CAMAROTOECHIOIDEA

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Superfamily CAMAROTOECHIOIDEA Schuchert, 1929

[*nom. transl.* SAVAGE, 1996, p. 254, *ex* Camarotoechiidae SCHUCHERT in SCHUCHERT & LEVENE, 1929a, p. 18]

Rhynchonellida with subcircular to transversely ovate outline; dorsal fold and ventral sulcus weak to moderate; tongue low to high; costae weak to strong, simple to bifurcating, more pronounced anteriorly so that umbones often smooth; foramen small with conjunct deltidial plates anteriorly. Dental plates strong, usually convergent ventrally, occasionally infilled with callus. Dorsal median septum long; septalium short, usually without cover plate; hinge plates divided anterior of septalium; cardinal process absent; crura long, commonly raduliform. Shell often thick and muscle fields deeply impressed. *lower Silurian (Llandovery)–Lower Carboniferous (Tournaisian).*

Family CAMAROTOECHIIDAE Schuchert, 1929

[Camarotoechiidae SCHUCHERT in SCHUCHERT & LEVENE, 1929a, p. 18]

Camarotoechioidea with short dental plates and low dorsal median septum. *lower Silurian (upper Llandovery)–Middle Devonian (Givetian).*

Subfamily CAMAROTOECHIINAE Schuchert, 1929

[Camarotoechiinae SCHUCHERT in SCHUCHERT & LEVENE, 1929a, p. 18]

Moderately biconvex Camarotoechiidae with costae that show some bifurcation. Dental plates nearly vertical. *Lower Devonian (Emsian)–Middle Devonian (Givetian).*

Camarotoechia HALL & CLARKE, 1893, p. 189 [**Atrypa congregata* CONRAD, 1841, p. 55; OD]. Subcircular to transversely ovate with moderately biconvex profile; maximum thickness at umbones, sides and anterior not steep. Fold and sulcus low, commencing at umbones; anterior commissure uniplicate, broad, gentle. Costae low, rounded, present on flanks as well as fold and sinus, bifurcating and intercalating. Dental plates short, strong. Hinge plates divided anteriorly; dorsal median septum long but low; septalium short; dorsal muscle field long, narrow. *Middle Devonian (Givetian):* North America.——FIG. 769,*1a–b. *C. congregata* (CONRAD), Skaneateles Formation, Butternut Shale, Onondaga County, Conklin's Falls, New York, USA; *a,* two dorsal valve internal molds, ×1.5; *b,* ventral valve internal mold, ×1 (Sartenaer, 1961b).

Ellesmerhynchia BRICE, 1990, p. 717 [**Camarotoechia* s.l. *pseudomedea* BRICE, 1982, p. 51; OD]. Elongate subtriangular to rounded outline and subequally biconvex profile; sides and anterior not truncated. Beak erect. Fold and sulcus low; anterior commissure uniplicate; tongue low, broad, gentle. Costae fine, numerous. Dental plates short, close to valve walls. Septalium short, shallow; hinge plates divided; dorsal median septum low; crura closely set, ventrally curved. *Lower Devonian (Emsian)–Middle Devonian (Eifelian):* Canada, Podolia.——FIG. 769,*2a–l. *E. pseudomedea* (BRICE), upper Emsian, Blue Fiord Formation, southwestern Ellesmere Island, Ontario, Arctic Canada; *a–d,* holotype, dorsal, ventral, anterior, and lateral views, ×1; *e–l,* serial sections 1.8, 1.9, 2.2, 2.3, 2.6, 2.8, 2.9, 4.5 mm from posterior, ×2.5 (Brice, 1990).

Subfamily LINGUOPUGNOIDINAE Savage, 1996

[Linguopugnoidinae SAVAGE, 1996, p. 254]

Early Camarotoechiidae with broad fold and sulcus; tongue high; costae strong, simple; dental plates weak. *lower Silurian (upper Llandovery)–Lower Devonian (Emsian).*

Linguopugnoides HAVLÍČEK, 1960, p. 242 [**Rhynchonella nympha* var. *carens* BARRANDE, 1879b, pl. 122; OD]. Subcircular to subpentagonal outline and dorsibiconvex profile; lateral and anterior margins steep. Beak incurved; delthyrium open; foramen may migrate to mesothyrid position in mature specimens. Fold and sulcus distinct, extending from umbones; anterior commissure uniplicate; tongue broad, high, dentate. Costae coarse, low, simple, subangular, from midlength, weak on flanks. Dental plates well developed, high, thin, convergent ventrally; ventral muscle field not deeply impressed. Dorsal median septum short, thin; septalium short, deep, narrow; hinge plates dividing immediately anterior of septalium; crura slender, ventrally curved, tips laterally flattened. *lower Silurian (upper Llandovery)–Lower Devonian (upper Emsian):* cosmopolitan.——FIG. 770,*1a–i. *L. carens* (BARRANDE), Lochkovian, Lochkov Limestone, Prague,

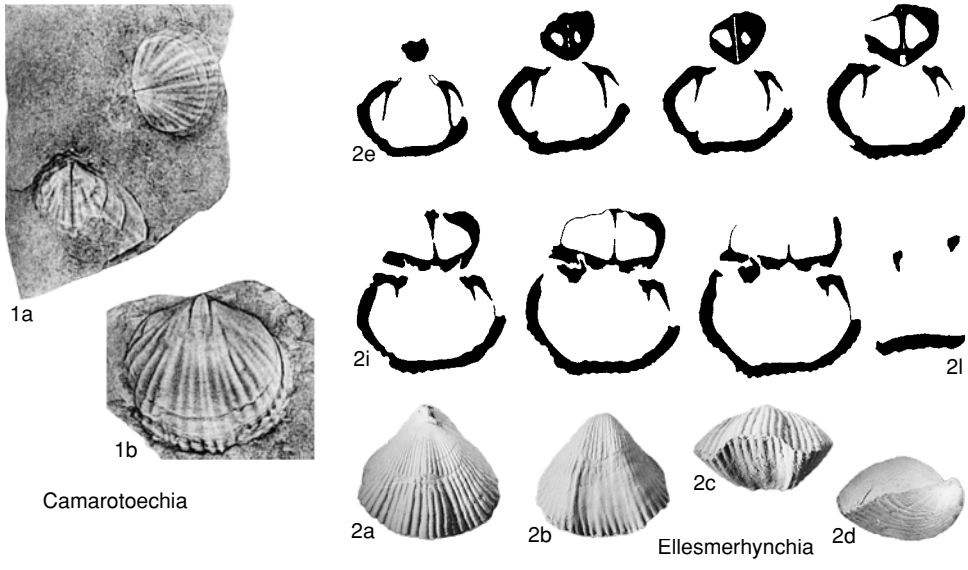

FIG. 769. Camarotoechiidae (p. 1132).

Svaty Jan, Bohemia; *a–e,* lectotype, dorsal, ventral, lateral, anterior, and posterior views, ×1.75 (new); *f–i,* serial sections 12.35, 12.15, 11.8, 11.6 mm from anterior, ×3.3 (Havlíček, 1961).

Astutorhyncha HAVLÍČEK, 1961, p. 105 [**Rhynchonella proserpina* BARRANDE, 1847, p. 64; OD]. Subcircular to subpentagonal outline; strongly biconvex profile, anteriorly inflated, sides and anterior nearly vertical. Beak incurved. Fold and sulcus strong, extending from umbones; anterior commissure uniplicate; tongue high, subrectangular, serrate. Costae strong, simple, subangular, arising just anterior of umbones, present in sulcus and on fold and flanks. Dental plates short, subvertical; ventral muscle field weakly impressed. Dorsal median septum slender, low; septalium broad, shallow; hinge plates dividing anterior of septalium. *Lower Devonian (Lochkovian–Emsian):* Bohemia, central Asia, China.——FIG. 770,*2a–j. *A. proserpina* (BARRANDE), upper Emsian, Suchomasty Limestone, Koneprusy, Bohemia; *a–e,* holotype, dorsal, ventral, lateral, anterior, and posterior views, ×1.5; *f–j,* serial sections 19.4, 19.3, 18.8, 18.7, 18.5 mm from anterior, ×2.5 (Havlíček, 1961).

Family LEIORHYNCHIDAE Stainbrook, 1945

[*nom. transl.* CRICKMAY, 1952b, p. 1, *ex* Leiorhynchinae STAINBROOK, 1945, p. 43]

Camarotoechioidea with dental plates convergent ventrally, and dorsal median septum long and high. Profile strongly biconvex. Shell commonly thick with ventral muscle field deeply impressed. *lower Silurian (Llandovery)–Lower Carboniferous (Tournaisian).*

Subfamily LEIORHYNCHINAE Stainbrook, 1945

[Leiorhynchinae STAINBROOK, 1945, p. 43]

Leiorhynchidae with smooth umbones. *Lower Devonian (Lochkovian)–Lower Carboniferous (Tournaisian).*

Leiorhynchus HALL, 1860a, p. 75 [**Orthis quadracostata* VANUXEM, 1842, p. 168; SD OEHLERT, 1887a, p. 1308] [=*Liorhynchus* OEHLERT, 1887a, p. 1308, obj., *non* RUDOLPHI, 1801; *Nudirostra* COOPER & MUIR-WOOD, 1951, p. 195, obj.]. Subcircular to transversely ovate outline and biconvex profile. Beak incurved; foramen small, permesothyrid. Fold and sulcus low; arising at midlength; anterior commissure gently uniplicate. Costae low, simple, most pronounced on fold and sulcus, weak on flanks; umbones smooth. Dental plates strongly convergent ventrally and almost meeting; occasionally forming spondylium duplex; ventral muscle field often in thick callus or deeply impressed. Dorsal median septum long, high; supporting short septalium; hinge plates divided anteriorly; dorsal muscle field narrow, usually with marginal thickening; crura long, thin, slightly curved ventrally, with narrow trough opening ventrally. *Middle Devonian (Givetian)–Upper Devonian (Frasnian):* North America, eastern Europe, Urals, Altai, Siberia,

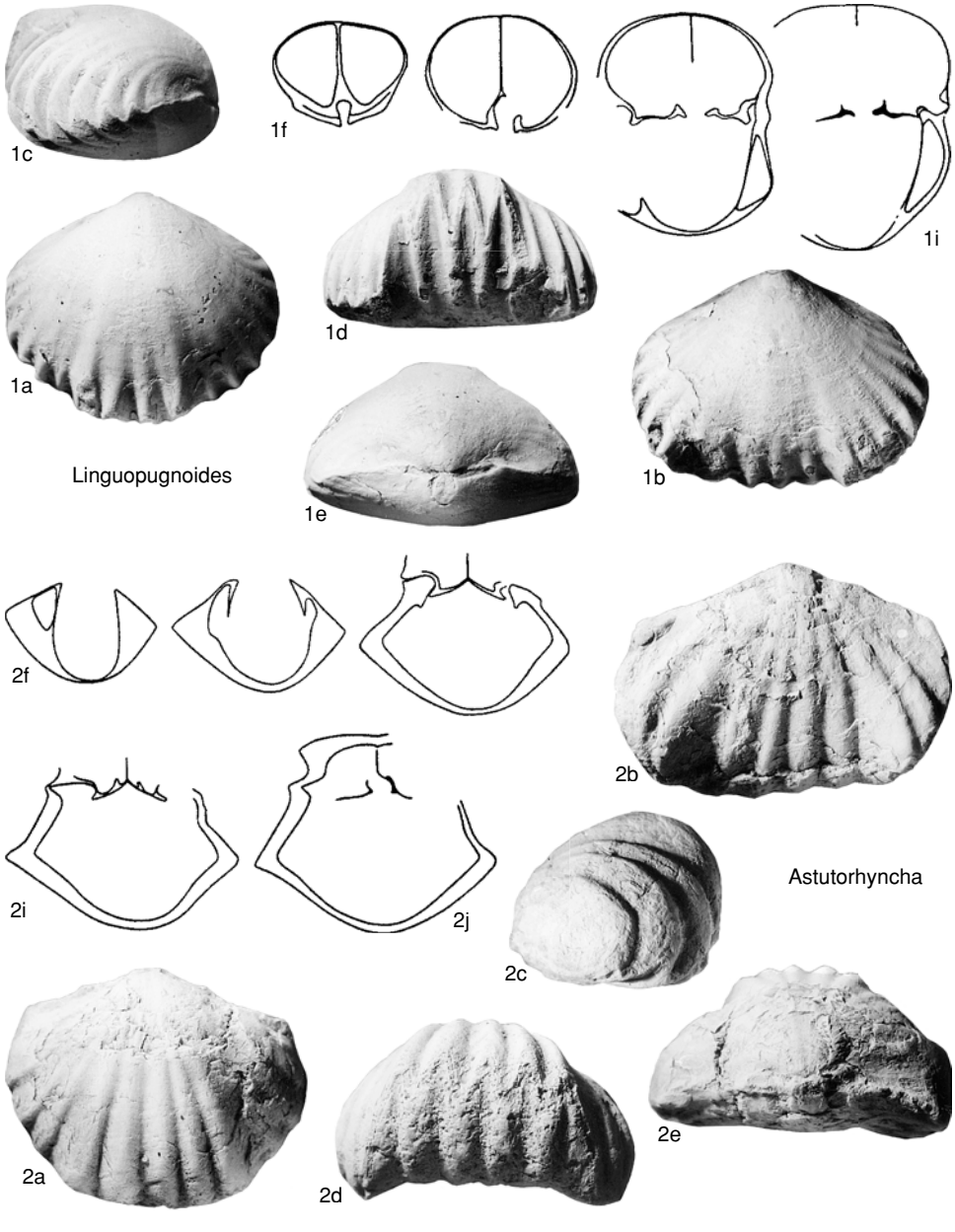

FIG. 770. Camarotoechiidae (p. 1132–1133).

China.——FIG. 771,*1a–o.* **L. quadracostata* (VANUXEM), uppermost Givetian, Sherburne Flagstone, Sheldrake, New York, USA; *a–e,* dorsal, ventral, posterior, anterior, and lateral views of internal mold, Cornell specimen no. 40605, listed by SARTENAER, 1961f, p. 969, ×1.5 (new); *f–o,* serial sections 0.45, 0.8, 0.85, 0.95, 1.0, 1.05, 1.1, 1.5, 1.8, 3.03 mm from posterior, ×3.2 (Sartenaer, 1961f).

Caryorhynchus CRICKMAY, 1952b, p. 1 [**Leiorhynchus carya* CRICKMAY, 1952a, p. 599; OD]. Subcircular outline and strongly dorsibiconvex to globular profile. Beak incurved; foramen small, semicircular, epithyridid. Fold and sulcus moderately developed, arising at umbones; anterior commissure broad; tongue moderately high, trapezoid, serrated. Fold with 2 pairs of costae separated by a sinus; sulcus with 3 costae, the median one wider than others;

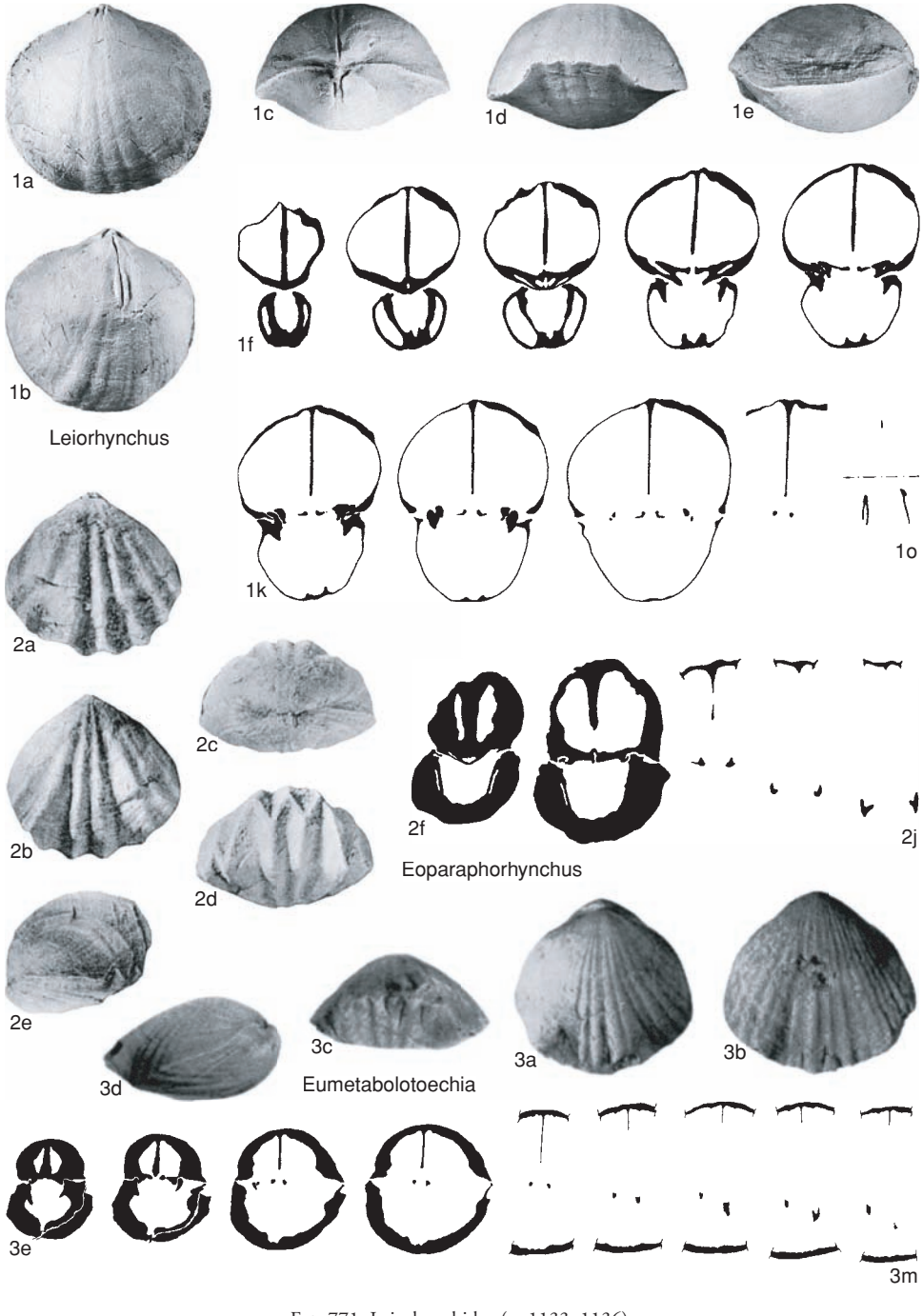

FIG. 771. Leiorhynchidae (p. 1133–1136).

flanks almost smooth. Dental plates short, converging ventrally, usually obscured by thick callus; ventral muscle field narrow, well impressed. Hinge plates short, divided; dorsal median septum high, long; dorsal muscle field narrow, well impressed; crura closely set, ventrally curved, laterally flattened distally. *Upper Devonian (middle Frasnian–upper Frasnian):* North America, Europe, Morocco.——

FIG. 772,*1a–q.* **C. carya* (CRICKMAY), middle Frasnian, Perdix Formation, Alberta, Canada; *a–d,* holotype, dorsal, ventral, anterior, and lateral views, ×1.3; *e–h,* hypotype, dorsal, posterior, anterior, and lateral views, ×1; *i,* enlargement of posterior, ×3; *j–m,* hypotype, serial sections, ×2.2 (Crickmay, 1952b); *n–q,* serial sections 1.0, 1.5, 2.1, 4.2 mm from posterior, ×1.5 (McLaren, 1962).

Eliorhynchus SARTENAER, 1987c, p. 142 [**Rhynchonella castanea* MEEK, 1868, p. 93; OD]. Subcircular to longitudinally ovate outline and strongly dorsibiconvex to globular profile. Ventral beak erect to incurved, sometimes pierced by small foramen; ventral beak overlapped by dorsal beak in holotype. Fold and sulcus low, most evident anteriorly; anterior commissure uniplicate; tongue high in mature shells, weakly serrate. Costae low, from midlength, with some bifurcation, mostly confined to fold and sulcus but may be weakly developed on flanks. Dental plates converging ventrally to meet at valve floor; ventral muscle field long, narrow, pointed posteriorly, rounded anteriorly. Dorsal median septum long, high; septalium very short; hinge plates short, breaking up early; dorsal muscle field narrow, well impressed, extending to midlength; crura long, ventrally curved, with distinct distal trough opening dorsally. *Middle Devonian (Givetian):* western North America.——FIG. 773,*1a–l.* **E. castanea* (MEEK), lower Givetian, Hare Indian Formation, Northwest Territories, Canada; *a–e,* holotype, dorsal, ventral, posterior, anterior, and lateral views [only specimen figured by MEEK], Carnwath River [given as Lockhart River by MEEK], USNM 5890, ×1.5 (Johnson, 1974); *f–l,* hypotype, serial sections 1.6, 2.1, 2.25, 2.5, 3.1, 4.4, 6.7 mm from posterior, Anderson River, ×2 (McLaren, 1962).

Eoparaphorhynchus SARTENAER, 1961c, p. 2 [**E. maclareni;* OD]. Subtriangular to ovate outline and dorsibiconvex profile. Beak suberect; foramen small, circular. Fold and sulcus strong, from beaks; anterior commissure uniplicate; tongue high, serrate. Costae angular, strong on fold and sulcus, weaker on flanks. Surface with fine radial striae. Dental plates short, close to walls, convergent ventrally; ventral muscle field impressed, flabellate, to midlength, with stout myophragm. Septalium short, narrow, deep; hinge plates divided, horizontal; dorsal median septum high, stout, extending to one-third valve length; dorsal muscle field transversely ovate, divided by septum; crura short, curved ventrally, V-shaped cross section open dorsally. *Upper Devonian (lower Famennian):* western North America, Europe, Kazakhstan, Pamir, China.——FIG. 771,*2a–j.* **E. maclareni,* Northwest Territories, Root River, Canada; *a–e,* holotype, dorsal, ventral, posterior, anterior, and lateral views, ×1; *f–j,* serial sections 1.65, 2.2, 3.6, 5.2, 5.8 mm from posterior, ×2 (Sartenaer, 1961c).

Eumetabolotoechia SARTENAER, 1975b, p. 2 [**Rhynchonella(?) laura* BILLINGS, 1860, p. 273; OD]. Subcircular to longitudinally ovate outline and biconvex profile; sides and anterior not precipitous. Beak incurved. Fold and sulcus low, arising at umbones; anterior commissure gently uniplicate; tongue low. Costae weak, increasing by bifurcation and intercalation, on flanks as well as fold and sulcus. Dental plates short, converging ventrally, obscured by thick callus; ventral muscle field narrow, well impressed. Dorsal median septum long, high; septalium short; hinge plates short, breaking up early; dorsal muscle field narrow, well impressed; crura long, ventrally curved, tip V-shaped in cross section, open dorsally. *Middle Devonian (Givetian):* eastern North America, Libya.——FIG. 771,*3a–m.* **E. laura* (BILLINGS), middle Givetian, Hamilton Group, Bosanquet, Ontario, Canada; *a–d,* holotype, dorsal, ventral, anterior, and lateral views, ×1; *e–m,* serial sections 0.8, 1.4, 1.8, 1.9, 3.4, 4.4, 4.7, 4.9, 4.95 mm from posterior, ×2 (Sartenaer, 1975b).

Evanescirostrum SARTENAER, 1965b, p. 8 [**Nudirostra gibbosa seversoni* MCLAREN, 1954, p. 180; OD]. Subpentagonal to transversely ovate outline and dorsibiconvex profile. Beak suberect, pierced by small foramen. Fold and sulcus strong, arising near umbones; anterior commissure uniplicate; tongue high, broad, serrate. Costae strong, angular, simple, weak on flanks. Dental plates short, near walls, convergent ventrally; ventral muscle field well impressed. Septalium short, well developed; hinge plates divided; dorsal median septum long, high; crura long, ventrally curved, tip with trough-shaped cross section open dorsally. *Upper Devonian (Famennian):* western North America, Europe, Afghanistan, Iran.——FIG. 772,*3a–l.* **E. seversoni* (MCLAREN), lower Famennian, Palliser Formation, Alberta, Banff Park, western Canada; *a–e,* holotype, dorsal, ventral, lateral, posterior, and anterior views, ×1; *f–l,* serial sections 1.4, 1.6, 2.05, 2.3, 2.7, 3.75, 4.1 mm from posterior, ×2.3 (Sartenaer, 1969).

Hadrotatorhynchus SARTENAER, 1986a, p. 138 [**Leiorhynchus Halli* FLAMAND, 1911, p. 820; OD]. Subcircular to transversely ovate outline and biconvex profile; sides not steep. Beak erect to incurved. Fold and sulcus distinct, arising at umbones; anterior commissure uniplicate; tongue low, broad. Costae low, simple, weak on fold and in sulcus, very weak on flanks. Dental plates very short; ventral muscle field deeply impressed. Dorsal median septum high, thin, extending to midlength; hinge plates short; septalium very short to absent, crural bases delicate; crura closely set, fine, laterally compressed at tips. *Middle Devonian (upper Givetian)–Upper Devonian (lower Frasnian):* northern Africa, Poland.——FIG. 773,*3a–h.* **H. halli* (FLAMAND), uppermost Givetian, Mouydir, Algeria; *a–b,* lectotype, dorsal and anterior views, ×1 (Flamand, 1911); *c–h,* serial sections 1.3, 1.5, 1.9, 2.9, 4.4, 5.1 mm from posterior, ×1.4 (Drot, 1964b).——FIG. 773,*3i–q. L. laskowaesis* SARTENAER & RACKI, uppermost Givetian, Szydlwek Beds, Holy Cross Mountains, Kostomloty, Poland; serial sections 0.95, 1.05, 1.75, 2.0, 2.1, 2.6, 3.05, 3.2, 4.1 mm from posterior, ×1.7 (Sartenaer & Racki, 1992).

Havlicekella AMSDEN, 1985, p. 6 [**H. miticonvexa;* OD]. Subcircular to subpentagonal outline and dorsibiconvex profile. Beak erect. Fold and sulcus

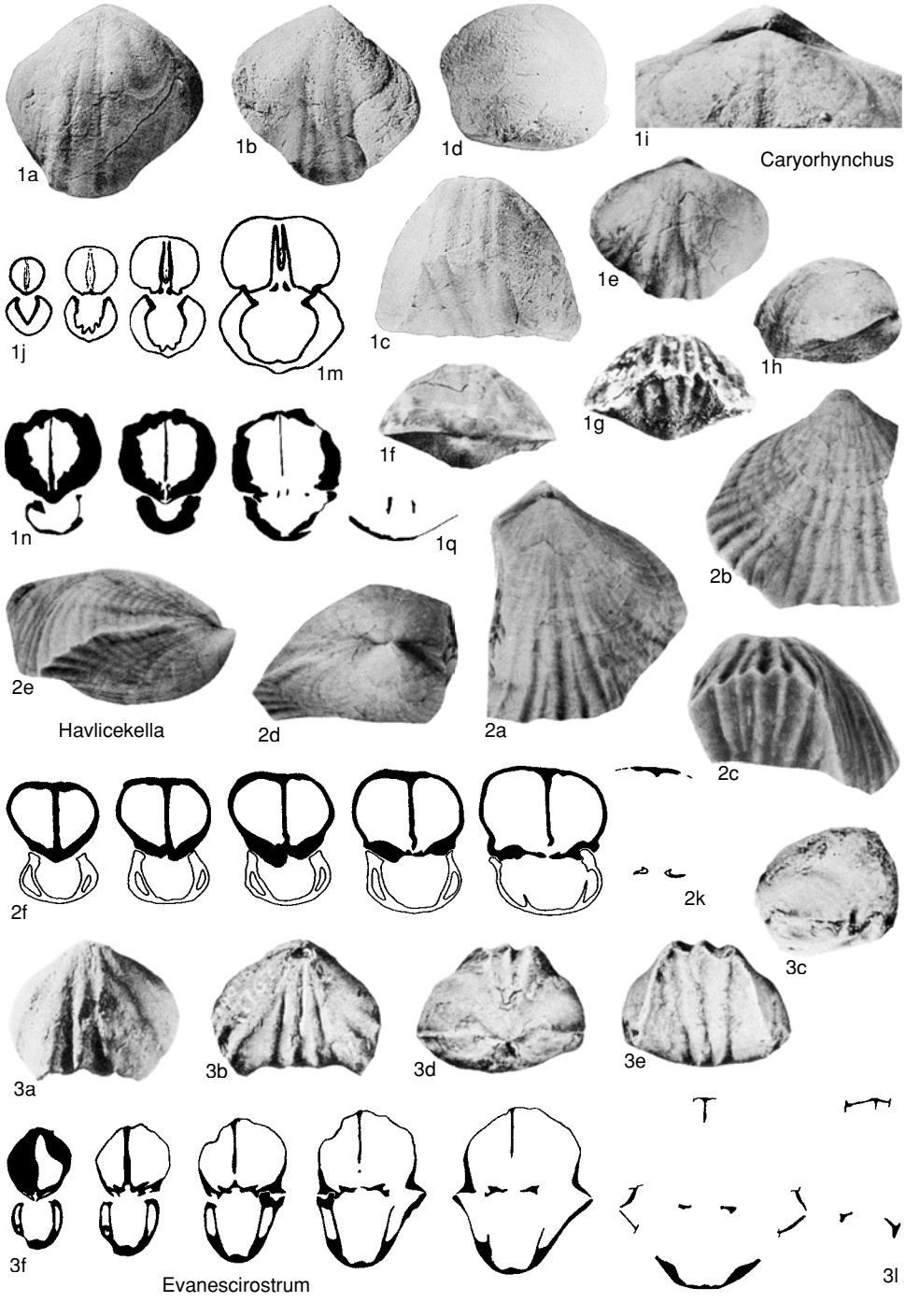

FIG. 772. Leiorhynchidae (p. 1134–1139).

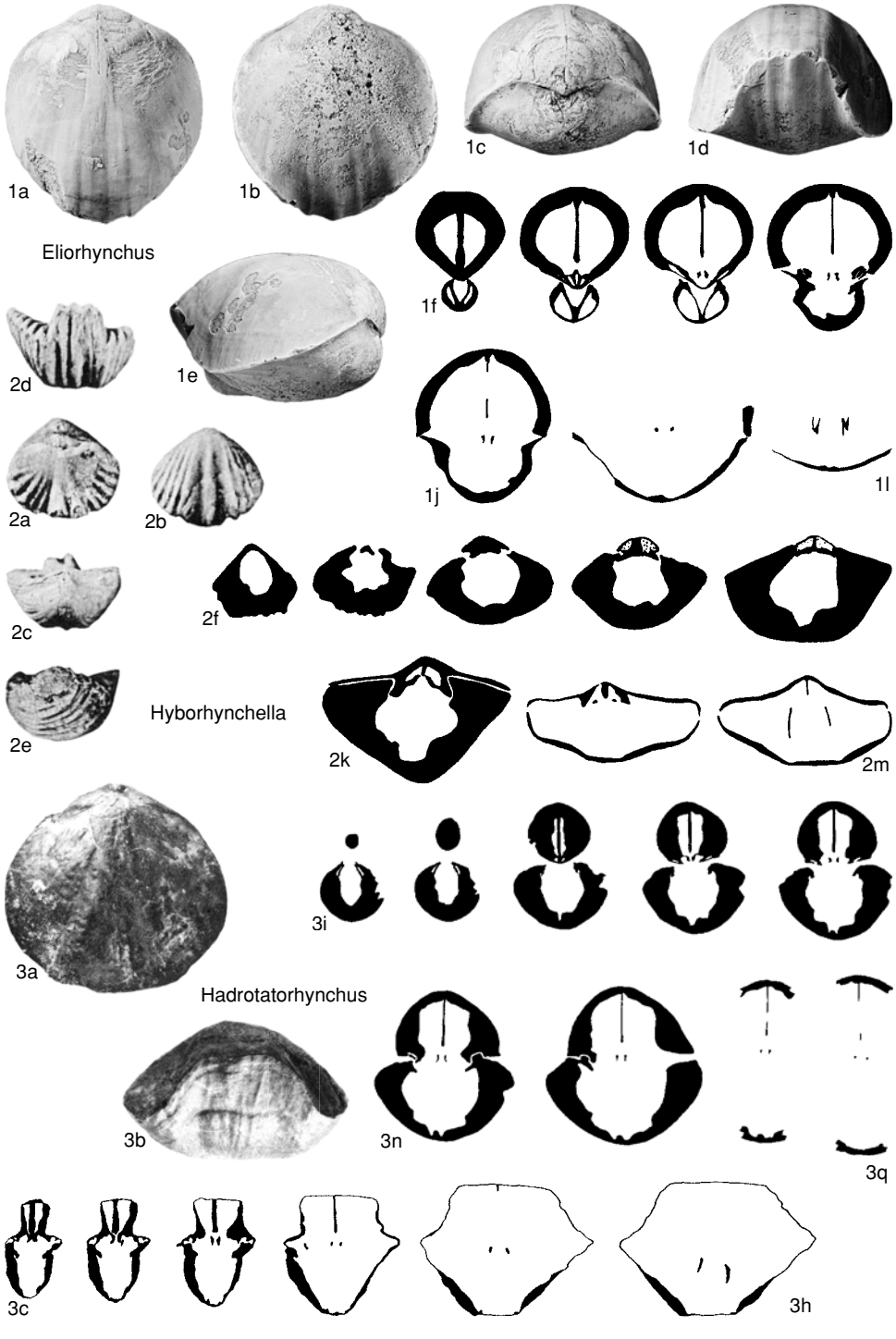

FIG. 773. Leiorhynchidae (p. 1136–1139).

from midlength; anterior commissure uniplicate, broad; tongue high, rounded in large specimens. Costae low, arising near beaks, bifurcating on fold, intercalating in sulcus; distinct posteriorly and on flanks. Dental plates short, converging ventrally; muscle field not strongly impressed. Dorsal median septum long, high; septalium short to absent; hinge plates dividing early. *Lower Devonian (Pragian):* USA.——Fig. 772,*2a–k. *H. miticonvexa,* Turkey Creek Limestone, Turkey Creek, Oklahoma; *a–e,* holotype, dorsal, ventral, anterior, posterior, and lateral views, ×2; *f–k,* serial sections 1.2, 1.3, 1.4, 1.5, 1.8, 2.2 mm from posterior, ×4.5 (Amsden, 1985).

Hyborhynchella Cooper, 1955, p. 59 [**H. bransoni;* OD]. Small size with subcircular outline and planoconvex profile. Beak incurved; delthyrium plugged by dorsal beak; foramen small, posterior of beak. Fold and sulcus strong, narrow, extending from umbones. Costae rounded, particularly large on fold and in sulcus, arising at umbones; smaller costae on flanks. Dental plates absent; ventral muscle field narrow, deeply impressed. Dorsal median septum thick, low, long, extending to midlength; hinge plates short, flattened posterior of wide septalium, then dividing anterior of septalium; crura long, slender, laterally compressed distally. *Upper Devonian (Frasnian):* western North America.——Fig. 773,*2a–m. *H. bransoni,* upper Frasnian, Sly Gap Formation, Alamogordo, Indian Wells Canyon, New Mexico, USA; *a–c,* holotype, dorsal, ventral, posterior views; *d–e,* paratype, anterior and lateral views, ×2; *f–k,* paratype, serial sections, sections 0.35, 0.5, 0.65, 0.8, 1.0, 1.15 from posterior, ×3; *l–m,* sections of another paratype 0.16 mm apart, showing crura, approximately ×3 (Cooper, 1955).

Iloerhynchus Balinski, 1995a, p. 47 [**I. mesoplicatus;* OD]. Subcircular outline and dorsibiconvex profile; lateral and anterior slopes gentle. Beak incurved. Fold and sulcus strong, arising at umbones; tongue of moderate strength, trapezoid, only rarely becoming vertical. Costae few, subangular, most prominent anteriorly; strong on fold and sulcus with generally 3 on fold and 2 in sulcus, weak or absent on flanks; anterior commissure typically triserrate. Dental plates absent or obscured by callus; ventral muscle field deeply impressed; teeth supported by short oblique ridges. Dorsal median septum thin, low, extending to one-third valve length; hinge plates and septalium very short; crura strongly curved ventrally. *Upper Devonian (lower Famennian):* Poland.——Fig. 774,*1a–l. *I. mesoplicatus, Palmatolepis triangularis* Zone, Debnik, southern Poland; *a–e,* holotype, dorsal, ventral, lateral, anterior, and posterior views, ×2; *f–l,* serial sections 1.1, 1.5, 1.8, 2.0, 2.3, 2.5, 2.7 mm from posterior, ×3.3 (Balinski, 1995a).

Ilopsyrhynchus Sartenaer, 1988, p. 59 [**I. iteinus;* OD]. Large with subcircular outline and dorsibiconvex profile; with sides and anterior not precipitous. Beak erect to incurved; foramen small, semicircular, mesothyrid. Fold and sulcus weak, from midlength; anterior commissure uniplicate; tongue low, broad, angular, trapezoid. Costae weak, restricted to fold and sulcus, arising at about midlength. Dental plates very short, meeting ventrally in thick callus to form short spondylium; ventral muscle field long, narrow, well impressed. Dorsal muscle field narrow, in thick callus; septalium long, narrow; hinge plates short, breaking up early; crura long, closely set, slightly curved ventrally. *Middle Devonian (lower Givetian):* western North America.——Fig. 774,*2a–m. *I. iteinus,* Denay Limestone, Roberts Mountains, Willow Creek, Nevada, USA; *a–e,* holotype, dorsal, ventral, posterior, lateral, anterior views, ×1 (Johnson, 1974); *f–m,* serial sections 2.75, 3.05, 3.25, 3.45, 4.05, 4.35, 5.35, 8.25 mm from posterior, ×2.5 (Sartenaer, 1988).

Katuniella Kulkov in Savage, herein, p. 1615, *nom. nov. pro Katunia* Kulkov, 1963, p. 54, *non* Romanenko & Romanenko, 1962, p. 25, Trilobita [**Katunia subtrigonata* Kulkov, 1963, p. 54*;* OD]. Subtrigonal outline and dorsibiconvex profile. Beak suberect to erect; foramen small. Fold and sulcus wide; anterior commissure uniplicate; tongue trapezoid in mature specimens. Costae weak, subangular, arising at midlength; Dental plates absent or obscured by callus. Dorsal median septum low, short, supporting very short septalium; crural bases triangular. *Lower Devonian (Lochkovian):* Gorno-Altai, China, North America.——Fig. 774,*3a–m. *K. subtrigonata,* Solovikha Limestone, Gorno-Altai; *a–d,* holotype, dorsal, ventral, lateral, and anterior views, ×1; *e–i,* topotype, serial sections of posterior, ×4 (Kulkov, 1963); *j–m,* topotype, new serial sections of dorsal valve showing median septum, intervals unknown, approximately ×4 (new; courtesy of N. P. Kulkov).

Leptocaryorhynchus Sartenaer, 1970a, p. 14 [*"*Camarotoechia" jamensis* Brice, 1967, p. 100; OD]. Subpentagonal outline and dorsibiconvex profile. Beak prominent, erect to incurved; foramen small, circular. Fold and sulcus pronounced anteriorly; tongue high, trapezoid, serrate. Costae strong, rounded, extending from umbones. Dental plates short, partly obscured by thick callus that also accentuates ventral muscle impression. Dorsal median septum thick, low; septalium partly overhung by hinge plates and obscured by callus; crura curved ventrally, tips with V-shaped cross section, open dorsomedially. *Upper Devonian (Famennian):* Afghanistan.——Fig. 775,*1a–m. *L. jamensis* (Brice), Ghor, Ghouk Pass; *a–e,* holotype, dorsal, ventral, posterior, lateral, and anterior views, ×1; *f–m,* serial sections 1.4, 1.6, 1.7, 1.9, 2.3, 2.5, 2.6, 3.6 from posterior, ×3 (Brice, 1967).

Mononusphaericorhynchus Sartenaer, 1996, p. 247 [**Leiorhynchus (Leiorhynchus) sartenaeri* Johnson, 1974, p. 56; OD]. Small to medium size for subfamily; subcircular to longitudinally ovate outline and strongly dorsibiconvex to globular profile. Ventral beak erect to incurved, pierced by small foramen. Fold and sulcus low, most evident anteriorly; anterior commissure uniplicate; tongue high in

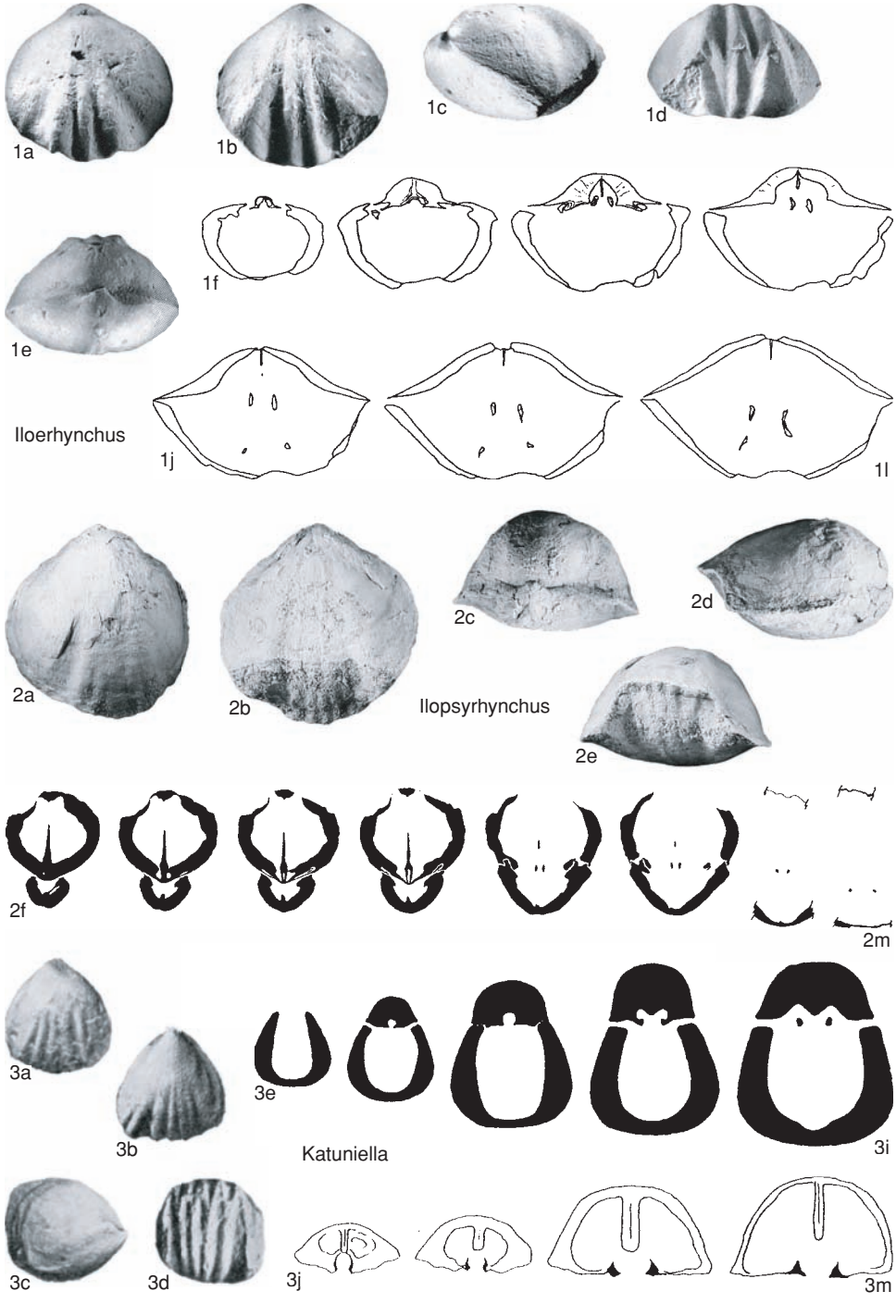

FIG. 774. Leiorhynchidae (p. 1139).

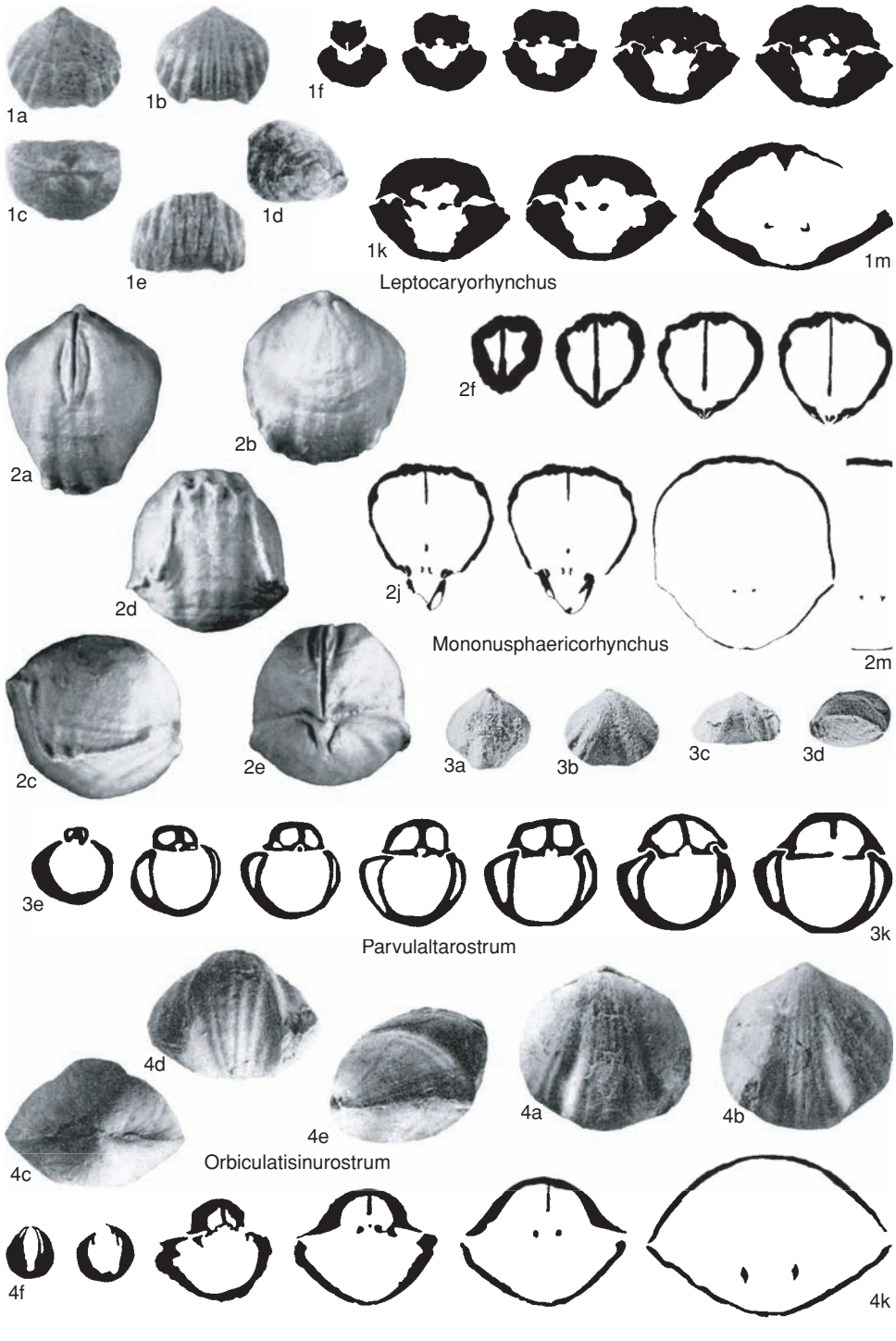

FIG. 775. Leiorhynchidae (p. 1139–1142).

mature shells, weakly serrate. Costae low, from midlength, mostly confined to fold and sulcus but may be weakly developed on flanks. Dental plates short, converge ventrally to meet at valve floor; teeth small, stout; ventral muscle field weakly impressed. Dorsal median septum thin, extending almost to valve midlength; hinge plates and septalium very short or not developed; dorsal muscle field narrow, well-impressed, extending to midlength, spindle shaped; crura long, almost touching, ventrally curved. *Middle Devonian (Givetian):* western North America.——Fig. 775,*2a–m. *M. sartenaeri* (Johnson), lower Givetian, Woodpecker Limestone, Sulphur Spring Range, Nevada, USA; *a–e,* holotype, dorsal, ventral, lateral, anterior, and posterior views, ×1.5 (Johnson, 1974); *f–m,* serial sections 0.95, 1.2, 1.7, 2.0, 2.35, 2.65, 5.6, 6.25 mm from posterior of topotype, ×1.7 (Sartenaer, 1996).

Orbiculatisinurostrum Sartenaer, 1984b, p. 2 [**Leiorhynchus laevis* Gurich, 1903, p. 150; OD]. Subcircular to subpentagonal outline and biconvex profile; lateral and anterior slopes gentle. Beak erect to incurved. Fold and sulcus strong, extending from umbones; anterior commissure uniplicate; tongue wide, trapezoid, high; Costae low, bifurcate and intercalate, arising at umbones, weak on flanks. Dental plates very short, close to walls, ventrally convergent. Dorsal median septum thin, long; septalium short; hinge plates short, divided, breaking up early; crura ventrally curved. *Upper Devonian (upper Frasnian):* Poland.——Fig. 775,*4a–k. *O. laevis* (Gurich), uppermost Frasnian, Cracow, near Debnik, southern Poland; *a–e,* neotype, dorsal, ventral, posterior, anterior, and lateral views, ×1.5; *f–k,* serial sections 0.3, 0.4, 1.0, 1.4, 1.7, 2.8 mm from posterior, ×1.5 (Balinski, 1979).

Parvulaltarostrum Sartenaer, 1979b, p. 2 [**P. veeversi;* OD]. Small with subcircular to transversely ovate outline and equibiconvex, lenticular profile. Beak suberect; delthyrium narrow, open. Fold and sulcus strong, arising just anterior of umbones; anterior commissure uniplicate, tongue high, rounded, tapering apically. Costae few, low, very weak on flanks. Dental plates long, close to walls, concave medially. Hinge plates divided; dorsal median septum long; septalium short. *Upper Devonian (Frasnian):* northwestern Australia.——Fig. 775,*3a–k. **P. veeversi,* Napier Formation, Fitzroy basin, Napier Range, south of Van Emmerick Range; *a–d,* holotype, dorsal, ventral, anterior, and lateral views, ×1; *e–k,* serial sections 1.1, 1.3, 1.4, 1.5, 1.6, 1.8, 2.0 mm from posterior, ×3 (Veevers, 1959a).

Paurorhyncha Cooper, 1942, p. 231 [**Rhynchonella endlichi* Meek, 1875, p. 46; OD]. Large with subtriangular outline and dorsibiconvex profile; convexoconcave form of large specimens resulting from strong, wide fold and sulcus. Beak small, erect; foramen minute. Fold and sulcus very wide; anterior commissure broad, uniplicate; tongue high, arched. Costae numerous, extending from beaks, with minor bifurcation and intercalation. Dental plates short, thin; ventral muscle field lachrymal, impressed, anteriorly expanded. Dorsal median septum short, high; septalium short, wide; hinge plates short, united by septalium, breaking up early. *Upper Devonian (Famennian):* western North America.——Fig. 776,*1a–b. **P. endlichi* (Meek), upper Famennian, Ouray Limestone, Mount Eolus, Colorado, USA; dorsal and ventral views, ×0.6 (Kindle, 1909).——Fig. 776,*1c–h. P. cooperi* Stainbrook, upper Famennian, Percha Shale, New Mexico, USA; *c–f,* dorsal, ventral, posterior, and lateral views of internal mold, ×0.9 (Cooper, 1942); *g,* interior of conjoined valves, ×2; *h,* transverse section, ×1.3 (Cooper & Dutro, 1982).

Properotundirostrum Sartenaer, 1986b, p. 490 [**Leiorhynchus miriam* Johnson, 1971, p. 315; OD]. Subcircular to subpentagonal outline and equibiconvex lenticular profile; gentle lateral and anterior slopes. Beak erect; foramen small, circular. Fold and sulcus low, extending from umbones; anterior commissure uniplicate, broad, low, serrate. Costae simple, arising at umbones, low on fold and sulcus; very weak on flanks. Dental plates thin, short, strongly convergent ventrally to almost meeting; ventral muscle field very faint, flabellate, extending almost to midlength. Dorsal median septum short, thin, high; septalium short; hinge plates divided; dorsal muscle field very faint. *Middle Devonian (Eifelian):* western North America.——Fig. 776,*2a–g. **P. miriam* (Johnson), upper Eifelian, Roberts Mountains, Lone Mountain, Nevada, USA; *a–e,* paratype, dorsal, ventral, posterior, lateral, anterior views, ×1.5; *f,* interior of ventral valve, ×3; *g,* interior of articulated valves, ×4 (Johnson, 1971).

