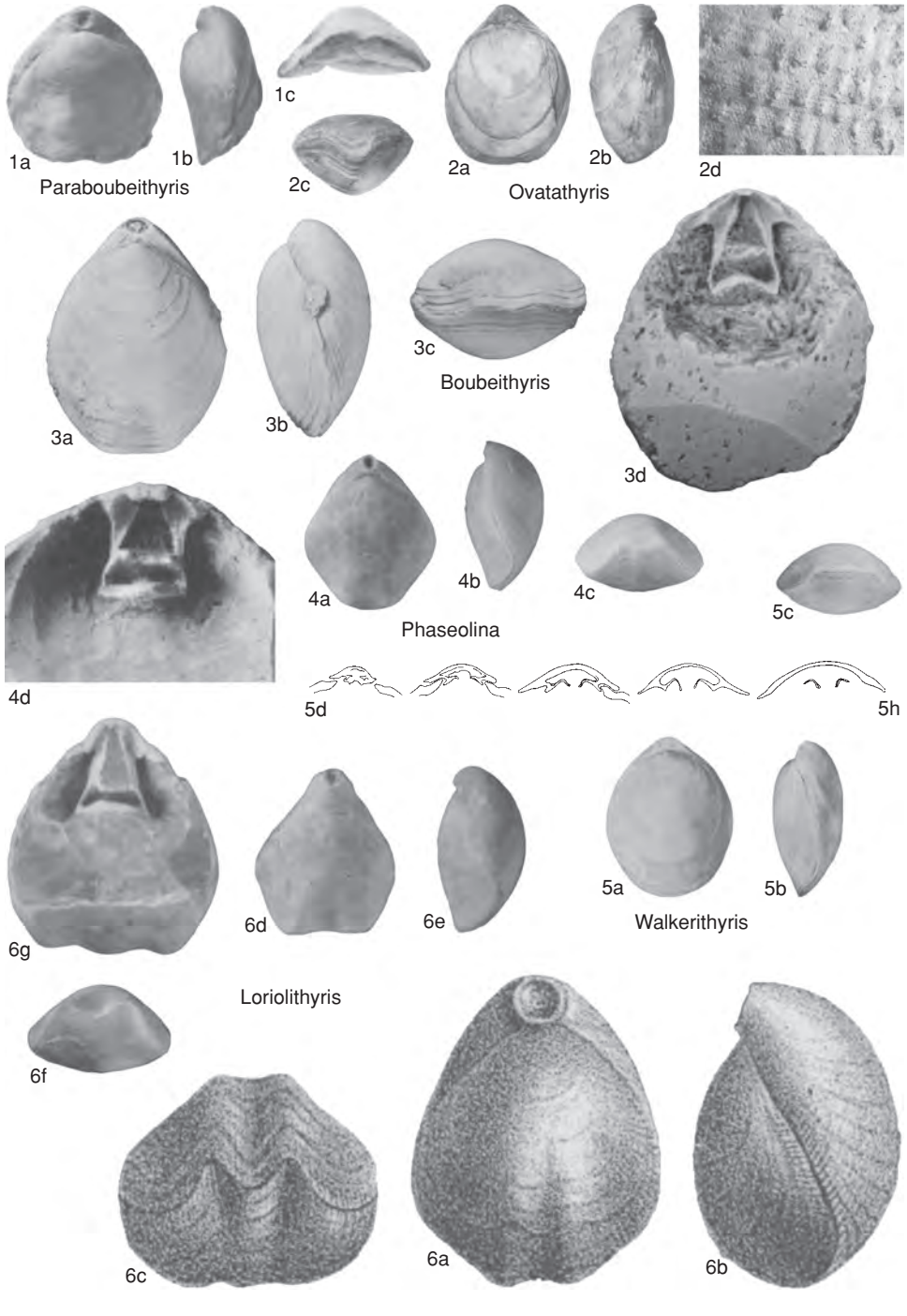

FIG. 1364. Sellithyrididae (p. 2062–2065).

diagnosis, description, and figures accompanying the erection of the new generic name [*Glosseudesia*] are not applicable to *T[erebratula] semistriata* DEFRANCE. . . . Nevertheless, since LOBACHEVA designated *T. semistriata* DEFRANCE, 1828b, as type species of *Glosseudesia,* the latter must stand as the valid generic name for DEFRANCE's species, irrespective of the inappropriate text and figures that accompany it. *Costithyris* MIDDLEMISS, 1981, is therefore a junior objective synonym of *Glosseudesia* LOBACHEVA, 1974" (see MIDDLEMISS, 1983, p. 689). The description and serial sections figured herein are from MIDDLEMISS, 1981.] *Lower Cretaceous (Valanginian–Barremian):* Switzerland, France, Turkmenia.——FIG. 1363,*2a–n. *G. semistriata* (DEFRANCE), Switzerland; *a–b,* dorsal and anterior views, ×1 (Pictet, 1872); *c–n,* serial transverse sections 0.8, 2.4, 2.8, 3.2, 4.0, 4.4, 4.8, 5.2, 6.0, 6.4, 7.2, 8.0 mm from ventral umbo, ×1 (adapted from Middlemiss, 1981).

Loriolithyris MIDDLEMISS, 1968, p. 176 [**Terebratula russillensis* DE LORIOL, 1868, p. 88; OD]. Similar to *Sellithyris,* but less strongly folded; cardinal process bilobed; outer hinge plates narrow, loop short, thin, transverse band narrow, rarely preserved. *Lower Cretaceous:* Europe, Morocco, northwestern Caucasus, Kazakstan, Turkmenia.——FIG. 1364,*6a–c. *L. russillensis* (DE LORIOL), Barremian, Switzerland; dorsal, lateral, and anterior views of lectotype, CB 1520, ×1 (de Loriol, 1868).——FIG. 1364,*6d–g. L. valdensis* DE LORIOL, Valanginian, Switzerland; *d–f,* dorsal, lateral, and anterior views, ×1; *g,* interior of dorsal valve, ×2 (Cooper, 1983).

Musculina SCHUCHERT & LEVENE, 1929b, p. 120, *nom. nov. pro Musculus* QUENSTEDT, 1868 in 1868–1871, p. 27, *non* BOLTEN, 1798, *nec* RAFINESQUE, 1818 [**Terebratula biplicata acuta* VON BUCH, 1835, p. 108; SD S. BUCKMAN, 1907a, p. 530; *non Terebratula acuta* J. SOWERBY, 1816, p. 115; =*Terebratula sanctaecrucis* CATZIGRAS, 1948, p. 391]. Medium size, elongate, dorsal valve strongly convex posteriorly, flattening anteriorly; anterior commissure sulciplicate, plication developed at an early growth stage; beak straight to suberect, symphytium bordered by ridges; foramen small, mesothyrid to permesothyrid; cardinal process small, wide, bilobed; hinge plates strongly concave, crural bases high, not clearly differentiated from hinge plates, clubbed; crural processes thickened at bases, incurved at tips, loop narrow, thin; transverse band thin, high arched. *Lower Cretaceous:* Germany, Switzerland, Russia, Spain, Sardinia, Caucasus, Turkmenia, Georgia.——FIG. 1363,*3a–o. *M. sanctaecrucis* (CATZIGRAS), Hauterivian, Switzerland; *a–d,* dorsal, ventral, lateral, and anterior views, ×1; *e–g,* serial transverse sections 3.6, 4.0, 4.4 from ventral umbo, ×2; *h–o,* serial transverse sections 4.8, 5.2, 5.6, 6.4, 6.8, 7.2, 7.6, 8.6 mm from ventral umbo, ×2 (Dieni, Middlemiss, & Owen, 1975).

Ovatathyris OWEN, 1988, p. 106 [**Terebratula ovata* J. SOWERBY, 1812 in 1812–1815, p. 46; OD]. Oval, shell ornament of short, radiating spinules, anterior commissure unisulcate to paraplicate; foramen large, mesothyrid; cardinal process low, flat. Differs internally from *Boubeithyris* in longer, more acutely concave outer hinge plates. *Upper Cretaceous (Cenomanian):* England.——FIG. 1364,*2a–d. *O. ovata* (J. SOWERBY); *a–c,* dorsal, lateral, and anterior views, ×1; *d,* enlargement of spinules on dorsal valve exterior, ×10 (Owen, 1988).

Paraboubeithyris MIDDLEMISS, 1980, p. 533 [**P. plicae;* OD]. Rounded pentagonal in outline, smooth, beak erect, anterior commissure strongly uniplicate or sulciplicate with very small, asymmetric median sinus; dorsal valve with strong median fold extending from umbonal region to anterior commissure; foramen mesothyrid; hinge plates concave, thin, sharply differentiated from inner socket ridges, piped to strongly corniced; transverse band with high arch. *Lower Cretaceous (Hauterivian–Barremian):* Morocco.——FIG. 1364,*1a–c. *P. plicae,* Barremian; dorsal, lateral, and anterior views of holotype, S.548/1/3, ×1 (Middlemiss, 1980).

Phaseolina GASPARD, 1988, p. 163 [**Terebratula phaseolina* LAMARCK, 1819, p. 252; OD; =*Aphragmus sohli* COOPER, 1983, p. 172] [=*Aphragmus* COOPER, 1983, p. 171, *nom. imperf.* (type, *A. sohli,* OD)]. Medium size, subpentagonal to subcircular in outline; biconvex, smooth with fine lateral capillae, anterior commissure sulciplicate; foramen large, mesothyrid to permesothyrid; cardinal process small, bilobed; loop similar to that of *Sellithyris,* but narrow anteriorly; outer hinge plates long, narrow, concave, tapering anteriorly into crural processes. *Upper Cretaceous (Cenomanian):* France, Spain, Czech Republic, Slovakia.——FIG. 1364,*4a–d. *P. phaseolina* (LAMARCK), France; *a–c,* dorsal, lateral, and anterior views, ×1; *d,* closeup of loop, ×1 (Cooper, 1983).

?Walkerithyris COX & MIDDLEMISS, 1978, p. 424 [**W. mendax* COX & MIDDLEMISS, 1978, p. 425; OD; =*Terebratula moutoniana* WALKER in LAMPLUGH & WALKER, 1903, p. 251, *non T. moutoniana* D'ORBIGNY, 1849]. Subpentagonal, smooth, dorsibiconvex, anterior commissure uniplicate; beak short, wide, foramen circular, mesothyrid; hinge plates wide, thin, deeply concave, piped. [Subfamily placing is uncertain, as loop is not known.] *Lower Cretaceous (Albian):* England.——FIG. 1364,*5a–h. *W. mendax*; *a–c,* dorsal, lateral, and anterior views, ×1; *d–h,* serial transverse sections 3.2, 3.6, 4.0, 4.2, 4.8 mm from ventral umbo, ×1.5 (Cox & Middlemiss, 1978).

Subfamily NERTHEBROCHINAE Cooper, 1983

[Nerthebrochinae COOPER, 1983, p. 38]

Medium size, planoconvex to ventribiconvex, smooth; foramen large, mesothyrid or submesothyrid, loop short, with broad, transverse band; outer hinge plates attached

at or near dorsal edge of crural base; inner hinge plates may be present. *Lower Cretaceous (Valanginian)–Paleogene (lower Eocene).*

Nerthebrochus COOPER, 1983, p. 206 [**Terebratula robertoni* D'ARCHIAC, 1847, p. 315; OD]. Planoconvex, anterior commissure rectimarginate to slightly uniplicate; foramen submesothyrid; symphytium exposed; cardinal process wide, semiellipse, outer hinge plates wide, triangular, concave, attached along dorsal edge of crural bases; loop short, triangular. *Upper Cretaceous (Cenomanian):* Belgium.——FIG. 1365,*1a–d. *N. robertoni* (D'ARCHIAC), Belgium; *a–c,* dorsal, lateral, and anterior views, ×1; *d,* dorsal valve interior, ×1 (Cooper, 1983).