Rossirhynchus Gaetani, 1964, p. 637 [**R. adamantinus;* OD] [=*Septemirostellum* Roberts, 1971, p. 132 (type, *Camarotoechia septima* Veevers, 1959b, p. 12, OD)]. Subpentagonal outline and dorsibiconvex profile; flanks steeply rounded. Beak incurved. Fold and sulcus moderately strong, from umbones; anterior commissure uniplicate, broad, rounded, denticulate. Costae strong, angular, simple, present on fold, sulcus, flanks. Dental plates moderately long, ventrally convergent, close to walls; ventral muscle field narrow, well impressed. Dorsal median septum long, high, thick; septalium deep, long, with cover; hinge plates united; dorsal muscle field narrow, well impressed; crura long, dorsally grooved, ventrally curved, with tips laterally compressed. *Lower Carboniferous (Tournaisian):* Iran, Australia, Argentina, Chile.——Fig. 776,*3a–k. **R. adamantinus,* Geirud Formation, central Elburz, Zaigun Valley, Iran; *a–e,* holotype, dorsal, ventral, lateral, anterior, and posterior views, ×1; *f–k,* serial sections 2.1, 2.4, 3.05, 3.55, 5.35, 5.55 mm from posterior, ×1.5 (Gaetani, 1964).

Ryocarhynchus Sartenaer, 1984b, p. 7 [**Camarophoria tumida* Kayser, 1872, p. 695; OD]. Subcircular outline and strongly dorsibiconvex to globular profile. Beak incurved; foramen small, semicircular, epithyrid. Fold and sulcus moderate to strong, arising at umbones; anterior commissure broad; tongue moderately high, trapezoid. Fold

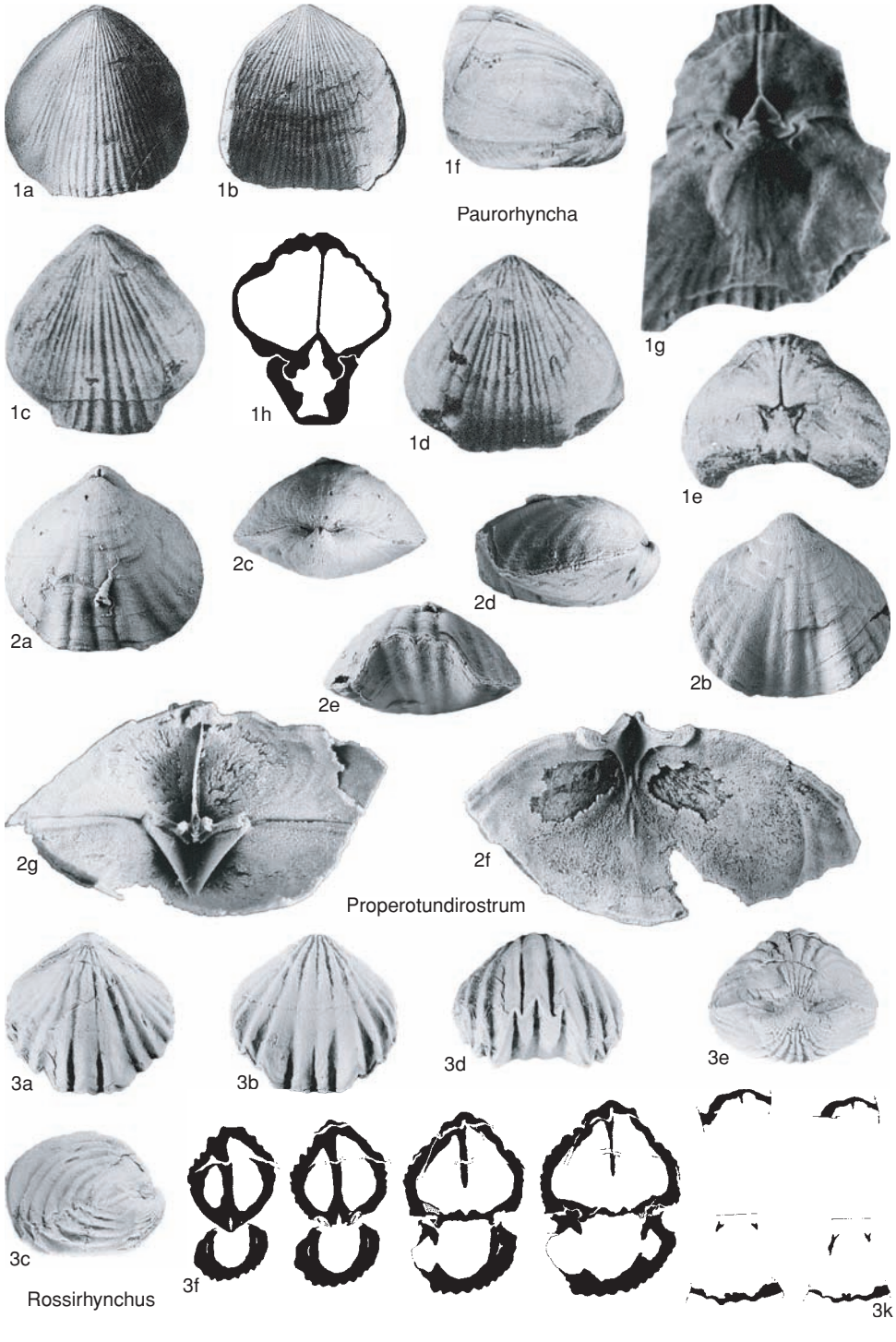

FIG. 776. Leiorhynchidae (p. 1142).

typically with pair of wide costae separated by sinus; sulcus with single costa; flanks almost smooth. Shell walls very thick. Dental plates absent; ventral muscle field narrow, deeply impressed. Dorsal median septum high, long, very thick posteriorly and along its ventral edge, thin anteriorly; septalium wide, short; hinge plates divided anterior of septalium; dorsal muscle field narrow, divided by low ridge; crura closely set, thin, ventrally curved. *Upper Devonian (upper Frasnian):* Europe, Morocco.——Fig. 777,*1a–j. *R. tumidus* (Kayser), "Matagne" Shales, Fragnes, Belgium; *a–d,* paralectotype, dorsal, ventral, anterior, and lateral views, ×1; *e–j,* serial sections 2.0, 2.1, 2.45, 2.6, 2.9, 3.1 mm from posterior, ×1.4 (Sartenaer, 1968b).

Stenoglossariorhynchus Sartenaer, 1970a, p. 6 [**Leiorhynchus awokanak* McLaren, 1962, p. 91; OD]. Subcircular to transversely ovate outline and equibiconvex profile. Beak incurved; foramen small, submesothyrid. Fold and sulcus low, from midlength; anterior commissure uniplicate; tongue wide, moderately high, trapezoid, serrate. Umbones smooth. Costae low, narrow, extending from near umbones, on fold, sulcus, flanks. Dental plates short, almost meeting ventrally in thick callus; ventral muscle field narrow. Dorsal median septum long, high, thick; septalium short, narrow; hinge plates divided immediately anterior of septalium; dorsal muscle field narrow; crura long, deep, ventrally curved, tips laterally compressed. *Middle Devonian (Givetian):* western Canada.——Fig. 777,*2a–m. *S. awokanak* (McLaren), lower Givetian, Pine Point Formation, Great Slave Lake, Pine Point; *a–e,* holotype, dorsal, ventral, posterior, lateral, and anterior views, ×1; *f–m,* serial sections 2.0, 2.4, 3.0, 3.4, 3.7, 4.2, 5.3, 5.6 mm from posterior, ×2 (McLaren, 1962).

Striatorhynchus Pushkin, 1986, p. 91 [**S. komarovichensis;* OD]. Subpentagonal outline and dorsibiconvex profile. Beak small, erect to incurved. Fold and sulcus weak except at anterior margin; anterior commissure uniplicate; tongue wide, high, serrate. Costae coarse, rounded, weak, restricted to anterior margin. Outer layer of shell bearing fine radial striae in which are dotlike exopunctae. Dental plates short, vertical. Dorsal median septum long, high; septalium long, deep; hinge plates horizontal, divided anterior of septalium. *Upper Devonian (Famennian):* Belorussia.——Fig. 777,*3a–k. *S. komarovichensis,* Zadonsk Horizon, Gomelsk; *a–e,* holotype, dorsal, ventral, lateral, posterior, anterior views, ×1; *f,* enlargement of surface showing striae, exopunctae, ×9; *g–k,* serial sections 0.8, 1.5, 1.7, 2.1, 2.4 mm from posterior, ×2 (Pushkin, 1986).

Tenuisinurostrum Sartenaer, 1967, p. 2 [**Camarophoria crenulata* Gosselet, 1877b, p. 316; OD]. Transversely ovate outline; moderately biconvex profile. Beak erect to incurved; foramen small, mesothyrid. Fold and sulcus moderate; anterior commissure uniplicate, tongue rounded to rectimarginate. Costae few, weak; flanks almost smooth. Dental plates absent; ventral muscle field well impressed. Hinge plates divided anterior of short septalium; dorsal median septum short and thin; crura laterally compressed; closely set. *Upper Devonian (lower Famennian):* Europe, northern Africa.——Fig. 778,*1a–n. *T. crenulatum* (Gosselet), Senzeilles section, upper *Palmatolepis triangularis* Zone, railway cutting northwest of Senzeilles tunnel, Belgium; *a–d,* lectotype, dorsal, ventral, anterior, and lateral views, ×1; *e–n,* serial sections 0.85, 1.05, 1.15, 1.4, 1.7, 2.1, 3.0, 3.15, 3.35, 3.4 mm from posterior, ×2 (Sartenaer, 1967).

Werneckeella Lenz, 1971, p. 844 [**W. hartensis;* OD] [=*Irgislella* Tjazheva, 1972, p. 90 (type, *I. indecora,* OD)]. Subtriangular to subpentagonal outline and dorsibiconvex profile. Beak small, suberect; foramen circular, delthyrium with conjunct deltidial plates. Fold and sulcus pronounced, extending from umbones; anterior commissure uniplicate; tongue high, broad, dentate. Costae moderately strong, simple, distinct on fold and in sulcus, weak on flanks. Dental plates thin, concave medially, converging ventrally; ventral muscle field narrow, anteriorly expanded, slightly impressed, reaching about one-third shell length. Dorsal median septum high, about one-third shell length; septalium short, narrow, deep; hinge plates divided; dorsal muscle field elongate oval; crura long, strongly curved ventrally, L-shaped in cross section. *Lower Devonian (Pragian):* North America, Russia (western Urals), Australia, China.——Fig. 777,*4a–l. *W. hartensis,* Prongs Creek Formation, Yukon, Wernecke Mountains, Canada; *a–c,* holotype, dorsal, ventral, and anterior views, ×1.5; *d,* hypotype, lateral view, ×1.25; *e,* dorsal valve interior, ×2.5; *f,* ventral valve interior, ×1.7; *g–l,* serial sections 0.4, 0.6, 0.75, 0.9, 1.15, 1.2 mm from posterior, approximately ×10 (Lenz, 1971).

Yocrarhynchus Sartenaer, 1995, p. 117 [**Leiorhynchus orientalis* Chen, 1978a, p. 326; OD]. Subpentagonal to subrounded outline and dorsibiconvex profile. Beak suberect, with small foramen; deltidial plates evident in sections. Fold and sulcus strong, arising near umbones; anterior commissure uniplicate; tongue low to moderate, serrate. Costae strong, rounded to subangular, simple, weak on flanks. Dental plates short, near walls, convergent ventrally, occasionally meeting near valve floor to form low ventral median septum that may continue anteriorly to hinge area as low median ridge; ventral muscle field weakly impressed. Teeth simple, short, thick. Hinge plates short, horizontal; septalium barely developed; dorsal median septum high posteriorly, thinning anteriorly and extending to about one-third valve length, bordered by well-impressed muscle field; crura short, thin, ventrally curved, tip V-shaped in cross section, open dorsally. *Upper Devonian (Frasnian):* China, northeastern Europe.——Fig. 778,*2a–o. *Y. orientalis* (Chen), lower Frasnian, Tuqiaozi Formation, Tuqiaozi,

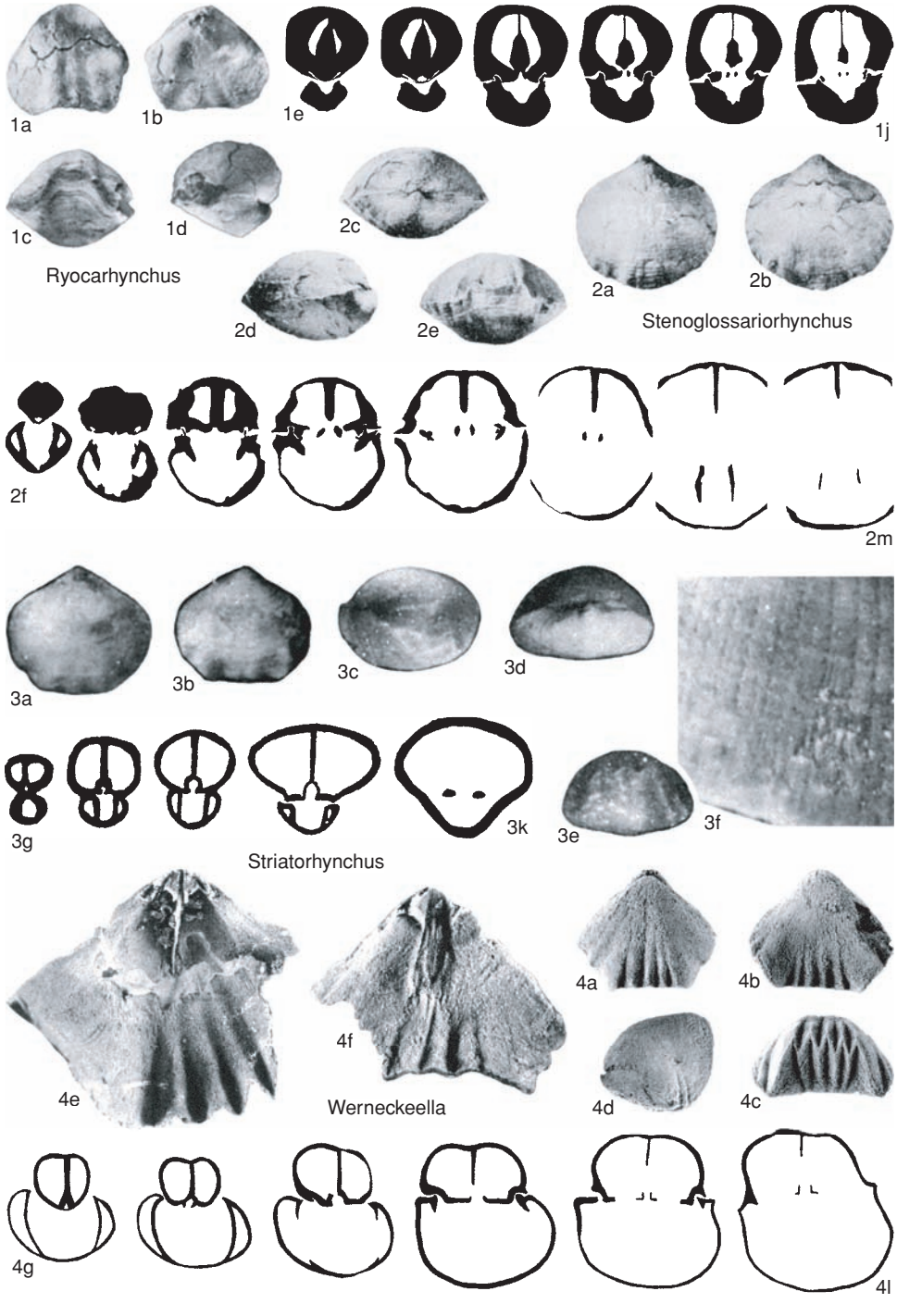

FIG. 777. Leiorhynchidae (p. 1142–1144).

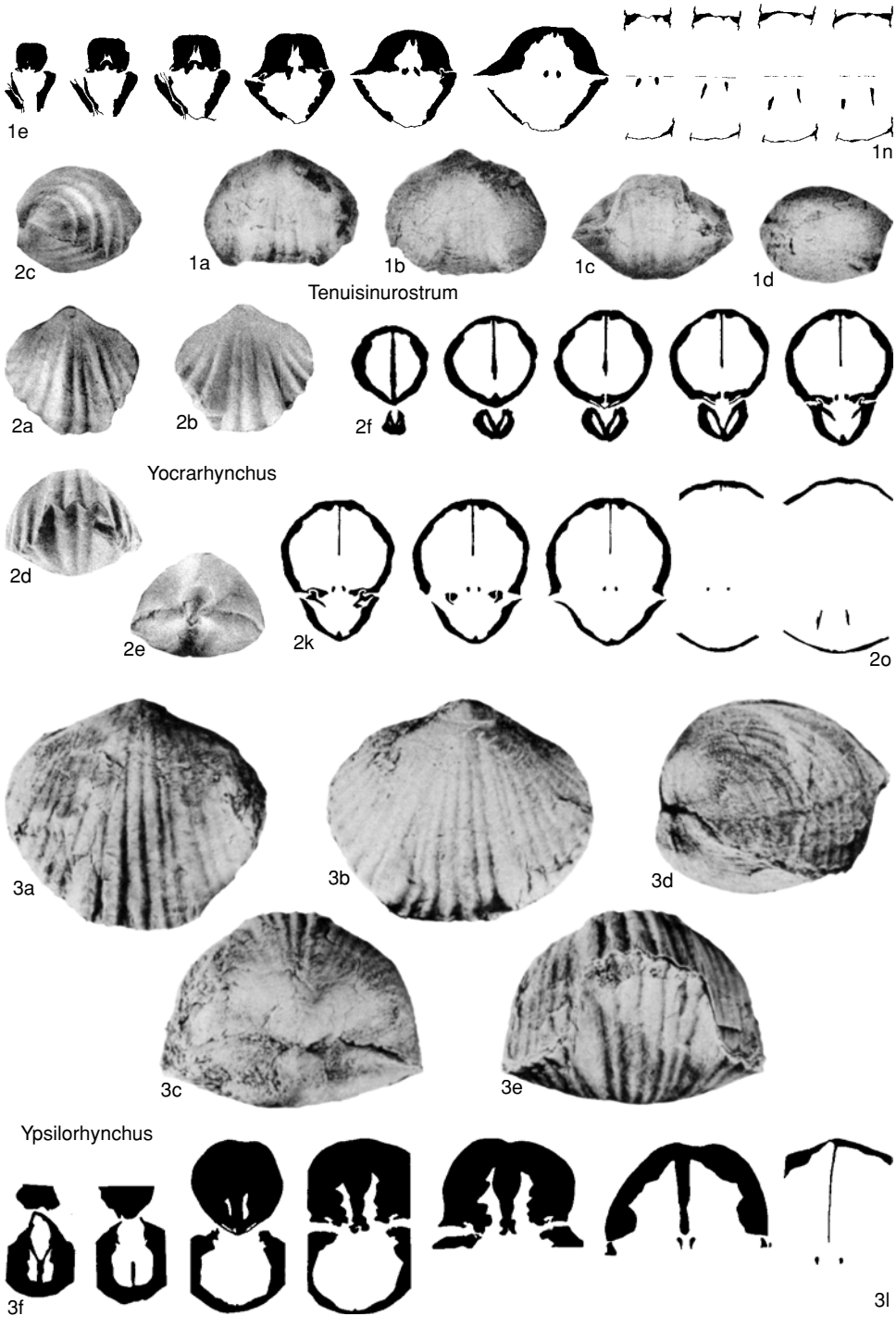

FIG. 778. Leiorhynchidae (p. 1144–1147).

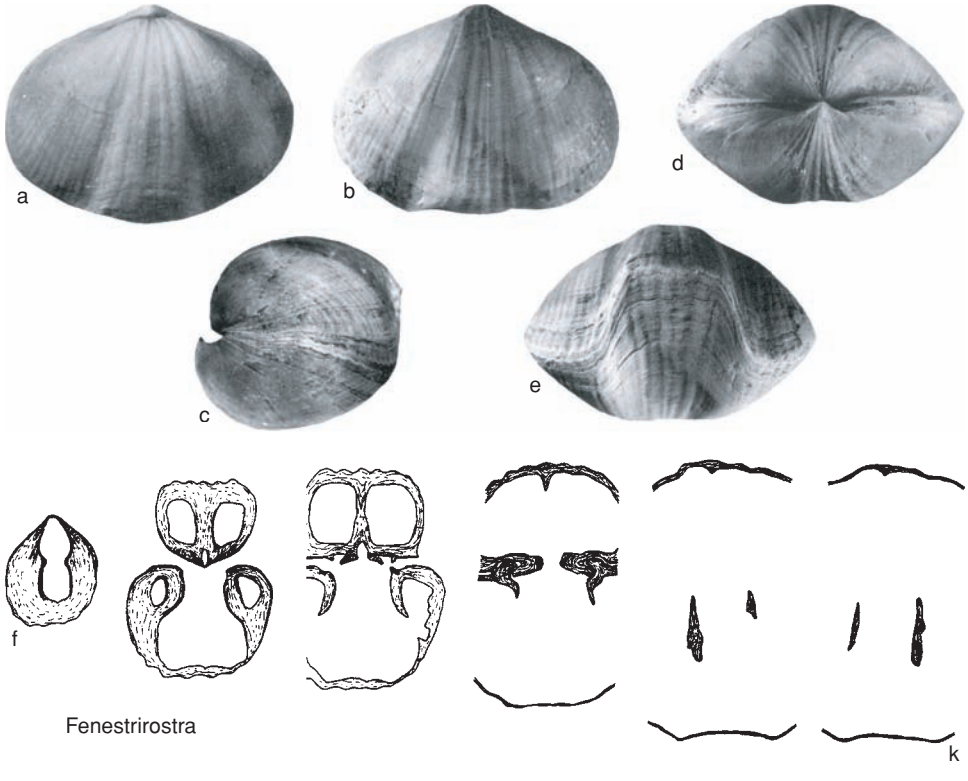

FIG. 779. Leiorhynchidae (p. 1147–1148).

Beichuan County, Sichuan Province, China; *a–e,* holotype, dorsal, ventral, lateral, anterior, and posterior views, ×1 (Chen, 1984); *f–o,* serial sections of topotype 1.7, 2.3, 2.55, 2.75, 3.0, 3.2, 3.5, 3.7, 5.8, 7.6 mm from dorsal umbo, ×1.5 (Sartenaer, 1995).

Ypsilorhynchus SARTENAER, 1970a, p. 9 [**Leiorhynchus manetoe* MCLAREN, 1962, p. 79; OD]. Subcircular to transversely ovate outline and dorsibiconvex to galeate profile. Beak incurved. Fold and sulcus broad, low, extending from umbones; anterior commissure uniplicate; tongue broad, low, serrate. Costae moderately strong on fold and sulcus, weak on flanks, with some bifurcation. Dental plates short, meeting ventrally where supported by septum to form spondylium; ventral muscle field elongate, narrow posteriorly, expanding anteriorly, well impressed. Dorsal median septum high, thick posteriorly, thin anteriorly, extending to midlength, well impressed; septalium very short; hinge plates very short, breaking up immediately anterior of septalium; crura close together, long, slender, strongly curved ventrally. *Middle Devonian (Eifelian–Givetian):* western North America, China.——FIG. 778,*3a–l.* **Y. manetoe* (MCLAREN), upper Eifelian, Headless Formation, Northwest Territories, southern Manetoe Range, western Canada; *a–e,* holotype, dorsal, ventral, posterior, lateral, and anterior views, ×1; *f–l,* serial sections 2.4, 2.8, 4.1, 4.8, 5.3, 6.8, 9.9 mm from posterior, ×1.5 (McLaren, 1962).

Subfamily FENESTRIROSTRINAE Savage, 1996

[Fenestrirostrinae SAVAGE, 1996, p. 254]

Early Leiorhynchidae with low costae, dental plates short to absent. *lower Silurian (Llandovery)–Lower Devonian (Pragian).*

Fenestrirostra COOPER, 1955, p. 56 [**Rhynchonella glacialis* BILLINGS, 1862, p. 143; OD]. Transversely ovate outline and subequally biconvex profile. Beak incurved; delthyrium open apically. Fold and sulcus arising at beak; anterior commissure uniplicate; tongue moderately high, trapezoid. Costae rounded, uneven, on fold, in sulcus, and on flanks, increasing by bifurcation and intercalation. Dental plates low, short, ventrally divergent, enclosing small circular umbonal cavities; ventral muscle field deeply impressed. Dorsal median septum low,

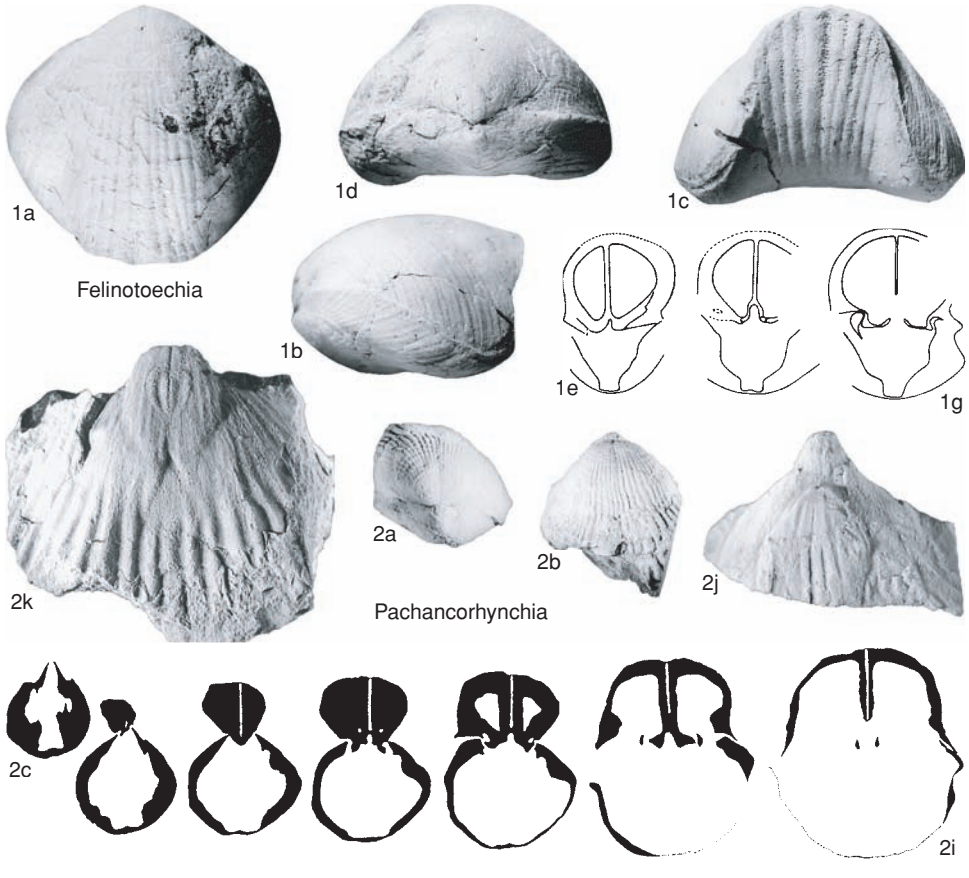

FIG. 780. Leiorhynchidae (p. 1148–1149).

short; septalium small, short; hinge plates divided immediately anterior of septalium; crura long, ventrally curved, tips laterally compressed. *lower Silurian (Llandovery):* eastern Canada (Quebec).——FIG. 779*a–k*. **F. glacialis* (BILLINGS), lower Llandovery, Merrimack Formation, Anticosti Island, Baie Innommée; *a–e,* lectotype, dorsal, ventral, lateral, posterior, and anterior views, ×1.6; *f–k,* serial sections 1.1, 2.0, 2.5, 3.0, 3.3, 3.5 mm from posterior, ×4 (Jin, 1989).

Felinotoechia HAVLÍČEK, 1961, p. 73 [**Atrypa astuta* BARRANDE var. *felina* BARRANDE, 1879b, pl. 18; OD]. Subpentagonal to transversely ovate outline and dorsibiconvex profile; dorsal valve strongly inflated. Beak incurved. Fold and sulcus pronounced from umbones; anterior commissure uniplicate; tongue very high, broad, rounded. Costae low, numerous on fold and in sulcus, weak on flanks and umbones. Dental plates absent or obscured by callus; ventral muscle field narrow, deeply impressed. Dorsal median septum long, high; septalium short, deep, narrow; hinge plates divided immediately anterior of septalium. *upper Silurian (Přídolí)–Lower Devonian (Pragian):* Bohemia.——FIG. 780,*1a–g*. **F. felina* (BARRANDE), Přídolí Limestone, Prague, Slivenec; *a–d,* lectotype, dorsal, lateral, anterior, and posterior views, ×1.7 (new); *e–g,* serial sections at 0.1 mm intervals, ×2.2 (Havlíček, 1961).

Pachancorhynchia BRICE, 1986, p. 121 [**P. leviniensis;* OD]. Subpentagonal to transversely ovate outline and dorsibiconvex profile; dorsal valve strongly inflated. Beak incurved. Fold and sulcus weak; anterior commissure uniplicate; tongue low. Costae numerous; weak on umbones. Dental plates very short, partly obscured by callus; ventral muscle field narrow, deeply impressed. Dorsal median septum long, high, thick; septalium long, deep; hinge plates united, narrow; crura closely set. *Lower Devonian (Lochkovian):* Europe.——FIG. 780,*2a–k*. **P. leviniensis,* Noulette Formation, Artois, Liévin, France; *a–b,* holotype, posterior and dorsal views,

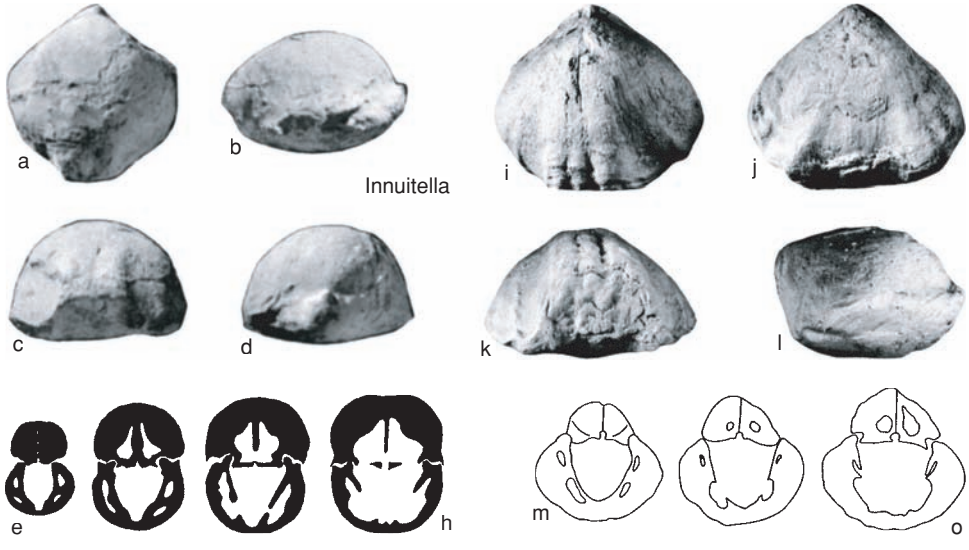

FIG. 781. Leiorhynchidae (p. 1149).

×1; *c–i,* serial sections 0.8, 1.5, 1.9, 2.5, 2.9, 3.9, 5.2 mm from posterior, ×1.7 (Brice, 1986); *j–k,* ventral valve internal molds showing muscle field, ×2 (Barrois, Pruvost, & Dubois, 1922).

Subfamily INNUITELLINAE Crickmay, 1968

[*nom. transl.* SAVAGE, 1996, p. 254, *ex* Innuitellidae CRICKMAY, 1968, p. 5]

Leiorhynchidae with dental plates supported by buttresses; dorsal valve inflated; fold and costae weak. *Lower Devonian (Emsian).*

Innuitella CRICKMAY, 1968, p. 5 [**I. innuitana;* OD]. Subcircular to subpentagonal outline and dorsibiconvex profile. Beak erect; foramen small, submesothyrid. Fold and sulcus weak; anterior commissure uniplicate; tongue low, weakly serrate. Costae low on fold and sulcus; weak to absent on flanks. Dental plates almost meeting ventrally, having lateral buttresses across umbonal cavities; ventral muscle field very narrow. Dorsal median septum long, high; septalium short; hinge plates united past hinge line; crura long, ventrally curved, triangular section. *Lower Devonian (Emsian):* western North America.——FIG. 781*a–h. *I. innuitana,* upper Emsian, Inuvik, Arctic Canada; *a–d,* holotype, dorsal, lateral, anterior, and posterior views, ×1; *e–h,* paratype, serial sections across posterior, ×1.5 (Crickmay, 1968).——FIG. 781*i–o. I.* aff. *I. innuitana,* upper Emsian, McColley Canyon Formation, Lone Mountain, Nevada, USA; *i–l,* dorsal, ventral, anterior, and lateral views, ×1.5; *m–o,* serial sections 9.2, 9.0, 8.6 mm from anterior, ×0.7 (Johnson, 1973a).

Subfamily GIGANTORHYNCHINAE Savage, 1996

[Gigantorhynchinae SAVAGE, 1996, p. 254]

Large Leiorhynchidae, smooth apart from low fold and sulcus, often with fine striae; thick hinge plates divided or undivided; dental plates and septalium short or absent. *Middle Devonian (Givetian)–Upper Devonian (Famennian).*

Gigantorhynchus SAPELNIKOV & MALYGINA, 1977, p. 62 [**G. dubius;* OD]. Very large with rounded subtriangular outline and biconvex profile. Beak incurved; delthyrium open apically; deltidial plates disjunct. Fold and sulcus low, flat, wide, arising at umbones; anterior commissure uniplicate, tongue low. Costae very weak to absent. Shell thick. Dental plates absent or obscured by callus; ventral muscle field narrow. Dorsal median septum short, thick; septalium absent; hinge plates united; cardinal process narrow, linguiform, unilobed to trilobed; crural bases stout; crura long, oblique in section. *Middle Devonian (Givetian):* Tian Shan.——FIG. 782,*1a–k. *G. dubius,* eastern Altai, Archaltur Range; *a–d,* holotype, dorsal, ventral, lateral, and anterior views, ×0.5; *e–k,* serial sections

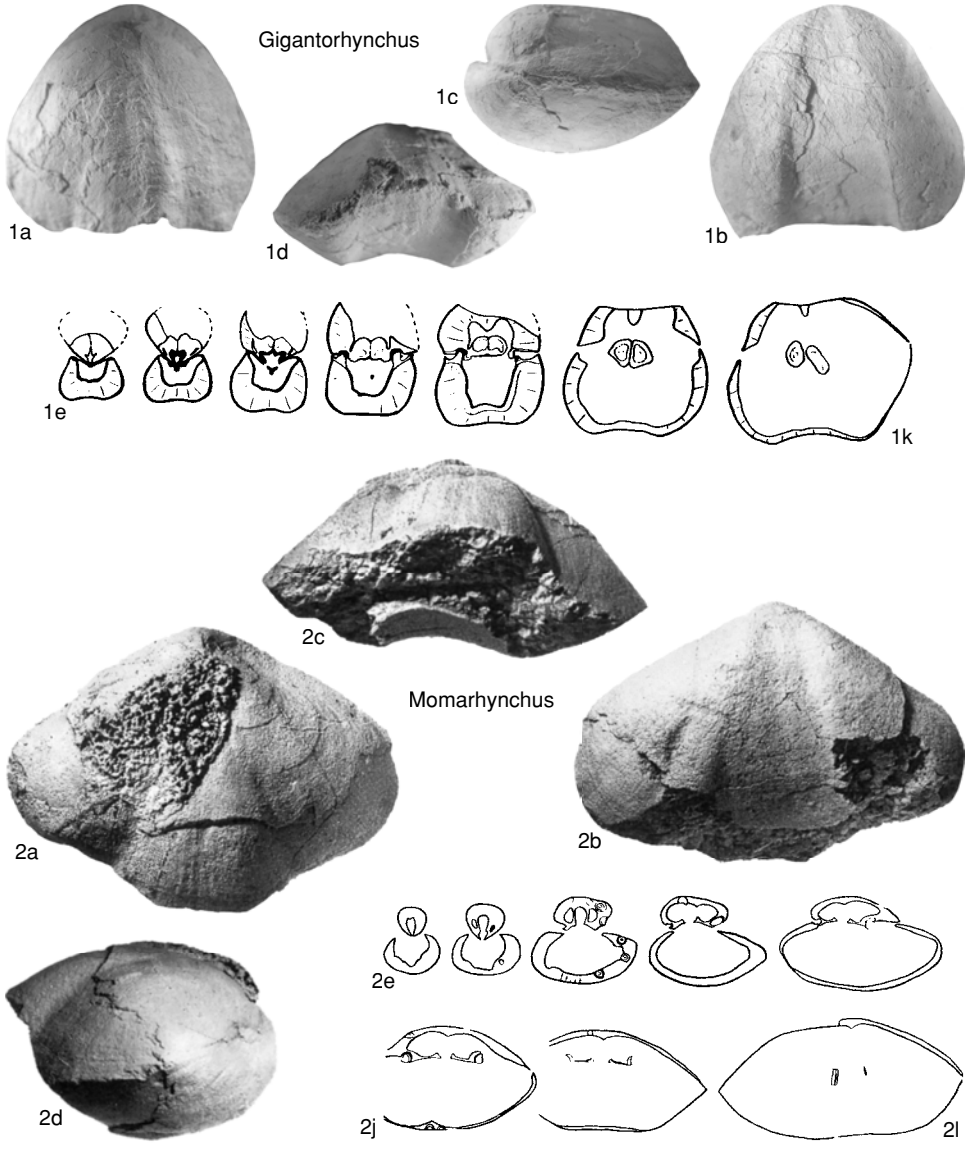

FIG. 782. Leiorhynchidae (p. 1149–1151).

30.0, 29.5, 29.0, 28.0, 27.0, 24.0, 20.0 mm from anterior, ×0.6 (Sapelnikov & Malygina, 1977).

Momarhynchus BARANOV & SARTENAER, 1996, p. 39 [**M. indigirkaensis;* OD]. Very large with transversely subpentagonal outline and biconvex profile. Ventral beak small, incurved; delthyrium open. Fold and sulcus wide, fold gently convex, sulcus gently concave; anterior commissure uniplicate, tongue low, slightly arched. Flanks of both valves gently convex. Costae very weak to absent; fine radial striae sometimes preserved. Shell thick posteriorly. Dental plates absent; teeth stout and short; ventral muscle field poorly defined. Dorsal median ridge long, low; hinge plates divided, subhorizontal, with short sockets and low inner socket ridges; crural bases stout, horizontal; crura subtriangular in cross section, distal parts curve ventrally. *Upper Devonian (Famennian):* Russia (Yakutia).——FIG. 782,*2a–l. *M. indigirkaensis,* lower Famennian, upper half of Moma Suite, Moma River, Moma

Range; *a–d,* holotype, dorsal, ventral, anterior, and lateral views, ×1; *e–l,* serial sections 1.5, 1.8, 2.2, 2.4, 3.1, 3.6, 4.2, 6.2 mm from posterior, ×1 (Baranov & Sartenaer, 1996).

Subfamily CALVINARIINAE Sartenaer, 1994

[*nom. transl.* Savage, 1996, p. 254, *ex* Calvinariidae Sartenaer, 1994, p. 97]

Leiorhynchidae with transverse outline, smooth umbones, high tongue, few coarse costae, and strongly convergent dental plates. *Upper Devonian (Frasnian).*

Calvinaria Stainbrook, 1945, p. 43 [**Rhynchonella ambigua* Calvin, 1878, p. 729; OD]. Large with markedly transversely ovate outline. Biconvex profile with lateral and anterior slopes low. Beak incurved; foramen oval. Fold and sulcus strong, arising at umbones; anterior commissure broadly uniplicate; tongue high, trapezoid, serrate. Costae broad, arising near umbones; present on fold, sulcus, and flanks. Dental plates convergent ventrally, often obscured by thick callus; ventral muscle field deeply impressed. Dorsal median septum long, thin, high; septalium short, narrow; hinge plates divided anterior of septalium; crura long, ventrally curved. *Upper Devonian (Frasnian):* North America, Europe, northern Africa, China.——Fig. 783,*1a–j.* **C. ambigua* (Calvin), upper Frasnian, Iowa, USA; *a–b,* hypotype, dorsal and posterior views, Amana Beds, Amana, ×1.2; *c,* holotype, ventral view, Independence Shale, Independence; *d,* hypotype, anterior view, Independence Shale, Brandon, ×1 (Stainbrook, 1945); *e–j,* serial sections 2.6, 2.7, 2.95, 3.3, 3.5, 3.8 mm from posterior, ×2 (Sartenaer, 1955).

Canavirilia Sartenaer, 1994, p. 97 [**C. atrousensis;* OD]. Large with transversely ovate, anteriorly emarginate outline; dorsibiconvex profile; lateral margins moderately steep but not truncated; dorsal valve inflated posteriorly and anteriorly. Beak incurved; foramen with deltidial plates. Fold and sulcus strong, arising at umbones; anterior commissure uniplicate; tongue high, trapezoid, subacuminate. Costae very broad, arising at umbones, mostly on fold and sulcus, rare on flanks. Dental plates short, strongly convergent ventrally; ventral muscle field well impressed. Dorsal median septum long, high, thin; septalium short; hinge plates dividing early; crura closely set, long, rodlike for much of length. *Upper Devonian (middle Frasnian):* Morocco, Europe, Urals, North America.——Fig. 783,*2a–l.* **C. atrousensis,* Tafilalt, Morocco; *a–d,* holotype, ventral, posterior, anterior, and lateral views, ×1; *e–l,* serial sections 0.6, 1.0, 1.1, 1.2, 1.45, 1.55, 1.8, 2.3 mm from posterior, ×2.3 (Sartenaer, 1994).

Lateralatirostrum Sartenaer, 1979a, p. 539 [**Leiorhynchus athabascense* Kindle, 1924, p. 217; OD]. Large, with transversely ovate outline and dorsibiconvex profile; lateral slopes gentle. Beak erect, truncated by small foramen. Fold and sulcus strong, arising at umbones; anterior commissure uniplicate; tongue very high, broad, rounded. Costae low, most evident on fold and in sulcus, weak on flanks. Dental plates short, converging ventrally; ventral muscle field weakly impressed. Dorsal median septum long, thin, high; septalium short; hinge plates breaking up early; crura long, ventrally curved. *Upper Devonian (lower Frasnian):* western North America, Russian Platform, Volga-Urals, central Timan.——Fig. 784,*1a–l.* **L. athabascense* (Kindle), Flume Formation, Jasper Park, Alberta, Canada; *a–d,* hypotype, ventral, lateral, posterior, and anterior views, ×1; *e–l,* serial sections 0.55, 1.1, 1.3, 1.4, 1.9, 2.2, 3.2, 5.5 mm from posterior, ×2 (McLaren, 1962).

Navalicria Sartenaer, 1989, p. 66 [**N. compacta;* OD]. Transversely ovate, anteriorly emarginate outline; dorsibiconvex profile, anteriorly inflated, flanks not steep. Beak slightly incurved; foramen small, deltidial plates narrow. Fold and sulcus strong, from umbones; anterior commissure uniplicate to biplicate; tongue high, trapezoid. Costae low, simple, rounded, arising anterior of umbones; approximately 2 costae on fold, 1 in sulcus; flanks smooth. Dental plates incipient, convergent ventrally; ventral muscle field narrow, deeply impressed. Septalium short, small; hinge plates divided; dorsal septum long, high, thin; dorsal muscle field narrow; crura long, thin, slightly curved ventrally, closely set. *Upper Devonian (Frasnian):* western Europe, western Canada, China.——Fig. 783,*3a–m.* **N. compacta,* middle Frasnian–upper Frasnian, Schistes gris with *Reticularia pachyrhyncha,* Ardennes, near Frasnes, Belgium; *a–e,* holotype, ventral, dorsal, lateral, posterior, and anterior views, ×1; *f–m,* serial sections 0.55, 0.95, 1.15, 1.3, 1.7, 2.0, 2.2, 3.7 mm from posterior, ×3.2 (Sartenaer, 1989).

Plionoptycherhynchus Sartenaer, 1979a, p. 537 [**P. exformosus;* OD]. Large, with transversely ovate outline and dorsibiconvex profile; gentle lateral slopes. Beak erect; foramen obscured by dorsal umbo. Fold and sulcus strong, arising at umbones; anterior commissure uniplicate; tongue high, trapezoid, serrate. Costae distinct, subangular, simple, extending from umbones, present on fold, sulcus, and flanks. Dental plates absent; ventral muscle field narrow, deeply impressed in thick shell material. Dorsal median septum long, high, thick; septalium short; hinge plates divided immediately anterior of septalium; crura curved ventrally, tips laterally flattened. *Upper Devonian (lower Frasnian):* Europe, western Canada.——Fig. 784,*2a–j.* **P. exformosus,* upper lower Frasnian, Givet, Chapel of Notre Dame de Walcourt, northeastern France; *a–d,* holotype, dorsal, ventral, anterior, and lateral views, ×1 (Sartenaer, 1979a); *e–j,* serial sections 1.8, 2.05, 2.3, 2.45, 3.15, 4.10 mm from posterior, ×2 (Sartenaer, 1955).

Tomestenoporhynchus Sartenaer, 1993, p. 13 [**Leiorhynchus rudkini* Ljaschenko, 1959, p. 151; OD]. Large; subpentagonal, transversely ovate outline;

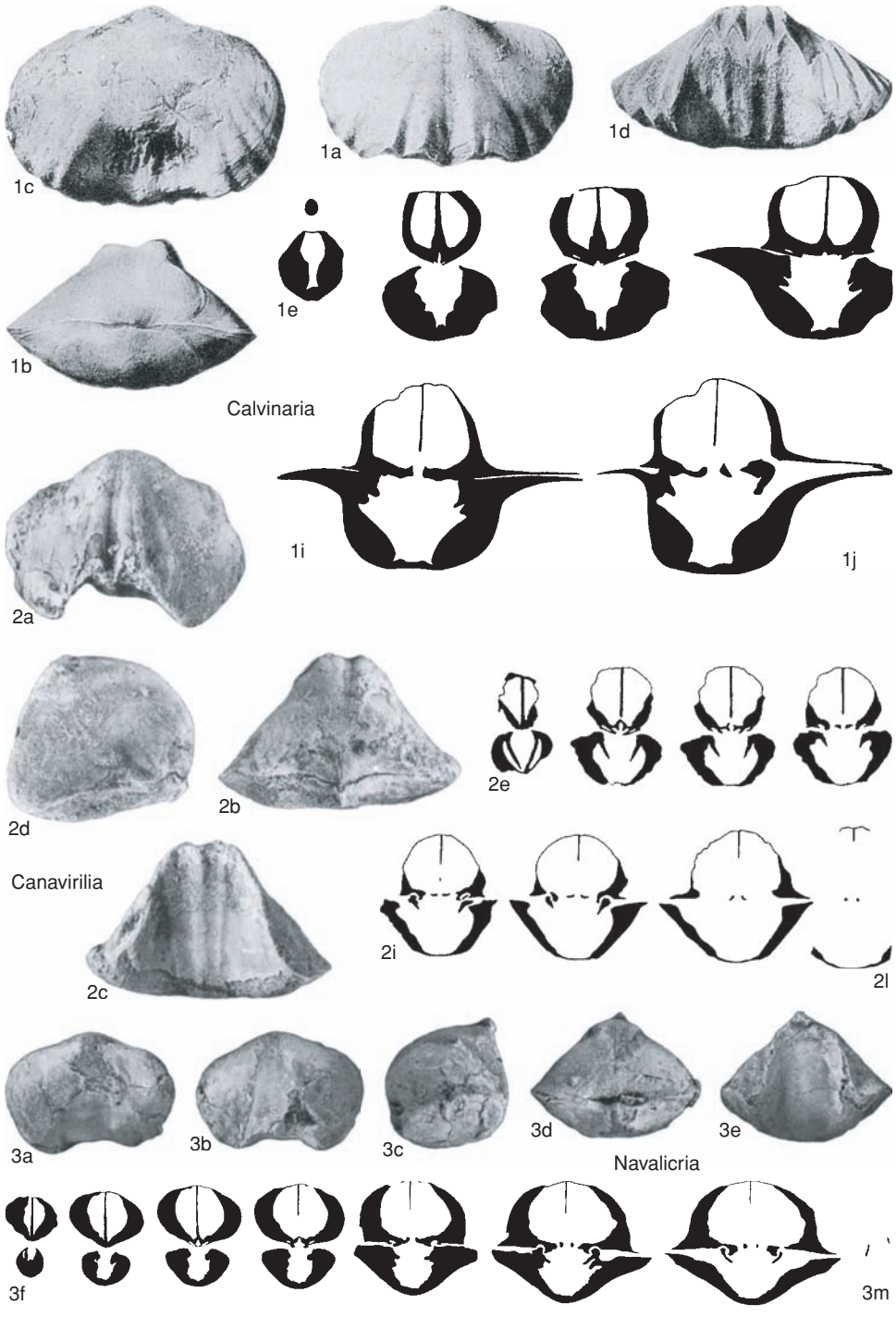

FIG. 783. Leiorhynchidae (p. 1151).

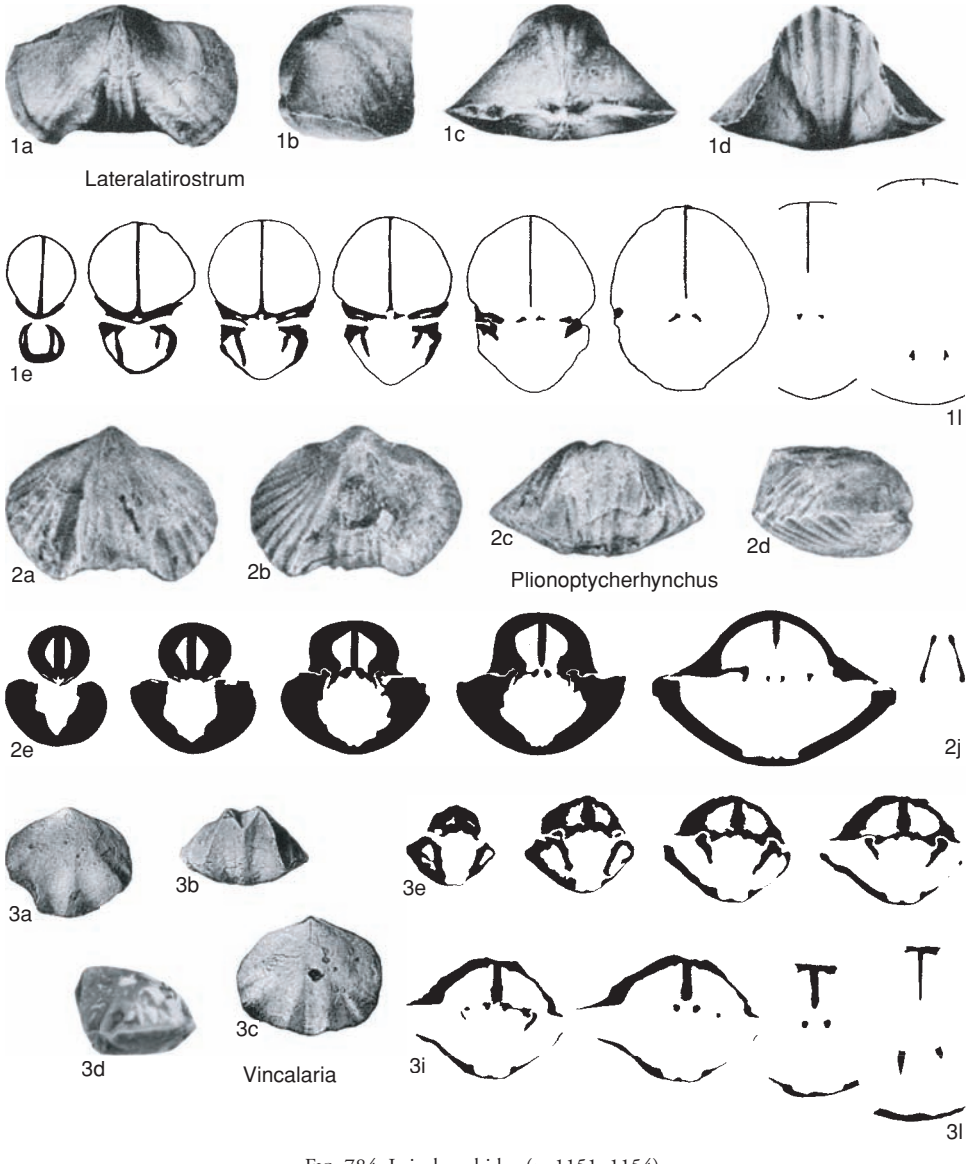

FIG. 784. Leiorhynchidae (p. 1151–1154).

dorsibiconvex profile with sides sloping steeply but not truncated; dorsal valve inflated posteriorly and anteriorly. Beak incurved; foramen small, semicircular; deltidial plates delicate. Fold and sulcus strong, arising at umbones; anterior commissure uniplicate; tongue high, subacuminate, dentate. Costae coarse, arising at umbones; angular; most prominent on fold and sulcus, weak on flanks. Dental plates short, strongly convergent ventrally; teeth small, delicate. Dorsal median septum long, high, thin; septalium short to absent; hinge plates very short; crura closely set, long, slender, ventrally curved at tips. *Upper Devonian (lower Frasnian):* European Russia.——FIG. 785*a–n.* **T. rudkini* (LJASCHENKO), Rudkino horizon, Russian Platform, River Don, Rudkino; *a–d,* holotype, dorsal, ventral, posterior, and anterior views, ×1; *e,* topotype, lateral view, ×1; *f–n,* serial sections 2.2, 2.25, 2.45, 2.55, 3.05, 3.2, 3.4, 5.9, 6.7 mm from posterior, ×3.25 (Sartenaer, 1993).

Vincalaria SARTENAER, 1989, p. 61 [**Calvinaria bransoni* STAINBROOK, 1948, p. 774; OD]. Transversely ovate outline and dorsibiconvex profile; lateral slopes moderate. Beak erect to incurved; foramen

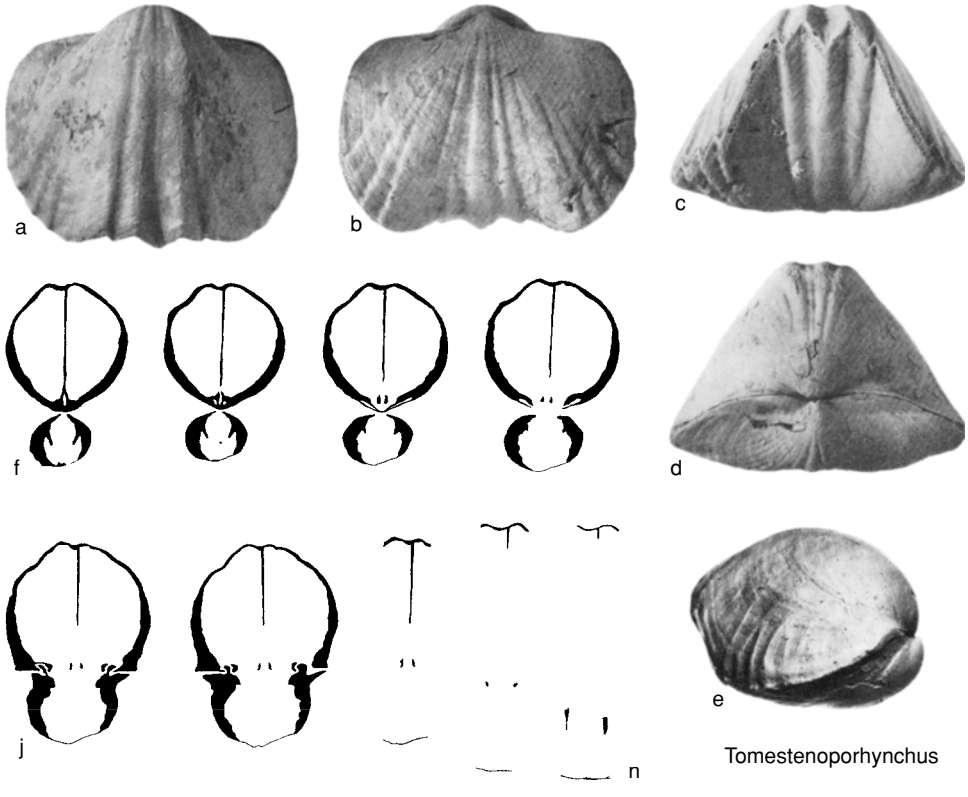

FIG. 785. Leiorhynchidae (p. 1151–1153).

small, oval. Fold and sulcus strong, arising at umbones; tongue pronounced, broadly biplicate to triplicate. Costae strong, broad, from umbones, usually 2 to 4 on fold, 1 to 3 in sulcus, weak on flanks. Dental plates strongly convergent ventrally, often obscured by thick callus; ventral muscle field well impressed. Septalium short; hinge plates divided anterior of septalium; dorsal median septum long, low, thick; crura closely set. *Upper Devonian (Frasnian):* Europe, western North America, China.——FIG. 784,*3a–l.* **V. bransoni* (STAINBROOK), middle Frasnian–upper Frasnian, Sly Gap Formation, Alamogordo, New Mexico, USA; *a–b,* holotype, ventral and anterior views; *c,* paratype, dorsal view, ×1 (Stainbrook, 1948); *d,* hypotype, lateral view, ×1 (Cooper & Dutro, 1982); *e–l,* serial sections 0.65, 0.9, 1.1, 1.3, 1.45, 1.55, 2.0, 3.2 mm from posterior, ×2.7 (Sartenaer, 1989).

Subfamily PLATYTERORHYNCHINAE Savage, 1996

[Platyterorhynchinae SAVAGE, 1996, p. 254]

Leiorhynchidae with lenticular profile and low fold; costae weak and uneven; dental plates short, almost meeting ventrally. *Middle Devonian (upper Givetian)–Upper Devonian (lower Famennian).*

Platyterorhynchus SARTENAER, 1970a, p. 5 [**Leiorhynchus russelli* MCLAREN, 1962, p. 95; OD]. Subcircular to transversely ovate outline and equibiconvex, lenticular profile. Beak incurved; delthyrium with vestigial deltidial plates, foramen mesothyrid. Fold and sulcus broad, low, from midlength; anterior commissure uniplicate; tongue low, wide. Costae weak and uneven on fold and sulcus, very weak on flanks. Dental plates short, converging ventrally; ventral muscle field narrow, moderately impressed. Dorsal median septum long, high, thin; septalium very short, shallow; hinge plates dividing immediately anterior of septalium; dorsal muscle field long, narrow; crura long, slender, ventrally curved, tips laterally flattened. *Middle Devonian (upper Givetian)–Upper Devonian (lower Frasnian):* western and eastern North America, western Europe, Morocco, Turkey, Russian Platform, Volga-Urals, Timan, China.——FIG. 786,*4a–l.* **P. russelli* (MCLAREN), uppermost Givetian, lowermost *Asymmetricus* Zone, Waterways Formation,

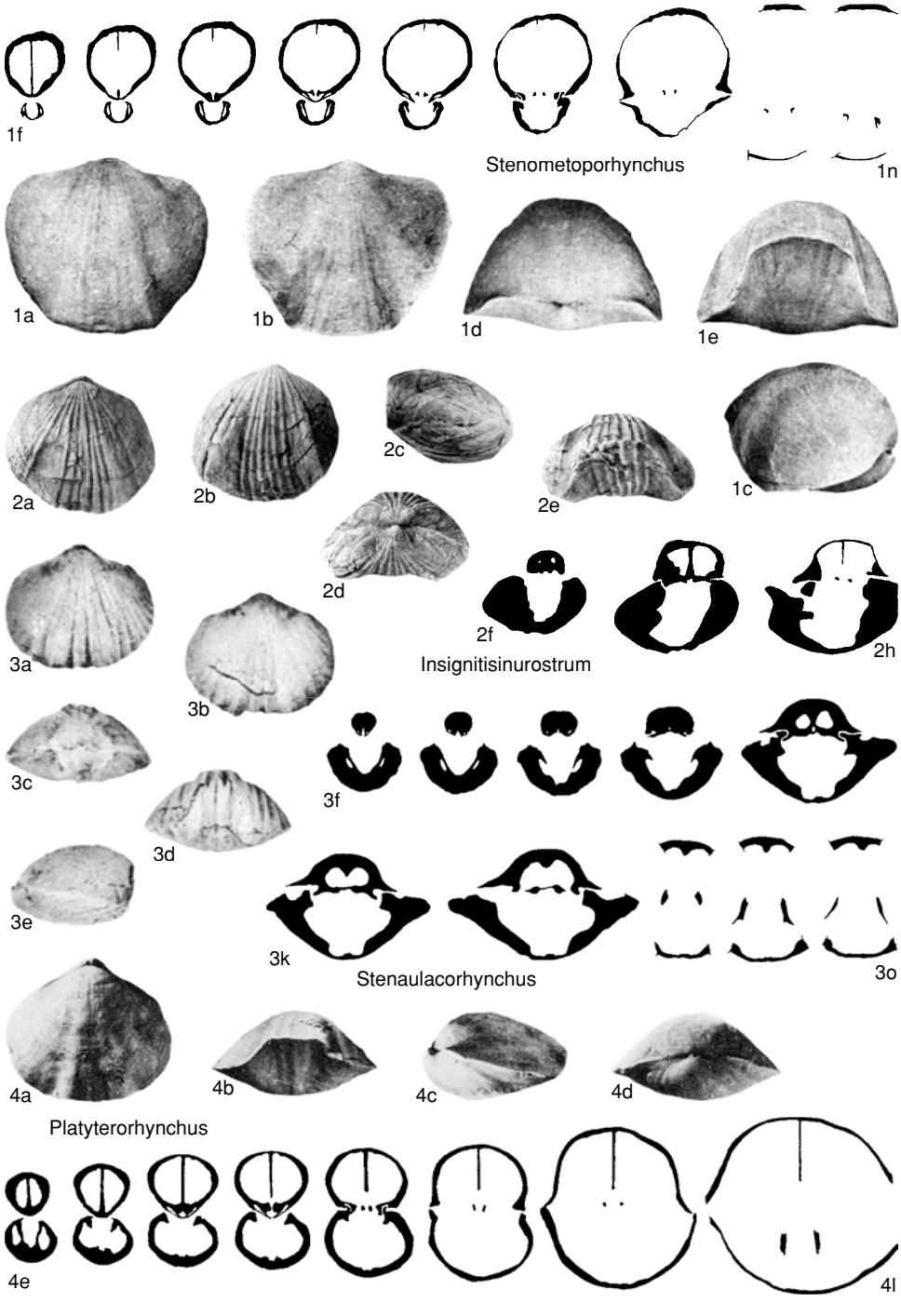

FIG. 786. Leiorhynchidae (p. 1154–1156).

Peace River, Boyer Rapids, Alberta, Canada; *a–d,* holotype, dorsal, anterior, lateral, and posterior views, ×1; *e–l,* serial sections 1.0, 1.3, 1.7, 1.8, 2.1, 2.7, 3.7, 5.5 mm from posterior, ×1.5 (McLaren, 1962).

Insignitisinurostrum Sartenaer, 1987b, p. 85 [**Camarotoechia latisinuata* Cooper & Dutro, 1982, p. 79; OD]. Subcircular to transversely ovate outline and dorsibiconvex profile; lateral slopes rounded. Beak erect to suberect; foramen subovate. Fold and sulcus low, from umbones; anterior commissure broadly uniplicate; tongue low, broad, serrate. Costae narrow, rounded, arising at beaks, increasing by bifurcation and intercalation, present on fold, sulcus, and flanks. Dental plates absent or buried in thick callus; ventral muscle field deeply impressed. Dorsal median septum short, thin; septalium very short, with crural bases arising from sides; hinge plates also very short, dividing immediately anterior of septalium; crura closely set, long, thin, distally ovate in cross section. *Upper Devonian (lower Famennian):* western USA.——Fig. 786,*2a–h. *I. latisinuatum* (Cooper & Dutro), upper lower Famennian, basal Thoroughgood Formation, Sheep Mountain, New Mexico; *a–e,* holotype, dorsal, ventral, lateral, posterior, and anterior views, ×1; *f–h,* serial sections 1.9, 2.4, 2.9 mm from posterior, ×2 (Cooper & Dutro, 1982).

Stenaulacorhynchus Sartenaer, 1968a, p. 3 [**S. cheshmehshirensis;* OD]. Transversely ovate outline and dorsibiconvex profile; gentle lateral and anterior slopes. Beak erect; foramen small, circular. Fold and sulcus moderate, extending from umbones; anterior commissure uniplicate; tongue low, rounded, serrate. Costae extending from umbones but most evident at anterior and lateral margins. Dental plates short, strongly convergent ventrally; ventral muscle field narrow, well impressed in thick shell material. Dorsal median septum very short, thick, low; septalium very short, wide, with cover plate anteriorly; hinge plates united anterior of septalium; dorsal muscle field narrow, well impressed; crura curve ventrally, tips laterally flattened. *Upper Devonian (lower Famennian):* northern Iran, Spain.——Fig. 786,*3a–o. *S. cheshmehshirensis,* Ozbak-Kuh, Cheshmeh Shir, northern Iran; *a–e,* holotype, dorsal, ventral, posterior, anterior, and lateral views, ×1; *f–o,* serial sections 1.37, 1.45, 1.6, 1.85, 2.35, 2.5, 2.7, 3.2, 3.4, 3.6 mm from posterior, ×2.2 (Sartenaer, 1968a).

Subfamily STENOMETOPORHYNCHINAE Savage, 1996

[Stenometoporhynchinae Savage, 1996, p. 254]

Leiorhynchidae with ventral valve flattened to concave and dorsal valve highly inflated; dental plates, dorsal median septum, and hinge plates very short; septalium absent. *Upper Devonian (lower Frasnian).*

Stenometoporhynchus Sartenaer, 1987d, p. 126 [**Liorhynchus pavlovi* Nalivkin, 1930b, p. 72; OD; *non Liorhynchus pavlovi* Mufke, *nomem manuscriptum* (see Nalivkin, 1930b, p. 73[88], and Sartenaer, 1987d, p. 126)]. Subpentagonal to scutiform outline and dorsibiconvex, galeate profile; dorsal valve inflated. Beak incurved; foramen small, apical. Fold and sulcus wide, low; anterior commissure uniplicate; tongue wide, rounded; Costae weak on fold and sulcus, very weak on flanks. Dental plates short, close to shell walls, ventrally convergent; ventral muscle field weakly impressed. Dorsal median septum short, thin; septalium absent; hinge plates very short, divided; dorsal muscle field narrow, weakly impressed; crura long, slender, closely set, ventrally curved, V-shaped distally with open side directed ventrally. *Upper Devonian (lower Frasnian):* European Russia, China.——Fig. 786,*1a–n. *S. pavlovi* (Nalivkin), Semiluki beds, Voronezh, Semiluki, European Russia; *a–e,* lectotype, dorsal, ventral, lateral, posterior, and anterior views, ×1 (Nalivkin, 1930b); *f–n,* serial sections 1.05, 1.3, 1.5, 1.7, 1.8, 2.1, 2.75, 4.65, 4.9 mm from posterior, ×1.7 (Sartenaer, 1987d).

Subfamily BASILICORHYNCHINAE Savage, 1996

[Basilicorhynchinae Savage, 1996, p. 254]

Leiorhynchidae with subcircular outline; high tongue; strong costae. Dental plates and dorsal median septum distinct. *Upper Devonian (Famennian).*

Basilicorhynchus Crickmay, 1952b, p. 1 [**Leiorhynchus basilicum* Crickmay, 1952a, p. 600; OD]. Subcircular outline and strongly dorsibiconvex profile; flanks and anterior very steep. Beak incurved; foramen mesohypothyrid. Fold and sulcus restricted to extreme anterior; anterior commissure uniplicate; tongue high, trapezoid to rectangular, serrate. Costae few, strong, subangular, developed only anteriorly. Dental plates long, ventrally convergent; ventral muscle field well impressed. Dorsal median septum long; septalium deep, V-shaped; hinge plates horizontal, divided anterior of septalium; crura short, slender, gutterlike distally with dorsal side open. *Upper Devonian (lower Famennian):* western and northern Canada, Europe, Siberia.——Fig. 787,*1a–k. *B. basilicus* (Crickmay), upper lower Famennian, Mackenzie River, Root River, Northwest Territories; *a–c,* holotype, dorsal, ventral, and anterior views; *d,* paratype, lateral view, ×1; *e–k,* serial sections 0.4, 0.5, 0.8, 1.1, 1.3, 1.4, 2.0 mm from posterior, ×5 (Sartenaer, 1969).

Gastrodetoechia Sartenaer, 1965b, p. 2 [**Leiorhynchus utahensis* Kindle, 1908, p. 105; OD]. Large; subpentagonal to transversely ovate outline; dorsibiconvex profile. Beak erect; foramen small, circular. Fold and sulcus strong, extending from umbones; anterior commissure uniplicate; tongue

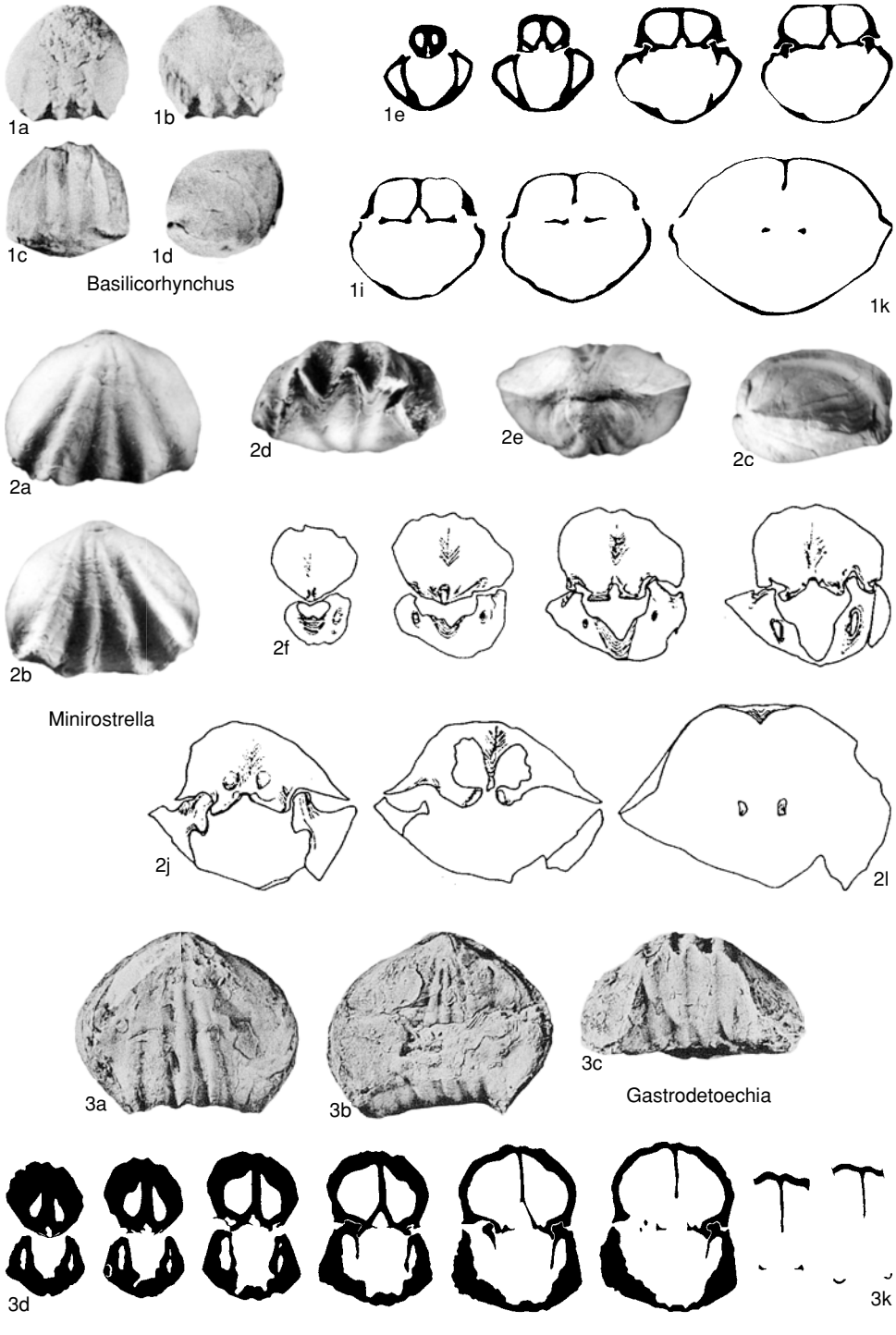

FIG. 787. Leiorhynchidae (p. 1156–1158).

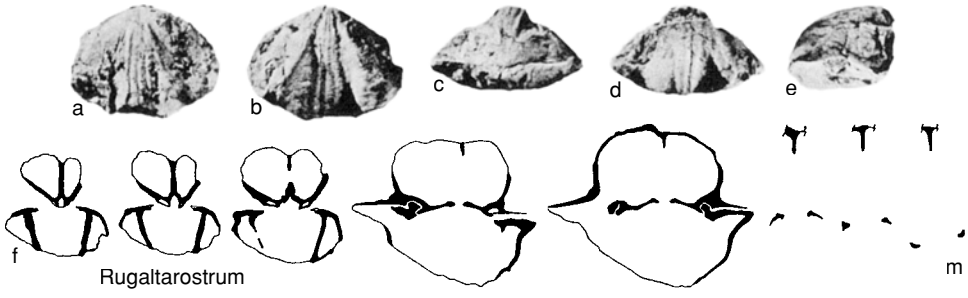

FIG. 788. Leiorhynchidae (p. 1158).

high, angular, serrate. Costae arising on umbones; subangular; strong on fold and in sulcus, weak on flanks. Dental plates long, near valve walls, convergent ventrally; ventral muscle field narrow, well impressed. Dorsal median septum long, high; septalium large, deep, long, V-shaped, with fragile cover; hinge plates joined by septalium; dorsal muscle field narrow, well impressed; crura curved ventrally, concave dorsally. *Upper Devonian (Famennian):* western North America, Europe, Iran, Armenia, Afghanistan, Algeria.——FIG. 787,*3a–k.* **G. utahensis* (KINDLE), lower upper Famennian; *a–c,* hypotype, dorsal, ventral, and anterior views, Three Forks Formation, Montana, USA, ×0.8; *d–k,* hypotype, serial sections 1.85, 1.95, 2.1, 2.85, 3.5, 3.8, 4.1, 5.3 mm from posterior, Palliser Formation, Mount Coleman, Banff Park, Alberta, Canada, ×1.5 (Sartenaer, 1969).

Minirostrella BALINSKI, 1995a, p. 50 [**M. rara;* OD]. Transversely ovate outline and dorsibicovex profile; flanks with low lateral slopes. Beak erect to incurved. Fold and sulcus of medium strength, extending from beaks; tongue wide, high, typically triplicate. Costae broad, subangular, arising at umbones, strong on fold and sulcus, weak on flanks. Dental plates very short, convergent ventrally; ventral muscle field deeply impressed. Dorsal median septum short, low, thick; septalium wide, short; hinge plates inclined dorsally, divided anterior of septalium; crura long, closely set, ventrally curved. *Upper Devonian (lower Famennian):* Poland.——FIG. 787,*2a–l.* **M. rara, Palmatolepis triangularis* Zone, Debnik, southern Poland; *a–e,* holotype, dorsal, ventral, lateral, anterior, and posterior views, ×2; *f–l,* serial sections 0.35, 0.65, 0.7, 0.85, 1.1, 1.4, 2.3 mm from posterior, ×4.4 (Balinski, 1995a).

Rugaltarostrum SARTENAER, 1961c, p. 6 [**Leiorhynchus madisonense* HAYNES, 1916, p. 39; OD]. Transversely ovate outline and dorsibicovex profile; flanks with low lateral slopes. Beak erect to incurved; foramen minute. Fold and sulcus strong, extending from beaks; anterior commissure uniplicate; tongue wide, high, serrate. Costae broad, arising at umbones, strong on fold and sulcus, weak on flanks. Dental plates long, convergent ventrally. Dorsal median septum long, high; septalium deep, short; hinge plates slightly inclined dorsally, divided anterior of septalium; crura long, ventrally curved, surfaces concave dorsally. *Upper Devonian (Famennian):* western North America, Western Australia, central Asia.——FIG. 788*a–m.* **R. madisonense* (HAYNES), lower upper Famennian, Three Forks Formation, Logan, Montana, USA; *a–e,* holotype, dorsal, ventral, posterior, anterior, and lateral views, ×1; *f–m,* serial sections 0.57, 0.62, 0.7, 1.0, 1.1, 1.4, 1.55, 1.7 mm from posterior, ×6 (Sartenaer, 1969).

Family SEPTALARIIDAE Havlíček, 1960

[Septalariidae HAVLÍČEK, 1960, p. 241]

Camarotoechioidea with tongue generally extended into trail; hinge plates united; dorsal median septum high; cardinal process commonly developed. *Lower Devonian (Pragian)–Upper Devonian (middle Frasnian).*

Septalaria LEIDHOLD, 1928, p. 35 [**Terebratula ascendens* STEININGER, 1853, p. 61; SD TORLEY, 1934, p. 74]. Subpentagonal outline and dorsibiconvex profile; anteriorly inflated. Beak sharp, incurved; foramen permesothyrid. Fold and sulcus strong, arising at umbones; anterior commissure uniplicate; tongue broad, high, rectangular, serrate, often projecting anterodorsally as trail. Costae low, simple, extending from umbones, weak on flanks; short marginal spines commonly developed. Dental plates very short, close to walls; ventral muscle field weakly impressed. Dorsal median septum short, high; pointed at about midlength in lateral view, with acute angle directed ventrally; septalium short, wide, partly filled by large, ridged cardinal process; hinge plates undivided for short distance anterior of septalium; crural bases arising from dorsal edge of hinge plates; crura long, straight, closely set, rodlike. *Lower Devonian (upper Emsian)–Middle Devonian (upper Givetian):* Europe, Urals, Altai, China, Australia.——FIG. 789,*1a–e.* **S. ascendens* (STEININGER), Eifelian, Nohn Beds, Prüm, Hauenborn, Ger-

many; neotype, dorsal, ventral, posterior, lateral, and anterior views, ×2 (Schmidt, 1975).——Fig. 789,*1f–p. S. subtetragona* (Schnur), Eifelian, Nohn Beds, Prüm, Germany; *f–i,* serial sections 15.2, 15.0, 14.9, 14.8 mm from anterior; *j–k,* serial sections 11.2, 11.1 mm from anterior, ×3.3 (Schmidt, 1965b); *l–p,* serial sections 10.25, 10.1, 10.0, 9.8, 9.6 mm from posterior, ×3 (Havlíček, 1961).

Amissopecten Havlíček, 1960, p. 243 [**Terebratula velox* Barrande, 1847, p. 74; OD]. Subpentagonal outline and dorsibiconvex profile; anteriorly inflated and with prominent trail. Beak suberect to incurved; foramen permesothyrid. Fold and sulcus strong, from umbones; anterior commissure uniplicate; tongue broad, very high, often splayed, serrate, projecting anterodorsally as trail. Costae of 2 sizes, fine costae from beaks to midlength merge to form coarse costae extending to anterior margin. Dental plates absent; ventral muscle field weakly impressed. Dorsal median septum high; septalium short, wide; cardinal process absent; hinge plates horizontal, divided anterior of septalium. *Lower Devonian (Emsian)–Middle Devonian (Eifelian):* Bohemia, Germany.——Fig. 789,*2a–i. *A. velox* (Barrande), upper Emsian, Suchomasty Limestone, Koneprusy, Bohemia; *a–e,* neotype, dorsal, ventral, lateral, anterior, and posterior views, ×2 (new); *f–i,* serial sections 16.3, 16.1, 15.9, 15.7 mm from anterior, ×5 (Havlíček, 1961).

Athyrhynchus Johnson, 1973a, p. 467 [**A. susanae;* OD]. Large; subpentagonal to subtriangular outline and dorsibiconvex profile; sides not truncated. Beak incurved. Fold and sulcus weak, arising at midlength; anterior commissure uniplicate; tongue broad, high, trapezoid. Costae few, weak, restricted mainly to fold and sulcus, arising near midlength. Dental plates short, close to walls; ventral muscle field elongate oval. Dorsal median septum long, high; septalium short; hinge plates undivided; sockets large, with recurved inner socket ridges; dorsal muscle field located near midlength, raised, rhombohedral outline; large bilobed cardinal process. *Lower Devonian (upper Emsian):* USA (Nevada), Arctic Canada.——Fig. 790,*1a–f. *A. susanae,* Disappointment Bay Formation, Lowther Island, Arctic Canada; *a–d,* dorsal, ventral, anterior, and lateral views, ×1.5; *e,* interior of dorsal valve, ×3; *f,* interior of ventral valve, ×3 (Johnson, 1973a).

Bergalaria Schmidt, 1975, p. 101 [**B. bergica;* OD]. Subpentagonal outline and dorsibiconvex profile. Beak erect to incurved; foramen small, with deltidial plates. Fold and sulcus strong, arising anterior of umbones; tongue broad, medium height, trapezoid, projecting anterodorsally as trail with commissure at leading edge. Costae developed on anterior third, numerous, rounded, weak on flanks, arising from radial capillae that are present posterior of costae. Dental plates short, convergent ventrally. Dorsal median septum short, high; in lateral profile with acute point directed ventrally at about one-third septum length; hinge plates horizontal, undivided; septalium absent; cardinal process large, ridged, rounded posteriorly but dividing into 2 splayed lobes anteriorly. *Upper Devonian (lower Frasnian–middle Frasnian):* Europe.——Fig. 790,*2a–j. *B. bergica,* lower Frasnian, Herzkamper Mulde, Bergisches Land, Elberfeld, Germany; *a–e,* holotype, dorsal, ventral, posterior, lateral, and anterior views, ×2; *f,* paratype, surface showing capillae, ×3; *g–h,* serial sections showing cardinal process, ×5; *i,* transverse section showing median septum and dental plates, ×4.2; *j,* longitudinal section showing acute angle on median septum, ×3 (Schmidt, 1975).

Monadotoechia Havlíček, 1960, p. 243 [**Terebratula monas* Barrande, 1847, p. 88; OD]. Small with elongate-oval outline and biconvex profile. Beak incurved. Fold and sulcus moderately strong, arising at umbones; anterior commissure uniplicate; tongue rounded to trapezoid, serrate, trail not developed. Costae few, subangular, extending from umbones. Dental plates small to absent. Hinge plates united, horizontal; cardinal process and septalium absent; dorsal median septum short, thin, high; crura closely set, delicate, tips laterally compressed. *Lower Devonian (Pragian–Emsian):* Bohemia, Morocco, southern Urals, Taimir.——Fig. 791,*1a–j. *M. monas* (Barrande), Koneprusy, Bohemia; *a–d,* holotype, dorsal, ventral, anterior, and lateral views, Pragian, Vinarice Limestone, ×5 (new); *e–i,* serial sections 5.65, 5.55, 5.4, 5.32, 5.2 mm from posterior, Emsian, Suchomasty Limestone, ×6; *j,* transverse section of another specimen, Emsian, Suchomasty Limestone, ×8 (Havlíček & Kukal, 1990).

Nemesa Schmidt, 1941a, p. 41 [**N. nemesana;* OD]. Transversely subpentagonal outline and dorsibiconvex profile; anteriorly inflated. Beak incurved; foramen permesothyrid. Fold and sulcus weak, from about midlength; tongue broad, low, sulciplicate to serrate. Surface smooth or with weak, broad costae developed anteriorly. Dental plates very short, close to walls. Dorsal median septum short; small cardinal process and septalium. *Middle Devonian (Eifelian):* Europe.——Fig. 789,*3a–c. *N. nemesana,* Rommersheimer Beds, Goldelsheim, Germany; holotype, ventral, anterior, and lateral views, ×1.5 (Schmidt, 1941a).——Fig. 789,*3d–f. N. hertae* Havlíček, Hlubocepy Limestone, Hlubocepy, Bohemia; serial sections 9.55, 9.1, 8.9 mm from anterior, ×2.5 (Havlíček, 1961).

Onugorhynchia Havlíček, 1992, p. 87 [**Terebratula matercula* Barrande, 1847, p. 65; OD]. Subpentagonal outline and dorsibiconvex profile; anteriorly inflated with very pronounced anterodorsal trail. Beak sharp, straight to suberect; foramen circular, mesothyrid; deltidial plates small, conjunct. Fold and sulcus strong anteriorly, weak posteriorly; tongue broad, very high, rectangular, projecting anterodorsally as prominent trail. In some specimens anterior trail and equivalent extensions of lateral margins unbroken but usually these thin flanges broken off, leaving introverted truncated edge. Costae low, simple, extending from

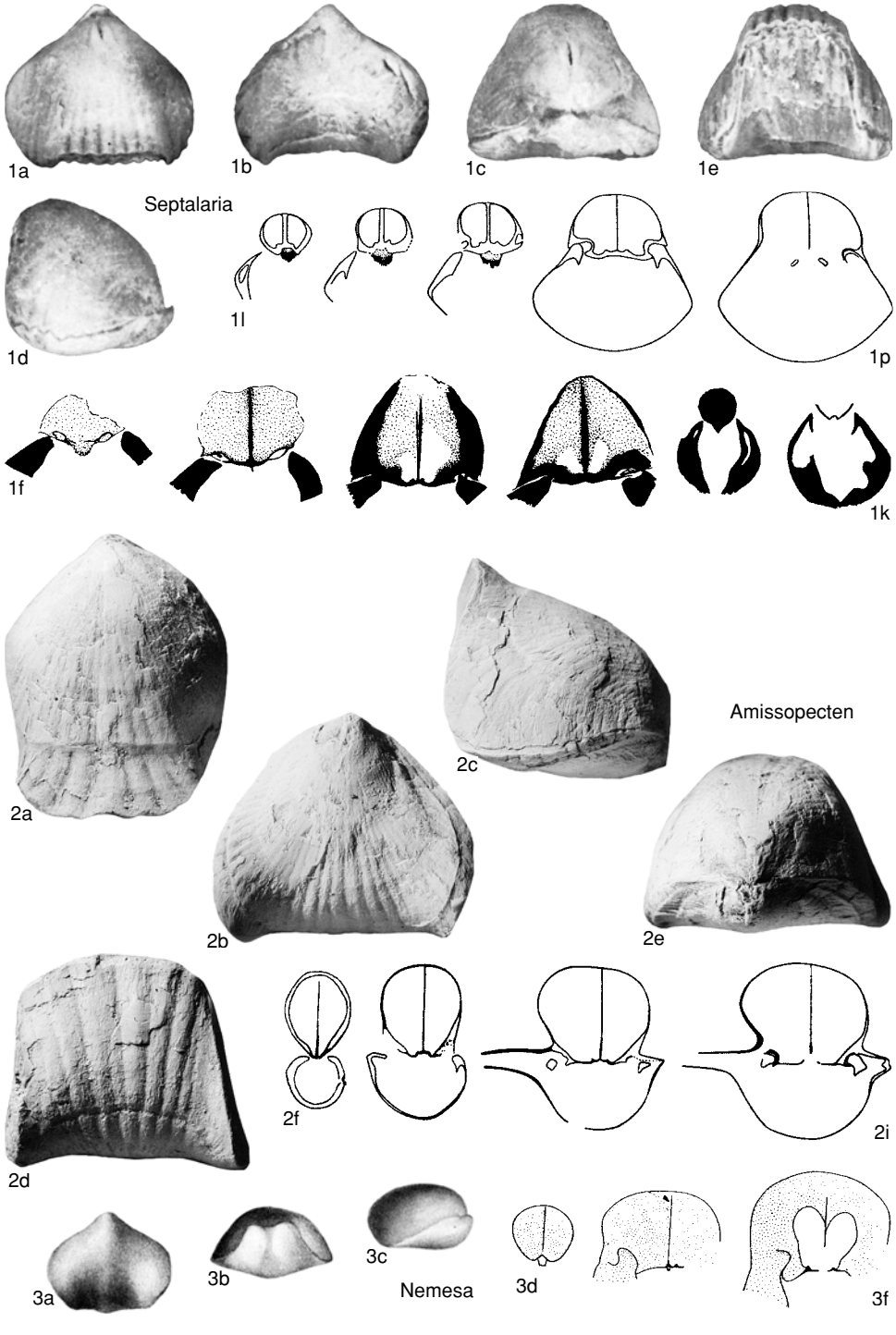

FIG. 789. Septalariidae (p. 1158–1159).

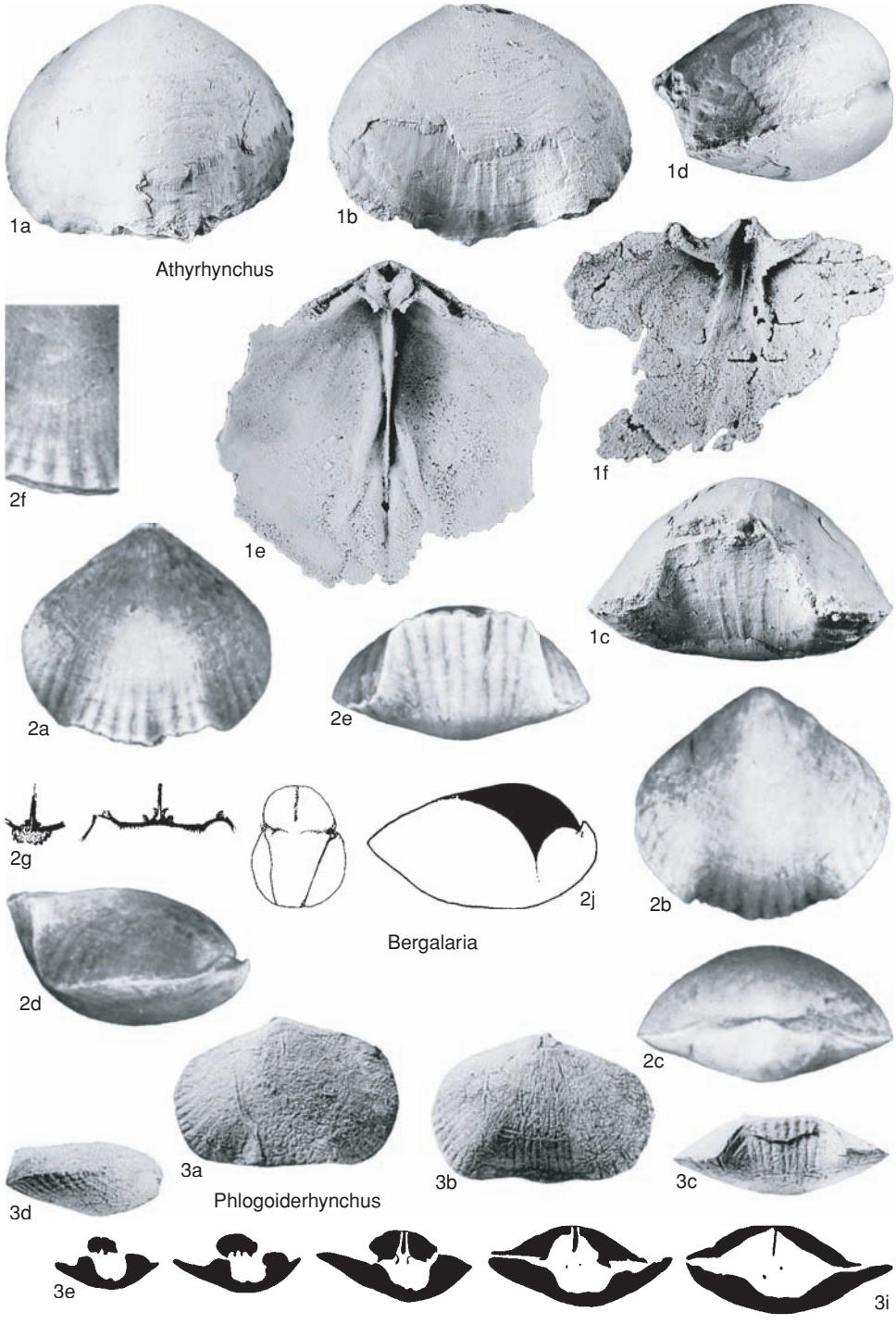

FIG. 790. Septalariidae (p. 1159–1164).

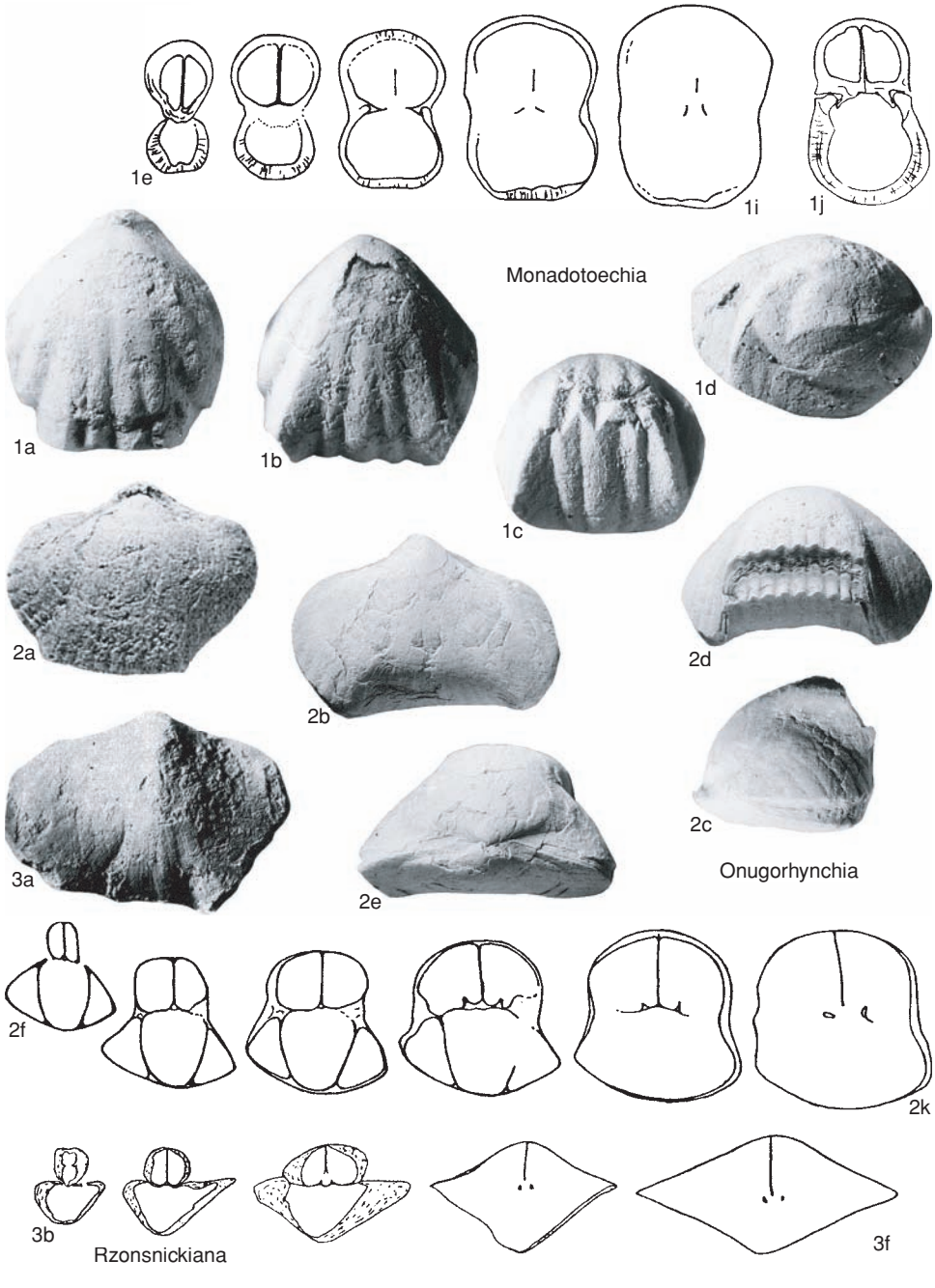

FIG. 791. Septalariidae (p. 1159–1164).

midlength, weak on umbones and flanks; costae changing into grooves on *paries geniculatus*. Short triangular marginal spines commonly developed. Dental plates short, convergent ventrally; ventral muscle field weakly impressed. Dorsal median septum short, high; septalium absent; hinge plates undivided, without median groove; cardinal process small to absent. *Lower Devonian (Pragian–Emsian):*

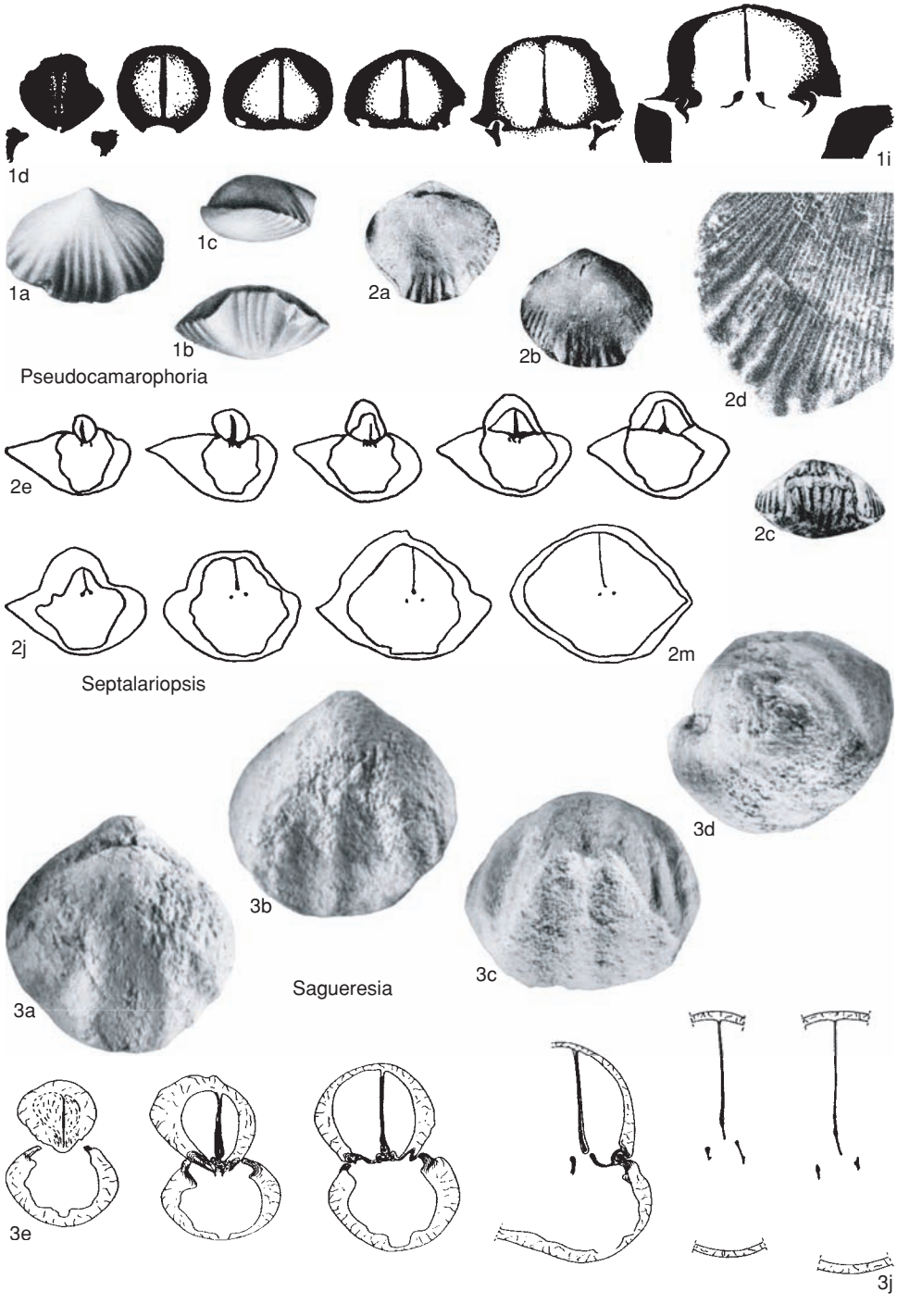

FIG. 792. Septalariidae (p. 1164).

Bohemia.——FIG. 791,*2a–k.* **O. matercula* (BARRANDE), Pragian, Koneprusy Limestone, Koneprusy, Prague; *a–e,* lectotype, dorsal, ventral, lateral, anterior, and posterior views, ×2.75 (new); *f–k,* serial sections 5.7, 5.5, 5.45, 5.35, 5.25, 5.15 mm from anterior, ×10 (Havlíček, 1992).

Phlogoiderhynchus SARTENAER, 1970a, p. 18 [**Uncinulus artefactus* VEEVERS, 1959a, p. 99; OD]. Transversely ovate outline and biconvex profile; gentle lateral slopes. Beak erect; foramen minute, circular. Fold and sulcus broad, extending from midlength; anterior commissure uniplicate; tongue variable, trapezoid to rounded, generally highest part of shell. Dental plates absent; teeth large, widely separated; ventral muscle field deeply impressed. Dorsal median septum long, high; septalium not developed; hinge plates incipient; crura long, slender, arising very early at extreme posterior of valve, thin and delicate, ventrally curved. *Middle Devonian (upper Givetian)–Upper Devonian (lower Frasnian):* Western Australia, Europe, China, Morocco.——FIG. 790,*3a–i.* **P. artefactus* (VEEVERS), lower Frasnian, Sadler Formation, Fitzroy Basin, Sadler Ridge, Western Australia; *a–d,* holotype, dorsal, ventral, anterior, and lateral views, ×1; *e–i,* serial sections 0.7, 0.85, 1.25, 1.95, 2.5 mm from posterior, ×1 (Veevers, 1959a).

Pseudocamarophoria WEDEKIND, 1926, p. 197 [**Terebratula microrhyncha* ROEMER, 1844, p. 65; OD]. Transversely ovate to equidimensional subpentagonal outline and biconvex, lenticular profile. Beak sharp, erect to incurved. Fold and sulcus moderately strong, from umbones; anterior commissure uniplicate; tongue wide, trapezoid, serrate. Costae from umbones, simple, subangular. Dental plates short, umbonal cavities commonly filled with callus. Dorsal median septum high, pointed ventrally in lateral profile, as in *Septalaria,* extending to about one-third valve length; septalium short, wide; cardinal process absent; crura closely set, thin, straight for much of length, arising from dorsal edge of undivided hinge plates. *Lower Devonian (Emsian)–Middle Devonian (Givetian):* Europe, China.——FIG. 792,*1a–i.* **P. microrhyncha* (ROEMER), lower Eifelian, Gondelsheimer Formation, Geeser bed, Eifel, Schönecken, Germany; *a–c,* ventral, anterior, and lateral views, ×1; *d–i,* serial sections 15.3, 15.0, 14.8, 14.6, 14.4, 14.0 mm from anterior, ×4 (Schmidt, 1965b).

Rzonsnickiana MAMEDOV, 1976, p. 121 [**R. sadarakensis;* OD]. Transversely ovate outline and moderately biconvex profile; gentle lateral slopes. Fold and sulcus broad, weak, extending from midlength; anterior commissure uniplicate; tongue low. Costae weak, broad, restricted to anterior margin; radial striae present. Dental plates absent. Dorsal median septum long, high; septalium short, with cover; crura closely set. *Middle Devonian (Eifelian):* Azerbaijan.——FIG. 791,*3a–f.* **R. sadarakensis,* Nakhichevan, Sadarak; *a,* holotype, ventral view, ×2.25; *b–f,* serial sections 1.0, 1.3, 1.4, 1.9, 2.34 mm from posterior, ×3.5 (Mamedov, 1976).