Dilophosina COOPER, 1983, p. 187 [**D. paraplicata;* OD]. Oval, ventribiconvex, anterior commissure paraplicate; foramen large, mesothyrid; no inner hinge plates, outer hinge plates attached to dorsal part of crural bases; loop short, squarish, transverse band narrow, nearly horizontal. Similar to *Boubeithyris,* but paraplicate rather than sulciplicate. *Upper Cretaceous (Cenomanian):* France, Spain.——FIG. 1365,*3a–d. *D. paraplicata,* France; *a–c,* dorsal, ventral, and anterior views of holotype, USNM 550932a, ×1; *d,* dorsal valve interior, ×1 (Cooper, 1983).

Hadrosia COOPER, 1983, p. 195 [**H. convexa;* OD]. Externally similar to *Sellithyris,* but more strongly convex and beak more incurved; loop anteriorly rounded with stout, broad, transverse band. *Lower Cretaceous (Valanginian):* France.——FIG. 1365,*4a–d. *H. convexa; a–c,* dorsal, lateral, and ventral views of holotype, USNM 550930a; *d,* dorsal valve interior, ×1 (Cooper, 1983).

Harmatosia COOPER, 1983, p. 196 [**Terebratula crassa* D'ARCHIAC, 1847, p. 318; OD]. Similar to *Dilophosina,* but with well-developed inner hinge plates. *Upper Cretaceous (Cenomanian):* Belgium, Germany.——FIG. 1365,*2a–d. *H. crassa* (D'ARCHIAC), Germany; *a–c,* dorsal, lateral, and anterior views; *d,* dorsal valve interior, ×1 (Cooper, 1983).

Leymerithyris CALZADA BADIA in CALZADA BADIA, SEGUIER, & TAMBAREAU, 1988, p. 40 [**Terebratula montolearensis* LEYMERIE, 1846, p. 362; OD]. Oval, biconvex, uniplicate or biplicate; outer hinge plates corniced or fasciculate; inner hinge plates concave; crural processes at midloop. *Paleogene (lower Eocene):* Spain, France.——FIG. 1365,*5a–h. *L. montolearensis* (LEYMERIE); *a–c,* dorsal, lateral, and anterior views, ×1; *d–g,* serial transverse sections 2.9, 6.1, 6.9, 8.8 mm from ventral umbo, approximately ×1; *h,* loop reconstruction, ×2 (Calzada Badia, Seguier, & Tambareau, 1988).

Subfamily RECTITHYRIDINAE Muir-Wood, 1965

[Rectithyridinae MUIR-WOOD, 1965a, p. 795]

Large, smooth, biconvex, beak generally elongate, exposing large, convex symphytium, foramen large, permesothyrid to mesothyrid; inner hinge plates rare; loop widely triangular, transverse band broad. *?Upper Jurassic, Lower Cretaceous (Berriasian)–Upper Cretaceous (Maastrichtian).*

Rectithyris SAHNI, 1929, p. 9 [**Terebratula depressa* VALENCIENNES in LAMARCK, 1819, p. 249; OD; =*T. nerviensis* D'ARCHIAC, 1847, p. 313] [=*Cyranoia* COOPER, 1983, p. 185 (type, *Terebratula depressa vissae* HADDING, 1919, p. 20, OD)]. Ventribiconvex, elongate oval, anterior commissure rectimarginate, uniplicate or sulciplicate; beak long, erect; foramen large, mesothyrid; symphytium large, convex; cardinal process transverse semiellipse; inner hinge plates variably developed in some adult specimens; thick, inclined socket ridges, crural bases and outer hinge plates forming U-shaped troughs (virgate keeled outer hinge plates), transverse band of loop medianly horizontal. *Cretaceous (Albian–Coniacian):* Spain, Crimea, *Albian;* Belgium, England, Germany, Poland, Russia, Tibet, India, *Cenomanian;* Antarctic Peninsula, *Albian–Coniacian.*——FIG. 1366,*1a–i. *R. depressa* (VALENCIENNES), Cenomanian, Belgium; *a–c,* dorsal, lateral, and anterior views, ×1; *d,* closeup of loop, ×2 (Cooper, 1983); *e–i,* serial transverse sections 6.0, 6.5, 8.0, 9.0, 11.5 mm from ventral umbo, ×2 (Cox & Middlemiss, 1978).

Collinithyris MIDDLEMISS, 1981, p. 722 [**Terebratula collinaria* D'ORBIGNY, 1849 in 1849–1852, p. 81; OD]. Subcircular or subpentagonal, anterior commissure uniplicate to gently sulciplicate; beak suberect, symphytium exposed; hinge plates initially horizontal, becoming gently concave; cuneate, not clearly differentiated from socket ridges; loop lamellae thin; transverse band low arched. *Lower Cretaceous (Valanginian–Aptian):* Europe.——FIG. 1366,*3a–d. *C. collinaria* (D'ORBIGNY), Neocomian, France; dorsal, ventral, lateral, and anterior views, ×1 (Smirnova, 1990a).

Cyrtothyris MIDDLEMISS, 1959, p. 123 [**Terebratula depressa* var. *cyrta* WALKER, 1868, p. 404; OD]. Oval to subpentagonal, biconvex, anterior commissure uniplicate; beak short, foramen large, mesothyrid; symphytium narrow, exposed; cardinal process small; loop wide, hinge plates ventrally concave, slightly clubbed, keeled. *Cretaceous (Valanginian–Campanian):* Mexico, *Valanginian;* Europe, Greenland, *Aptian;* Madagascar, *?Albian;* South Africa (Zululand), *Aptian–Campanian.*——FIG. 1366,*2a–b. *C. cyrta* (WALKER), Aptian, England; dorsal view, dorsal valve interior, ×1 (Cooper, 1983).——FIG. 1366,*2c–e. C. uniplicata* WALKER, Aptian, England; dorsal, lateral, and anterior views of holotype, BMNH 67843, ×1 (Muir-Wood, 1965a).

Moutonithyris MIDDLEMISS, 1976, p. 63 [**Terebratula moutoniana* D'ORBIGNY, 1849 in 1849–1852, p. 89; OD] [=*Atactosia* COOPER, 1983, p. 173 (type, *Terebratula obtusa* J. DE C. SOWERBY, 1823 in 1823–1825, p. 53)*; Biplicatoria* COOPER, 1983, p. 174

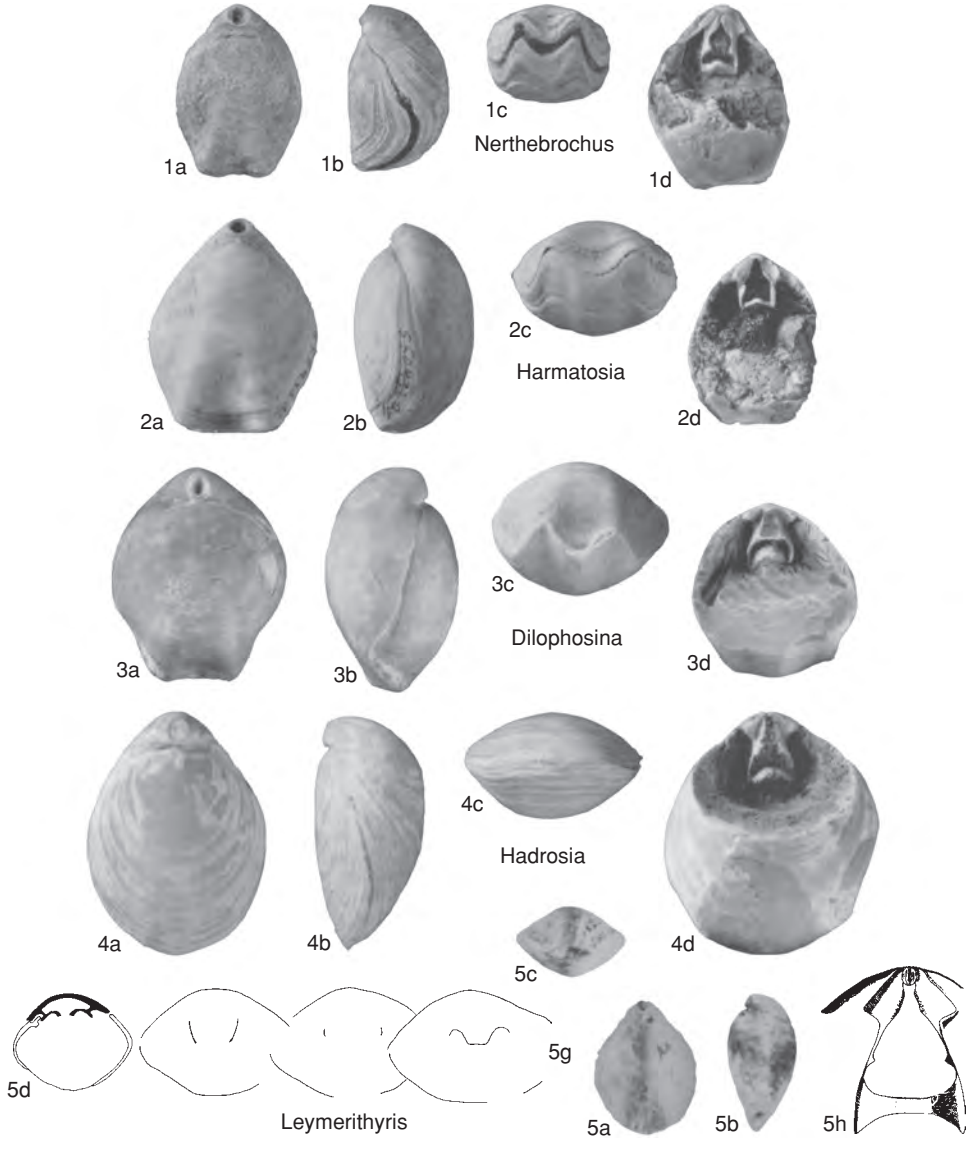

FIG. 1365. Sellithyrididae (p. 2066).

(type, *B. ferruginea* COOPER, 1983, p. 175; =*Terebratula biplicata dutempleana* DAVIDSON, 1853, pl. 6,*1, non T. dutempleana* D'ORBIGNY, 1847]. Oval to subcircular, anterior commissure rectimarginate to bisulcate; beak erect, foramen circular, permesothyrid; deltidium generally concealed; hinge plates horizontal or slightly convex, cuneate, keeled; crural flanges and keels may be present; loop narrow, transverse band low arched. *Cretaceous (Berriasian–Cenomanian):* France, Czech Republic, Slovakia, Germany, Hungary, Switzerland, Portugal, Spain, Sardinia, Ukraine.——FIG. 1367,*1a–p. *M. moutoniana* (D'ORBIGNY), Aptian, France; *a–c,* dorsal, lateral, and anterior views of lectotype, MNHN 5529, ×1; *d–p,* serial transverse sections 1.5, 3.1, 3.9, 4.3, 4.7, 5.1, 5.5, 6.3, 6.7, 7.1, 7.9, 8.7, 9.1, 9.5 mm from ventral umbo, ×1 (Middlemiss, 1976).

Neoliothyrina SAHNI, 1925, p. 375 [**Terebratula obesa* DAVIDSON, 1852a, p. 53; OD; *non* J. DE C. SOWERBY, 1823, p. 54; =*N. obesa* SAHNI, 1925, p. 375]. Elongate oval, biconvex, anterior commissure

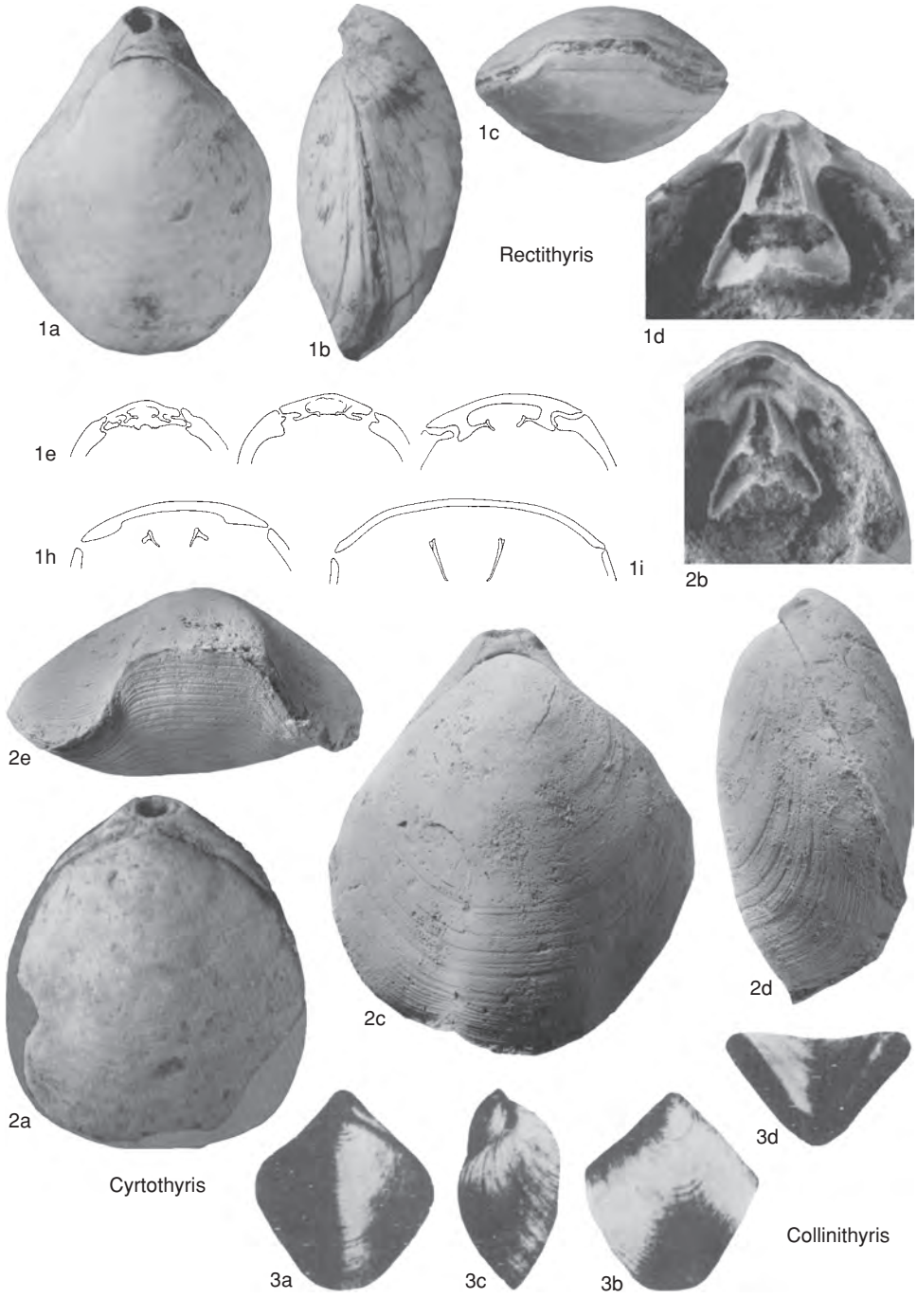

FIG. 1366. Sellithyrididae (p. 2066).

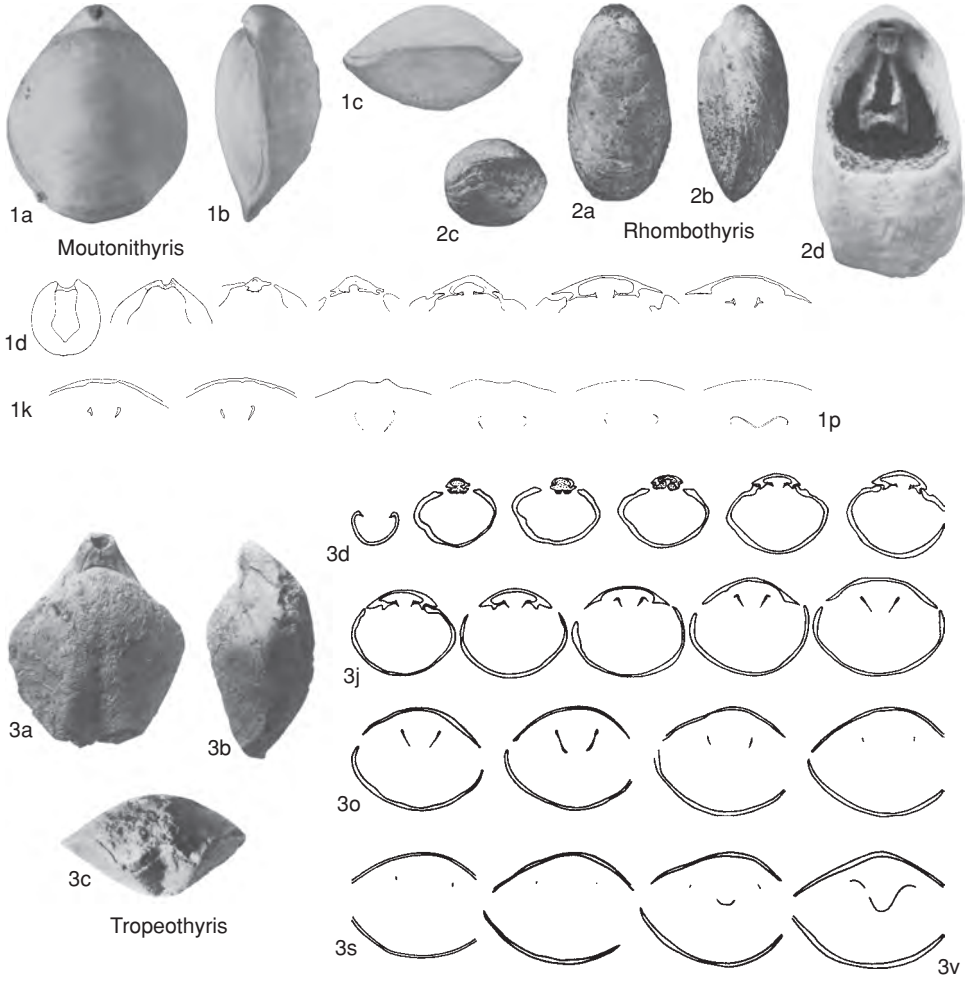

FIG. 1367. Sellithyrididae (p. 2066–2070).

rectimarginate to sulciplicate; foramen large, permesothyrid; cardinal process small semiellipse; outer hinge plates narrow, concave; socket ridges, outer hinge plates, and crural bases forming narrow, U-shaped troughs; inner hinge plates well developed, may coalesce; transverse band broad, high arched. *Upper Cretaceous (Coniacian–Maastrichtian):* Europe.——FIG. 1368,*2a–d.* **N. obesa* (DAVIDSON), Senonian, England; *a–c,* dorsal, lateral, and anterior views, ×1; *d,* loop, ×2 (Muir-Wood, 1965a).

Praelongithyris MIDDLEMISS, 1959, p. 134 [**P. praelongiforma;* OD; = *Terebratula praelonga* J. DE C. SOWERBY in FITTON, 1836, p. 339, auctt., *partim*]. Elongate oval, anterior commissure rectimarginate, becoming sulciplicate; beak long, suberect, foramen large, circular, permesothyrid; hinge plates in section ventrally concave, becoming V-shaped, clubbed, and anteriorly keeled; loop long, high arched. *Cretaceous (Hauterivian–Cenomanian):* Europe, Greenland, Asia; South Africa (Zululand), ?Madagascar, Iran, *Albian.*——FIG. 1368,*1a–d.* **P. praelongiforma,* Aptian, England; *a–c,* dorsal, lateral, and anterior views of holotype, BMNH BM67590, ×1 (Middlemiss, 1959); *d,* interior of dorsal valve, ×1 (Cooper, 1983).

Rhombothyris MIDDLEMISS, 1959, p. 99 [**Terebratula extensa* MEYER, 1864, p. 252; OD]. Elongate oval, ventribiconvex, anterior commissure rectimarginate, unisulcate or sulciplicate; beak short, nearly straight, foramen large, mesothyrid, attrite; symphytium very short, exposed; loop short, high

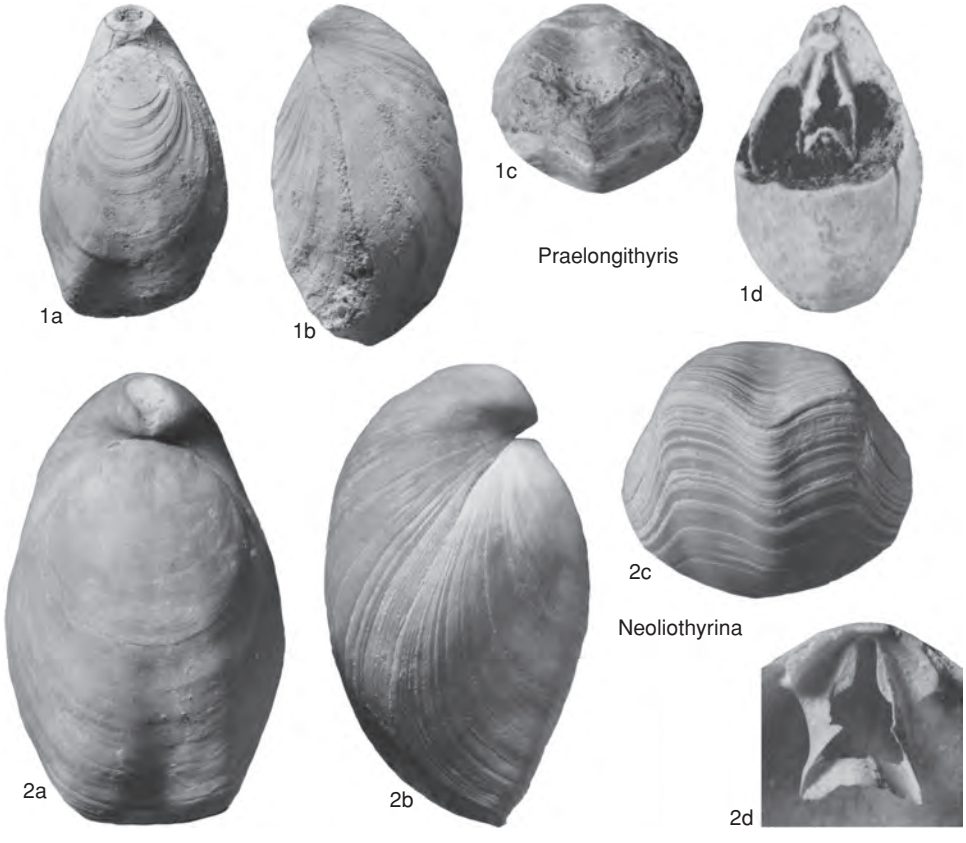

FIG. 1368. Sellithyrididae (p. 2071).

arched, with narrow transverse band. *Lower Cretaceous (Aptian):* England.——FIG. 1367,*2a–c.* **R. extensa* (MEYER); dorsal, lateral, and anterior views of lectotype, BMNH BB.16739, ×1 (Middlemiss, 1959).——FIG. 1367,*2d. R. microtrema* WALKER; interior of dorsal valve, ×1 (Cooper, 1983).