Sagueresia MOHANTI, 1972, p. 172 [**S. saguerana;* OD]. Subpentagonal outline and biconvex, globular profile. Beak incurved. Fold and sulcus moderate, from umbones; anterior commissure sulciplicate. Costae few, large, simple, rounded, arising at midlength. Dental plates absent or obscured by callus; ventral muscle field well impressed. Dorsal median septum high, thin; septalium short to absent; hinge plates undivided; cardinal process absent; crura long, almost straight, closely set, laterally compressed. *Middle Devonian (Eifelian–Givetian):* Spain.——FIG. 792,*3a–j.* **S. saguerana,* Eifelian–Givetian boundary, Portilla Formation, Cantabrian Mountains, Saguera; *a–d,* holotype, dorsal, ventral, anterior, and lateral views, ×3; *e–j,* serial sections, ×5.6 (Mohanti, 1972).

Septalariopsis CHEN, 1978a, p. 331 [**S. zhonghuanensis;* OD]. Subcircular to transversely ovate outline and dorsibiconvex profile; moderate lateral slopes. Beak erect to incurved; foramen small, circular. Fold and sulcus strong, from umbones; anterior commissure uniplicate, tongue wide, rectangular; broken anterior commissure in several specimens suggests projecting trail. Costae of 2 sizes, fine costae from beaks to near margins merging to form coarse costae at anterior and lateral margins. Dental plates absent or obscured by thick callus; ventral muscle field well impressed, narrow in thick callus. Dorsal median septum thin, high, long; septalium short; hinge plates divided anterior of septalium; cardinal process large, with longitudinal ridges; dorsal muscle field narrow, well impressed; crura long, slender, almost straight, closely placed. *Upper Devonian (lower Frasnian):* China (Sichuan).——FIG. 792,*2a–m.* **S. zhonghuanensis,* Tuqiaozi Member, Longmenshan; *a–c,* holotype, dorsal, ventral, and anterior views, ×1; *d,* holotype, costae at margin, ×6; *e–m,* serial sections 1.85, 2.1, 2.3, 2.5, 2.85, 2.95, 3.15, 3.85, 4.15 mm from posterior, ×3 (Chen, 1984).

PUGNACOIDEA

NORMAN M. SAVAGE,[1] MIGUEL O. MANCEÑIDO,[2] ELLIS F. OWEN,[3] and A. S. DAGYS[4]

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Superfamily PUGNACOIDEA Rzhonsnitskaia, 1956

[*nom. transl.* SAVAGE, 1996, p. 253, *ex* Pugnacidae SCHMIDT, 1965b, p. 572, *nom. correct. pro* Pugnaxinae RZHONSNITSKAIA, 1956a, p. 125] [contains superfamily Basilioloidea COOPER, *nom. transl.* MAKRIDIN, 1964, p. 198, *ex* Basiliolidae COOPER, 1959, p. 15]

[Diagnosis prepared by N. M. SAVAGE, M. O. MANCEÑIDO, E. F. OWEN, and A. S. DAGYS]

Rhynchonellida with transversely ovate to subtriangular outline; strongly inflated anteriorly. Dorsal fold and ventral sulcus distinct; tongue high; plicae or costae few, simple, most pronounced anteriorly; umbones usually smooth; superimposed radial striae or costellae occasionally present; foramen generally present, usually with conjunct deltidial plates. Dental plates short to absent, or rarely long. Dorsal median septum short to absent; hinge plates commonly divided, often sloping dorsally to merge with crural plates; septalium absent to rare, short when present; cardinal process absent; crura commonly calciform or septiform. *Lower Devonian (Lochkovian)–Holocene.*

Family PUGNACIDAE Rzhonsnitskaia, 1956

[*nom. transl. et correct.* SCHMIDT, 1965b, p. 572, *ex* Pugnaxinae RZHONSNITSKAIA, 1956a, p. 125]

[Materials prepared by NORMAN M. SAVAGE]

Pugnacoidea with high fold and tongue; umbones usually smooth; costae few; superimposed radial striae common; foramen generally present, with conjunct deltidial plates. Dental plates variable, occasionally absent. Dorsal median septum short to absent; hinge plates divided; crural plates inclined dorsally; septalium absent. *Lower Devonian (Pragian)–Upper Permian (Tatarian).*

Pugnax HALL & CLARKE, 1893, p. 202 [**Terebratula acuminata* SOWERBY, 1822 in 1821–1822, p. 23; SD ICZN Opinion 420, 1956, p. 134] [=*Physetorhyncha* SARTENAER & ROZMAN, 1968, p. 137 (type, *Pugnax biloba* ROZMAN, 1960, p. 386, OD); *Striatopugnax* CHEN, 1978a, p. 322 (type, *S. triplica,* OD)]. Commonly large size; subtriangular to transversely ovate outline; tetrahedral shape with tongue very high, forming pointed arch, dorsal valve strongly inflated, ventral valve relatively flat or concave posteriorly. Beak incurved; foramen small. Fold and sulcus very strong and narrow anteriorly. Costae weak to absent, when present few, simple, most pronounced anteriorly where may be angular; fine radial striae commonly present. Dental plates short, vertical, or ventrally divergent. Septalium and dorsal median septum absent; hinge plates divided; crural plates inclined dorsally, almost meeting valve floor; crura laterally flattened, subparallel, variable. *Middle Devonian (Givetian)–Upper Permian (Tatarian):* cosmopolitan.——FIG. 793,*1a–t.* **P. acuminatus* (SOWERBY); *a–e,* hypotype, dorsal, ventral, lateral, anterior, and posterior views, Lower Carboniferous, Viséan subzone D2, Derbyshire, Thorpe Cloud, England, ×1 (new); *f–t,* hypotype, serial sections, Lower Carboniferous, Dublin, Eire, ×2.8 (Schmidt, 1965a).

Aikarhyncha HAVLÍČEK, 1990b, p. 212 [**Rhynchonella praecox* BARRANDE, 1879b, pl. 29, case 1, fig. 1a–e; OD]. Shell small; subpentagonal outline; dorsibiconvex profile with dorsal valve strongly inflated anteriorly. Beak suberect; delthyrium open. Fold and sulcus strong, from midlength. Costae very strong, angular, arising at about one-third shell length; anterior commissure uniplicate and coarsely dentate, tongue high. Dental plates short, converging toward valve floor. Hinge plates divided; dorsal median septum and septalium absent. *Lower Devonian (Pragian):* Bohemia, Salair.——FIG. 793,*2a–i.* **A. praecox* (BARRANDE), Koneprusy Limestone, Koneprusy, Bohemia; *a–e,* holotype, dorsal, ventral, lateral, posterior, and anterior views, ×4 (new); *f,* serial section, ventral valve, ×6; *g–i,* serial sections, dorsal valve at 7.1, 6.95, 6.7 from anterior, ×6 (Havlíček, 1990b).

Allorhynchoides SAVAGE, EBERLEIN, & CHURKIN, 1978, p. 392 [**A. kirki;* OD]. Small, subcircular to longitudinally ovate, with few, strong plications on fold and in sulcus. Umbones smooth. Fold with median sinus and sulcus with median plication. Dental plates short, ventrally convergent; large elongate teeth inclined dorsally. Hinge plates divided, subhorizontal. Dorsal median septum and septalium absent. *Upper Devonian (Famennian):* southeastern Alaska.——FIG. 794,*3a–l.* **A. kirki,* upper

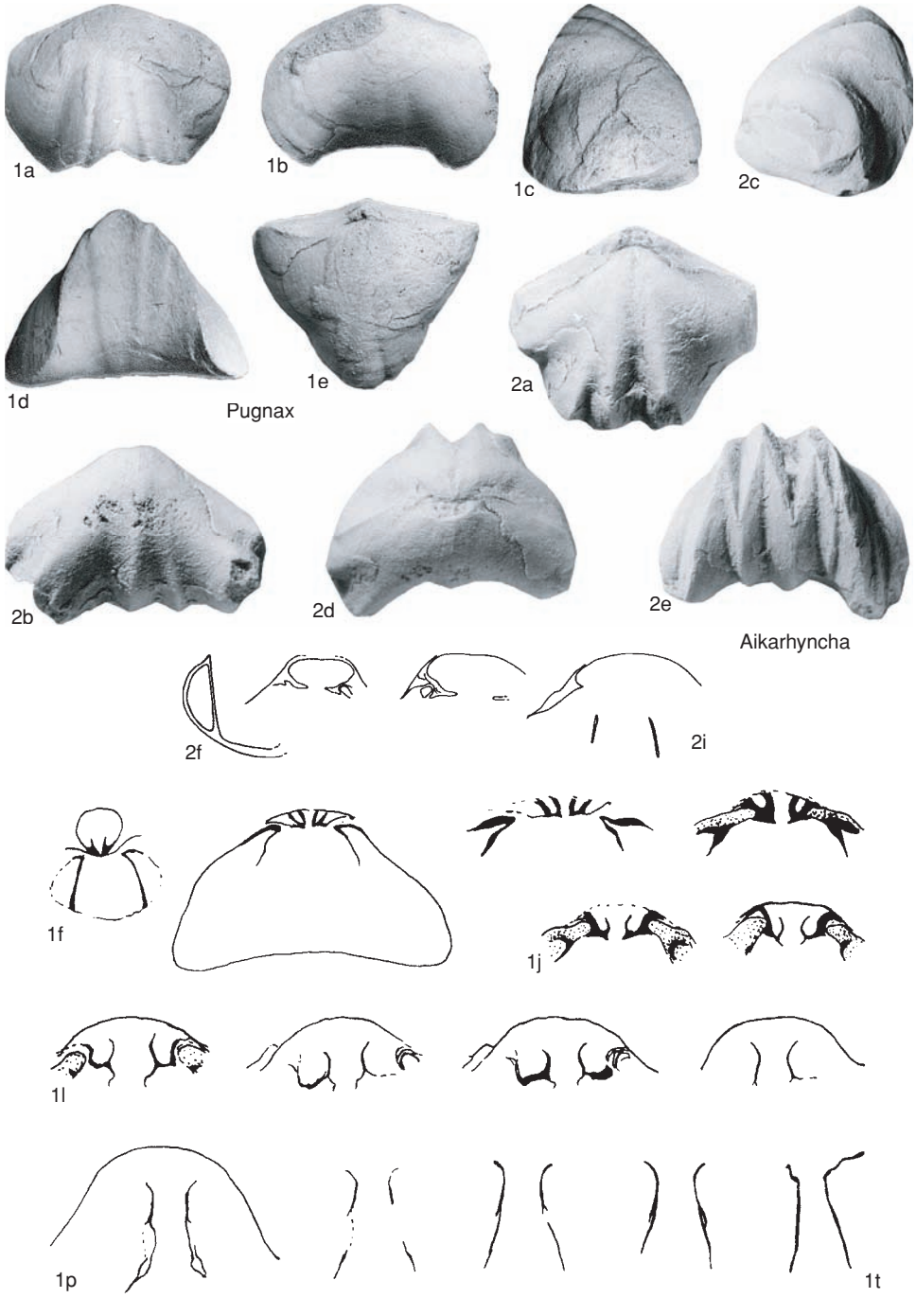

FIG. 793. Pugnacidae (p. 1165).

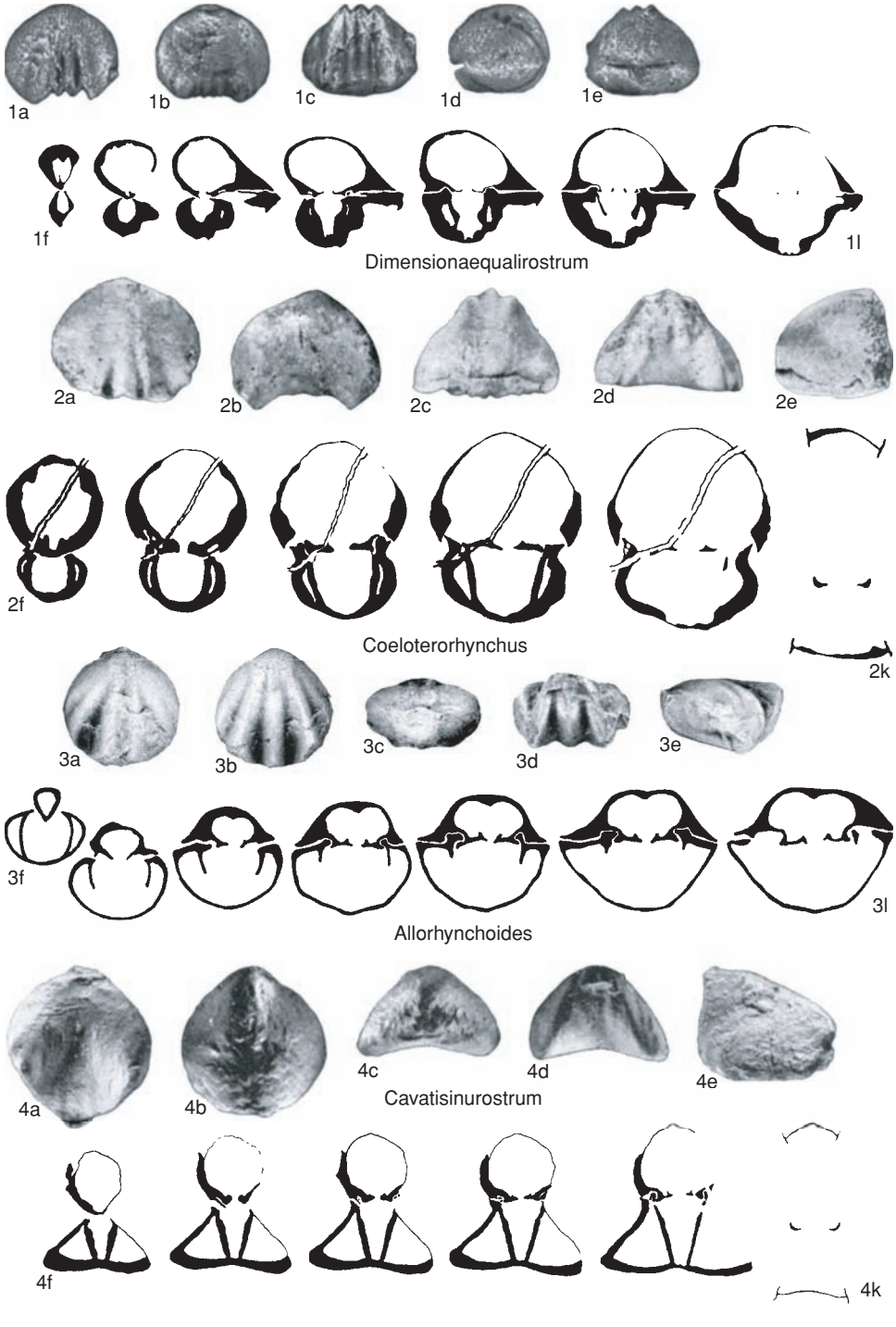

FIG. 794. Pugnacidae (p. 1165–1168).

Famennian, Port Refugio Formation, Suemez Island, Port Refugio; *a–e,* holotype, dorsal, ventral, posterior, anterior, and lateral views, ×3; *f–l,* serial sections 0.6, 0.7, 0.8, 0.9, 1.1, 1.2, 1.3 mm from posterior, ×4 (Savage, Eberlein, & Churkin, 1978).

Cavatisinurostrum Sartenaer, 1972, p. 2 [**C. faniae;* OD]. Large; subcircular to subtriangular; strongly convexiconcave, dorsal valve inflated anteriorly, ventral valve flat to concave; anterior commissure uniplicate to acuminate. Costae weak, rounded, restricted to extreme anterior of fold and sulcus; fine radial striae present. Dental plates long, converging almost to meet ventrally. Hinge plates divided, small; dorsal septum absent; crura long, thin, convex ventrolaterally. *Upper Devonian (Famennian):* western Europe, Western Australia.——Fig. 794,*4a–k. *C. faniae,* lower Famennian, Heure, Belgium; *a–e,* holotype, dorsal, ventral, posterior, anterior, and lateral views, ×1; *f–k,* serial sections 1.9, 2.35, 2.5, 2.9, 3.5, 6.1 mm from posterior, ×2 (Sartenaer, 1972).

Chapinella Savage, Eberlein, & Churkin, 1978, p. 388 [**C. bucareliensis;* OD]. Small; transversely ovate outline and dorsibiconvex profile. Fold and sulcus distinct anteriorly; shell mostly smooth but costae strong and subangular in anterior third; tongue strongly plicated. Dental plates short, ventrally convergent. Dorsal median septum and septalium absent; hinge plates divided, inner edges flexed dorsally. *Upper Devonian (Famennian):* southeastern Alaska.——Fig. 795,*1a–l. *C. bucareliensis,* upper Famennian, Port Refugio Formation, Suemez Island, Port Refugio; *a–d,* holotype, dorsal, ventral, anterior, and lateral views, ×2; *e–l,* serial sections 0.4, 0.6, 0.7, 0.8, 0.9, 1.0, 1.1, 2.1 mm from posterior, ×4 (Savage, Eberlein, & Churkin, 1978).

Coeloterorhynchus Sartenaer, 1966a, p. 41 [**C. tabasensis;* OD]. Subtriangular to transversely ovate; dorsal valve inflated, ventral flat to concave. Beak incurved; foramen small, with small deltidial plates. Fold and sulcus wide; tongue high, serrated to acute. Costae few, rounded, from about midlength, with striae in some specimens. Dental plates distinct, ventrally convergent; ventral muscle field well impressed. Hinge plates divided; dorsal median septum and septalium absent. *Middle Devonian (Givetian)–Upper Devonian (Frasnian):* Iran, Afghanistan, Europe, northern Africa, China.——Fig. 794,*2a–k. *C. tabasensis,* Frasnian, Shishtu Formation, Niaz, Sardar Valley, Iran; *a–e,* holotype, dorsal, ventral, posterior, anterior, and lateral views, ×1; *f–k,* serial sections 1.0, 1.45, 1.75, 2.1, 2.3, 3.35 mm from posterior, ×3 (Sartenaer, 1966a).

Colophragma Cooper & Dutro, 1982, p. 77 [**C. ellipticum;* OD]. Transversely subpentagonal outline; strongly biconvex, dorsal valve inflated. Beak erect; foramen small, mesothyridid, deltidial plates conjunct. Fold and sulcus pronounced anteriorly; tongue high, serrate; umbones smooth. Costae weak and rounded at midlength, strong and angular anteriorly. Dental plates long, ventrally convergent. Hinge plates divided, horizontal; septalium and dorsal median septum very short. *Upper Devonian (Frasnian–Famennian):* USA (New Mexico).——Fig. 796,*1a–j. *C. ellipticum,* upper Frasnian, Contadero Formation, San Andres Mountains; *a–e,* holotype, dorsal, ventral, lateral, anterior, and posterior views, ×1; *f–j,* serial sections 0.3, 0.5, 0.6, 1.1, 1.7 mm from posterior, ×2 (Cooper & Dutro, 1982).

Dimensionaequalirostrum Sartenaer, 1980, p. 2 [**D. pileum;* OD]. Subcircular outline and strongly biconvex profile. Beak erect; foramen small and circular. Fold and sulcus wide, commencing at midlength; tongue high. Costae strong and subangular anteriorly. Dental plates short, ventrally convergent; ventral muscle field deeply impressed. Hinge plates divided; dorsal median septum weak to absent; crura delicate, tips curved ventrally and in form of inverted gutter. *Upper Devonian (Famennian):* Belgium, Moravia, ?Bashkirskaya.——Fig. 794,*1a–l. *D. pileum,* lower Famennian, Senzeilles section, railway cutting southeast of Senzeilles tunnel, Belgium; *a–e,* holotype, dorsal, ventral, anterior, lateral, and posterior views, ×1; *f–l,* serial sections 0.7, 1.3, 1.6, 2.2, 2.6, 3.0, 3.4 mm from posterior, ×2.4 (Sartenaer, 1980).

Eopugnax Baranov, 1991, p. 37 [**E. gonensis;* OD]. Small; subtriangular to subpentagonal outline; dorsibiconvex. Fold and sulcus weak, wide; shell mostly smooth. Costae few, rounded, arising at two-thirds shell length, with 2 wide costae on fold, 1 in sulcus; tongue high; anterior commissure sulciplicate. Dental plates absent. Hinge plates divided, inclined dorsally; dorsal median ridge present; septum and septalium absent. *Lower Devonian (Emsian):* eastern Siberia.——Fig. 796,*2a–i. *E. gonensis,* middle Krivoy Ruchey Formation, Selennyakhskiy Kryazh, Gon Creek; *a–d,* holotype, dorsal, ventral, anterior, and lateral views, ×2; *e–i,* serial sections, intervals not given, ×7 (Baranov, 1991).

Evanidisinurostrum Sartenaer, 1987a, p. 135 [**Pseudoleiorhynchus (?) zemoulensis* Drot, 1964b, p. 172; OD]. Subtriangular outline; moderately biconvex profile. Beak suberect; foramen small. Fold and sulcus weak but arising at umbones; most of shell smooth, with costae developed anteriorly. Costae coarse, rounded, with 2 costae on fold, single costa in sulcus; tongue low, rounded; anterior commissure sulciplicate. Dental plates absent; ventral muscle field moderately impressed. Hinge plates divided, sloping slightly dorsally; dorsal median septum and septalium absent; crura rodlike, subparallel, with distal ends sharply flexed ventrally. *Upper Devonian (Famennian):* Morocco.——Fig. 795,*3a–k. *E. zemoulensis* (Drot), lower Famennian, plains of Drah-el-Kelba; *a–c,* holotype, dorsal, anterior, and lateral views, ×1; *d–k,* serial sections 1.1, 1.3, 1.5, 1.7, 1.9, 2.1, 2.6, 3.0 mm from posterior, ×3.6 (Drot, 1964b).

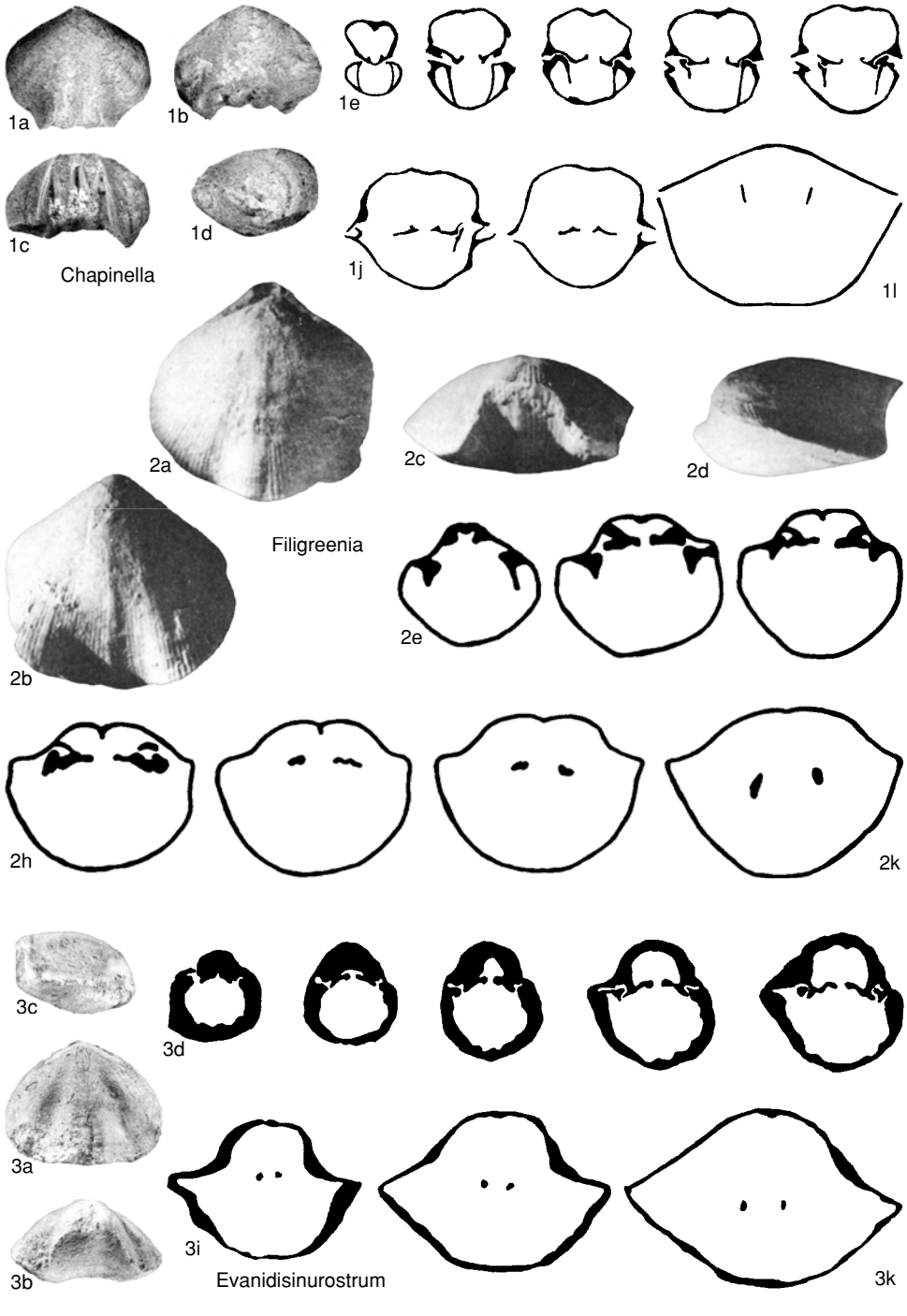

FIG. 795. Pugnacidae (p. 1168–1171).

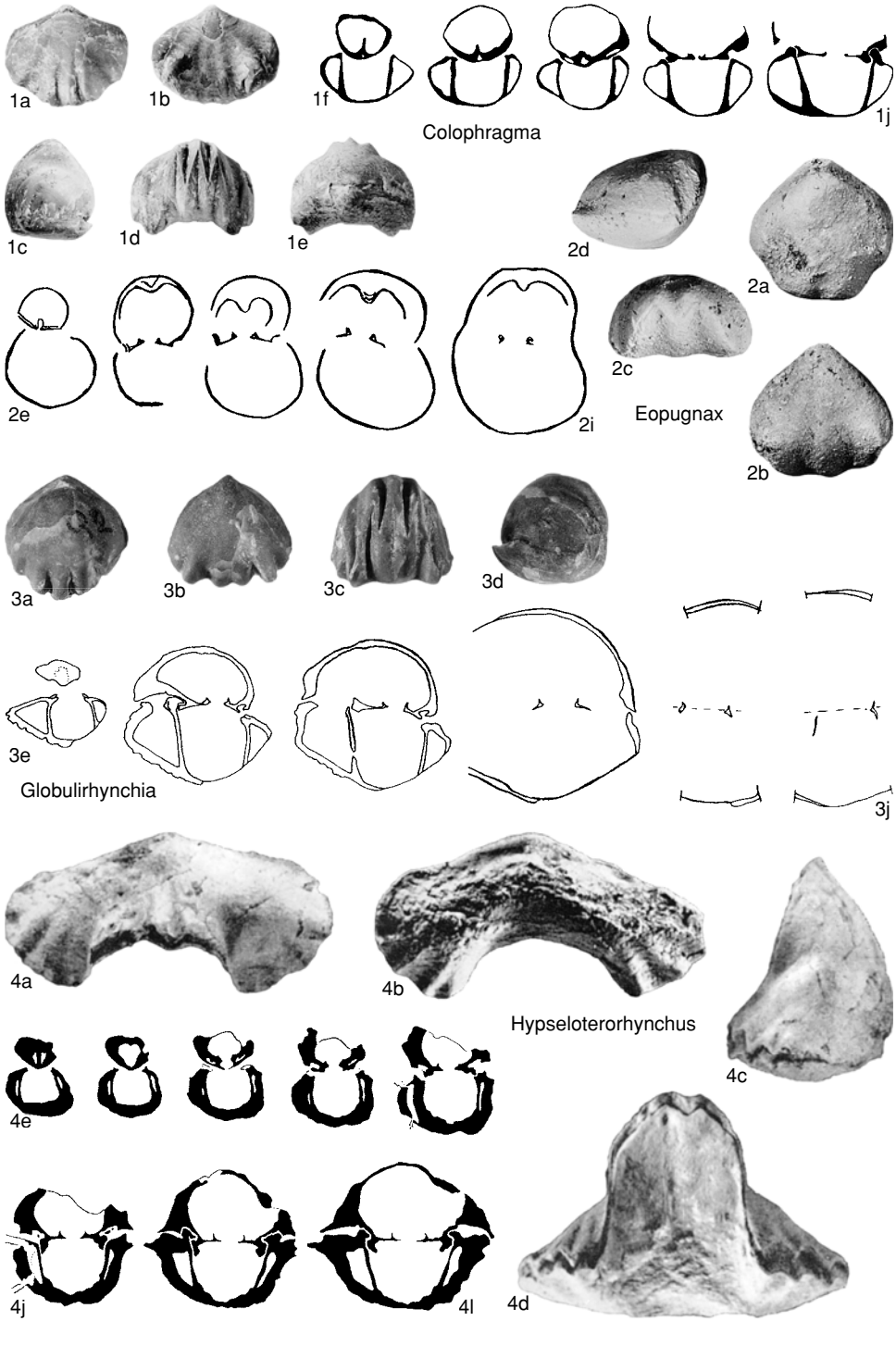

FIG. 796. Pugnacidae (p. 1168–1171).

Filigreenia Soja, 1988, p. 156 [**F. circularis;* OD]. Outline subcircular; profile dorsibiconvex. Beak suberect; foramen hypothyrid. Fold and sulcus rounded, arising near umbones; faint sinus on fold, ridge in sulcus; anterior commissure uniplicate. Fine costellae present and most evident anteriorly. Dental plates short and ventrally divergent. Hinge plates divided; dorsal median ridge extending to about hinge line; crural bases horizontal; crura becoming laterally compressed distally. *Lower Devonian (Emsian):* USA (southeastern Alaska).——Fig. 795,*2a–k.* **F. circularis,* middle Emsian, Kasaan Island; *a–d,* holotype, dorsal, ventral, anterior, and lateral views, ×2.5; *e–k,* serial sections 1.3, 1.55, 1.65, 1.75, 1.85, 1.95, 2.20 mm from posterior, ×6 (Soja, 1988).

Globulirhynchia Brice, 1981a, p. 149 [**Rhynchonella le mesli* Rigaux, 1892, p. 103; OD]. Subtriangular outline; strongly inflated dorsal valve. Beak suberect; foramen small, mesothyridid. Fold and sulcus strong anteriorly; tongue high. Costae coarse, few, rounded, developed only anteriorly. Dental plates well developed, slightly convergent ventrally. Hinge plates divided; dorsal median septum and septalium absent. *Upper Devonian (lower Frasnian):* western Europe.——Fig. 796,*3a–j.* **G. lemesli* (Rigaux), Beaulieu Formation, Boulonnais, Ferques, northeastern France; *a–d,* dorsal, ventral, anterior, and lateral views, ×1; *e–j,* serial sections 0.7, 1.1, 1.2, 1.7, 2.0, 2.4 mm from posterior, ×8 (Brice, 1981a).

Hypseloterorhynchus Sartenaer, 1971a, p. 2 [**H. pennatus;* OD]. Large; transversely ovate, with emarginate anterior; inflated profile, tongue very high. Beak incurved. Fold and sulcus very strong anteriorly. Costae few, low, developed anteriorly only. Dental plates long, ventrally convergent. Hinge plates divided; septalium absent; dorsal median septum rudimentary. *Upper Devonian (Famennian):* Western Australia.——Fig. 796,*4a–l.* **H. pennatus,* Virgin Hills Formation, Mount Pierre, Casey Falls; *a–d,* holotype, dorsal, ventral, lateral, and anterior views, ×1; *e–l,* paratype, serial sections 0.85, 0.95, 1.20, 1.35, 1.55, 1.75, 2.05, 2.25 mm from posterior, ×3 (Sartenaer, 1971a).

Kwangsirhynchus Hou & Xian, 1975, p. 38 [**K. liujingensis;* OD]. Small with subtriangular to subpentagonal outline and dorsibiconvex profile, strongly inflated anteriorly. Beak suberect. Fold and sulcus from umbones; anterior commissure uniplicate with high tongue trapezoid to acuminate. Costae subangular, simple, from beak, present on entire surface. Dental plates short, thin, vertical. Hinge plates divided, horizontal; crural plates not meeting valve floor; dorsal septum and septalium absent. *Lower Devonian (Pragian–Emsian):* southern China, Vietnam.——Fig. 797,*2a–i.* **K. liujingensis,* Pragian–lower Emsian, Nagaoling Formation, Guangxi, Hengxian County, Liujing, southern China; *a–d,* holotype, dorsal, ventral, lateral, and anterior views, ×1 (Hou & Xian, 1975); *e–i,* serial sections 1.0, 3.8, 4.0, 4.2, 5.5 mm from posterior, ×3 (new).

Longdongshuia Hou & Xian, 1975, p. 39 [**L. subaequata;* OD]. Small to medium with subcircular to subpentagonal outline and dorsibiconvex profile. Beak erect. Fold and sulcus strong but obscured by shell convexity; anterior commissure uniplicate; tongue high, rounded, dentate. Costae strong, simple, interspaces narrow, subangular, from beaks, covering entire surface. Dental plates short, vertical. Dorsal median septum, septalium, cardinal process absent; hinge plates united by convex plate, supported by pair of short crural plates posteriorly; crura short, strongly curved ventrally. *Middle Devonian (Eifelian):* China.——Fig. 798,*2a–n.* **L. subaequata,* Beiliuan, Longdongshui Formation, Guizhou, Dushan County, Houershan; *a–c,* holotype, ventral, lateral, and anterior views, ×1 (Hou & Xian, 1975); *d–g,* hypotype, dorsal, ventral, anterior, and lateral views, ×2; *h–n,* serial sections 0.9, 1.0, 1.4, 1.8, 1.9, 2.4, 2.5 mm from posterior, ×2.5 (Wang & Zhu, 1979).

Ningbingella Roberts, 1971, p. 152 [**N. flexuosa;* OD]. Large; outline transversely subpentagonal with emarginate anterior margin. Beak small, erect to incurved, pierced by small foramen. Fold and sulcus strong anteriorly; tongue high. Costae few, subangular, most pronounced anteriorly; radial striae present. Dental plates short, convergent ventrally, concave medially; uncovered septalium short, wide, supported by low dorsal median septum for one-third valve length; crura laterally compressed, with medially directed flange on distal ventral edge. *Lower Carboniferous (Tournaisian):* Western Australia, western Canada.——Fig. 799,*2a–l.* **N. flexuosa,* Ningbing Limestone, Bonaparte Gulf, Ningbing Range, northwestern Australia; *a–d,* holotype, ventral, anterior, posterior, and lateral views, ×1; *e–l,* serial sections 1.8, 2.0, 2.2, 2.8, 3.0, 3.2, 3.5, 3.9 mm from posterior, ×3.6 (Roberts, 1971).

Pammegetherhynchus Sartenaer, 1977, p. 68 [**P. merodae;* OD]. Transversely ovate with emarginate anterior; strongly dorsibiconvex with inflated anterior. Beak erect to incurved. Fold and sulcus very strong; anterior commissure strongly uniplicate; tongue high, rounded. Costae very weak to absent; radial striae present. Dental plates short, convergent ventrally. Hinge plates short, divided; dorsal median septum and septalium absent; long thin crura, concave dorsally. *Upper Devonian (Frasnian):* France, Poland.——Fig. 797,*1a–k.* **P. merodae,* upper Frasnian, Trélon, France; *a–e,* holotype, dorsal, ventral, lateral, anterior, and posterior views, ×1; *f–k,* serial sections 1.5, 1.65, 2.1, 2.8, 4.1, 4.2 mm from posterior, ×2.5 (Sartenaer, 1977).

Parapugnax Schmidt, 1964, p. 505 [**Pugnax pugnus brecciae* Schmidt, 1941b, p. 278; OD]. Large; transversely subovate outline with emarginate anterior; strongly inflated, especially anteriorly. Fold and sulcus pronounced; tongue very high. Costae few, developed anteriorly. Dental plates very short. Hinge plates slope dorsally to form septalium-like structure supported by weak median septum; hinge plates divided anterior of septalium; crura laterally

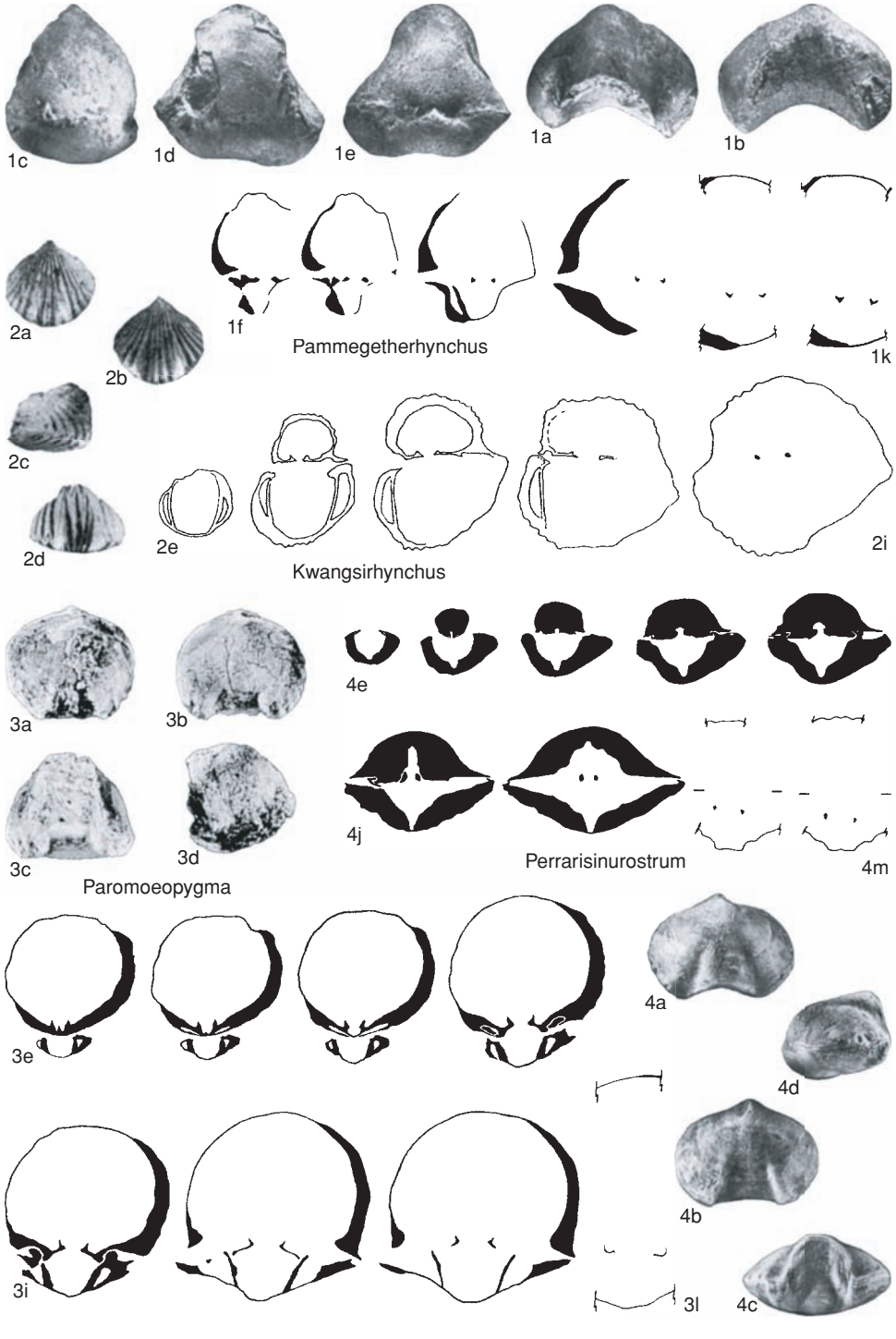

FIG. 797. Pugnacidae (p. 1171–1174).

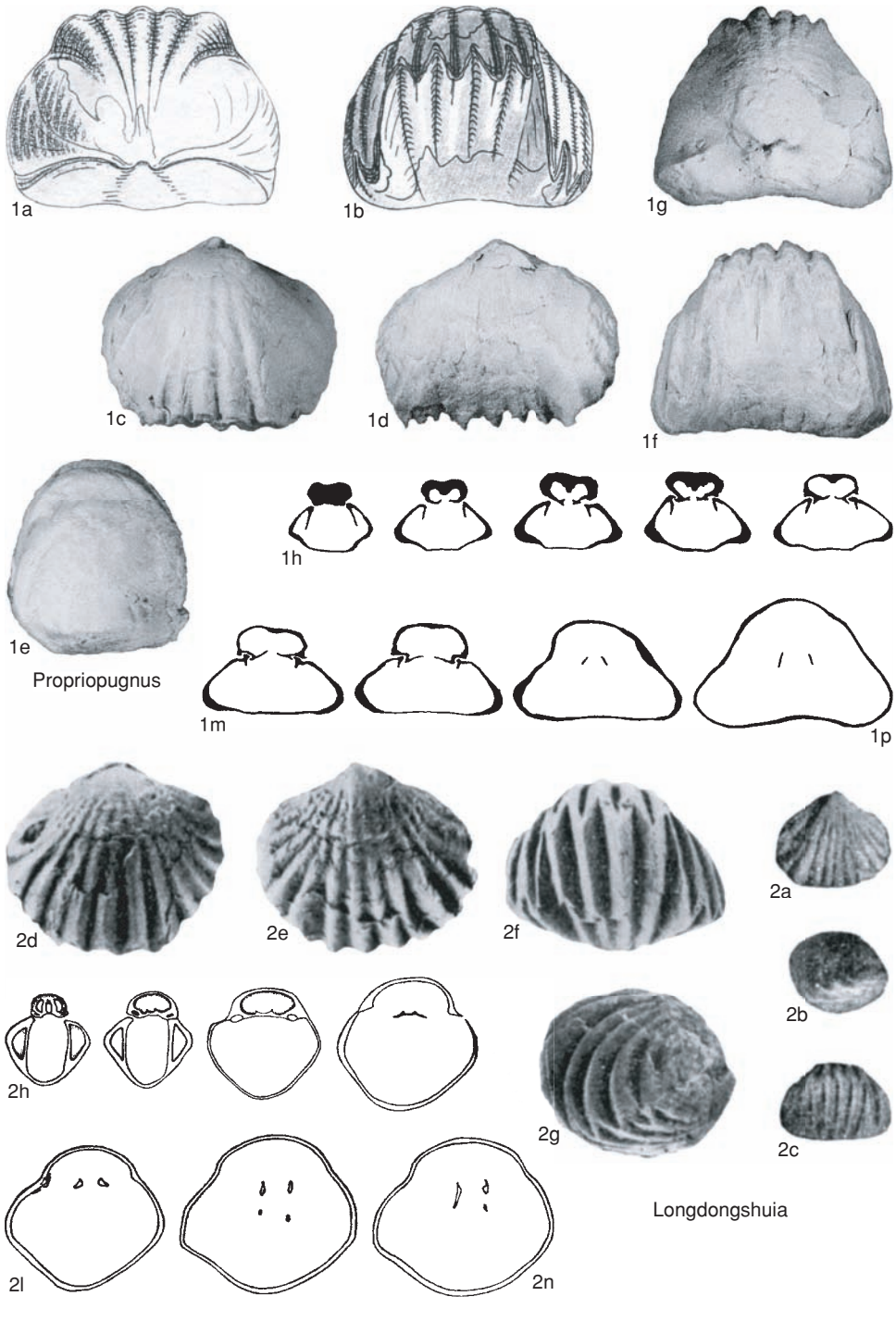

FIG. 798. Pugnacidae (p. 1171–1174).

compressed, with small, medially directed flange on distal ventral edge. *Middle Devonian (Givetian)–Upper Devonian (Frasnian):* cosmopolitan.——Fig. 799,*1a–m. *P. brecciae* (Schmidt), Upper Devonian, Iberger Limestone, Dill syncline, Langenaubach, Germany; *a–c,* holotype, posterior, anterior, and lateral views, ×1 (Schmidt, 1941b); *d–i,* serial sections 15.3, 15.1, 15.0, 14.9, 14.7, 14.6 mm from anterior, ×3; *j–m,* serial sections 22.2, 21.8, 21.3, 21.0 mm from anterior, ×2.3 (Schmidt, 1965a).

Paromoeopygma Sartenaer, 1968c, p. 3 [**P. bellicastellana;* OD]. Medium to large with subcircular to transversely ovate outline and dorsibiconvex, anteriorly inflated profile. Beak suberect to erect; foramen small, deltidial plates present. Fold and sulcus most evident anteriorly; tongue high, serrate, may be rounded. Costae weak, coarse, rounded, only distinct anteriorly; umbones smooth; fine radial striations present. Dental plates low, short, ventrally convergent. Hinge plates divided; inner hinge plates inclined dorsally; dorsal median septum and septalium absent; crural bases small, crescentic in section, concave laterally; crura thin, concave dorsally. *Upper Devonian (Famennian):* Europe.——Fig. 797,*3a–l. *P. bellicastellana,* lower Famennian, railway cutting southeast of Senzeilles tunnel, Belgium; *a–d,* holotype, dorsal, ventral, anterior, and lateral views, ×1; *e–l,* serial sections 0.9, 0.95, 1.05, 1.25, 1.35, 1.75, 1.85, 3.25 mm from posterior, ×3 (Sartenaer, 1968c).

Perrarisinurostrum Sartenaer, 1984a, p. 4 [**P. bensbergicum;* OD]. Transversely ovate outline; strongly biconvex, inflated anteriorly. Beak incurved; foramen small, deltidial plates present. Fold and sulcus strong; tongue rounded. Costae very weak, few, flanks smooth. Dental plates absent; hinge plates divided; dorsal median septum and septalium absent; crura long, thin, closely placed, slightly curved ventrally. *Upper Devonian (Famennian):* Germany, Morocco.——Fig. 797,*4a–m. *P. bensbergicum,* lower Famennian, Knoppenbiessener Beds, Bergischland, Bensberg, Germany; *a–d,* holotype, dorsal, ventral, anterior, and lateral views, ×1; *e–m,* serial sections 0.65, 1.15, 1.35, 1.55, 1.7, 1.85, 2.3, 4.2, 4.45 mm from posterior, ×2.1 (Sartenaer, 1984a).

Pleuropugnoides Ferguson, 1966, p. 354 [**Terebratula pleurodon* Phillips, 1836, p. 222; OD]. Subpentagonal to transversely ovate outline and dorsibiconvex profile, inflated anteriorly. Beak straight to suberect; deltidial plates conjunct, foramen circular to oval. Fold and sulcus strong, from umbones; anterior commissure uniplicate; tongue wide, high, trapezoid to rounded; margins zigzag. Costae strong, simple, rounded, extending from beaks. Dental plates short, vertical. Septalium very short to absent; hinge plates divided; dorsal median septum very short; crura ventrally curved with V-shaped section, open ventrally, and tips laterally flattened. *Carboniferous (lower Viséan–lower Westphalian):* Europe, Libya, China, Australia.——Fig. 800,*1a–k. *P. pleurodon* (Phillips); *a–c,* lectotype, dorsal, anterior, and lateral views, ×1; *d–k,* serial sections 0.7, 0.8, 1.0, 1.2, 1.6, 1.8, 2.2, 3.4 mm from posterior, ×4.5 (Ferguson, 1966).

Propriopugnus Brunton, 1984, p. 32 [**Conchyliolithus Anomites (Pugnus)* Martin, 1809, pl. 22, fig. 4–5; OD]. Large with subtriangular to subpentagonal outline and strongly biconvex profile; inflated anteriorly. Beak incurved; foramen mesothyrid. Fold and sulcus distinct, arising at umbones; tongue high, wide, trapezoid. Costae arising at umbones, coarse, most pronounced anteriorly, 4 or 5 on fold and in sulcus, fewer and weaker on flanks; radial striae not evident. Dental plates short. Dorsal median septum very short, low, thick; small septalium; hinge plates divided, thin, subhorizontal or inclined slightly dorsally; crura thin, becoming steeply oblique distally, laterally compressed. *Lower Carboniferous (Viséan):* western Europe.——Fig. 798,*1a–p. *P. pugnus* (Martin), Carboniferous Limestone, England; *a–b,* holotype, posterior and anterior views, Derbyshire, ×1 (Martin, 1809); *c–g,* hypotype, dorsal, ventral, lateral, anterior, and posterior views, Staffordshire, Wetton, ×1.5; *h–p,* serial sections 1.1, 1.2, 1.3, 1.4, 1.5, 1.9, 2.4, 3.0, 4.3 mm from posterior, Staffordshire, Wetton, ×1.3 (new).

Solidipontirostrum Sartenaer, 1970a, p. 21 [**Terebratula pugnoides* Schnur, 1851, p. 3; OD]. Triangular to subpentagonal outline; very inflated dorsally. Beak erect to incurved. Fold and sulcus strong anteriorly; uniplicate with prominent tongue. Costae few, most prominent anteriorly. Dental plates short, vertical. Hinge plates united anterior of small septalium; dorsal median septum short. *Middle Devonian (Eifelian–Givetian):* Europe, western Siberia.——Fig. 800,*4a–i. *S. pugnoides* (Schnur), upper Eifelian, Gondelsheimer Beds, Geeser bed, Germany; *a–c,* ventral, lateral, and anterior views, ×1.33; *d–i,* serial sections across posterior, intervals not given, ×3 (Schmidt, 1941a).

Trifidorostellum Sartenaer, 1961c, p. 5 [**Leiorhynchus dunbarense* Haynes, 1916, p. 38; OD] [=*Pseudoleiorhynchus* Rozman, 1962, p. 122 (type, *Leiorhynchus uralicus* Nalivkin, 1947, p. 90, OD)]. Transversely ovate outline; strongly biconvex, anteriorly inflated. Beak erect to incurved; foramen small, hypothyrid. Fold and sulcus strong, extending from umbones; anterior commissure uniplicate; tongue high, rounded. Strong costae arising at umbones, present in sulcus and on fold and flanks. Dental plates very short, close to walls. Hinge plates divided; dorsal median septum and septalium absent; crural plates short; crura concave dorsolaterally. *Upper Devonian (Famennian):* western North America, China, Kazakhstan.——Fig. 800,*2a–i. *T. dunbarense* (Haynes), middle Famennian, Three Forks Shale, Three Forks, Montana, USA; *a–e,* holotype, dorsal, ventral, lateral, posterior, and anterior views, ×1; *f–i,* serial sections 0.8, 1.0, 1.1, 1.3 mm from posterior, ×2.9 (Sartenaer, 1961c).

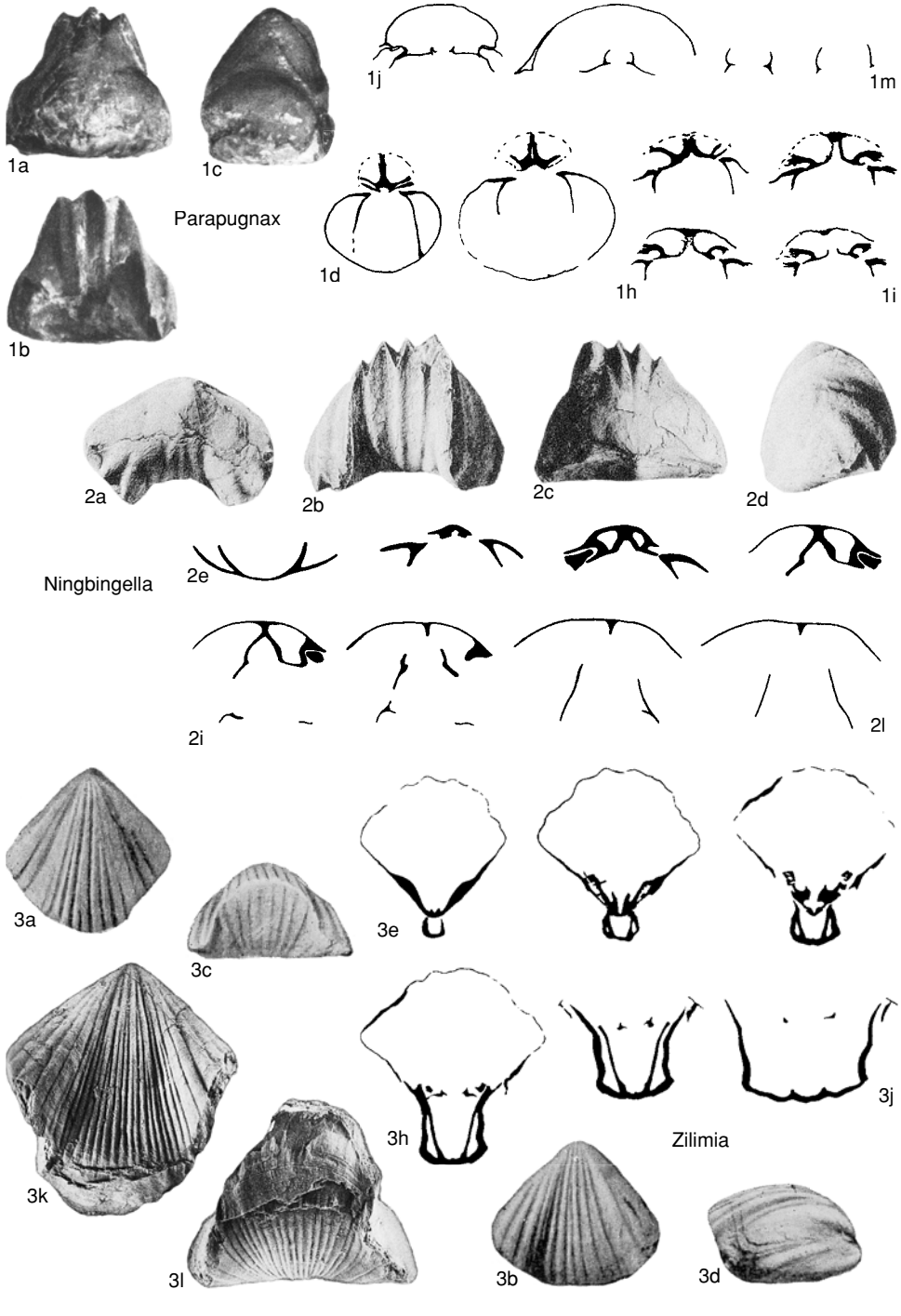

FIG. 799. Pugnacidae (p. 1171–1176).

Ujandinella Baranov, 1977, p. 75 [**U. remissiformis;* OD]. Small; subtriangular outline; moderately biconvex. Beak erect; fold and sulcus developed anteriorly; uniplicate with moderate tongue; smooth except for anterior costae; costae coarse, few, subangular. Dental plates short, thin. Hinge plates divided; dorsal septum and septalium absent. *Lower Devonian (Pragian):* eastern Siberia.——Fig. 800,*3a–k. *U. remissiformis,* lower Pragian, Sagyrian suite, Selennyakhskiy Kryazh; *a–d,* holotype, dorsal, ventral, anterior, and lateral views, ×2; *e–k,* serial sections 0.6, 0.8, 0.9, 1.0, 1.1, 1.2, 1.3 mm from posterior, ×4.5 (Baranov, 1977).

Zilimia Nalivkin, 1947, p. 93 [**Rhynchonella polonica* Gürich, 1896, p. 291; OD]. Large with subtriangular to subpentagonal outline and dorsibiconvex profile; ventral valve concave anteriorly because of strong, wide sulcus. Beak straight to suberect; foramen ovate. Fold and sulcus strong, wide, rounded; anterior commissure uniplicate, arched. Costae moderately strong, arising at beak, multiplying by bifurcation, variable in size. Dental plates long, converging and almost meeting toward valve floor. Hinge plates divided, small; dorsal septum absent; crural bases triangular in section; crura long, thin, convex ventrolaterally in section. *Upper Devonian (lower Famennian):* Poland, Urals, Kazakhstan, Tian Shan.——Fig. 799,*3a–l. *Z. polonica* (Gurich); *a–d,* dorsal, ventral, anterior, and lateral views, southern Urals, ×1 (Rzhonsnitskaia, Likharev, & Makridin, 1960); *e–j,* serial sections 3.0, 3.4, 4.0, 4.95, 5.5, 7.7 mm from posterior, southern Urals, ×1.7 (Sartenaer, 1972); *k–l,* neotype, ventral and anterior views, Holy Cross Mountains, Gora Cmentarna, Poland, ×1.3 (Biernat & Szulczewski, 1993).

Family PLECTORHYNCHELLIDAE Rzhonsnitskaia, 1958

[Plectorhynchellidae Rzhonsnitskaia, 1958, p. 117]

[Materials prepared by Norman M. Savage]

Small Pugnacoidea with dorsal sulcus and ventral fold, longitudinally ovate outline, anterior commissure plicosulcate, smooth or with weak costae on fold and in sulcus. Dental plates short. Dorsal median septum absent or very short; hinge plates divided. *Lower Devonian (Lochkovian)–Upper Devonian (upper Famennian).*

Subfamily PLECTORHYNCHELLINAE Rzhonsnitskaia, 1958

[*nom. transl.* Savage, 1996, p. 254, *ex* Plectorhynchellidae Rzhonsnitskaia, 1958, p. 117]

Plectorhynchellidae with crura long, closely set. *Middle Devonian (lower Eifelian)–Upper Devonian (upper Famennian).*

Plectorhynchella Cooper & Muir-Wood, 1951, p. 195, *nom. nov. pro Monticola* Nalivkin, 1930b, p. 86, *non* Boie, 1822 [**Athyris collinensis* Frech, 1902, p. 99; OD]. Small; longitudinally ovate outline; ventribiconvex. Beak straight to erect; foramen rounded, hypothyrid. Dorsal sulcus and ventral fold low, wide; anterior commissure plicosulcate; umbones smooth. Costae subrounded, irregular, most pronounced in sulcus and on fold. Dental plates short, convergent to divergent ventrally; teeth short, convergent dorsally. Dorsal median septum short, thin, abruptly truncated; hinge plates divided; septalium absent; crura long, closely set. *Upper Devonian (Famennian):* Europe, Urals, northern Africa, central Asia, western North America.——Fig. 801,*1a–k. *P. collinensis* (Frech), middle Famennian, Pizzo Collina Formation, Carnic Alps, Pizzo Collina, northern Italy; *a–d,* neotype, dorsal, ventral, anterior, and lateral views, ×1.5; *e–k,* serial sections 0.7, 0.8, 0.9, 1.0, 1.15, 1.3, 1.4 mm from posterior, ×7 (Ferrari & Vai, 1973).

Ipherron Havlíček, 1982a, p. 113 [**I. iphis;* OD]. Small; longitudinally ovate to cordiform with emarginate anterior; dorsal valve broadly sulcate, ventral valve broadly convex; anterior commissure unisulcate. Beak straight to suberect; foramen rounded and hypothyrid. Costae absent. Dental plates short, thin, vertical to ventrally convergent. Hinge plates united to form single flat plate supported by thin median septum that increases in height toward valve midlength. *Middle Devonian (lower Eifelian):* Bohemia.——Fig. 801,*2a–j. *I. iphis,* upper Eifelian, Chotec Formation, Holyne, Prastav Quarry, Prague; *a–d,* holotype, dorsal, ventral, anterior, and lateral views, ×3; *e–j,* serial sections 6.55, 6.43, 6.33, 6.20, 6.05, 5.70 mm from anterior, ×7.5 (Havlíček, 1982a).

Kindleina Savage, Eberlein, & Churkin, 1978, p. 390 [**K. suemezensis;* OD]. Small; longitudinally ovate to subpentagonal outline; equibiconvex to ventribiconvex profile. Beak suberect; foramen circular, small, mesothyrid. Wide ventral fold extending most of valve length, bearing strong median groove; correspondingly wide dorsal sulcus bearing median ridge; anterior commissure plicosulcate. Costae weak, low, restricted to anterior of fold and sulcus; shell flanks smooth. Dental plates short, ventrally convergent; ventral muscle scars weakly impressed. Hinge plates divided, subhorizontal; crural plates, dorsal median septum, and septalium absent. *Upper Devonian (Famennian):* USA (southeastern Alaska).——Fig. 801,*3a–n. *K. suemezensis,* upper Famennian, Port Refugio Formation, Suemez Island, Port Refugio; *a–e,* holotype, dorsal, ventral, anterior, posterior, and lateral views, ×2; *f–n,* serial sections 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.9 mm from posterior, ×4.5 (Savage, Eberlein, & Churkin, 1978).

Nyege Veevers, 1959a, p. 113 [**N. scopimus;* OD]. Small; longitudinally subpentagonal outline; equibiconvex to ventribiconvex profile. Beak suberect; delthyrium open; dorsal sulcus with median

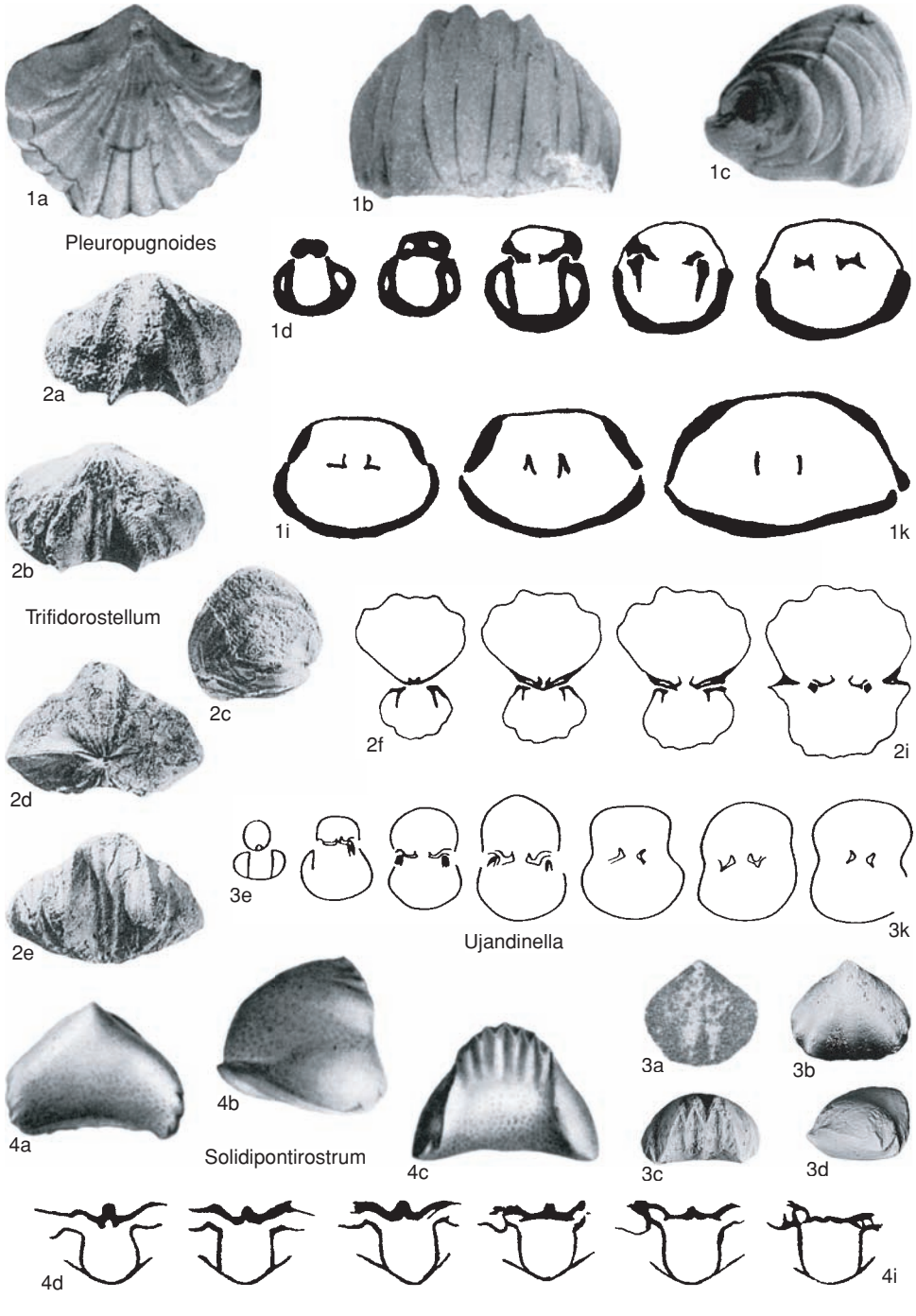

FIG. 800. Pugnacidae (p. 1174–1176).

fold and ventral fold with median sinus; anterior commissure plicosulcate. Costae arising at umbones, increasing by intercalation and bifurcation, present on flanks, fold, and sulcus. Dental plates short, vertical. Hinge plates divided, subhorizontal; crural plates, dorsal median septum, and septalium absent; cardinal process probably absent; crura long, parallel. *Upper Devonian (Famennian):* Western Australia.——Fig. 801,*5a–k. *N. scopimus,* Bugle Gap Limestone, Fitzroy basin, Bugle Gap; *a–e,* holotype, dorsal, ventral, posterior, anterior, and lateral views, ×1.5; *f–k,* serial sections 0.7, 0.9, 0.95, 1.05, 1.15, 1.35 mm from posterior, ×4.5 (Veevers, 1959a).

Pseudoyunnanella Chen, 1978a, p. 336 [**P. sichuanensis;* OD]. Small size with subcircular to subpentagonal outline and ventribiconvex profile. Beak straight to suberect. Dorsal sulcus with median fold and ventral fold with median sinus; anterior commissure plicosulcate. Fine costae arising at umbones, often coalescing to form coarse costae anteriorly. Dental plates short, vertical. Dorsal median septum short to absent; hinge plates divided, subhorizontal; cardinal process probably absent; crura long, parallel. *Upper Devonian (upper Famennian):* China.——Fig. 801,*4a–k. *P. sichuanensis,* Maoba Formation, Sichuan, Chongin, Changheba; *a–d,* holotype, dorsal, ventral, anterior, and lateral views, ×1; *e–k,* serial sections 0.35, 0.5, 0.6, 0.9, 1.1, 1.85, 2.0 mm from posterior, ×4 (Chen, 1978a).

Subfamily PYGMAELLINAE Baranov, 1977

[*nom. transl.* Savage, 1996, p. 254, *ex* Pygmaellidae Baranov, 1977, p. 79]

Early Plectorhynchellidae with lyre-shaped crura in cross section. *Lower Devonian (Lochkovian–Emsian).*

Pygmaella Baranov, 1977, p. 80 [**P. pygmaea;* OD]. Small; longitudinally ovate outline; ventribiconvex. Beak suberect to erect; delthyrium with narrow deltidial plates; foramen permesothyrid. Dorsal sulcus with low median ridge and ventral fold with low median groove; anterior commissure plicosulcate. Costae few, strong; umbones smooth. Dental plates short, slender. Hinge plates divided; crural plates resting on valve floor; dorsal median septum and septalium absent; crura long, straight, bearing small distal plates with lyre-shaped section. *Lower Devonian (Pragian):* eastern Siberia.——Fig. 802,*1a–m. *P. pygmaea,* lower Pragian, Sagyrian beds, Selennyakh Range, Yakutsk; *a–d,* holotype, dorsal, ventral, anterior, and lateral views, ×3; *e–m,* serial sections 0.3, 0.4, 0.5, 0.7, 1.0, 1.1, 1.3, 1.5, 1.6 mm from posterior, ×6 (Baranov, 1977).

Sibiritoechia Alekseeva, 1966, p. 1147 [**S. convexa;* OD]. Small with longitudinally ovate outline and ventribiconvex profile. Beak suberect to erect. Dorsal valve with slight sulcus; ventral valve with weak fold; anterior commissure bisulcate. Costae few, strong, arising just anterior of umbones. Dental plates very short. Hinge plates divided; crural plates resting on valve floor; dorsal median septum and septalium absent; crural bases ovate, oblique; crura poorly known. *Lower Devonian (Lochkovian–Emsian):* eastern Siberia.——Fig. 802,*2a–e. *S. convexa,* Emsian, southern Verkhoyansk Range, Sette-Daban Ridge, Krutoy Creek, northeastern Siberia; *a–d,* holotype, dorsal, ventral, anterior, and lateral views, ×2.4; *e,* topotype, transverse section across posterior, ×7 (Alekseeva, 1966).——Fig. 802,*2f–l. S. oblongata* Alekseeva, Lochkovian, southern Verkhoyansk Range, Sette-Daban Ridge, Tikhiy Creek, northeastern Siberia; topotype, serial sections, ×5 (Alekseeva, 1966).

Family LADOGIIDAE Ljaschenko, 1973

[Ladogiidae Ljaschenko, 1973, p. 52]

[Materials prepared by Norman M. Savage]

Pugnacoidea with high, rounded to acuminate tongue and fine, evenly spaced costae arising at beaks. Dental plates and dorsal median septum distinct; septalium short, often with cover plate. *Lower Devonian (Pragian)–Upper Devonian (Famennian).*

Ladogia Nalivkin, 1941, p. 165 [**Terebratula meyendorfii* de Verneuil, 1845, p. 74; OD]. Large with longitudinally ovate to rhomboid outline; strongly convex, acuminate dorsal valve and concave, sulcate ventral valve. Beak small, pointed, incurved; foramen hypothyrid. Fold and sulcus strong, wide to include most of shell width, extending from umbones. Anterior commissure uniplicate, acuminate. Flattened costellae cover shell surface. Dental plates long, convex medially; ventral muscle field well impressed, divided by low median ridges. Dorsal median septum strong, long; septalium wide, long; hinge plates concave, divided anteriorly; crura long, ventrally curved, distal parts concave dorsally. *Upper Devonian (Frasnian):* Baltic, European Russia, Urals, Siberia, Pamirs.——Fig. 803,*2a–o. *L. meyendorfii* (de Verneuil), lower Frasnian, Pskov Beds, Pskov, Baltic Russia; *a–c,* holotype, posterior, anterior, and lateral views, ×1 (de Verneuil, 1845); *d–h,* hypotype, dorsal, ventral, posterior, and anterior views, ×1; *i,* part of *e* showing costellae, ×3; *j–o,* hypotype, serial sections 1.8, 2.6, 3.1, 3.8, 4.9, 6.5 mm from posterior, ×2.4 (McLaren, 1962).

Camarothyridina Linnik, 1966, p. 129 [**C. furssenkoi;* OD]. Medium size with subtriangular to subpentagonal outline and dorsibiconvex profile. Beak suberect; delthyrium open. Fold and sulcus arising at umbones; anterior commissure uniplicate, high, rounded. Costae fine, simple, numerous, covering entire surface. Dental plates short, vertical. Septalium short; hinge plates divided; dorsal median

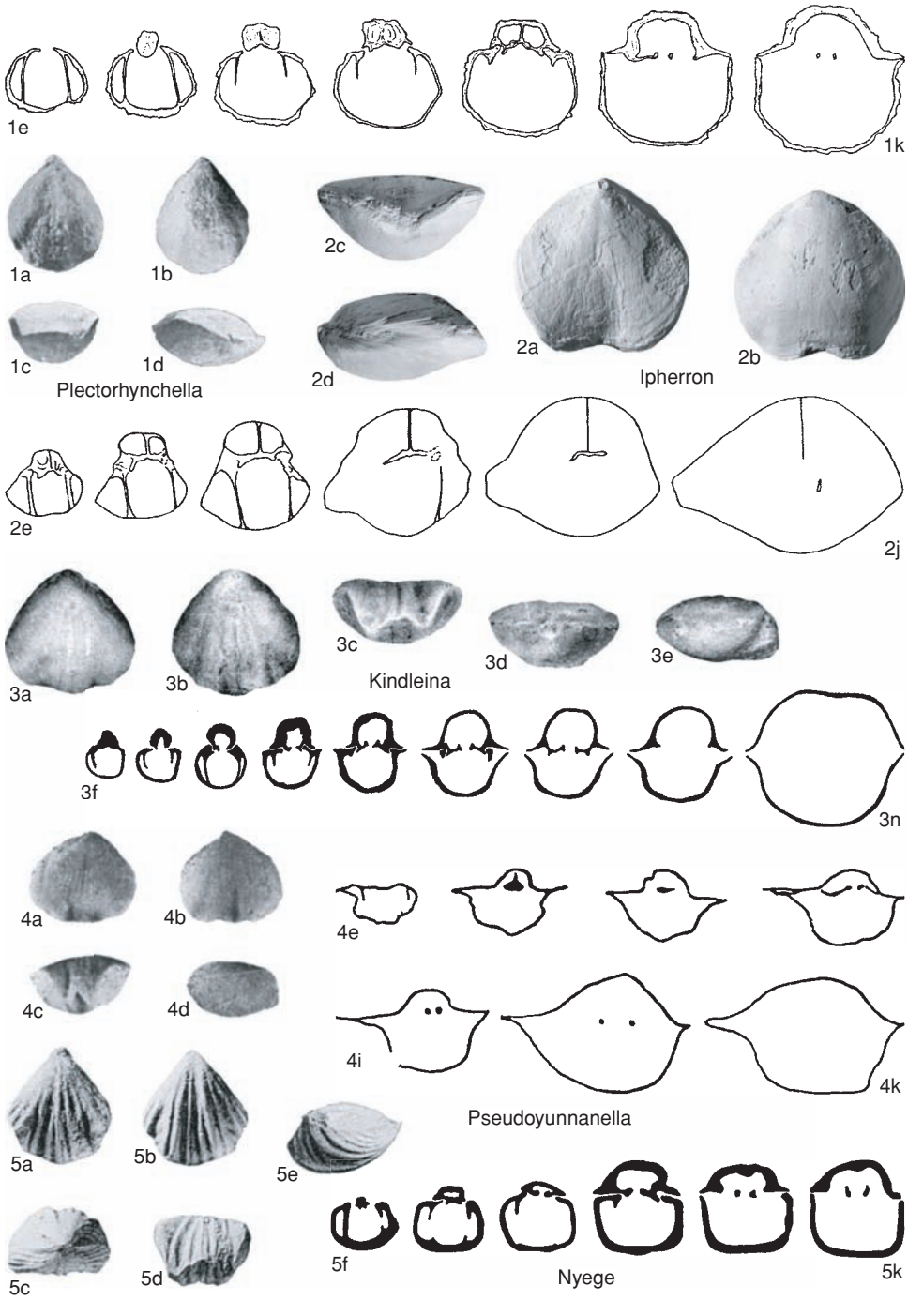

FIG. 801. Plectorhynchellidae (p. 1176–1178).

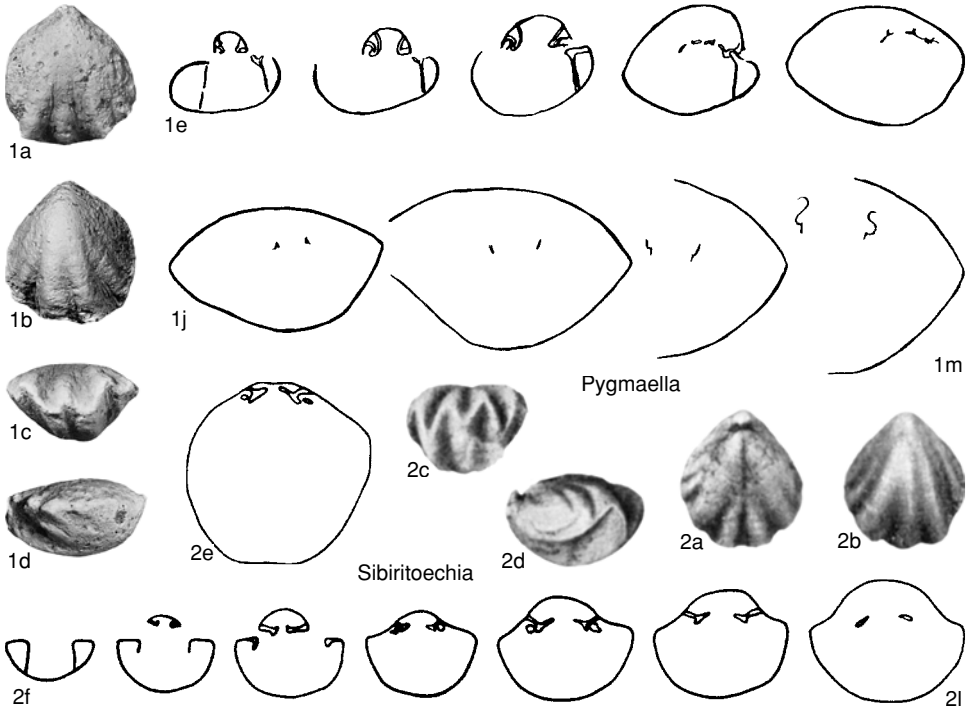

FIG. 802. Plectorhynchellidae (p. 1178).

septum long, low. Crura long, concave dorsomedially. *Upper Devonian (Famennian):* Belorussia (Pripet depression).——FIG. 804,*4a–g.* **C. furssenkoi,* lower Famennian, Zadonsk horizon, Minsk; *a–d,* holotype, dorsal, ventral, anterior, and lateral views, ×1; *e,* serial section, ×1.7; *f,* serial section, ×1.2; *g,* serial section, ×1.5 (Linnik, 1966).

Comiotoechia LJASCHENKO, 1973, p. 37 [**Camarotoechia galinae* LJASCHENKO, 1958, p. 124; OD]. Small size with transversely ovate outline and moderately biconvex profile. Beak large, posteriorly protruding, suberect. Fold and sulcus with rounded margins, expressed anteriorly as evenly rounded, flared tongue. Costae fine, simple, rounded, extending from umbones to commissure. Dental plates stout, short. Dorsal median septum short; septalium open posteriorly but with ridged cover plate anteriorly. *Upper Devonian (lower Frasnian):* Timan, Urals, central Russian Platform.——FIG. 804,*1a–g.* **C. galinae* (LJASCHENKO), Ust-laregisk beds, southern Timan, mouth of Yaregi River; *a–e,* dorsal, ventral, anterior, posterior, and lateral views, ×2; *f–g,* serial sections, ×2 (Ljaschenko, 1973).

Gracilotoechia BARANOV, 1977, p. 78 [**G. sinuata;* OD]. Subpentagonal to subcircular outline and biconvex, lenticular profile. Beak straight; delthyrium open. Fold and sulcus weak, from midlength; anterior commissure gently uniplicate. Surface costellate. Dental plates short, vertical. Dorsal median septum short, low; septalium wide, short; hinge plates divided anterior of septalium. *Lower Devonian (Pragian):* eastern Siberia.——FIG. 803,*1a–m.* **G. sinuata,* lower Pragian, Sagyrian suite, Selennyakh Ridge; *a–d,* holotype, dorsal, ventral, anterior, and lateral views, ×2; *e–h,* hypotype, dorsal, ventral, anterior, and lateral views, ×2; *i–m,* serial sections 0.5, 1.4, 2.1, 2.3, 2.4 mm from posterior, ×5 (Baranov, 1977).

Ladogifornix SCHMIDT, 1964, p. 505 [**Terebratula fornicata* SCHNUR, 1853, p. 175; OD]. Subtetrahedral shape; ventral valve flat to concave, dorsal valve convex and inflated anteriorly. Beak suberect. Fold and sulcus broad, rounded; anterior commissure uniplicate; tongue wide, high, rounded. Costae fine, from umbones, with some bifurcation. Dental plates vertical, long; umbonal cavities wide. Dorsal median septum high, extending to midlength; septalium long, wide, V-shaped, partly covered by inner hinge plates; hinge plates undivided; crura long, ventrally curved. *Middle Devonian (Eifelian):* Germany.——FIG. 804,*6a–j.* **L. fornicatus* (SCHNUR), Eifel; *a–d,* dorsal, ventral, anterior, and lateral views, Gerolsteiner Kalk, ×1 (Schnur, 1853); *e–j,* serial sections 16.5, 16.0, 15.4, 15.2, 15.0, 14.3 mm from anterior, Nohner Beds, ×5 (Schmidt, 1965a).

Ladogilina LJASCHENKO, 1973, p. 58 [**L. rossica;* OD] [=*Ladogilinella* LJASCHENKO, 1973, p. 61 (type, *L.*

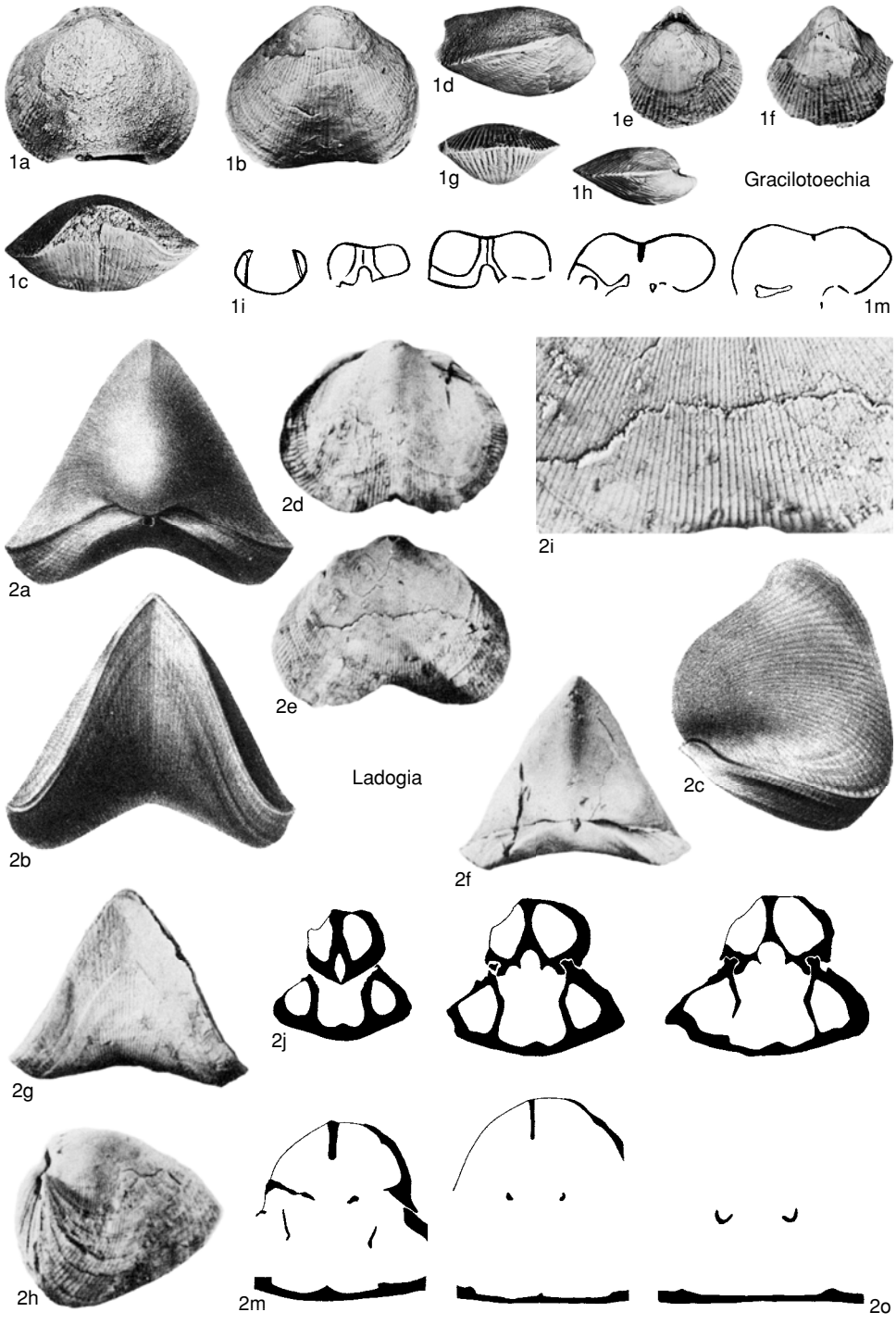

FIG. 803. Ladogiidae (p. 1178–1180).

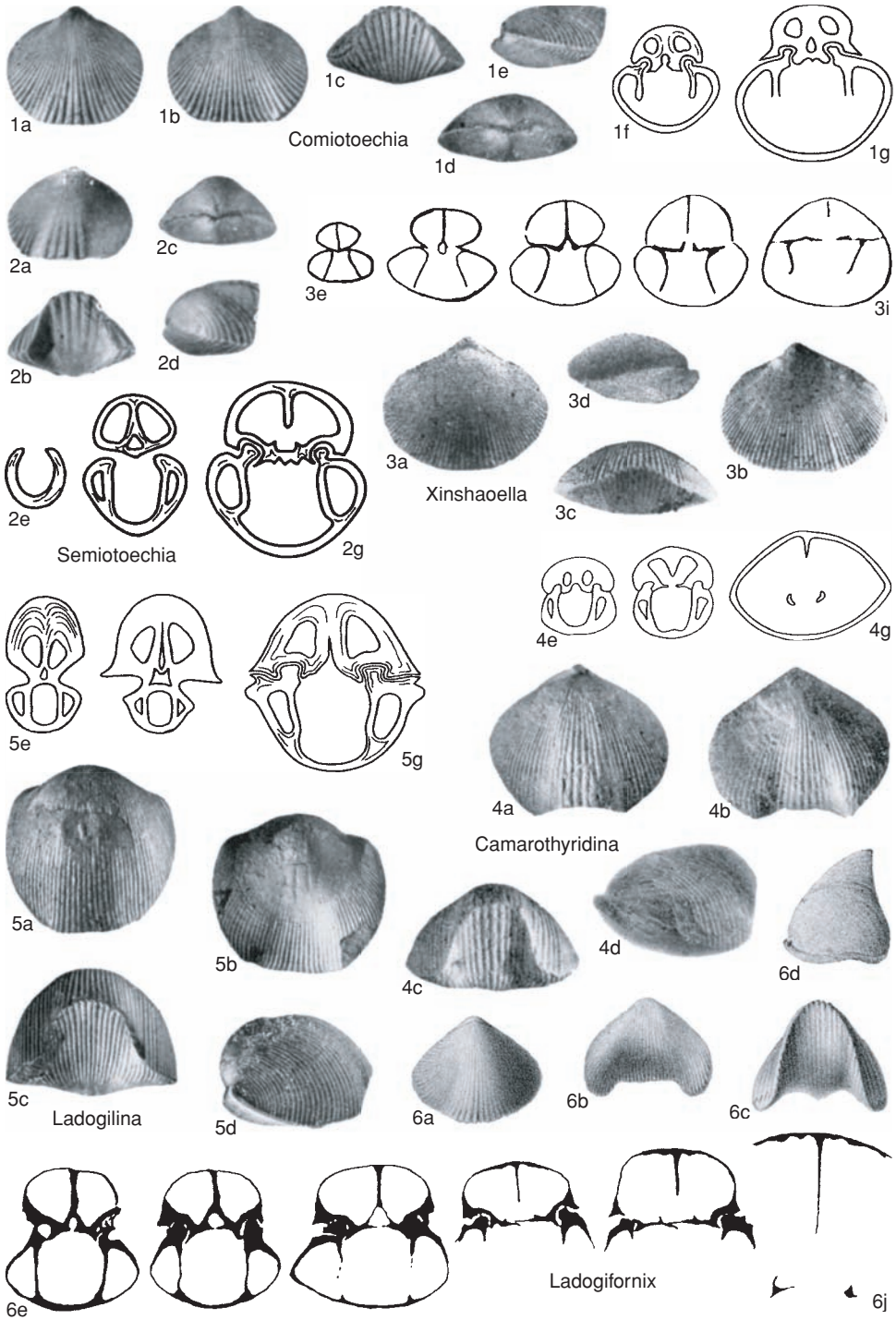

FIG. 804. Ladogiidae (p. 1178–1183).

mutabilis, OD)]. Subcircular to subovate outline and strongly dorsibiconvex profile. Beak erect to incurved. Fold and sulcus with gentle lateral margins, arising at about one-third valve length. Tongue high, flared, and rounded. Costae fine, even, simple, rounded, arising at beaks. Dental plates distinct, vertical. Dorsal interior with strong median septum; septalium with posterior cover plate. *Upper Devonian (lower Frasnian):* Volga-Urals, Timan.——Fig. 804,*5a–d. *L. rossica,* Sargaevsk Beds, Perm, Veslianka, Volga-Urals; holotype, dorsal, ventral, anterior, and lateral views, ×1.5 (Ljaschenko, 1973).——Fig. 804,*5e–g. L. simensis* (Ellern, Ivanov, & Kurbanov), lower Ust-laregsk Beds, Ukhta River, southern Timan; serial sections (Ljaschenko, 1973).

Semiotoechia Ljaschenko, 1973, p. 44 [**Camarotoechia polita* Ljaschenko, 1960, p. 9; OD]. Small with subpentagonal to transversely ovate outline and dorsibiconvex profile; anterior high because of strong fold; lateral flanks gently sloping. Beak erect. Fold and sulcus strong, extending from umbones; anterior commissure uniplicate; tongue wide, high, rounded, commonly forming highest part of shell. Costae extending from umbones, weak and rounded on umbones and flanks, becoming moderately strong and subangular anteriorly on fold and sulcus. Dental plates short, vertical. Dorsal median septum low, short; septalium short, with cover plate; hinge plates undivided anterior of septalium. *Middle Devonian (upper Givetian)–Upper Devonian (lower Frasnian):* Timan, Volga-Urals.——Fig. 804,*2a–g. *S. polita* (Ljaschenko), lower Frasnian, between Kynovsk and Ust-laregsk beds, Ukhta River, mouth of the Yarega River, southern Timan; *a–d,* holotype, dorsal, anterior, posterior, and lateral views, ×1; *e–g,* serial sections (Ljaschenko, 1973).

Xinshaoella Zhao, 1977, p. 391 [**X. huaqiaoensis;* OD]. Transversely ovate outline and biconvex, lenticular profile. Beak suberect. Fold and sulcus very weak, restricted to anterior fifth of shell; anterior commissure gently uniplicate, rounded. Costae fine, numerous, rounded, from beaks. Dental plates short, ventrally divergent posteriorly, becoming convergent anteriorly. Dorsal median septum long; septalium short; hinge plates undivided, horizontal. *Upper Devonian (Famennian):* southern China.——Fig. 804,*3a–i. *X. huaqiaoensis,* Hsikuangshan Formation, Hunan, Xinshau, Huaqiao; *a–d,* holotype, dorsal, ventral, anterior, and lateral views, ×1; *e–i,* serial sections, ×2 (Zhao, 1977).

Family ROZMANARIIDAE Havlíček, 1982

[*nom. transl.* Havlíček, 1990b, p. 214, *ex* Rozmanariinae Havlíček, 1982a, p. 112]

[Materials prepared by Norman M. Savage]

Pugnacoidea with transversely ovate to subcircular outline; fold and sulcus sometimes low, generally fold in dorsal valve but may be in ventral valve; costae weak to absent; foramen with conjunct deltidial plates anteriorly. Dental plates short to absent. Dorsal median septum low or lacking; hinge plates divided; cardinal process absent. *Lower Devonian (Pragian)–Upper Devonian (Famennian).*

Rozmanaria Weyer, 1972, p. 85 [**Liorhynchus? equitans* Schmidt, 1924, p. 145; OD]. Transversely ovate outline, emarginate anterior, and ventribiconvex profile. Beak erect to incurved; foramen small; deltidial plates conjunct. Dorsal sulcus and ventral fold very strong anteriorly, resulting in unisulcate anterior commissure. Costae absent. Ventrally directed tongue pronounced, rounded. Dental plates absent. Hinge plates divided and curved dorsally, almost reaching valve floor; dorsal median septum and septalium absent; crura laterally compressed, ventrally divergent. *Upper Devonian (upper Famennian):* Germany, Bohemia, Poland, Urals.——Fig. 805,*1a–n. *R. equitans* (Schmidt), Dasberg Beds, Sauerland, Oberroedinghausen, Germany; *a–e,* hypotype, dorsal, ventral, lateral, posterior, and anterior views, ×2; *f–n,* serial sections, ×8 (Weyer, 1972).

Errhynx Havlíček, 1982a, p. 112 [**E. erron;* OD]. Transversely ovate to cordiform outline; moderately ventribiconvex profile; emarginate anterior margin. Beak erect to incurved; foramen small; deltidial plates conjunct. Dorsal sulcus and ventral fold narrow, arising at umbones, becoming strong anteriorly; tongue rounded to rectangular, ventrally directed. Costae absent. Dental plates very short. Hinge plates divided, delicate, slightly inclined dorsally; dorsal median septum and septalium absent. *Middle Devonian (Eifelian):* Bohemia.——Fig. 805,*2a–g. *E. erron,* upper Eifelian, Chotec Formation, Prague, Holyne; *a–d,* holotype, dorsal, ventral, posterior, and anterior views, ×3; *e–g,* serial sections 9.2, 8.8, 8.35 mm from anterior, ×5.5 (Havlíček, 1982a).

Hadyrhyncha Havlíček, 1979, p. 98 [**H. hadyensis;* OD]. Transversely ovate outline and weakly biconvex, lenticular profile. Beak small, incurved. Dorsal sulcus and ventral fold low, arising at midlength; anterior commissure gently unisulcate. Costae weak, rounded, developed on fold, in sulcus, and on flanks. Dental plates short to absent. Hinge plates divided, small, resting on valve floor; dorsal median septum and septalium absent. *Upper Devonian (Famennian):* Moravia.——Fig. 805,*3a–d. *H. hadyensis,* upper Famennian, Hady Limestone, Brno, Hady Hill; *a–c,* holotype, dorsal, ventral, and anterior views, ×2; *d,* transverse section showing crural bases, scale not given (Havlíček, 1979).

Levipugnax Pushkin, 1986, p. 78 [**L. malynskensis;* OD]. Small; subcircular outline; evenly biconvex to lenticular. Beak suberect to erect; fold and sulcus wide, weak; anterior commissure weakly uniplicate. Costae faint to absent. Dental plates short, vertical. Hinge plates divided; septalium and dorsal median septum absent. *Upper Devonian (Famennian):*

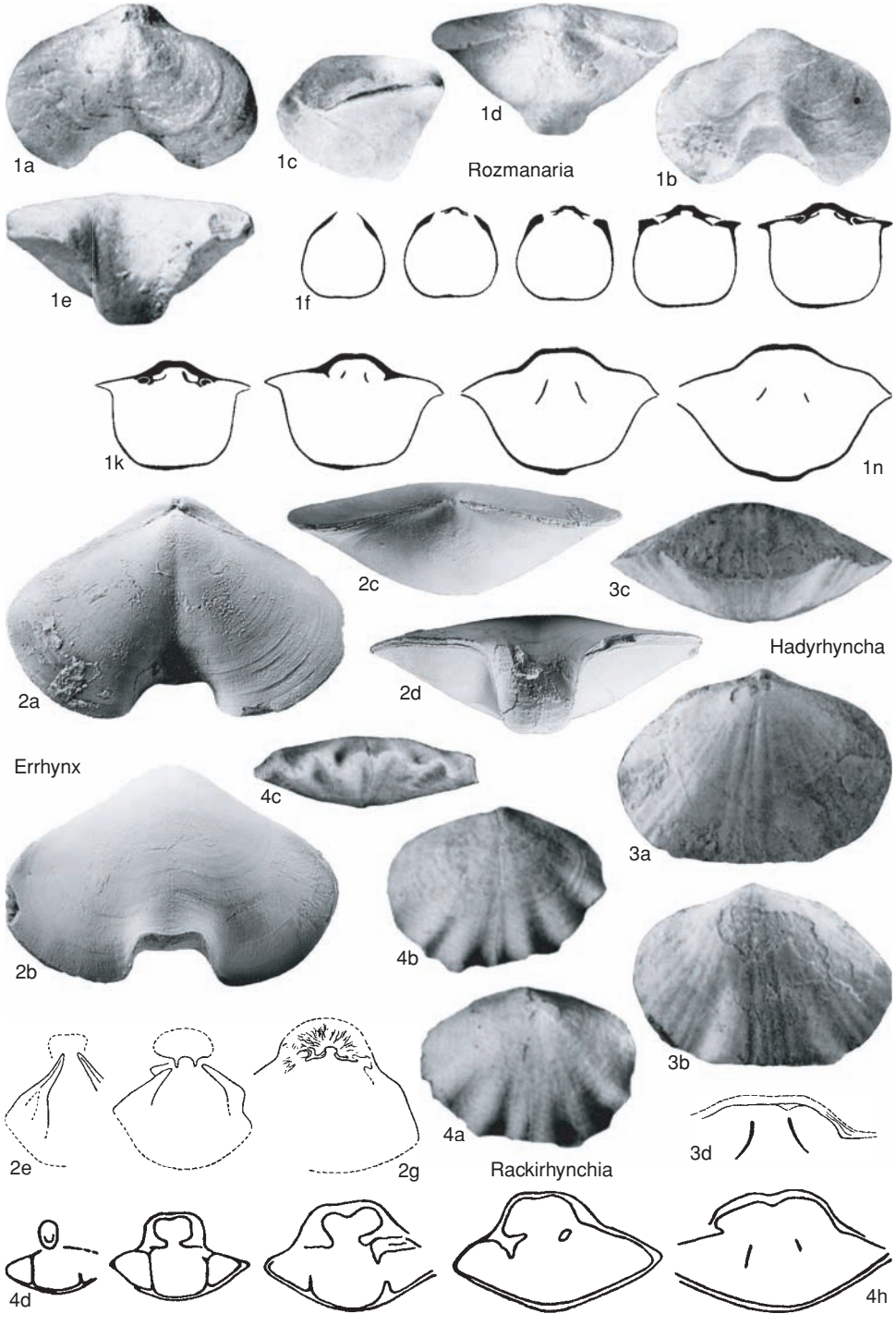

FIG. 805. Rozmanariidae (p. 1183–1186).

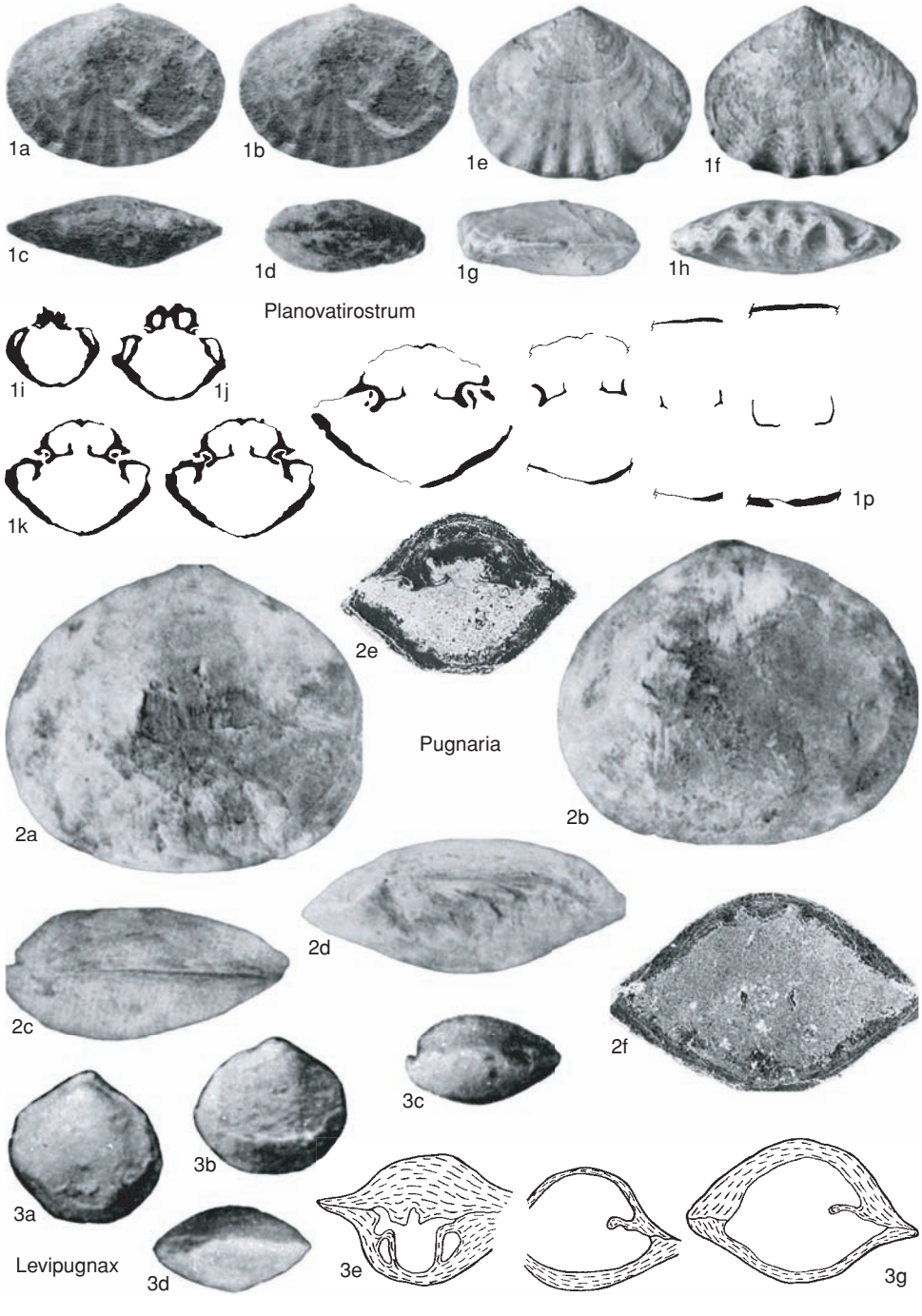

FIG. 806. Rozmanariidae (p. 1183–1186).

Belorussia (Gomel).——Fig. 806,*3a–g.* **L. malynskensis,* Petrikovsk Horizon, Malynsk borehole; *a–d,* holotype, dorsal, ventral, lateral, and anterior views, ×3; *e–g,* serial sections 0.5, 0.7, 0.9 mm from posterior, ×7.5 (Pushkin, 1986).

Planovatirostrum Sartenaer, 1970a, p. 16 [**Liorhynchus plano-ovalis* Nalivkin, 1937, p. 76; OD]. Transversely ovate outline; flattened to weakly biconvex. Beak suberect to incurved; foramen small. Fold and sulcus low, wide. Costae low, rounded, from about midlength. Dental plates short; ventral muscle field moderately impressed; teeth long, thick. Hinge plates divided; dorsal median septum and septalium absent; crura plates present; crura long, convex ventrolaterally. *Upper Devonian (Famennian):* Kazakhstan, China, Poland, Moravia, Germany, northern Africa.——Fig. 806,*1a–p.* **P. planoovale* (Nalivkin), upper Famennian; *a–d,* holotype, dorsal, ventral, anterior, and lateral views from *sulcifer* beds, Ulenty district, Mount Alchagyr, northeastern Kazakhstan, ×1 (Nalivkin, 1937); *e–h,* hypotype, dorsal, ventral, lateral, and anterior views, Hongguleleng Formation, Xinjiang, China, ×1; *i–p,* serial sections 0.9, 1.1, 1.5, 1.6, 2.0, 2.2, 3.2, 4.15 mm from posterior, ×3.2 (Sartenaer & Xu, 1989).

Pugnaria Biernat & Racki, 1986, p. 95 [**P. plana;* OD]. Circular outline; weakly biconvex profile. Fold and sulcus very low; anterior commissure uniplicate; tongue low, wide; valves smooth. Dental plates, dorsal median septum, septalium absent. Hinge plates horizontal, divided; crura long, thin. *Upper Devonian (Famennian):* Poland.——Fig. 806,*2a–f.* **P. plana,* upper Famennian, Holy Cross Mountains, Kowala, Wola Quarry; *a–d,* holotype, dorsal, ventral, lateral, and anterior views, ×2; *e–f,* serial sections, ×3.5 (Biernat & Racki, 1986).

Rackirhynchia Havlíček, 1990b, p. 214 [**Atrypa lacerata* Barrande, 1879b, pl. 87, case 1, fig. 1a–e; OD]. Transversely ovate outline and equibiconvex, lenticular profile. Beak small, straight to suberect. Fold and sulcus absent; anterior commissure rectimarginate to undulate. Costae few, broad, gentle to weak, arising at shell midlength. Dental plates short, thin, vertical. Hinge plates divided; septalium and dorsal median septum absent; crura laterally compressed. *Lower Devonian (Pragian):* Bohemia.——Fig. 805,*4a–h.* **R. lacerata* (Barrande), Koneprusy Limestone, Koneprusy; *a–c,* dorsal, ventral, and anterior views, ×2.7; *d–h,* serial sections 8.3, 8.2, 8.1, 8.05, 8.0 mm from anterior, ×8 (Havlíček, 1990b).