Tropeothyris SMIRNOVA, 1972, p. 69 [**T. kugusemi;* OD]. Oval or rounded pentagonal, anterior commissure parasulcate, beak long, massive, suberect to incurved, beak ridges weak, symphytium high, exposed; pedicle collar present; cardinal process small, transverse; hinge plates horizontal or concave in section, may be keeled; loop wide, short, transverse band strongly arched. *?Upper Jurassic; Cretaceous (Berriasian–Cenomanian):* Western Europe; Turkmenia, *Lower Cretaceous.*——FIG. 1367,*3a–v.* **T. kugusemi,* Hauterivian, Mangyschlak; *a–c,* dorsal, lateral, and anterior views of holotype, MGU No.16 060/89, ×1; *d–v*, serial transverse sections 0.00, 2.65, 2.85, 3.05, 3.75, 3.85, 4.25, 4.65, 5.15, 5.55, 6.15, 6.5, 6.85, 7.35, 7.95, 8.25, 8.8, 9.6, 9.75 mm from first section, ×1 (new).

Family CAPILLITHYRIDIDAE Cooper, 1983

[*nom. transl.* LEE & SMIRNOVA, herein, *ex* Capillithyridinae COOPER, 1983, p. 42]

Small to large, biconvex or ventribiconvex, rectimarginate, uniplicate, unisulcate, rarely sulciplicate; capillate, smooth, or faintly capillate on shell flanks; foramen generally medium to large, mesothyrid or permesothyrid; loop short (0.25 to 0.3 dorsal valve length), wide, outer hinge plates broad, tranverse band generally broad; crural props may be present. *Lower Cretaceous–Upper Cretaceous.*

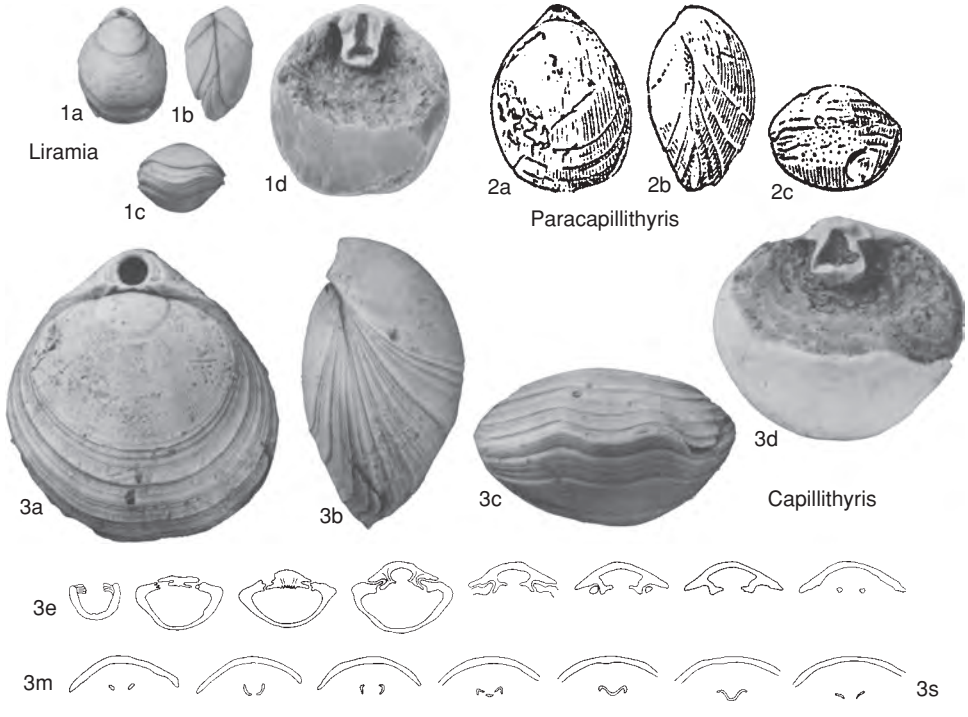

FIG. 1369. Capillithyrididae (p. 2070–2071).

Subfamily CAPILLITHYRIDINAE Cooper, 1983

[Capillithyridinae COOPER, 1983, p. 42]

Finely capillate over entire shell, foramen large, mesothyrid. *Lower Cretaceous (Albian)–Upper Cretaceous (Turonian).*

Capillithyris KATZ, 1974, p. 258 [**Terebratula capillata* D'ARCHIAC, 1847, p. 323; OD] [=*Capillarina* COOPER, 1983, p. 177 (type, *Platythyris diversa* COX & MIDDLEMISS, 1978, p. 434)]. Large, subcircular to subpentagonal, anterior commissure rectimarginate, uniplicate or sulciplicate; beak short, symphytium short, partly exposed; cardinal process small; hinge plates parallel to valve floor, becoming slightly concave anteriorly; loop variable, short (0.25 to 0.3 dorsal valve length), subtriangular, with broad, transverse band. Spicules may be preserved. *Cretaceous (Albian–Cenomanian):* Russia, Belgium, England, France, Poland, Germany, Spain, ?Antarctic Peninsula.——FIG. 1369,*3a–s.* **C. capillata* (D'ARCHIAC), Cenomanian, Belgium; *a–c,* dorsal, lateral, and anterior views; *d,* dorsal valve interior, ×1 (Cooper, 1983); *e–s,* serial transverse sections 0.6, 2.2, 2.6, 3.0, 3.5, 3.9, 4.1, 4.5, 4.9, 5.3, 6.0, 6.6, 7.0, 7.3, 7.8 mm from ventral umbo, ×1 (Bilinkevich & Popiel-Barczyk, 1979).

Liramia COOPER, 1983, p. 199 [**Terebratula disparilis* D'ORBIGNY, 1849 in 1849–1852, p. 100; OD]. Small, elongate oval, anterior commissure slightly unisulcate; loop stout, narrow. [May be a synonym of *Paracapillithyris.*] *Cretaceous (Turonian):* France, England.——FIG. 1369,*1a–d.* **L. disparilis* (D'ORBIGNY); *a–c,* dorsal, lateral, and anterior views, ×1; *d,* dorsal valve interior, ×2 (Cooper, 1983).

?Paracapillithyris KATZ & POPOV, 1974a, p. 26 [**P. alexeevi;* OD]. Medium size, elongate oval, rectimarginate; beak narrow, incurved, foramen apical; hinge plates broad, low; crura wide with dorsal and lateral carinae. [The description does not provide details of the loop, and no illustrations of the interior are available for this genus.] *Upper Cretaceous (Cenomanian):* Russia, Ukraine, Caucasus, Crimea.——FIG. 1369,*2a–c.* **P. alexeevi,* ?Ukraine; dorsal, lateral, and anterior views, ×1 (Katz & Popov, 1974a).

Subfamily ANIABROCHINAE Manceñido, 1993

[Aniabrochinae MANCEÑIDO, 1993, p. 203, *nom. nov. pro* Platythyridinae DIENI, MIDDLEMISS, & OWEN, 1975, p. 195, based on invalid junior homonym]

Small to medium size, smooth or very faintly capillate. *Lower Cretaceous*

(Berriasian)–Upper Cretaceous (Maastrichtian).

Aniabrochus Cooper, 1983, p. 170, *nom. nov. pro Platythyris* Middlemiss, 1959, p. 109, *non Platythyris* Grote & Robinson, 1866, p. 361 [**Platythyris comptonensis* Middlemiss, 1959, p. 109; OD]. Medium size, elongate oval to subpentagonal, biconvex, smooth to faintly capillate on flanks, anterior commissure rectimarginate, uniplicate, sulciplicate, or unisulcate; beak short, truncated; foramen large, mesothyrid to permesothyrid, symphytium very short; cardinal process small; hinge plates in section horizontal to very slightly concave, tapering, or with rounded inner margins, becoming cuneate and keeled in gerontic stage; crural processes incurved; loop short (0.3 dorsal valve length), transverse band broad, low arched. *Cretaceous (Barremian–Turonian):* England, Belgium, France, Italy, Poland, Sardinia, Spain, Crimea, Georgia, Tibet, ?Sarawak.——Fig. 1370,*5a–r. *A. comptonensis* (Middlemiss), Aptian, England; *a–c,* dorsal, lateral, and anterior views; *d,* closeup of loop, ×1 (Cooper, 1983); *e–r,* serial tranverse sections 2.4, 2.5, 3.6, 3.8, 4.1, 4.6, 4.9, 5.4, 6.2, 8.3, 9.2, 9.6, 10.0, 10.8 mm from ventral umbo, ×1 (Middlemiss, 1959).

Bolgarithyris Titova, 1986, p. 118 [**B. boncevi;* OD]. Small to medium size, strongly biconvex, anterior commissure rectimarginate or unisulcate; oval to subtriangular in outline; may be faintly capillate; cardinal process lamellar; hinge plates horizontal or dorsally deflected, often straight; crural bases prolongations of hinge plates; loop short, transverse band low arched. [Subfamily placing is uncertain.] *Upper Cretaceous (Maastrichtian):* Turkmenia.——Fig. 1370,*1a–n. *B. boncevi; a–c,* dorsal, lateral, and anterior view of holotype, TsNIGR Museum No. 203/10445, ×1; *d–n,* serial transverse sections 1.4, 3.15, 3.35, 3.8, 4.2, 4.55, 4.95, 5.25, 5.85, 6.25, 6.6 mm from ventral umbo, ×2 (Titova, 1986).

Dyscritothyris Cooper, 1979, p. 15 [**D. cubensis;* OD]. Small, subcircular to subpentagonal, smooth or may be faintly capillate, biconvex, anterior commissure uniplicate; beak small, foramen submesothyrid, deltidial plates disjunct; outer hinge plates nearly flat, horizontally tapering; loop short, about 0.3 dorsal valve length, imperfectly known. [Subfamily placing is uncertain.] *Upper Cretaceous:* Cuba.——Fig. 1371,*1a–m. *D. cubensis; a–c,* dorsal, lateral, and anterior views of holotype, USNM 550460a, ×2 (Cooper, 1983); *d–m,* serial transverse sections 0.7, 0.8, 1.0, 1.4, 1.5, 1.7, 1.9, 2.3, 2.3, 2.5 mm from ventral umbo, ×5 (Sandy & others, 1997).

Iberithyris Kvakhadze, 1972, p. 75 [**I. rionensis* Kvakhadze, 1972, p. 76; OD]. Small, elongate to rounded pentagonal, smooth, rectimarginate, unisulcate or uniplicate; beak incurved; foramen small, mesothyrid; pedicle collar weakly developed; cardinal process small, platelike; outer hinge plates broad, thin, horizontal throughout their length, often ventrally convex; loop short, narrow, rounded, with gently convex, broad, transverse ribbon supported by dorsal crural props attaching crural bases to valve floor. [Subfamily placing is uncertain.] *Lower Cretaceous (Hauterivian–Barremian):* Georgia, Spain.——Fig. 1370,*3a–o. *I. rionensis,* Hauterivian, Georgia; *a–c,* dorsal, lateral, and anterior views of holotype, ×1; *d–n,* serial transverse sections 0.5, 1.6, 2.2, 2.8, 3.3, 3.9, 4.6, 5.1, 5.3, 5.7, 6.5 mm from ventral umbo, ×2; *o,* drawing of loop, ×1 (Kvakhadze, 1972).

Lunpolaia Ching & Ye in Ye & Yang, 1979, p. 67 [**L. cymbaliformis;* OD]. Smooth or with faint capillae, subcircular, ventribiconvex, uniplicate, beak erect, foramen large; pedicle collar short; cardinal process small; hinge plates horizontal, tapering, and with low, rounded margins anteriorly; outer hinge plates narrowly concave; loop short, wide, transverse band gently convex. [Subfamily placing is uncertain.] *Cretaceous (Aptian–Cenomanian):* China.——Fig. 1370,*4a–d. *L. cymbaliformis; a–c,* dorsal, lateral, and anterior views, ×1; *d,* closeup view of loop, ×3 (Ye & Yang, 1979).