Family ASEPTIRHYNCHIIDAE Savage, 1996

[Aseptirhynchiidae Savage, 1996, p. 254]

[Materials prepared by Norman M. Savage]

Pugnacoidea lacking dental plates, dorsal median septum, and septalium. Fold and sulcus developed anteriorly. *Lower Devonian (Pragian)–Upper Devonian (Famennian).*

Aseptirhynchia Soja, 1988, p. 153 [**A. glabrata;* OD]. Subtriangular outline and dorsibiconvex profile. Beak erect to incurved; foramen small, hypothyrid. Fold and sulcus weak to moderate, arising at umbones; anterior commissure uniplicate; tongue low, typically coarsely serrate but rounded in immature specimens. Costae weak, few, stronger in mature shells, flanks smooth. Dental plates short, close to walls. Hinge plates short, divided; dorsal median septum absent; crural bases crescentic in section, concave laterally; crura long, thin. *Lower Devonian (middle Emsian):* USA (Alaska).——Fig. 807,*1a–m.* **A. glabrata,* Kasaan Island, southeastern Alaska; *a–d,* holotype, dorsal, ventral, lateral, and anterior views, ×2.7; *e–g,* hypotype, dorsal, ventral, and anterior views, ×2.8; *h–m,* serial sections 0.9, 1.4, 1.6, 1.7, 1.9, 2.2 mm from posterior, ×6 (Soja, 1988).

Brunnirhyncha Havlíček, 1979, p. 97 [**B. brunniensis;* OD]. Subcircular outline and dorsibiconvex profile. Beak suberect to erect; foramen small. Fold and sulcus wide, flattened. Most of shell smooth; weak costae developed anteriorly, very low and broad. Dental plates absent, teeth arising from valve wall; ventral muscle field well impressed. Hinge plates thick, divided, sloping dorsally and resting on thick callus; dorsal median septum and septalium absent; crura laterally flattened distally. *Upper Devonian (Famennian):* Moravia.——Fig. 807,*2a–j.* **B. brunniensis,* lower Famennian, Krtiny Limestone, Brno, Hady Hill; *a–d,* holotype, dorsal, ventral, anterior, and lateral views, ×1.5; *e–j,* serial sections 0.08, 0.43, 0.53, 0.68, 1.18, 1.43 mm from posterior (Havlíček, 1979).

Carolirhynchia Havlíček, 1992, p. 73 [**C. carolina;* OD]. Subpentagonal subtrigonal outline and dorsibiconvex profile, inflated anteriorly. Beak suberect to erect; foramen small. Fold and sulcus wide, tongue high. Most of shell smooth; costae weak, developed anteriorly. Shell walls thick; dental plates absent. Hinge plates divided, horizontal, resting on secondary shell material; dorsal median septum absent but weak ridge developed; crura flattened laterally. *Lower Devonian (Pragian–Emsian):* Bohemia.——Fig. 808,*1a–h.* **C. carolina,* Emsian, Zlichov Limestone, Karlstejn; *a–d,* holotype, dorsal, ventral, anterior, and lateral views, ×2.2; *e–h,* serial sections 10.0, 9.3, 9.15, 8.8 mm from anterior, ×3 (Havlíček, 1992).

Chalimia Baranov, 1978, p. 45 [**C. gracilis;* OD]. Transversely subpentagonal outline and moderately dorsibiconvex profile. Beak erect to incurved and fold and sulcus distinct but not strong. Costae weak to absent. Dental plates short, vertical. Hinge plates divided; septalium, dorsal median septum, and cardinal process absent. *Middle Devonian (Eifelian):* eastern Siberia.——Fig. 808,*2a–l.* **C. gracilis,* Geremgandzhinsk series, Tas-Khaiakhtakh Mountains, Khalim River; *a–c,* holotype, dorsal, ventral,

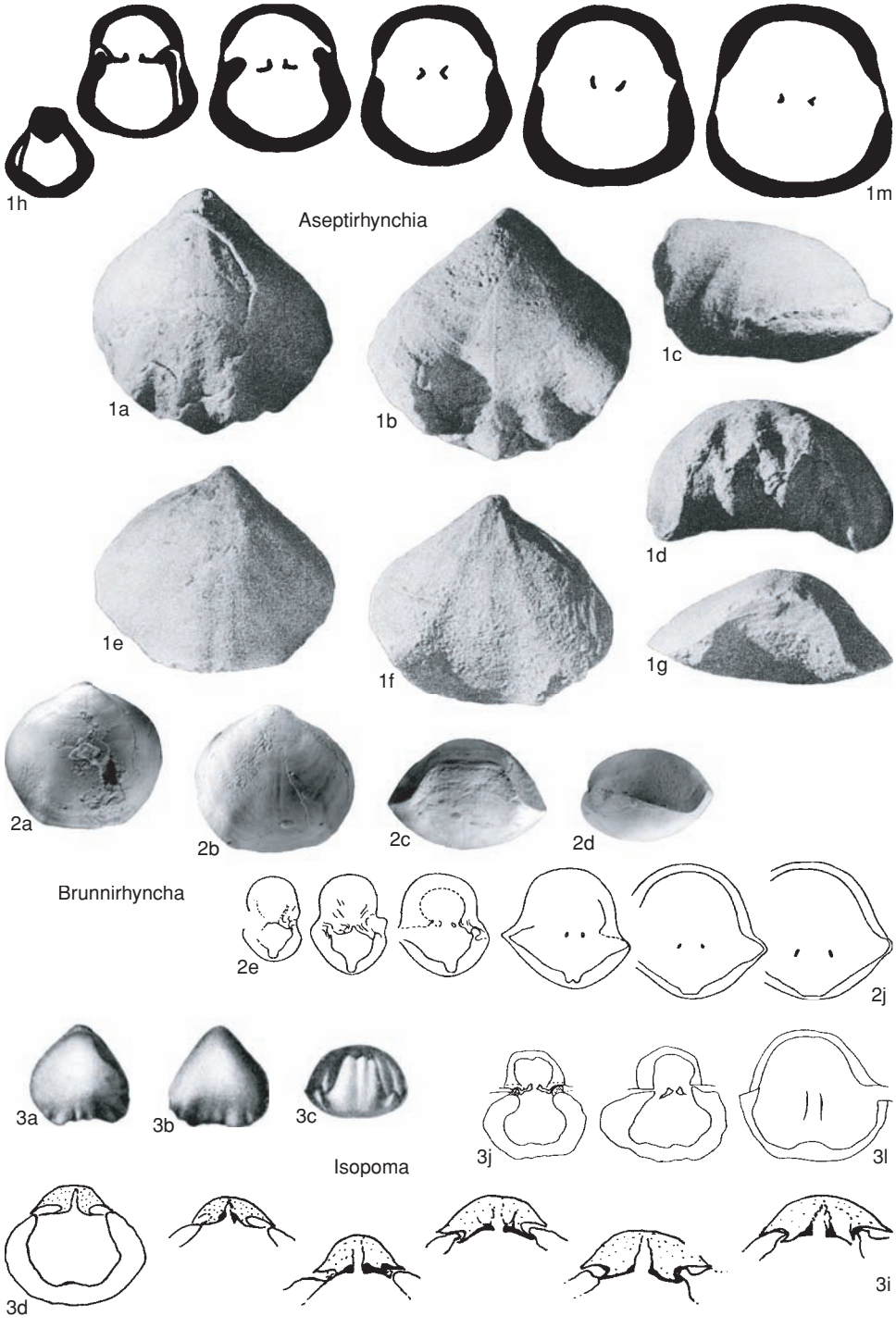

FIG. 807. Aseptirhynchiidae (p. 1186–1189).

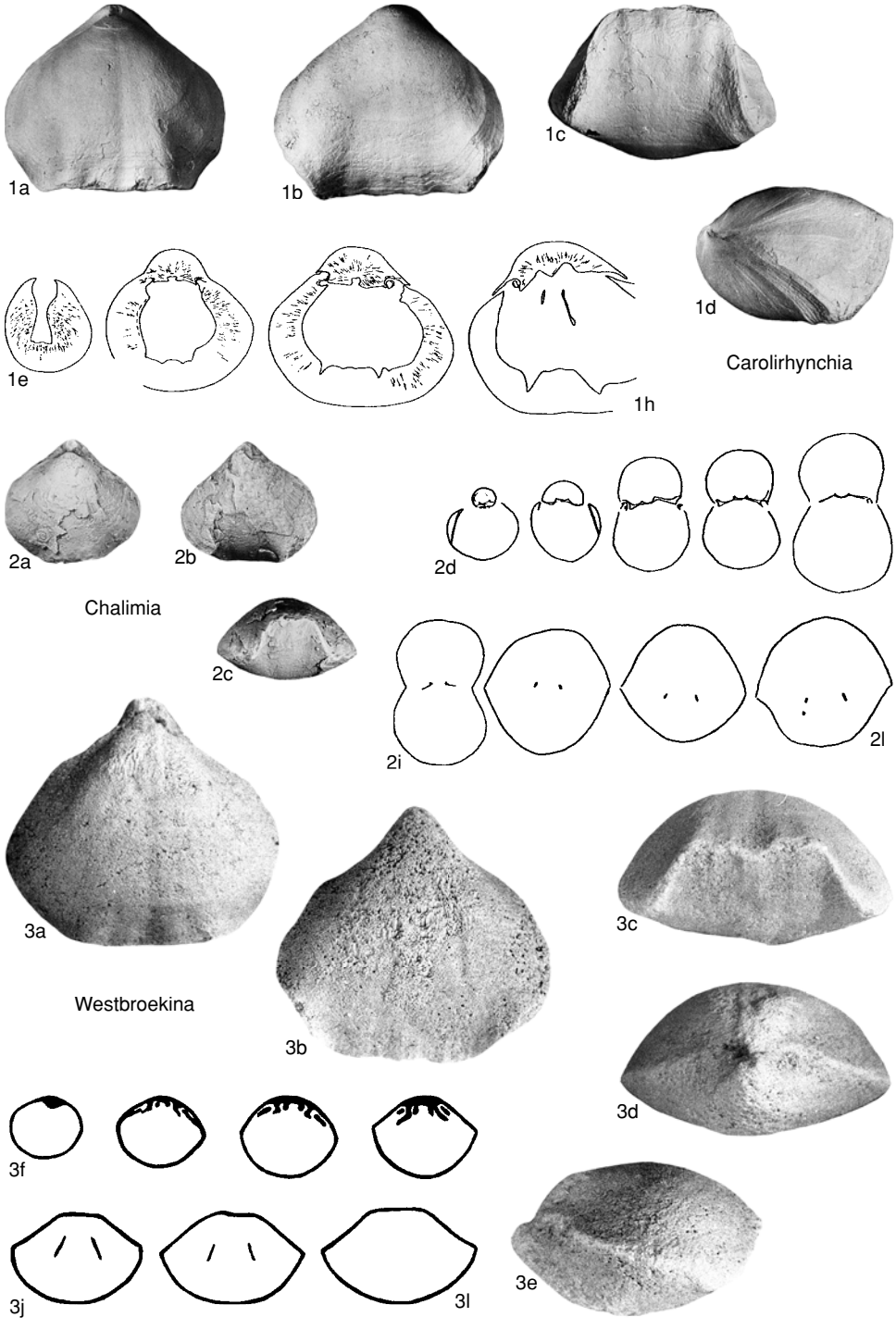

FIG. 808. Aseptirhynchiidae (p. 1186–1189).

and anterior views, ×2 (Baranov, 1978); *d–l,* serial sections, ×3.5 (new).

Isopoma Torley, 1934, p. 81 [**Terebratula brachyptycta* Schnur, 1853, p. 178; OD]. Small to medium size with subtriangular to subcircular outline and equibiconvex profile. Beak erect, foramen small. Fold and sulcus weak; tongue high. Costae coarse and only developed anteriorly. Dental plates weak to absent. Low median ridge in ventral valve. Hinge plates divided; septalium and dorsal median septum absent; crura thin, short, parallel. *Middle Devonian (Givetian):* Europe, Urals, Altai, China. ——Fig. 807,*3a–l. *I. brachyptycta* (Schnur); *a–c,* hypotype, dorsal, ventral, and anterior views, middle Eifelian, Gonelsheimer Beds, Geeser Horizon, Eifel, Ahrdorf, Germany, ×1.5 (Schmidt, 1941a); *d–i,* serial sections 8.0, 7.9, 7.8, 7.7, 7.6, 7.5 mm from anterior, upper Givetian, Bergische Land, Schneppruthe, ×5 (Schmidt, 1965a); *j–l,* serial sections 8.6, 8.5, 7.7 mm from anterior, upper Eifelian, Skaly Beds, Holy Cross Mountains, Poland, ×3 (Biernat, 1966).

Westbroekina Savage, 1995, p. 1037 [**W. chaconensis;* OD]. Transversely ovate to subpentagonal outline with weakly biconvex lateral profile; dorsal valve inflated anteriorly. Beaks suberect; foramen small. Weak dorsal fold with broad medial depression and ventral sulcus with broad medial fold; gently paraplicate anterior commissure. Costae absent or very faint. Dental plates absent. Hinge plates divided, with outer edges curved ventrolaterally. Crural bases long, rodlike, expanding into oblique and laterally flattened crura that terminate at about one-third valve length. Cardinal process absent. Muscle scars not impressed. *Upper Devonian (Frasnian):* USA (Alaska).——Fig. 808,*3a–l. *W. chaconensis,* upper Frasnian, Wadleigh Limestone, islet near Wadleigh Island, southeastern Alaska; *a–e,* holotype, dorsal, ventral, anterior, posterior, and lateral views, ×6.5; *f–l,* paratype, serial sections 0.75, 0.95, 1.25, 2.45, 2.85, 2.95, 3.05 mm from posterior, ×5 (Savage & Baxter, 1995).

Family PETASMARIIDAE Savage, 1996

[Petasmariidae Savage, 1996, p. 254]

[Materials prepared by Norman M. Savage]

Pugnacoidea with strong dental plates; hinge plates divided and horizontal. Dorsal median septum short but distinct; septalium short to absent. Fine striae present on surface with rows of pits observed in well-preserved specimens of some genera. *Middle Devonian (Eifelian)–Upper Permian (Capitanian).*

Petasmaria Cooper & Dutro, 1982, p. 83 [**P. patens;* OD]. Subpentagonal outline and dorsibiconvex, anteriorly inflated profile. Beak incurved; foramen mesothyrid; deltidial plates disjunct. Fold and sulcus very strong, from umbones; anterior commissure uniplicate; tongue high, rounded, dentate. Costae angular, from umbones, infrequent increase by bifurcation and intercalation; fine radial striae present anteriorly. Dental plates strong, long, vertical; ventral muscle field weakly impressed. Dorsal median septum long, high; septalium narrow, deep; hinge plates divided, horizontal; crura subtriangular to dorsally concave in section. *Upper Devonian (upper Famennian):* USA (New Mexico).——Fig. 809,*1a–m. *P. patens,* Percha Formation, Box Member, Alamogordo; *a–e,* holotype, dorsal, ventral, lateral, anterior, and posterior views, ×1; *f,* paratype, part of dorsal valve, showing surface striae, ×3; *g–m,* serial sections 1.5, 1.8, 2.8, 2.9, 3.2, 3.3, >3.3 mm from posterior, ×2.3 (Cooper & Dutro, 1982).

Athabaschia Crickmay, 1963, p. 9 [**A. asmenista;* OD]. Subpentagonal outline and moderately biconvex profile. Beak erect to incurved; foramen hypothyrid; deltidial plates large. Fold and sulcus pronounced anteriorly; tongue wide, typically triplicate. Costae few, arising at midlength. Dental plates short, vertical. Septalium very short; dorsal median septum strong, extending to about one-third valve length; hinge plates divided, inner hinge plates elevated ventrally. *Upper Devonian (lower Frasnian):* western Canada.——Fig. 809,*4a–i. *A. asmenista,* Waterways Formation, Athabasca River, Alberta; *a–e,* holotype, dorsal, ventral, posterior, anterior, and lateral views, ×2; *f–i,* serial sections 1.0, 1.8, 2.5, 3.0 mm from posterior, ×4 (Crickmay, 1963).

Bryorhynchus Cooper & Grant, 1969, p. 11 [**Camarophoria(?) bisulcata* Shumard, 1860a, p. 296; OD]. Subcircular to longitudinally ovate outline and biconvex profile with sides and anterior not truncated. Beak erect; foramen triangular, deltidial plates small, conjunct. Fold and sulcus weak, developed anteriorly; anterior commissure broadly uniplicate. Costae weak, present only anteriorly, usually restricted to fold and sulcus. Dental plates convergent ventrally, often fused to valve walls; ventral muscle field narrow, triangular, expanding anteriorly. Dorsal median ridge low, long, extending almost to midlength; septalium short; hinge plates divided anteriorly; sockets crenulated; dorsal muscle field long, narrow, diverging anteriorly; crura curved ventrally, obliquely flattened in section. *Upper Permian (Capitanian):* USA (Texas).——Fig. 810,*1a–i. *B. bisulcata* (Shumard), Bell Canyon Formation, Guadalupe Mountains; *a–e,* hypotype, dorsal, ventral, posterior, anterior, and lateral views, ×1; *f,* dorsal view of posterior showing deltidial plates, ×5; *g,* interior of conjoined shell, ×4; *h,* dorsal interior showing socket plates and crura, ×3; *i,* ventral interior, ×2 (Cooper & Grant, 1976a).

Eurycolporhynchus Sartenaer, 1968e, p. 566 [**Pugnax pugnus torleyi* Schmidt, 1941b, p. 279; OD]. Subcircular to subpentagonal in outline; strongly dorsibiconvex in profile with inflated dorsal valve, lateral and anterior margins precipitous. Beak erect to incurved; small circular foramen. Fold and sulcus strong, arising at about one-third shell

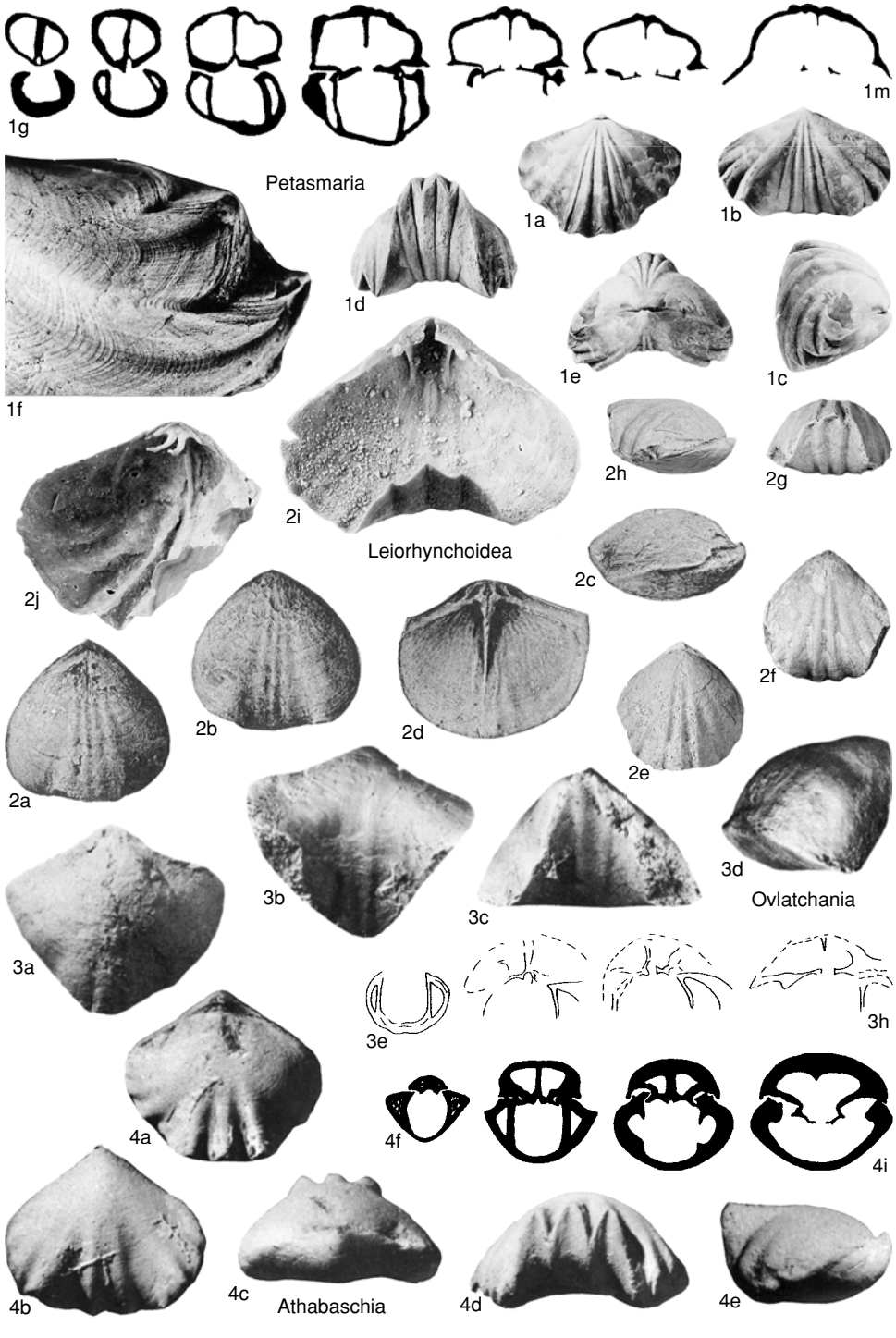

FIG. 809. Petasmariidae (p. 1189–1192).

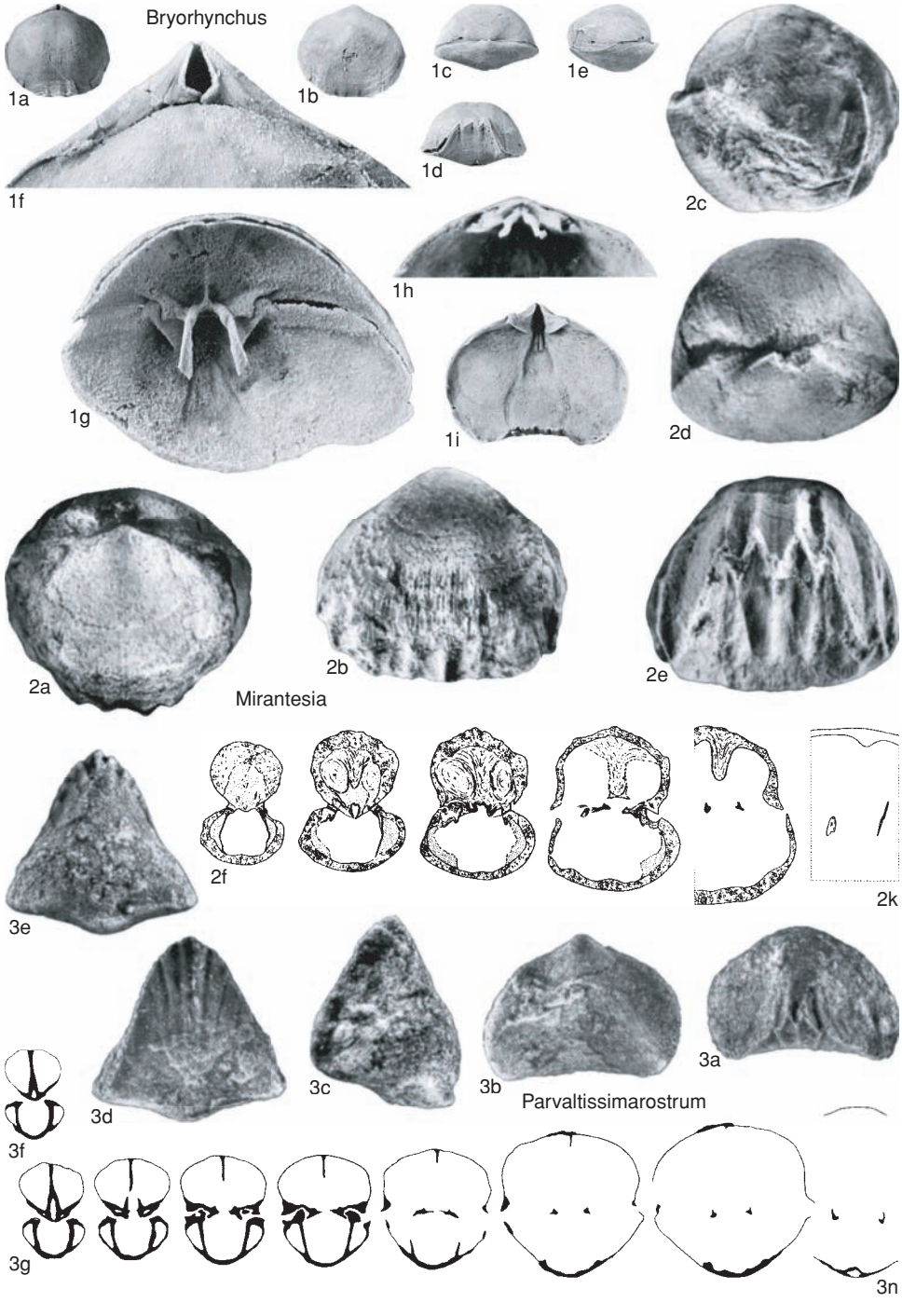

FIG. 810. Petasmariidae (p. 1189–1192).

length; anterior commissure uniplicate, tongue high, broad, and rectangular. Costae low, simple, strongest on fold and in sulcus, weak on flanks. Dental plates short, convergent ventrally. Septalium absent or incipient; hinge plates divided, horizontal; dorsal median septum short, low; crura long, straight, triangular in cross section. *Middle Devonian (Givetian):* Germany, France, Urals.——Fig. 811,*2a–j.* **E. torleyi* (Schmidt), upper Givetian, Massenkalk, Sauerland, Bilveringsen, Germany; *a–c,* holotype, posterior, anterior, and lateral views, ×1 (Schmidt, 1941b); *d–j,* serial sections 0.45, 0.55, 0.85, 0.95, 1.45, 1.65, 1.95 mm from posterior, ×2.3 (Sartenaer, 1968e).

Leiorhynchoidea Cloud, 1944, p. 57 [**L. schucherti;* OD]. Large; subcircular to elongate oval; biconvex profile; gentle lateral and anterior slopes. Beak erect; delthyrium open apically, conjunct deltidial plates. Fold and sulcus weak, from umbones; anterior commissure uniplicate, tongue low, serrate. Costae low, few, rounded; weak on fold and in sulcus, very weak on flanks. Dental plates short, slightly convergent ventrally; ventral muscle field an elongate triangle expanding anteriorly. Dorsal median septum moderately strong, long; septalium short; dorsal muscle field narrow; crura long, ventrally curved, tips horizontally flattened. *Lower Carboniferous (lower Namurian)–Upper Permian (Wordian):* North America, eastern Siberia.——Fig. 809,*2a–d.* **L. schucherti,* Wordian, southwestern Coahuila, Las Delicias, Mexico; *a–c,* holotype, dorsal, ventral, and lateral views, ×1; *d,* Plasticine cast of dorsal interior mold, ×2 (Cloud, 1944).——Fig. 809,*2e–j. L. amygdaloidea* Cooper & Grant, Guadalupian, Word Formation, Glass Mountains, Texas, USA; *e–h,* holotype, dorsal, ventral, anterior, and lateral views, ×1; *i,* paratype, ventral valve interior, ×2; *j,* paratype, oblique view of dorsal valve interior, ×2.6 (Cooper & Grant, 1976a).

Megalopterorhynchus Sartenaer, 1965b, p. 5 [**M. haynesi;* OD]. Subpentagonal to transversely ovate outline; biconvex profile, anteriorly inflated. Beak small, erect; foramen absent. Fold and sulcus strong, extending almost from beak; anterior commissure uniplicate with high rounded tongue. Costae originate near beak, pronounced on fold and in sulcus, weak on flanks; radial striae cover surface. Dental plates slightly convergent ventrally, umbonal cavities wide; septalium wide and deep; hinge plates divided anterior of septalium; dorsal median septum long and thin; crura long, straight, slightly incurved. *Upper Devonian (Famennian):* western North America, Iran, Afghanistan, northern Africa, Spain.——Fig. 811,*3a–k.* **M. haynesi,* upper Famennian, Palliser Formation, Banff National Park, Alberta, Canada; *a–e,* paratype, dorsal, ventral, lateral, anterior, and posterior views, ×1; *f–k,* serial sections 1.9, 2.8, 3.05, 3.9, 6.9, 8.1 mm from posterior, ×2 (Sartenaer, 1969).

Mirantesia Mohanti, 1972, p. 176 [**M. mirantana;* OD]. Subcircular outline and strongly biconvex profile. Beak erect, foramen small, submesothyrid. Fold and sulcus weak but tongue high, subrectangular. Umbones smooth. Angular costae arising anteriorly in mature specimens, young specimens wholly smooth. Dental plates short, slightly convergent ventrally. Dorsal median septum short; very short septalium buried in posterior callus; hinge plates divided; crura triangular in cross section, curved ventrally, becoming laterally flattened distally. *Middle Devonian (Eifelian):* Spain.——Fig. 810,*2a–k.* **M. mirantana,* middle Eifelian, lower Member A of Portillo Formation, Leon, Mirantes; *a–d,* holotype, dorsal, ventral, lateral, and posterior views, ×3.5; *e,* holotype, anterior view, ×3.2; *f–k,* serial sections, ×4.5 (Mohanti, 1972).

Ovlatchania Abramov & Grigorjewa, 1986, p. 113 [**Leiorhynchus ovlatchanensis* Abramov, 1970, p. 129; OD]. Large; subpentagonal to transversely ovate; dorsibiconvex, inflated, tetrahedral. Beak erect; delthyrium with small apical opening. Fold and sulcus very strong, extending from umbones; anterior commissure uniplicate, tongue high, acute; few low costae in sulcus, few low grooves on fold, flanks smooth. Dental plates vertical. Septalium short; hinge plates divided; dorsal median septum short, low. *Lower Carboniferous (Tournaisian–Viséan):* eastern Siberia.——Fig. 809,*3a–h.* **O. ovlatchanensis* (Abramov), Ovlatchansk Series, southern Verkhoyansk; *a–d,* holotype, dorsal, ventral, anterior, and lateral views, ×0.8; *e–h,* serial sections 0.3, 0.8, 0.9, 1.4 mm from posterior, ×3.3 (Abramov & Grigorjewa, 1986).

Parvaltissimarostrum Sartenaer & Xu, 1991, p. 127 [**P. minimum;* OD]. Small with tetrahedral shape; outline transversely ovate and lateral profile subtrigonal with very high anterior margin. Beak suberect; foramen large, rounded; deltidial plates narrow, disjunct. Fold and sulcus very strong; anterior commissure uniplicate; tongue very high and broad but tapering dorsally, rounded at crest. Commissure flared and sharp where valves meet anteriorly. Costae few, low, flattened; only present anteriorly; weak to absent on flanks. Dental plates short, convergent ventrally. Dorsal median septum short, low; septalium narrow, deep; hinge plates divided; crural bases flattened, becoming triangular and then crescentic in section distally. *Upper Devonian (Frasnian):* China.——Fig. 810,*3a–n.* **P. minimum,* middle Frasnian–upper Frasnian, Shetienchiao Formation, Xiangxiang County, Hunan; *a–e,* holotype, dorsal, ventral, lateral, anterior, and posterior views, ×3; *f–n,* serial sections 0.625, 0.675, 0.775, 0.825, 0.95, 1.15, 1.25, 1.325, 1.55 mm from posterior, ×4.8 (Sartenaer & Xu, 1991).

Porostictia Cooper, 1955, p. 62 [**Paraphorhynchus perchaensis* Stainbrook, 1947, p. 316; OD]. Subpentagonal outline and dorsibiconvex, anteriorly inflated profile. Beak suberect; deltidial plates disjunct or just meeting anteriorly, foramen large. Fold and sulcus strong, from umbones; anterior commissure uniplicate; tongue broad, high, dentate. Costae strong, angular, from umbones, weak on flanks. In well-preserved specimens surface with radial striae separated by rows of fine pits. Dental plates short, ventrally convergent. Dorsal median

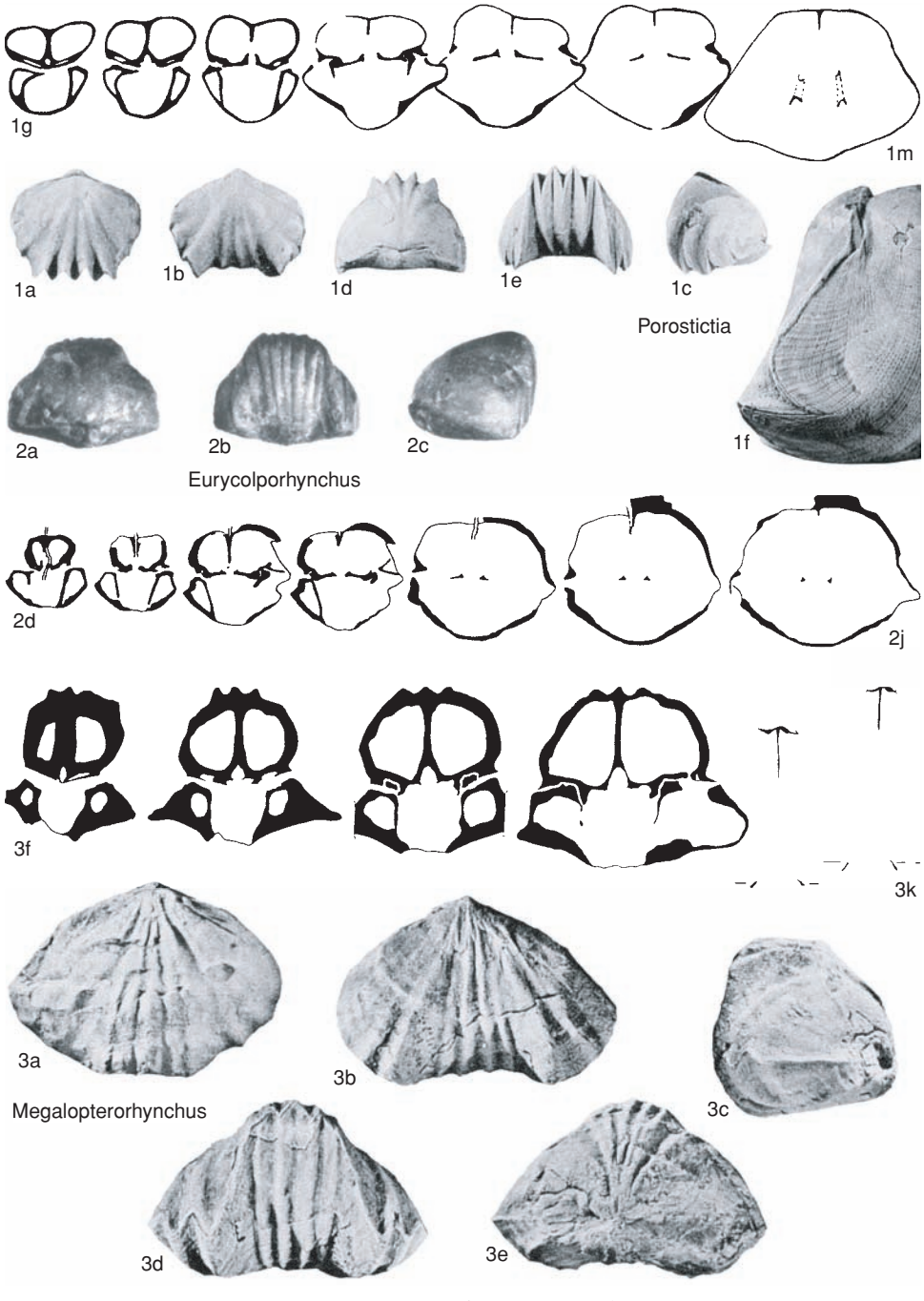

FIG. 811. Petasmariidae (p. 1189–1194).

septum long, low, slender; septalium short, V-shaped; hinge plates divided, horizontal; crura long, ventrally curved, horizontal posteriorly, tips compressed laterally. *Upper Devonian (upper Famennian):* USA (New Mexico).——FIG. 811,*1a–m. *P. perchaensis* (STAINBROOK), Percha Formation, Box Member, Hillsboro; *a–e,* hypotype, dorsal, ventral, lateral, posterior, and anterior views, ×1; *f,*

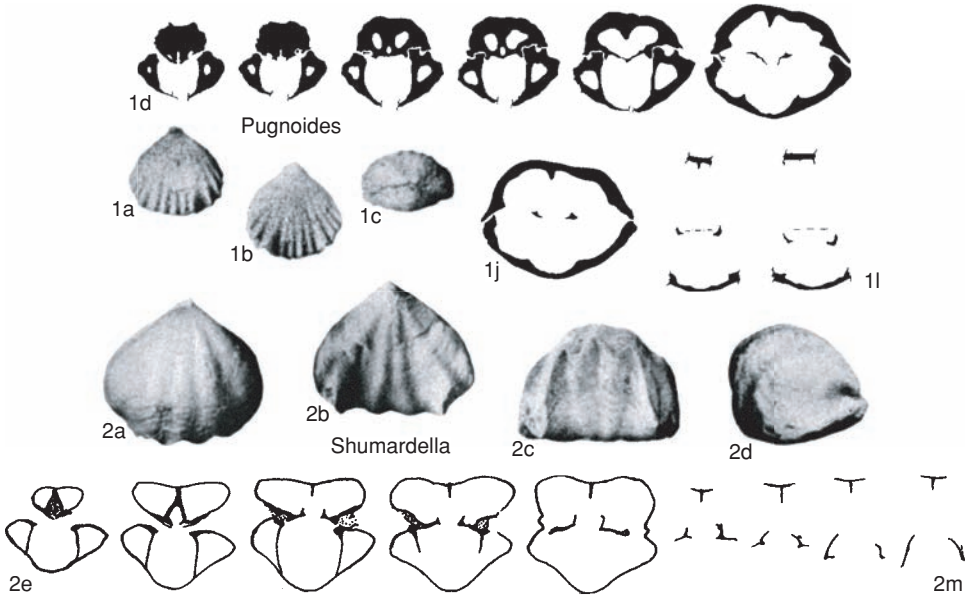

FIG. 812. Petasmariidae (p. 1194).

paratype, side view, showing striae and pits, ×2; *g–m,* serial sections 1.5, 2.2, 2.6, 3.0, 3.2, 3.4, 3.7 mm from posterior, ×3.5 (Cooper, 1955).

Pugnoides WELLER, 1910, p. 512 [**Rhynchonella ottumwa* WHITE, 1865, p. 23; OD]. Small to medium; subcircular to subtriangular; strongly biconvex. Beak incurved; large oval foramen. Fold and sulcus arising at midlength; anterior commissure uniplicate; tongue moderate. Costae arising at one-third shell length. Dental plates well developed, vertical, umbonal cavities large. Septalium distinct, with cover posteriorly; hinge plates divided, horizontal; dorsal median septum short and thick; crura long, concave dorsomedially, curving slightly ventrally. *Lower Carboniferous (Viséan):* North America, Europe, Asia, Western Australia.——FIG. 812,*1a–l. *P. ottumwa* (WHITE), Mississippian, Meramecian, Ottumwa, Iowa, USA; *a–c,* dorsal, ventral, and posterior views, ×1 (Cooper, 1944); *d–l,* serial sections 1.15, 1.25, 1.4, 1.45, 1.6, 1.95, 2.15, 2.50, 2.85 mm from posterior, ×3.5 (Sartenaer, 1964).

Shumardella WELLER, 1910, p. 512 [**Rhynchonella missouriensis* SHUMARD, 1855, p. 204; OD]. Subtriangular to subpentagonal outline; dorsibiconvex profile, inflated anteriorly. Beak suberect to incurved. Fold and sulcus strong; tongue high. Costae coarse, few, subangular, arising on umbones. Dental plates vertical to ventrally convergent. Dorsal median septum low, long; hinge plates subhorizontal, divided anterior of short septalium; crura laterally compressed. *Lower Carboniferous (Tournaisian):* North America, Asia.——FIG. 812,*2a–m. *S. missouriensis* (SHUMARD), Mississippian, Kinderhookian, Chouteau Limestone, Missouri, USA; *a–d,* dorsal, ventral, anterior, and lateral views, ×1 (Cooper, 1944); *e–m,* serial sections 12.05, 12.0, 11.9, 11.8, 11.6, 11.2, 11.0, 10.8, 10.7 mm from posterior, ×4 (Schmidt, 1965a).

Family CAMEROPHORINIDAE Rzhonsnitskaia, 1958

[*nom. correct.* RZHONSNITSKAIA, 1958, p. 115 *pro* Camarophorinidae RZHONSNITSKAIA, 1956a, p. 126]

[Materials prepared by NORMAN M. SAVAGE]

Pugnacoidea with dental plates joined to form spondylium. Dorsal median septum and septalium absent; hinge plates undivided. *Middle Devonian (Eifelian–Givetian).*

Camerophorina SCHMIDT, 1941a, p. 43 [**Terebratula pachyderma* QUENSTEDT, 1871 in 1868–1871, p. 200; OD]. Transversely ovate outline and dorsibiconvex profile. Beak erect to incurved. Fold and sulcus low; anterior commissure uniplicate, tongue moderately high, triserrate. Costae low, rounded, restricted to fold and sulcus, umbones and flanks smooth. Dental plates meet ventrally with septum to form spondylium. Hinge plates undivided; dorsal septum and septalium absent. *Middle Devonian (Eifelian–Givetian):* Germany, Spain, Moravia, Urals.——FIG. 813*a–f. *C. pachyderma* (QUENSTEDT), Givetian, Rommersheimer Beds, Heiligenstein, Eifel; *a–d,* dorsal, ventral, anterior, and lateral views, ×1; *e–f,* serial sections, ×2.5 (Schmidt, 1941a).

Family YUNNANELLIDAE Rzhonsnitskaia, 1959

[*nom. transl.* McLaren, 1965, p. 585, *ex* Yunnanellinae Rzhonsnitskaia, 1959, p. 28]

[Materials prepared by Norman M. Savage]

Pugnacoidea with fine costae posteriorly merging into coarse costae anteriorly. Dental plates usually present. Dorsal median septum supporting short septalium. *Middle Devonian (Givetian)–Upper Devonian (Famennian).*

Yunnanella Grabau, 1923 in 1923–1924, p. 195 [**Rhynchonella Hanburii* Davidson, 1853a, p. 356; OD]. Subpentagonal outline and dorsibiconvex profile; anteriorly inflated. Beak suberect to erect; foramen small, semicircular, bounded by deltidial plates. Fold and sulcus strong from umbones and particularly pronounced anteriorly; anterior commissure uniplicate; tongue high, typically tridentate. Costae angular, originating at about midlength; entire surface bearing radial striae. Dental plates strong, ventrally convergent. Dorsal median septum strong, short; septalium narrow, short, V-shaped, open; hinge plates dividing immediately anterior of septalium, horizontal; crura long, slender, tips concave ventrally in cross section. *Upper Devonian (Famennian):* China.——Fig. 814*a–n.* **Y. hanburii* (Davidson), Kwangsi; *a–d,* lectotype, dorsal, ventral, anterior, and lateral views, ×1.5; *e,* paralectotype, dorsal view showing striae, ×2; *f–n,* serial sections 0.95, 1.1, 1.25, 1.4, 1.5, 2.0, 2.25, 3.3, 3.65 mm from posterior, ×2 (Sartenaer, 1971b).

Ladogioides McLaren, 1961, p. 4 [**L. pax;* OD]. Subcircular outline and strongly dorsibiconvex, anteriorly inflated profile. Beak erect; foramen large, hypothyrid to submesothyrid; deltidial plates small, disjunct. Fold and sulcus pronounced anteriorly; anterior commissure uniplicate, tongue acuminate. Costae few, weak, restricted to anterior; radial striae over whole shell. Dental plates close to walls, ventrally convergent. Septalium deep, narrow, short; hinge plates divided, horizontal; dorsal median septum short, high, thin. Crura short, slender, dorsally grooved. *Middle Devonian (upper Givetian)–Upper Devonian (lower Frasnian):* western North America, western Europe, Siberia, China.——Fig. 815,*3a–i.* **L. pax,* lower Frasnian, Waterways Formation, Alberta, Gypsum Cliffs, Canada; *a–c,* holotype, dorsal, lateral, and anterior views, ×1; *d,* surface showing radial striae, ×3; *e–i,* serial sections 1.0, 1.4, 1.7, 2.1, 2.6 mm from posterior, ×3 (McLaren, 1961).

Nayunnella Sartenaer, 1961a, p. 2, *nom. nov. pro Yunnanella* Grabau, 1931b, p. 141, *non* Grabau, 1923 in 1923–1924 [**Yunnanella synplicata* Grabau, 1931b, p. 141; OD]. Subpentagonal outline and dorsibiconvex profile; anterior and lateral margins truncated. Beak suberect; delthyrium with disjunct deltidial plates leaving elongate foramen. Fold and sulcus moderately strong, from midlength; anterior commissure uniplicate; tongue serrate, moderately high, broad. Costae large, rounded, developed only anteriorly; radial costellae extending from umbones, superimposed on costae. Dental plates short, convex medially. Dorsal median septum low, short; hinge plates divided anterior of short septalium. *Upper Devonian (Famennian):* China, Kazakhstan, Australia.——Fig. 815,*1a–e.* **N. synplicata* (Grabau), Yaoso Group, eastern Yunnan, China; *a–c,* holotype, dorsal, anterior, and lateral views, ×2 (Grabau, 1931b); *d–e,* transverse sections, enlarged (Grabau, 1932a).——Fig. 815,*1f–k. N. tugida* Roberts, Ningbing Limestone, Bonaparte Gulf basin, Ningbing Range, northwestern Australia; serial sections 1.6, 1.8, 2.0, 2.8, 3.4, 3.6 mm from posterior, ×2 (Roberts, 1971).

Schnurella Schmidt, 1964, p. 505 [**Terebratula schnurii* de Verneuil, 1840, p. 261; OD]. Subtriangular to longitudinally ovate outline and dorsibiconvex, anteriorly inflated profile; anterior and lateral margins truncated. Beak erect to incurved. Fold and sulcus weak, obscured by convexity of shell; anterior commissure uniplicate; tongue low. Costae low, restricted to anterior margin; costellae present from midlength, superimposed on costae anteriorly. Dental plates short, close to walls. Dorsal median septum short, obscured by callus; septalium U-shaped; hinge plates undivided. *Middle Devonian (Givetian):* Europe, Kuznetsk basin, Armenia, Urals.——Fig. 815,*2a–i.* **S. schnuri* (de Verneuil), lower Givetian, Gerolstein, Eifel; *a–c,* ventral, anterior, and lateral views, ×1 (Schmidt, 1941b); *d–i,* serial sections 13.1, 13.0, 12.8, 12.6, 12.3, 12.0 mm from anterior, ×2 (Schmidt, 1965a).

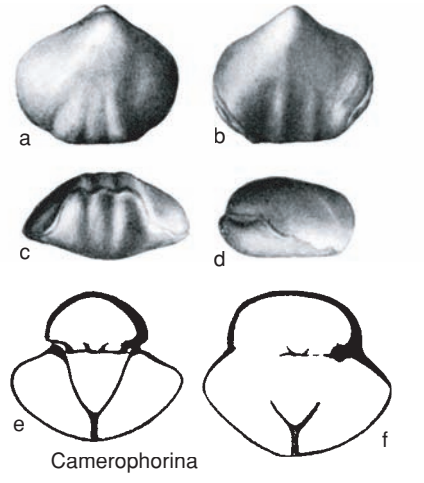

Fig. 813. Camerophorinidae (p. 1194).

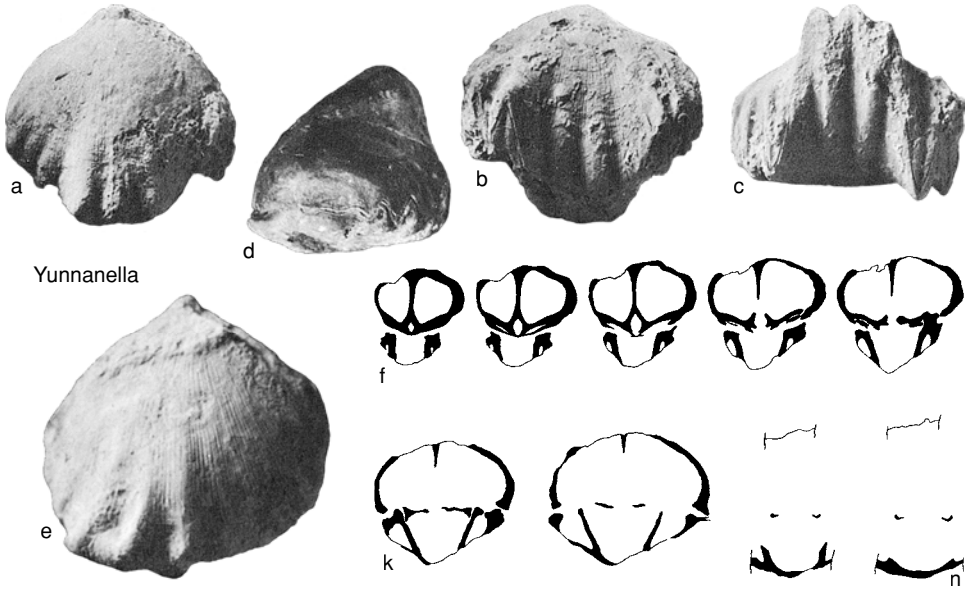

FIG. 814. Yunnanellidae (p. 1195).

Family PARANORELLIDAE Cooper & Grant, 1976

[*nom. transl.* SAVAGE, 1996, p. 254, *ex* Paranorellinae COOPER & GRANT, 1976a, p. 2073]

[Materials prepared by NORMAN M. SAVAGE]

Pugnacoidea with subcircular to elongate outline; fold and sulcus weak, commonly ventral fold, dorsal sulcus; costae weak to absent. Hinge plates divided. Dental plates and dorsal median septum short. *Lower Carboniferous (Tournaisian)–Upper Permian (Kazanian).*

Subfamily PARANORELLINAE Cooper & Grant, 1976

[Paranorellinae COOPER & GRANT, 1976a, p. 2073]

Subcircular Paranorellidae with dorsal sulcus. *Lower Carboniferous (Tournaisian)–Upper Permian (Kazanian).*

Paranorella CLOUD, 1944, p. 59 [**P. imperialis;* OD]. Subcircular outline and ventribiconvex profile. Beak incurved. Ventral fold and dorsal sulcus weak, extending from midlength. Surface smooth. Dental plates short; ventral muscle field elliptical, with bounding ridge. Socket ridges strongly recurved. Hinge plates undivided but deeply notched, short. Crural bases stout, with keels that unite with low median septum to form narrow septalium. Dorsal muscle field elliptical, divided by median ridge. *Permian (Asselian–Kazanian):* Mexico, USA.——FIG. 816,*1a–e.* **P. imperialis,* Wordian, *Waagenoceras* Shale, southwestern Coahuila, Mexico; *a–c,* holotype, dorsal, ventral, and lateral views, ×1 (Cloud, 1944); *d–e,* hypotype, dorsal and anterior view, ×1 (Cooper & Grant, 1976a).——FIG. 816,*1f–g. Paranorella* sp., Wordian, Word Formation, western Texas, USA; *f,* ventral interior, ×1.5; *g,* dorsal interior, ×3 (Cooper & Grant, 1976a).

Boloria GRUNT, 1973, p. 119 [**B. garmoensis;* OD]. Subcircular to subpentagonal outline and ventribiconvex profile. Beak long, suberect; foramen small and circular. Ventral fold and dorsal sulcus arising at umbones, deep, wide, with gentle margins. Costae absent. Tongue pronounced, subtrapezoid. Dental plates short, vertical. Hinge plates divided; dorsal median septum absent but with low, short ridge. *Lower Permian (Asselian–Sakmarian):* Pamir.——FIG. 816,*2a–g.* **B. garmoensis,* Darvaz Stage, Mamazair, southeastern Pamir; *a–d,* holotype, dorsal, ventral, anterior, and lateral views, ×1; *e–g,* serial sections 0.2, 0.5, 0.7 mm from posterior, ×2.8 (Grunt, 1973).

Sanjuania AMOS, 1958, p. 841 [**S. dorsisulcata;* OD]. Subcircular to subpentagonal outline and ventriconvex profile. Beak slightly incurved; foramen submesothyridid, circular. Fold and sulcus weak; anterior commissure weakly unisulcate. Costae absent. Dental plates short, vertical. Hinge plates divided; dorsal median septum and septalium absent. *Lower Carboniferous (Tournaisian):* Argentina.——FIG. 816,*3a–g.* **S. dorsisulcata,* Volcan Formation, Guandacol; *a–d,* holotype, dorsal, ventral, anterior,

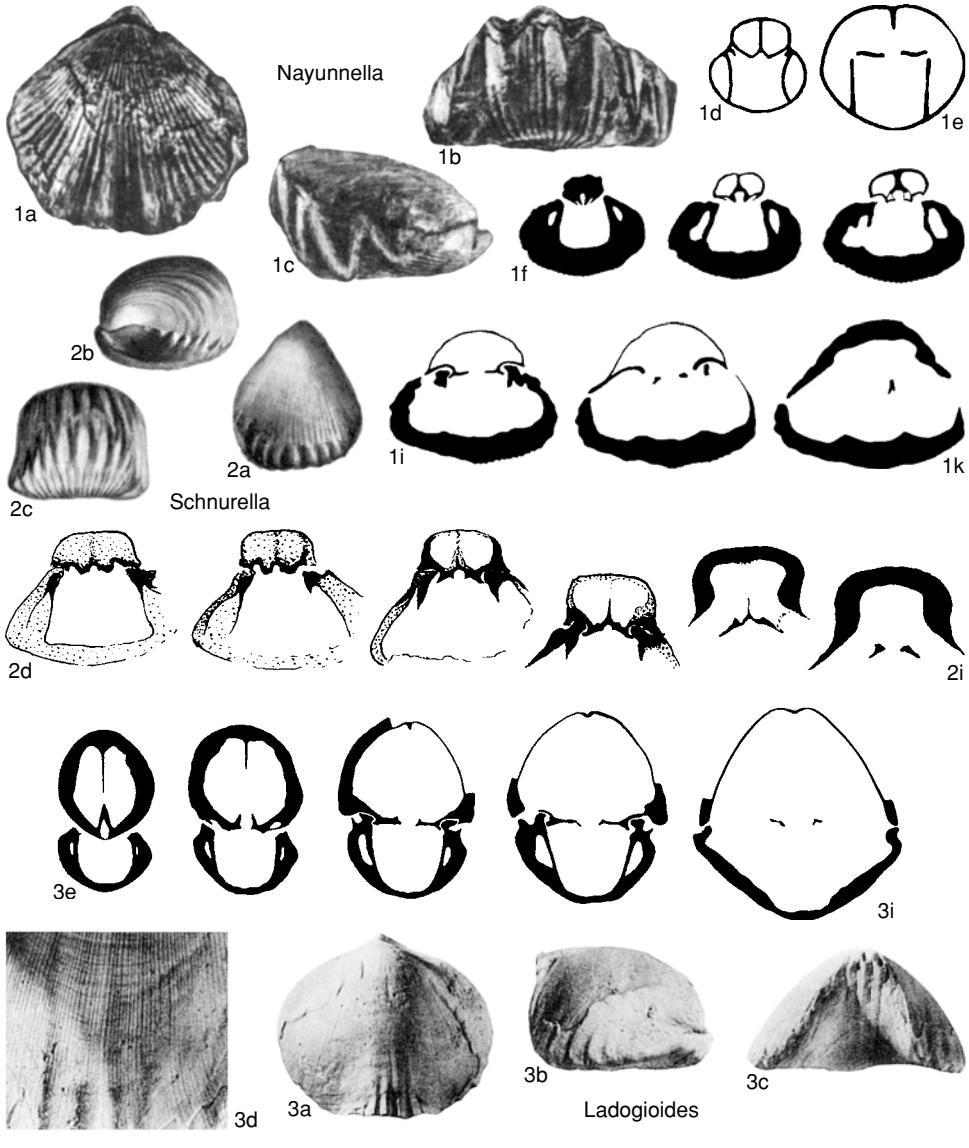

FIG. 815. Yunnanellidae (p. 1195).

and lateral views, ×1.3; *e–g,* serial sections 1.15, 2.0, 2.2 mm from posterior, ×1.8 (Amos, 1958).

Subfamily IOWARHYNCHINAE Savage, 1996

[Iowarhynchinae SAVAGE, 1996, p. 254]

Small, smooth Paranorellidae with elongate oval outline; weak dorsal fold; mesothyrid foramen. Dental plates short. Dorsal median septum and septalium absent; hinge plates divided. *Lower Carboniferous (Tournaisian).*

Iowarhynchus CARTER, 1983, p. 66 [**I. mirandum;* OD]. Small with elongate cordate outline and equibiconvex profile. Beak suberect; delthyrium narrow, joining rounded foramen. Dorsal fold very low to absent, dorsal sulcus rare; ventral sulcus very low; anterior commissure weakly uniplicate to rectimarginate. Costae absent. Dental plates short,

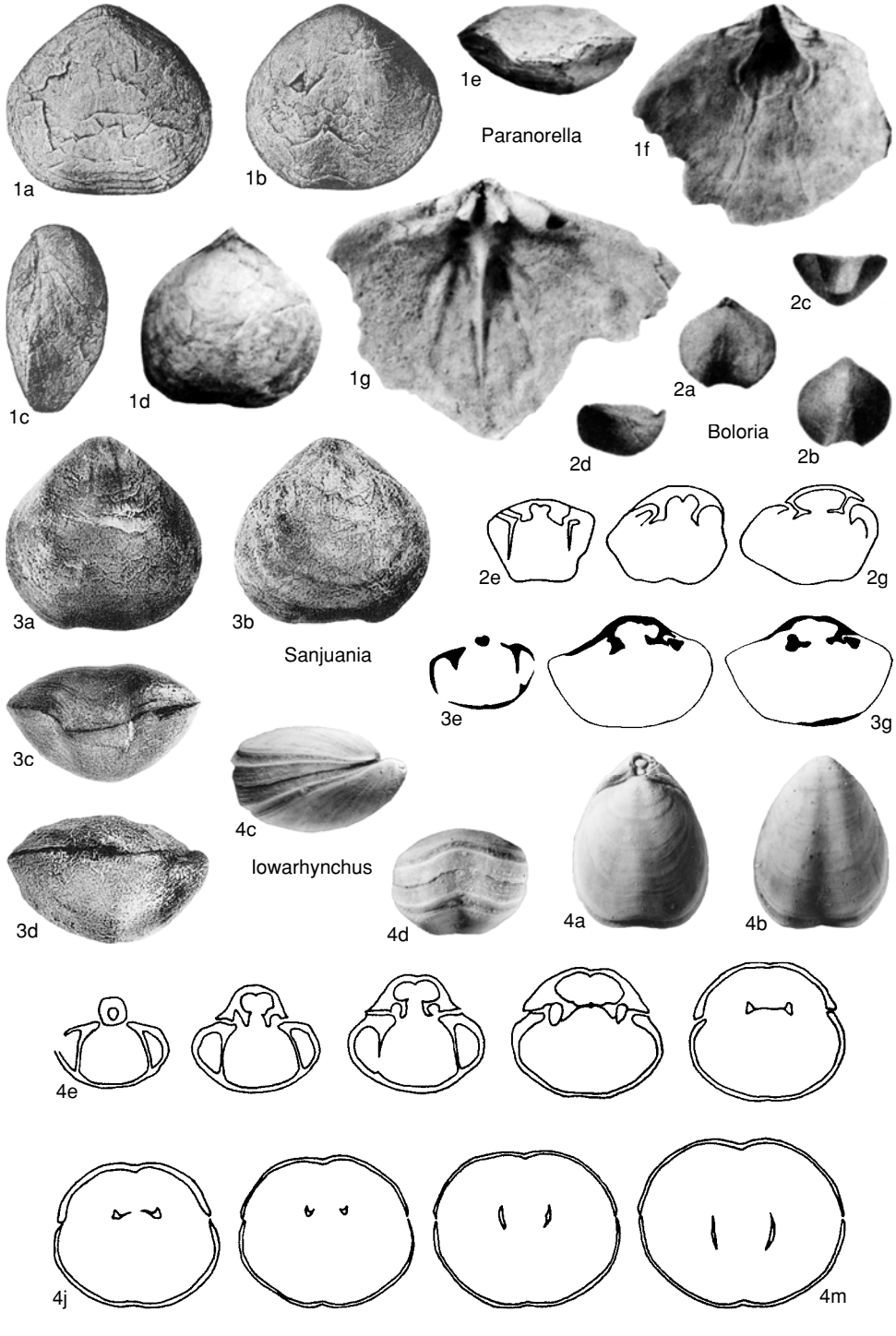

FIG. 816. Paranorellidae (p. 1196–1199).

diverging toward valve floor; hinge plates divided; inner socket ridges overhanging sockets; dorsal median septum absent, myophragm low; crura ventrally curved, becoming flattened laterally. *Lower Carboniferous (Tournaisian):* USA.——Fig. 816,*4a–m. *I. mirandum,* Gilmore City Limestone, Humboldt County, Hodge's Quarry, Iowa; *a–d,* holotype, dorsal, ventral, lateral, and anterior views, ×6; *e–m,* serial sections 0.12, 0.16, 0.20, 0.24, 0.28, 0.30, 0.34, 0.38, 0.44 mm from posterior, ×12 (Carter, 1983).

Family BASILIOLIDAE Cooper, 1959

[Basiliolidae Cooper, 1959, p. 15]

[Materials prepared by Miguel O. Manceñido & Ellis F. Owen]

Smooth or radially costate Pugnacoidea with deltidial plates conjunct and foramen small and auriculate; pedicle collar well developed; squama and glotta absent; crura broad, falciform (or modification thereof) supported by outer hinge plates or socket ridges; dorsal median septum reduced to ridge or absent; conoidal spirolophe bearing several whorls. *Upper Triassic (Carnian)–Holocene.*

Subfamily BASILIOLINAE Cooper, 1959

[Basiliolinae Cooper, 1959, p. 15]

Smooth or marginally costate Basiliolidae; commissure broadly to acutely uniplicate, occasionally asymmetrical. Dorsal valve with hamiform to falciform crura attached to broad outer hinge plates; median septum and spines absent. *Lower Jurassic (?Sinemurian, Pliensbachian)–Holocene.*

Basiliola Dall, 1908, p. 442 [**Hemithyris beecheri* Dall, 1895, p. 717; OD] [=*Basiola* Thomson, 1915, p. 390, *nom. null.; Neohemithyris* Yabe & Hatai, 1934, p. 587 (type, *Rhynchonella lucida* Gould, 1861, p. 323, OD)]. Smooth, elongate-pentagonal to rounded-subpentagonal; widest at about midvalve; dorsibiconvex, dorsal valve acutely convex, ventral valve moderately convex; uniplicate, dorsal fold almost imperceptible; ventral sulcus broad, shallow, arcuate; beak small, suberect; foramen small, circular, submesothyrid; deltidial plates small, conjunct, auriculate. Crura often distally serrate, bases not thickened; pedicle collar strong, elaborate. [Living species mainly bathyal, ranging from abyssal to sublittoral.] *Upper Cretaceous (Turonian)–Holocene:* Donetz basin, Turkmenistan, ?Denmark, *Turonian–Maastrichtian;* western Pacific (Okinawa, Ryukyu, Fiji, Vanuatu), *Miocene–Pleistocene;* Indo-Pacific (Madagascar to Japan and Hawaii), *Holocene.*——Fig. 817,*1a–e. *B. beecheri* (Dall), Holocene, off Hawaii; *a,* dorsal view, ×2; *b,* lateral view, ×1; *c,* anterior view, USNM 334678, ×1; *d,* ventral valve interior, ×4; *e,* oblique view of crura, USNM 334679, ×4 (Cooper, 1959).——Fig. 817,*1f–t. B. lucida* (Gould), Holocene, Bonin Islands; transverse serial sections, distances in mm from first section, 0.0, 0.2, 0.6, 1.0, 1.5, 2.0, 2.3, 2.6, 2.8, 3.0, 3.3, 3.5, 3.7, 3.9, 4.1 (Zezina & Smirnova, 1977).

?Almorhynchia Ovcharenko, 1983, p. 45 [**Rhynchonella urtabusensis* Moiseev, 1935, p. 128; OD] [=*Shroshaerhynchia* Ovcharenko, 1977, p. 38, *nom. nud.*]. Small, posteriorly smooth, with 11 to 21 rounded costae or plicae anteriorly (4 to 6 on feebly defined fold); beak small. Pedicle collar well developed; dental plates long, ventrally convergent proximally to subparallel; hinge plates broad, crura hamiform, dorsoventrally oriented; septal pillar broad, long. *Lower Jurassic (Toarcian)–Middle Jurassic (lower Aalenian):* southeastern Pamirs.——Fig. 817,*2a–u. *A. urtabusensis* (Moiseev), Toarcian; *a–c,* dorsal, lateral, anterior views, MUGT 93/1266, ×1; *d–u,* transverse serial sections, distances in mm from ventral umbo, 0.3, 0.5, 0.7, 0.9, 1.1, 1.2, 1.4, 1.5, 1.9, 2.1, 2.2, 2.3, 2.6, 2.7, 3.1, 3.4, 3.6, 3.9, MUGT 94/1266 (Ovcharenko, 1983).

Apringia de Gregorio, 1886, p. 22 [**A. giuppa;* OD]. Small to medium size, subcircular, globose equibiconvex; uniplication wide, rectangular (possibly asymmetrical), and fold scarcely raised; faint irregular costae anteriorly (up to 3 on fold), otherwise smooth; beak small, erect, with minute foramen. Delicate pedicle collar; dental plates subvertical; hinge plates narrow, without septalium, nor dorsal median septum; crura hamiform. *Lower Jurassic (?Sinemurian, Pliensbachian)–Middle Jurassic (Bathonian):* Italy, Sicily, Austria, Hungary, ?Greenland, Morocco.——Fig. 817,*3a–c. *A. giuppa,* Toarcian, Italy; dorsal, lateral, anterior views, ×1 (de Gregorio, 1886).——Fig. 817,*3d–m. *A.* sp., Toarcian, eastern High Atlas, Morocco; transverse serial sections through umbo (Rousselle, 1975).

Basiliolella d'Hondt, 1987, p. 39 [**B. ferox;* OD]. Small, subtriangular, smooth but for few, obscure marginal plicae; uniplication flattopped, paucidentate; beak ridges submesothyrid; foramen small, slightly auriculate. Median septum reduced to a ridge or low keel; distal ends of crura broad and truncated or serrated; crural bases thickened, increasingly swollen to medially coalescent. [Living species inhabit upper bathyal zone.] *Holocene:* New Caledonia, Fiji, Australia.——Fig. 818,*1a–e. *B. ferox,* Chesterfield Bank, New Caledonia; *a–d,* dorsal, ventral, lateral, anterior views, ×1.5; *e,* cardinalia and crura, ×25 (d'Hondt, 1987).

Eohemithiris Hertlein & Grant, 1944, p. 55 [**E. alexi;* OD] [=*Eohemithyris* Cooper, 1959, p. 30, unjust. emend.]. Similar to *Basiliola* but flatter, almost equibiconvex, with broader, lower

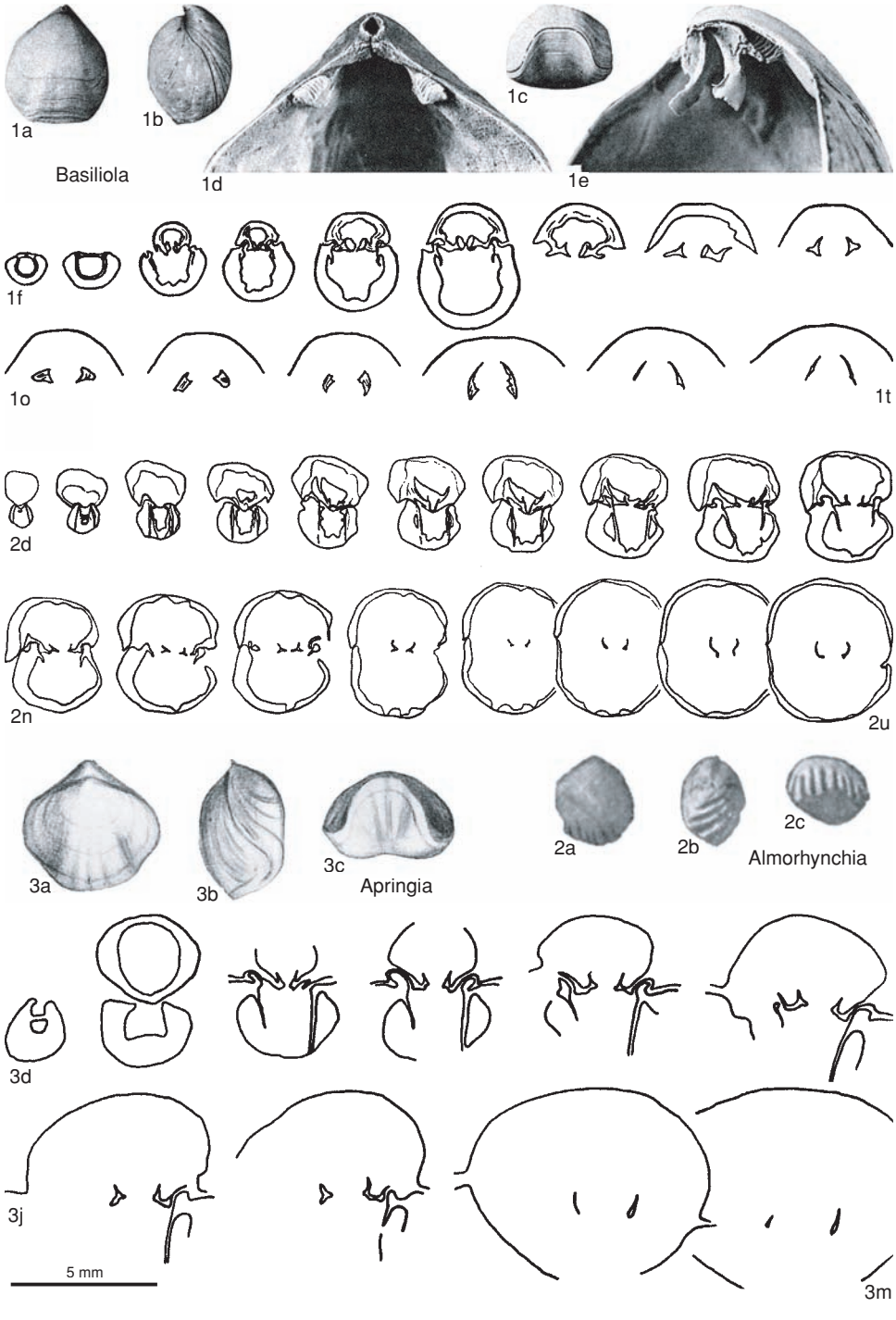

FIG. 817. Basiliolidae (p. 1199).

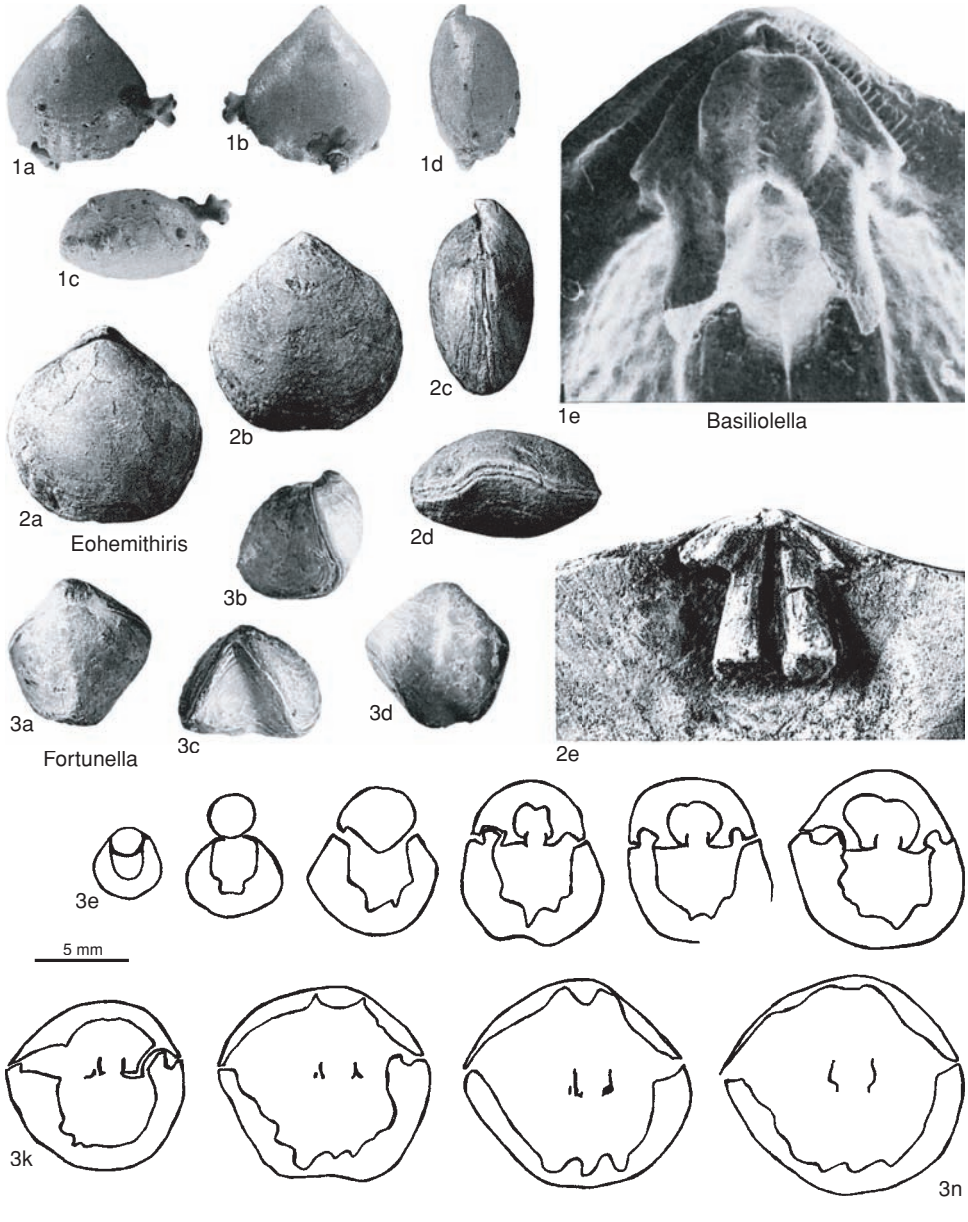

FIG. 818. Basiliolidae (p. 1199–1202).

uniplication and shallow ventral sulcus; surface smooth; deltidial plates conjunct, rimmed. Very broad subfalciform crura; no pedicle collar. *Paleogene (Eocene)–Neogene (Miocene):* western USA (California, Washington).——FIG. 818,*2a–e. *E. alexi,* Eocene, California; *a–d,* dorsal, ventral, lateral, anterior views, UCMP 15524, ×2; *e,* dorsal interior showing cardinalia and crura, UCMP 15545, ×6 (Cooper, 1959).

Fortunella CALZADA, 1985, p. 78 [**F. fortunae;* OD]. Small to medium, smooth but faintly capillate in early stages; uniplicate with high, shallow, acutely arcuate ventral sulcus and extensive triangular linguiform extension. Pedicle collar present; dental

plates usually fused to shell wall; hinge plates narrow, long falciform crura. [Closely related to *Rionirhynchia* KAMYSHAN & KVAKHADZE, 1980, p. 72, possibly even a junior subjective synonym.] *Upper Jurassic (lower Oxfordian)–Lower Cretaceous (upper Aptian):* southeastern Spain, Alps, Poland, Moravia, Slovakia, Russian platform, Caucasus, Azerbaijan, ?Hungary, ?Greenland, Algeria.——FIG. 818,*3a–n.* **F. fortunae,* lower Hauterivian, Sierra del Lugar, southeastern Spain; *a–d,* holotype, dorsal, lateral, anterior, ventral views, MGSB 32491-13, ×1; *e–n,* transverse serial sections, distances in mm from ventral umbo, 1.1, 1.5, 1.9, 2.2, 2.4, 2.7, 3.0, 3.4, 3.7, 4.1, MGSB 32491-L4 (Calzada, 1985).

Probolarina COOPER, 1959, p. 37 [**Rhynchonella holmesii* DALL, 1903, p. 1536; OD]. Small, subpentagonal, uniplicate, anteriorly costate; beak long, pointed, nearly straight; foramen hypothyrid to submesothyrid; deltidial plates auriculate, conjunct. Strong pedicle collar and dental plates; crura long, scimitar-like. *Upper Cretaceous–Paleogene (Eocene):* ?central Asia, *Upper Cretaceous;* eastern USA, Jamaica, New Zealand (Chatham Islands), *Paleocene–Eocene.*——FIG. 819,*1a–e.* **P. holmesii* (DALL), Eocene, North Carolina, USA; *a–d,* dorsal, ventral, lateral, anterior views, USNM 549359a, ×2; *e,* oblique view of crura, USNM 549359g, ×6 (Cooper, 1959).

Rhytirhynchia COOPER, 1957b, p. 8 [**Hemithyris sladeni* DALL, 1910, p. 440; OD]. Similar to *Basiliola* but paucicostate anteriorly and with much reduced dental plates; deltidial plates auriculate, conjunct; anterior commissure sulciplicate, i.e., dorsal fold not differentiated, but bidentate, trapezoidal linguiform extension well developed. Crural bases incipiently thickened. [Living species inhabit upper bathyal zone.] *Neogene (Pliocene)–Holocene:* Pacific, Indian Ocean.——FIG. 819,*2a–e.* **R. sladeni* (DALL), Holocene, Saya de Malha Banks, western Indian Ocean; *a–c,* dorsal, lateral, anterior views, ×1; *d,* ventral interior showing foramen and teeth, ×3; *e,* lectotype, dorsal interior showing crura, USNM 111086, ×4 (Cooper, 1959).

Rionirhynchia KAMYSHAN & KVAKHADZE, 1980, p. 72 [**R. tsessiensis;* OD]. Small, equibiconvex, broadly oval; smooth or with few marginal costae; beak short, suberect, foramen small. Uniplicate, ventral valve with shallow sulcus and subtriangular linguiform extension; dorsal fold poorly developed. Shell thickened; dental plates fused to shell wall; hinge plates short, subquadrate with concave inner surfaces; crura moderately long. *Lower Cretaceous (Hauterivian–Barremian):* western Georgia (Caucasus).——FIG. 819,*5a–j.* **R. tsessiensis,* lower Hauterivian, Georgia; *a–d,* dorsal, lateral, anterior, ventral views, GMG 327/120, ×1; *e–j,* transverse serial sections, distances in mm from ventral umbo, 2.0, 2.7, 3.4, 3.9, 4.7, 5.3 (Kamyshan & Kvakhadze, 1980).

?Soaresirhynchia ALMÉRAS, 1994, p. 26 [**Rhynchonella bouchardi* DAVIDSON, 1852b, p. 82; OD]. Small to medium size, subcircular to transversely oval, equibiconvex to dorsibiconvex; smooth stage extended at least to midvalve; costae few, simple, rounded anteriorly (2 to 7 on scarcely raised dorsal fold); uniplication generally symmetrical; beak delicate, suberect to slightly incurved, foramen circular to oval, deltidial plates mostly disjunct, otherwise conjunct. Dental plates subparallel to ventrally convergent, often fused to shell wall; hinge plates divided; cardinal process and septalium absent; dorsal median septum absent or reduced to a ridge; crura hamiform to subfalciform; pedicle collar reduced to absent. [May be a subjective synonym of *Almorhynchia* OVCHARENKO, 1983, p. 45.] *Lower Jurassic (Toarcian):* England, ?Scotland, Germany, France, Spain, Portugal, Italy, Dinarids, Morocco, Algeria.——FIG. 819,*4a–t.* **S. bouchardi* (DAVIDSON), lower Toarcian; *a–c,* dorsal, lateral, anterior views, Somerset, England, SM J.36787, ×2 (Ager, 1962); *d–t,* transverse serial sections, distances in mm from ventral umbo, 0.3, 0.5, 0.8, 2.2, 2.35, 2.5, 2.65, 2.8, 2.95, 3.1, 3.25, 3.45, 3.7, 3.8, 4.0, 4.2, 4.4, Portugal, FSL 307406 (Alméras, 1994).

Streptaria COOPER, 1959, p. 38 [**Terebratula de Buchii* MICHELOTTI, 1839, p. 122; OD]. Pentagonal, almost planoconvex with acutely uniplicate asymmetrical commissure; possible faint striation anteriorly; beak short, foramen auriculate. Dental plates reduced; pedicle collar poorly developed. [Probably a subgenus of *Basiliola* DALL, 1908, p. 442.] *Paleogene (Eocene)–Neogene (Miocene):* southern Europe, northern Africa, Cuba, Arabia, western Kazhakhstan, ?New Zealand, Antarctica.——FIG. 819,*3a–d.* **S. debuchii* (MICHELOTTI), middle Miocene, Messina, Sicily; *a–c,* dorsal, lateral, anterior views, USNM 549352a, ×2; *d,* internal view of dorsal umbo showing strong socket ridges, wide outer hinge plates and crura, USNM 549352b, ×6 (Cooper, 1959).

Subfamily PAMIRORHYNCHIINAE Ovcharenko, 1983

[Pamirorhynchiinae OVCHARENKO, 1983, p. 50; *emend.,* MANCEÑIDO & OWEN, herein]

Medium to small Basiliolidae, subspherical to somewhat depressed, compact, equibiconvex shells; fully costate with round-crested but sharply incised costae, typically acute and simple, sometimes bifurcating or intercalated, never spinose; uniplication of anterior commissure gently to strongly arcuate, but not disrupting overall shell outline. Dental plates relatively thin, subparallel, or slightly ventrally convergent; dorsal median septum absent or extremely reduced (confined apically); outer hinge

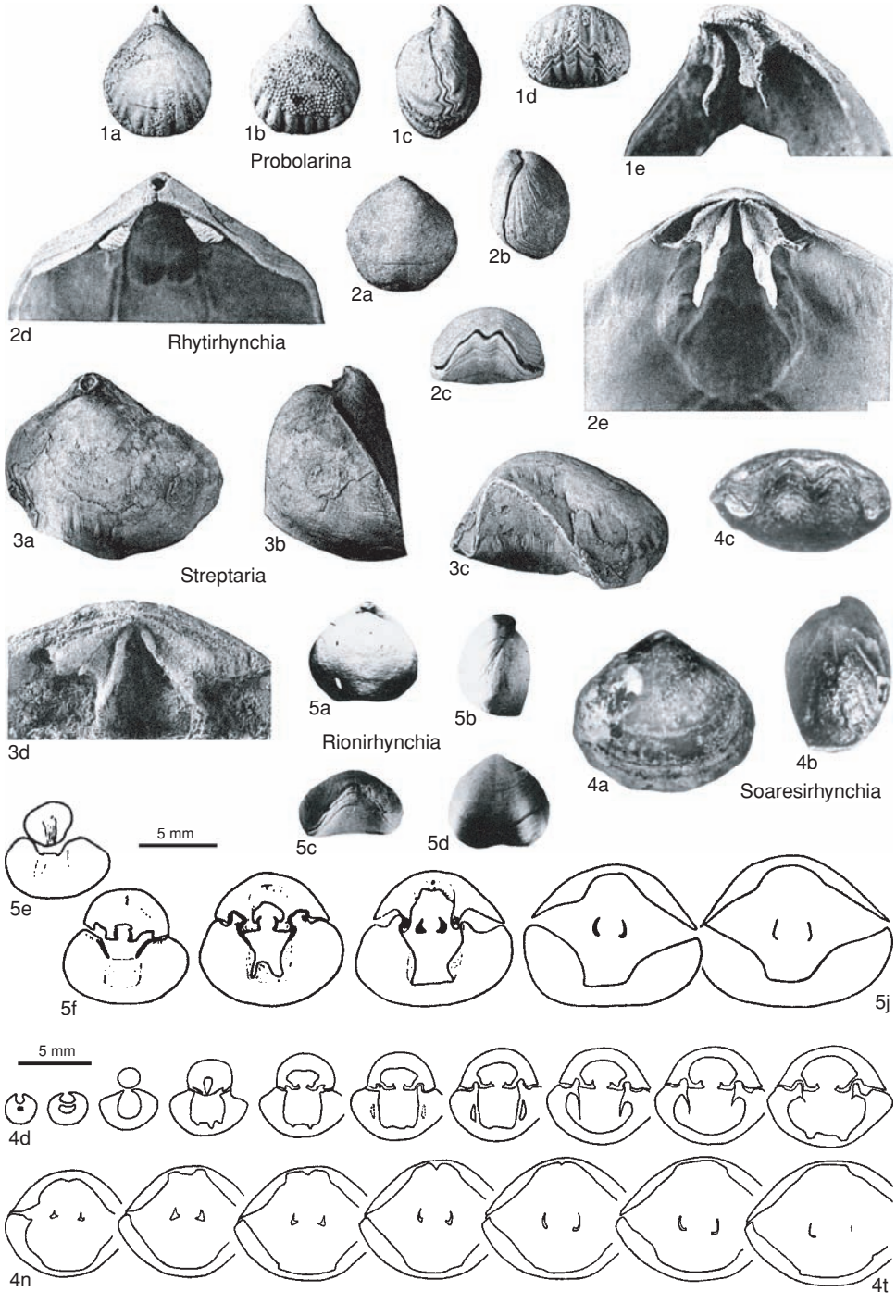

FIG. 819. Basiliolidae (p. 1202).

plates ventrally convex; crura falciform or modification thereof (may be hamiform in young stages). [Other special crural types named by OVCHARENKO seem superfluous; name herein redefined to include demoted Pamirorhynchiidae OVCHARENKO, 1983, p. 49 and part of Dzhangirhynchiinae OVCHARENKO, 1983, p. 70, *emend.* SHI & GRANT, 1993, p. 20 (*partim* excluding type genus *Dzhangirhynchia*).] *Upper Triassic (Carnian)–Paleogene (Paleocene, ?Eocene).*

Pamirorhynchia OVCHARENKO, 1983, p. 51 [**Rhynchonella pamirensis* MOISEEV, 1937, p. 7; OD] [=*Pamirorhynchia* OVCHARENKO, 1977, p. 38, *nom. nud.; Aidynkulirhynchia* OVCHARENKO, 1983, p. 59–60 (type, *A. aidynkulensis,* OD); *Aidynkulirhynchia* OVCHARENKO, 1977, p. 38, *nom. nud.; Aldynkulirhynchia* DOESCHER, 1981, p. 3, *nom. nud.*]. Medium to large, with costae rather thick, not numerous, seldom dichotomizing. Dental plates long, subparallel, converging ventrally or diverging; young shells with small septalium, septum not distinct; adult shells with massive distinct septum; outer hinge plates ventrally convex; crura hamiform in young shells to subfalciform in adults. *Middle Jurassic (upper Aalenian–upper Bajocian):* southeastern Pamirs.——FIG. 820,*2a–l. *P. pamirensis* (MOISEEV); *a–d,* dorsal, lateral, anterior, ventral views, MUGT 104/1266, ×1; *e–l,* transverse serial sections, distances in mm from ventral umbo, 0.55, 1.7, 2.3, 2.85, 3.25, 3.8, 4.6, 5.0, MUGT 106/1266 (Ovcharenko, 1983).——FIG. 820,*2m–v. P. aidynkulensis* (OVCHARENKO), lower Bajocian; *m–o,* holotype, dorsal, lateral, anterior views, MUGT 125/1266, ×1; *p–v,* transverse serial sections, distances in mm from ventral umbo, 3.65, 4.55, 4.8, 5.35, 6.15, 7.15, 9.1, MUGT 124/1266 (Ovcharenko, 1983).

Gagriella MOISEEV, 1939, p. 193[205] [**G. abhasiaensis;* OD]. Globose, compact, covered with numerous sharp costae, usually simple, but possibly showing bifurcations. Otherwise like *Orbirhynchia* in its internal structures. [This genus is revalidated herein.] *Upper Jurassic (Tithonian), Lower Cretaceous (?Hauterivian, Barremian):* Georgia, Stramberk.——FIG. 821,*3a–q. *G. abhasiaensis,* Barremian, Georgia; *a–d,* dorsal, lateral, anterior, ventral views, ×1 (Moiseev, 1939); *e–q,* transverse serial sections, distances in mm from ventral umbo, 0.8, 2.3, 3.1, 3.4, 4.1, 4.4, 4.7, 5.0, 5.3, 5.9, 6.3, 7.1, 7.4, LGE 10/181 (new; courtesy of S. V. Lobacheva).

?Kvesanirhynchia KVAKHADZE, 1976, p. 505 [**K. tenuicostata;* OD]. Small, rounded-pentagonal, broader than long; dorsibiconvex; costae numerous, simple, angular; beak slender, low, slightly incurved to suberect, foramen mesothyrid; anterior commissure with broad, shallow sulcus meeting low, weakly developed dorsal median fold. Umbonal chambers small; outer hinge plates narrow; crural bases thick; dorsal ridge or low septum persisting to middle part of valve. [Closely related to *Gagriella* MOISEEV, 1939, p. 193, possibly even a junior subjective synonym.] *Lower Cretaceous (Berriasian):* Georgia.——FIG. 822,*1a–s. *K. tenuicostata,* Berriasian, Abhazia; *a–d,* holotype, dorsal, lateral, anterior, ventral views, GMG 334/3, ×1; *e–s,* transverse serial sections, distances in mm from first section, 0.0, 0.3, 0.4, 0.5, 0.7, 0.9, 1.1, 1.3, 1.6, 1.8, 2.2, 2.3, 2.4, 2.7, 2.8 (Kvakhadze, 1976).

Orbirhynchia PETTITT, 1954, p. 29 [**O. orbignyi* PETTITT, 1954, p. 45; OD]. Small, biconvex, orbicular with uniplication low, arcuate or ventral sulcus shallow; dorsal fold poorly developed; anterior commissure rarely asymmetrical; numerous finely rounded costae, shell smooth posteriorly; beak small, foramen circular, beak ridges indistinct. Dental plates slender, often close to wall; dorsal septum absent. *Cretaceous (Albian–lower Maastrichtian):* England, France, Germany, Switzerland, Spain, Italy, Slovakia, Poland, Bulgaria, Ukraine, Caucasus, Turkmenistan, western Kazakhstan, Tibet.——FIG. 822,*2a–r. *O. orbignyi,* lower Cenomanian, Holy Cross Mountains, Poland; *a–c,* dorsal, lateral, anterior views, MZ VIII Bra-997, ×2; *d–r,* transverse serial sections, distances in mm from first section, 0.0, 0.3, 0.6, 0.8, 1.0, 1.2, 1.3, 1.5, 1.6, 1.8, 2.1, 2.3, 2.5, 2.8, 3.3, MZ VIII Bra-997/a1 (Popiel-Barczyk, 1977).

?Parthirhynchia TITOVA, 1980, p. 77 [**P. unguiseformis;* OD] [=*Partirhynchia* IASIUKEVICH, 1974, p. 108, *nom. nud.*]. Small, costate or semicostate without dichotomy or bifurcation; elongate-oval; anterior commissure broad, arcuate with dorsal fold poorly developed and ventral sulcus shallow. Dental plates weakly ventrally divergent; dorsal valve with median ridge low, poorly developed or very low septum. [Though shell shape of type species is unusual, evidence from other assigned species tends to support this subfamily allocation, being similar to *Orbirhynchia* but with longer smooth stage.] *Upper Cretaceous (Turonian–Maastrichtian):* Turkmenistan, Bulgaria.——FIG. 821,*1a–n. *P. unguiseformis,* upper Maastrichtian, Kopet Dag, Turkmenistan; *a–c,* holotype, dorsal, lateral, anterior views, CNIGR 148/10445, ×1.5; *d–n,* transverse serial sections, distances in mm from ventral umbo, 2.05, 2.45, 2.55, 2.7, 2.95, 3.25, 3.4, 3.7, 4.35, 4.8, 4.95, CNIGR 134/10445, approximately ×2 (Titova, 1980).

Pseudogibbirhynchia AGER, 1962, p. 108 [**Rhynchonella Moorei* DAVIDSON, 1852b, p. 82; OD]. Small, globose, subcircular, equibiconvex, dorsal valve flattened posteriorly; uniplication low, but dorsal fold absent, multicostate throughout; beak small, incurved. Median septum very short, strengthened deltidial plates, hamiform crura. *Lower Jurassic (Sinemurian)–Middle Jurassic (lower Bajocian):* England, France, Portugal, Spain, Germany, Switzerland, Italy, Slovakia, Dinarids, Hungary, Greece, Morocco, Algeria, Madagascar, Thailand,

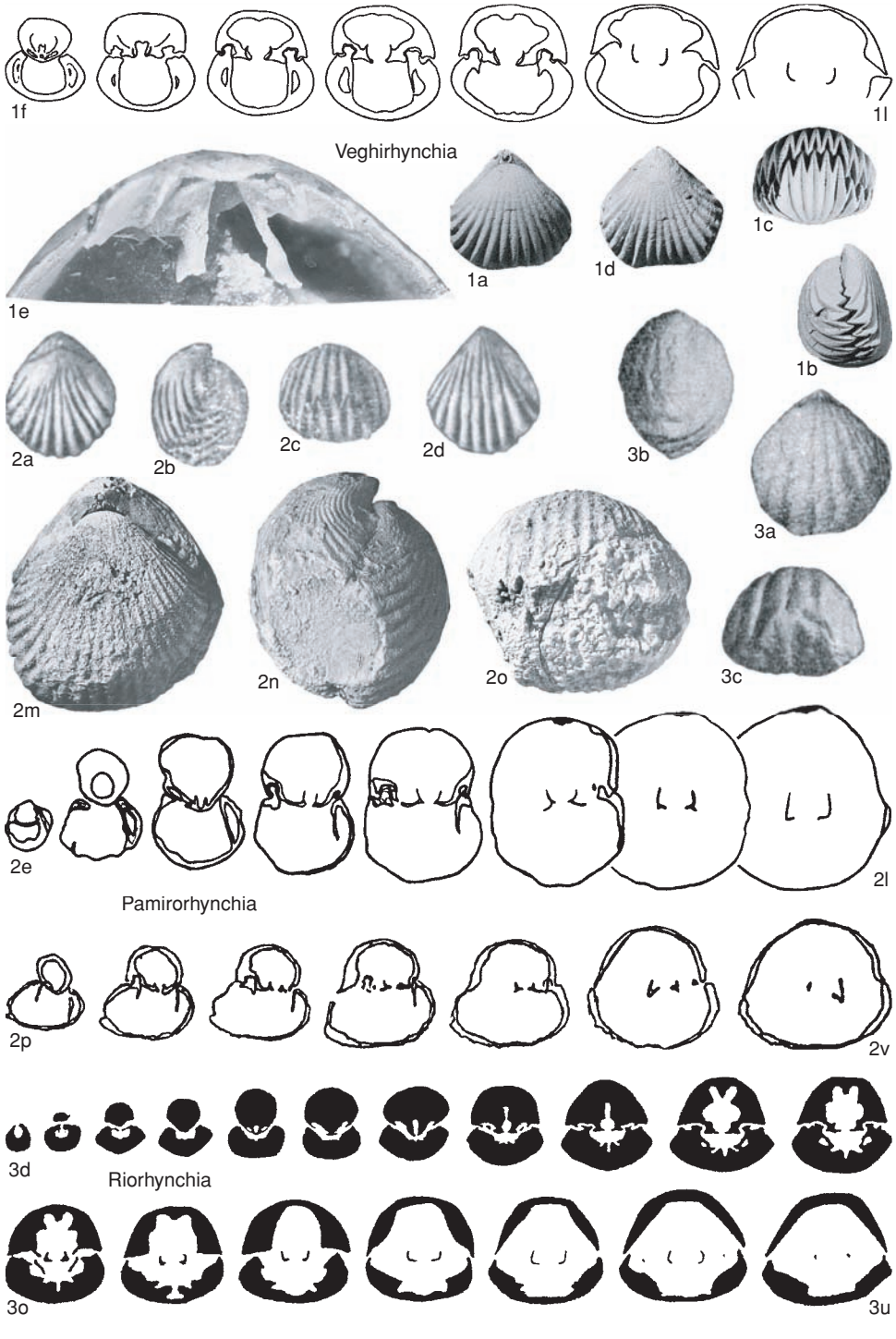

FIG. 820. Basiliolidae (p. 1204–1208).

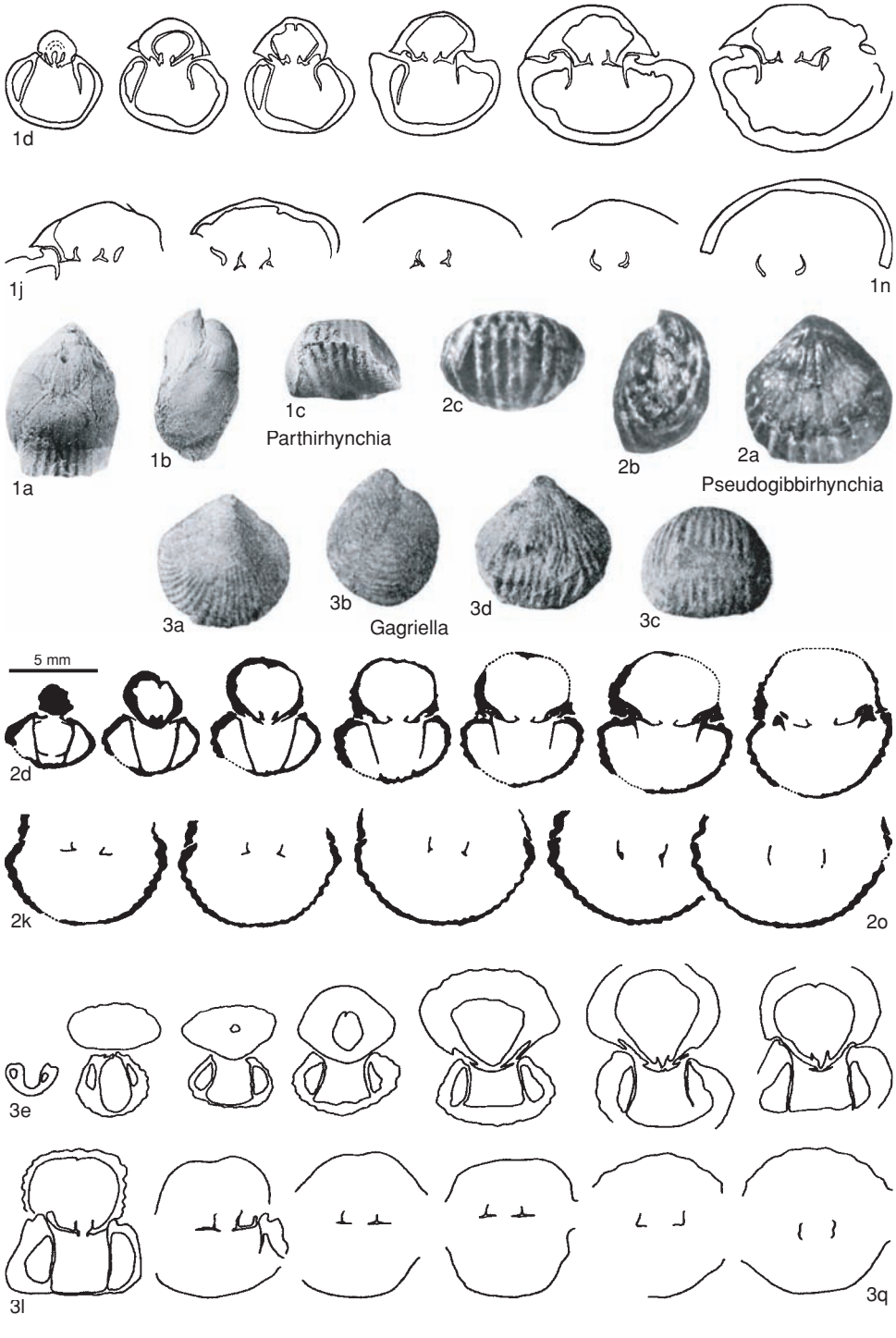

FIG. 821. Basiliolidae (p. 1204–1208).

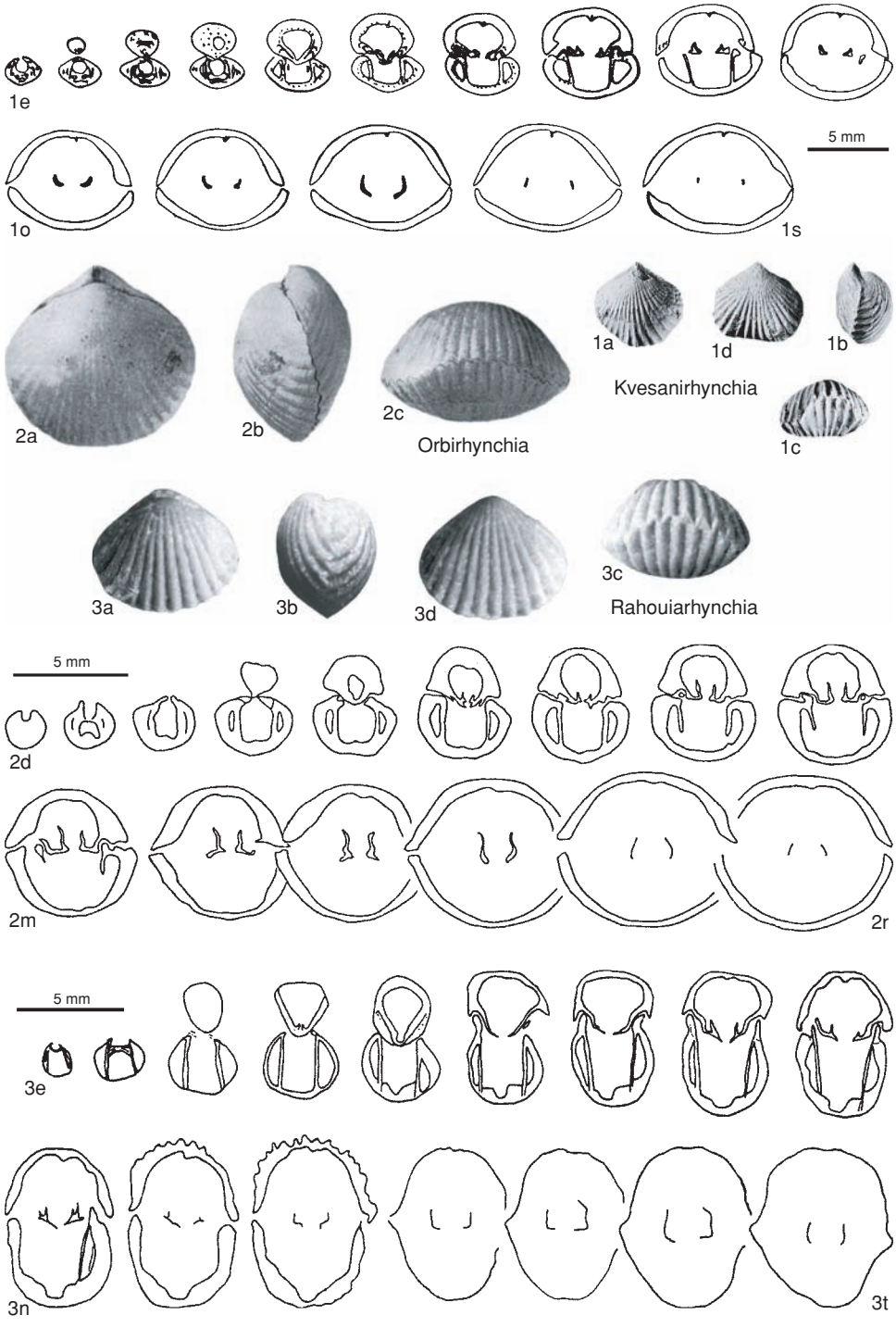

FIG. 822. Basiliolidae (p. 1204–1208).

?Indonesia, western USA (Oregon), *Sinemurian–Toarcian;* Italy, Austria, Yugoslavia, Caucasus, Transcaucasus, *Aalenian–lower Bajocian.*——FIG. 821,*2a–o.* **P. moorei* (DAVIDSON), lower Toarcian, England; *a–c,* lectotype, dorsal, lateral, anterior views, Somerset, BMNH B.12230, ×2; *d–o,* transverse serial sections, distances in mm from ventral umbo, 0.9, 1.1, 1.3, 1.5, 1.7, 1.9, 2.1, 2.3, 2.5, 2.7, 3.0, 3.2, Dorset, MKH D.134 (Ager, 1962).