Middlemissithyris Smirnova, 2001, p. 598 [**M. rarus;* OD]. Medium size, smooth, ventribiconvex, subpentagonal to subtriangular, anterior commissure slightly uniplicate; beak incurved, foramen mesothyrid, pedicle collar present; cardinal process small, hinge plates wide, horizontal, crural bases high; loop very short, anteriorly rounded. *Lower Cretaceous:* Crimea, Ukraine.——Fig. 1371,*3a–q. *M. rarus; a–c,* dorsal, lateral, and anterior views, ×1; *d–p,* serial transverse sections 0.9, 1.4, 1.7, 1.9, 2.0, 2.1, 2.2, 2.4, 2.9, 3.4, 3.9, 4.2, 4.6 mm from ventral umbo, ×1; *q,* drawing of loop, ×4 (Smirnova, 2001).

Paraplatythyris Sun, 1987, p. 77 [**P. xizangensis;* OD]. Small, oval, smooth, biconvex, anterior commissure uniplicate; beak short, erect; foramen mesothyrid to permesothyrid, pedicle collar short; no cardinal process, hinge plates tapering and slightly concave; loop short, widely triangular, tranverse band narrow, low arched. *Lower Cretaceous (Berriasian):* Tibet.——Fig. 1371,*2a–l. *P. xizangensis; a,* dorsal view, ×3; *b–l,* serial transverse sections 0.1, 1.0, 1.2, 1.6, 1.9, 2.1, 2.2, 2.5, 2.9, 3.6, 3.7 mm from ventral umbo, ×2.65 (Sun, 1987).

Sardope Dieni, Middlemiss, & Owen, 1975, p. 196 [**S. sardoa* Dieni, Middlemiss, & Owen, 1975, p. 198; OD]. Similar to *Aniabrochus,* but smooth with straight beak; posterior part of shell bulbous. *Lower Cretaceous (Aptian–Albian):* Sardinia, *Aptian;* France, *Albian.*——Fig. 1370,*2a–j. *S. sardoa,* Sardinia; *a–c,* dorsal, lateral, and anterior views of holotype, IGPSB 31, ×1; *d–j,* serial transverse sections 1.6, 2.0, 2.4, 2.8, 3.2, 3.6, 4.4 mm from ventral umbo, ×1 (Dieni, Middlemiss, & Owen, 1975).

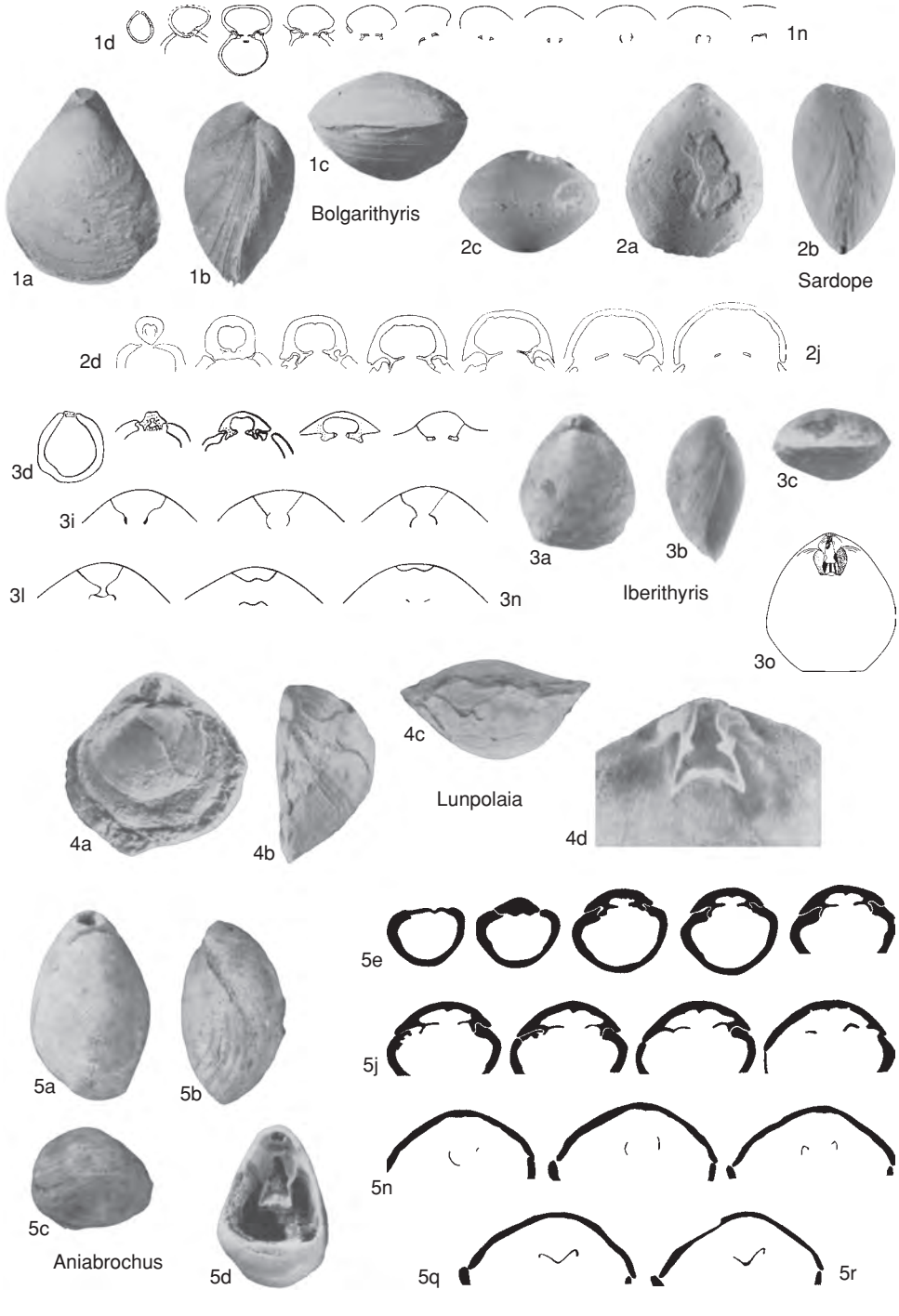

FIG. 1370. Capillithyrididae (p. 2072).

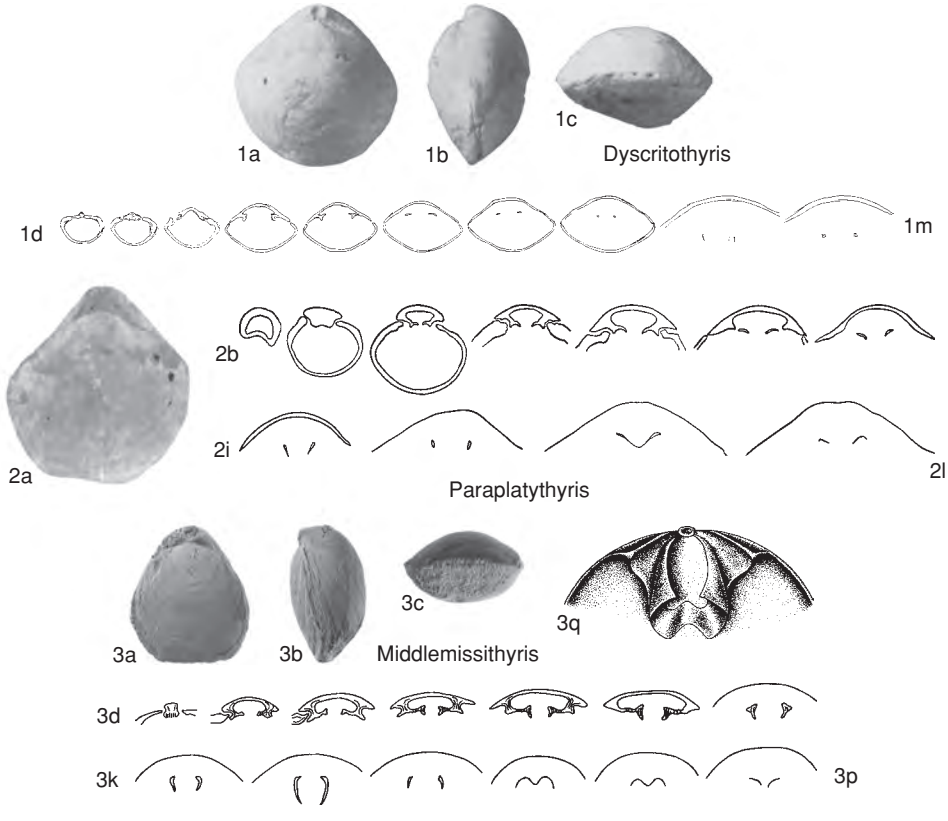

FIG. 1371. Capillithyrididae (p. 2072).

Family WEBERITHYRIDIDAE Smirnova, 1990

[Weberithyrididae SMIRNOVA, 1990a, p. 66]

Smooth, anterior commissure unisulcate, rarely bisulcate; no inner hinge plates; early loop stages with secondary loop structures. *Upper Jurassic–Lower Cretaceous.*

Weberithyris SMIRNOVA, 1969b, p. 144 [**Rectithyris moisseevi* WEBER, 1949, p. 116; OD]. Elongate, beak high, erect, symphytium high, grooved; no pedicle collar; cardinal process small, concave, bilobed; hinge plates horizontal or slightly concave with obtuse margins; loop with thin branches, transverse band thin, rectimarginate, strongly arched. *Upper Jurassic–Lower Cretaceous:* Crimea, Caucasus; Western Europe, *Upper Jurassic.*——FIG. 1372*a–x.* **W. moisseevi* (WEBER), Lower Cretaceous, Crimea; *a–c,* dorsal, lateral, and anterior views, ×1; *d–w,* serial transverse sections 0.0, 0.4, 0.5, 0.7, 0.8, 1.0, 1.7, 1.9, 2.1, 2.3, 2.8, 3.3, 4.0, 4.3, 4.8, 5.8, 6.3, 6.4, 6.7, 7.2 mm from first section, approximately ×0.85; *x,* reconstruction of loop, ×1 (Smirnova, 1969).

Family GIBBITHYRIDIDAE Muir-Wood, 1965

[*nom. correct.* KATZ & POPOV, 1974a, p. 24, *pro* Gibbithyridae DAGYS,1968, p. 26, *nom. transl. ex* Gibbithyridinae MUIR-WOOD, 1965a, p. 797]

Medium to large, biconvex or ventribiconvex, rectimarginate, uniplicate or sulciplicate, beak often incurved, foramen permesothyrid to epithyrid, very small to large; cardinal process variable, small to massive; loop short, crural bases broad, outer hinge plates attached at or near ventral edge of crural bases; crural processes anterior of midloop, transverse band usually broad, variably arched. *Cretaceous–Paleogene (Paleocene).*

Subfamily GIBBITHYRIDINAE Muir-Wood, 1965

[Gibbithyridinae MUIR-WOOD, 1965a, p. 797]

Smooth or with prominent growth lamellae or rugae, with small cardinal process. *Cretaceous–Paleogene (Paleocene).*

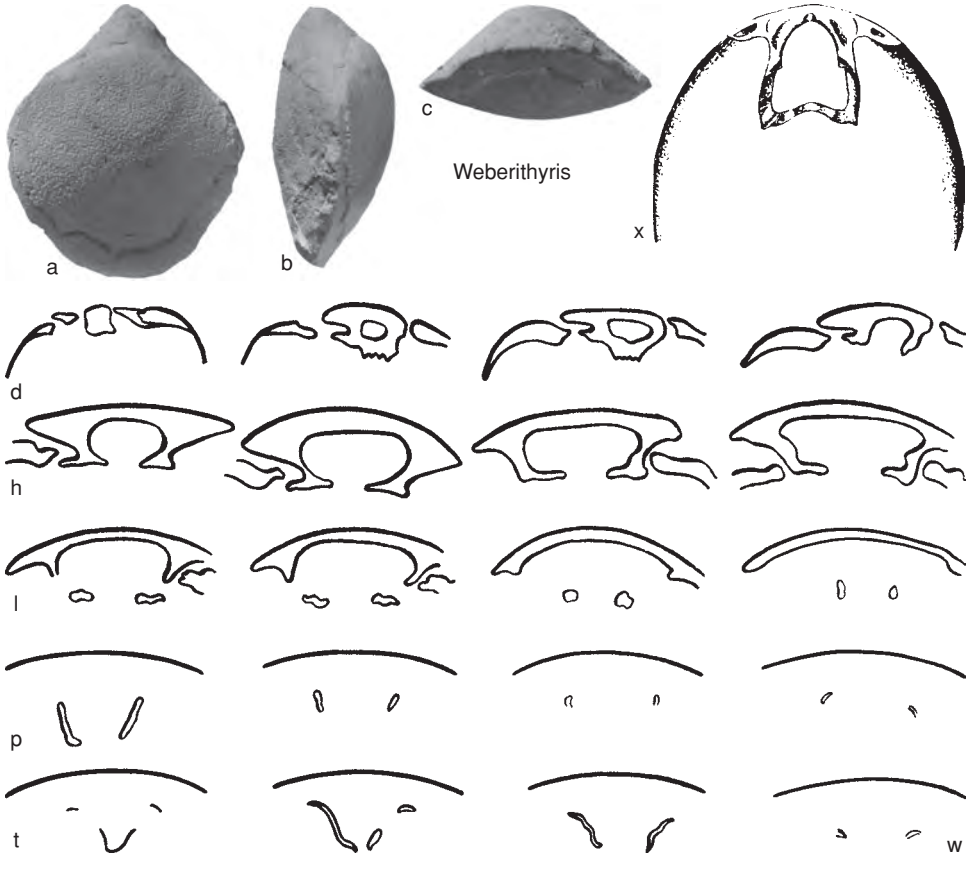

FIG. 1372. Weberithyrididae (p. 2074).

Gibbithyris SAHNI, 1925, p. 372 [**G. gibba;* OD] [=*Kestonithyris* SAHNI, 1925, p. 363 (type, *K. inflata*); *Piarothyris* SAHNI, 1925, p. 370 (type, *P. rotunda*)]. Medium size, strongly biconvex, anterior commissure rectimarginate to sulciplicate, beak short, suberect to erect, incurved, symphytium usually concealed, foramen minute, epithyrid to permesothyrid, beak ridges strong; cardinal process small, transverse, crural bases broad, dorsally directed; outer hinge plates in section usually convex or horizontal, with pendant, dorsally directed crural bases; loop short, 0.3 dorsal valve length, triangular, transverse band gently arched. [No satisfactory illustrations of the type are available.] *Upper Cretaceous (Cenomanian–Santonian):* England, France, Sweden, Russia.——FIG. 1373,*1a–d. G. semiglobosa* J. SOWERBY, Cenomanian, England; *a–c,* dorsal, lateral, and anterior views of holotype, BMNH B.49833, ×0.9; *d,* close up view of loop, ×1.8 (Muir-Wood, 1965a).——FIG. 1373,*1e–q. G. subrotunda* J. SOWERBY, Turonian, England; serial transverse sections 0.8, 1.2, 1.6, 2.0, 2.4, 3.2, 3.6, 4.4, 4.8, 5.6, 6.0, 6.4, 7.2 mm from ventral umbo, ×1 (Middlemiss, 1991).

Concinnithyris SAHNI, 1929, p. 11 [**Terebratula obesa* J. DE C. SOWERBY, 1823 in 1823–1825, p. 54; OD]. Medium to large, elongate oval to subcircular in outline, ventribiconvex, anterior commissure rectimarginate to uniplicate or sulciplicate; beak slightly incurved to erect, truncated; foramen small to large, circular, permesothyrid to epithyrid, rarely labiate; symphytium concealed, beak ridges indistinct; cardinal process low, flat, poorly developed; outer hinge plates horizontal to gently convex, may be keeled, attached to ventral edge of broad, flat crural bases; crural processes high, tapering, inwardly curving; thin, descending branches of short, narrow loop with low, arched transverse band, may have small depression or sulcus posteriorly. *Cretaceous (Albian–Turonian):* England, France, Poland.——FIG. 1373,*2a–n. *C. obesa* (J. DE C. SOWERBY), Cenomanian, Lower Chalk, Wiltshire, England; *a–c,* dorsal, lateral, and anterior views of holotype, BMNH B.49832, ×1; *d–n,* serial transverse sections 4.1, 5.7, 6.5, 6.8, 7.2, 7.8, 8.2, 8.6, 9.0, 9.3, 9.9 mm from ventral umbo, ×1 (Owen, 1988).——FIG. 1373,*2o. C. rouenensis* COOPER, Cenomanian, France; close up view of loop, ×2 (Cooper, 1983).

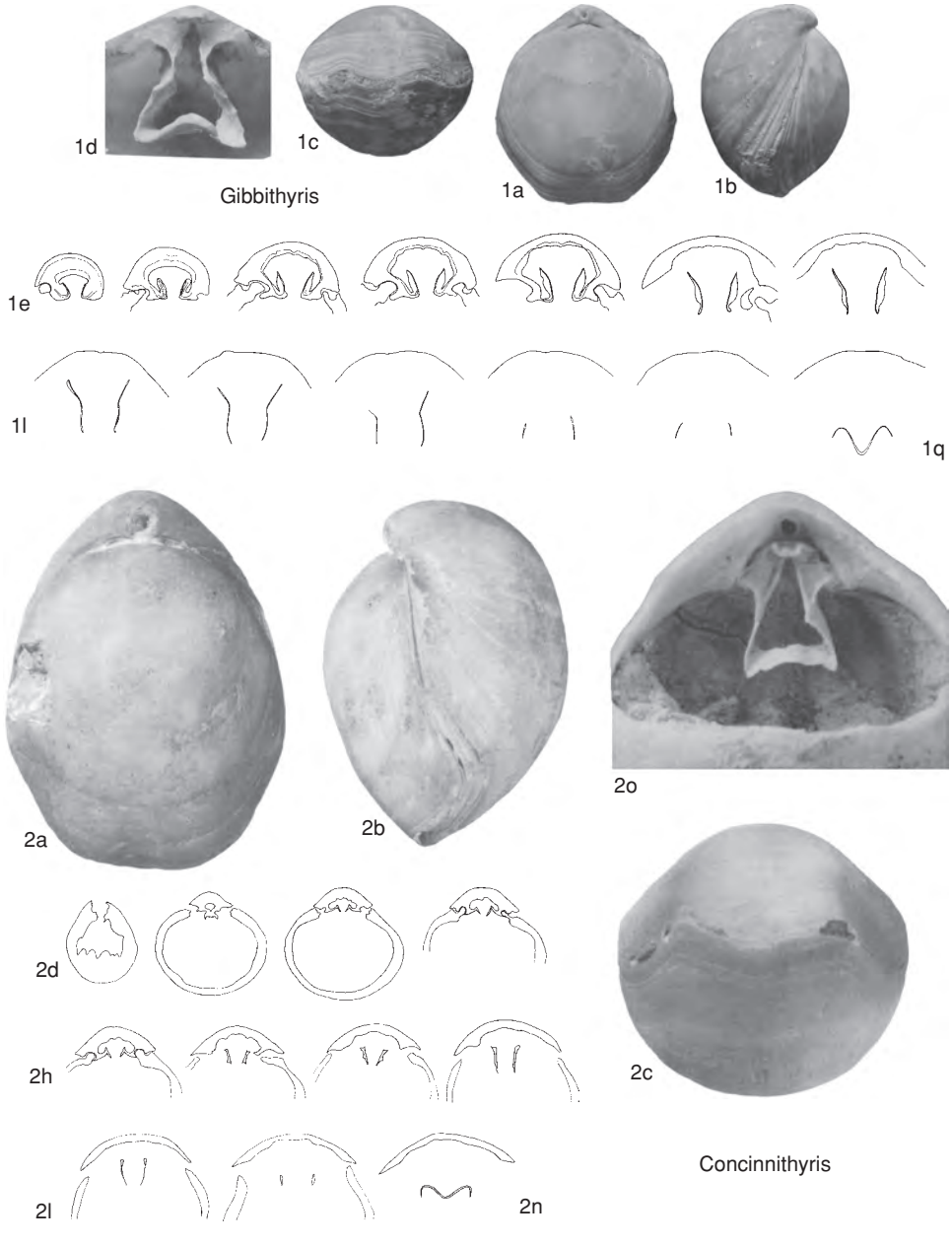

FIG. 1373. Gibbithyrididae (p. 2075).

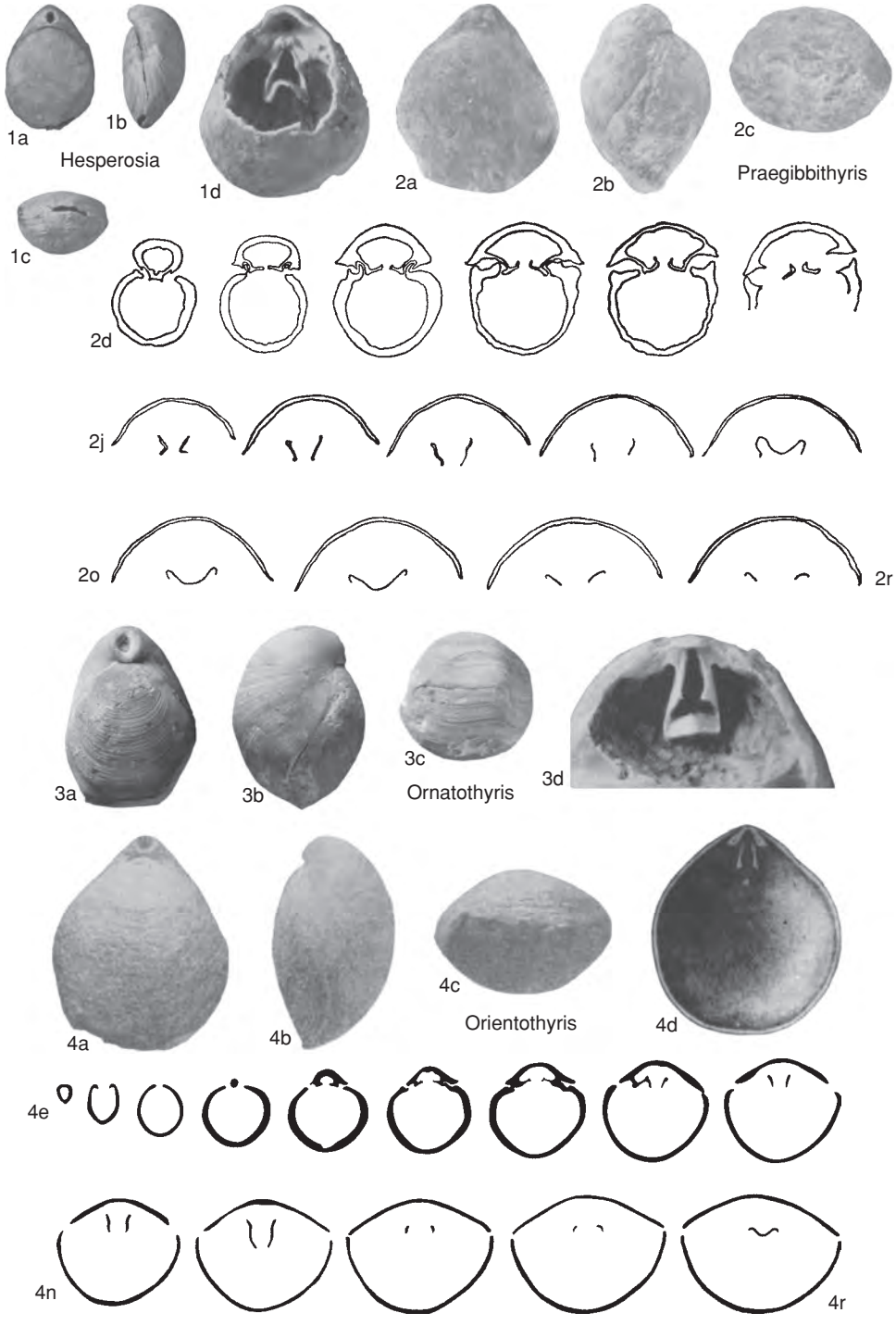

FIG. 1374. Gibbithyrididae (p. 2078).

Hesperosia Cooper, 1983, p. 197 [**Rectithyris vespertina* Cooper, 1955b, p. 4; OD]. Medium size, oval, ventribiconvex, rectimarginate, smooth, beak large, protuberant, erect; foramen large, permesothyrid; cardinal process small semiellipse; loop similar to that of *Concinnithyris* but with narrow crural bases and wider loop angle. *Cretaceous:* USA (Arizona), Mexico.——Fig. 1374,*1a–d.* **H. vespertina* (Cooper), Arizona; *a–c,* dorsal, lateral, and anterior views of holotype, USNM 124194b, ×1; *d,* interior of dorsal valve, ×2 (Cooper, 1983).

Orientothyris Katz & Popov, 1974a, p. 28 [**Gryphus orientalis* Vantschurov & Kalugin, 1966, p. 119; OD]. Medium size, elongate oval; anterior commissure uniplicate, faint lateral capillae may be present; beak massive, foramen large, epithyrid; crural bases attached to wide hinge plates that hang low into dorsal apical cavity, almost uniting with floor of valve; crural bases with high ventral keels. Differs from *Concinnithyris* in wide hinge plates and type of crura. [Subfamily placing is uncertain.] *Upper Cretaceous* (*Maastrichtian)–Paleogene (Paleocene):* Crimea, Caucasus, Kazakstan, Turkmenia.——Fig. 1374,*4a–r.* **O. orientalis* (Vantschurov), ?Maastrichtian, ?Crimea; *a–c,* dorsal, lateral, and anterior views of holotype, ×1; *d,* interior of dorsal valve, ×0.5; *e–r,* serial transverse sections 0.4, 1.0, 1.6, 2.6, 3.2, 3.6, 4.0, 4.6, 5.1, 5.5, 6.4, 7.1, 7.7, 8.5 mm from ventral umbo, ×1 (Vantschurov & Kalugin, 1966).

Ornatothyris Sahni, 1929, p. 45 [**Terebratula sulcifera* Morris in Morris & Davidson, 1847, p. 254; OD]. Large, ovate to subpentagonal, ventribiconvex, anterior commissure gently uniplicate to sulciplicate; ornament of strong, concentric lamellae; beak massive, short, foramen permesothyrid, large, labiate, symphytium visible or hidden; pedicle collar well developed; cardinal process narrow semiellipse; crural bases broad, extending under short, narrow, horizontal outer hinge plates to produce a keeled hinge plate in section, loop narrow but variable, transverse band broad. *Cretaceous (Cenomanian):* England, France, Poland, Switzerland, Russia, ?Sarawak, China.——Fig. 1374,*3a–d.* **O. sulcifera* (Morris), England; *a–c,* dorsal, lateral, and anterior views of holotype, BMNH Davidson Collection, 50822, ×0.6 (Muir-Wood, 1965a); *d,* interior of dorsal valve, ×2 (Cooper, 1983).

Praegibbithyris Sun, 1987, p. 82 [100] [**P. langshanensis;* OD]. Medium size, oval, strongly biconvex, anterior commissure sulciplicate; smooth; beak short, nearly straight; foramen large, permesothyrid to epithyrid; beak ridges rounded, delthyrium covered by symphytium; pedicle collar present, cardinal process low, transversely oval, bilobate myophore directed posteroventrally; hinge plates separate, ventrally convex with dorsally directed crural bases; inner socket ridges fused with narrow, outer hinge plates; loop short, triangular, wide, transverse band trapezoidal. *Lower Cretaceous (Aptian):* Tibet.——Fig. 1374,*2a–r.* **P. langshanensis; a–c,* dorsal, lateral, and anterior views of holotype, ×1; *d–r,* serial transverse sections 3.1, 3.6, 3.8, 4.0, 4.3, 4.5, 5.3, 6.2, 6.7, 7.3, 7.9, 8.3, 8.9, 9.2, 9.5 mm from ventral umbo, ×1 (Sun, 1987).

Pseudogibbithyris Owen, 1995, p. 275 [**P. arabica;* OD]. Medium size, elongate oval to subcircular, biconvex, uniplicate, beak short, suberect, foramen small, permesothyrid, cardinal process flat, bifid, hinge trough deep, hinge plates short, triangular. *Upper Cretaceous (Maastrichtian):* United Arab Emirates (Jebel Huwayyah), Oman.——Fig. 1375,*1a–m.* **P. arabica; a–c,* dorsal, lateral, and anterior views of holotype, BMNH BF47, ×1; *d–m,* serial tranverse sections 1.3, 1.5, 1.9, 2.0, 2.2, 2.4, 2.6, 3.3, 3.7, 4.0 mm from first section, ×1 (Owen, 1995).

Sahnithyris Radulović & Ramamoorthy, 1995, p. 187 [**Concinnithyris andurensis* Sahni, 1960, p. 10; OD]. Very large, elongate oval, ventribiconvex, beak short, massive, concealing symphytium; foramen mesothyrid; anteriorly commissure broadly sulciplicate; pedicle collar present; cardinal process wide, concave with well-defined myophore; loop thin, transverse band broad, strongly arched. *Upper Cretaceous (Campanian):* southern India, ?Bulgaria.——Fig. 1375,*2a–p.* **S. andurensis* (Sahni), southern India; *a–c,* dorsal, lateral, and anterior views of lectotype, GSI 1553, ×1 (Sahni, 1960); *d–p,* serial transverse sections 2.1, 6.4, 7.2, 9.3, 10.3, 12.5, 13.5, 14.0, 15.2, 18.7, 19.1, 19.5, 20.7 mm from ventral umbo, ×0.5 (Radulović & Ramamoorthy, 1995).

Subfamily CARNEITHYRIDINAE Muir-Wood, 1965

[Carneithyridinae Muir-Wood, 1965a, p. 799]

Medium to large, smooth, subcircular to oval to subpentagonal in outline, rectimarginate to uniplicate, rarely unisulcate, smooth; beak incurved, foramen small to minute; loop short, variable in shape, cardinal process large to massive; outer hinge plates often swollen, no inner hinge plates; crural processes anterior to midloop; transverse band usually narrow, moderately arched. *Upper Cretaceous (Coniacian)–Paleogene (upper Paleocene).*

Carneithyris Sahni, 1925, p. 364 [**C. subpentagonalis;* OD] [=*Chatwinothyris* Sahni, 1925, p. 368 (type, *C. subcardinalis,* OD); *Ellipsothyris* Sahni, 1925, p. 371 (type, *E. similis,* OD); *Magnithyris* Sahni, 1925, p. 367 (type, *M. magna,* OD); *Ornithothyris* Sahni, 1925, p. 374 (type, *O. carinata,* OD); *Pulchrithyris* Sahni, 1925, p. 361 (type, *P. gracilis,* OD); *Ogmusia* Cooper, 1983, p. 207 (type, *Terebratula incissa* von Buch, 1835, p. 95)]. Medium to large, oval to subcircular, ventribiconvex, anterior commissure rectimarginate to uniplicate or unisulcate; foramen small to minute, beak ridges angular, mesothyrid to permesothyrid; symphytium hidden; cardinal process large to massive, bulbous,

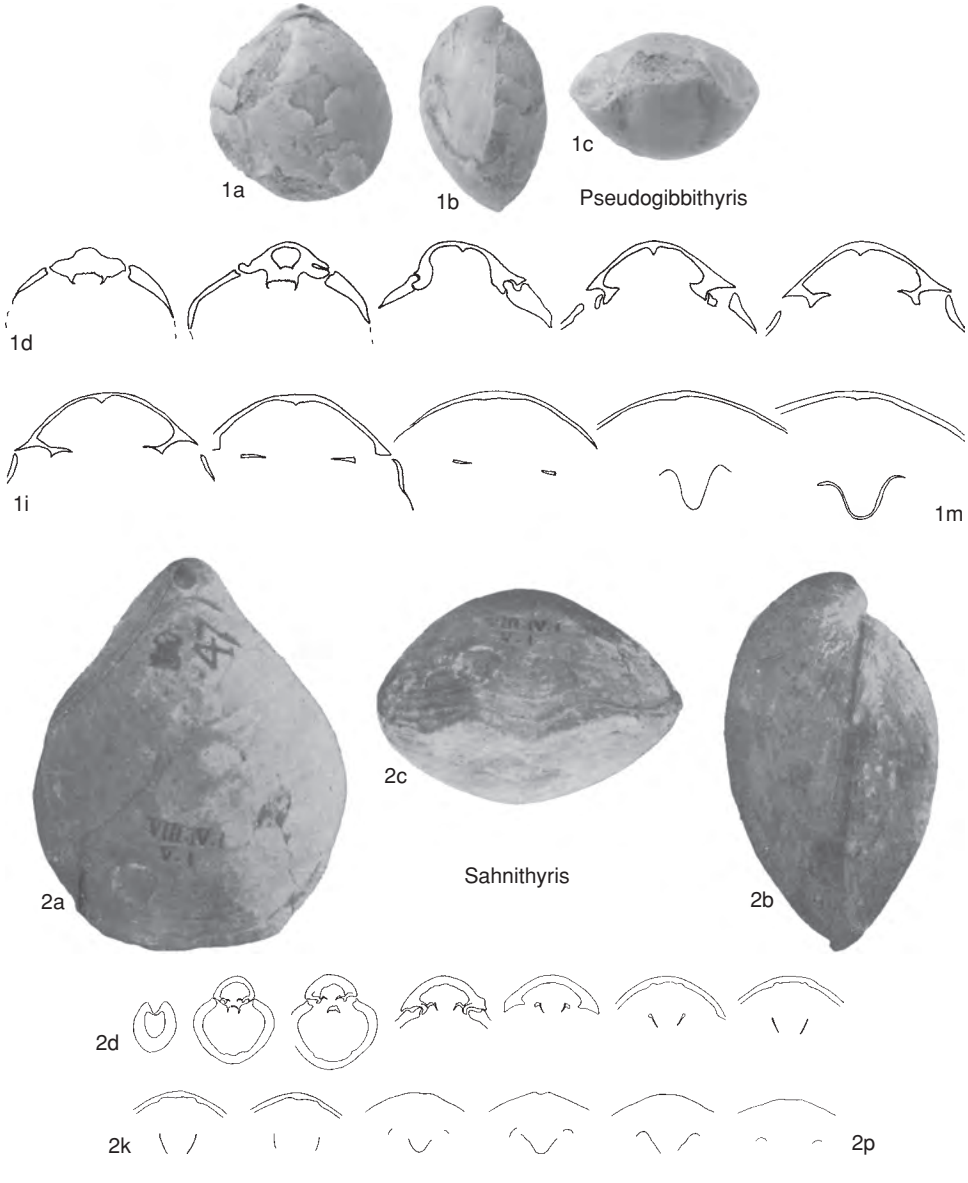

FIG. 1375. Gibbithyrididae (p. 2078).

highly variable; myophore forming bilobed pit with elevated sides and median ridge; socket ridges and hinge plates thickened, fused, and forming prominent, broad ridge; loop subtriangular to subrectangular. [Synonyms listed above are considered to be variants of *Carneithyris* and not distinct genera.] *Upper Cretaceous (Coniacian)–Paleogene (Danian):* England, Belgium, Denmark, France, Germany, Poland, Russia, Sweden.——FIG. 1376,*2a–d. *C. subpentagonalis,* Senonian, England; *a–c,* dorsal, lateral, and anterior views, ×1; *d,* closeup view of cardinalia, ×3 (Cooper, 1983).——FIG. 1376,*2e. C. rotunda* SAHNI, Senonian, England; interior of dorsal valve, ×1 (Cooper, 1983).

Giraliathyris CRAIG, 2000, p. 117 [**G. mcnamarai;* OD]. Medium size, biconvex, subcircular to subpentagonal, anterior commissure rectimarginate to slightly unisulcate; beak short, foramen small, mesothyrid to permesothyrid; symphytium narrow, concave, mostly concealed, deltidial plates conjunct; with median ridge, cardinal process a protuberant cup; loop short, 0.35 dorsal valve length.

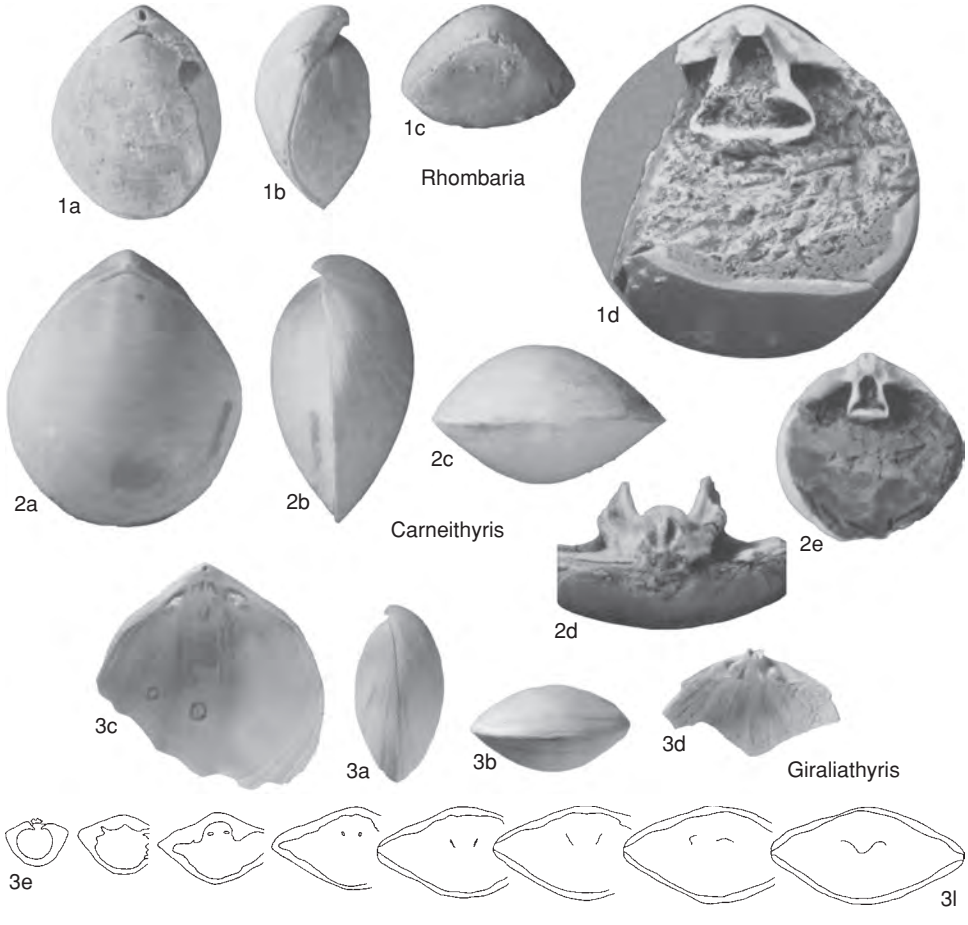

FIG. 1376. Gibbithyrididae (p. 2078–2080).

Paleogene (upper Paleocene): Western Australia (Carnarvon basin).——FIG. 1376,*3a–l.* **G. mcnamarai; *a–b,* lateral and anterior views of holotype, WAM 96.826, ×1; *c,* interior of ventral valve, ×1; *d,* interior of dorsal valve, ×1; *e–l,* serial transverse sections 4.8, 6.0, 7.2, 8.2, 10.5, 11.3, 11.5, 11.7 mm from ventral umbo, ×0.5 (Craig, 2000).

Subfamily RHOMBARIINAE Cooper, 1983

[Rhombariinae COOPER, 1983, p. 41]

Smooth, foramen small, anterior commissure uniplicate; loop wide, outer hinge plates narrow, ventrally attached to crural bases, crural processes anterior to midloop, transverse band thin, medially protuberant. *Upper Cretaceous (Coniacian–Maastrichtian).*

Rhombaria COOPER, 1983, p. 215 [**Terebratula rhomboidalis* NILSSON, 1827, p. 34; OD]. Medium size, elongate oval, strongly ventribiconvex; beak long, narrow, erect, beak ridges rounded, foramen small, symphytium exposed, permesothyrid; cardinal process large, shelflike, outer hinge plates very narrow, attached ventrally, tapering anteriorly to crural processes; crural bases, outer hinge plates and socket ridges forming V-shaped troughs; loop triangular, as wide as long. *Upper Cretaceous (Coniacian–Maastrichtian):* Sweden.——FIG. 1376,*1a–d.* **R. rhomboidalis* (NILSSON), Senonian; *a–c,* dorsal, lateral, and anterior views, ×1; *d,* interior of dorsal valve, ×2 (Cooper, 1983).

Family UNCERTAIN

Heligothyris MIDDLEMISS, 1991, p. 230 [**H. schmidi;* OD]. Small, rounded triangular, smooth, biconvex, anterior commissure unisulcate; dorsal valve

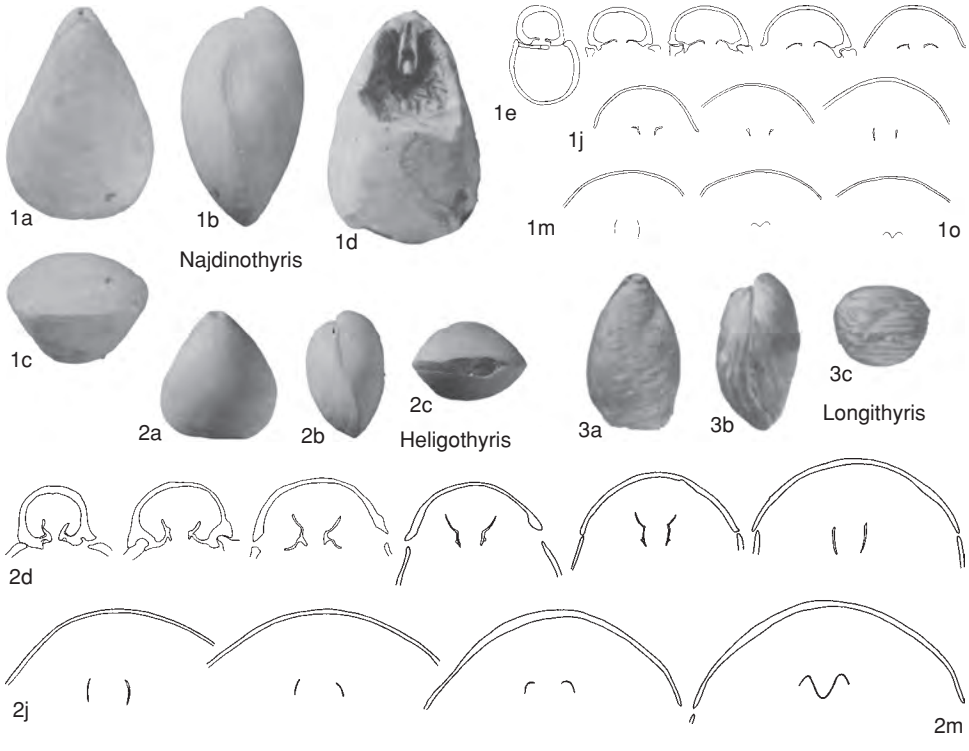

FIG. 1377. Uncertain (p. 2080–2081).

strongly inflated posteriorly; umbo suberect, foramen circular, mesothyrid, deltidium hidden in gerontic forms; cardinal process small; hinge plates initially horizontal, becoming convex; cuneate; attached crural bases given off dorsally and ventrally; free crural bases extended dorsally as thin, curved plates; loop narrow, transverse band low arched. *Upper Cretaceous (Turonian):* North Sea (Helgoland), ?Ireland.——FIG. 1377,*2a–m. *H. schmidi,* Helgoland; *a–c,* dorsal, lateral, and anterior views of holotype, HG1700a, ×1; *d–f,* serial transverse sections 2.0, 2.4, 2.8 mm from ventral umbo, ×2; *g–m,* serial transverse sections 3.2, 3.6, 4.4, 5.2, 5.6, 6.4, 6.8 mm from ventral umbo, ×2 (Middlemiss, 1991).

Ilyinella JASSJUKEVITCH, 1973, p. 104 [**I. mangyschlakensis;* OD]. Small, elongate oval, possibly finely capillate; anterior commissure rectimarginate; pedicle collar short; cardinal process trilobed; loop exceptionally short and narrow (loop reported to measure 1 mm by 1 mm in 12-mm-long dorsal valve). [This genus is poorly known; there are no illustrations of internal structures available.] *Paleogene (lower Eocene):* Mangyschlak, Kazakstan.

?Longithyris KATZ & POPOV, 1974a, p. 30 [**Najdinothyris? longa* KATZ, 1974, p. 260; OD]. Small, elongate oval, biconvex, anterior commissure uniplicate; smooth or with lateral capillae; beak incurved, foramen large, epithyrid; crural bases attached to broad, thin, outer hinge plates that are suspended in dorsal umbonal cavity, almost reaching valve floor; loop short, 0.25 dorsal valve length, narrow, with wide transverse band. [The status of this genus is questionable, as no serial sections or illustrations of the shell interior are available.] *Upper Cretaceous (Cenomanian):* Ukraine.——FIG. 1377,*3a–c. *L. longa* (KATZ); dorsal, lateral, and anterior views of holotype, ×1 (Katz, 1974).

Najdinothyris KATZ, 1974, p. 260 (MAKRIDIN & KATZ in MAKRIDIN, 1964, p. 35, *nom. nud.*) [**Terebratula becksii* ROEMER, 1841, p. 44; OD]. Medium size, elongate, smooth, ventribiconvex, anterior commissure unisulcate; dorsal valve strongly inflated posteriorly, beak suberect, foramen large, circular, permesothyrid; cardinal process small; inner socket ridges well differentiated from hinge plates; hinge plates initially concave, cuneate, becoming wide, thin, horizontal; crura given off ventrally; hinge plates attached to free crural bases; loop narrow, transverse band low arched. *Upper Cretaceous:* Germany, Poland, Russia.——FIG. 1377,*1a–o. *N. becksii* (ROEMER), Turonian, Germany; *a–c,* dorsal, lateral, and anterior views; *d,* dorsal valve interior, ×1 (Cooper, 1983); *e–o,* serial transverse sections 2.0, 2.4, 2.8, 3.2, 3.6, 4.0, 4.8, 5.6, 6.0, 7.2, 7.6 mm from ventral umbo, ×1 (Middlemiss, 1991).