Rahouiarhynchia TCHOUMATCHENKO, 1987, p. 53 [**R. zidarovi;* OD]. Medium to small size, dorsibiconvex; costae numerous (13 to 17), subangular, running from umbo to front commissure; uniplicate sinus wide and low, fold not raised from shell surface. Dorsal median septum and septalium absent; crura subfalciform to hamiform. *Upper Jurassic (upper Oxfordian–lower Kimmeridgian):* Algeria, ?China (Qinghai).——FIG. 822,*3a–t.* **R. zidarovi,* Algeria; *a–d,* holotype, dorsal, lateral, anterior, ventral views, ×1.5; *e–t,* transverse serial sections, distances in mm from ventral umbo, 0.17, 0.44, 0.8, 1.0, 1.17, 1.4, 1.6, 1.82, 1.97, 2.14, 2.3, 2.49, 2.8, 2.97, 3.22, 3.47 (Tchoumatchenko, 1987).

?Riorhynchia IASIUKEVICH, 1974, p. 108, footnote [**R. nechrikovae;* OD]. Rounded-pentagonal, with more or less strong radial ribs in anterior part; short, curved beak; short pedicle collar; small ventral sulcus. Thick dental plates often almost fused to shell walls; outer hinge plates narrow and very thick, sometimes almost vestigial; crura hamiform; all elements of cardinalia massive, thickened. [Serial sections from type species unknown.] *Paleogene (Paleocene, ?Eocene):* Caucasus, Ukraine (Crimea), Turkmenistan, western Kazakhstan, ?Italy.——FIG. 820,*3a–u. R. rionensis* (ANTHULA), Paleocene, Danian, Kopet Dagh, Turkmenistan; *a–c,* dorsal, lateral, anterior views, MG 35/1915, ×1; *d–u,* transverse serial sections, distances in mm from ventral umbo, 0.3, 0.8, 1.1, 1.4, 1.9, 2.1, 2.3, 2.5, 2.9, 3.3, 3.6, 3.9, 4.3, 4.8, 5.6, 6.0, 6.6, 6.9 (Vanchurov & Kalugin, 1966).

Veghirhynchia DAGYS, 1974, p. 84 [**Rhynchonella arpadica* BITTNER, 1890, p. 160; OD] [=*Veghirhynchia* DETRE, 1972, p. 88, *nom. nud.; Veghjirhynchia* XU, 1990, p. 68, *nom. null.; Vegirhynchia* SULSER, 1993, p. 157, *nom. null.*]. Small, subpentagonal, moderately dorsibiconvex, uniplicate; multicostate, similar in general outline to *Orbirhynchia;* ventral sulcus broad, shallow, and trapezoidal linguiform extension meeting a poorly developed dorsal fold; beak short, suberect, beak ridges distinct, deltidial plates conjunct. Dental plates long, subparallel; hinge teeth subquadrate; hinge plates short, distally concave; crura long, subfalciform. *Upper Triassic (Carnian):* southern Alps, Carpathians, ?northwestern Caucasus.——FIG. 820,*1a–l.* **V. arpadica* (BITTNER), Hungary; *a–d,* dorsal, lateral, anterior, ventral views, IGiG 394/199, ×2; *e,* detail of crura, IGiG 394/200, ×7; *f–l,* transverse serial sections, distances in mm from first section, 0.8, 1.0, 1.2, 1.4, 1.6, 1.8, 2.1, IGiG 394/202 (Dagys, 1974).

Subfamily LACUNOSELLINAE Smirnova, 1963

[Lacunosellinae SMIRNOVA, 1963, p. 15] [Includes Dzhangirhynchiinae OVCHARENKO, 1983, p. 70, with its original scope, *partim* Dzhangirhynchiinae OVCHARENKO, *emend.,* SHI & GRANT, 1993, p. 20 (i.e., only the type genus)]

Medium to large Basiliolidae, multicostate to partly smooth, trilobate, with central dorsal fold usually well detached from lateral slopes; costae sharp, simple, commonly bifurcating, occasionally antidichotomous; anterior commissure typically uniplicate, sometimes asymmetrical; spines absent; characterized mainly by absence or very slight development of dorsal median septum and septalium and by presence of falciform crura. *Middle Jurassic (Aalenian)–Lower Cretaceous (Barremian).*

Lacunosella WISNIEWSKA, 1932, p. 30 [**Rhynchonella arolica* OPPEL in OPPEL & WAAGEN, 1866, p. 294; OD] [=*Kolhidaella* MOISEEV, 1939, p. 189 (type, *K. kolhidaensis,* OD); *Kolchidaella* MAKRIDIN in SARYCHEVA, 1960, p. 334, *nom. null.; Lagunosella* KAMYSHAN & KVAKHADZE, 1980, p. 74, *nom. null.*]. Medium to large, equibiconvex to dorsibiconvex, subtriangular to subpentagonal; trilobate, uniplicate, rarely asymmetrical; with few strong costae commonly bifurcating; dorsal fold little raised; beak small, conjunct deltidial plates. Hinge teeth strong, dental plates reduced; hinge plates long, almost horizontal; crura falciform; dorsal septum and septalium absent. *Middle Jurassic (Bathonian)–Lower Cretaceous (Barremian):* Europe, Africa, Asia, ?Mexico, ?Argentina.

L. (Lacunosella). Costae simple, subangular, starting near umbo and often showing normal dichotomous branching. *Upper Jurassic (Oxfordian)–Lower Cretaceous (Barremian):* France, Greenland, Switzerland, Germany, Carpathians, Poland, Bulgaria, Crimea, Caucasus, Turkmenistan, Tunisia, southwestern China, ?India, ?Mexico, ?Argentina.——FIG. 823,*2a–o.* **L. (L.) arolica* (OPPEL), Upper Jurassic, France; *a–c,* dorsal, lateral, anterior views, BMNH B.12037, ×1; *d–o,* transverse serial sections, distances in mm from ventral umbo, 1.0, 1.8, 2.0, 2.3, 2.7, 3.1, 3.6, 4.3, 4.7, 5.2, 5.6, 6.3, ×2 (Childs, 1969).——FIG. 823,*2p–z. L. (L.) kolhidaensis* (MOISEEV), Barremian, Caucasus, Georgia; *p–s,* holotype, dorsal, lateral, anterior, ventral views, approximately ×1 (Moiseev, 1939); *t–z,* transverse serial sections, distances in mm from ventral umbo, 1.7, 4.2, 5.25, 5.65, 6.0, 7.1, 8.0, LGE 3/181 (new; courtesy of S. V. Lobacheva).

L. (Dichotomosella) TCHOUMATCHENKO, 1987, p. 51 [**L. (D.) bourheddouensis;* OD]. Ornament of antidichotomous costae fused into few, short, coarse, marginal plicae anteriorly. *Middle Jurassic*

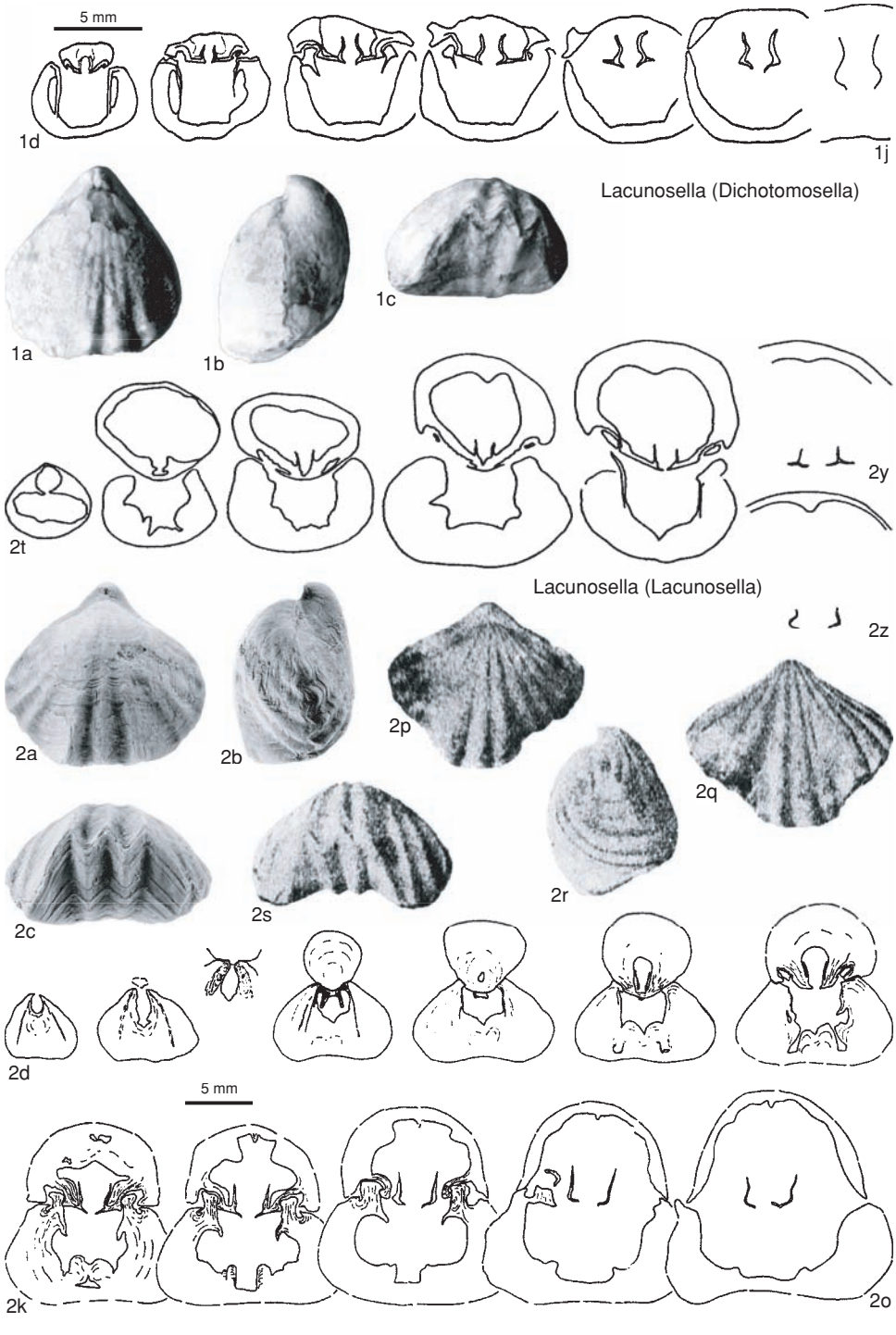

FIG. 823. Basiliolidae (p. 1208–1210).

(Bathonian)–Upper Jurassic (Kimmeridgian): Algeria, Hungary.——FIG. 823,*1a–j. *L. (D.) bourheddouensis,* upper Kimmeridgian, north of Tiaret, Algeria; *a–c,* holotype, dorsal, lateral, anterior views, ×1.5; *d–j,* transverse serial sections, distances in mm from first section, 1.6, 1.98, 2.35, 2.75, 2.95, 3.18, 3.43 (Tchoumatchenko, 1987).

Stolmorhynchia BUCKMAN, 1918, p. 46 [**S. stolidota;* OD] [=*Stolmorhynchia* BUCKMAN, 1914, p. 1, and 1915, p. 76, both suppressed (ICZN, 1971, Opinion 957); *Dzhangirhynchia* OVCHARENKO, 1983, p. 71 (type, *D. dzhangiensis,* OD)]. Small to medium, subtrigonal to subpentagonal, uniplicate; dorsal fold usually well developed, sometimes asymmetrical; few (12 to 16) strong, fairly angular costae; posterior smooth area absent; beak small, strong, suberect. Dental plates strong, subparallel; dorsal median septum absent or barely detectable; no septalium; muscle scars impressed; crura falciform. *Middle Jurassic (Aalenian–Callovian):* Europe, northern Africa, Asia.

S. (Stolmorhynchia). Dorsibiconvex, globose posteriorly; anterior commissure often asymmetrical; costae typically simple. Hinge plates strong and slightly convergent ventrally. *Middle Jurassic (Aalenian–Bathonian):* England, France, Spain, Italy, Austria, Hungary, Ukraine, Caucasus, Morocco, southeastern Pamirs, ?India.——FIG. 824,*2a–r. *S. stolidota,* upper Bajocian, Dorset, England; *a–c,* topotype, dorsal, lateral, anterior views, BMNH B.70762, ×1 (new); *d–r,* topotype, transverse serial sections, distances in mm from ventral umbo, 0.5, 1.6, 2.0, 2.2, 2.4, 2.8, 3.2, 3.4, 3.9, 4.3, 4.6, 4.9, 5.3, 5.6, 5.8, BMNH B. 71933 (Prosser, 1993).

S. (Praelacunosella) WISNIEWSKA-ZELICHOWSKA, 1978, p. 109[148] [**P. substephani;* OD] [=*Praelacunesella* WISNIEWSKA-ZELICHOWSKA, 1978, p. 65, alternative original spelling]. Subequibiconvex, tapering, and somewhat depressed posteriorly, may be highest at front; uniplication gentle, arcuate but indistinct dorsal fold, tendency to asymmetry slight; only densely ribbed shells may show dichotomy. Hinge plates subhorizontal, dental plates relatively thinner. *Middle Jurassic (upper Bajocian–Callovian):* Poland, Carpatho-Balkanids, Crimea, southeastern Pamirs, ?southwestern China.——FIG. 824,*1a–v. *S. (P.) substephani,* lower Callovian, Czestochowa area, Poland; *a–e,* paratype, dorsal, lateral, anterior, ventral, posterior views, Muz IG 1352.II.144, ×1; *f,* detail of apical region, Muz IG 1352.II.140, ×3; *g–v,* transverse serial sections, distances in mm from first section, 0.0, 0.5, 0.7, 1.3, 1.7, 2.0, 2.2, 2.5, 2.6, 2.9, 3.1, 3.6, 4.3, 4.4, 5.0, 5.3, Muz IG 1352.II.147 (Wisniewska-Zelichowska, 1978).——FIG. 824,*1w–ll. S. (?P.) dzhangiensis* (OVCHARENKO), upper Bajocian, southeastern Pamirs; *w–y,* dorsal, lateral, anterior views, MUGT 137/1266, ×1; *z–gg,* transverse serial sections, distances in mm, 0.6, 1.55, 2.25, 2.7, 3.15, 3.6, 3.8, 4.1; *hh–ll,* transverse serial sections, distances in mm, 1.55, 1.85, 2.05, 2.7, 3.15, MUGT 138/1266 (Ovcharenko, 1983).

Subfamily AETHEIINAE Cooper, 1959

[Aetheiinae COOPER, 1959, p. 15]

Smooth Basiliolidae, without spines; foramen minute, deltidial plates concave. Dental plates reduced to obsolete, inner hinge plates thick. *Paleogene (?lower Eocene, middle Eocene)–Neogene (lower Miocene).*

Aetheia THOMSON, 1915, p. 389 [**Waldheimia(?) sinuata* HUTTON, 1873, p. 36; OD; =*?Terebratula gualteri* MORRIS in MANTELL, 1850, p. 329] [=*Thomsonica* COSSMANN, 1920, p. 137, obj.]. Medium, elongate oval to triangular, dorsibiconvex, smooth; broadly uniplicate, but inconspicuous dorsal fold; beak small, erect, submesothyrid, with concave, conjunct deltidial plates. Hinge teeth thick, buttressed directly against shell wall; dental plates absent; dorsal median septum short, stout; swollen inner hinge plates filling intercrural space; cardinal process small; subfalciform crura, crescentic in section. *Paleogene (?lower Eocene, middle Eocene)–Neogene (lower Miocene):* New Zealand.——FIG. 825,*2a–e. *A. gualteri* (MORRIS), upper Oligocene, Duntroonian, Otago; *a–c,* dorsal, lateral, anterior views, USNM 89828a, ×1; *d,* ventral interior, USNM 369298a, ×2; *e,* dorsal interior, detail of cardinalia, USNM 89828b, ×4 (Cooper, 1959).

Subfamily APHELESIINAE Cooper, 1959

[Aphelesiinae COOPER, 1959, p. 15]

Smooth or marginally costate Basiliolidae, without spines. Crura attached directly to side of socket ridge; dorsal valve with thick median ridge (myophragm). *Paleogene (Eocene)–Neogene (Pliocene).*

Aphelesia COOPER, 1959, p. 41 [**Anomia bipartita* BROCCHI, 1814, p. 469; OD]. Subtrigonal to subpentagonal, uniplicate, smooth with faint or incipient costae developing anteriorly; beak elongated, hypothyrid, foramen small, auriculate. Dental plates slightly convergent, teeth subquadrate; hinge plates short, distally concave; dorsal septum absent, septalial plates not developed; crura broad with acutely concave dorsal surfaces. *Paleogene (Eocene)–Neogene (Pliocene):* Italy (northern Apennines to Sicily), Malta, Hungary, Spain, ?Germany.——FIG. 826,*3a–e. *A. bipartita* (BROCCHI); *a–c,* dorsal, lateral, anterior views, Pliocene, Sicily, USNM 549349a, ×1; *d,* oblique view of crura, USNM 549380, ×3; *e,* detail of ventral umbo showing teeth and auriculate foramen, Pliocene,

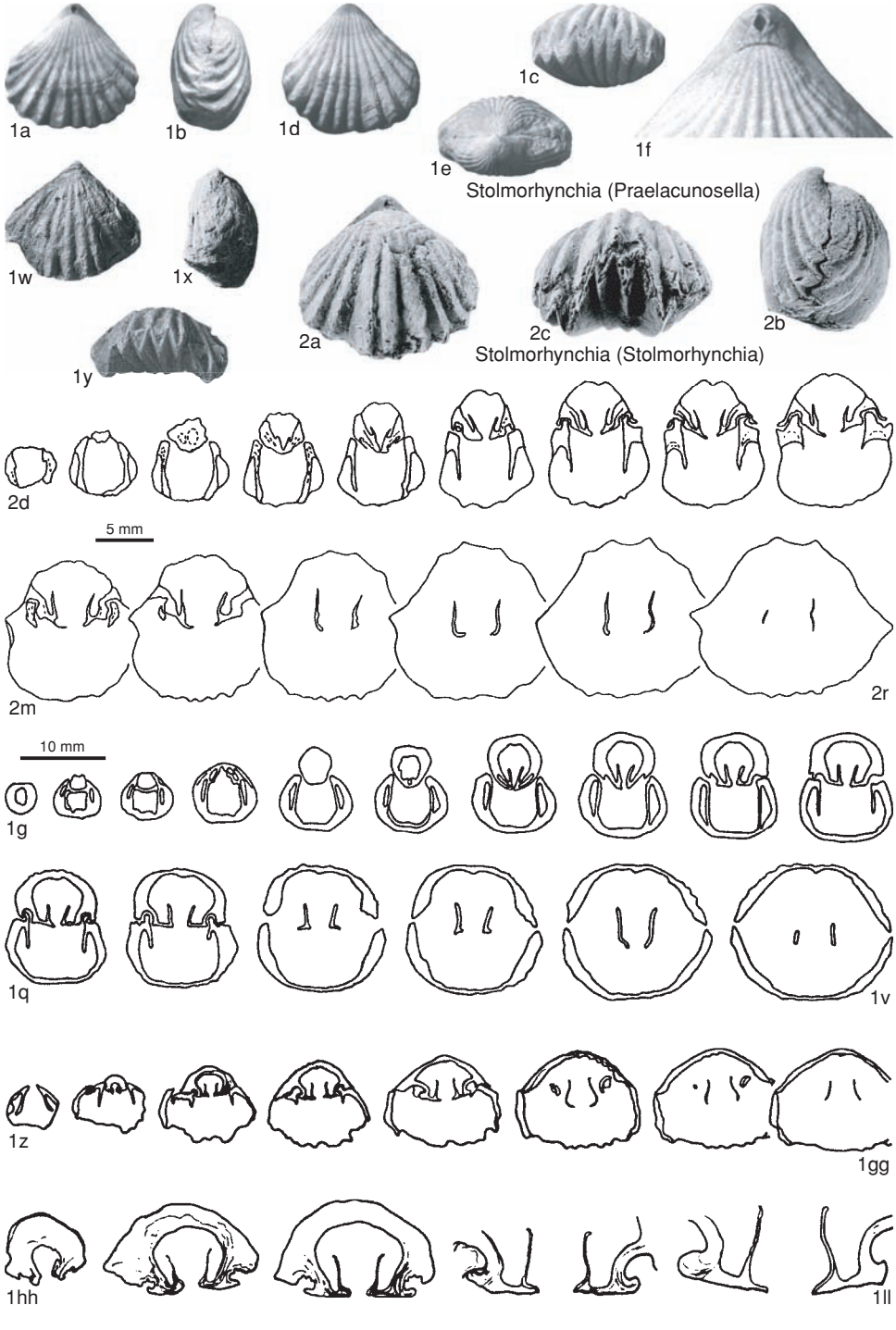

FIG. 824. Basiliolidae (p. 1210).

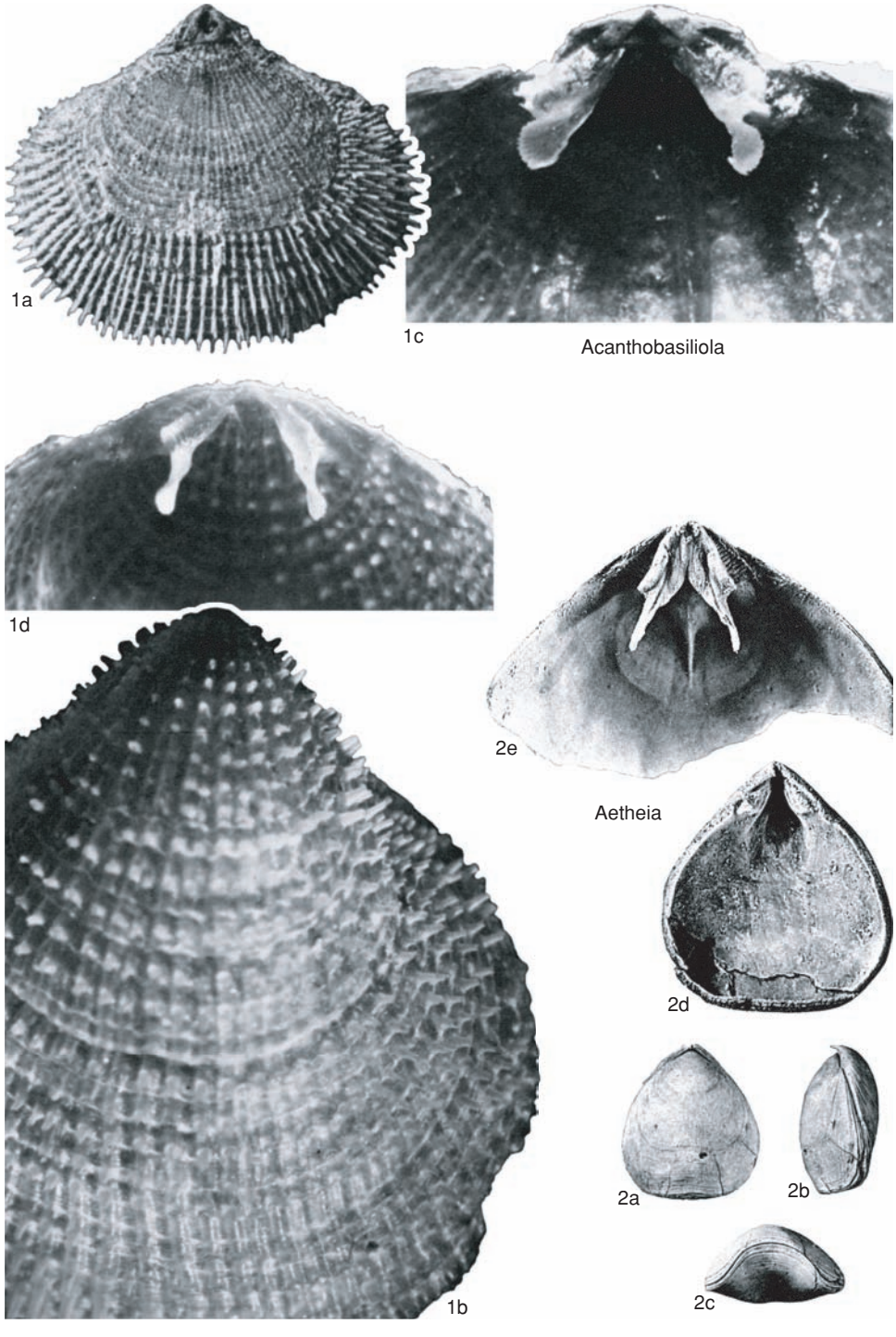

FIG. 825. Basiliolidae (p. 1210–1214).

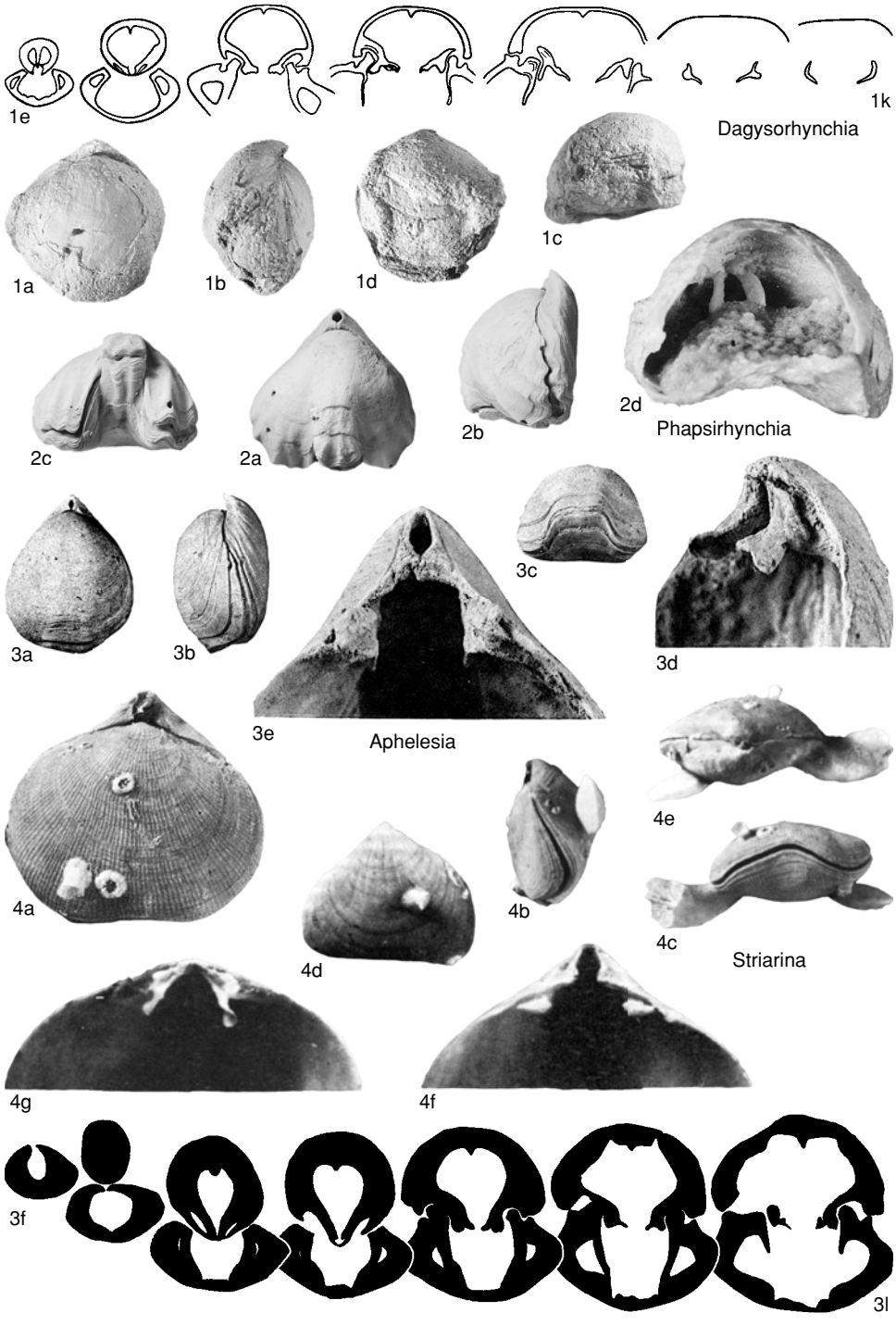

FIG. 826. Basiliolidae (p. 1210–1214).

Sicily, USNM 549349b, ×4; *f–l,* transverse serial sections, distances in mm from ventral umbo, 1.0, 2.0, 2.6, 2.8, 3.2, 3.6, 4.0, Miocene, Tuscany, BMNH unnumbered, ×2 (Cooper, 1959).

Phapsirhynchia PÁJAUD, 1976, p. 102 [**P. sanctapaulensis;* OD]. Medium to large, globose, almost planoconvex with acutely concave ventral valve developed anteriorly; few strong marginal costae; foramen relatively small, subapical. Large, dorsally concave subfalciform crura deflected ventrally. [Regarded as a junior subjective synonym of *Aphelesia* by LLOMPART & CALZADA, 1983, and GAETANI & SACCÀ, 1985.] *Neogene (Pliocene):* southern Spain.——FIG. 826,*2a–d. *P. sanctapaulensis,* Alicante; *a–c,* dorsal, lateral, anterior views, ×1; *d,* anterior view showing crura, ×1.5 (Pájaud, 1976).

Subfamily ACANTHOBASILIOLINAE Zezina, 1981

[Acanthobasiliolinae ZEZINA, 1981, p. 11]

Basiliolidae with outer surface of shell covered by spines; densely costate. Crura attached to narrow outer hinge plates; dorsal valve with thick median ridge. *Neogene (Miocene)–Holocene.*

Acanthobasiliola ZEZINA, 1981, p. 11 [**Rhynchonella doederleini* DAVIDSON, 1886a, p. 1; OD]. Medium, transversely oval, inflated, uniplicate. Resembles *Basiliola* in outline but differs in having shell surface covered with short spines; beak small, erect with complete foramen, strong pedicle collar; dental plates weak or not well developed. Hinge plates narrow; dorsal valve with thin median ridge or weak septum; crura short, with additional festoons at distal ends. [Differs from *Tegulorhynchia* CHAPMAN & CRESPIN, 1923, p. 175, in general morphology, type of crura, and spinose shell ornament.] *Neogene (Miocene)–Holocene:* Borneo to Japan, bathyal.——FIG. 825,*1a–d. *A. doederleini* (DAVIDSON), Holocene; *a,* dorsal view, BMNH ZB3999, Banda Sea, ×3 (Brunton & Alvarez, 1989); *b,* detail of spinose ornament, Java Sea, ×5; *c,* dorsal interior showing crura and weak septal ridge, Java Sea, ×5; *d,* cardinalia of juvenile, Java Sea, ×6 (Zezina, 1981).

Subfamily UNCERTAIN

?Dagysorhynchia SMIRNOVA, 1994, p. 34 [**D. compacta;* OD]. Medium, equibiconvex, roundedpentagonal, almost as wide as long; umbo broad, massive; shell smooth or with fine, indistinct costellation. Pedicle collar sometimes developed; dental plates ventrally divergent; hinge plates narrow, dorsal surfaces concave, acutely dorsally inclined with well-developed inner and outer socket ridges; crura hamiform; dorsal median septum apically confined. *Lower Cretaceous (Hauterivian–Barremian):* Russia (northwestern Kamchatka).——FIG. 826,*1a–k. *D. compacta; a–d,* holotype, dorsal, lateral, anterior, ventral views, MGU 138/515, ×1; *e–k,* transverse serial sections, distances in mm from first section, 1.6, 2.5, 3.0, 3.2, 3.7, 4.5, 5.3, MGU 138/517 (Smirnova, 1994).

?Striarina COOPER, 1973, p. 7 [**Rhynchonella valdiviae* HELMCKE, 1940, p. 290; OD]. Small, transversely triangular to subpentagonal, dorsibiconvex; broadly, irregularly uniplicate, finely costellate; beak small, nearly straight, with fairly large hypothyrid foramen and disjunct deltidial plates. Pedicle collar short; teeth strong, triangular, with flaring dental plates; sockets broad, deep, corrugated; outer hinge plates narrow, concave, inner hinge plates absent; crura short, subfalciform with rounded extremities; slender dorsal median ridge. [Living species is bathyal.] *Holocene:* southern Indian Ocean.——FIG. 826,*4a–g. *S. valdiviae* (HELMCKE), St. Paul Island; *a,* dorsal view, ×3; *b–e,* lateral, anterior, ventral, posterior views, ×2; *f,* detail of ventral umbo, ×4; *g,* hypotype, detail of cardinalia, dorsal interior, USNM 549729a–b, ×4 (Cooper, 1973).

Family ERYMNARIIDAE Cooper, 1959

[Erymnariidae COOPER, 1959, p. 17]

[Materials prepared by MIGUEL O. MANCEÑIDO & ELLIS F. OWEN]

Pugnacoidea with septiform crura or variation thereof (sometimes with lyre-shaped cross section distally), variously folded, smooth to partially or fully costate. Trend to reduction or loss of dental plates, dorsal median septum, and septalium; squama and glotta absent, cardinal process exceptionally present. *Upper Triassic (Carnian)–Paleogene (Eocene).*

Subfamily ERYMNARIINAE Cooper, 1959

[*nom. transl.* AGER, CHILDS, & PEARSON, 1972, p. 217, *ex* Erymnariidae COOPER, 1959, p. 17]

Erymnariidae with full septiform crura; uniplicate or asymmetrical; smooth to irregularly costate around margins, occasionally finely and densely costate. Dental plates weak; median septum, septalium, and cardinal process absent. *Upper Cretaceous (Cenomanian)–Paleogene (Eocene).*

Erymnaria COOPER, 1959, p. 64 [**Terebratula polymorpha* MASSALONGO, 1850, p. 18; OD]. Subtrigonal to subpentagonal, dorsibiconvex; uniplication broadly arcuate, commissure sometimes asymmetrical; smooth or irregularly costate anteriorly; beak short, foramen hypothyrid, deltidial plates conjunct, planareas absent. Crural plates ventrally convergent, somewhat sigmoidal, or lyrate anteriorly.

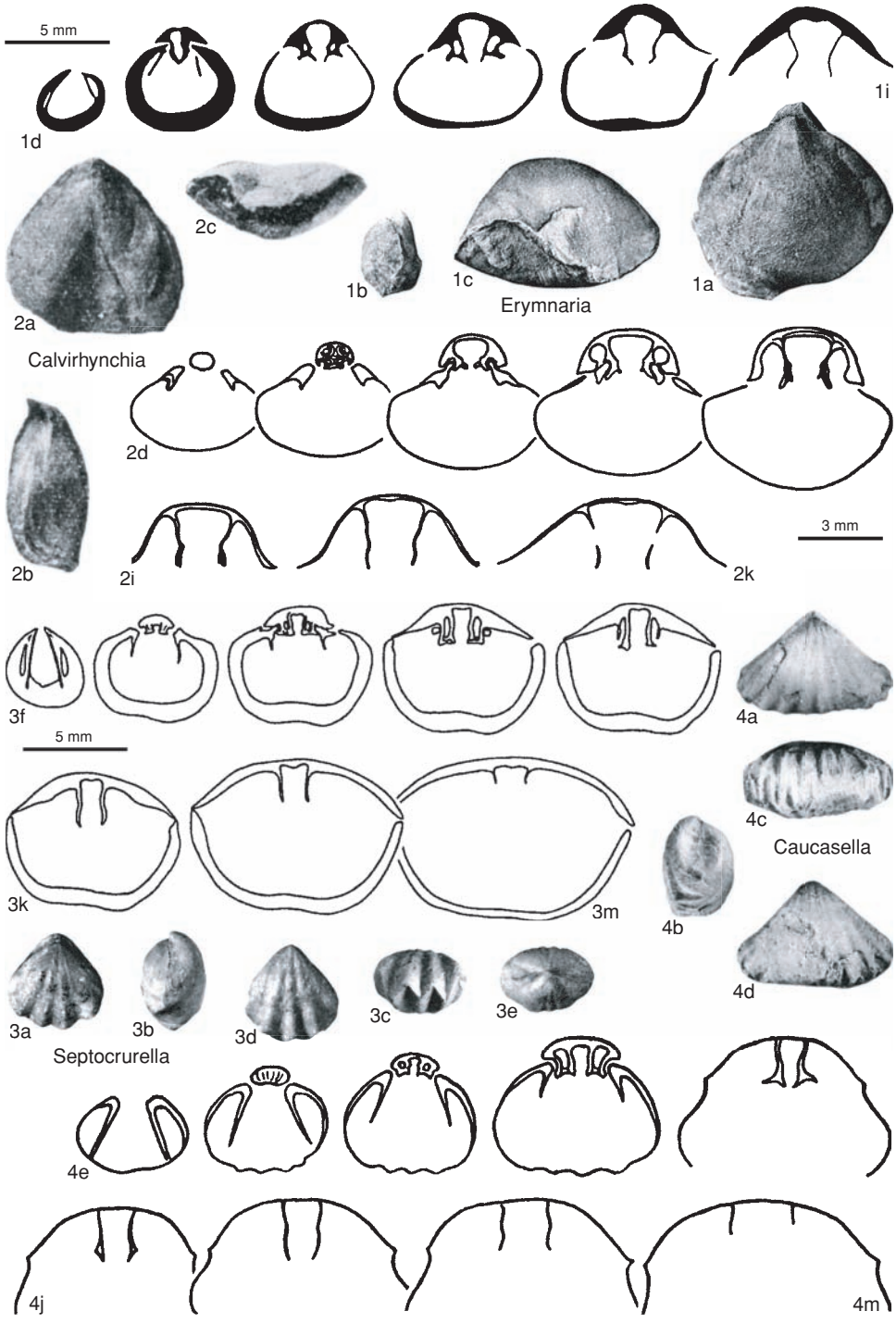

FIG. 827. Erymnariidae (p. 1214–1218).

Upper Cretaceous (Cenomanian)–Paleogene (Eocene): Caucasus, Ukraine, Austria, Italy, Turkmenistan, Kazakhstan, *Cenomanian–Danian;* Mediterranean, Hungary, Cuba, western Kazakhstan, *Eocene.*——FIG. 827,*1a–i.* **E. polymorpha* (MASSALONGO), Eocene, Verona, Italy; *a,* dorsal view, USNM 75888a, ×2; *b,* lateral view, USNM 549384a, ×1; *c,* anterior view, USNM 75888a, ×2; *d–i,* transverse serial sections, distances in mm from ventral umbo, 1.0, 1.7, 1.95, 2.25, 2.6, 4.0, USNM 549384e (Cooper, 1959).

Subfamily CRYPTORHYNCHIINAE Shi & Grant, 1990

[Cryptorhynchiinae SHI & GRANT in SHI, 1990, p. 313]

Erymnariidae bearing septiform crura, with lateral septa totally or partially fused to socket fulcral plates; fully and sharply multicostate to densely costellate, no smooth areas; uniplication variable, scarcely to well developed. Septalium rudimentary, confined to early stages, dorsal median septum variably developed; subparallel dental plates; crural plates ventrally convergent and typically detached from dorsal floor distally. *Upper Triassic (Carnian)–Middle Jurassic (Callovian), Upper Jurassic (?Kimmeridgian).*

Cryptorhynchia BUCKMAN, 1918, p. 66 [**Rhynchonella pulcherrima* KITCHIN, 1897, p. 33; OD] [=*Cryptorhynchia* BUCKMAN, 1914, p. 2, and 1915, p. 77, both suppressed (ICZN, 1971, Opinion 957)]. Small, dorsibiconvex, uniplicate, transversely oval; dorsal fold moderate; reticulate ornament, with costae sharp and growth lamellae foliaceous; beak sharp, suberect. Teeth and sockets projecting well into dorsal valve, fulcral plates fused to lateral septa; septalium absent. *Middle Jurassic (Aalenian–Callovian), ?Upper Jurassic (?Kimmeridgian):* Alps, Pamirs, India, ?China, ?North America.——FIG. 828,*1a–o.* **C. pulcherrima* (KITCHIN), Callovian, Kutch, India; *a–c,* topotype, dorsal, lateral, anterior, USNM 76009a, ×1.8; *d,* topotype, dorsal, USNM 429605, ×2; *e–o,* topotype, transverse serial sections, distances in mm from ventral umbo, 0.3, 0.5, 0.6, 0.9, 1.2, 1.5, 1.9, 2.2, 2.4, 2.5, 2.8, USNM 76009b (Shi & Grant, 1993).

Aethirhynchia SHI, 1990, p. 314 [**A. lenticulata;* OD]. Medium size, elongate-oval to cuneiform, gently equibiconvex; nearly rectimarginate, fully covered with numerous fine costellae; beak slightly incurved. Dorsal median septum stout, septalial plates pendant, lateral septa short, incompletely fused with fulcral plates. *Middle Jurassic (middle Callovian–upper Callovian):* China (Qinghai).——FIG. 828,*3a–v.* **A. lenticulata,* Geladangdong, southern Qinghai; *a,* dorsal view, MCMB G14751, ×1 (Shi, 1992); *b–i,* holotype, transverse serial sections, distances in mm from ventral umbo, 2.6, 3.0, 4.6, 5.3, 5.7, 6.0, 6.3, 7.0, MCMB Y14750 (Shi, 1990).

Crurirhynchia DAGYS, 1961, p. 96 [**C. kiparisovae;* OD]. Small to medium size, rounded-subpentagonal, gently dorsibiconvex; weakly uniplicate, sharply multicostate throughout; beak low, suberect, with hypothyrid foramen and conjunct deltidial plates. Pedicle collar fused to dental plates; dorsal median septum low; septalium rudimentary or absent; crura long, arising from oblique septa, more or less fused with socket fulcral plates. *Upper Triassic (Norian–Rhaetian):* Balkans, Crimea, northwestern Caucasus, Pamirs, China.——FIG. 828,*2a–v.* **C. kiparisovae,* Norian, northwestern Caucasus; *a–d,* holotype, dorsal, lateral, anterior, ventral views, IGiG 91/600, ×1; *e–v,* transverse serial sections, distances in mm from first section, 0.1, 0.3, 0.4, 0.6, 0.8, 0.9, 1.1, 1.2, 1.3, 1.4, 1.5, 1.7, 1.8, 2.0, 2.2, 2.4, 2.5, 2.9, IGiG 394/203 (Dagys, 1974).

Dierisma CHING, SUN, & YE in CHING & others, 1979, p. 133 [**D. furcatum;* OD]. Medium size, transverse-oval; depressed lenticular, almost equibiconvex; dorsal fold gentle and flattopped, ventral sulcus wide and shallow; slight, low arch, uniplication, costae narrow, subangular, and sometimes bifurcated anteriorly. Dental plates short; crural plates issued vertically from inner edge of outer hinge plates to floor of dorsal valve and extending to one-third dorsal valve length. [May be a subgenus of *Crurirhynchia* or a synonym.] *Upper Triassic (Carnian–Norian):* China (Qinghai, Tibet).——FIG. 828,*4a–k.* **D. furcatum,* Upper Triassic, Qinghai; *a–d,* holotype, dorsal, lateral, anterior, ventral views, NIGP 42813, ×1; *e–k,* holotype, transverse serial sections, distances in mm from ventral umbo, 0.4, 0.65, 1.0, 1.6, 2.0, 2.2, 3.8, NIGP 42813 (Ching & others, 1979).

Subfamily SEPTOCRURELLINAE Ager, Childs, & Pearson, 1972

[Septocrurellinae AGER, CHILDS, & PEARSON, 1972, p. 217]

Erymnariidae with full septiform crura; broadly unisulcate to rectimarginate and fairly sharply paucicostate (mostly anteriorly). Dental plates weak, ventrally divergent; median septum ridgelike to absent; crural plates vertical; cardinal process absent. *Lower Jurassic (?Sinemurian, Pliensbachian)–Upper Jurassic (Kimmeridgian, ?Tithonian).*

Septocrurella WISNIEWSKA, 1932, p. 63 [**Rhynchonella Sanctae Clarae* ROEMER, 1870, p. 247; OD]. Small, ventribiconvex, dorsally sulcate, with few rounded

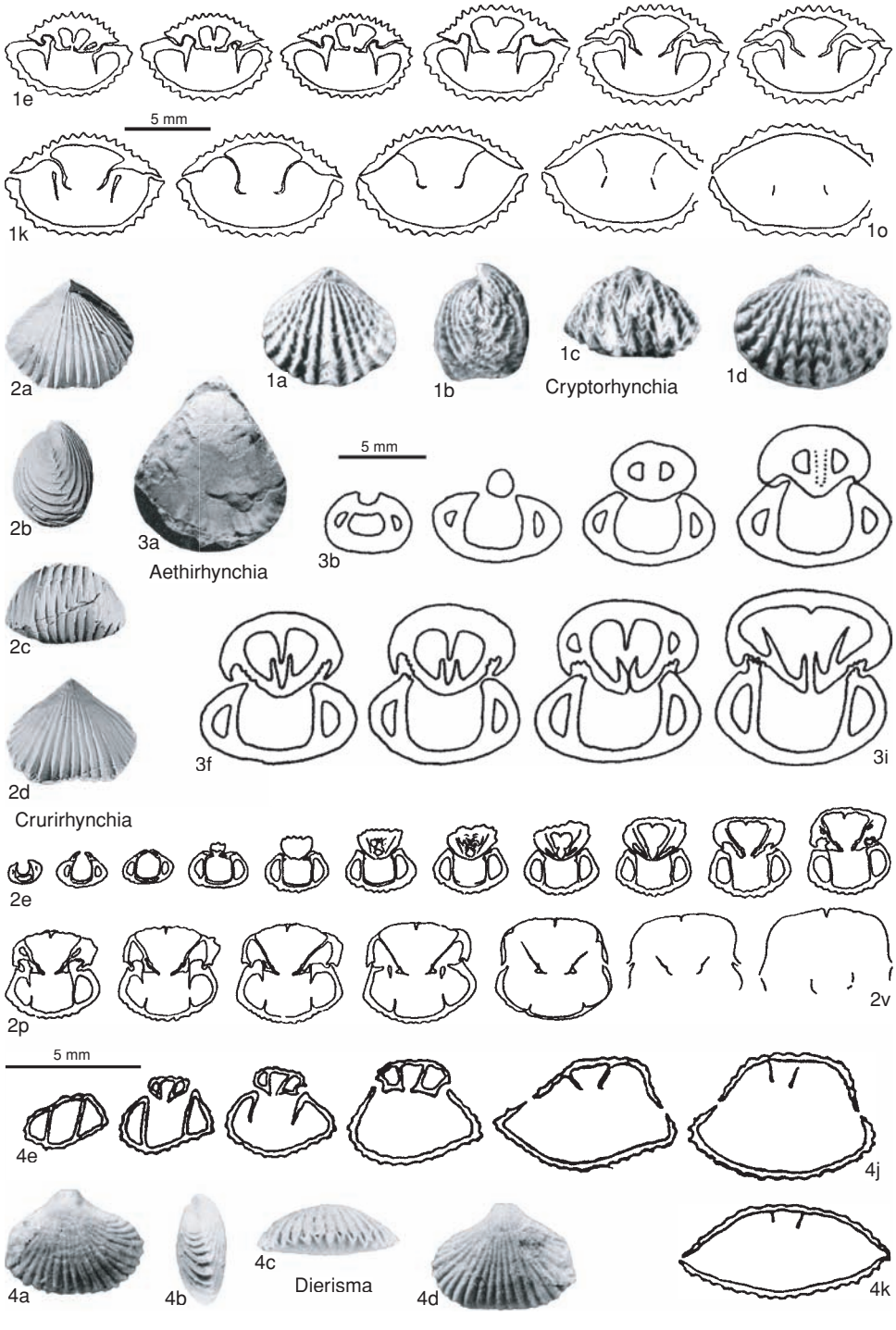

FIG. 828. Erymnariidae (p. 1216).

costae; beak small, upright, without planareas, foramen hypo- to submesothyrid. Crura short, supported by subparallel crural plates extending to one-third dorsal valve length; dorsal septum absent to vestigial. *Lower Jurassic (?Sinemurian, Pliensbachian)–Upper Jurassic (Kimmeridgian, ?Tithonian):* southern and eastern Europe.——Fig. 827,*3a–m.* **S. sanctaeclarae* (Roemer); *a–e,* dorsal, lateral, anterior, ventral, posterior views, Oxfordian, Jasna Góra, Poland, ×1 (Wisniewska, 1932); *f–m,* transverse serial sections, distances in mm from ventral umbo, 1.4, 2.4, 2.8, 3.3, 3.4, 3.6, 4.5, 5.2, Aiglun, France (Laurin, 1979).

Caucasella Moiseev, 1934, p. 83[187] *non* Hacobjan in Akopyan & others, 1969, Gastropoda, *nec* Longoria, 1974, Foraminiferida [**Rhynchonella trigonella* Rothpletz, 1886, p. 154; OD]. Small, trigonal to securiform, depressed equibiconvex, wide and flat anteriorly; sharply costate, with evenly serrate commissure but no fold or sulcus; beak small, gently incurved, with planareas. Short dental plates, no dorsal median septum, crural plates closely subparallel. *Middle Jurassic (upper Bajocian–Callovian), Upper Jurassic (?Kimmeridgian):* France, Switzerland, Germany, Austria, Italy, Slovakia, Romania, Bulgaria, Ukraine, Yugoslavia, Tisia River (Hungary), Caucasus, Crimea.——Fig. 827,*4a–m.* **C. trigonella* (Rothpletz), Callovian, Greben, Yugoslavia; *a–d,* dorsal, lateral, anterior, ventral views, 4/45, ×1 (Radulovic & Rabrenovic, 1993); *e–m,* transverse serial sections, distances in mm from ventral umbo, 0.5, 1.1, 1.3, 1.8, 2.0, 2.1, 2.6, 4.3, 4.9, Theodosia, Crimea, KHGU 3298/8 (Kamyshan & Babanova, 1973).

Subfamily CALVIRHYNCHIINAE Kamyshan, 1967

[*nom. transl.* Manceñido & Owen, herein, *ex* Calvirhynchiidae Kamyshan, 1967a, p. 56]

Erymnariidae with septiform crura, broadly unisulcate and smooth or only faintly undulate anteriorly. Dental plates reduced, ventrally divergent or concave; median septum ridgelike to absent; crural plates variably fused to socket fulcral plates, remaining joined to dorsal floor; sometimes with cardinal process (or possible callus-infilled septalium); outer hinge plates absent. *Lower Jurassic (?Sinemurian, ?Pliensbachian), Middle Jurassic (Aalenian–Callovian).*

Calvirhynchia Kamyshan, 1967a, p. 56 [**C. kubanensis;* OD]. Small to medium size, smooth, rounded subtrigonal, ventribiconvex; well-defined median dorsal sulcus and ventral fold; beak small, suberect, planareas absent. Pedicle collar absent. *Lower Jurassic (?Sinemurian, ?Pliensbachian), Middle Jurassic (Aalenian–Callovian):* southern Europe, Caucasus, central Asia.——Fig. 827,*2a–k.* **C. kubanensis,* upper Bajocian, Kuban River, Caucasus; *a–c,* holotype, dorsal, lateral, anterior views, KHGU 6/2135, ×1.5; *d–k,* transverse serial sections, distances in mm from ventral umbo, 1.1, 1.3, 1.7, 2.1, 2.3, 2.8, 3.3, 4.0, KHGU 6/2140 (Kamyshan, 1967a).

STENOSCISMATOIDEA

S. J. Carlson and R. E. Grant

[University of California, Davis; and deceased]

Superfamily STENOSCISMATOIDEA Oehlert, 1887 (1883)

[*nom. correct.* Carlson, herein, *pro* Stenoscismatacea Muir-Wood, 1955, p. 69, *nom. correct. pro* Stenoscismacea Shrock & Twenhofel, 1953, p. 317, *nom. transl. et correct. ex* Stenoschismatinae Oehlert, 1887a, p. 1304] [=Camerophoriacea Waagen, 1883, p. 435, *nom. transl.* Grabau, 1936, p. 70, *ex* Camerophoriinae Waagen, 1883, p. 435]

Small to medium sized, rarely large; outline commonly subpentagonal, may be triangular, oval, or round; valves moderately to strongly dorsibiconvex; strong uniplication with flat, rarely rounded, fold and sulcus, rarely unisulcate; stolidium present uncommonly in well-preserved individuals of a few species; slit-shaped to oval foramen present; ventral spondylium present, commonly elevated on low duplex septum, less commonly sessile; dorsal camarophorium present, commonly robust, strongly curved, on high median septum; hinge plates undivided, rarely divided in some forms lacking intercamarophorial plate; cardinal process absent, weak, or robust; intercamarophorial plate may be present or absent; crura raduliform. [Regarding the two dates of publication listed for Oehlert, Grant (1965a) states [comments in square brackets by SJC]: