

Opinion 957]). Medium to large size, equibiconvex to dorsibiconvex; transversely oval; very slightly uniplicate, but no proper fold; thin test, very densely and finely costellate, often dichotomously, delicately spinose throughout; beak strong, sharp, suberect to incurved; disjunct deltidial plates. Dorsal median septum feeble, apically confined; crura calcariform or raduliform; cardinal process or small septalium sometimes present; dental plates weak, wide apart. *Middle Jurassic (upper Bajocian)–Lower Cretaceous (Berriasian)*: western and eastern Europe, Africa, India.—FIG. 888,3a–u. \**A. panacanthina* (BUCKMAN & WALKER), upper Bajocian, Dorset, England; a–e, lectotype, dorsal, lateral, anterior, ventral, posterior views, BMNH B.12082,  $\times 1$  (new); f–u, topotype, transverse serial sections, distances in mm from ventral umbo, 0.4, 1.0, 1.2, 1.4, 1.7, 1.9, 2.3, 2.6, 2.9, 3.2, 3.4, 3.6, 4.0, 4.3, 4.6, 5.0 (Childs, 1969).

?*Acanthomyopsis* KAMYSHAN, 1967b, p. 7 [\**Rhynchonella crossi* WALKER, 1869, p. 215; OD; virtual monotypy] [= *Acanthomyopsis* KAMYSHAN in KAMYSHAN & BABANOVA, 1973, p. 64, obj.]. Small, equibiconvex to dorsibiconvex; uniplicate, dorsal fold gentle to well marked, bearing 2 to 8 costae; costae simple, effaced posteriorly to smooth stage and bearing few rows of weak, mostly peripheral, spines; beak suberect to incurved; deltidial plates disjunct.

Sessile septalial plates parallel or dorsally divergent, separated from myophragm; hinge plates absent; crura thickly based and sharply bent (allegedly calcariform or spinuliform). *Lower Jurassic (?Pliensbachian)*, *Middle Jurassic (Aalenian–Bajocian)*: England, ?Switzerland, ?France, Caucasus, ?Pliensbachian, Aalenian–Bajocian; ?Argentina, ?Pliensbachian.—FIG. 888,1a–q. \**A. crossi* (WALKER), Bajocian, northwestern Caucasus; a–c, dorsal, lateral, anterior views,  $\times 1.5$ ; d–q, transverse serial sections, distances in mm from ventral umbo, 0.5, 0.7, 0.8, 0.9, 0.95, 1.05, 1.15, 1.35, 1.45, 1.65, 1.75, 1.85, 1.95, 2.05 (Kamyshan & Babanova, 1973).

*Echinirhynchia* CHILDS, 1969, p. 73 [\**Terebratulites senticosus* VON SCHLOTHEIM, 1820 in 1820–1823, p. 268; OD] [= *Spinulirhynchia* SMIRNOVA, 1972, p. 52, *nom. nud.*]. Similar to *Acanthorhynchia*, but smaller, equibiconvex to ventribiconvex; usually subtriangular, rectimarginate or sulcate. Dental plates and septalium absent. *Upper Jurassic (Oxfordian)–Lower Cretaceous (lower Aptian)*: western and eastern Europe, Crimea, Caucasus, Antarctica.—FIG. 888,2a–i. \**E. senticosus* (VON SCHLOTHEIM), Kimmeridgian, Franconia, near Erlangen, Germany; a–d, dorsal, lateral, anterior, posterior views,  $\times 1$ ; e–i, transverse serial sections, distances in mm from ventral umbo, 1.7, 2.0, 2.4, 2.8, 3.1 (Childs, 1969).

## NORELLOIDEA

MIGUEL O. MANCENIDO,<sup>1</sup> ELLIS F. OWEN,<sup>2</sup> A. S. DAGYS,<sup>3</sup> and SUN DONG-LI<sup>4</sup>

[<sup>1</sup>La Plata Natural Sciences Museum, Argentina; <sup>2</sup>formerly of The Natural History Museum; <sup>3</sup>deceased; and <sup>4</sup>Nanjing Institute of Geology and Palaeontology]

### Superfamily NORELLOIDEA Ager, 1959

[*nom. transl.* MANCENIDO, OWEN, DAGYS, & SUN, herein, ex Norellinae AGER, 1959b, p. 330]

Rhynchonellida with shells smooth to capillate or gently fluted, ovoid to subtriangular, with generally sulcate dorsal valves, minute beak and foramen; squama and glotta absent. Crura arcuiform or a derivation thereof; dorsal median septum variable to absent. *Lower Triassic–Holocene*.

#### Family NORELLIDAE Ager, 1959

[*nom. transl.* AGER, CHILDS, & PEARSON, 1972, p. 175, ex Norellinae AGER, 1959b, p. 330]

Small- to medium-sized Norelloidea, smooth or with plicae blunt, radial, com-

monly with sulcate dorsal valves (at least in juvenile, often also in adult stage), and often with ventral valves subcarinate. Dorsal median septum absent or present. *Lower Triassic–Upper Cretaceous (Turonian)*.

#### Subfamily NORELLINAE Ager, 1959

[Norellinae AGER, 1959b, p. 330]

Small, mostly smooth Norellidae with small delthyria; dorsally sulcate to rectimarginate, or dorsal fold broad and flat, if present. Crura arcuiform where known; dorsal septum and septalium absent. *Middle Triassic (Anisian)–Middle Jurassic (Bathonian)*.

*Norella* BITTNER, 1890, p. 315 [\**Rhynchonella refractifrons* BITTNER, 1890, p. 39; SD ICZN, 1962, Opinion 633, p. 148]. Small, smooth, unequally biconvex, with dorsal valve flattened, anterior

- commissure unisulcate; to plicisulcate; beak short, incurved, ridges rounded, foramen hypothyril. Dental plates very short, fused to lateral wall, pedicle collar absent; septum and septalium absent, outer hinge plate narrow, fused with socket ridges; crura short, arcuiform. *Middle Triassic (Anisian)–Upper Triassic (Rhaetian)*: Alps, Carpathians, northwestern Caucasus.—FIG. 889,2a–d. \**N. refractifrons* (BITTNER), Anisian, Alps, Austria; dorsal, lateral, anterior, ventral views,  $\times 1.5$  (Bittner, 1890).
- ?**Austriellula** STRAND, 1928, p. 37, *nom. nov. pro Austriella* BITTNER, 1890, p. 314, *non* TENISON-WOODS, 1883, Mollusca [*\*Rhynchonella dilatata* SUESS, 1855, p. 29; OD] [= *Jacobella* PATTE, 1926, p. 125, *non* JEANNET, 1908, Cephalopoda, *nec* PASSENDORFER, 1930, Cephalopoda, *nec* MERCIER, 1935, Echinodermata; *Austriellina* SCHUCHERT & LEVENE, 1929b, p. 119, obj.]. Small or medium size, subtrigonal, with anterior commissure rectimarginate or incipiently unisulcate, some species uniplicate; beak short, suberect, ridges rounded, foramen hypothyril, deltidial plates disjunct. Internal structures similar to *Norella*. ?*Middle Triassic, Upper Triassic (Carnian–Norian)*, ?*Lower Jurassic*: Alps, Dinarids, Carpathians, northwestern Caucasus, Indonesia, ?Vietnam, ?Himalayas, ?*Middle Triassic, Carnian–Norian*; Greece, ?*Lower Jurassic*.—FIG. 889,5a–j. \**A. dilatata* (SUESS), Norian, northern Alps, Sandling, Austria; a–d, dorsal, lateral, anterior, ventral views, IGI 394/209,  $\times 1.5$  (Dagys, 1974); e–j, transverse serial sections, distances in mm from ventral umbo, 0.3, 0.45, 0.6, 1.0, 1.3, 1.8, MB B233.23 (Siblík, 1982).
- ?**Kericserella** VÖRÖS, 1983, p. 9 [*\*Rhynchonella inversaeformis* SCHLOSSER in BÖSE & SCHLOSSER, 1900, p. 199; OD]. Small, outline subtrigonal to rounded; subequibiconvex; broadly sulcate anteriorly; costae few, strong, rounded after short posterior smooth stage; planareae flat, well demarcated by beak ridges; beak small, erect; lateral commissure straight, running in middle of planareae. Dorsal median septum and septalium absent; hinge plates missing, crural bases supported by elevated inner socket ridges; crura reminiscent of falciform but convex toward each other, possibly modified arcuiform; dental plates subparallel. *Lower Jurassic (Pliensbachian)*: Apennines, southern Alps, Hungary, ?Greece.—FIG. 889,4a–k. \**K. inversaeformis* (SCHLOSSER), lower Pliensbachian, Kericser, Hungary; a–e, dorsal, lateral, anterior, ventral, posterior views, HNHMB M.98.1.  $\times 2$  (new); f–k, transverse serial sections, distances in mm from ventral umbo, 0.4, 0.5, 0.7, 0.9, 1.15, 1.6, HGI J.9187 (Vörös, 1983).
- Pisirhynchia** BUCKMAN, 1918, p. 28 [*\*Rhynchonella pisoides* VON ZITTEL, 1869, p. 129; OD] [= *Pisirhynchia* BUCKMAN, 1914, p. 1, and 1915, p. 76, both suppressed (ICZN, 1971, Opinion 957)]. Small, globose, subequibiconvex; sulcate, ventral fold low, possibly with few rounded plicae after long smooth stage. Umbonal callosities absent. *Lower Jurassic (Sinemurian–Pliensbachian)*: Italy, Austria, Slovakia, Hungary, ?southern Spain, Greece.—FIG. 889,1a–e. \**P. pisoides* (VON ZITTEL), Pliensbachian, Kericser, Hungary; dorsal, lateral, anterior, ventral, posterior views, HNHMB M.98.2,  $\times 2$  (new).
- Rectirhynchia** BUCKMAN, 1918, p. 74 [*\*Rhynchonella lopensis* MOORE, 1855, p. 114; OD]. Minute, subtrigonal smooth, depressed, gently ventribiconvex; sulcate, with strong ventral fold; short, straight hinge line; beak large, hypothyril. *Middle Jurassic (Bajocian–Bathonian)*: England, Italy.—FIG. 889,3a–b. \**R. lopensis* (MOORE), England; dorsal, ventral views,  $\times 4$  (Davidson, 1878).—FIG. 889,3c–h. *R. camporoverensis* FERRARI, Bajocian–Bathonian, Trentino, Italy; transverse serial sections, distances in mm from first section, 0.0, 0.1, 0.45, 0.55, 0.65, 0.75 (Ferrari, 1962).

### Subfamily PARANORELLININAE Xu, 1990

[*nom. transl.* MANCENIDO, OWEN, DAGYS, & SUN, herein, *ex* Paranorellinidae Xu, 1990, p. 76]

Small, shallow sulcate Norellidae with long smooth stage and variable number of round marginal plicae on anterior part. Septalium shallow and dorsal median septum present; hinge plates gently inclined, often remaining welded to the latter anteriorly from sockets; crura resembling spinuliform, approaching ventral valve floor distally. *Lower Triassic (Scythian)–Middle Triassic (Anisian)*.

**Paranorellina** DAGYS, 1974, p. 100 [*\*P. parisi*; OD] [= *Paxanorellina* XU & LIU, 1983, p. 72, *nom. null.*]. Minute, thin, equibiconvex, smooth, with distinct sulcus on anterior half of dorsal valve, corresponding ventral fold low, flat, anterior commissure unisulcate; beak suberect, ridges sharp, foramen hypothyril, deltidial plates disjunct. Dental plates short, diverging, pedicle collar absent; septum long, septalium distinct, crura close to spinuliform, allegedly raduliform. *Lower Triassic (Scythian)*: Russia (Far East, Primorye), China (Jiangsu, Zhejiang, Anhui, Tibet).—FIG. 890,2a–l. \**P. parisi*, Olenekian, Primorye; a–d, holotype, dorsal, lateral, anterior, ventral views, IGI 394/46,  $\times 2$ ; e–l, transverse serial sections, distances in mm from ventral umbo, 0.8, 1.2, 1.4, 1.6, 1.8, 1.9, 2.2, 2.8, IGI 394/50 (Dagys, 1974).

**Costinorella** DAGYS, 1974, p. 101 [*\*C. zbornikova*; OD]. Minute, rounded-triangular, thin, equally biconvex; dorsal sulcus shallow, broad, without corresponding fold; anterior commissure weakly unisulcate, multicostate anteriorly and smooth posteriorly; beak short, suberect, ridges rounded, foramen hypothyril, deltidial plates conjunct. Dental plates long, subparallel, pedicle collar absent; septum high, about one-half valve length, septalium shallow, crura spinuliform. *Middle Triassic (Anisian)*: Russia (Far East).—FIG. 890,1a–k. \**C.*

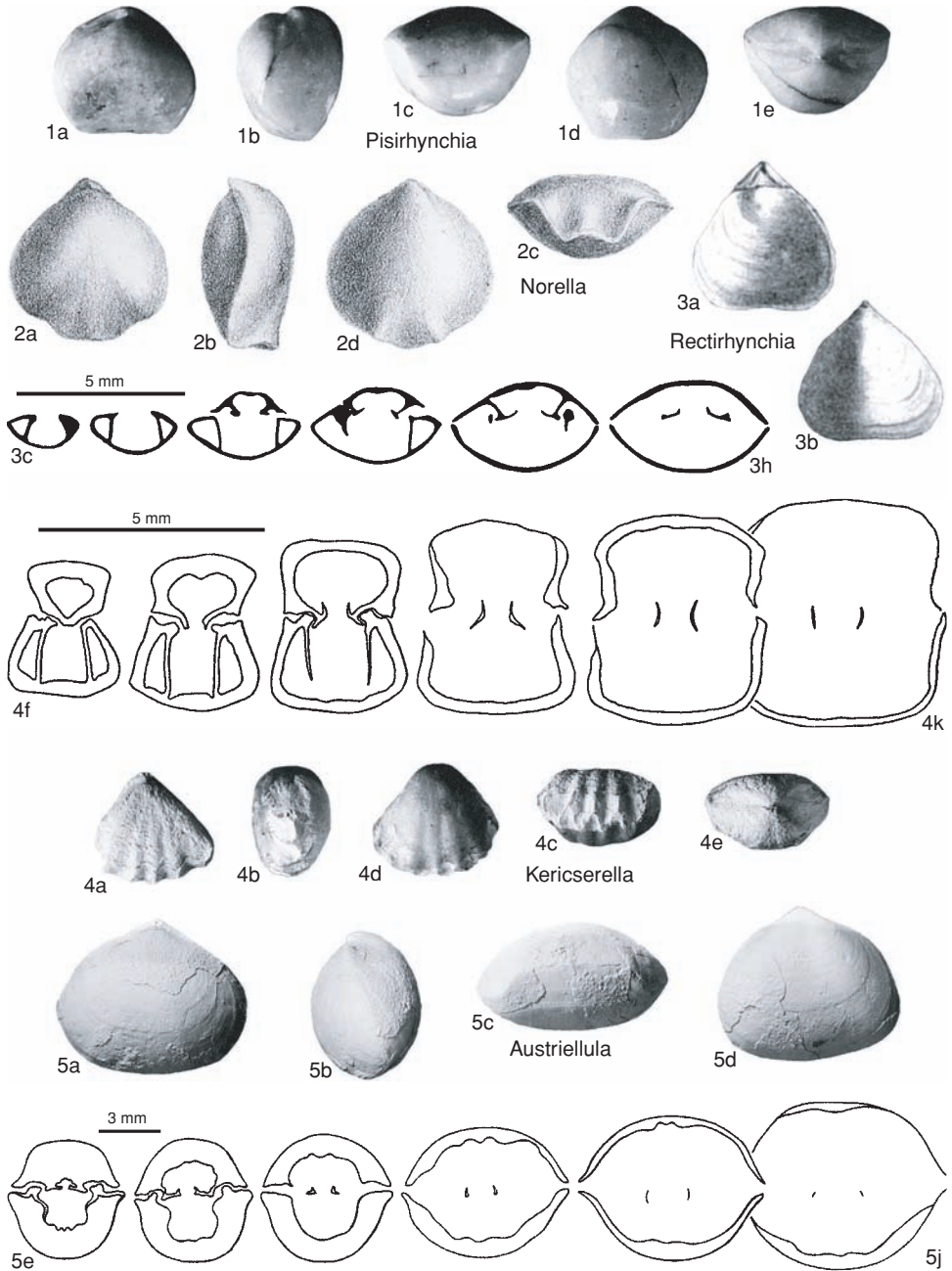


FIG. 889. Norellidae (p. 1308–1309).

*zharnikovae*, Primorye; *a–d*, holotype, dorsal, lateral, anterior, ventral views, IGiG 394/51,  $\times 2$ ; *e–k*, transverse serial sections, distances in mm from first section, 0.8, 1.05, 1.4, 1.5, 1.7, 2.0, 2.2, IGiG 394/53 (Dagys, 1974).

?*Qilianoconcha* CHING, SUN, & YE in CHING & others, 1979, p. 166 [\**Q. corcula*; OD]. Small to medium size, subpentagonal to elongate-elliptical, planoconvex to ventribiconvex; commissure sulcate-antiplicate; surface smooth; ventral valve axially

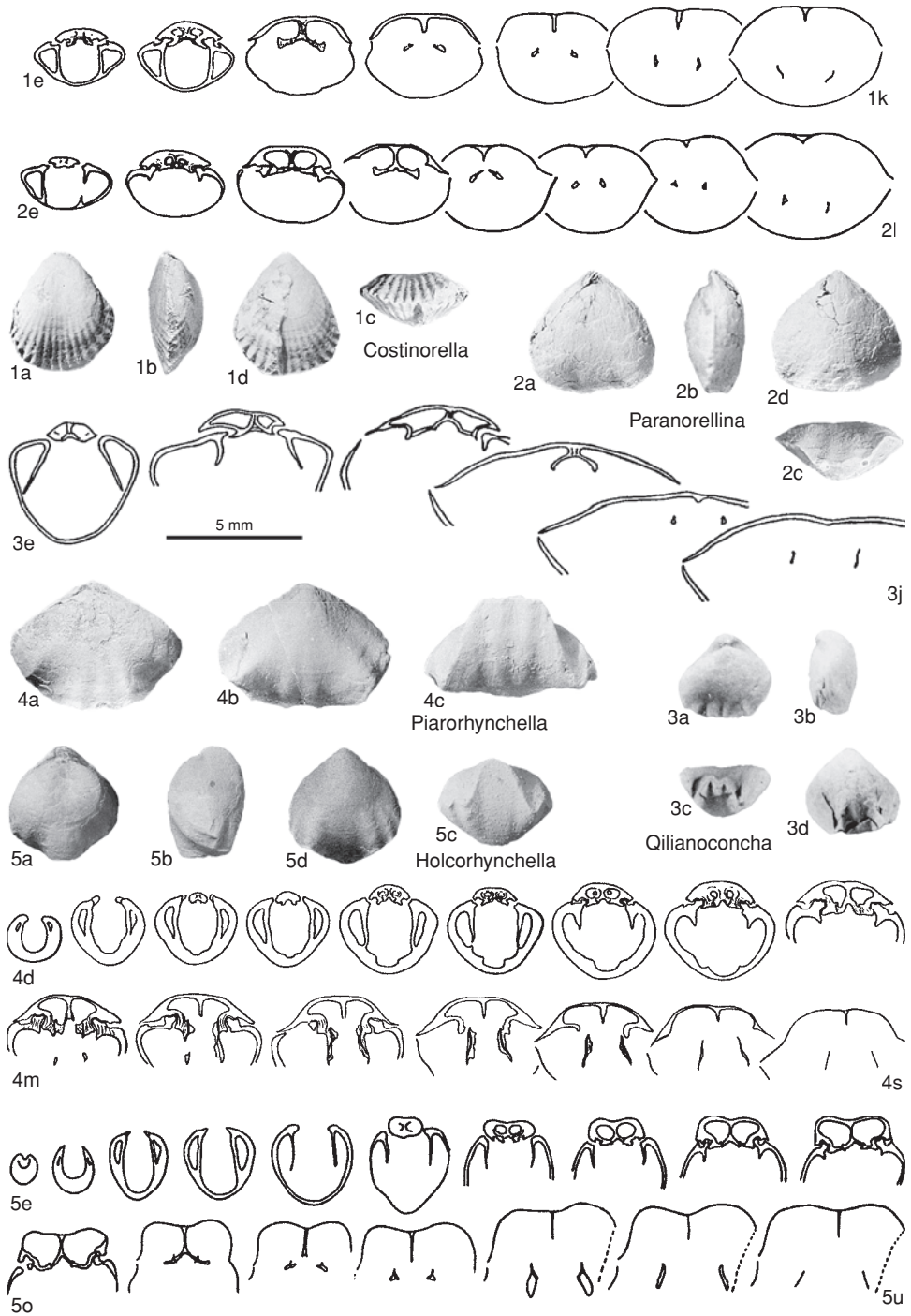


FIG. 890. Norellidae (p. 1309–1312).

carinate or with median groove marked by 1 short plica; dorsal sulcus variously developed, gradually merging into lateral slopes and sometimes with median ridge or 2 short plicae anteriorly; beak small and pointed; beak ridges narrow and rounded; foramen epithyrid; delthyrium closed by symphytium. Pedicle collar may be present; dental plates widely divergent ventrally; umbonal chambers narrow, about one-fourth width of delthyrial chamber; outer hinge plates slightly inclining toward dorsal floor; septalium wide and deep; septum attaining one-third length of dorsal valve; crural bases trigonal; crura allegedly pefalciform, also resemble arcuiform, extending horizontally, thinly ridge shaped in proximal part and upright short blades at distal ends. [Discrimination from co-occurring genera *Eoantipychia*, *Parasulcatinella*, and *Paraantipychia* interpreted as terebratulides by XU & LIU, 1983, is not yet unequivocally resolved.] *Middle Triassic (Anisian)*: China (Qinghai).—FIG. 890, 3a–j. \**Q. corcula*; a–d, holotype, dorsal, lateral, anterior, ventral views, NIGP 42868, ×1; e–j, paratype, transverse serial sections, distances in mm from ventral umbo, 1.7, 2.1, 2.8, 3.85, 4.05, 4.75, NIGP 42869 (Ching & others, 1979).

### Subfamily HOLCORHYNCHELLINAE

Dagys, 1974

[Holcorhynchellinae DAGYS, 1974, p. 109]

Small Norellidae with long smooth stage and with round marginal plicae on anterior part; sulcate or depressed in early ontogeny to become uniplicate later. Dental plates, median septum, and septalium present; crura allegedly calcariform, modified arcuiform, distally flaring ventrally. *Lower Triassic (Scythian)—Middle Triassic (Ladinian)*.

*Holcorhynchella* DAGYS, 1974, p. 110 [\**Rhynchonella delicatula* BITTNER, 1890, p. 17; OD]. Small, subpentagonal, unisulcate young and uniplicate adult, distinct sulcus in posterior half of dorsal valve, posteriorly smooth, costae few, short in anterior part; beak short, incurved, ridges rounded, foramen hypothyrid, deltidial plates disjunct. Dental plates subparallel, pedicle collar absent; outer hinge plates broad, ventrally convex on section, dorsal median septum high, more than one-half valve length, septalium distinct; crura as for subfamily. *Middle Triassic (Anisian–Ladinian)*: Alps, Dinarids, Carpathians, Hungary, northwestern Caucasus, Turkey, Vietnam, ?China.—FIG. 890, 5a–u. \**H. delicatula* (BITTNER), Anisian, northwestern Caucasus; a–d, dorsal, lateral, anterior, ventral views, IGiG 394/234, ×2; e–u, transverse serial sections, distances in mm from first section, 0.0, 0.2, 0.5, 0.7, 0.9, 1.0, 1.1, 1.2, 1.4, 1.5, 1.6, 1.8, 2.0, 2.3, 2.6, 2.8, 3.0, IGiG 394/236 (Dagys, 1974).

*Piarorhynchella* DAGYS, 1974, p. 110 [\**P. mangyshlakensis*; OD] [= *Piarorhyncholla* XU & LIU, 1983, p. 72, *nom. null.*]. Small, rounded-pentagonal, strongly uniplicate, posteriorly smooth, costae few and low anteriorly; beak short, suberect, ridges rounded, foramen hypothyrid, deltidial plates disjunct. Dental plates subparallel, pedicle collar absent, outer hinge plates horizontal in section, dorsal median septum and septalium distinct, crura curved from cardinalia at right angles. *Lower Triassic–Middle Triassic*: Alps, Balkans, Carpathians, northwestern Caucasus, western Kazakhstan, Primorye, ?China, western USA.—FIG. 890, 4a–s. \**P. mangyshlakensis*, Scythian, Olenekian, Mangyshlak, Kazakhstan; a–c, holotype, dorsal, ventral, anterior views, IGiG 394/61, ×2; d–s, transverse serial sections, distances in mm from first section, 0.0, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.2, 1.4, 1.5, 1.6, 1.7, 1.8, 2.0, 2.2, IGiG 394/66 (Dagys, 1974).

### Subfamily PRAEMONTICLARELLINAE new subfamily

[Praemonticlarellinae MANCENIDO & OWEN, herein]

Small, depressed equibiconvex Norellidae; usually narrow at hinge and somewhat truncated anteriorly; smooth stage variable, blunt plicae often peripheral; rectimarginate or weakly uniplicate. With shallow septalium and variable dorsal median septum; hinge plates inclined dorsally. *Lower Triassic–Upper Jurassic (Volgian)*.

*Praemonticlarella* GARCÍA JORAL, 1993, p. 75 [\**P. distercica*; OD] [= *Praemonticlarella* GARCÍA JORAL, GOY, & URETA, 1990, p. 58, *nom. nud.*]. Small, round to subpentagonal, depressed equibiconvex; costae numerous, blunt, and radial, attenuated posteriorly; uniplication subrectangular, but fold not raised; beak short and erect, with sharp beak ridges. Hinge plates oblique inclined; dental plates nearly subparallel; septalium shallow; dorsal median septum long, low; crura arcuiform. *Lower Jurassic (Toarcian)—Middle Jurassic (lower Aalenian)*: Spain, ?France, ?Italy.—FIG. 891, 5a–j. \**P. distercica*, lower Aalenian, Spain; a–c, holotype, dorsal, lateral, anterior views, DPUCM HT.15.2, ×3; d–j, transverse serial sections, distances in mm from ventral umbo, 1.0, 1.1, 1.4, 1.65, 1.85, 2.1, 2.2, DPUCM FZ.68.17 (García Joral, 1993).

?*Aparimarhynchia* MACFARLAN, 1992, p. 65 [\**A. dunrobinensis* MACFARLAN, 1992, p. 66; OD; *non* p. 16, confirmed by first reviser MACFARLAN, 1995, p. 527]. Small, slightly inflated ventribiconvex, rounded to subtrigonal in outline; rectimarginate or shallowly uniplicate; costae narrow, rounded, sometimes branching, other times with long smooth stage posteriorly; beak large, erect; hypothyrid

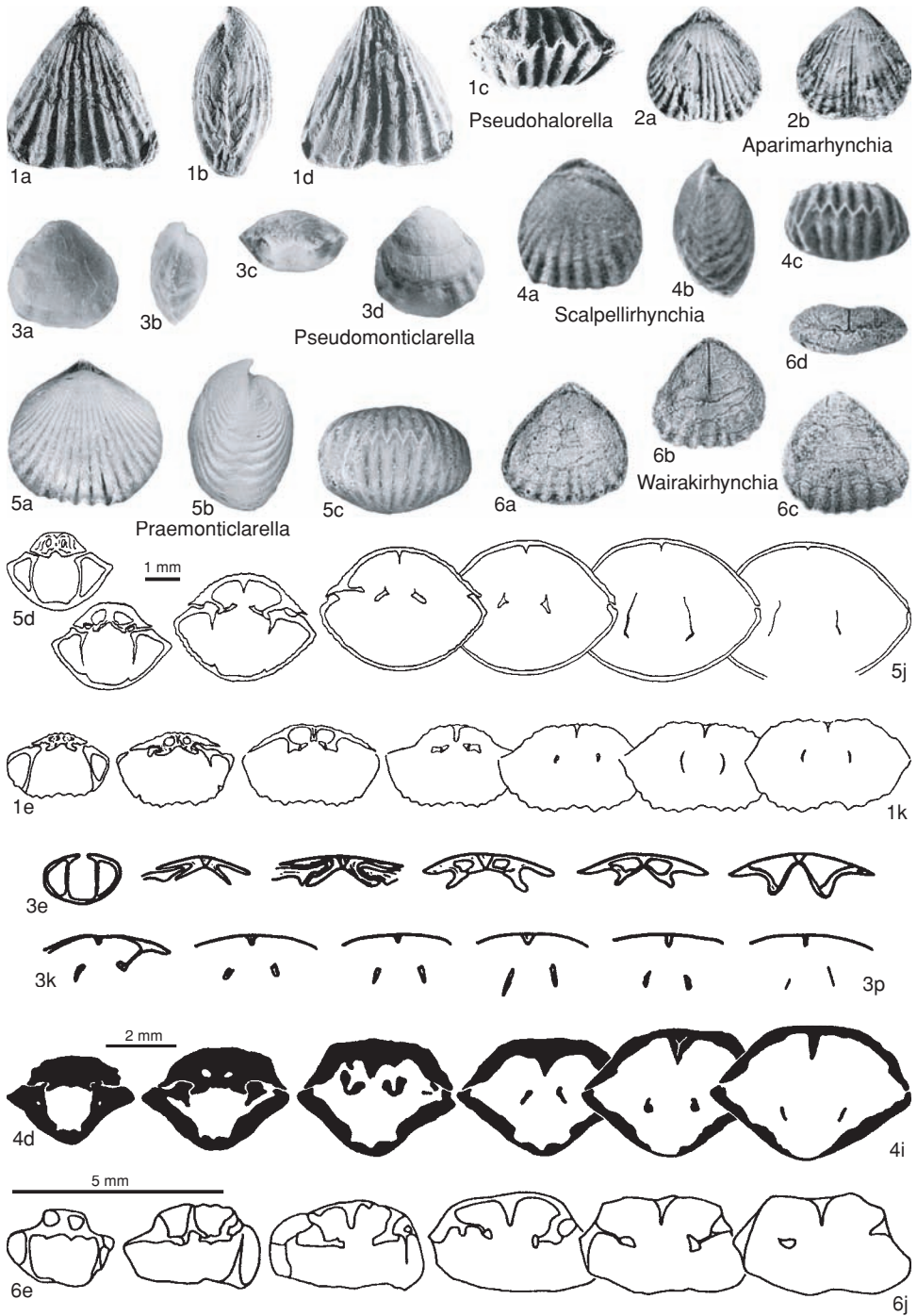


FIG. 891. Norellidae (p. 1312–1314).

- elliptical foramen with conjunct deltidial plates. Broad, thick hinge plate; no septal plates; dorsal median septum long, high. *Lower Triassic–Middle Triassic (Anisian)*: New Zealand.—FIG. 891,2a–b. \**A. dunrobinensis*, Etalian, Southland syncline; holotype, dorsal, ventral views, OU NZ 15533,  $\times 2$  (MacFarlan, 1992).
- Pseudohalorella** DAGYS, 1965, p. 66 [\**P. sibirica*; OD]. Minute, trigonal, moderately equibiconvex, both valves medially flattened, with distinct sulci, beginning from umbonal part, anterior commissure rectimarginate, multicostate, costae sharp; beak short, suberect, ridges rounded, foramen hypothryid, deltidial plates disjunct. Dental plates slightly ventrally divergent, pedicle collar absent; septum and septalium distinct, crura modified spinuliform. *Upper Triassic (Rhaetian)*: northeastern Siberia.—FIG. 891,1a–k. \**P. sibirica*; a–d, holotype, dorsal, lateral, anterior, ventral views, IGIG 135/118,  $\times 3$ ; e–k, transverse serial sections, distances in mm from first section, 1.4, 1.8, 2.3, 2.5, 2.9, 3.8, 4.2 (Dagys, 1965).
- Pseudomonticarella** SMIRNOVA, 1987, p. 30 [\**P. varia*; OD]. Small, equibiconvex, striate, somewhat ligate; outline variable from rounded-triangular to rounded or pyriform; maximum width at midvalve; 3 to 5 small lateral folds or plicae; anterior commissure with lateral folds resembling *Monticarella*; ventral sulcus broadly arcuate with trapezoidal linguiform extension; ventral umbo long with pointed and slightly incurved beak; foramen small, hypothryid. Hinge teeth long, deeply inserted; dental plates subparallel to weakly ventrally divergent; strong socket ridges; elongated hinge plates supported by strong, low septum. *Upper Jurassic (Volgian)*: Russian Platform.—FIG. 891,3a–p. \**P. varia*; a–d, holotype, dorsal, lateral, anterior, ventral views, MGU 139/570,  $\times 3$ ; e–p, transverse serial sections, distances in mm from first section, 0.13, 0.25, 0.35, 0.48, 0.61, 0.66, 0.76, 0.84, 0.96, 1.0, 1.06, 1.15, MGU 139/584 (Smirnova, 1987).
- Scalpellirhynchia** MUIR-WOOD, 1936a, p. 477 [\**Terebratulula scalpellum* QUENSTEDT, 1851 in 1851–1852, p. 453; OD]. Small, depressed equibiconvex, flattened anteriorly; uniplication low, flattopped, with at least 10 to 16 blunt costae anteriorly (3 to 6 of them on indistinct fold); beak short, erect; deltidial plates disjunct to barely touching. Dental plates short, almost fused to wall, teeth crenulated; dorsal median septum long, supporting wide septalium; oblique hinge plates, inclined dorsally; crura bladelike, nearly to arcuiform, allegedly raduliform or calcariform. [Middle Jurassic records from Asia (China, Pamirs) should be verified.] *Lower Jurassic (upper Sinemurian–Pliensbachian)*: England, France, Germany, Bulgaria, ?Switzerland, ?Algeria, ?Turkey, ?Argentina.—FIG. 891,4a–i. \**S. scalpellum* (QUENSTEDT), lower Pliensbachian, Württemberg, Germany; a–c, dorsal, lateral, anterior views,  $\times 2$ ; d–i, transverse serial sections, distances in mm from ventral umbo, 0.9, 1.1, 1.3, 1.5, 1.8, 2.0, BMNH B.38460 (Ager, 1967).
- ?**Wairakirhynchia** MACFARLAN, 1992, p. 55 [\**W. etaliana*; OD]. Small to medium size, rounded to subtriangular, usually longer than wide; equibiconvex depressed to moderately inflated; shallow posterior sulcus and strongly convex lateral slopes on brachial dorsal valve; rectimarginate or uniplicate; costae strong, subangular to rounded, usually after posterior smooth stage; beak short, broad, erect. Hinge plate thick, with shallow septalium; dorsal median septum long, high. *Middle Triassic (Anisian, ?Ladinian)*: New Zealand (South Island).—FIG. 891,6a–j. \**W. etaliana*, Anisian, upper Etalian, Southland; a–d, holotype, dorsal view, dorsal internal mold, ventral, posterior views, OU NZ 17382,  $\times 2$ ; e–j, transverse serial sections, distances in mm from ventral umbo, 0.6, 1.0, 1.1, 1.3, 1.4, 1.5, OU NZ 15525 (MacFarlan, 1992).

### Subfamily DIHOLKORHYNCHIIDAE Xu & Liu, 1983

[Diholkorhynchiinae Xu & Liu, 1983, p. 74]

Small to medium-sized Norellidae, subequibiconvex to ventribiconvex; dorsally sulcate, ventrally subcarinate; long smooth stage followed by blunt marginal plicae. Dental plates parallel; dorsal median septum high, steeply inclined hinge plates; septalium not persisting beyond articulation zone; crura modified arcuiform, distal ventral flaring variable. [Raising to family Diholkorhynchiidae (as in Xu, 1990, p. 77) is not endorsed herein.] *Middle Triassic–Middle Jurassic (Bajocian, ?Bathonian, ?Callovian)*.

**Diholkorhynchia** YANG & XU, 1966, p. 24 [99] [\**Rhynchonella sinensis* KOKEN, 1900, p. 206; OD] [= *Dihorhynchia* XU & LIU, 1983, p. 72, *nom. null.*]. Small, triangular to subpentagonal, with short hinge; biconvex; anterior commissure multiplicate; beak small, straight or strongly incurved; pedicle opening small, oval; deltidial plates conjunct; ventral sulcus well developed and limited to anterior half of shell; dorsal valve regularly convex, but with medial depression starting near umbonal area, widening at slightly anterior of middle of dorsal length, and weakening on fold; shell completely smooth posteriorly and marked only anteriorly and laterally with short plicae; costellae absent. Dental plates almost parallel; muscle scars pear shaped; pallial markings bifurcated in ventral interior. Dorsal interior with well-developed hinge plates, septalium, median septum; muscle scars oval, situated at both sides of median septum; pallial markings bifurcated. *Middle Triassic*: southwestern China.—FIG. 892,2a–q. \**D. sinensis* (KOKEN), Anisian, Gheizhou; a, syntype, dorsal view, MCMB DDM4,  $\times 3$ ; b–d, syntype, lateral, anterior, ventral views, MCMB DDM4,  $\times 1$ ; e, syntype, dorsal view of steinkern

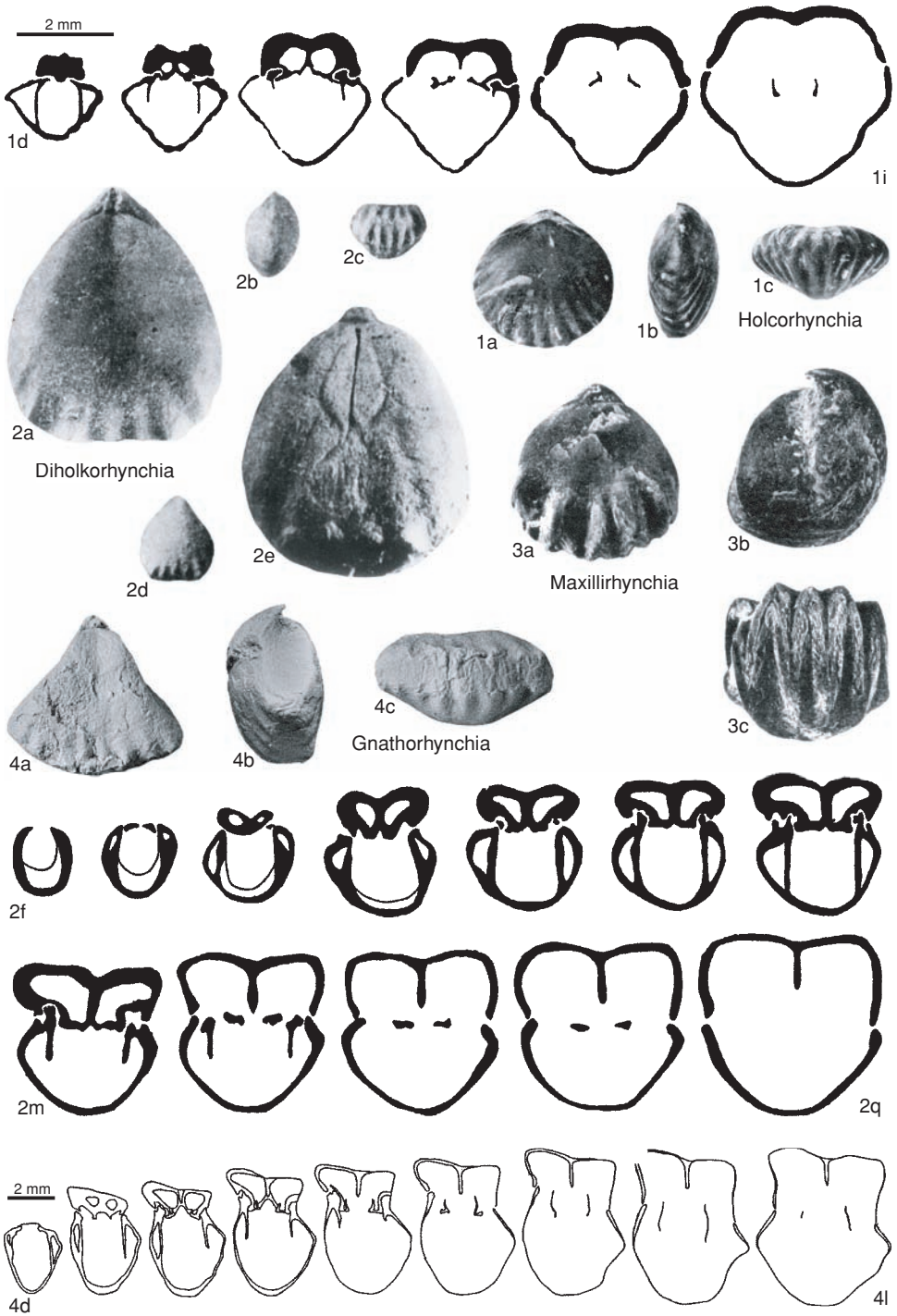


FIG. 892. Norellidae (p. 1314–1316).



with muscle scars,  $\times 3$ ; *f-q*, paratype, transverse serial sections, distances in mm from ventral umbo, 0.4, 0.8, 1.0, 1.3, 1.5, 1.6, 1.8, 2.0, 2.2, 2.4, 2.6, 2.9, MCMB DDKC 120 \*4-2 (Yang & Xu, 1966).

**Gnathorhynchia** BUCKMAN, 1918, p. 29 [*\*Rhynchonella liostraca* BUCKMAN, 1886, p. 217; OD] [= *Gnathorhynchia* BUCKMAN, 1914, p. 1, and 1915, p. 76, both suppressed (ICZN, 1971, Opinion 957)]. Similar to *Holcorhynchia* but triangular to securiform in outline, depressed equibiconvex to ventribiconvex, wide and flat anteriorly; posteriorly smooth, paucicostate anteriorly, with shallow dorsal sulcus and evenly serrate anterior commissure. Dorsal median septum strong, septalium wide; crura allegedly septiform, but arcuiform rather. *Middle Jurassic* (*Aalenian-Bajocian*, ?*Bathonian*, ?*Callovian*): England, France, Austria, ?Morocco, ?Algeria, USA (?California).—FIG. 892,4*a-l*. \**G. liostraca* (BUCKMAN), Aalenian, Vilser Alps, Austria; *a-c*, dorsal, lateral, anterior views,  $\times 2$ ; *d-l*, transverse serial sections, distances in mm from ventral umbo, 0.8, 1.3, 1.5, 1.8, 2.1, 2.3, 2.6, 3.1, 3.6 (new; courtesy of F. García Joral).

**Holcorhynchia** BUCKMAN, 1918, p. 28 [*\*Rhynchonella standishensis* BUCKMAN, 1901, p. 245; OD] [= *Holcorhynchia* BUCKMAN, 1914, p. 1, and 1915, p. 76, both suppressed (ICZN, 1971, Opinion 957); *Holochorhynchia* TOKUYAMA, 1957, p. 133, *nom. null.*]. Small, subcircular to subtriangular, depressed ventribiconvex; posteriorly sulcate, subcarinate ventrally with costae numerous, fine, blunt anteriorly after long smooth stage; beak small, hypothryid slightly incurved. Persistent dorsal median septum, septalium deep, hinge plates inclined dorsally; arcuiform crura rather than raduliform. *Lower Jurassic* (?*Sinemurian*, *Pliensbachian-Toarcian*), *Middle Jurassic* (?*Bathonian*): England, Portugal, Italy, Germany, ?Austria, Anatolia, Algeria, ?*Sinemurian*, *Pliensbachian-Toarcian*; ?Siberia, ?*Bathonian*.—FIG. 892,1*a-c*. \**H. standishensis* (BUCKMAN), lower Toarcian, Gloucestershire, England; dorsal, lateral, anterior views, GSM 31920,  $\times 2$  (Ager, 1967).—FIG. 892,1*d-i*. *H. yakacikensis* AGER, ?*Sinemurian*, Pliensbachian, Turkey; transverse serial sections, distances in mm from ventral umbo, 0.5, 0.7, 0.9, 1.0, 1.3, 1.8, J.1076/3, Derek Ager, personal collection (Ager, 1959c).

**Maxillirhynchia** BUCKMAN, 1918, p. 55 [*\*M. implicata*; OD] [= *Maxillirhynchia* BUCKMAN, 1914, p. 2, and 1915, p. 77, both suppressed (ICZN, 1971, Opinion 957)]. Small, round subpentagonal, equibiconvex to dorsibiconvex; fold and uniplication low, rectangular after short early sulcate stage; capillate throughout, few strong costae anteriorly; beak sharp, incurved, hypothryid. Dental plates ventrally divergent; septalium pendant; dorsal median septum ill developed; crura weakly flared, pedicle collar absent. *Upper Triassic* (*Norian*), *Lower Jurassic* (?*Pliensbachian*, *Toarcian*), *Middle Jurassic* (?*Aalenian*, *Bajocian*): ?Siberia, *Norian*; England, ?*Pliensbachian*, *Toarcian*; Caucasus, ?Italy, ?*Aalenian*,

*Bajocian*.—FIG. 892,3*a-c*. \**M. implicata*, upper Toarcian, Gloucestershire, England; dorsal, lateral, anterior views, GSM 31938,  $\times 2$  (Ager, 1967).

### Subfamily MONTICLARELLINAE Childs, 1969

[Monticlarellinae CHILDS, 1969, p. 18]

Small to medium-sized Norellidae, ornamented with radial striae but costae variably developed or even absent; beak small and pointed; slightly sulcate, rectimarginate or weakly uniplicate. Crura arcuiform where known; dorsal median septum and septalium much reduced or absent; dental plates may be obsolescent. *Middle Triassic* (*Ladinian*)–*Upper Cretaceous* (*Turonian*).

**Monticlarella** WISNIEWSKA, 1932, p. 55 [*\*Rhynchonella czenstochowiensis* ROEMER, 1870, p. 247; OD, *error pro R. czenstochaviensis*]. Small, subtriangular to subpentagonal with maximum width anterior to midvalve; slightly ventribiconvex, posteriorly sulcate, umbonally capillate, becoming costellate anteriorly with some intercalation; anterior commissure polyplacate with characteristic lateral enlarged pliae; small, sharp beak, tiny foramen. Dental plates weak to vestigial; dorsal median septum poorly developed; crura arcuiform. [Species name was originally spelled *Czenstochaviensis*, then WISNIEWSKA (1932, p. 55) adopted the spelling *czenstochowiensis*, attributing it to ROEMER, but this is an unjustified emendation.] *Middle Jurassic* (*upper Callovian*)–*Upper Cretaceous* (*Turonian*): England, France, Switzerland, Germany, western Carpathians, Poland, Bulgaria, Crimea, Caucasus, Algeria, ?China.—FIG. 893,2*a-r*. \**M. czenstochowiensis* (ROEMER), Oxfordian, Czestochowa area, Poland; *a-d*, dorsal, lateral, anterior, ventral views,  $\times 1$ ; *e*, detail of apical region showing deltidial plates,  $\times 5$  (Wisniewska, 1932); *f-r*, transverse serial sections, distances in mm from ventral umbo, 0.7, 0.8, 1.0, 1.1, 1.2, 1.3, 1.4, 1.6, 1.8, 2.0, 2.1, 2.3, 2.4, J.1219/2, Derek Ager, personal collection (Childs, 1969).

**Batangorhynchia** SUN & LI, 1990, p. 108[118] [*\*B. xiaoleica*; OD]. Small to medium size; roughly triangular to roundly pentagonal in outline; almost equibiconvex; anterior commissure sulcate; beak small, incurved; pedicle opening small, rounded, and hypothryid; surface of shell smooth posteriorly and marked by low, rounded costae anteriorly. Pedicle collar and dental plates absent or fused to wall; teeth thin; hinge plates discrete, narrow, and tapering; inner socket ridges high, merged with outer hinge plates; crural base triangular; crura arcuiform; median septum just a ridge; septalium absent. *Middle Triassic* (*Ladinian*): China (southern Qinghai).—FIG. 894,3*a-r*. \**B. xiaoleica*; *a-d*, holotype, dorsal, lateral, anterior, ventral views, NIGP

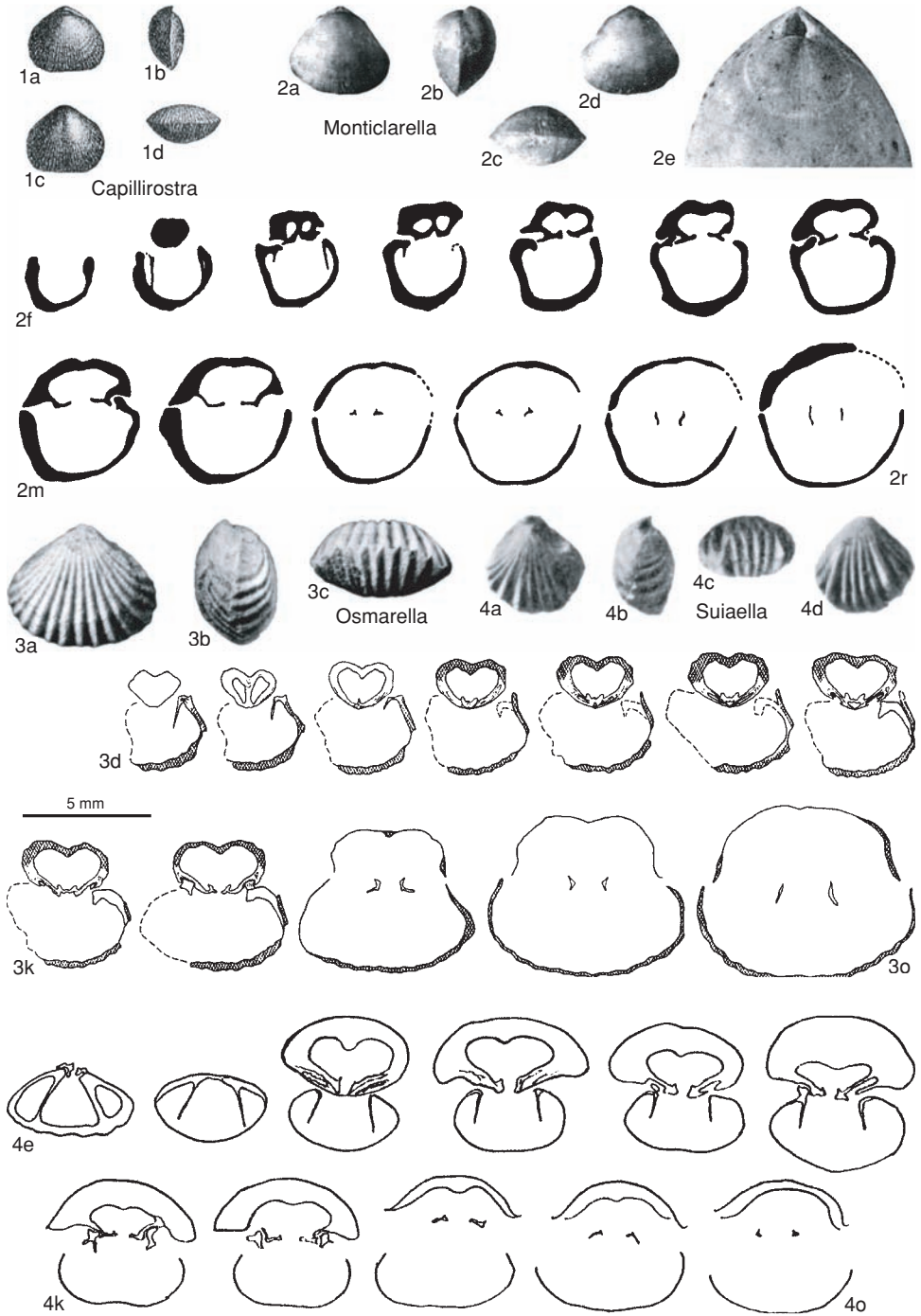


FIG. 893. Norellidae (p. 1316-1319).

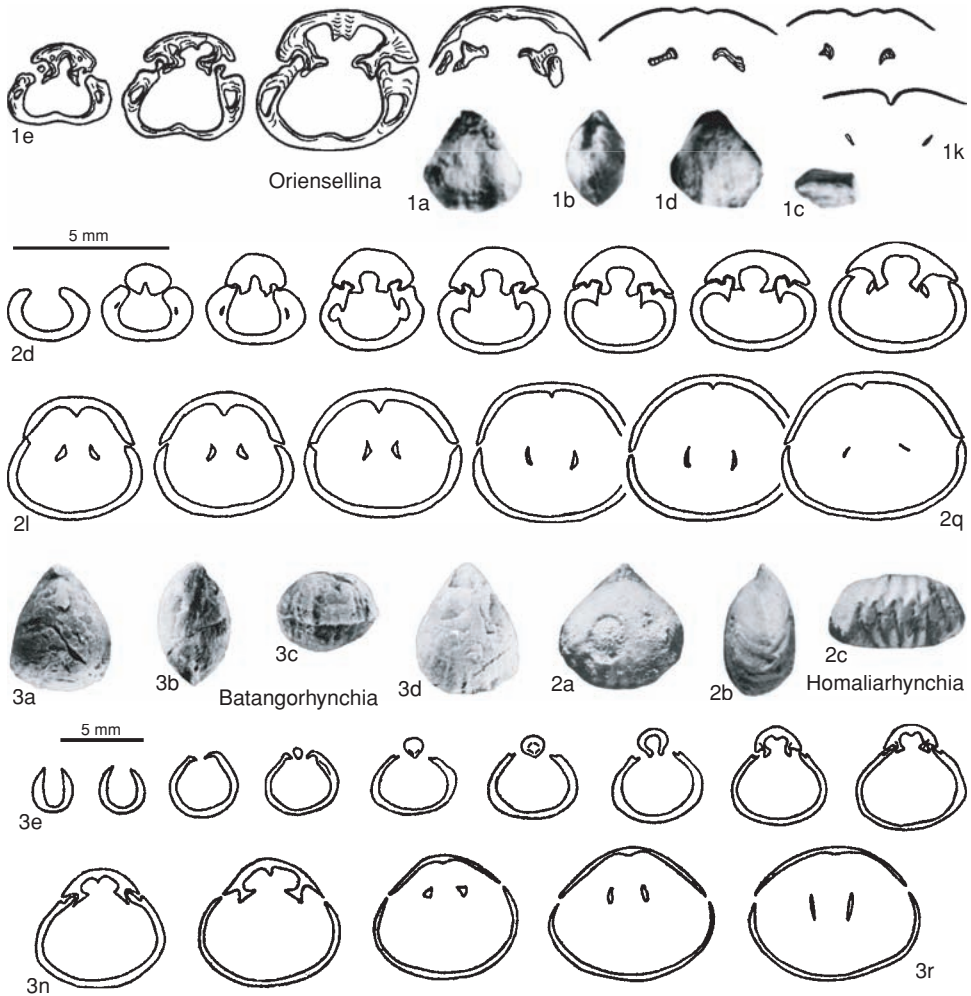


FIG. 894. Norellidae (p. 1316–1319).

97336,  $\times 1$ ; *e–n*, paratype, transverse serial sections, distances in mm from ventral umbo, 0.4, 0.6, 1.15, 1.4, 1.65, 1.8, 1.9, 2.1, 2.5, 3.1, 3.5, 3.8, 4.6, 4.9, NIGP 97337 (Sun & Li, 1990).

**Capillirostra** COOPER & MUIR-WOOD, 1951, p. 195, *nom. nov. pro Rhynchonellopsis* BÖSE, 1894, p. 78 (footnote), *non* VINCENT, 1893, Terebratulida, *nec* DE GREGORIO, 1930b, also Rhynchonellida [*\*Rhynchonellina? finkelsteini* BÖSE, 1894, p. 77; SD SCHUCHERT & LEVENE, 1929a, p. 107] [= *Capillirostra* MAKRIDIN in SARYCHEVA, 1960, p. 257, *nom. null.*]. Similar to *Monticlarella* but rectimarginate; small, depressed, ventribiconvex, with grooves delimiting dorsal muscle scars and short crura. [Probably a juvenile form and a subjective synonym of *Monticlarella* WISNIEWSKA, 1932, p. 55; cf. AGER,

CHILDS, & PEARSON, 1972, p. 181; SULSER, 1993, p. 32, unless recognizable as subgenus.] *Upper Jurassic (Oxfordian, ?Kimmeridgian)*: Germany.—FIG. 893, 1a–d. *\*C. finkelsteini* (BÖSE), Oxfordian or ?Kimmeridgian, Swabia, Germany; dorsal, lateral, anterior, ventral views,  $\times 1$  (Böse, 1894).

**Homaliarhynchia** SHI, 1990, p. 306 [*\*H. minuta*; OD]. Shell minute, gently equibiconvex and uniplicate; costate anteriorly after a long smooth stage, no sulcation in dorsal umbo. Dorsal median septum a vestigial ridge; septalium and septalial plates absent; hinge plates not differentiated; rudimentary dental plates fused to wall; crura arcuiform. *Middle Jurassic (Bathonian)*: China (eastern Tibet), England.—FIG. 894, 2a–g. *\*H. minuta*; a–c, holotype, dorsal, lateral, anterior views, MCMB

M161761,  $\times 1.5$  (Shi, 1992); *d–g*, transverse serial sections, distances in mm from ventral umbo, 0.2, 0.5, 0.6, 0.8, 0.9, 1.0, 1.1, 1.2, 1.4, 1.5, 1.7, 1.9, 2.0, 2.2, MCMB L126172 (Shi, 1990).

?**Oriensellina** SMIRNOVA in SMIRNOVA & KONOVALOV, 1986, p. 75 [\**O. minutalis*; OD] [= *Oriensirhynchia* SMIRNOVA, 1984, p. 116, *nom. nud.*; *Eastirhynchia* SMIRNOVA, 1984, p. 120, *nom. nud.*]. Small, rounded to triangular or pyriform, equibiconvex, smooth stage occupying half the length of shell; ventral sulcus shallow; dorsal fold moderately developed; beak long, slightly incurved, foramen small. Dental plates parallel to slightly ventrally divergent; sessile septalium developed; hinge plates short, dorsally concave; crura narrow, divergent, approaching spinuliform. *Lower Cretaceous (Berriasian–Valanginian)*: Russia (eastern Siberia).—FIG. 894, 1a–k. \**O. minutalis*, Primorye; *a–d*, holotype, dorsal, lateral, anterior, ventral views, MGU 245/141,  $\times 2$  (Smirnova, 1990); *e–k*, transverse serial sections, distances in mm from first section, 0.9, 1.1, 1.3, 1.5, 2.1, 2.5, 3.4, MGU 245/145, approximately  $\times 4$  (Smirnova & Konovalov, 1986).

?**Osmarella** PEARSON, 1977, p. 58 [\**Rhynchonella Starhembergica* ZUGMAYER, 1880, p. 38; OD]. Small to medium size; ribs numerous, low, rounded; branching occurring posteriorly or may be smooth; beak and area very small; sulcus and fold poorly developed. Dorsal median septum very low and short; hinge plate entire; crural bases bulbous, crura arcuiform. [Alternatively, may be related to Praemonticlarellinae, or, according to DAGYS (1994, personal communication), even to Cirpinae, being similar to *Euxinella*.] *Upper Triassic (Norian)–Lower Jurassic (Hettangian, ?Pliensbachian)*: Slovakia, northern Alps.—FIG. 893, 3a–o. \**O. starhembergica* (ZUGMAYER), Rhaetian, Austria; *a–c*, dorsal, lateral, anterior views,  $\times 1.3$ ; *d–o*, topotype, transverse serial sections, distances in mm from ventral umbo, 0.6, 0.7, 0.85, 0.9, 0.95, 1.0, 1.05, 1.1, 1.2, 1.6, 2.0, 2.5, PC.28, personal collection of D. A. B. Pearson, to be placed in the Natural History Museum of Vienna (Pearson, 1977).

**Suiaella** MOISSEEV in WEBER, 1949, p. 109 [\**S. weberi* MOISSEEV in WEBER, 1949, p. 110; M] [= *Suiaella* MOISSEEV in RZHONSNIKAIKA & others, 1956, p. 61, obj.]. Small, subtriangular, depressed equibiconvex; rounded costae throughout, with some bifurcation; beak short, suberect, foramen small, hypothyril; ventral sulcus broad with shallow trapezoidal linguiform extension bounded by marked lateral plicae. Dental plates ventrally divergent, not attached along full length. [Possibly a subjective synonym of *Monticlarella* WISNIEWSKA, 1932, or else a subgenus with sharper costation.] *Lower Cretaceous (Valanginian, Barremian)*: Crimea, western Carpathians.—FIG. 893, 4a–o. \**S. weberi*, lower Barremian, Crimea; *a–d*, dorsal, lateral, anterior, ventral views, MGU 522/3,  $\times 2$  (Smirnova, 1972); *e–o*, transverse serial sections, distances in mm from ventral umbo, 0.6, 0.9, 1.0, 1.2, 1.25, 1.3, 1.4, 1.7, 1.9, 2.0, 2.4, CNIGR 299/4802 (new; courtesy of S. V. Lobacheva).

## Subfamily LAEVIRHYNCHIIINAE Dagys, 1974

[*nom. transl.* MANCEÑIDO & OWEN, herein, ex *Laevirhynchidae* DAGYS, 1974, p. 91]

Very small smooth norellids with neat sinus on ventral valve and round fold on dorsal, usually flanked by radial sulci. Hinge plates divided; dorsal median septum and septalium absent; dental plates much reduced or absent; crura arcuiform or variant. *Upper Triassic (Carnian)–Middle Jurassic (Bajocian)*.

**Laevirhynchia** DAGYS, 1974, p. 91 [\**Terebratula tricostrata* VON MÜNSTER in WISSMANN & VON MÜNSTER, 1841, p. 57; OD] [= *Levirhynchia* DETRE, 1972, p. 88, *nom. nud.*]. Small, subtriangular, smooth, moderately biconvex; ventral valve with marked sulcation originating from umbo and broadening anteriorly; dorsal valve with matching, arcuate, median fold; umbo massive, beak slightly produced, suberect, foramen small; deltidial plates absent; beak ridges well defined, permesothyril. Dental plates absent; hinge teeth deeply inserted, outer socket ridges well developed; hinge plates short; crura wide, deflected ventrally, connected by spicules; dorsal septum and septalium absent. *Upper Triassic (Carnian)*: southern Alps, Carpathians.—FIG. 895, 1a–x. \**L. tricostrata* (VON MÜNSTER), Hungary; *a–d*, dorsal, lateral, anterior, ventral views, IGI 394/219,  $\times 2$ ; *e–x*, transverse serial sections, distances in mm from first section, 0.0, 0.1, 0.2, 0.3, 0.5, 0.6, 0.7, 0.8, 1.0, 1.1, 1.2, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2.0, 2.05, 2.15, IGI 394/220 (Dagys, 1974).

**Nannirhynchia** BUCKMAN, 1918, p. 67 [\**N. subpygmaea*; OD] [= *Nannirhynchia* BUCKMAN, 1914, p. 2, and 1915, p. 77, both suppressed (ICZN, 1971, Opinion 957)]. Minute, globose equibiconvex; sulcate, with well-marked median uniplication and fold rounded to flattened; with few rounded costae anteriorly, otherwise smooth; beak small, short, incurved, foramen small, deltidial plates disjunct. Dental plates weak, subparallel to dorsally divergent, often almost fused to wall; dorsal median septum absent; crura arcuiform. *Lower Jurassic (?Pliensbachian, Toarcian)–Middle Jurassic (Bajocian)*: England, France, Portugal, ?Slovakia, ?Austria, Morocco, Algeria, Tunisia.—FIG. 895, 2a. \**N. subpygmaea*, upper Bajocian, Somerset, England; holotype, dorsal view, GSM 51308,  $\times 2.5$  (Ager, 1967).—FIG. 895, 2b–t. *N. pygmaea* (MORRIS), Toarcian, Peniche, Portugal; *b–d*, dorsal, lateral, anterior views, FSL 305185, approximately  $\times 2.5$ ; *e–t*, transverse serial sections, distances in mm from ventral umbo, 0.1, 0.2, 0.3, 0.35, 0.4, 0.45, 0.5, 0.55, 0.6, 0.65, 0.7, 0.8, 0.9, 1.0, 1.2, 1.3, FSL 307191 (Alm ras & others, 1995).

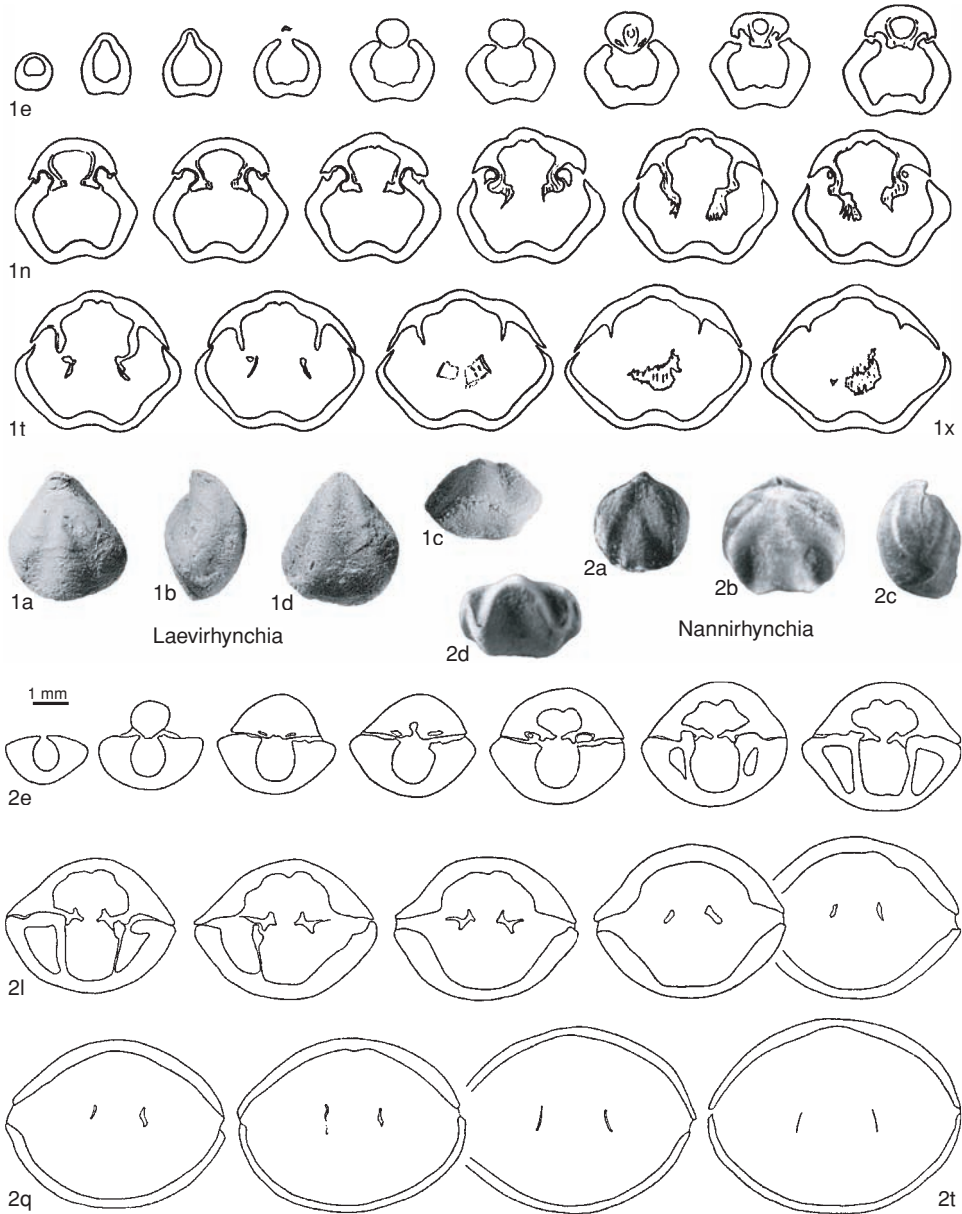


FIG. 895. Norellidae (p. 1319).

**?Family OCHOTORHYNCHIIDAE**  
**Dagys, 1968**

[Ochotorhynchiidae DAGYS, 1968, p. 47]

Small, subequibiconvex to nearly planoconvex shells, with sulcate dorsal valve, straight or slightly curved hinge margin, and

round radial costae. Crura arising from inner socket ridges and directed anteroventrally, so-called divuliform type; dental plates rudimentary to absent; median septum, septalium, and cardinal process undeveloped. [This small group with a discontinuous record, which was proposed among rhyncho-

nelloids, is now tentatively placed closer to sulcate norelloids.] *Lower Jurassic (Sinemurian), Lower Cretaceous (Berriasian).*

**Ochotorhynchia** DAGYS, 1968, p. 47 [*\*O. omolonensis*; OD]. Minute, thin, planoconvex, with few, low, rounded costae, distinct sulcus on dorsal valve, anterior commissure unisulcate; beak suberect, ridges distinct, foramen hypothryid, deltidial plates absent. Dental plates and pedicle collar absent; cardinalia massive, fused inner socket ridges and hinge plates similar to brachiophores; crura thick, knoblike, almost reaching ventral valve. *Lower Jurassic (Sinemurian)*: northeastern Siberia.—FIG. 896, 1a–r. *\*O. omolonensis*; a–d, dorsal, lateral, anterior, ventral views, IGiG 231/78, ×3; e–r, transverse serial sections, distances in mm from first section, 0.0, 0.2, 0.3, 0.4, 0.6, 0.8, 1.1, 1.3, 1.4, 1.7, 1.9, 2.1, 2.2, 2.4 (Dagys, 1968).

‡**Tonasirhynchia** LOBACHEVA & SMIRNOVA, 1994, p. 131 [*\*T. janini*; OD]. Ventribiconvex, transversely oval in outline with dorsal sulcus and anterior commissure broad, arcuate and ventral fold smooth; umbo low, broad and beak small; valves ornamented by numerous fine plicae developing anteriorly. Pedicle collar present, dental plates undifferentiated; inner socket ridges high; hinge plates strongly inclined toward floor of dorsal valve; crural bases rounded in outline, developing thick, platelike crura fused with socket ridges. *Lower Cretaceous (Berriasian)*: Ukraine (Crimea).—FIG. 896, 3a–q. *\*T. janini*; a–d, holotype, dorsal, ventral, lateral, anterior views, CNIGR 1/12075, ×2; e–q, transverse serial sections, distances in mm from first section, 0.2, 0.3, 0.4, 0.5, 0.6, 0.8, 1.0, 1.2, 1.5, 1.7, 2.0, 2.2, 2.4, CNIGR 5/12810, approximately ×3 (Lobacheva & Smirnova, 1994).

### Family FRIELEIIDAE Cooper, 1959

[Frieleidae COOPER, 1959, p. 16] [=Hispanirhynchiidae COOPER, 1959, p. 16]

Small, thinly shelled Norelloidea, subtriangular to subpentagonal, rectimarginate, sulcate or ligate. Dental plates strong, crura modified from arcuiform, small septalium occurring apically sometimes; dorsal median septum present, ridgelike, or absent; 2 pairs of metanefridia; intestines straight, no terminal expansion; lophophore trocholophe to spirolophe. *Paleogene (?Danian, Eocene)–Holocene.*

### Subfamily FRIELEIINAE Cooper, 1959

[*nom. transl.* MANCENIDO & OWEN, herein, ex Frieleidae COOPER, 1959, p. 16]

Subrectimarginate or ligate Frieleidae, with shell surface capillate to costellate; with septalium supported by variably developed

dorsal median septum; with short, straight, nonflaring spinuliform crura. *Paleogene (?Danian), Neogene (Miocene), Holocene.*

**Frieleia** DALL, 1895, p. 713 [*\*F. halli* DALL, 1895, p. 714; OD]. Elongate-oval to subtrigonal; rectimarginate to ligate, shell surface smooth to faintly costellate; beak short, nearly straight to suberect, hypothryid; deltidial plates thick, disjunct. Inner hinge plates strongly developed; median dorsal septum supporting short septalium; crura long and divergent. [Living species range from bathyal to neritic.] *Paleogene (?Danian), Neogene (Miocene), Holocene*: western USA and North Pacific.—FIG. 897, 3a–l. *\*F. halli*, Holocene; a–c, dorsal, lateral, anterior views, off Kamchatka, North Pacific, USNM 110830a, ×1; d, internal view of ventral valve showing dental plates and foramen, off Kamchatka, North Pacific, USNM 110830b, ×2; e, internal view of dorsal valve showing crura, off San Diego, California, USA, USNM 549348b, ×4 (Cooper, 1959); f–l, transverse serial sections through dorsal umbo (Dagys, 1968).

**Compsothyris** JACKSON, 1918, p. 188 [*\*Rhynchonella racovitzae* JOUBIN, 1901, p. 5; OD]. Uniplication trigonal, broad, gentle, dorsal fold poorly developed; shell surface with fine radial striae; foramen hypothryid. Median dorsal septum ridgelike, supporting small septalium; crura somewhat spatulate, flat. [Living species have a circumpolar, bathyal range.] *Holocene*: Antarctica.—FIG. 897, 2a–e. *\*C. racovitzae* (Joubin), McMurdo Sound; a, enlarged dorsal view, ×2; b–c, lateral, anterior views, ×1; d, ventral umbo showing foramen, deltidial plates, and hinge teeth, ×4; e, dorsal umbo showing crura, USNM 549343, ×4 (Cooper, 1959).

**Grammetaria** COOPER, 1959, p. 58 [*\*Hemithyris bartschi* DALL, 1920, p. 289; OD]. Elongate-trigonal, rectimarginate; capillate; beak small, suberect; foramen comparatively large, hypothryid; deltidial plates conjunct, auriculate; crura short; dorsal median ridge or septum stout, supporting wide septalium. [Living species are bathyal.] *Holocene*: Philippines, Molluccas, off Bali, New Caledonia, South Africa.—FIG. 897, 1a–e. *\*G. bartschi* (DALL), Mollucca Pass; a, enlarged dorsal view, ×2; b–c, lateral, anterior view, ×1; d, detail of ventral umbo, ×4; e, holotype, oblique view of dorsal umbo showing cardinalia and crura, USNM 239269, ×4 (Cooper, 1959).

### Subfamily HISPANIRHYNCHIINAE Cooper, 1959

[*nom. transl.* MANCENIDO & OWEN, herein, ex Hispanirhynchiidae COOPER, 1959, p. 16]

Rectimarginate to faintly sulcate, with capillate or striate shell surface; with crura short, straight, spinuliform, and with dorsal median ridge reduced to absent and without septalium. *Paleogene (Eocene)–Holocene.*

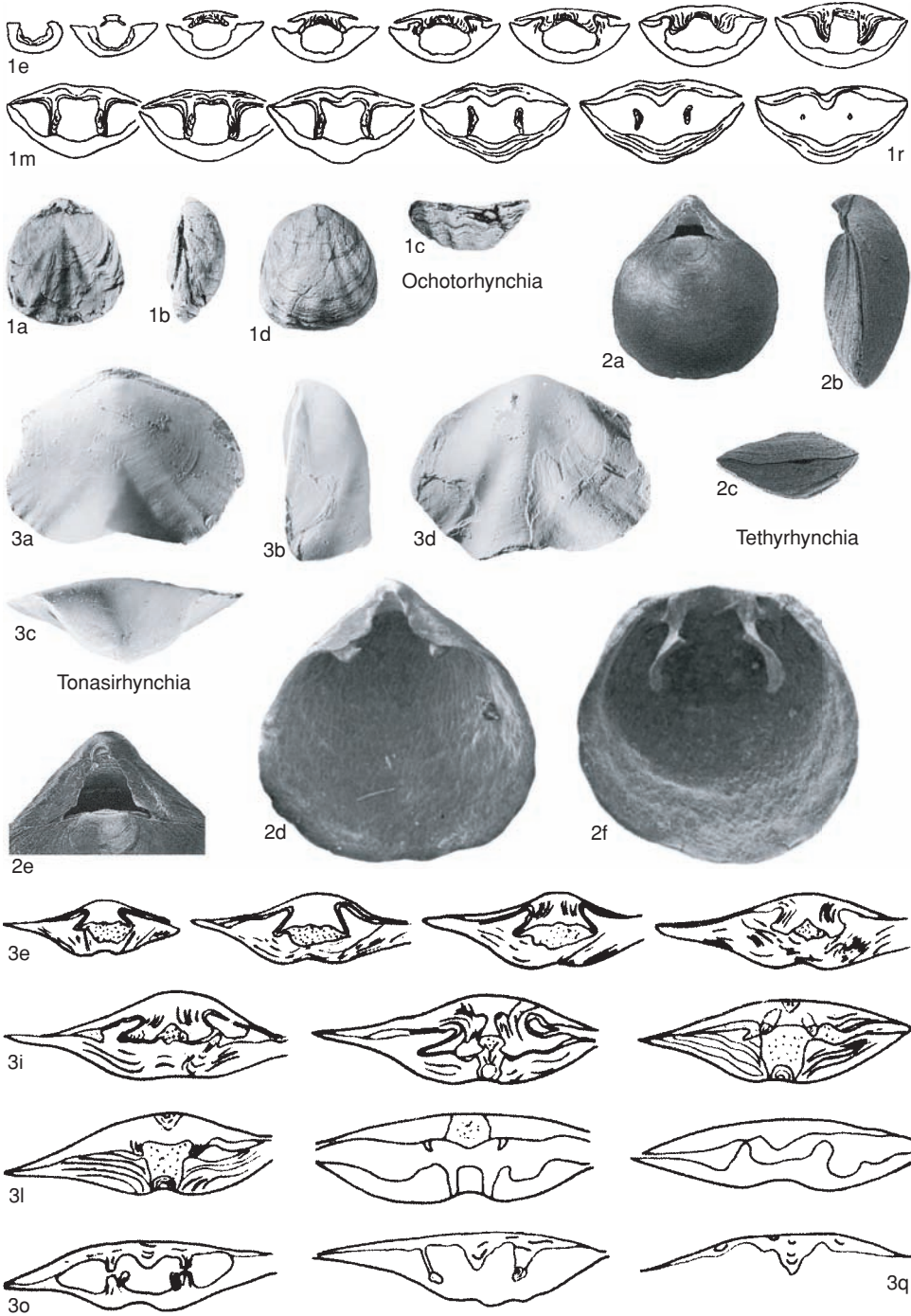


FIG. 896. Ochotorhynchiidae and Tethyrhynchiidae (p. 1321–1325).

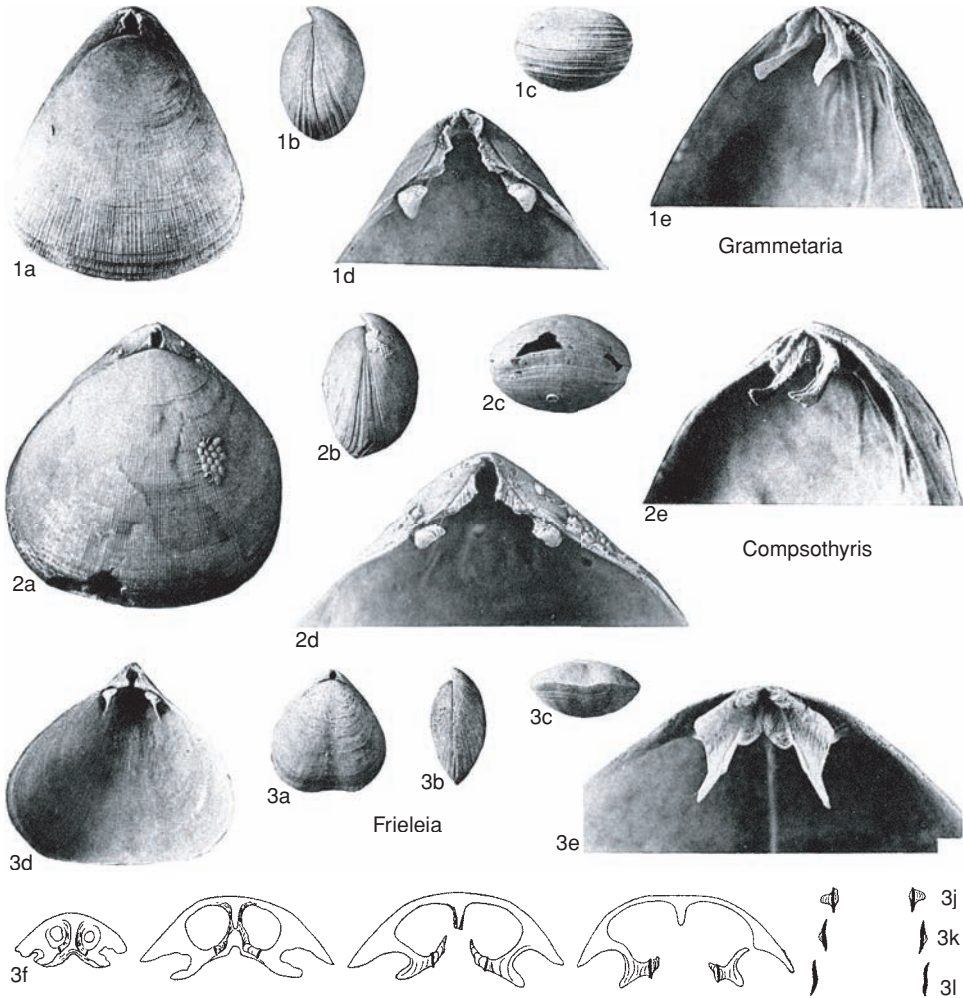


FIG. 897. Frieleiidae (p. 1321).

**Hispanirhynchia** THOMSON, 1927, p. 159 [*Rhynchonella cornea* FISCHER (MS) in DAVIDSON, 1887, p. 171; OD]. Elongate-triangular with greatest width anterior to midvalve; ventribiconvex; rectimarginate to incipiently uniplicate; beak short, suberect, foramen large, incomplete, hypothyrid; deltidial plates small, disjunct. Ventral valve with well-developed but incomplete pedicle collar and thick teeth supported by short dental plates; dorsal valve with crenulated sockets, small and narrow hinge plates, short bladelike crura and thick median ridge extending to apex of valve. [Living species are largely bathyal.] *Paleogene* (*Eocene*), *Holocene*: Cuba, *Eocene*; Morocco, off Sudan and Canary Islands to Cape Finistere, *Holocene*.—FIG. 898, 1a–e. \*H.

*cornea* (FISCHER), *Holocene*, off Mogador, Morocco; a–c, dorsal, lateral, anterior views, USNM 130327a, ×1; d, dorsal interior showing cardinalia and crura, USNM 130327d, ×6; e, ventral umbo, USNM 130327c, ×4 (Cooper, 1959).

**Abyssoirhynchia** ZEZINA, 1980, p. 16 [*Hemithyris craneana* DALL, 1895, p. 717; OD]. Medium, translucent, rounded-triangular; rectimarginate to broadly sulcate; ventribiconvex; shell smooth to faintly striate; beak short, suberect, foramen open, large, hypothyrid. Dorsal septum very short and low; crura anteriorly enlarged, forming small, flat, spadelike distal ends. [Living species range from deep-bathyal to abyssal.] *Holocene*: southeastern Pacific Ocean.—FIG. 898, 2a–e. \*A. *craneana*



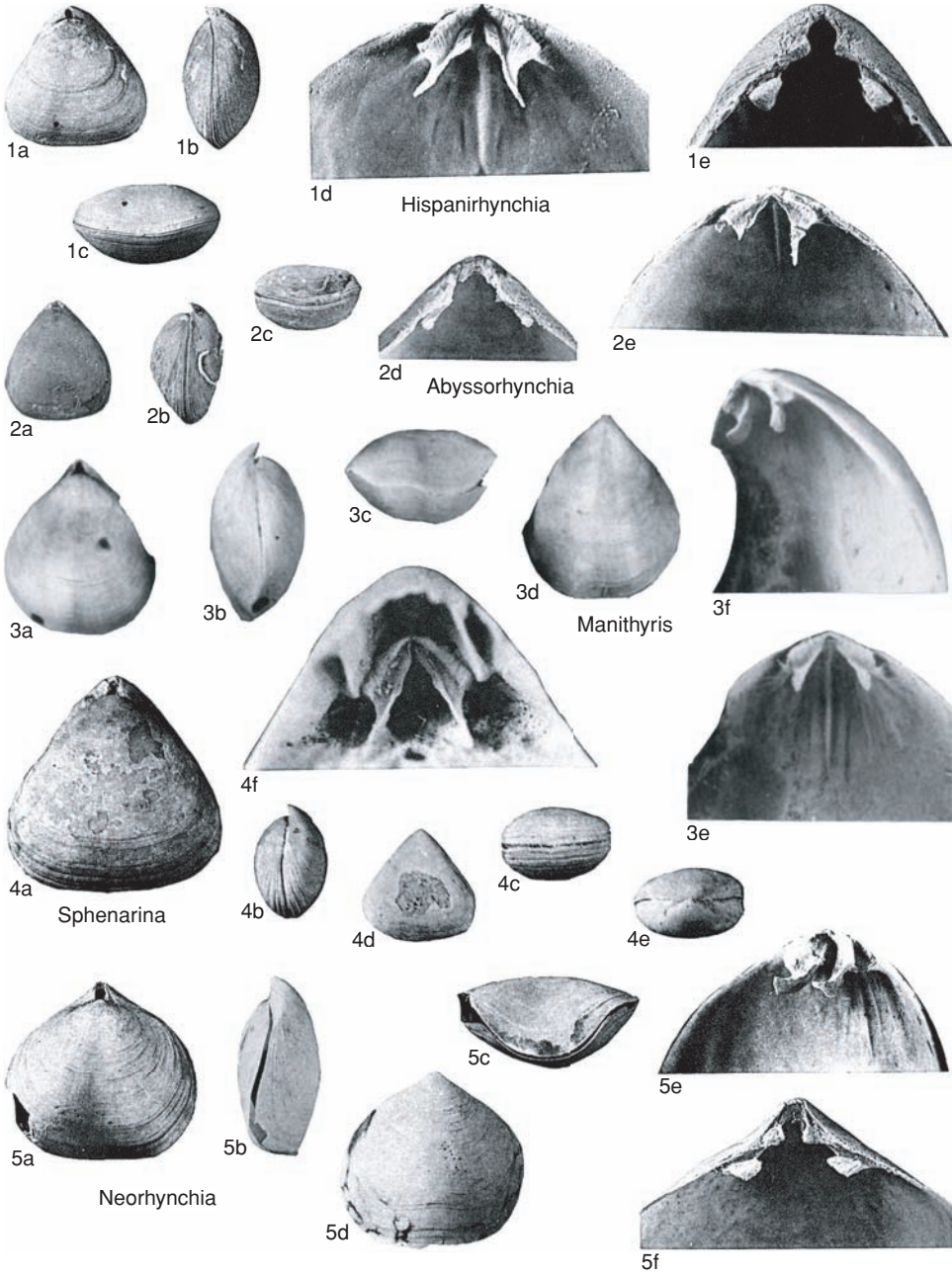


FIG. 898. Frieleiidae (p. 1323–1325).

(DALL), off Cocos Island, Panama; *a-c*, dorsal, lateral, anterior views,  $\times 1$ ; *d*, detail of beak region,  $\times 4$ ; *e*, holotype, cardinalia and crura in dorsal interior, USNM 122861,  $\times 4$  (Cooper, 1959).

?*Manithyris* FOSTER, 1974, p. 55 [*\*M. rossi*; OD]. Small, subequibiconvex, broadest anterior to midlength; finely capillate shell surface and irregularly ligate anterior commissure. Widely spaced crura spatulate, with outer surfaces strongly convex and inner surfaces concave, transitional between spinuliform and arcuiform; low dorsal median ridge; outer hinge plate narrow, no inner hinge plate. [Living species are abyssal.] *Holocene*: Antarctica (Ross Sea).—FIG. 898,3*a-f*. *\*M. rossi*; *a-d*, dorsal, lateral, anterior, ventral views,  $\times 1.5$ ; *e*, dorsal interior,  $\times 5$ ; *f*, holotype, oblique view of cardinalia, USNM 549997,  $\times 5$  (Foster, 1974).

*Sphenarina* COOPER, 1959, p. 62 [*\*Rhynchonella sicula* SEGUENZA in DAVIDSON, 1870, p. 461; OD]. Triangular in outline with greatest width anterior to midvalve; slightly ventribiconvex; rectimarginate; shell surface with fine radial striae. Similar in general character to *Hispanirhynchia* but without dorsal ridge or low septum. [Living species are bathyal.] *Neogene* (*Pliocene*), *Holocene*: Mediterranean region, *Pliocene*; Flores Sea, *Holocene*.—FIG. 898,4*a-f*. *\*S. sicula* (SEGUENZA), *Pliocene*, Messina, Sicily; *a*, enlarged dorsal view,  $\times 2$ ; *b-e*, lateral, anterior, ventral, posterior view, USNM 173728s,  $\times 1$ ; *f*, interior of dorsal umbo showing cardinalia and crura, USNM 549318a,  $\times 10$  (Cooper, 1959).

### Subfamily NEORHYNCHIIINAE new subfamily

[Neorhynchiiinae MANCERIDO & OWEN, herein]

Smooth Frieleiidae, subpentagonal and strongly sulcate to almost rectimarginate. Teeth crenulated, dental plates short; dorsal median ridge present; crura crescentic, arcuiform; septalium absent. *Holocene*.

*Neorhynchia* THOMSON, 1915, p. 388 [*\*Hemithyris strebeli* DALL, 1908, p. 441; OD]. Suboval to pentagonal, gently ventribiconvex, typically sulcate, smooth; broad but deep, arcuate anterior commissure; beak short, hypothrid; foramen moderate, deltidial plates disjunct. Crura short, gently arcuiform. [Living species are largely abyssal, shallower in Antarctica.] *Holocene*: Pacific Ocean.—FIG. 898,5*a-f*. *\*N. strebeli* (DALL), mid-Pacific; *a-d*, paratype, dorsal, lateral, anterior, ventral views, USNM 110741a,  $\times 2$ ; *e*, oblique view of crura,  $\times 4$ ; *f*, holotype, detail of ventral umbo, USNM 110741,  $\times 4$  (Cooper, 1959).

### Family TETHYRHYNCHIIDAE Logan, 1994

[Tethyrhynchidae LOGAN in LOGAN & ZIBROWIUS, 1994, p. 81]

Smooth Norelloidea, rectimarginate, faintly ventribiconvex; teeth not crenulated; dental plates, dorsal median septum, and cardinal process absent; flaring crescentic, so-called luniform crura; bell-shaped trocholophe. *Holocene*.

*Tethyrhynchia* LOGAN in LOGAN & ZIBROWIUS, 1994, p. 79 [*\*T. mediterranea*; OD]. Very small, smooth, translucent to transparent; subcircular, rectimarginate; almost equibiconvex with ventral valve barely deeper than dorsal; beak large, produced, slightly incurved; deltidium incomplete, deltidial plates disjunct, foramen comparatively large. *Holocene*: southern France, off Tunisia, Croatia (in submarine caves).—FIG. 896,2*a-f*. *\*T. mediterranea*, paratype, Marseille region, French coast; *a*, dorsal view, USNM 477119,  $\times 25$ ; *b*, lateral view, USNM 477121,  $\times 25$ ; *c*, anterior view, USNM 477120,  $\times 25$ ; *d*, ventral interior, USNM 477123,  $\times 36$ ; *e*, detail of apical region showing deltidium and foramen, USNM 477119,  $\times 50$ ; *f*, dorsal interior showing flared arcuiform crura, USNM 477125,  $\times 36$  (Logan & Zibrowius, 1994).

# HEMITHIRIDOIDEA

MIGUEL O. MANCENIDO,<sup>1</sup> ELLIS F. OWEN,<sup>2</sup> SUN DONG-LI,<sup>3</sup> and A. S. DAGYS<sup>4</sup>

[<sup>1</sup>La Plata Natural Sciences Museum, Argentina; <sup>2</sup>formerly of The Natural History Museum; <sup>3</sup>Nanjing Institute of Geology and Palaeontology; and <sup>4</sup>deceased]

## Superfamily HEMITHIRIDOIDEA Rzhonsnitskaia, 1956

[*nom. transl. et correct.* MANCENIDO, OWEN, SUN, & DAGYS, herein, *ex* Hemithyrinae RZHONSNITSKAIA, 1956a, p. 126]

Rhynchonellida with subtriangular to subpentagonal, often globose, commonly strongly costate shells, sometimes bearing attenuated radial ribbing; moderate to prominent beak; dorsal fold and squama and glotta usually well defined. Dorsal median septum and uncovered septalium present, though variably developed; crura raduliform or variation thereof. *Middle Triassic–Holocene.*

### Family HEMITHIRIDIDAE Rzhonsnitskaia, 1956

[*nom. transl. et correct.* AGER, 1965, p. 623, *ex* Hemithyrinae RZHONSNITSKAIA, 1956a, p. 126]

Dorsibiconvex, globose Hemithiridoidea, typically bearing numerous, fine, dense, radial costellae; commissure broadly to narrowly uniplicate, but dorsal fold indistinct; squama and glotta junction dorsally convex. Crura strong, slender, curved raduliform, attached to small outer hinge plates by their posterodorsal face or to thick socket ridges; crura raduliform, distally pointed and horizontally flattened; somewhat sunken biconcave cardinal process. Two pairs of metanefridia; intestines with curved distal end and terminal expansion; conoidal spirolophe bearing up to 5 whorls. [Based on unjustified emendation of *Hemithiris* D'ORBIGNY, 1847, p. 268, herein corrected in accordance with Article 35.4.1 of ICZN, 1999.] *Paleogene (Eocene)–Holocene.*

*Hemithiris* D'ORBIGNY, 1847, p. 268 [\**Anomia psittacea* GMELIN, 1790, p. 3348; SD DAVIDSON, 1852a, p. 252] [=*Hemithyris* [BRONN], 1848, p. 246, obj., unjustified emendation]. Medium, trigonal, uniplicate, finely costellate, finely striate to smooth; beak long, suberect, hypothyrid. Ventral median ridge posteriorly; dorsal median ridge low; crura long, flattened posteriorly, and with moderate

concave surfaces dorsally becoming more acute at the distal ends. [Living species range from subtidal to circalittoral, even bathyal.] *Paleogene (Eocene)–Holocene:* England, Belgium, Japan, Alaska, Canada, Sicily, *Pliocene–Pleistocene;* from Alaska to Japan via European Mediterranean and North Atlantic to North Pacific, *Holocene;* Antarctica (Cockburn and Seymour Islands), *Eocene–Oligocene.*—FIG. 899, 2a–f. \**H. psittacea* (GMELIN), Holocene, Alaska; a–c, dorsal, lateral, anterior views, USNM 111004a, ×1; d, internal view of dorsal valve showing crura and low median ridge, ×2; e, ventral interior showing dental plates and teeth, ×2; f, dorsal interior showing crura, USNM 111004b, ×3 (Cooper, 1959).

?*Patagorhynchia* ALLAN, 1938, p. 199 [\**Rhynchonella patagonica* VON IHERING, 1903, p. 334; OD]. Subcircular to subpentagonal, uniplicate; finely costate with growth lines prominent anteriorly; dorsal fold well defined; ventral sulcus shallow, broadly trapezoidal. Beak small, nearly straight, foramen submesothyrid. *Paleogene (Eocene):* Argentina, Chile.—FIG. 899, 1a–e. \**P. patagonica* (VON IHERING), Santa Cruz province, Argentina; dorsal, ventral interior, lateral, anterior, dorsal interior showing thickened cardinalia and crura, ×1 (Cooper, 1959).

*Mempixina* COOPER, 1981, p. 13–14 [\**Rhynchonella nigricans* var. *pyxidata* DAVIDSON, 1880, p. 59; OD]. Small to medium, moderately dorsibiconvex, rounded to globular, strongly uniplicate, but dorsal fold scarcely raised; beak short, erect, foramen hypothyrid, elongate-oval, small; deltidial plates disjunct; shell surface multicostellate, costellae rounded, interrupted by numerous concentric growth lines. Hinge teeth thick, buttressed by short dental plates; crura short, crescentic in cross section, incipiently canaliform; dorsal median septum short but rising to crest just anterior to crura. [Living species range from circalittoral to upper bathyal.] *Holocene:* southern Indian Ocean (Kerguelen and Amsterdam Islands).—FIG. 899, 3a–f. \**P. pyxidata* (DAVIDSON), off Kerguelen Island; a, dorsal view, MNHN BRA-78-15d, ×2; b–c, lateral, anterior views, MNHN BRA-78-15h, ×1; d, oblique view of crura and cardinalium, MNHN BRA-78-15f, ×2; e, ventral interior, ×2; f, dorsal interior showing septum and cardinalia, MNHN BRA-78-15i, ×2 (Cooper, 1981).

### Family CYCLOTHYRIDIDAE Makridin, 1955

[*nom. correct.* SMIRNOVA, 1984, p. 78, *pro* Cyclothyridae MAKRIDIN, 1964, p. 189, *nom. transl. ex* Cyclothyrisinae MAKRIDIN, 1955, p. 82]

Trilobate, sharply costate Hemithiridoidea, with anterior commissure uniplicate

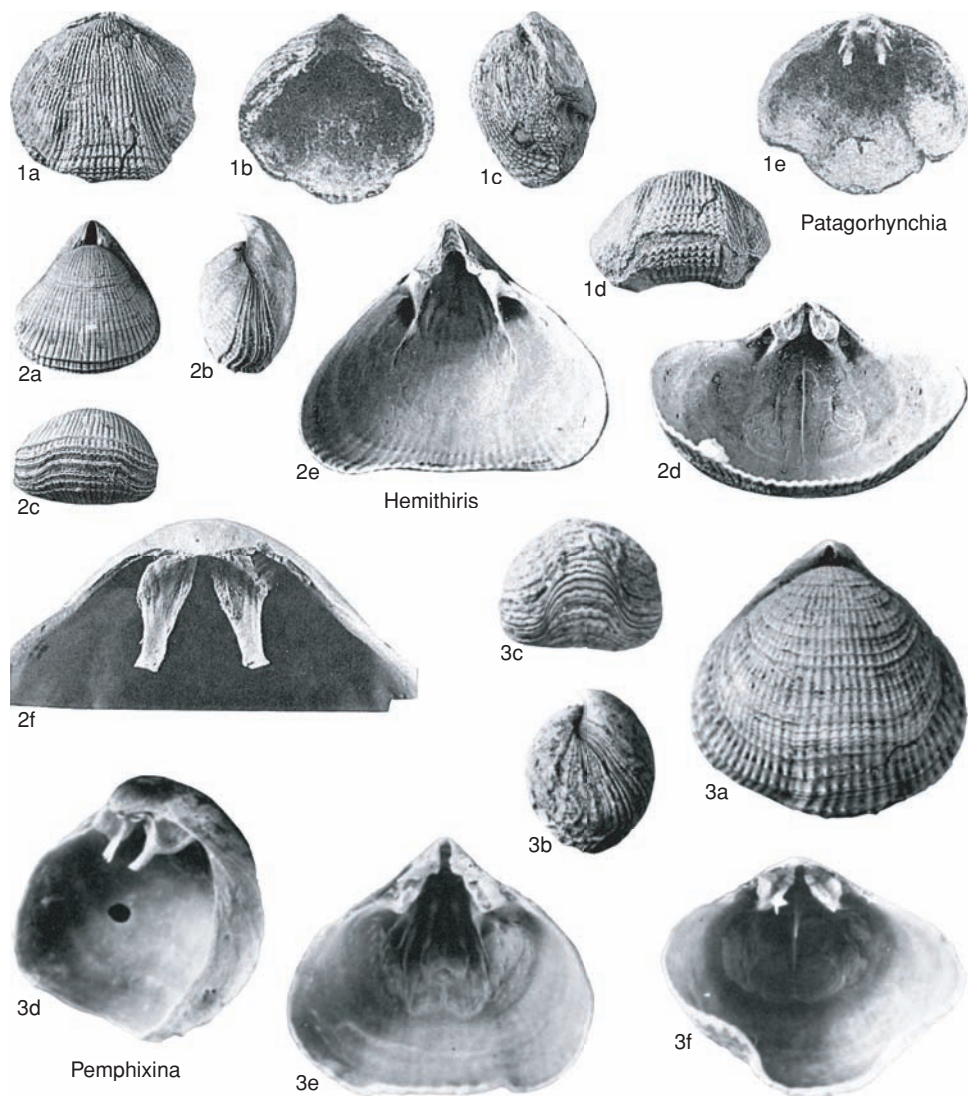


FIG. 899. Hemithirididae (p. 1326).

or sometimes asymmetrical; lamellose ornament frequently developed; squama-glotta obsolescent. *Middle Triassic (Anisian)*–*Upper Cretaceous (Maastrichtian)*.

**Subfamily CYCLOTHYRIDINAE**  
**Makridin, 1955**

[*nom. correct.* AGER, 1965, p. 614, *pro* Cyclothyrisinae MAKRIDIN, 1955, p. 82] [=Praecyclothyridinae MAKRIDIN, 1964, p. 149 *partim* (containing type genus)]

Fully costate Cyclothyrididae, rarely with posterior smooth area; beak massive, with

large hypothyril rimmed foramen (i.e., deltidial plates produced into short tube around pedicle). Dorsal median septum usually very much reduced, septalium reduced or absent; crura canaliform (or at least distally concave modified raduliform). Characteristically strongly and densely costate. [Cyclothyridae, proposed by PHILLIPS, 1841, p. 55 for *Epithyris* and *Hypothyris*, is not an available family group name under Article 11.7.1.1 of the ICZN (1999).] *Middle*

*Triassic (Anisian)—Upper Cretaceous (Maastrichtian).*

- Cyclothyris** M'COY, 1844, p. 103 [*\*Terebratula latissima*]. de C. SOWERBY, 1840 in 1840–1846, index, p. 7; SD BUCKMAN, 1906, p. 326; =*T. lata*]. de C. SOWERBY, 1825 in 1823–1825, p. 165, non J. SOWERBY, 1815 [= *Cyclothiris* D'ORBIGNY, 1850, p. 323, *nom. null.*]. Medium to large, wide, with uniplication low, arcuate, commonly asymmetrical; costellae numerous, fine posteriorly, given to bifurcation and antidichotomy anteriorly; beak erect, foramen large, auriculate; deltidial plates conjunct, well exposed. Dorsal septum short or absent; hinge plates distally concave; crura long, dorsally concave. *Lower Cretaceous (Aptian)—Upper Cretaceous (Maastrichtian)*: England, France, Germany, Switzerland, Belgium, Poland, Romania, Bulgaria, Spain, Slovakia, Yugoslavia, Russia, Morocco, South Africa, Madagascar, ?Pakistan, India, Turkmenistan, USA, Chile.—FIG. 900,1a–g. *\*C. latissima* (J. de C. SOWERBY), upper Aptian, Berkshire, England; a–c, toptype, dorsal, lateral, anterior views, BMNH BB.41494, ×1 (new); d–g, toptype, transverse serial sections, distances in mm from ventral umbo, 1.3, 1.7, 2.3, 2.7, 3.2, 3.6, 3.9, 4.1, 4.4, 4.8, 5.1, 5.3, 5.6, 5.8, BMNH BB.5482 (Owen, 1962).—FIG. 900,1r. *C. aff. difformis* (VALENCIENNES in LAMARCK), Cenomanian, near Prague, Bohemia; interior showing dorsal septum, canaliform crura, and dental plates, CGS ON16/690, ×3 (Nekvasilová, 1973).
- Almerarhynchia** CALZADA BADIA, 1974, p. 94 [*\*A. virgiliana*; OD]. Medium, equibiconvex, nearly as wide as long; median dorsal fold poorly developed; umbo short, massive, truncated by large foramen; costae rounded, deeply incised (4 to 8 on fold). Dental plates short, subparallel; hinge plates moderately long, ventrally deflected in early stages to horizontal; dorsal myophragm ridgelike to indistinct; crura incurved, distally canaliform. [Possibly a junior synonym of *Hesperorhynchia*.] *Upper Cretaceous (Campanian—upper Maastrichtian)*: Spain, ?eastern Europe.—FIG. 900,2a–j. *\*A. virgiliana*, Maastrichtian, Catalanian pre-Pyrenees, Spain; a–c, paratype, dorsal, lateral, anterior views, MGSB 11789, ×1; d–j, transverse serial sections, distances in mm from ventral umbo, 2.6, 3.1, 3.5, 3.9, 4.6, 5.8, 6.2 (Calzada Badia, 1974).
- Aucklandirhynchia** MACFARLAN, 1992, p. 217 [*\*A. aucklandica*; OD]. Small to moderate size, rounded to subpentagonal; dorsibiconvex, well inflated; uniplicate, may be asymmetrical, fold ill defined and sulcus distinct, rounded; costae strong, narrow, subangular to rounded, sometimes with posterior smooth stage; beak large, foramen large, circular and pedicle collar. Dorsal median septum moderately short, usually low; septalium broad; dental plates wide apart, slightly dorsally divergent. *Lower Jurassic (Pliensbachian)—Middle Jurassic (Callovian)*:

New Zealand.—FIG. 900,3a–k. *\*A. aucklandica*, Teraikan, North Island; a–d, holotype, dorsal, lateral, anterior, ventral views, NZGS BR1874, ×2; e–k, toptype, transverse serial sections, distances in mm from ventral umbo, 1.2, 1.3, 1.6, 1.9, 2.2, 2.4, 2.6, OU NZ 17309 (MacFarlan, 1992).

- Bicepsirhynchia** SHI, 1990, p. 310 [*\*B. asperata*; OD]. Small to medium; suboval to pyriform; fully costate; beak relatively strong; foramen hypothyrid to mesothyrid with deltidial plates conjunct and thickened. Dorsal median septum and septalial plates extremely reduced; no septalium; crura canaliform, incurved abruptly toward ventral valve. *Upper Jurassic (Oxfordian)*: China (southern Qinghai), France.—FIG. 900,4a–j. *\*B. asperata*, lower Oxfordian, southern Qinghai; a–c, holotype, dorsal, lateral, anterior, MCMB Y154193, ×1 (Shi, 1992); d–j, paratype, transverse serial sections, distances in mm from first section, 4.0, 4.2, 4.7, 5.4, 5.8, 6.0, 6.2, MCMB Y154192 (Shi & Grant, 1993).
- Costirhynchopsis** DAGYS, 1977, p. 387[139], *nom. nov. pro Costirhynchia* DAGYS, 1974, p. 105, non BUCKMAN, 1918, also Rhynchonellida [*\*Costirhynchia spatiosa* DAGYS, 1974, p. 106; OD]. Small to medium size, laterally oval to wide subpentagonal, uniplicate, with fold low or absent; thickest near front; strongly costate throughout; beak suberect, ridges distinct, foramen hypothyrid, deltidial plates disjunct. Dental plates ventrally divergent; septalium short, supported by low septum, crura raduliform; pedicle collar absent. *Middle Triassic (Anisian)—Upper Triassic (Carnian)*: Alps, Balkans, central Europe, Carpathians, northwestern Caucasus, Pamirs, northeastern Iran, China, ?New Guinea.—FIG. 901,1a–k. *\*C. spatiosa* (DAGYS), Carnian, northwestern Caucasus; a–d, holotype, dorsal, lateral, anterior, ventral views, IGiG 394/55, ×2; e–k, transverse serial sections, distances in mm from first section, 0.2, 1.1, 1.5, 1.9, 2.2, 2.6, 3.1, IGiG 394/58 (Dagys, 1974).
- Fissirhynchia** PEARSON, 1977, p. 48 [*\*Rhynchonella fissicostata* SUESS, 1854, p. 30; OD]. Small to medium size, laterally oval to subpentagonal; uniplicate, sinus broad, corresponding fold low or absent; fully costate, costae sharp, branching prominently near umbones; beak acuminate, incurved to erect, ridges indistinct; foramen submesothyrid. Dental plates long, subparallel; pedicle collar absent; outer hinge plates arched, septalium deep, supported by high median septum; crura canaliform. *Upper Triassic (?upper Carnian, Norian)—Lower Jurassic (Pliensbachian)*: Alps (Austria), Balkans (Bulgaria, Greece), Carpathians (Slovakia), central Italy, Hungary, northwestern Romania, Yugoslavia, Crimea, northwestern Caucasus, Turkey, Iran, New Zealand, New Caledonia, ?Himalayas, ?Peru, ?upper Carnian, Norian–Rhaetian; northern Alps (Austria, Switzerland), Sicily, Hungary, ?Indonesia, Argentina, Hettangian–Pliensbachian.—FIG. 901,2a–k. *\*F. fissicostata*

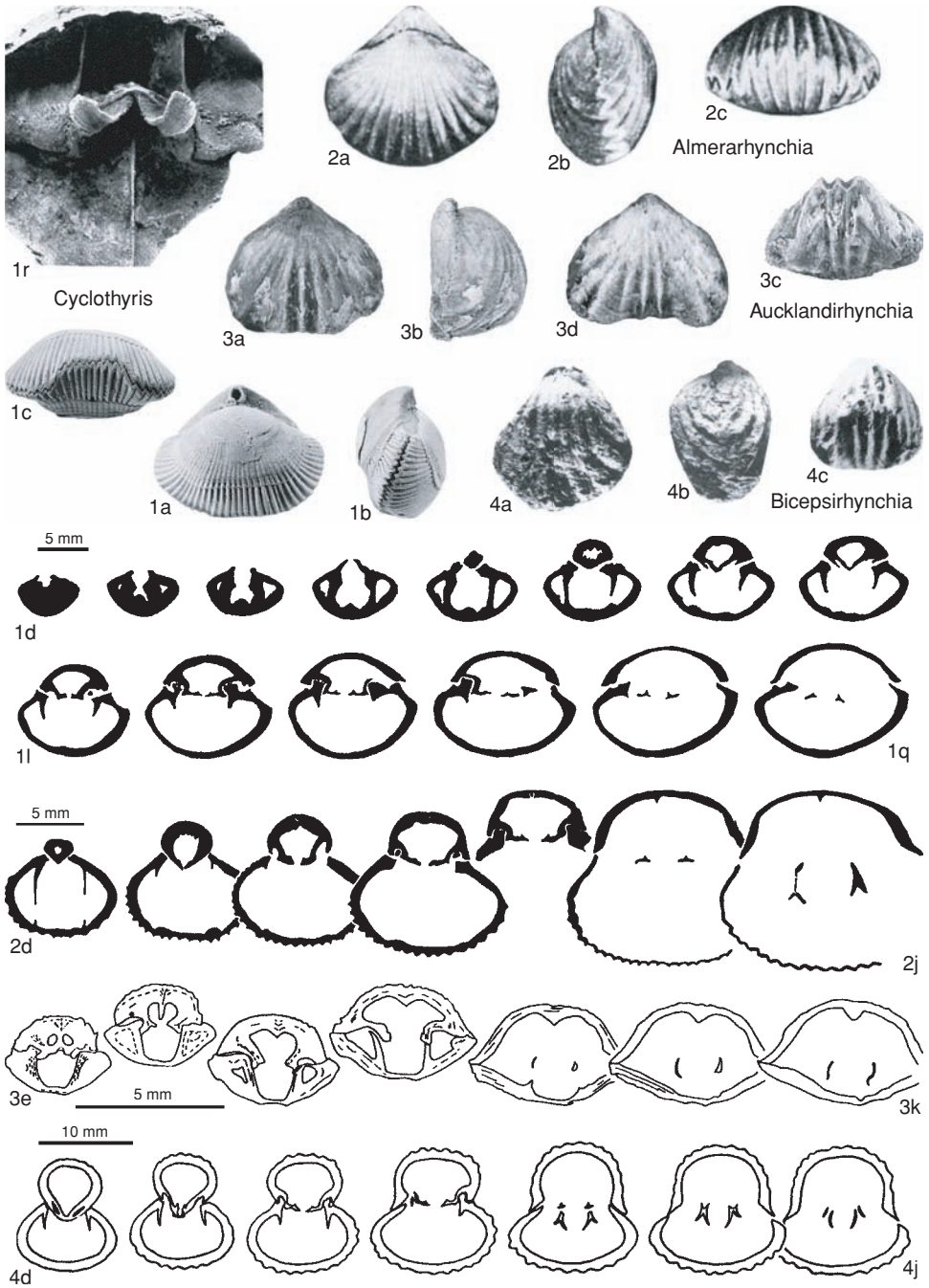


FIG. 900. Cyclothyrididae (p. 1328).

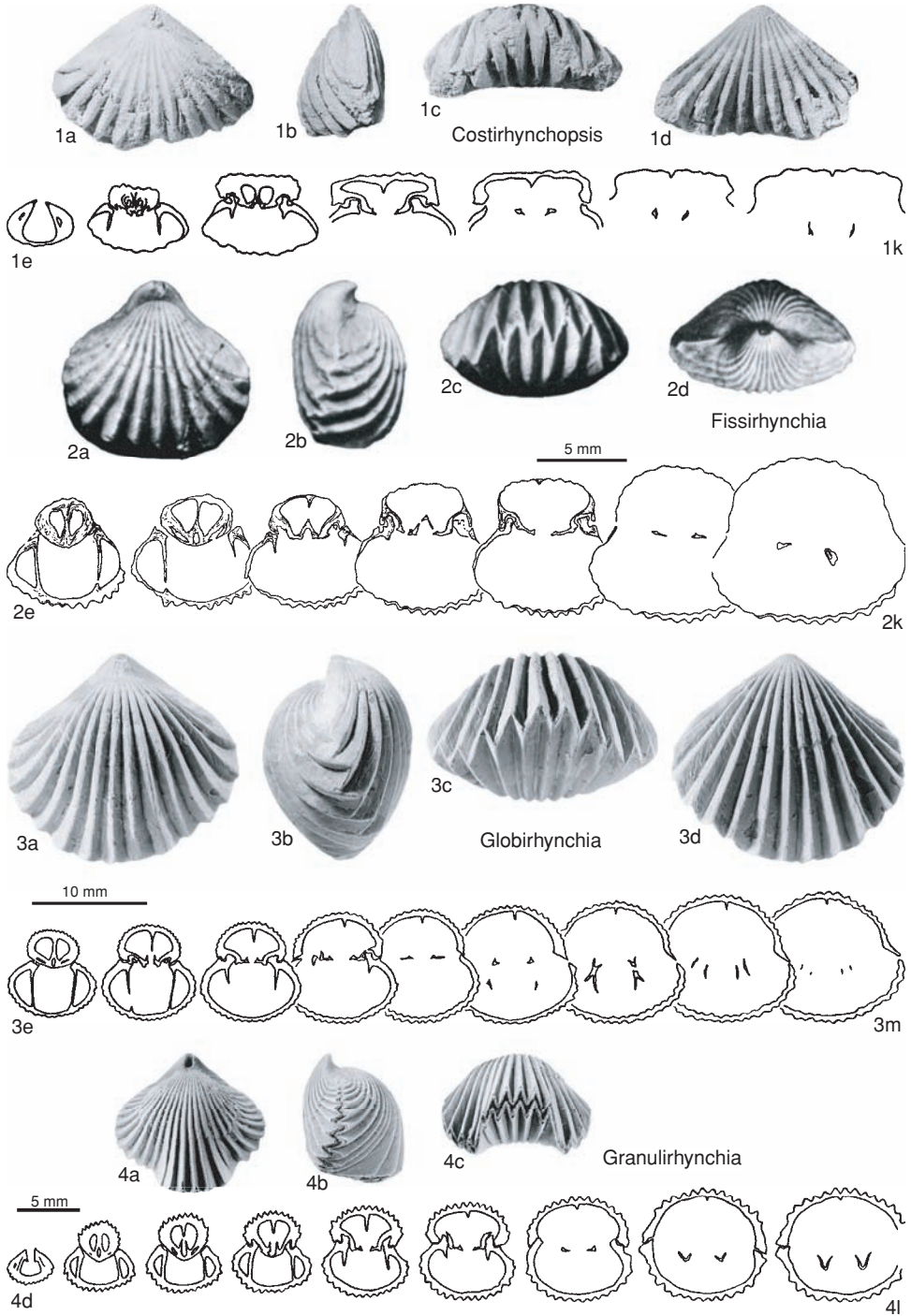


FIG. 901. Cyclothyrididae (p. 1328–1331).

- (Suess), Rhaetian, Piesting-Tal, Austria; *a-d*, topotype, dorsal, lateral, anterior, posterior views,  $\times 1.3$ ; *e-k*, transverse serial sections, distances in mm from ventral umbo, 2.7, 3.0, 3.15, 3.65, 4.05, 5.05, 5.75, PC 2, D. A. B. Pearson, personal collection, to be placed in the Natural History Museum of Vienna (Pearson, 1977).
- Globirhynchia** BUCKMAN, 1918, p. 48 [*\*Rhynchonella suboboleta* DAVIDSON, 1852b, p. 91; OD] [= *Globirhynchia* BUCKMAN, 1914, p. 1, and 1915, p. 76, both suppressed (ICZN, 1971, Opinion 957)]. Small to medium size, globose subequibiconvex; uniplication arcuate and dorsal fold low, indistinct; costae numerous, simple, coarse subangular, no smooth stage; beak massive, suberect, foramen rimmed, hypothyrid. Dorsal septum long and low; septalium variable, may be pitlike to deep V-shaped; hinge plates broad, subhorizontal; canaliform crura strongly incurved ventrally. *Middle Jurassic (Aalenian-Bajocian, ?Bathonian)*: England, France, Spain, Austria, Italy, Transcarpathia, northwestern Caucasus, Arabia, Egypt (Sinai), Thailand, USA (?California).—FIG. 901, *3a-m*. *\*G. suboboleta* (DAVIDSON), Aalenian, Cotswolds, England; *a-d*, dorsal, lateral, anterior, ventral views, BMNH B.31698,  $\times 1.5$  (new); *e-m*, transverse serial sections, distances in mm from ventral umbo, 2.3, 2.5, 2.7, 3.5, 3.8, 4.4, 4.6, 5.0, 5.3, USNM 429428 (Shi & Grant, 1993).
- Granulirhynchia** BUCKMAN, 1918, p. 64 [*\*Rhynchonella granulata* UPTON, 1905, p. 83; OD] [= *Granulirhynchia* BUCKMAN, 1914, p. 2, and 1915, p. 77, both suppressed (ICZN, 1971, Opinion 957)]. Medium size, subtrigonal, wide, depressed, dorsibiconvex; fold low, wide and uniplication strong; costae numerous, complete, simple, sharp, covered with fine granules; beak strong, suberect to nearly straight; foramen large, rimmed, with conjunct deltidial plates. Dorsal median septum strong; hinge plates broad; crura canaliform. *Middle Jurassic (Aalenian)*: England, France.—FIG. 901, *4a-l*. *\*G. granulata* (UPTON), Cotswolds, England; *a-c*, dorsal, lateral, anterior views, BMNH B.68633,  $\times 1$  (new); *d-l*, topotype, transverse serial sections, distances in mm from ventral umbo, 1.8, 2.9, 3.3, 3.5, 3.7, 4.4, 4.9, 5.7, 5.9, USNM 104770d (Shi & Grant, 1993).
- ?Halorellina** XU, 1978, p. 276 [*\*H. zhonghuaensis*; OD]. Small to medium size; pentagonal to transverse elliptical in outline; beak stout, short, and nearly straight; beak ridges angular; palintrope wide and flattened; delthyrium open; sulci commonly developed on both valves; commissure rectimarginate to slightly uniplicate; surface ornamented with angular plicae increasing by bifurcation or intercalation. Dental plates present; teeth strongly developed; dorsal interior with septum high and narrow, septalium very short, and crura short. [Possibly a junior subjective synonym of *Fissirhynchia*; differences, such as special gabled inner hinge plates and chiselled crura, attributable to tilted sectioning.] *Upper Triassic*: southeastern China (Sichuan).—
- FIG. 902, *4a-i*. *\*H. zhonghuaensis*; *a-d*, holotype, dorsal, lateral, anterior, ventral views,  $\times 1$ ; *e*, detail of apical region, CIGMR SCSb 6036,  $\times 4$ ; *f-i*, transverse serial sections, distances in mm from ventral umbo, 1.5, 2.15, 2.65, 3.15 (Xu, 1978).
- Hesperorhynchia** WARREN, 1937, p. 2 [*\*H. superba*; OD]. Medium, subtriangular to subcircular; semiglobose with uniplication moderate, wide, arcuate, and dorsal fold low, inconspicuous; costae few, strong, subangular (3 to 4 on fold); beak small, incurved. Dorsal septum and septalium reported as absent; dental plates short and weak. [Very similar to *Almerarhynchia*.] *Upper Cretaceous*: Canada, western USA.—FIG. 903, *3a-d*. *\*H. superba*, upper Senonian, Saskatchewan, Canada; holotype, dorsal, lateral, anterior, ventral views, UA H160 ct809,  $\times 1$  (new).
- Lacunaerhynchia** ALMÉRAS, 1966, p. 97 [*\*L. vergissonensis*; OD] [= *Septulirhynchia* ALMÉRAS, 1966, p. 110 (type, *S. davidi*, OD); *Nyalamurhynchia* CHING, RONG, & SUN in CHING, SUN, & RONG, 1976, p. 300 (type, *N. mirifica* CHING, RONG, & SUN in CHING, SUN, & RONG, 1976, p. 301, OD)]. Medium, subtrigonal, subcircular to subpentagonal, depressed equibiconvex; uniplication shallow, arcuate to flattened, but median fold barely raised; costae numerous, subangular, 5 to 8 on fold; beak short, suberect to incurved; foramen submesothyrid; deltidial plates conjunct to subconjunct. Dental plates thin, subparallel; dorsal median septum well developed and septalium deep; crura raduliform, long. *Middle Jurassic (Bajocian-Bathonian)*: France, Poland, Romania, China (Himalayas), Argentina.—FIG. 903, *1a-k*. *\*L. vergissonensis*, lower Bajocian, Saône-et-Loire, France; *a-c*, holotype, dorsal, anterior, ventral views, FSL 45737,  $\times 1$ ; *d-k*, transverse serial sections, distances in mm from ventral umbo, 1.5, 2.75, 2.9, 3.55, 4.6, 4.9, 5.8, 6.2, FSL 45736 (Almérás, 1966).—FIG. 903, *1l-u*. *L. davidi* (ALMÉRAS), lower Bajocian, Saône-et-Loire, France; *l-n*, dorsal, anterior, ventral views, FSL 45750,  $\times 1$ ; *o-u*, transverse serial sections, distances in mm from ventral umbo, 1.0, 2.45, 2.55, 2.75, 3.3, 3.5, 4.6, FSL 45745 (Almérás, 1966).—FIG. 903, *1v-gg*. *L. mirifica* (CHING, RONG, & SUN), Bajocian, Tibet; *v-y*, holotype, dorsal, lateral, anterior, ventral views, NIGP 28762,  $\times 1$ ; *z-gg*, holotype, transverse serial sections, distances in mm from ventral umbo, 1.2, 1.6, 2.0, 2.3, 2.6, 3.3, 3.8, 4.8, NIGP 28762 (Ching, Sun, & Rong, 1976).
- Lamellaerhynchia** BURRI, 1953, p. 274 [*\*Terebratula rostriformis* ROEMER, 1836, p. 40; OD; = *T. multiformis* ROEMER, 1839, p. 19, *partim*]. Medium size, multicostate; uniplicate, rectimarginate or asymmetrical; beak strong, suberect; dorsal septum ridgelike, strong, varying in length; crura long, dorsally concave with acutely concave distal ends giving rise to diabolo appearance when serial sectioned. *Lower Cretaceous (?Berriasian, Valanginian-Barremian, ?Aptian, Albian)*: England, France, Switzerland, Germany, Italy, Caucasus,



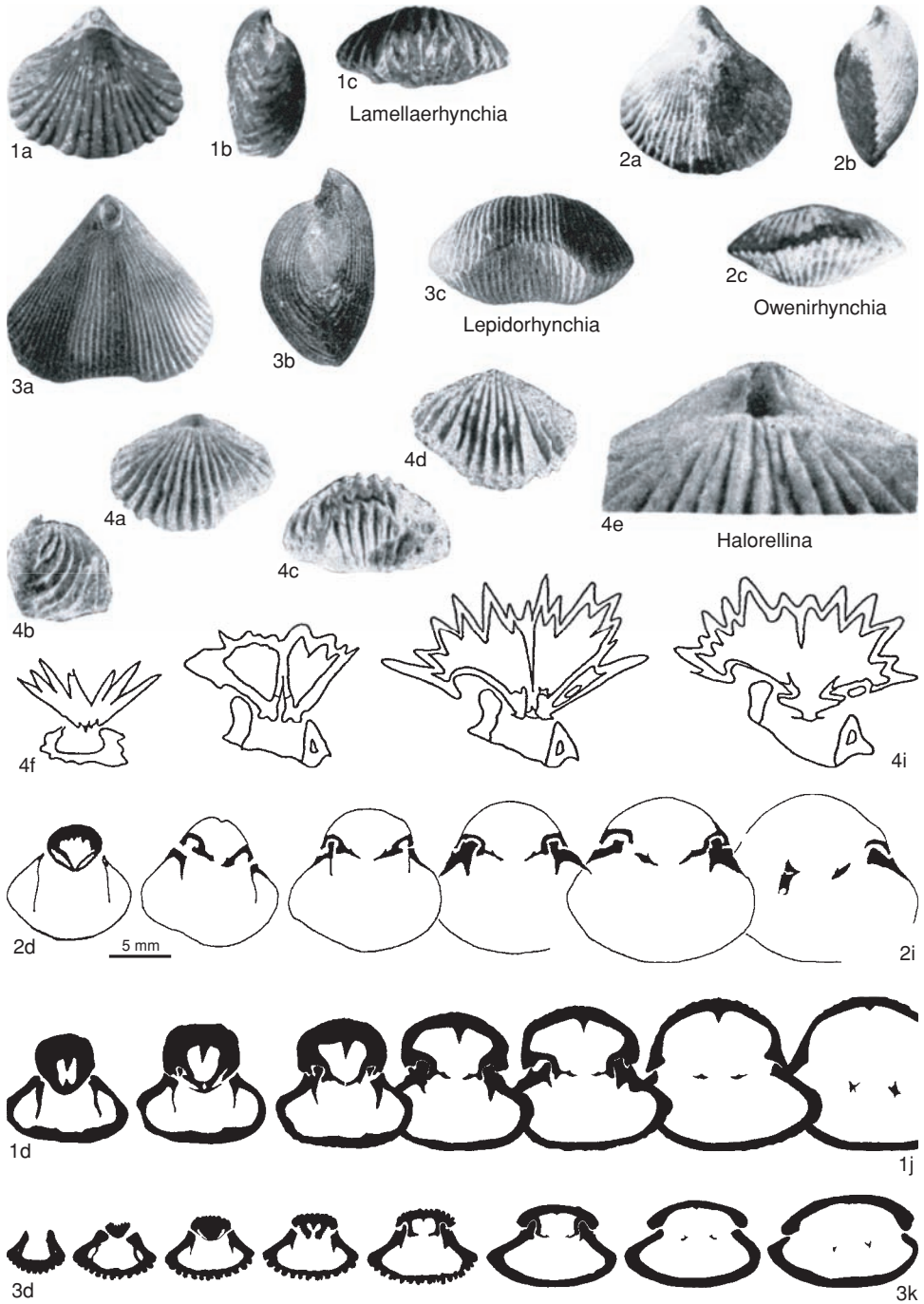


FIG. 902. Cyclothyrididae (p. 1331–1334).

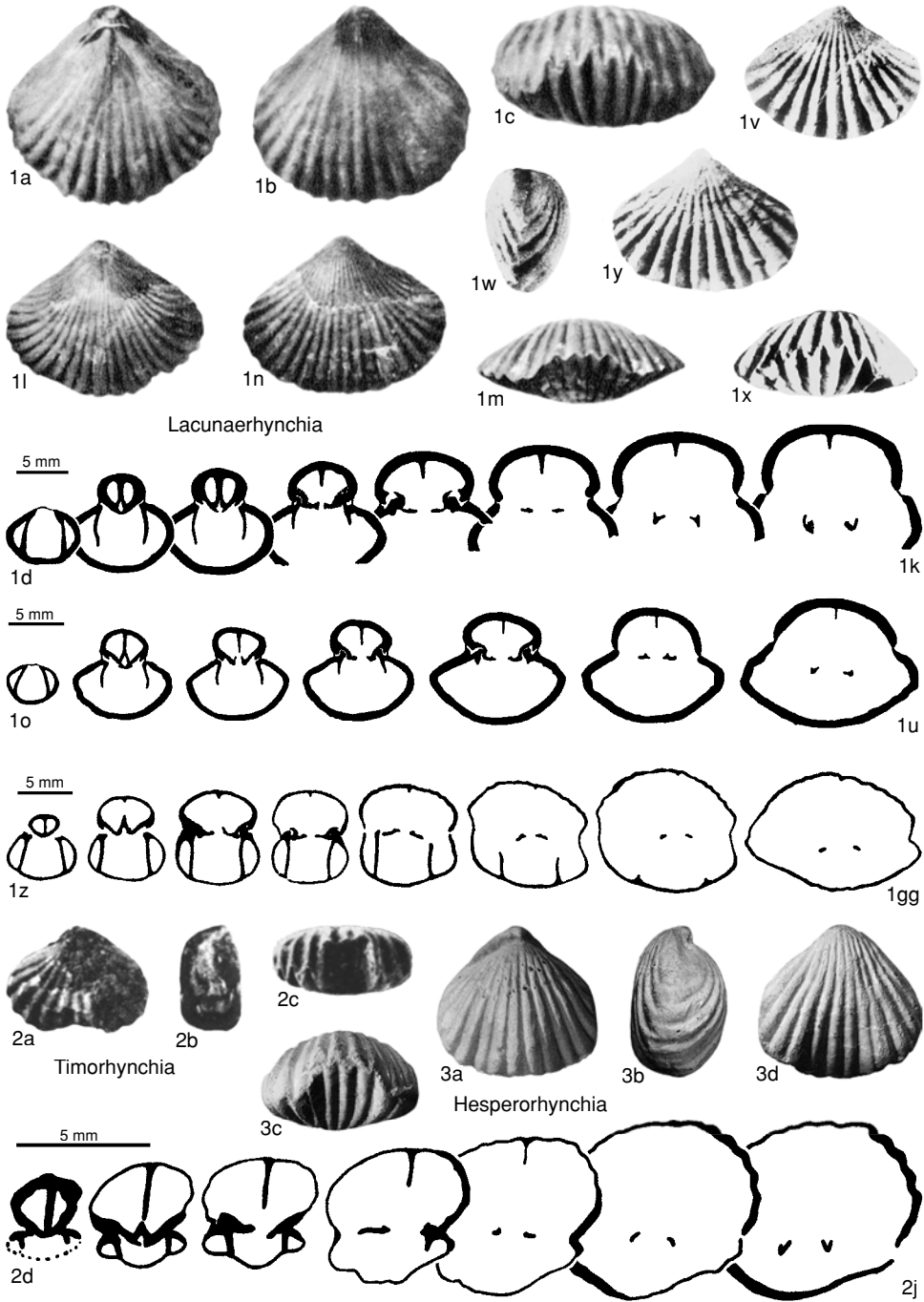


FIG. 903. Cyclothyrididae (p. 1331-1337).

- Morocco, USA, Mexico, Turkmenistan, ?Antarctica.—FIG. 902, 1a–j. \**L. rostriformis* (ROEMER); *a–c*, dorsal, lateral, anterior views, lowest Hauterivian, St. Croix, Swiss Jura, NHMB 6,  $\times 1$  (Burri, 1953); *d–j*, transverse serial sections of umbo, 3.8, 4.4, 4.8, 5.1, 5.8, 6.4, 6.9, Neocomian, northwestern Germany, BMNH B.35703, approximately  $\times 2$  (Owen & Thurell, 1968).
- Lepidorhynchia** BURRI, 1957, p. 689 [\**L. dichotoma*; OD]. Small to medium, equibiconvex, with numerous, fine, rounded costellae given to marginal dichotomy; rectimarginate, faintly bisulcate; beak long with large circular foramen. Dental plates short; median septum poorly developed or low ridge in dorsal valve; hinge plates horizontal to dorsally deflected; crural bases with concave distal ends. General appearance similar to young *Cyclothyris*. *Lower Cretaceous (upper Hauterivian–lower Barremian)*: France, Switzerland.—FIG. 902, 3a–k. \**L. dichotoma*, lower Barremian, Switzerland; *a–c*, holotype, dorsal, lateral, anterior views, NHMB 25a,  $\times 2$ ; *d–k*, transverse serial sections, cumulative distances in mm from first section, 0.5, 1.2, 1.4, 1.7, 1.9, 2.4, 2.9, 3.3,  $\times 2$  (Burri, 1957).
- Owenirhynchia** CALZADA in CALZADA & POCOVÍ, 1980, p. 14 [\**O. rubra*; OD]. Medium, oval-subtriangular, equibiconvex, wider than long, similar to *Cyclothyris*, rather more densely multicostate; anterior commissure broadly arcuate, rectimarginate but given to slight asymmetry. Dental plates subparallel to slightly ventrally divergent, supporting deeply inserted subquadrate hinge teeth; hinge plates long, ventrally deflected, distally concave; inner and outer socket ridges well developed. [Possibly a subgenus or a subjective synonym of *Cyclothyris*.] *Upper Cretaceous (Turonian–upper Campanian)*: Spain, ?France, ?Bohemia.—FIG. 902, 2a–i. \**O. rubra*, upper Campanian, Lérida, Spain; *a–c*, holotype, dorsal, lateral, anterior views, MGSB 30294,  $\times 1.3$ ; *d–i*, transverse serial sections, distances in mm from ventral umbo, 3.3, 3.7, 4.3, 4.7, 5.3, 5.9 (Calzada & Pocoví, 1980).
- Pararhynchonella** SHI, 1990, p. 311 [\**P. trigona*; OD]. Shell subtriangular to subpentagonal; uniplicate; strong ribs; inequivalve, weakly subcynocephalous in profile. Dorsal median septum and septalium well developed; crura canaliform, incurved ventrally. *Middle Jurassic (Bajocian)*: southern Tibet.—FIG. 904, 4a–l. \**P. trigona*; *a–d*, holotype, dorsal, lateral, anterior, ventral views, MCMB N124051-1,  $\times 1$ ; *e–l*, holotype, transverse serial sections, 2.6, 3.1, 3.7, 4.3, 4.7, 5.8, 6.4, 6.8, distances in mm from ventral umbo, MCMB N124050-1 (Shi, 1992).
- Plicarostrom** BURRI, 1953, p. 281 [\**P. hauteriviense*; OD]. Medium size, with costae numerous, sharp, or angular, deeply incised; cynocephalous, nearly convexoplane; beak projecting. Thick dental plates almost fused to shell wall; median septum or low ridge rising late; crura distally concave. *Lower Cretaceous (Hauterivian)*: Switzerland.—FIG. 904, 1a–j. \**P. hauteriviense*; *a–c*, holotype, dorsal, lateral, anterior views, NHMB L348,  $\times 1.5$ ; *d–j*, transverse serial sections, distances in mm from first section, 1.5, 1.6, 1.8, 2.4, 3.1, 4.1, 5.3 (Burri, 1957).
- Proteorhynchia** OWEN, 1981, p. 307 [\**Rhynchonella miquibuanensis* IMLAY, 1937, p. 570; OD]. Small, poorly biconvex, broadly oval-subtriangular, dorsal fold well defined, ventral sulcus shallow, linguiform extension trapezoidal; ornament of strong angular costae; beak slightly incurved, interarea poorly demarcated. Subparallel dental plates support elongate, deeply inserted hinge teeth; dorsal septum high, supporting deep septalium; concave distal ends of hinge plates developing long crura. *Lower Cretaceous (Valanginian–Aptian)*: Mexico.—FIG. 904, 2a–l. \**P. miquibuanensis* (IMLAY), Valanginian, Tamaulipas; *a–c*, holotype, dorsal, lateral, anterior views, UM 18738,  $\times 1$  (Imlay, 1937); *d–l*, transverse serial sections, distances in mm from ventral umbo, 0.9, 1.6, 2.0, 2.6, 3.0, 3.5, 3.8, 4.4, 4.8,  $\times 2$  (Owen, 1981).
- Rudirhynchia** BUCKMAN, 1918, p. 44 [\**R. rudis*; OD] [= *Rudirhynchia* BUCKMAN, 1914, p. 1, and 1915, p. 76, both suppressed (ICZN, 1971, Opinion 957); *Mediterranirhynchia* SUCIC-PROTIC, 1969, p. 53–54 (type, *M. mediterranea* SUCIC-PROTIC, 1969, p. 54, OD)]. Small to medium size, subtriangular to subpentagonal, depressed dorsibiconvex, uniplicate, dorsal fold low; smooth posteriorly, with costae numerous, strong, fairly sharp (2 to 6 on fold); beak strong, sharp, projecting, upright to slightly incurved, with large elongate rimmed foramen and disjunct deltidial plates. Dental plates thin, becoming subparallel, teeth crenulated; dorsal median septum and septalium well developed; crura raduliform, perhaps developing concave distal ends; pedicle collar usually present. *Lower Jurassic (Pliensbachian, ?lower Toarcian)*: England, Scotland, France, Germany, ?Portugal, Slovakia, Yugoslavia, Romania, Italy, ?Bulgaria, Caucasus, Siberia, ?Algeria, Argentina, Chile.—FIG. 905, 3a–k. \**R. rudis*, lower Pliensbachian, Cotswolds, England; *a–c*, dorsal, lateral, anterior views, GSM 31867,  $\times 1.5$ ; *d–k*, transverse serial sections, distances in mm from ventral umbo, 2.7, 2.9, 3.1, 3.4, 4.1, 4.7, 5.5, 6.0, J.922/1, Derek Ager, personal collection (Ager, 1959a).—FIG. 905, 3l–v. *R. mediterranea* (SUCIC-PROTIC), middle Lias, Carpatho-Balkanids, Yugoslavia; *l–n*, holotype, dorsal, lateral, anterior views, MFMGB 1/64,  $\times 1$ ; *o–v*, transverse serial sections, distances in mm from first section, 1.3, 1.6, 2.0, 2.2, 2.4, 3.2, 3.7, 3.95 (Sucic-Protic, 1969).
- Septaliphoria** LEIDHOLD, 1921, p. 354 [\**Rhynchonella arduennensis* OPPEL, 1857 in 1856–1858, p. 608 [p. 310 of 2nd part]; OD; = *R. inconstans* D'ORBIGNY, 1850 in 1849–1852, p. 24, non SOWERBY, 1821] [= *Praecyclothyris* MAKRIDIN, 1955, p. 84 (type, *Rhynchonella moeschi doneziana* MAKRIDIN, 1952, p. 74, OD); *Septaliphoria* MACFARLAN, 1992, p. 191, *nom. null.*]. Medium size to large,

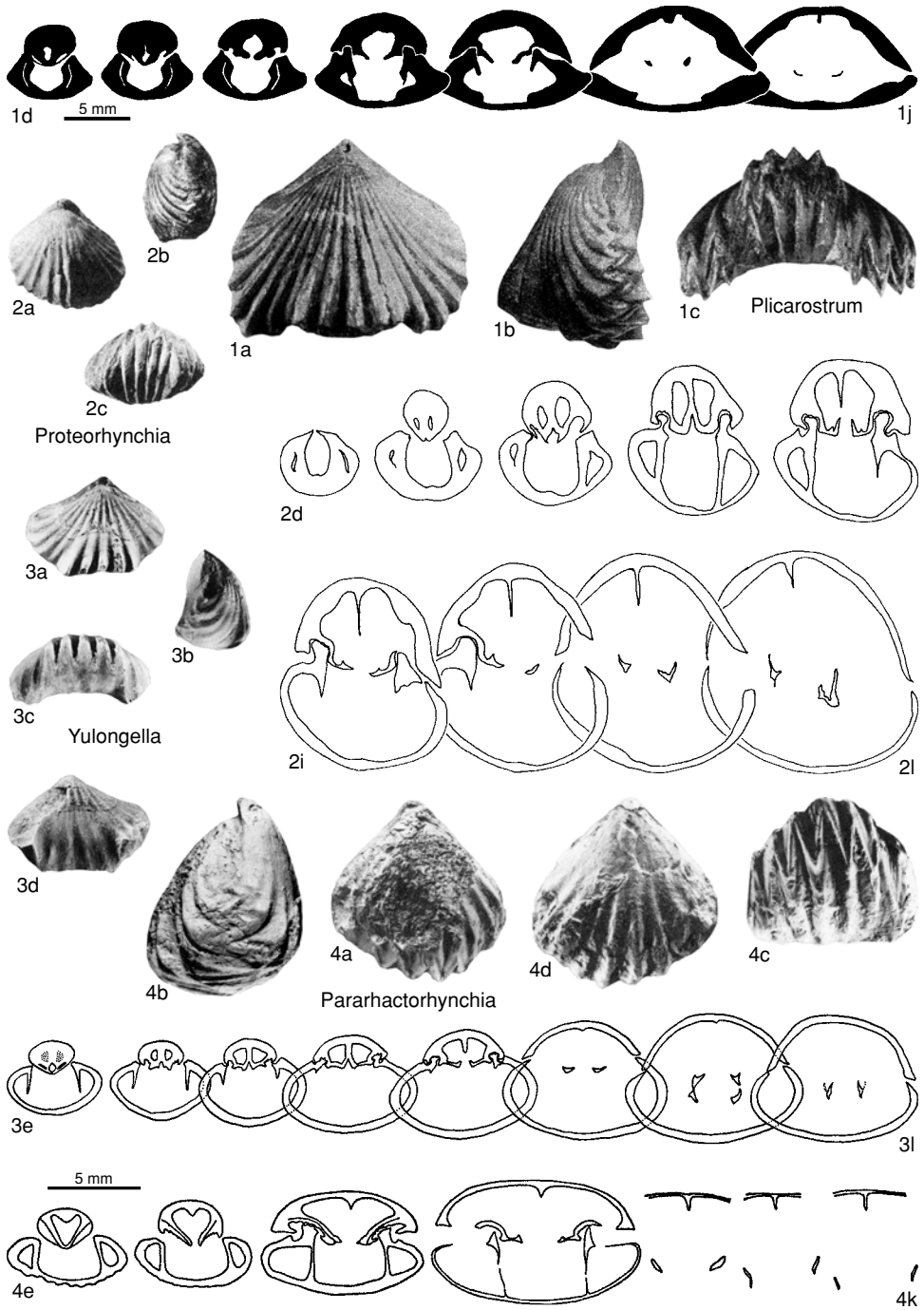


FIG. 904. Cyclothyrididae (p. 1334–1340).

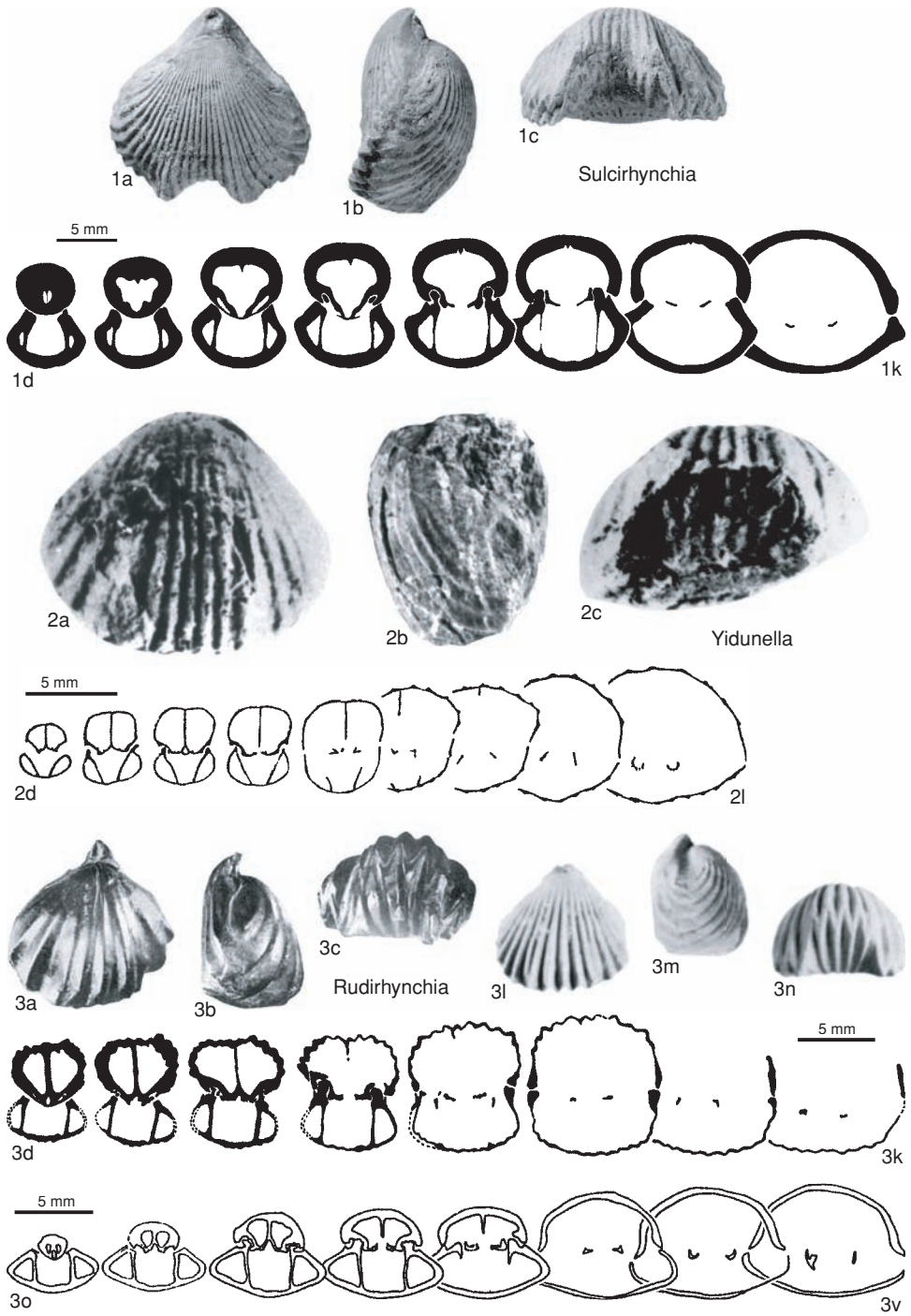


FIG. 905. Cyclothyrididae (p. 1334–1340).

- dorsibiconvex, subpentagonal to oval, uniplicate, or slightly asymmetrical; dorsal fold wide, conspicuous to indistinct, posterior smooth area absent, with costae numerous, coarse, simple, subangular (3 to 7 on fold); beak strong, high, with foramen large, rimmed, hypothyrid, deltidial plates usually conjunct. Septalium raised on reduced median septum, or sessile; crura strongly curved, concave dorsally, canaliform. *Middle Jurassic (Callovian)–Lower Cretaceous (Barremian, ?Aptian)*: England, Scotland, France, ?Portugal, Switzerland, Germany, Poland, Russia, Ukraine, ?Crimea, Caucasus, Morocco, Algeria, Uzbekistan, Turkmenistan, Turkey, southwestern and eastern China, India, Mexico, ?South America, *Callovian–Volgian*; Russian platform, Caspian basin, Crimea, Caucasus, Slovakia, Germany, Turkmenistan, *Berriasian–Barremian, ?Aptian*.—FIG. 906, 1a–k. \**S. arduennensis* (OPPEL), Oxfordian, Lorraine, France; *a–d*, neotype, dorsal, lateral, anterior, posterior views, BMNH BB.44173,  $\times 1$ ; *e–k*, transverse serial sections, distances in mm from ventral umbo, 3.1, 3.3, 3.6, 4.3, 5.0, 6.1, 6.5 (Childs, 1969).—FIG. 906, 1l–v. *S. donetziana* (MAKRIDIN), upper Oxfordian, Russian Platform; *l–n*, holotype, dorsal, lateral, anterior views, KHGU 196/102,  $\times 1$ ; *o–v*, transverse serial sections, distances in mm from ventral umbo, 2.7, 3.1, 3.3, 4.5, 5.4, 6.2, 6.7, 6.8 (Makridin, 1964).
- Septocyclothyris** XU, 1978, p. 282 [\**S. markamensis*; OD]. Small, trigonal to pentagonal; inequibiconvex to convexoplane; beak small and slightly incurved; foramen circular, submesothyrid-hypothyrid with short tubular rim produced by raised deltidial plates; sulcus and fold present; surface marked by simple costae starting from beak. Dental plates well developed and long; teeth stout, hooked, crenulated; dorsal septum well developed; septalium small and short; hinge plates subhorizontal; crural bases triangular. *Upper Triassic*: Tibet.—FIG. 906, 2a–l. \**S. markamensis*; *a–c*, holotype, dorsal, lateral, ventral views,  $\times 1$ ; *d*, detail of apical region and conjunct deltidial plates, CIGMR SCSb 6039,  $\times 4$ ; *e–l*, transverse serial sections, distances in mm from first section, 0.35, 0.45, 0.9, 1.3, 1.45, 1.55, 1.65, 1.75 (Xu, 1978).
- ?Squamirhynchia** BUCKMAN, 1918, p. 63 [\**Terebratula triplicata squamiplex* QUENSTEDT, 1871 in 1868–1871, p. 72; OD] [= *Squamirhynchia* BUCKMAN, 1914, p. 2, and 1915, p. 77, both suppressed (ICZN, 1971, Opinion 957)]. Medium size, depressed equibiconvex to dorsibiconvex; dorsal valve nearly flat, with uniplication and fold low; costae strong (3 to 6 on central fold) showing early branching and no smooth stage; beak strong, upright, with large foramen. Septum low, persistent, septalium shallow; crura canaliform-like, concave dorsally, or diaboloid shaped at distal ends; possibly buttressed deltidial plates. *Lower Jurassic (Sinemurian–Pliensbachian)*: England, Germany.—FIG. 906, 3a–k. \**S. squamiplex* (QUENSTEDT), lower Pliensbachian, Württemberg, Germany; *a–c*, lectotype, dorsal, lateral, anterior, GPIT, approximately  $\times 2$ ; *d–k*, transverse serial sections, distances in mm from ventral umbo, 2.1, 2.2, 2.3, 2.5, 2.9, 3.6, 3.8, 4.0, BMNH B.38425 (Ager, 1967).
- Sulciryhynchia** BURRI, 1953, p. 272 [\**Rhynchonella valangiensis* DE LORIO, 1864, p. 442; OD]. Medium size with many sharp or angular costae; slight sulcus in dorsal fold anterior to midvalve; anterior commissure with ventral sulcus deep, trapezoidal, meeting slight sulcus on dorsal valve and developing well-defined ligation; beak strong, sharp, and slightly projecting, suberect. Median septum low, diminishing to low ridge; crura slightly concave distally; dental plates subparallel, supporting strong, subquadrate hinge teeth; hinge plates short, slightly concave dorsally. *Lower Cretaceous (upper Valanginian–Hauterivian, ?lower Aptian)*: England, France, Switzerland.—FIG. 905, 1a–k. \**S. valangiensis* (DE LORIO), upper Valanginian, Switzerland; *a–c*, dorsal, lateral, anterior views,  $\times 1.5$  (new); *d–k*, transverse serial sections, distances in mm from first section, 2.25, 2.5, 3.0, 3.2, 3.5, 3.95, 4.7, 7.2 (Burri, 1957).
- Timorhynchia** AGER, 1968, p. 58 [\**Halorella nimassica* KRUMBECK, 1924, p. 10; OD]. Small to medium, subtrigonal to transverse-oval to subpentagonal, equibiconvex to depressed dorsibiconvex; dorsal valve flattened or sulcate posteriorly, with uniplication broad, low, flattopped, but fold scarcely raised; multicostate throughout, costae low posteriorly, may become strong and angular anteriorly; beak small, incurved with submesothyrid foramen. Dental plates diverging; dorsal median septum high, long, supporting short septalium; canaliform crura projecting into ventral valve. *Middle Triassic (Ladinian)–Upper Triassic (Norian)*: New Zealand, New Caledonia, *Ladinian–lower Norian*; Timor, China, ?*Carnian, Norian*.—FIG. 903, 2a–j. \**T. nimassica* (KRUMBECK), Upper Triassic, Alianbata, eastern Timor; *a–c*, dorsal, lateral, anterior views, Derek Ager, personal collection,  $\times 1.5$ ; *d–j*, transverse serial sections, distances in mm from ventral umbo, 0.8, 1.1, 1.2, 1.6, 2.0, 2.6, 2.8, Derek Ager, personal collection (Ager, 1968).
- Torquirhynchia** CHILDS, 1969, p. 95 [\**Terebratula inconstans* J. SOWERBY, 1821 in 1818–1821, p. 137; OD] [= *Serbioryhynchia* RADULOVIC, 1991, p. 16 (type, *S. asymmetrica*, OD)]. Medium to large, equibiconvex to dorsibiconvex, subtriangular to suboval, bilobate, asymmetrical, indiscriminately twisted either side, but uniplication and fold never developed; costae coarse, subangular, simple beginning from umbones; beak suberect to incurved with foramen circular, deltidial plates disjunct or conjunct. Teeth strong, crenulated; dorsal median septum low and relatively long; septalium poorly developed, often reduced to pendant septalial plates; crura basically raduliform, showing channelling and other variations toward distal ends. *Middle Jurassic (?upper Bajocian, Bathonian)–Lower Cretaceous (Valanginian)*: Great Britain, France, Germany,

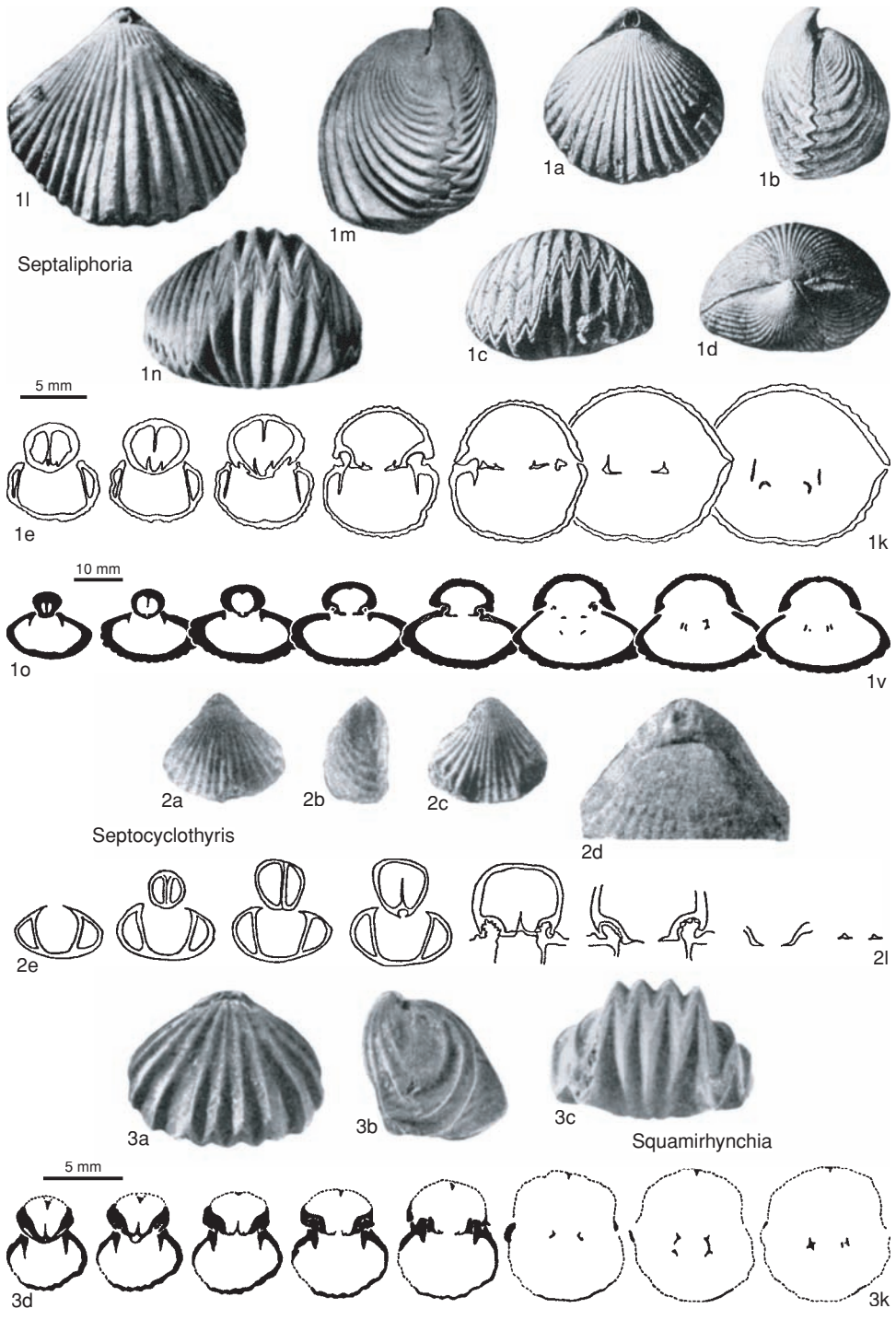


FIG. 906. Cyclothyridae (p. 1334–1337).

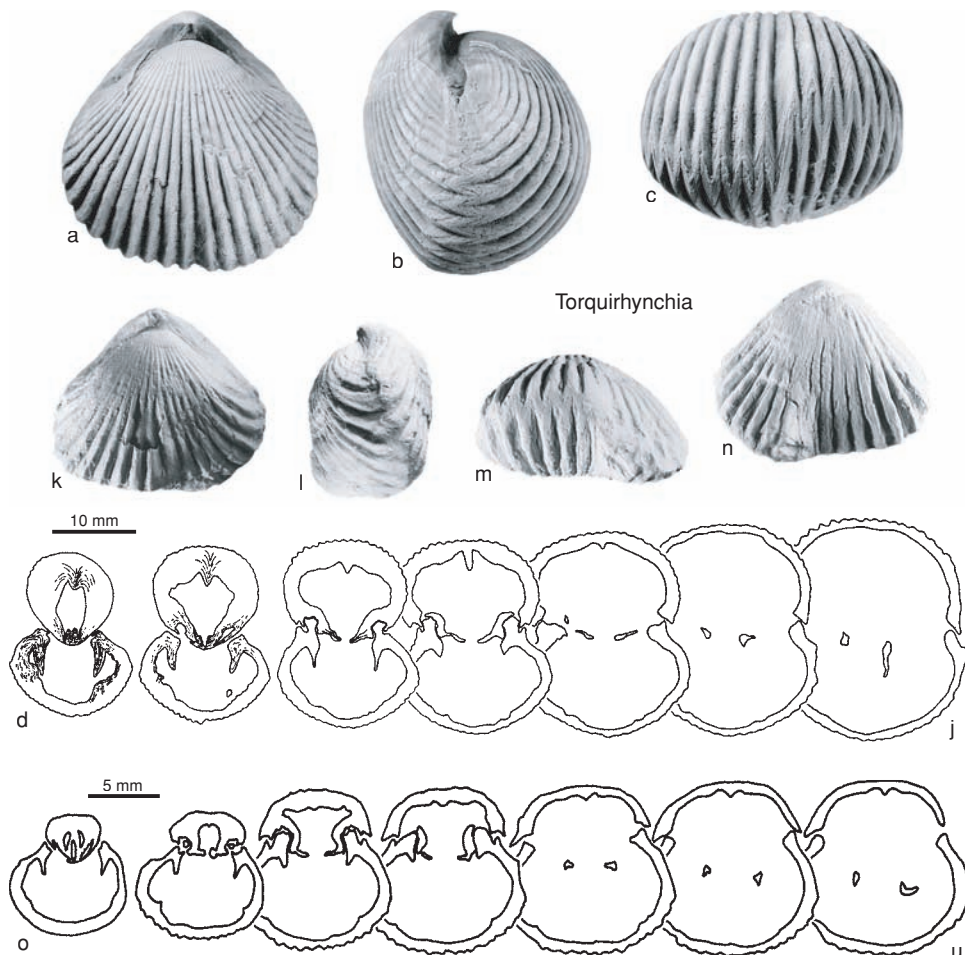


FIG. 907. Cyclothyrididae (p. 1337–1339).

Switzerland, Poland, Slovakia, Yugoslavia, Romania, Russian Platform, ?Crimea, ?Caucasus, Algeria, Somalia, Madagascar, India, China, Iran, Argentina, ?Chile, ?upper Bajocian, Bathonian–Vulganian; France, ?Switzerland, ?Caucasus, Caspian depression, Berriasian–Valanginian. —FIG. 907a–j. \**T. inconstans* (J. SOWERBY), Kimmeridgian, Dorset, England; a–c, topotype, dorsal, lateral, anterior views, BMNH 67671,  $\times 1$  (new); d–j, topotype, transverse serial sections, distances in mm from ventral umbo, 5.2, 5.9, 6.8, 7.6, 8.4, 9.4, 10.0 (Childs, 1969). —FIG. 907k–u. *T. asymmetrica* (RADULOVIC), ?upper Bajocian, Bathonian, Carpatho-Balkanids, Yugoslavia; k–n, holotype, dorsal, lateral, anterior, ventral, L 1/319,  $\times 1$ ; o–u, transverse serial sections, distances in mm from ventral umbo, 3.1, 3.6, 4.8, 5.2, 5.7, 6.0, 6.2, L 1/326 (Radulovic, 1991).

*Yidunella* CHING, SUN, & YE in CHING & others, 1979, p. 148 [\**Y. magna*; OD]. Large, asymmetrical; nearly convexoplane in lateral view; fold and sulcus starting from umbones, but more marked anteriorly; plicae simple, appearing near beak, round-subangular; posterior smooth area obscure or absent; beak short, slightly incurved; beak ridges angular; planarea concave; foramen hypothyrilid; delthyrium covered by thickened symphytium. Dental plates subparallel or ventrally convergent; dorsal septum high and long; septalium wide; crura canaliform, extending along plane of commissure, bladelike proximally, passing distally to semicircular canal. *Upper Triassic*: southwestern China (Tibet, Sichuan). —FIG. 905,2a–l. \**Y. magna*, Sichuan; a–c, holotype, dorsal, lateral, anterior views, NIGP 42862,  $\times 1$ ; d–l, paratype, transverse serial sections,



distances in mm from ventral umbo, 0.25, 0.85, 0.95, 1.15, 1.25, 1.85, 2.45, 3.25, 3.95, NIGP 42859 (Ching & others, 1979).

†*Yulongella* SUN, 1981, p. 191 [\**Y. bolilaensis*; OD]. Medium size, roundly trigonal and transversely widened; convexoplane to convexoconcave, thickest anteriorly; ventral sulcus wide, deeply concave and dorsally geniculated anteriorly; dorsal fold wide and flattened; linguiform extension transverse rectangular; commissure uniplicate; angular plicae starting from beak, 4 to 5 on fold and 5 to 6 on lateral slopes; ventral beak pointed and nearly straight; foramen circular and permesothyrid; delthyrium open. Dental plates long, slightly ventrally divergent to subparallel; subhorizontal hinge plates narrow, divided; crura with triangular crural bases, and distally forming subvertical short blades; dorsal median ridge low near umbo, elevated anteriorly, and extending to midvalve. [Remarkably similar to *Costirhynchopsis* except for alleged lack of septalium.] *Upper Triassic (Norian)*: Tibet.—FIG. 904, 3a–k. \**Y. bolilaensis*; a–d, holotype, dorsal, lateral, anterior, ventral views, NIGP 48396, ×1; e–k, paratype, transverse serial sections, distances in mm from ventral umbo, 1.4, 1.8, 2.2, 2.7, 3.4, 3.6, 3.8, NIGP 48541, ×2.5 (Sun, 1981).

### Subfamily CARDINIRHYNCHIIINAE Makridin, 1964

[*nom. transl.* KAMYSHAN, 1968, p. 59, ex *Cardinirhynchidae* MAKRIDIN, 1964, p. 192; *emend.*, MANCECIDO & OWEN, herein]

Small- to medium-sized Cyclothyridae, transversely expanded, fully covered by subangular radial costae; growth lines often lamellose; palintrope well developed, and beak acute, prominent; deltidial plates disjunct to conjunct; hinge margin long and nearly straight. Crural bases attached to inner socket ridges; dorsal valve with conspicuous median septum and very feebly developed septalium, nearly always filled with shell substance; crura canaliform; fusiform cardinal furrow and commissural groove usually present. *Middle Jurassic (Aalenian)–Upper Jurassic (Oxfordian)*.

*Cardinirhynchia* BUCKMAN, 1918, p. 74 [\**Terebratulacuticosta* HEHL, 1832, in VON ZIETEN, 1830–1833, p. 58; OD]. Medium to large size, equibiconvex to dorsibiconvex, flabelliform to semicircular, widest at nearly straight hinge line; sharply multicostate throughout; uniplication incipient to acuminate, central fold variably raised, often high; broad suberect to erect beak with large foramen; deltidial plates narrow, disjunct. Teeth broad, crenulated; hinge plates massive, narrow; dorsal median septum well developed, septalium ill developed; crura canaliform; commissural grooves sometimes present. *Middle Jurassic (Bajocian–Callovian)*, *Upper*

*Jurassic (?lower Oxfordian)*: Germany, ?Switzerland, Poland, Romania, Russia, Crimea, ?India, *Bajocian–Callovian*; Russian platform, ?*lower Oxfordian*.—FIG. 908, 1a–g. \**C. acuticosta* (HEHL), upper Bajocian, Suabia, Germany; a–c, dorsal, lateral, anterior views, ×1.5; d, detail of hinge area, BMNH B.38123, ×4 (new); e–g, paratype, transverse serial sections through umbo (Seifert, 1963).

*Eurysites* COOPER, 1989, p. 32 [\**E. transversus*; OD]. Small, dorsibiconvex; transversely elliptical to subtriangular; commissure gently uniplicate, but dorsal fold and ventral sulcus mostly indistinct; strong, narrowly rounded costae throughout; beak long, straight to suberect; deltidial plates disjunct; large foramen. Dental plates long; septalium small, dorsal median septum weak; raduliform crura. *Middle Jurassic (Batthonian–Callovian)*: Saudi Arabia, ?China, ?Argentina.—FIG. 909, 2a–t. \**E. transversus*, Bathonian, Saudi Arabia; a–e, holotype, dorsal, lateral, anterior, ventral, posterior views, USNM 380232, ×1.5; f–t, transverse serial sections, distances in mm from ventral umbo, 0.3, 1.1, 1.8, 2.2, 2.3, 2.5, 2.9, 3.1, 3.3, 3.5, 3.7, 4.0, 4.3, 4.5, 4.6, USNM 380680 (Cooper, 1989).

*Flabellirhynchia* BUCKMAN, 1918, p. 65 [\**Rhynchonella lycettii* DAVIDSON, 1852b, p. 81; OD] [= *Flabellirhynchia* BUCKMAN, 1914, p. 2, and 1915, p. 77, both suppressed (ICZN, 1971, Opinion 957)]. Medium size, wide subtrigonal, depressed subequibiconvex, with fold low and costae numerous, strong, sharp; anterior margin thickened; growth lines lamellose; beak strong, upright, with foramen large, rimmed; deltidial plates conjunct to disjunct, thickened. Dorsal median septum feeble; crura canaliform; septalium pitlike. *Middle Jurassic (Aalenian–Bajocian, ?Batthonian)*: England, France, USA (California), Argentina, Antarctica.—FIG. 908, 2a–s. \**F. lycettii* (DAVIDSON), Aalenian, Cotswolds, England; a–c, dorsal, lateral, anterior views, USNM 75591, ×1 (Shi & Grant, 1993); d, detail of hinge area, BMNH B.32284, ×3 (new); e–s, transverse serial sections, distances in mm from ventral umbo, 0.7, 2.1, 2.5, 2.9, 3.2, 3.4, 3.8, 3.9, 4.2, 4.4, 4.6, 5.0, 5.4, 6.0, 6.6, CDP 28, C. D. Prosser, personal collection (new; courtesy of C. D. Prosser).

*Parvirhynchia* BUCKMAN, 1918, p. 56 [\**Rhynchonella parvula* EUDES-DESLONGCHAMPS, 1862, p. 276; OD] [= *Parvirhynchia* BUCKMAN, 1914, p. 2, and 1915, p. 77, both suppressed (ICZN, 1971, Opinion 957)]. Small, depressed equibiconvex, round subpentagonal, with low fold and uniplication almost flattened; fully costate, costae few, strong, blunt, widely spaced over whole surface (2 to 6 on fold), bifurcations or intercalations rare; beak small, pointed, erect to straight, deltidial plates disjunct to conjunct, foramen rimmed, submesothyrid, short pedicle collar. Dental plates dorsally divergent; hinge plates subhorizontal; dorsal median septum low, short; crura canaliform, cardinal furrows and commissural grooves present. *Middle Jurassic (Aalenian)–Upper Jurassic (Oxfordian)*: England, France, Germany, Switzerland, Poland, Romania,

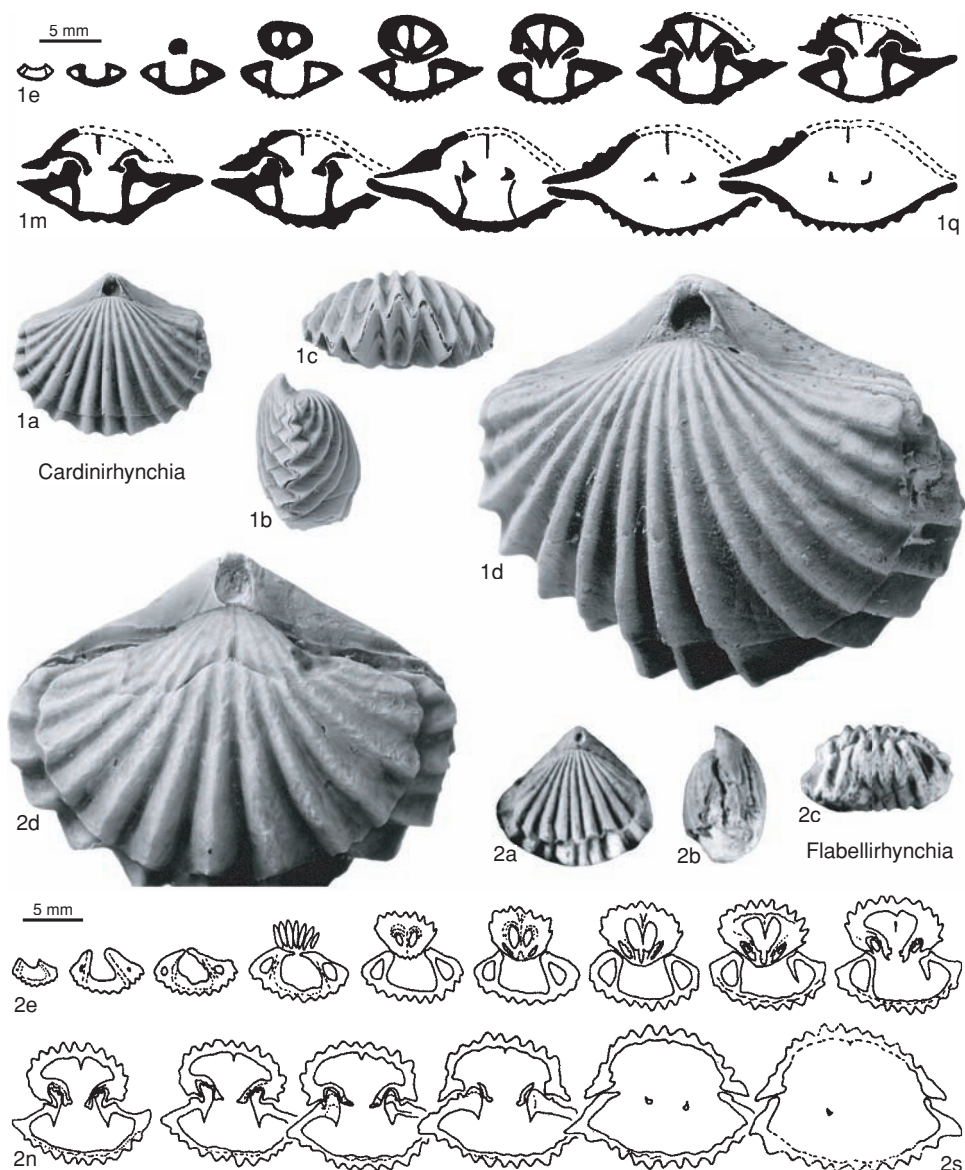


FIG. 908. Cyclothyrididae (p. 1340).

Caucasus, Transcaucasia, Spain, ?Italy, Morocco, Argentina, *Aalenian–Callovian*; France, ?Japan, *Oxfordian*.—FIG. 909, 1a–s. \**P. parvula* (EUDES-DESLONGCHAMPS), lower Bajocian, France; a–d, neotype, dorsal, lateral, anterior, ventral views, FSL 305425,  $\times 1$ ; e, detail of hinge area of ventral valve, FSL 305456,  $\times 5$ ; f–s, transverse serial sections, distances in mm from ventral umbo, 0.4, 0.6, 1.1, 1.4, 1.55, 1.7, 1.85, 2.0, 2.15, 2.3, 2.45, 2.6, 2.8, 3.0, FSL 305458 (Alm eras & Lathuili ere, 1984).

**Subfamily INDORHYNCHIINAE**  
**Ovcharenko, 1975**

[Indorhynchiinae OVCHARENKO, 1975, p. 123–124]

Medium-sized Cyclothyrididae, fully multicostate and uniplicate; dorsal fold and ventral sinus weak, sometimes asymmetrical; costae dense, often dichotomous. Dental

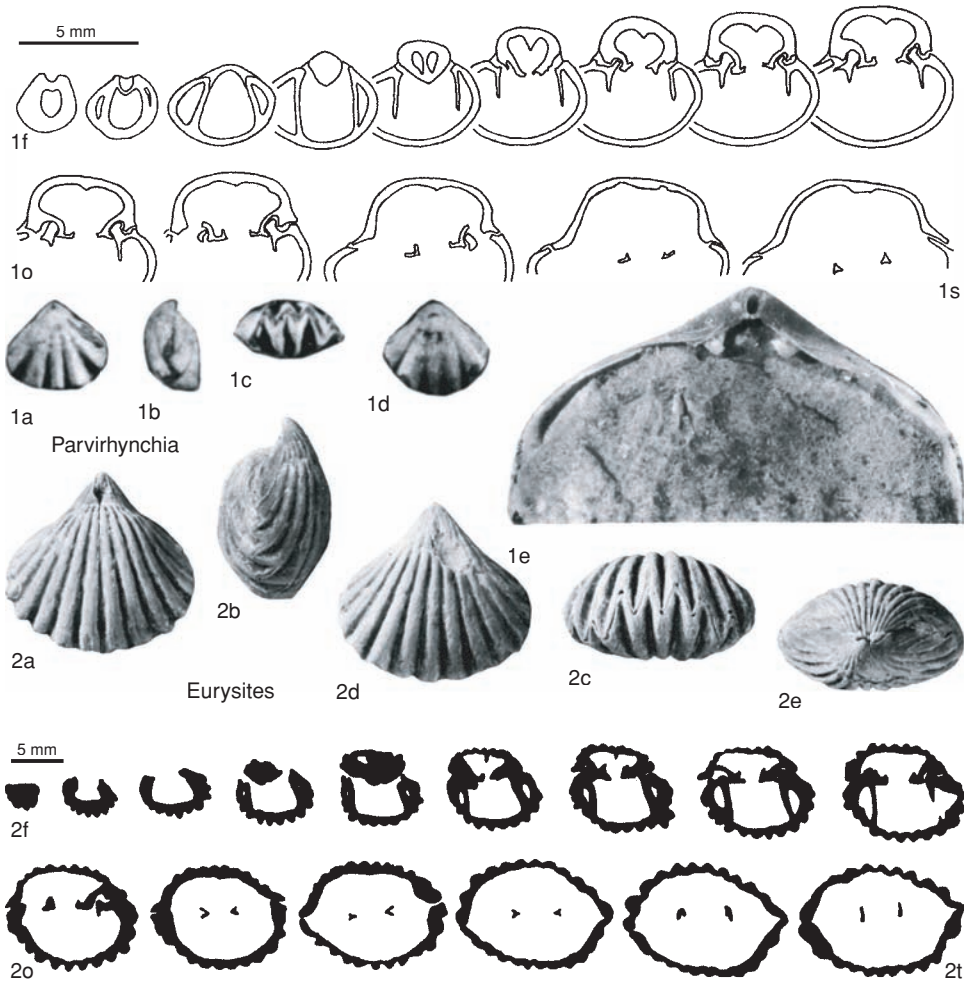


FIG. 909. Cyclothyrididae (p. 1340–1341).

plates thin, subparallel; median septum reduced, septalial plates well developed, typically sessile; crura peculiarly modified raduliform with various canaliform distal ends or transitional to calcariform. *Middle Jurassic (Bajocian–Callovian)*.

**Indorhynchia** OVCHARENKO, 1975, p. 124 [*\*I. subtrigonalis*; OD]. Medium size, often asymmetrical shells, covered with numerous dichotomizing costae, fold weakly raised. Dental plates thin, rather short, from parallel to ventrally divergent; hinge teeth simple, massive, sometimes with short denticula; hinge plates ventrally convex, septalial plates variously developed, sessile or pendant, oriented dorsoventrally or slightly diverging dorsally; crura short, ventrally deflected, may be flared distally. *Middle Jurassic (?lower Callovian, middle*

*Callovian–upper Callovian)*: Tadjikistan, southeastern Pamirs, India, ?Arabia, ?Sinai. —FIG. 910, 4a–n. *\*I. subtrigonalis*, middle Callovian, southeastern Pamirs; a–c, holotype, dorsal, lateral, anterior views, MUGT 12/1184,  $\times 1$ ; d–j, transverse serial sections, distances in mm from first section, 0.0, 0.7, 1.2, 1.8, 2.5, 3.1, 3.4, approximately  $\times 1.25$ ; k–n, enlarged details of dorsal umbo, 1.1, 1.2, 1.5, 1.7, MUGT 16/1184, approximately  $\times 5$  (Ovcharenko, 1975).

**Moquellina** CHING, SUN, & YE in CHING & others, 1979, p. 141 [*\*M. arcuata*; OD]. Medium size, cuneiform-elongate oval, dorsibiconvex, fold and sulcus only anteriorly; commissure subrectimarginate or slightly uniplicate; costae subangular or rounded, developed anteriorly to fully costate; beak nearly straight to suberect; foramen hypothyril; deltidial plates disjunct, rimmed. Pedicle collar short; dental plates long, subparallel; hinge plates discrete;

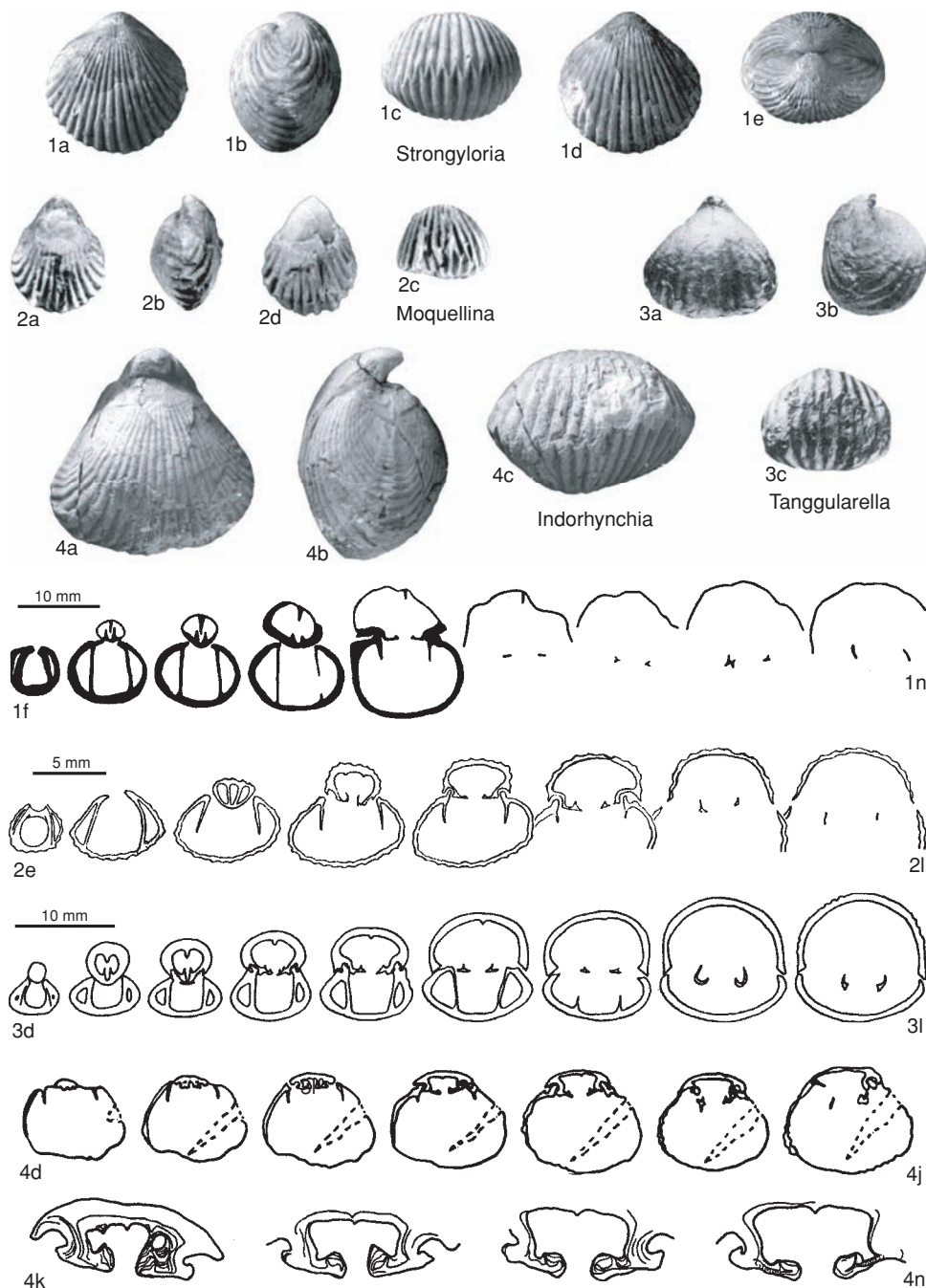


FIG. 910. Cyclothyrididae (p. 1342–1344).

septal plates descending directly to floor of dorsal valve and extending to articulation zone; crura projecting horizontally, trigonal proximally and vertical blade-like distally; dorsal median septum re-

duced or absent. *Middle Jurassic (Bathonian–Callovian)*: China (Qinghai, Yunnan).—FIG. 910, 2a–l. \**M. arcuata*, upper Bathonian–lower Callovian, Qinghai; a–d, holotype, dorsal, lateral,

- anterior, ventral views, NIGP 42893,  $\times 1$ ; *e-l*, paratype, transverse serial sections, distances in mm from ventral umbo, 0.8, 1.9, 2.4, 2.9, 3.55, 4.4, 4.95, 5.35, NIGP 42894 (Ching & others, 1979).
- Strongyloria** COOPER, 1989, p. 63 [*S. circularis*; OD]. Medium size, moderately equibiconvex, round, with uniplication gently arcuate; dorsal fold subdued; costae numerous, low, rounded, with intercalation and bifurcation on umbones (7 to 10 on fold); beak low, incurved; deltidial plates disjunct, rimmed; foramen small. Dental plates well developed; dorsal median septum moderate; septalium short, may be pendant; raduliform to canaliform crura. *Middle Jurassic (Bajocian–Bathonian)*: Arabia.—FIG. 910, 1a–n. \**S. circularis*, upper Bajocian, Saudi Arabia; *a–e*, holotype, dorsal, lateral, anterior, ventral, posterior views, USNM 380200a,  $\times 1$ ; *f–n*, transverse serial sections, distances in mm from ventral umbo, 0.6, 1.4, 1.6, 1.9, 2.5, 3.3, 3.7, 4.0, 4.3, USNM 400917 (Cooper, 1989).
- Tangularella** SHI, 1990, p. 308–309 [\**T. feraxa*; OD]. Small, rounded subtrigonal to subpentagonal, inequibiconvex; uniplicate and fully multicostate; fold and sulcus generally weak; costae simple. Dorsal median septum very short or reduced; pendant septalial plates; incurved canaliform crura, dorsally concave. *Middle Jurassic (Bathonian, ?lower Callovian)*: China (northern Tibet, southern Qinghai).—FIG. 910, 3a–l. \**T. feraxa*, upper Bathonian, southern Qinghai; *a–c*, holotype, dorsal, lateral, anterior views, MCMB Y 152164,  $\times 1$  (Shi, 1992); *d–l*, transverse serial sections, distances in mm from ventral umbo, 0.5, 1.5, 1.6, 2.1, 2.5, 3.4, 3.8, 4.9, 5.2, MCMB Y152167 (Shi, 1990).

**?Family TRIASORHYNCHIIDAE**  
Xu & Liu, 1983

[Triasorhynchiidae Xu & Liu, 1983, p. 74(90)]

[Materials prepared by MIGUEL O. MANCENIDO,  
E. F. OWEN, & SUN DONG-LI]

Hemithiridoidea with completely costate shells, dental plates absent; dorsal fold and ventral sulcus developed; anterior commissure uniplicate; dorsally arched squamaglotta junction. Septalium and median septum present; crura raduliform (triangular-ridge form). [Recognition of this queried family (or subfamily) rests on lack of dental plates; if this were due to any preservational accident, both genera included would fall entirely within the Tetrarhynchiinae.] *Middle Triassic*.

**Triasorhynchia** XU & LIU, 1983, p. 90 [\**T. subglobulina*; OD]. Small, subcircular, subglobular, dorsibiconvex; uniplication arcuate; ventral sulcus wide and shallow, starting slightly anterior to midlength; dorsal fold low, beginning from slightly posterior to midlength; plicae angular starting from umbonal

area; plicae arranged with 3 within sulcus, 4 on fold, 3 or 4 on each side; ventral beak short, pedicle opening relatively large, permesothyrid, delthyrium completely covered by dorsal beak. Dental plates and pedicle collar absent; dorsal hinge plates discrete and narrow, septalium shallow; septum extending over two-fifths of dorsal length; crura triangular-ridge form. *Middle Triassic (Anisian)*: China (Qilian Mountains).—FIG. 911, 1a–t. \**T. subglobulina*, Qinghai; *a–e*, holotype, dorsal, lateral, anterior, ventral, posterior views, QIGX DDDY010,  $\times 1$ ; *f–t*, paratype, transverse serial sections, distances in mm from ventral umbo, 0.5, 0.8, 1.0, 1.2, 1.3, 1.4, 1.6, 1.7, 1.8, 1.9, 2.1, 2.3, 2.5, 2.7, 2.9, QIGX DDDY011 (Xu & Liu, 1983).

**Multicorhynchia** CHEN Yongming, 1983, p. 152 [\**M. tulungensis*; OD]. Medium size, roundly triangular to pentagonal in outline; shell length nearly equal to shell width; depressed dorsibiconvex; subrecti-marginate commissure, dorsal fold and ventral sulcus subdued and only appearing anteriorly; costae thin and round, 6 to 7 in sulcus, 7 to 8 on fold; 7 to 8 at each lateral region; beak small; foramen circular, submesothyrid. Teeth short; dental plates absent; pedicle collar undeveloped; dorsal septum high and thin; septalium narrow and deep. *Middle Triassic*: China (Tibet, ?southern Qilian Mountains).—FIG. 911, 2a–m. \**M. tulungensis*, Tibet, Tulung; *a–d*, holotype, dorsal, lateral, anterior, ventral views, CIGMR SC22-2,  $\times 1$ ; *e–m*, paratype, transverse serial sections, distances in mm from ventral umbo, 0.2, 0.4, 0.6, 0.9, 1.3, 1.6, 1.9, 2.3, 2.8, CIGMR SC22-2 (Chen Yongming, 1983).

**Family TETRARHYNCHIIDAE**  
Ager, 1965

[*nom. transl.* MANCENIDO & OWEN, herein, ex Tetrarhynchiinae AGER, 1965, p. 611]

Globose to trilobate Hemithiridoidea, with dorsally arched squama-glotta junction, though variably developed; dorsal fold always present (moderate to ill defined); radial costae invariably present; surface spines not developed. Crura raduliform or modified; cardinal process absent. *Upper Triassic–Upper Cretaceous (Maastrichtian)*.

**Subfamily TETRARHYNCHIIINAE**  
Ager, 1965

[Tetrarhynchiinae AGER, 1965, p. 611] [Includes Praecyclothyridinae MAKRIDIN, 1964, p. 149, *partim* (not containing type genus)]

Dorsibiconvex to convexoplane trilobate Tetrarhynchiidae; multicostate, sometimes with short smooth stage posteriorly; uniplicate, with dorsal fold well defined, moderately to strongly raised, often subcarinate; linguiform extension distinct, trapeziform to subtriangular; beak small, usually suberect to

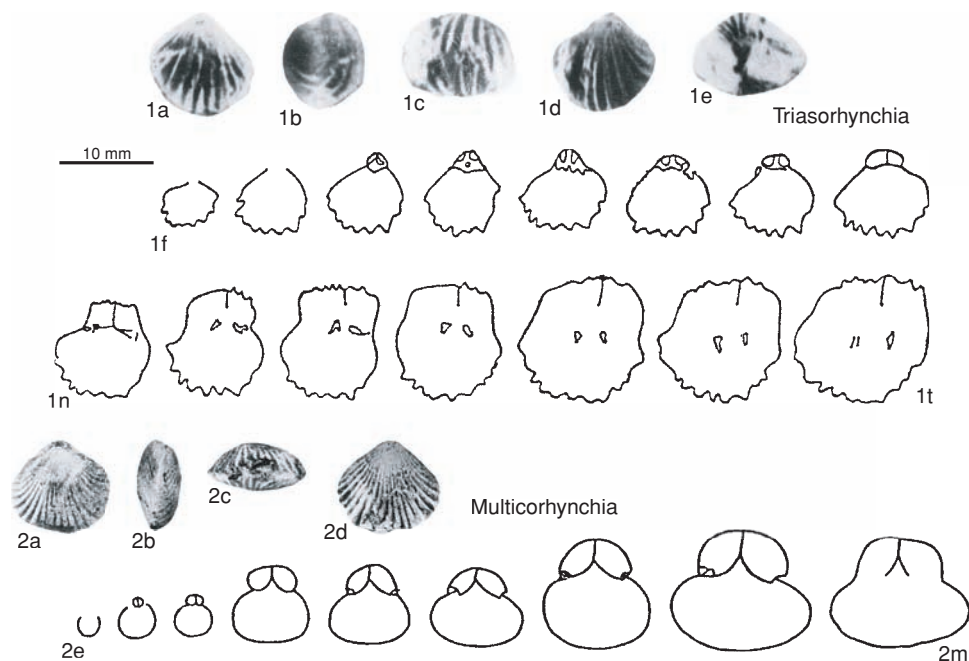


FIG. 911. Triasorhynchiidae (p. 1344).

incurved; delthyrium typically small, foramen usually not rimmed. Hinge plates subhorizontal to convex ventrally; dental plates variable, subparallel, convergent or divergent ventrally; conspicuous septalium, Y-shaped to pitlike; lateral umbonal chambers subtriangular, empty. Crura raduliform, usually in form of simple hooks, occasionally somewhat expanded distally. *Upper Triassic–Lower Cretaceous (Aptian)*.

**Tetrarhynchia** BUCKMAN, 1918, p. 41 [*\*Terebratula tetraëdra* J. SOWERBY, 1812 in 1812–1815, p. 191; OD; = *Tetrarhynchia tetrahedra* J. SOWERBY, 1812 in 1812–1815, p. 191, *nom. correct.* AGER, 1956, p. 7, prevailing spelling preserved under Article 33.3.1 of ICZN (1999)] [= *Tetrarhynchia* BUCKMAN, 1914, p. 1, and 1915, p. 76, both suppressed (ICZN, 1971, Opinion 957); *Makridinirhynchia* SUCIC-PROTIC, 1969, p. 81 (type, *M. makridini*, OD)]. Medium size, laterally expanded, rounded subtriangular, dorsibiconvex; arcuate uniplication well developed; costae numerous, fairly sharp, short smooth stage posteriorly; beak small, incurved. Dorsal median septum short, septalium deep; crura raduliform, possibly widening distally; subparallel dental plates separating subrectangular delthyrial cavity from triangular lateral umbonal chambers. *Lower Jurassic, Middle Jurassic (?Bajocian)*: Eurasia, northern Africa, North and South America.

**T. (Tetrarhynchia)**. Shell becoming gibbous, everted with age; strong dorsal fold with subangular top. [Differences in internal structure attributable to tilted sectioning.] *Lower Jurassic (Sinemurian–Toarcian)*, *Middle Jurassic (?Bajocian)*: England, Scotland, France, Portugal, Spain, Germany, Switzerland, Austria, Italy, Slovakia, Yugoslavia, Hungary, Romania, Bulgaria, Morocco, Algeria, Turkey, Siberia, northwestern Canada, Argentina, Chile.—FIG. 912, 1a–k. \**T. (T.) tetrahedra* (J. SOWERBY), upper Pliensbachian, Northamptonshire, England; a–c, holotype, dorsal, lateral, anterior views, BMNH B.71566, ×1; d–k, transverse serial sections, distances in mm from ventral umbo, 1.2, 2.2, 2.4, 2.7, 3.3, 3.9, 4.8, 5.2, Warwickshire, J.500/105, Derek Ager, personal collection (Ager, 1956). —FIG. 912, 1l–u. *T. (T.) makridini* (SUCIC-PROTIC), middle Lias, Carpatho-Balkanids, Yugoslavia; l–n, holotype, dorsal, lateral, anterior views, MFMGB 1/10, ×1; o–u, transverse serial sections, distances in mm from first section, 1.2, 1.8, 2.2, 2.5, 2.8, 3.1, 3.3 (Sucic-Protic, 1969).

**T. (Rostrirhynchia)** SUCIC-PROTIC, 1969, p. 47 [*\*R. rostrata*; OD]. Depressed subtriangular shape persisting in adult; dorsal fold little raised, uniplication broadly arcuate, reduced linguiform extension; costation may be denser. *Lower Jurassic (Sinemurian–Toarcian)*: Great Britain, France, Spain, Yugoslavia, Romania, ?Crimea, Algeria, Argentina.—FIG. 912, 2a–k. \**T. (R.) rostrata*, middle Lias, Carpatho-Balkanids,

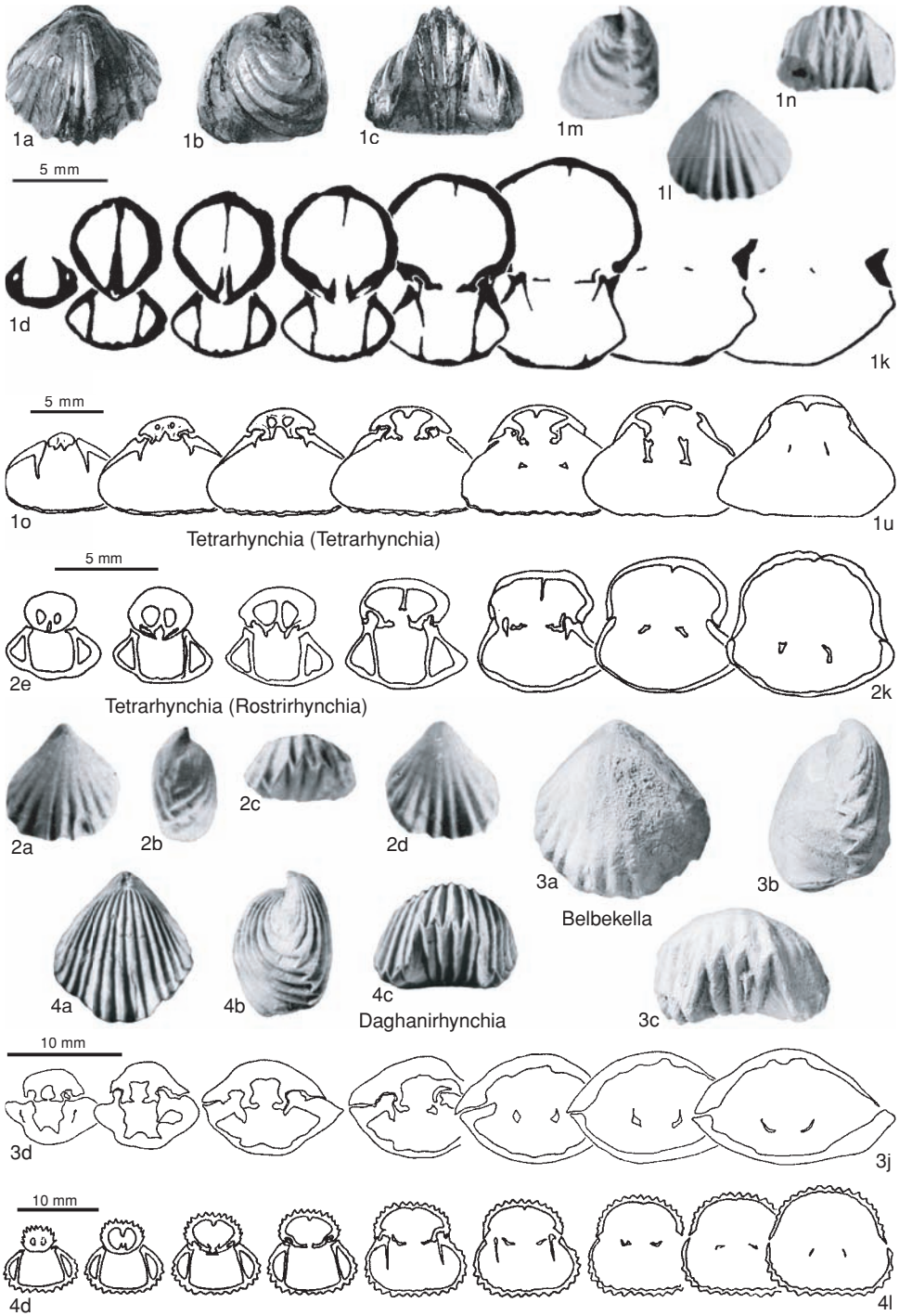


FIG. 912. Tetrarhynchiidae (p. 1345–1347).

- Yugoslavia; *a-d*, holotype, dorsal, lateral, anterior, ventral views, MFMGB 1/961,  $\times 1$ ; *e-k*, transverse serial sections, distances in mm from first section, 1.5, 1.8, 2.0, 2.2, 2.7, 3.2, 3.8 (Susic-Protic, 1969).
- Baeorhynchia** COOPER, 1989, p. 12 [\**B. nucleata*; OD]. Small, dorsibiconvex; subtriangular; narrowly uniplicate, rounded dorsal fold starting anterior to umbo and bearing 3 to 6 costae; completely costate, subangular; beak long, erect to suberect; deltidial plates disjunct to almost conjunct. Dental plates short; dorsal median septum long; septalium small, narrow; crura raduliform. *Middle Jurassic (Bajocian-Bathonian)*: Saudi Arabia.—FIG. 913, *1a-n*. \**B. nucleata*, Bathonian; *a-e*, holotype, dorsal, lateral, anterior, ventral, posterior views, USNM 380264a,  $\times 1.5$ ; *f-n*, transverse serial sections, distances in mm from ventral umbo, 1.1, 1.5, 1.8, 2.0, 2.3, 2.5, 2.9, 3.2, 3.7, USNM 380675 (Cooper, 1989).
- ?**Belbekella** MOISEEV, 1939, p. 195 [205] [\**B. airgulensis*; OD] [= *Belbekella* MOISEEV in RZHONSNITSKALIA & others, 1956, p. 62, obj.]. Medium size, subtriangular to subpentagonal, dorsibiconvex, globose, uniplicate; dorsal fold poorly developed, ventral sulcus shallow, trapezoidal; costae sharp, angular, radiating from umbo; beak massive, erect. Dental plates slightly ventrally convergent; teeth subquadrate, strong; dorsal median septum weak to absent; septalium not developed or pitlike; raduliform crura gently concave distally. *Lower Cretaceous (BerriAsian-Aptian)*: Crimea, Caucasus, Turkmenistan, France, Sardinia, Romania, Russia (Caspian Basin), ?eastern China (Heilongjiang).—FIG. 912, *3a-j*. \**B. airgulensis*, Hauterivian, Crimea; *a-c*, dorsal, lateral, anterior views,  $\times 1.5$  (new); *d-j*, topotype, transverse serial sections, distances in mm from ventral umbo, 1.5, 2.4, 3.0, 3.3, 4.1, 4.6, 5.2 (Dieni, Middlemiss, & Owen, 1975).
- Cymatorhynchia** BUCKMAN, 1918, p. 53 [\**Rhynchonella cymatophorina* BUCKMAN, 1910, p. 105; OD; = *R. cymatophora* BUCKMAN, 1895, p. 447, non ROTHPLETZ, 1886] [= *Cymatorhynchia* BUCKMAN, 1914, p. 2, and 1915, p. 77, both suppressed (ICZN, 1971, Opinion 957); *Formosarhynchia* SEIFERT, 1963, p. 177 (type, *F. formosa*, OD)]. Medium size to large, subpentagonal to transverse-oval, depressed equibiconvex to dorsibiconvex, with strong uniplication and dorsal fold broad, gently raised; many (10 to 24) sharp costae (4 to 10 on fold), no smooth stage; beak small, erect to incurved, foramen hypothyrid, conjunct or disjunct deltidial plates. Dorsal median septum strong; septalium deep; straight, subhorizontal hinge plates; crura raduliform, with concave distal ends; crenulated teeth. *Middle Jurassic (Aalenian-lower Bathonian)*: England, France, Germany, Switzerland, Poland, Bulgaria, Romania, Spain, ?Caucasus, Morocco, Algeria, Madagascar, Arabia, Israel, ?Jordan, southwestern China (Tibet, Himalayas), Argentina.—FIG. 914, *1a-j*. \**C. cymatophorina* (BUCKMAN), Aalenian, Dorset, England; *a-c*, topotype, dorsal, lateral, anterior views, BMNH B.11981,  $\times 1$  (new); *d-j*, topotype, transverse serial sections, distances in mm from ventral umbo, 3.9, 4.2, 4.7, 5.5, 6.3, 6.8, 7.3, BMNH B.68374 (new; courtesy of C. D. Prosser).—FIG. 914, *1k*. *C. quadruplicata* (ZIETEN), Bajocian; interior showing raduliform crura and cardinalia of silicified specimen, BMNH B.69919,  $\times 2$  (new).—FIG. 914, *1l-u*. *C. formosa* (SEIFERT), lower Bajocian, Swabian Alb, Germany; *l-n*, holotype, dorsal, lateral, anterior views, GPIT Br 3/38/42,  $\times 1$ ; *o-u*, paratype, transverse serial sections through umbo (Seifert, 1963).
- Daghanirhynchia** MUIR-WOOD, 1935, p. 82 [\**D. daghaniensis*; OD]. Medium size, subtrigonal to subpentagonal, subglobose dorsibiconvex, often nasute; uniplicate, with distinct dorsal fold, costae few (3 to 6 on fold); linguiform extension high, trapezoidal; beak acute, erect to incurved. Dental plates strong, dorsal median septum weak, persistent; divided hinge plates, septalium usually pendant; crura nearly horizontal, raduliform slightly incurved ventrally. *Middle Jurassic (Bathonian-Callovian)*, *Upper Jurassic (?Oxfordian)*: ?Morocco, Tunisia, Somalia, Kenya, ?Ethiopia, Egypt (Sinai), Arabia, Israel, Syria, China, India.—FIG. 912, *4a-l*. \**D. daghaniensis*, lower Callovian, Daghani, Somalia; *a-c*, topotype, dorsal, lateral, anterior views, USNM 75666b,  $\times 1$ ; *d-l*, transverse serial sections, distances in mm from ventral umbo, 3.1, 3.4, 3.8, 4.0, 4.9, 5.1, 5.5, 5.9, 6.4, USNM 75666a (Shi & Grant, 1993).
- Deltarhynchia** COOPER, 1989, p. 29 [\**D. triangulata*; OD]. Medium to large, inequivalve dorsibiconvex; subtriangular; strongly uniplicate, with dorsal fold conspicuous, narrow, subcarinate; costae thick, angular, 3 to 5 on fold; beak narrow, short, suberect to erect; deltidial plates disjunct, thick; foramen small, hypothyrid. Dental plates very long, divergent; dorsal median septum high, reaching midvalve; teeth and sockets corrugated; septalium fairly large; raduliform crura. [Very similar to *Daghanirhynchia*.] *Middle Jurassic (Bathonian)*: Saudi Arabia.—FIG. 913, *2a-n*. \**D. triangulata*, lower Bathonian; *a-e*, paratype, dorsal, lateral, anterior, ventral, posterior views, USNM 380217a,  $\times 1$ ; *f-n*, transverse serial sections, distances in mm from ventral umbo, 0.8, 1.6, 2.1, 2.3, 2.6, 2.8, 3.5, 4.1, 4.8, USNM 380679 (Cooper, 1989).
- Druganirhynchia** TCHOUMATCHENKO, 1983, p. 70 [\**D. nevelinae*; OD]. Medium to large size, with rounded subpentagonal outline; dorsibiconvex spherical in adult specimens; uniplicate, sinus and fold rather distinct; costae sharp numerous; beak small, of medium height, erect. Hinge plates massive, overgrown ventrally convergent; dorsal median septum short; septalium lacking; crura radulifer; hinge teeth crenulated. *Middle Jurassic (Aalenian)*: Bulgaria.—FIG. 915, *1a-k*. \**D. nevelinae*, southwestern Bulgaria; *a-c*, holotype, dorsal, lateral, anterior views, GIBAS Br.465/1,  $\times 1$ ; *d-k*, transverse serial sections, distances in mm from ventral umbo, 1.6, 2.45, 3.85, 4.85, 5.3, 6.95, 9.2, 9.9, GIBAS Br.465/9 (Tchoumatchenko, 1983).



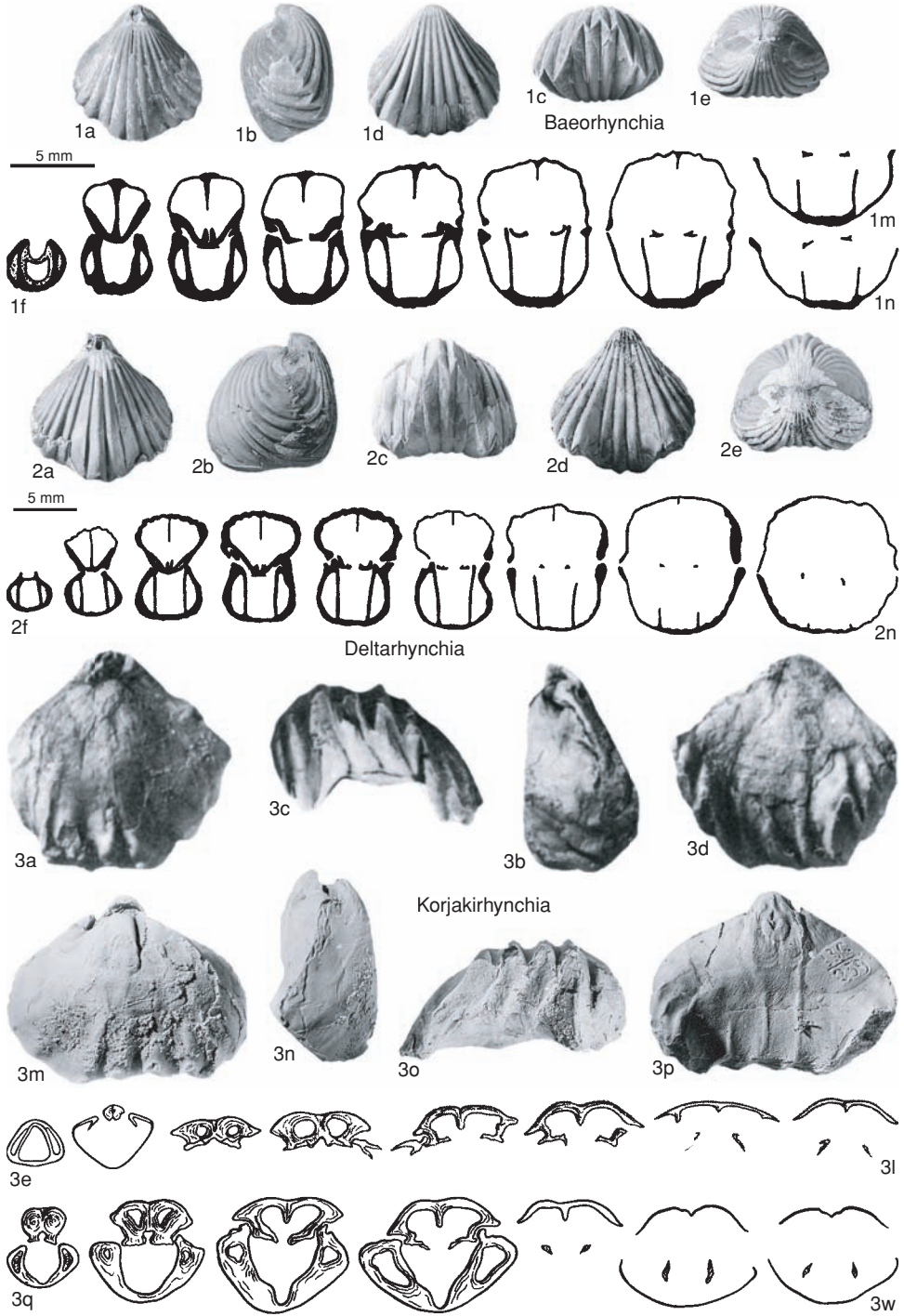


FIG. 913. Tetrarhynchiidae (p. 1347–1351).

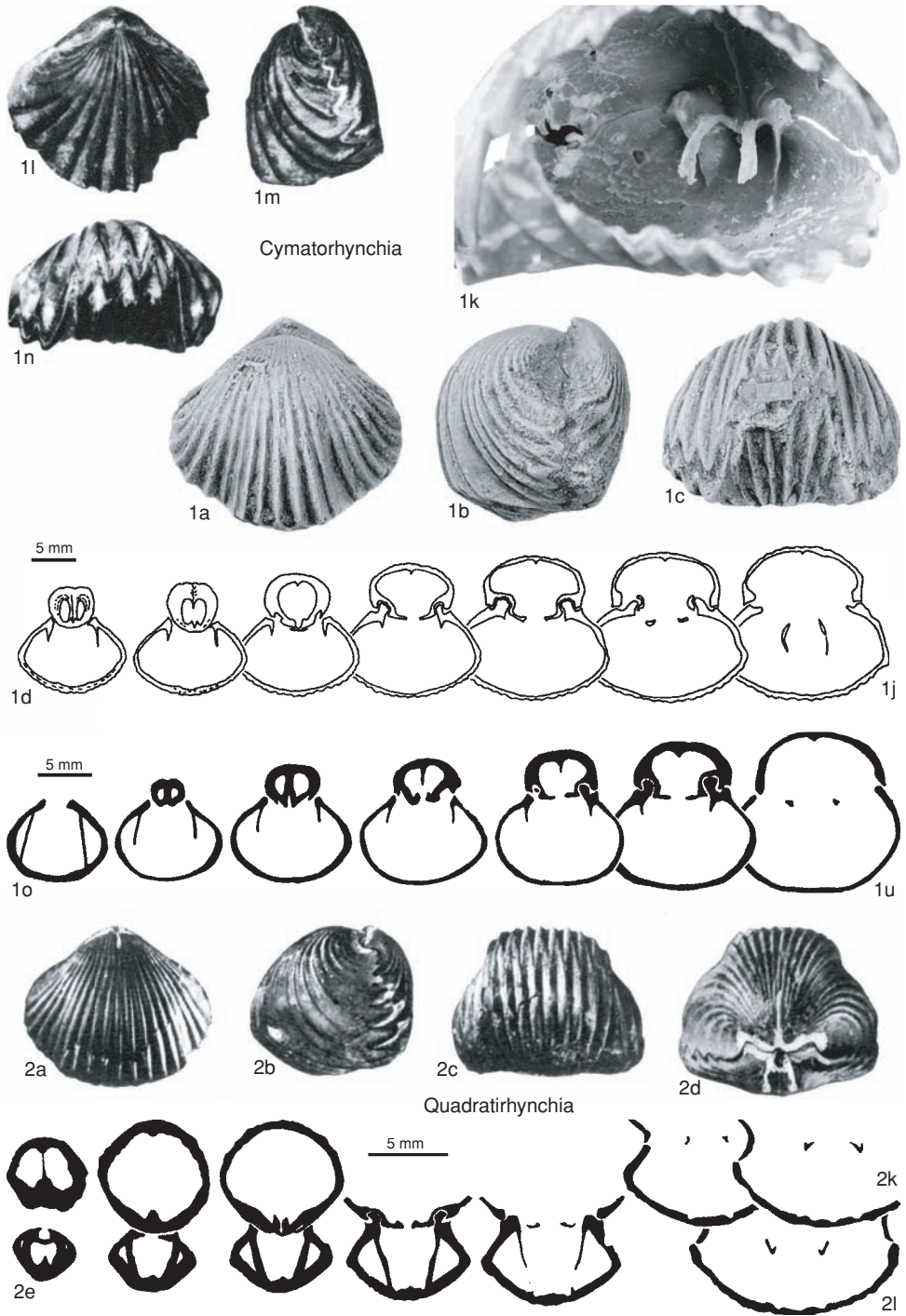


FIG. 914. Tetrarhynchiidae (p. 1347–1354).

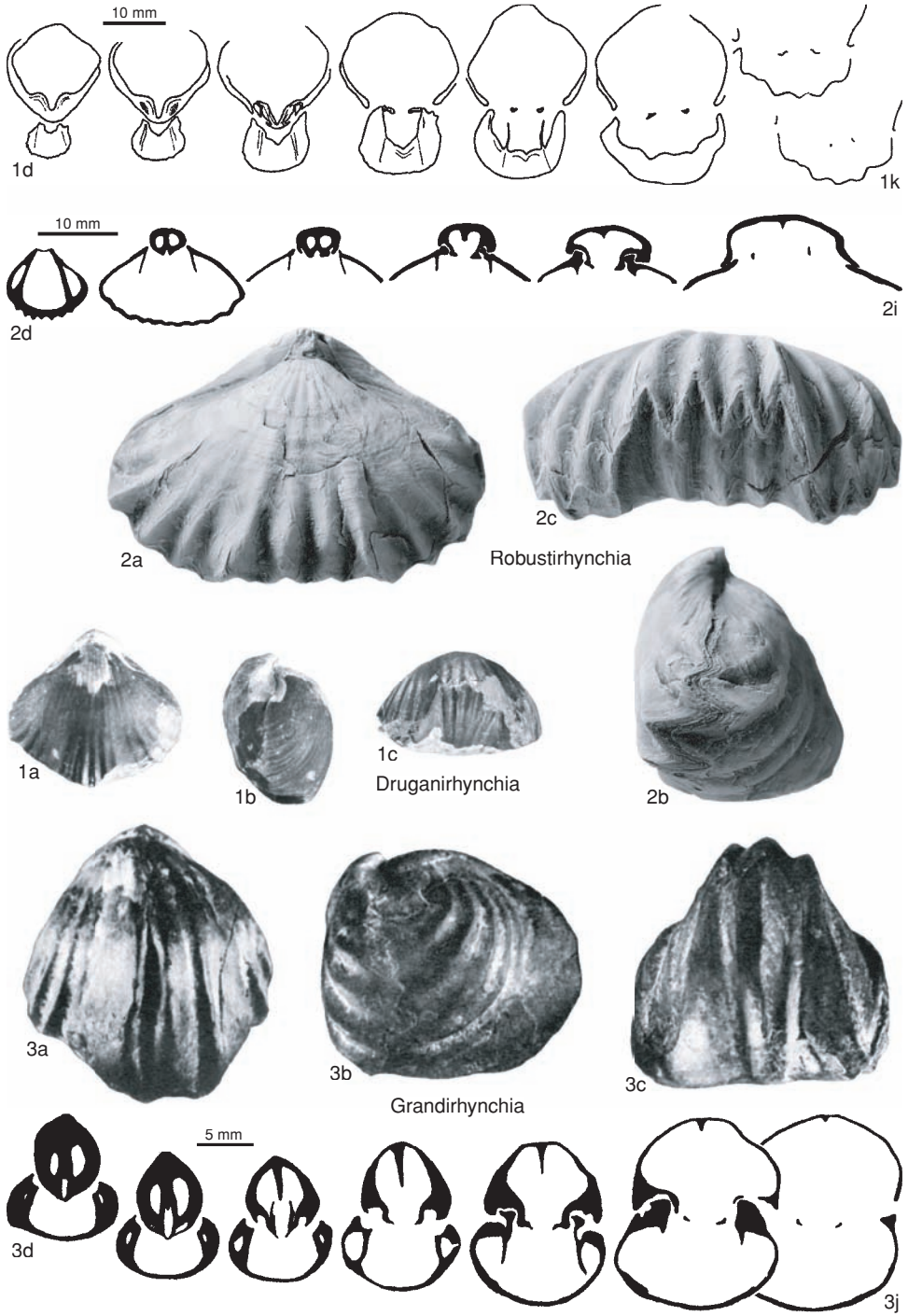


FIG. 915. Tetrarhynchiidae (p. 1347–1354).

- Echyrosia** COOPER, 1989, p. 30 [*\*E. costata*; OD]. Medium size, inequivalve dorsibiconvex; subtriangular in outline; uniplicate, dorsal fold narrow, low posteriorly, well elevated in anterior half; costae few, strong, subangular, with 3 to 5 on fold; beak erect; deltidial plates narrow, thick, disjunct; foramen small. Dental plates long; dorsal median septum short; septalium narrow, no cardinal process; crura thin, raduliform. *Middle Jurassic (Bajocian)*: Saudi Arabia, ?Israel.—FIG. 916,1a–l. *\*E. costata*, upper Bajocian, Saudi Arabia; a–e, holotype, dorsal, lateral, anterior, ventral, posterior views, USNM 380195a,  $\times 1$ ; f–l, transverse serial sections, distances in mm from ventral umbo, 2.0, 2.8, 3.1, 3.4, 3.9, 4.5, 5.2, USNM 380650 (Cooper, 1989).
- Eoseptaliphoria** CHING & SUN in CHING, SUN, & RONG, 1976, p. 294 [*\*E. tulungensis*; OD]. Small to medium, elongate pentagonal or oval, subequibiconvex and subspherical; maximum width slightly anterior to midvalve; uniplication multidentate; linguiform extension prominent, semicircular; with ribs simple, subangular, starting from umbo; beak short, slightly incurved; delthyrium open; foramen permesothyrid. Dental plates short and subparallel; hinge plates disjunct and fused with inner socket ridges; median septum long, thin, high, supporting deep, narrow septalium; crura raduliform. *Upper Triassic*: China (Tibet, Qinghai), ?Alps, ?Caucasus.—FIG. 917,3a–m. *\*E. tulungensis*, Norian, Tibet; a–e, holotype, dorsal, lateral, anterior, ventral, posterior views, NIGP 28751,  $\times 1.5$  (new); f–m, paratype, transverse serial sections, distances in mm from ventral umbo, 0.4, 0.7, 1.0, 1.3, 1.5, 1.7, 1.9, 2.1, NIGP 28752 (Ching, Sun, & Rong, 1976).
- Goniorhynchia** BUCKMAN, 1918, p. 52 [*\*G. goniaeae*; OD] [= *Goniorhynchia* BUCKMAN, 1914, p. 2, and 1915, p. 77, both suppressed (ICZN, 1971, Opinion 957)]. Medium size, wide subtrigonal to transversely subpentagonal; markedly dorsibiconvex; trilobate, with uniplication strong and dorsal fold conspicuous; costae numerous, strong, sharp; not smooth posteriorly; beak short, suberect with small, circular, hypo- to submesothyrid foramen, conjunct deltidial plates. Strong, crenulated teeth; dorsal median septum low, persistent, small, pitlike septalium; crura raduliform; much internal secondary thickening. *Middle Jurassic (Bathonian)*: England, France.—FIG. 916,3a–n. *\*G. boueti goniaeae*, upper Bathonian, Dorset, England; a–c, dorsal, lateral, anterior views, BMNH B.27527,  $\times 1$  (new); d–n, transverse serial sections, distances in mm from ventral umbo, 0.8, 1.5, 2.2, 3.1, 3.3, 3.5, 4.0, 4.6, 4.8, 5.0, 5.2 (Laurin, 1984).
- Grandirhynchia** BUCKMAN, 1918, p. 40 [*\*G. grandis*; OD] [= *Grandirhynchia* BUCKMAN, 1914, p. 1, and 1915, p. 76, both suppressed (ICZN, 1971, Opinion 957)]. Large, oval to subtrigonal, laterally expanded, uniplicate; depressed equibiconvex to gibbous dorsibiconvex; uniplication slight to strongly arcuate; with few (10 to 16) strong blunt costae (3 to 5 on central fold) and pronounced smooth stage posteriorly; beak large, suberect, sharp beak ridges, foramen large. Septalium very deep, median septum long; crura long, raduliform, strongly divergent distally. *Lower Jurassic (Pliensbachian)*: Scotland, England, Greenland.—FIG. 915,3a–j. *\*G. grandis*, upper Pliensbachian, Hebrides, Scotland; a–c, topotype, dorsal, lateral, anterior views, MKH J44324,  $\times 1$ ; d–j, transverse serial sections, distances in mm from ventral umbo, 3.9, 4.1, 4.5, 5.1, 5.8, 7.3, 8.1, MKH R.112 (Ager, 1956).
- Korjakirhynchia** SMIRNOVA, 1990a, p. 23 [*\*K. vodopadica*; OD] [= *Korjakirhynchia* SMIRNOVA, 1984, p. 116, *nom. nud.*; *Snezhnorhynchia* SMIRNOVA, 1990a, p. 26 (type, *S. dvorjankini*, OD); *Snezhnorhynchia* SMIRNOVA, 1984, p. 116, *nom. nud.*]. Medium to large, acutely dorsibiconvex, broad with deep ventral sulcus and trapeziform linguiform extension; smooth posteriorly, with costae few, strong, and angular, developed marginally; beak short, broad, strongly incurved; deltidial plates conjunct, foramen small. Dental plates wide apart, subparallel or divergent; dorsal median septum high, supporting septalium; crura moderately long, elongated ventrally; posterior diductor scars with strongly divergent anterior ends; adductor scars horseshoe shaped. [Synonymized because differences between their nominal type species are insignificant, attributable to deformation and tilted sectioning of the same taxon.] *Lower Cretaceous (Hauterivian)*: northeastern Russia (Koryakiya), Slovakia.—FIG. 913,3a–l. *\*K. vodopadica*, Koryakiya; a–d, holotype, dorsal, lateral, anterior, ventral views, MGU 138/278,  $\times 1$ ; e–l, transverse serial sections, distances in mm from first section, 0.8, 1.4, 2.4, 2.7, 3.0, 3.6, 4.3, 4.6 (Smirnova, 1990a).—FIG. 913,3m–w. *K. dvorjankini* (SMIRNOVA), Koryakiya; m–p, dorsal, lateral, anterior, ventral views, MGU 138/276,  $\times 1.5$ ; q–w, transverse serial sections, distances in mm from first section, 1.6, 1.8, 2.3, 2.9, 3.3, 4.15, 4.3,  $\times 1$  (Smirnova, 1990a).
- Orlovirhynchia** DAGYS, 1968, p. 75 [*\*Septaliphoria viligaensis* MOISEEV, 1947b, p. 90; OD]. Very large, oval to rounded-pentagonal, sulcus broad, corresponding fold low or not developed, anterior commissure uniplicate, costae strong; beak short, incurved, ridges distinct, foramen hypothyrid. Dental plates long, subparallel, pedicle collar absent; septum high and long (about two-fifths valve length), septalium narrow, deep, crura raduliform. *Lower Jurassic (Pliensbachian)*: northeastern Siberia.—FIG. 916,2a–k. *\*O. viligaensis* (MOISEEV); a–c, dorsal, anterior, ventral views, IGIG 318/78,  $\times 1$ ; d–k, transverse serial sections, distances in mm from first section, 3.2, 4.1, 4.7, 5.8, 6.8, 7.9, 9.7, 10.9 (Dagys, 1968).
- Pontaltorhynchia** OWEN & ROSE, 1997, p. 505 [*\*Rhynchonella schopeni* DI STEFANO, 1887, p. 68; OD]. Medium size, transversely oval, equibiconvex, multicostate; broadly uniplicate with linguiform extension moderate, trapezoidal, and dorsal fold poorly developed; umbo massive; beak short,

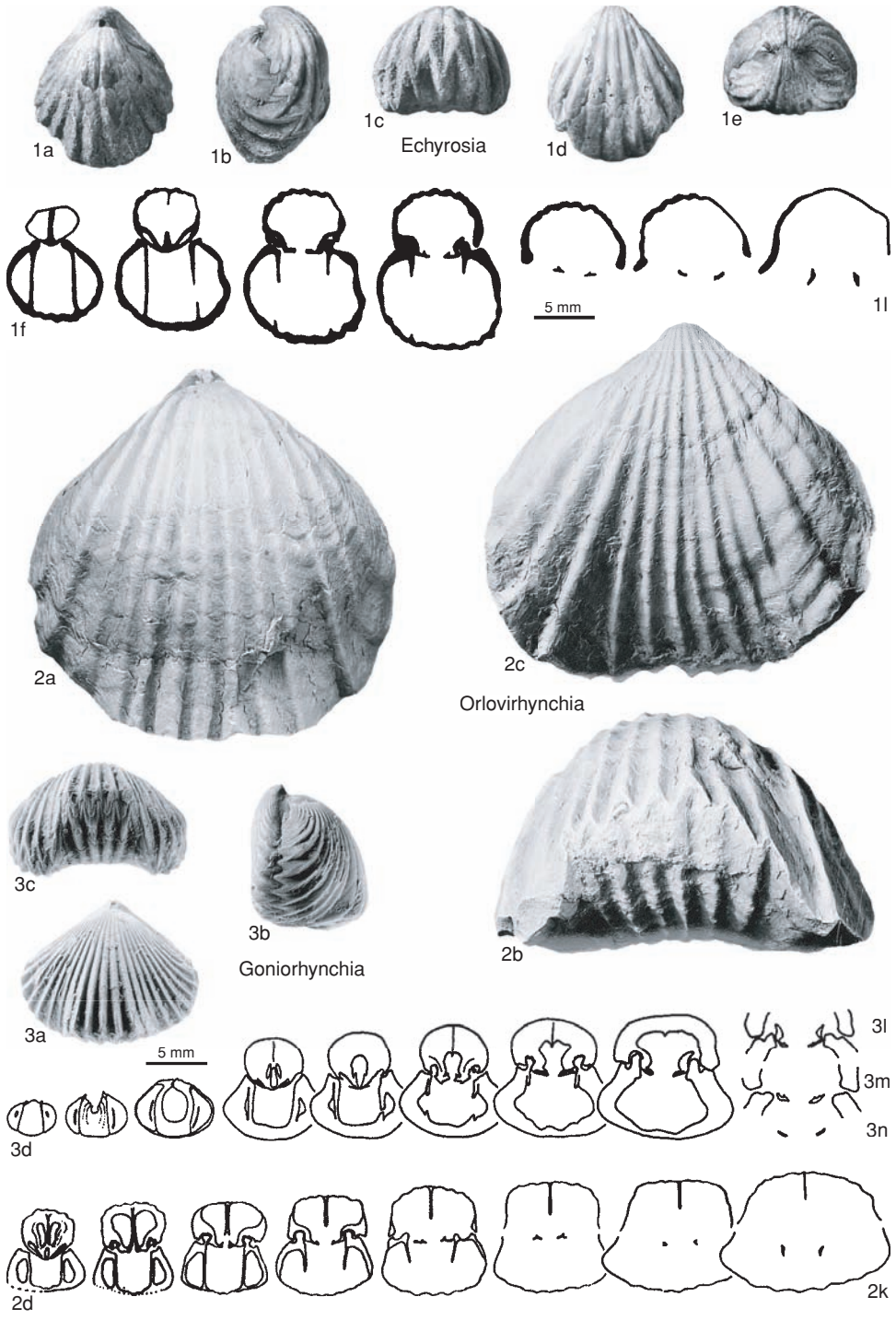


FIG. 916. Tetrarhynchiidae (p. 1351).

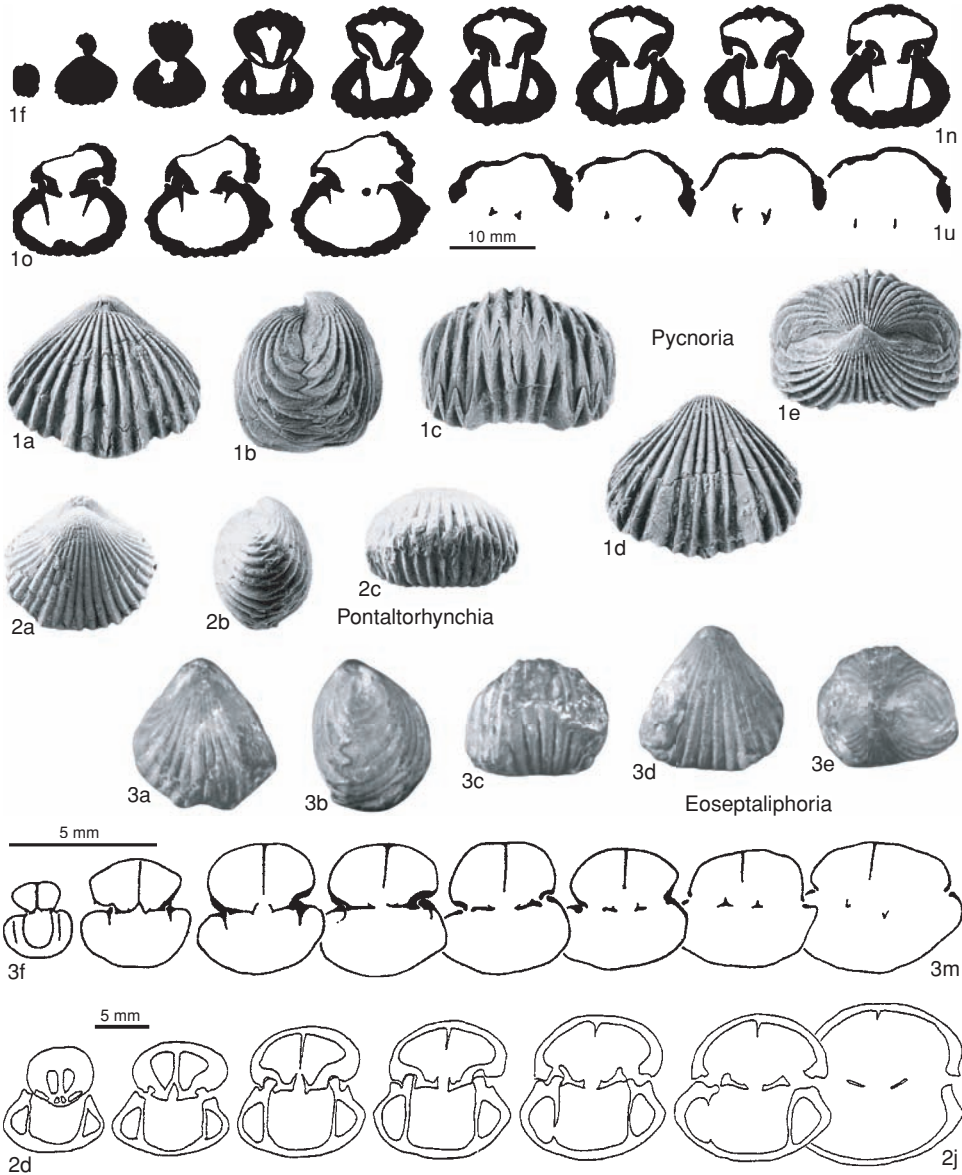


FIG. 917. Tetrarhynchiidae (p. 1351–1354).

suberect, beak ridges rounded, indistinct. Cardinal process bilobed; median dorsal ridge short, low; dental plates subparallel; hinge plates gently convex, dorsal median septum high, and septalium deep. *Lower Jurassic (Sinemurian–Pliensbachian)*: Italy (Apennines, Sicily), Gibraltar.—FIG. 917,2a–j. \**P. schopeni* (DI STEFANO); a–c, dorsal, lateral, anterior views, Sinemurian, central Apennines, BMNH B.14969, ×1; d–j, transverse serial sections, distances in mm from ventral umbo, 1.6, 2.0, 2.2, 2.4,

2.6, 2.8, 3.4, lower Pliensbachian, Sicily, BMNH BB.20290 (Owen & Rose, 1997). *Pycnoria* COOPER, 1989, p. 51 [*P. magna*; OD]. Medium to large, dorsibiconvex; subtriangular to subpentagonal; narrowly uniplicate, dorsal fold gently elevated above steep, rounded lateral slopes; strong, subangular costae (3 to 5 on fold); beak small, low, erect to incurved; deltidial plates conjunct, rimmed; foramen small. Dental plates long, thick; dorsal median ridge low, thick, moderately

long; septalium small, raduliform crura; both valves thickened by adventitious shell. *Middle Jurassic* (*Bathonian*): Saudi Arabia, Sinai, Israel, ?Somalia, ?Tunisia, ?southern France.—FIG. 917, 1*a*–*u*. \**P. magna*, Saudi Arabia; *a*–*e*, paratype, dorsal, lateral, anterior, ventral, posterior views, USNM 380565*a*,  $\times 1$ ; *f*–*n*, transverse serial sections, distances in mm from ventral umbo, 1.6, 3.1, 3.4, 3.7, 4.0, 4.3, 4.6, 4.8, 5.1, USNM 380648; *o*–*u*, distances in mm from first section, 0.0, 0.5, 0.9, 1.2, 1.8, 2.1, 2.6, USNM 380678 (Cooper, 1989).

**Quadrirhynchia** BUCKMAN, 1918, p. 42–43 [\**Q. quadrata*; OD] [= *Quadrirhynchia* BUCKMAN, 1914, p. 1, and 1915, p. 76, both suppressed (ICZN, 1971, Opinion 957)]. Medium size to large, oval to subtrigonal, laterally expanded, depressed equibiconvex to gibbous dorsibiconvex, everted; uniplication strong, wide, flattened, with costae numerous, very sharp (5 to 10 or 15 on fold); no smooth stage; beak small, incurved, foramen small, submesothyrid. Pedicle collar present; dorsal median septum very short, septalial plates short; crura raduliform. Dorsal muscle scars elliptical, separated, equidimensional; ventral muscle scar area U-shaped or elliptical. *Lower Jurassic* (*upper Sinemurian*)–*Middle Jurassic* (*Aalenian*): England, France, Spain, Portugal, ?Germany, Morocco, Algeria, Argentina, USA (Nevada).—FIG. 914, 2*a*–*l*. \**Q. quadrata*, upper Pliensbachian, Somerset, England; *a*–*d*, holotype, dorsal, lateral, anterior, posterior views, GSM 31864,  $\times 1$ ; *e*–*l*, transverse serial sections, distances in mm from ventral umbo, 1.0, 1.6, 1.9, 2.5, 2.9, 3.7, 4.7, 5.0, J.953/1, Derek Ager, personal collection (Ager, 1956).

**Robustirhynchia** SEIFERT, 1963, p. 174–175 [\**Terebratula Ehningensis* QUENSTEDT, 1857 in 1856–1857, p. 497; OD; = *R. kurri* OPPEL, 1857 in 1856–1858, p. 577 (p. 279 in 2nd part), subj.] [= *Robustirhynchia* SULSER, 1993, p. 221, *nom. null.*]. Similar to *Goniorhynchia* but very wide, with uniplication broad, flattened, and shell thinner. Large, depressed dorsibiconvex, wide subrectangular, transversely elongate; sinus anteriorly flattened and fold strong; costae few (12 to 15), sharp, simple, beginning at apex (4 to 6 on fold); apical region massive, foramen oval to circular; deltidial plates disjunct; apex suberect to weakly incurved. Dental plates thin, strongly divergent; teeth long, tongue shaped, not completely filling wide sockets; dorsal median septum strong but low reaching beyond midvalve; hinge plates straight or slightly concave ventrally; crura not fully preserved. *Middle Jurassic* (*Callovian*): Germany, Poland (extra-Alpine).—FIG. 915, 2*a*–*i*. \**R. ehningensis* (QUENSTEDT), Swabian Alb, Germany; *a*–*c*, dorsal, lateral, anterior views, BMNH B.12005,  $\times 1.5$  (new); *d*–*i*, paratype, transverse serial sections through umbo (Seifert, 1963).

**Somalirhynchia** WEIR, 1925, p. 79 [\**S. africana*; OD] [= *Somalirhynchia* GACOVIC & TCHOUMATCHENCO, 1994, p. 20, *nom. null.*]. Large, roundly subtrigonal to broadly subpentagonal, trilobate; dorsibiconvex, uniplicate, dorsal fold low, distinct; 20 to 38

multicostate, coarse, simple, subangular costae (5 to 12 on fold); beak strong, suberect to incurved, with small hypothrydial foramen; muscle scars well marked. Dorsal median septum long, septalium strong, pitlike; hinge plates subhorizontal; crura raduliform, enlarged distally; teeth crenulated. [Genus in need of further studies; pre-Callovian records are suspect and thus excluded.] *Middle Jurassic* (?*Callovian*), *Upper Jurassic* (*Oxfordian*–*Kimmeridgian*): Scotland, France, Spain, Switzerland, Russia, Caucasus, ?Poland, ?Yugoslavia, Morocco, Algeria, Tunisia, Egypt, Somalia, Ethiopia, Kenya, Syria, Jordan, Saudi Arabia, Israel, Nepal, India, ?Pakistan.—FIG. 918*a*–*q*. \**S. africana*, Oxfordian, Bihendula, Somalia; *a*–*c*, dorsal, lateral, anterior views, USNM 429404,  $\times 1$  (Shi & Grant, 1993); *d*–*q*, transverse serial sections, distances in mm from ventral umbo, 1.1, 1.4, 2.3, 3.8, 4.2, 4.8, 5.1, 5.3, 5.5, 5.9, 6.4, 6.7, 7.0, 7.2, BMNH B.46172,  $\times 1.4$  (Muir-Wood, 1935).—FIG. 918*r*: *S. arabica* COOPER, Kimmeridgian, Saudi Arabia; paratype, interior showing septalium and raduliform crus, USNM 380514,  $\times 2$  (Cooper, 1989).

### Subfamily GIBBIRHYNCHIIINAE new subfamily

[Gibbirhynchiiinae MANCENIDO & OWEN, herein]

Tetrahynchiiidae with densely costate, moderately uniplicate, nearly equibiconvex shells; dorsal and ventral valves both globose, with fold and sulcus ill defined, often merging gradually into convex lateral slopes; linguiform extension typically arcuate and rather low; ventral beak acuminate, erect to incurved. Usually with median septum high and septalium narrow; dental plates subparallel to slightly ventrally divergent; strongly incurved raduliform crura. *Lower Jurassic* (*Sinemurian*), *Middle Jurassic* (*Callovian*).

**Gibbirhynchia** BUCKMAN, 1918, p. 43 [\**G. gibbosa*; OD] [= *Gibbirhynchia* BUCKMAN, 1914, p. 1, and 1915, p. 76, both suppressed (ICZN, 1971, Opinion 957)]. Small, globose, equibiconvex to dorsibiconvex, with uniplication strong, arched topped; multicostate, 11 to 38 costae (3 to 9 on fold); beak small, incurved, with 2 deep, narrow muscle impressions. Crura raduliform short, rodlike. [Middle Jurassic (Bajocian–Bathonian) records of Arabia as in COOPER, 1989, are probably referable to *Nastosia*.] *Lower Jurassic* (*Sinemurian*–*Toarcian*): England, Scotland, France, Belgium, Germany, ?Portugal, Spain, Gibraltar, Switzerland, Italy, Yugoslavia, Greece, Slovakia, Hungary, Romania, ?Bulgaria, Morocco, Algeria, Anatolia, Israel, Iran, Argentina, ?Peru, western USA (?Nevada), Canada,

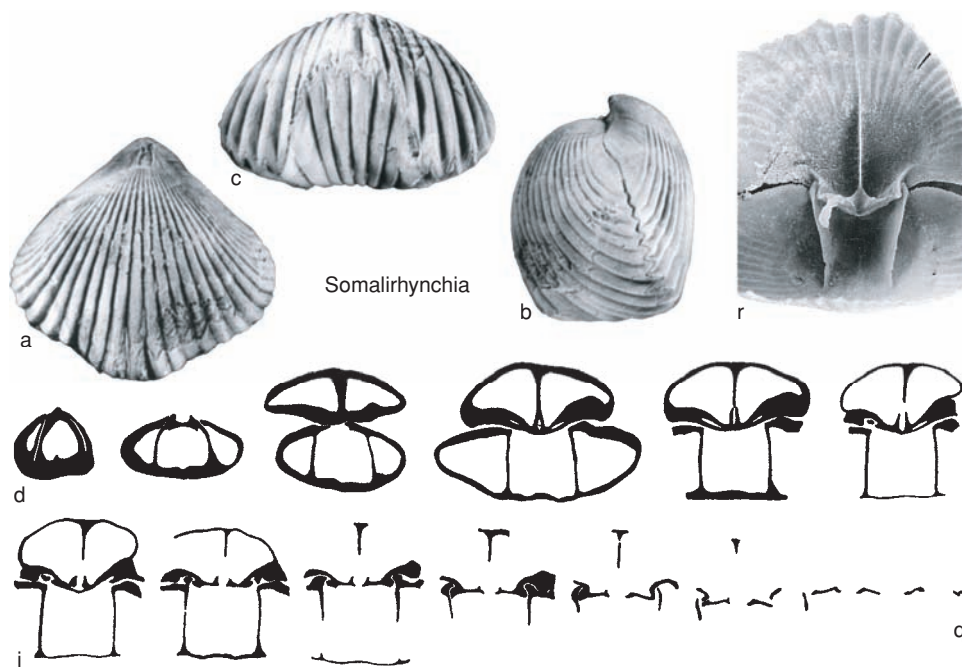


FIG. 918. Tetrarhynchiidae (p. 1354).

?Indonesia.—FIG. 919,3a–i. \**G. gibbosa*, upper Pliensbachian, Somerset, England; a–c, holotype, dorsal, lateral, anterior views, GSM 31866,  $\times 1.5$ ; d–i, topotype, transverse serial sections, distances in mm from ventral umbo, 0.5, 0.8, 1.2, 1.5, 1.8, 2.7, BMNH B.64700 (Ager, 1962).

**Amydroptychus** COOPER, 1989, p. 10 [*A. formosus*; OD]. Medium size, dorsibiconvex to equibiconvex; widely, roundly subtriangular; rectimarginate or with slight, faint arcuate uniplication, but dorsal fold barely perceptible; costae full length, subangular, with occasional intercalations on umbones; long, erect beak with small, tubular, hypothryid foramen; deltidial plates disjunct rimmed. Dorsal median septum short, supporting small septalium; dental plates short, wide apart; raduliform crura, laterally expanded distally. *Middle Jurassic (Bajocian)*: Saudi Arabia, ?Israel.—FIG. 920,1a–m. \**A. formosus*, Saudi Arabia; a–e, holotype, dorsal, lateral, anterior, ventral, posterior views, USNM 380223c,  $\times 1$ ; f–m, transverse serial sections, distances in mm from ventral umbo, 2.8, 3.2, 3.5, 3.7, 4.2, 4.7, 5.1, 5.4, USNM 380683 (Cooper, 1989).

**Burmirhynchia** BUCKMAN, 1918, p. 49 [*B. gutta*; OD] [= *Burmirhynchia* BUCKMAN, 1915, p. 76, suppressed (ICZN, 1971, Opinion 957)]. Small to medium, globose, equibiconvex to dorsibiconvex, thickest at midvalve, convex anteriorly; uniplication distinct, but dorsal fold indistinct to gently prominent; linguiform extension always neat, deflected dorsally; costae numerous, simple, smooth posterior area not present; beak massive, incurved to suberect, sub-

duced beak ridges; foramen small, hypothryid, deltidial plates disjunct to barely conjunct. Dental plates ventrally divergent; dorsal median septum strong, septalium variable; crura slender, strongly incurved, raduliform. *Middle Jurassic (?Bajocian, Bathonian–Callovian)*: Europe, Africa, Asia, ?Australasia.

**B. (Burmirhynchia)**. More subspherical, both valves inflated, dorsal fold undifferentiated, and costae rounder. Dorsal septum and septalium may be reduced; secondary thickenings not noticeable on the interior. *Middle Jurassic (?Bajocian, Bathonian–Callovian)*: Europe, Somalia, Middle East, Afghanistan, India, Myanmar (Burma), China, ?Japan, ?New Zealand.—FIG. 919,1a–k. \**B. (B.) gutta*, Bathonian, northern Shan States, Myanmar; a–c, topotype, dorsal, lateral, anterior views, USNM 123602,  $\times 1$ ; d–k, topotype, transverse serial sections, distances in mm from ventral umbo, 1.9, 2.2, 2.4, 2.7, 3.0, 3.5, 4.0, 4.7, USNM 123602 (Shi & Grant, 1993).

**B. (Hopkinsirhynchia)** SHI & GRANT, 1993, p. 63 [*Rhyntonella hopkinsi* DAVIDSON, 1852b, p. 97; OD] [= *Hopkinsirhynchia* SHI & YANG, 1992, p. 555, *nom. nud.*]. More dorsibiconvex, and somewhat trilobate; fold and sulcus well developed, linguiform extension high, trapezoidal; costae rather coarser, subangular. Dorsal median septum stout, septalium generally V-shaped; secondary thickenings frequently developed inside both valves. *Middle Jurassic (middle*



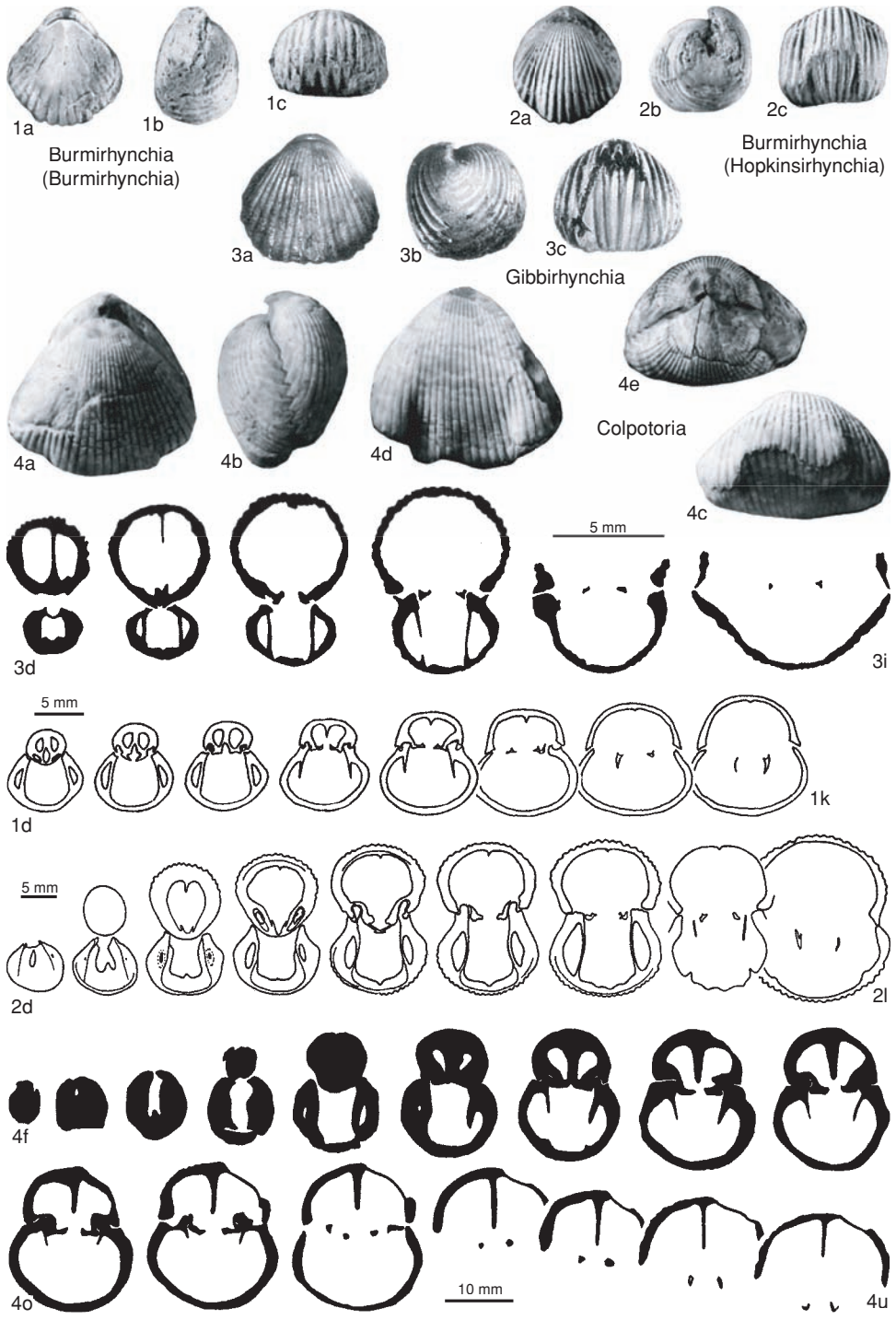


FIG. 919. Tetrarhynchiidae (p. 1354–1358).

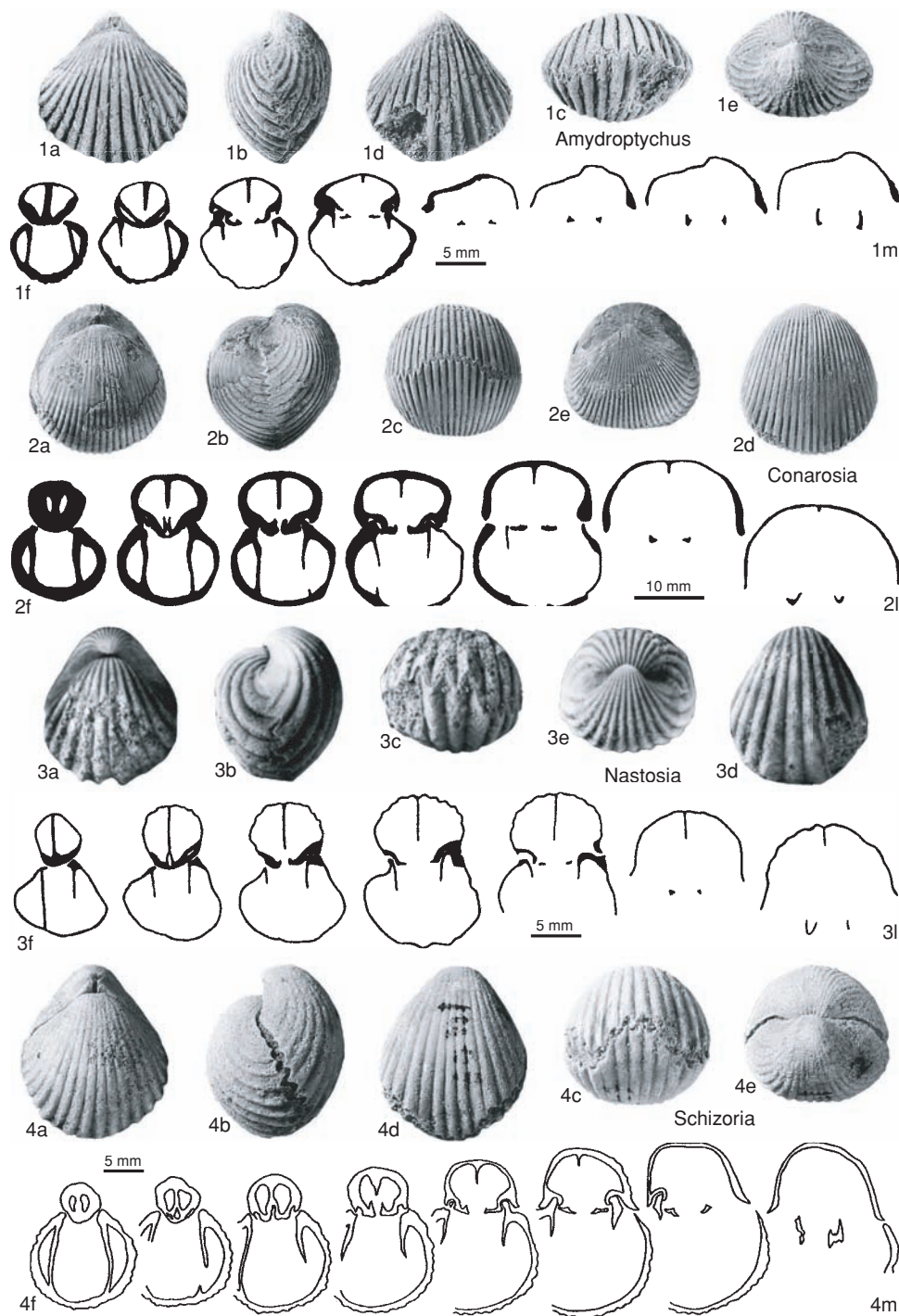


FIG. 920. Tetrarhynchiidae (p. 1355–1358).

- Bathonian–lower Callovian*): England, France, Germany, Switzerland, Middle East, Africa.—FIG. 919,2a–l. \**B. (H.) hopkinsi* (DAVIDSON), middle Bathonian, northwestern France; *a–c*, dorsal, lateral, anterior views, USNM 104676a,  $\times 1$  (Shi & Grant, 1993); *d–l*, transverse serial sections, distances in mm from ventral umbo, 1.6, 2.2, 3.1, 3.6, 4.1, 4.4, 5.0, 5.7, 6.6 (Laurin, 1984).
- ?**Colpotoria** COOPER, 1989, p. 18 [\**C. plicatilis*; OD; =*Burmhirynchia nazeri* ALMÉRAS, 1987, p. 177, subj.]. Large, dorsibiconvex; elongate subtriangular; anteriorly quadrilobate, dorsal fold with anterior sulcus; costae numerous, narrow, flattened, crowded, separated by striae narrower than costae; beak narrow pointed, straight to erect; deltidial plates disjunct to conjunct; foramen small, hypothyrud. Dental plates long, divergent; dorsal median septum long, thick; cardinalia thickened; septalium small, shallow; cardinal process absent; crura raduliform, distally concave. [May be an iterative forerunner of Cretaceous Cretirhynchinae or ancestral to them.] *Middle Jurassic (Bathonian–Callovian)*): Saudi Arabia.—FIG. 919,4a–u. \**C. nazeri plicatilis*, Bathonian; *a–e*, holotype, dorsal, lateral, anterior, ventral, posterior views, USNM 380208a,  $\times 1$ ; *f–u*, transverse serial sections, distances in mm from ventral umbo, 0.9, 2.1, 2.7, 3.0, 4.0, 4.7, 5.0, 5.4, 5.6, 6.0, 6.4, 6.7, 7.0, 7.3, 7.7, 8.1, USNM 380654 (Cooper, 1989).
- Conarosia** COOPER, 1989, p. 20 [\**C. rotundata*; OD; =*Burmhirynchia moulani* ALMÉRAS, 1987, p. 177, subj.]. Often large, strongly dorsibiconvex; roundly oval in outline and side view; uniplicate, but with indistinct dorsal fold and ventral sulcus; costae numerous, narrow, rounded to flattened, separated by striae narrower than costae; beak massive, rounded, strongly incurved, almost touching umbo of dorsal valve; deltidial plates disjunct to conjunct; foramen small, hypothyrud. Dental plates long; dorsal median septum long; septalium small, cardinal process absent; crura raduliform, widening distally. *Lower Jurassic (Toarcian), Middle Jurassic (Bajocian–Bathonian)*): Saudi Arabia.—FIG. 920,2a–l. \**C. moulani rotundata*, upper Bajocian–Bathonian; *a–e*, paratype, dorsal, lateral, anterior, ventral, posterior views, USNM 380379,  $\times 1$ ; *f–l*, transverse serial sections, distances in mm from ventral umbo, 3.0, 3.7, 4.0, 4.5, 5.0, 6.5, 7.6, USNM 380663 (Cooper, 1989).
- Nastosia** COOPER, 1989, p. 50 [\**N. coangustata*; OD]. Medium to large, nearly equibiconvex; roundly ovate; moderately uniplicate, but dorsal fold and sulcus subdued; strongly costate; beak erect; deltidial plates disjunct, marginally rimmed; foramen a minute, narrow slit. Dental plates long, thin, very closely positioned and nearly parallel; dorsal median septum thin, persistent; septalium thin; raduliform crura. *Middle Jurassic (upper Bajocian)*): Arabia.—FIG. 920,3a–l. \**N. coangustata*, Saudi Arabia; *a–e*, paratype, dorsal, lateral, anterior, ventral, posterior views, USNM 380279,  $\times 1$ ; *f–l*, transverse serial sections, distances in mm from ventral umbo, 3.3, 3.7, 4.0, 4.5, 4.8, 5.7, 6.2, USNM 380656 (Cooper, 1989).
- ?**Schizoria** COOPER, 1989, p. 54 [\**S. elongata*; OD]. Small to medium, dorsibiconvex; subtriangular, subpentagonal to subcircular, narrowly uniplicate, dorsal fold poorly defined; costae numerous, subangular, bifurcated and intercalated especially on umbones, 3 to 8 on fold; beak suberect to strongly incurved; deltidial plates disjunct; foramen small, narrow, tubular hypothyrud. Dental plates long, subparallel; dorsal median septum long; septalium small, short; crura raduliform. [Also shows affinities with Indorhynchinae but placed here due to its deep, Y-shaped septalium.] *Middle Jurassic (Bajocian)*): Arabia, Sinai.—FIG. 920,4a–m. \**S. elongata*; *a–e*, holotype, dorsal, lateral, anterior, ventral, posterior views, Saudi Arabia, USNM 380260b,  $\times 2$  (Cooper, 1989); *f–m*, transverse serial sections, distances in mm from ventral umbo, 3.9, 4.2, 4.7, 5.5, 6.5, 7.5, 8.3, 8.8, Sinai, GSI M6823 (Feldman, Owen, & Hirsch, 1991).

### Subfamily KALLIRHYNCHIIINAE new subfamily

[Kallirhynchinae MANCERIDO & OWEN, herein]

Tetrarhynchidaea with densely costate, trilobate, moderately inequibiconvex shells; dorsal valve with broad, flat, multidentate fold, best defined anteriorly; linguiform extension variably developed, often wide, trapeziform to subquadrate; beak prominent, erect to substraight. Dental plates thin, subparallel to ventrally divergent; dorsal median septum apically confined, supporting narrow or pitlike septalium; incurved raduliform crura strongly deflected ventrally. [Circumstantial evidence suggests likely persistence of members of this subfamily into the Cretaceous.] *Middle Jurassic (?Aalenian, Bajocian–Bathonian, ?Callovian), Upper Jurassic (?Oxfordian)*.

**Kallirhynchia** BUCKMAN, 1918, p. 31 [\**Rhynchonella concinna* var. *yaxleyensis* DAVIDSON, 1878, p. 206; OD] [=*Kallirhynchia* BUCKMAN, 1914, p. 1, and 1915, p. 76, both suppressed (ICZN, 1971, Opinion 957)]. Medium size, globose, almost convex-plane, thickest anteriorly; subpentagonal, anteriorly flat to gently indented; uniplication prominent, subrectangular, but fold indistinct; linguiform extension shallowly concave, flattened, strongly bent and rising above midheight; multicostate (24 to 32) after short posterior smooth stage (5 to 8 on fold); beak hypothyrud, suberect, deltidial plates disjunct or barely conjunct. Dorsal septum short, low; septalium almost sessile or pendant; crura long, allegedly calcariform to possibly falciform, in fact raduliform with concave distal ends. *Middle Jur-*

*sic* (Bajocian–Bathonian, ?Callovian): England, France, ?Germany, ?Switzerland, ?Poland, ?Egypt, Saudi Arabia, ?Jordan, Pamirs, India, China, ?Japan, ?USA, Canada, ?Argentina.—FIG. 921,2*a–j*. \**K. yaxleyensis* (DAVIDSON), upper Bathonian; *a–c*, topotype, dorsal, lateral, anterior, Cambridgeshire, England, USNM 429303,  $\times 1$  (Shi & Grant, 1993); *d–j*, transverse serial sections, distances in mm from ventral umbo, 2.0, 2.2, 3.4, 4.2, 4.3, 4.4, 4.5, Lorraine, France (Laurin, 1984).

**Kutchirhynchia** BUCKMAN, 1918, p. 54 [\**Rhyntonella concinna* var. *kutchensis* KITCHIN, 1897, p. 31; OD] [= *Kutchirhynchia* BUCKMAN, 1914, p. 2, and 1915, p. 77, both suppressed (ICZN, 1971, Opinion 957); *Karakulirhynchia* OVCHARENKO, 1991, p. 18 (type, *K. karakulensis*, OD)]. Medium to large, subglobose, moderately dorsibiconvex, roundly subpentagonal; uniplication broad, strong and dorsal fold little raised; smooth stage absent, costae numerous, simple, sharp; beak short, suberect to erect; foramen large; deltidial plates disjunct or conjunct. Dental plates long, subparallel; teeth massive, expanded, crenulated; dorsal median septum stout but short, low; hinge plates subhorizontal; septalium variable; slender raduliform crura, strongly curved ventrally. [Possibly comprising *Obsoletirhynchia* as synonym or subgenus.] *Middle Jurassic* (Bathonian–lower Callovian): England, France, Romania, ?Morocco, ?Tunisia, ?Somalia, Saudi Arabia, India, Uzbekistan, Pamirs, ?Iran.—FIG. 921,3*a–j*. \**K. kutchensis* (KITCHIN), upper Bathonian, Kutch, India; *a–c*, topotype, dorsal, lateral, anterior views, USNM 75997,  $\times 1$  (Shi & Grant, 1993); *d–j*, transverse serial sections, distances in mm from first section, 5.45, 5.8, 6.0, 7.2, 8.2, 9.0, 9.5, BMNH B.52574,  $\times 1$  (new).—FIG. 921,3*k–u*. *K. karakulensis* (OVCHARENKO), lower Callovian, Pamirs; *k–m*, dorsal, lateral, anterior views,  $\times 1$ ; *n–u*, transverse serial sections, distances in mm from first section, 2.6, 3.5, 3.9, 4.2, 4.6, 5.0, 5.5, 6.5 (Ovcharenko, 1991).

**Obsoletirhynchia** SHI, 1992, p. 143 [\**Terebratulina obsoleta* J. SOWERBY, 1815 in 1812–1815, p. 192; OD] [= *Obsoletirhynchia* YANG & SHI, 1990, p. 18, *nom. nud.*]. Similar to *Kutchirhynchia* but with beak substraight to suberect, foramen rimmed, fold and sulcus less developed, occasionally given to slight asymmetry; septalium rudimentary, pendant. [May be included in *Kutchirhynchia* as synonym or subgenus.] *Middle Jurassic* (Bathonian): England, France, Germany, China.—FIG. 921,1*a–k*. \**O. obsoleta* (SOWERBY), upper Bathonian; *a–c*, topotype, dorsal, lateral, anterior views, Bradford-on-Avon, England, USNM 31006a,  $\times 1$  (Shi & Grant, 1993); *d–k*, transverse serial sections, distances in mm from ventral umbo, 1.67, 2.5, 3.0, 3.7, 4.2, 4.6, 6.0, 8.5, France (Laurin, 1984).

**Rhactorhynchia** BUCKMAN, 1918, p. 50 [\**R. rhacta*; OD; = *Rhyntonella subtetrahedra* DAVIDSON, 1852b, p. 95, subj.] [= *Rhactorhynchia* BUCKMAN, 1914, p. 1, and 1915, p. 77, both suppressed (ICZN, 1971, Opinion 957); *Rhactorhynchia* WISNIEWSKA-ZELICHOWSKA, 1978, p. 65, *nom. null.*]. Medium

size to large, dorsibiconvex, oval to round subtriangular, subglobose to globose; dorsal fold and ventral sulcus generally weak, sometimes asymmetrical; costae numerous, strong, sharp; beak strong, slightly incurved, foramen rimmed, hypothyrid, conjunct deltidial plates. Dorsal median septum strong, septalium brief, pitlike; crura raduliform, transitional to canaliform distally; muscle scars expanded. [Species name was originally spelled *subtetraëdra*. Prevailing spelling adopted by BUCKMAN (1918, p. 226), preserved under Article 33.3.1 of ICZN (1999).] *Middle Jurassic* (?Aalenian, Bajocian–Bathonian, ?Callovian), *Upper Jurassic* (?Oxfordian): England, France, ?Switzerland, ?Austria, ?Poland, ?Yugoslavia, Russia, Caucasus, ?Morocco, ?Israel, India, China, ?USA, ?Canada, ?Chile.—FIG. 922*a–p*. \**R. subtetrahedra* (DAVIDSON), upper Bajocian, Cotswolds, England; *a–c*, dorsal, lateral, anterior views, USNM 88731,  $\times 1$  (Shi & Grant, 1993); *d–p*, transverse serial sections, distances in mm from ventral umbo, 1.0, 1.8, 2.5, 3.7, 4.4, 5.2, 5.5, 6.2, 6.7, 7.5, 8.2, 9.1, 9.4, BUM 5029(3) (new; courtesy of C. D. Prosser).

### Subfamily ISJUMINELLINAE new subfamily

[Isjuminellinae MANCEÑO & OWEN, herein]

Tetrahynchiidae with shells paucicostate, uniplicate, strongly inequibiconvex; dorsal valve prominently inflated, with central fold conspicuously raised; linguiform extension high and prominent; ventral beak strongly incurved, often closely appressed to dorsal umbo. Hinge plates very narrow; inner structures thickened, with lateral umbonal chambers often infilled with callus; crura raduliform, short, and slender. *Middle Jurassic* (Aalenian)—*Upper Jurassic* (Volgian).

**Isjuminella** MAKRIDIN, 1955, p. 85, *pars* [\**Rhyntonella decorata* BUCH [sic]; OD; = *Terebratulites decoratus* VON SCHLOTHEIM, 1820 in 1820–1823, p. 264; DROT & FISCHER, 1966, p. 53] [= *Sardorhynchia* TADDEI-RUGGIERO & UNGARO, 1984, p. 228 (type, *S. crassa* TADDEI-RUGGIERO & UNGARO, 1984, p. 232, OD)]. Large, pentagonal, strongly folded, and highly uniplicate; costae few, very strong, sharp, posterior smooth areas absent; beak massive, incurved; foramen small, hypothyrid, conjunct deltidial plates. Dental plates very short, ill-defined posteriorly; dorsal median septum reduced, thin, bulging in middle; hinge plates narrow, divided, septalium present; crura raduliform, short, incurved ventrally; shell thick, with marked secondary thickenings and callus inside both valves. *Middle Jurassic* (Bathonian–Callovian): western France, Belgium, England, Germany, Portugal, Sardinia, ?Morocco, ?Algeria.—FIG. 923*a–n*. \**I. decorata* (VON SCHLOTHEIM), Bathonian, Ardennes,

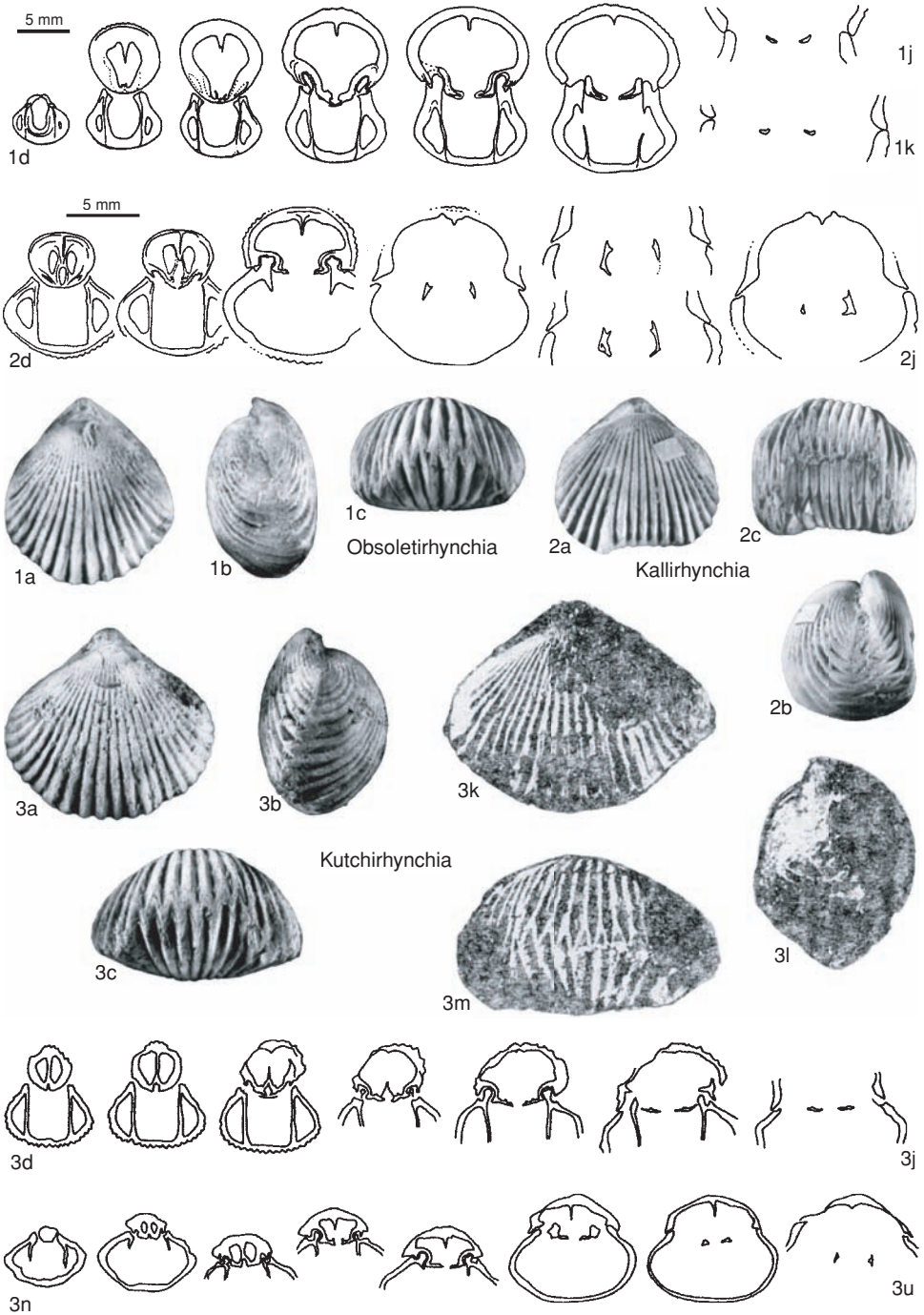


FIG. 921. Tetrarhynchiidae (p. 1358–1359).

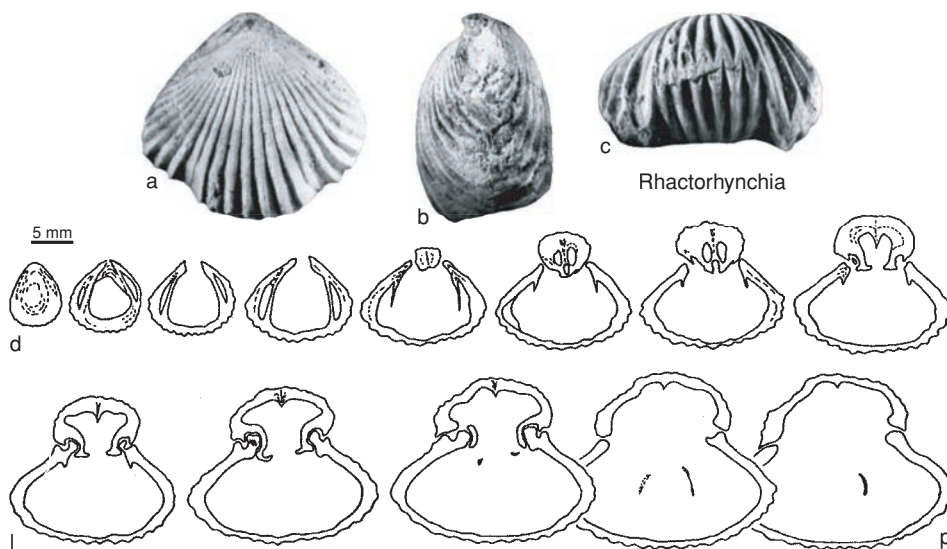


FIG. 922. Tetrarhynchiidae (p. 1359).

France; *a-c*, dorsal, lateral, anterior views, USNM 31331b,  $\times 1$  (Shi & Grant, 1993); *d-n*, transverse serial sections, distances in mm from ventral umbo, 2.9, 4.3, 6.5, 6.8, 8.1, 8.6, 9.4, 9.9, 10.5, 11.5, 13.3 (Drot & Fischer, 1966).—FIG. 923*o-cc*. *I. crassa* (TADDEI-RUGGIERO & UNGARO), upper Bathonian–Callovian, northwestern Sardinia; *o-r*, holotype, lateral, anterior, ventral, posterior views, T187, Paleontological Museum, University of Naples, Naples, Italy,  $\times 1$ ; *s-cc*, transverse serial sections, distances in mm from ventral umbo, 1.5, 3.5, 4.8, 5.4, 5.7, 6.6, 7.3, 7.9, 8.1, 8.4, 8.8, T164, Paleontological Museum, University of Naples, Naples, Italy (Taddei-Ruggiero & Ungaro, 1984).

**Costirhynchia** BUCKMAN, 1918, p. 39, *non* DAGYS, 1974, also Rhynchonellida [*C. costigera*; OD] [= *Costirhynchia* BUCKMAN, 1914, p. 1, and 1915, p. 76, both suppressed (ICZN, 1971, Opinion 957)]. Small, globose, dorsibiconvex, with fold high, bi- or tridentate and costae few, coarse; dorsal flanking costae often branching at least once quite early; beak small, short, suberect to incurved with foramen slitlike; squama and glotta present. Shell thick; dental plates short, convex; dorsal median septum high and long; hinge plates narrow; septalium pitlike. *Middle Jurassic (Aalenian–Bajocian)*: England, Italy, Pamirs.—FIG. 924, *1a-j*. \**C. costigera*, Aalenian, Cotswolds, England; *a-c*, topotype, dorsal, lateral, anterior views, BMNH B.86314,  $\times 1.5$  (new); *d-j*, topotype, transverse serial sections, distances in mm from ventral umbo, 1.6, 1.8, 2.2, 2.5, 2.8, 3.4, 4.5, CDP 10, C. D. Prosser, personal collection (new; courtesy of C. D. Prosser).

**Mosquilla** MAKRIDIN, 1955, p. 86 [\**Rhynchonella oxyptycha* FISCHER WALDHEIM (sic), 1843, p. 118; OD; = *Terebratula oxyptycha* FISCHER DE WALD-

HEIM, 1843, p. 118, OD] [= *Mosquilla* MAKRIDIN, 1954, p. 103, *nom. nud.*]. Large and medium size, oval or rounded-trigonal, covered with costae, simple, coarse, radial (6 to 7 on fold); sulcus and fold wide and well developed. Dorsal septum in young specimens wedge shaped; dental plates crescentic; crura slender, short, bladeliike, almost straight; distal end of septum in mature specimens indistinctly overgrown and filling cavity in beak region; septum buttressing disjunct parts of hinge plate, crura gradually becoming hook shaped; ventral muscle scars slender, deep, demarcated with distinct ridges, diverging anteriorly from bases of dental plates; dorsal anterior adductors small, rounded-trigonal near anterior part of septum; adjustors punctate shaped near crural bases. *Upper Jurassic (Volgian)*: Russian Platform.—FIG. 924, *2a-m*. \**M. oxyptycha* (FISCHER DE WALDHEIM), lower Volgian, Moscow basin; *a-c*, dorsal, lateral, anterior views,  $\times 1$ ; *d-m*, transverse serial sections, distances in mm from first section, 0.0, 0.1, 1.5, 1.8, 2.2, 2.9, 3.6, 4.7, 5.7, 6.5 (Makridin, 1964).

**Russirhynchia** BUCKMAN, 1918, p. 52 [\**Terebratula (Rhynchonella) Fischeri* ROUILLIER, 1847 in ROUILLIER & VOSINSKY, 1847–1848, p. 394; OD] [= *Russirhynchia* BUCKMAN, 1914, p. 2, and 1915, p. 77, both suppressed (ICZN, 1971, Opinion 957)]. Medium size to large, globose, round subpentagonal to subtrigonal, depressed dorsibiconvex to almost convexoplane; uniplication strong, dorsal fold; costae numerous, very strong (3 to 7 on fold); beak short, suberect, foramen round, deltidial plates disjunct. Dental plates subparallel, teeth stout; dorsal septum strong, low; septalium distinct in juveniles, extremely narrow and sessile in adults; crura raduliform; with much internal secondary thickening. *Upper Jurassic (Kimmeridgian–Volgian)*: Russia,

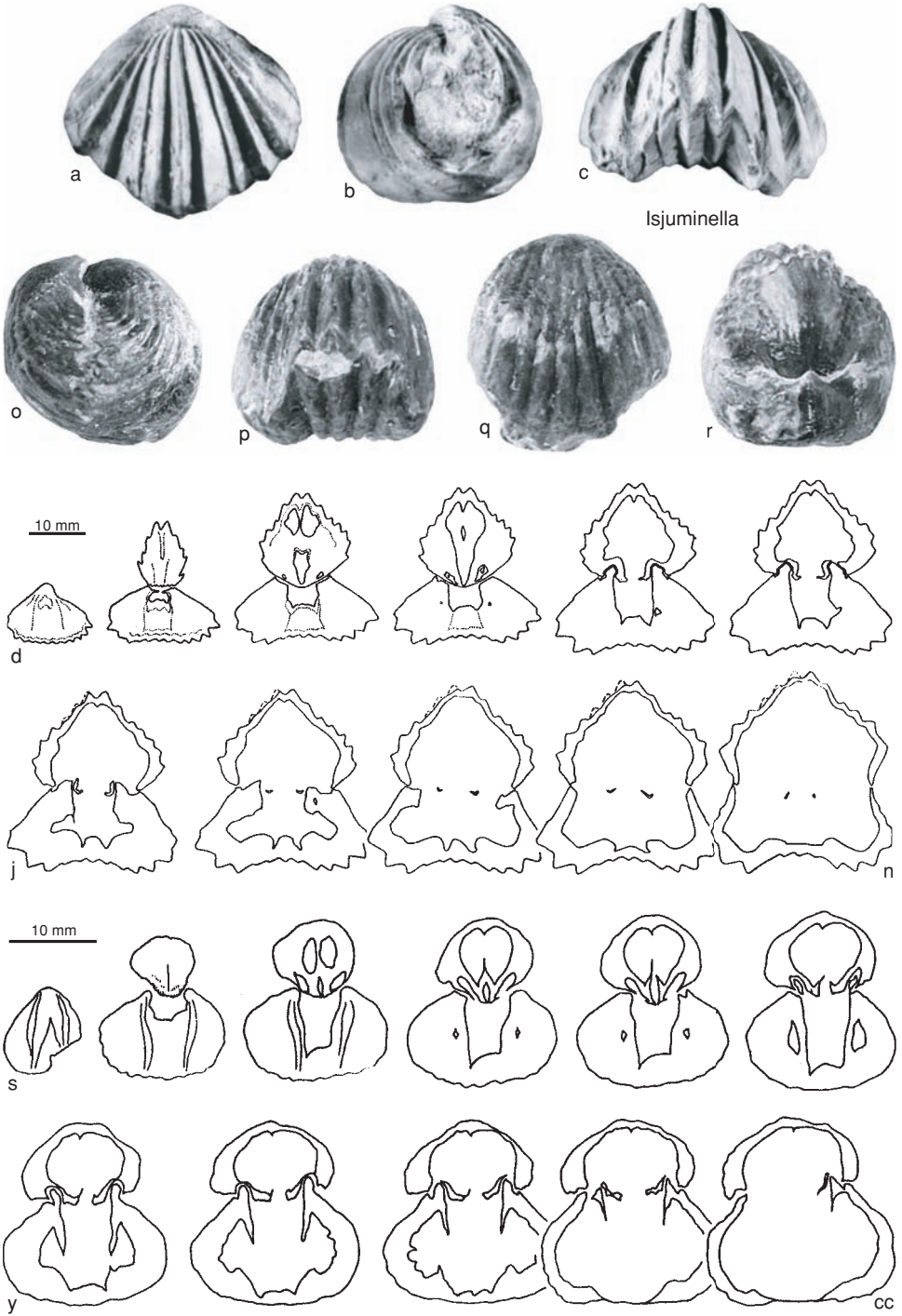


FIG. 923. Tetrarhynchiidae (p. 1359–1361).

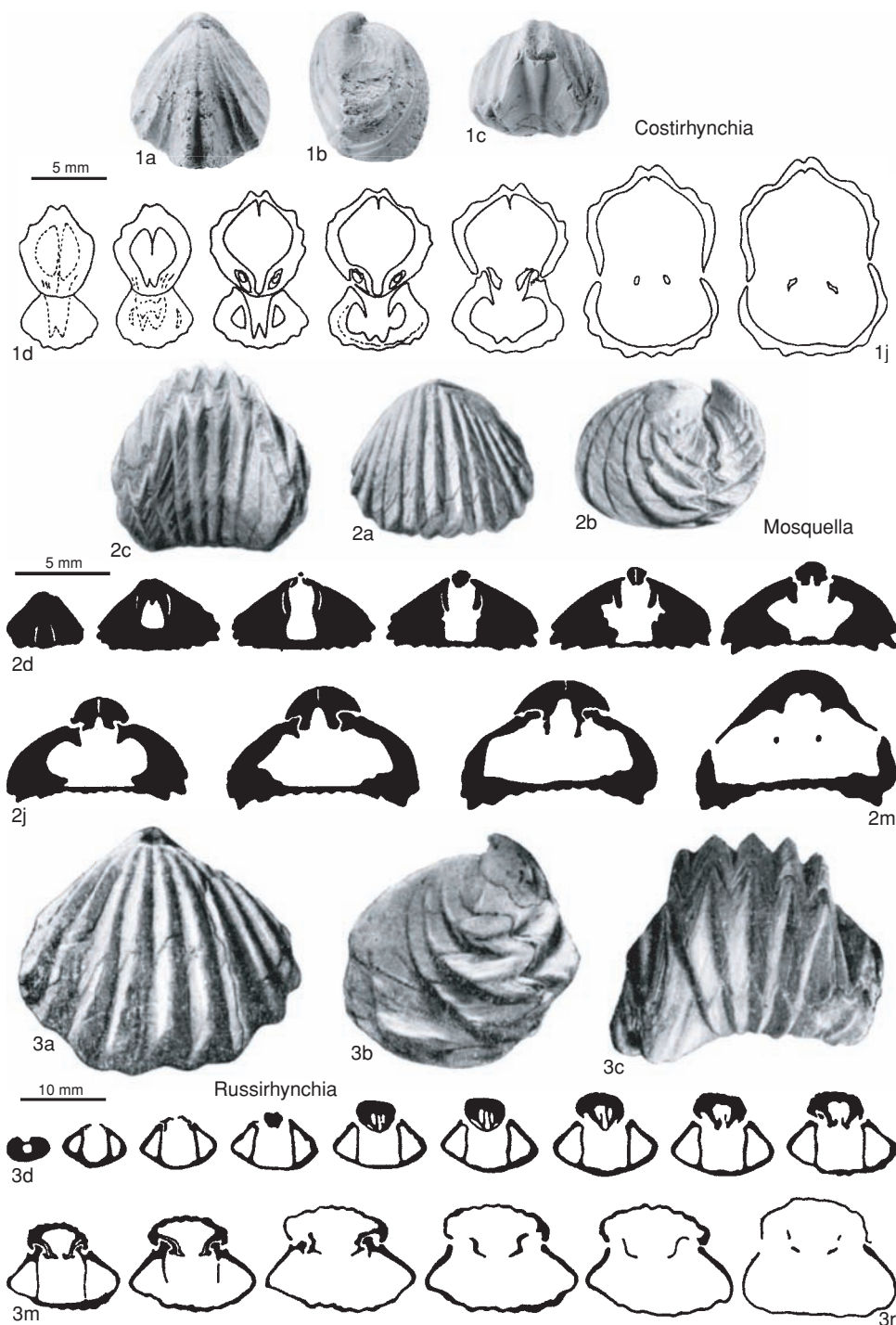


FIG. 924. Tetrarhynchiidae (p. 1361–1364).



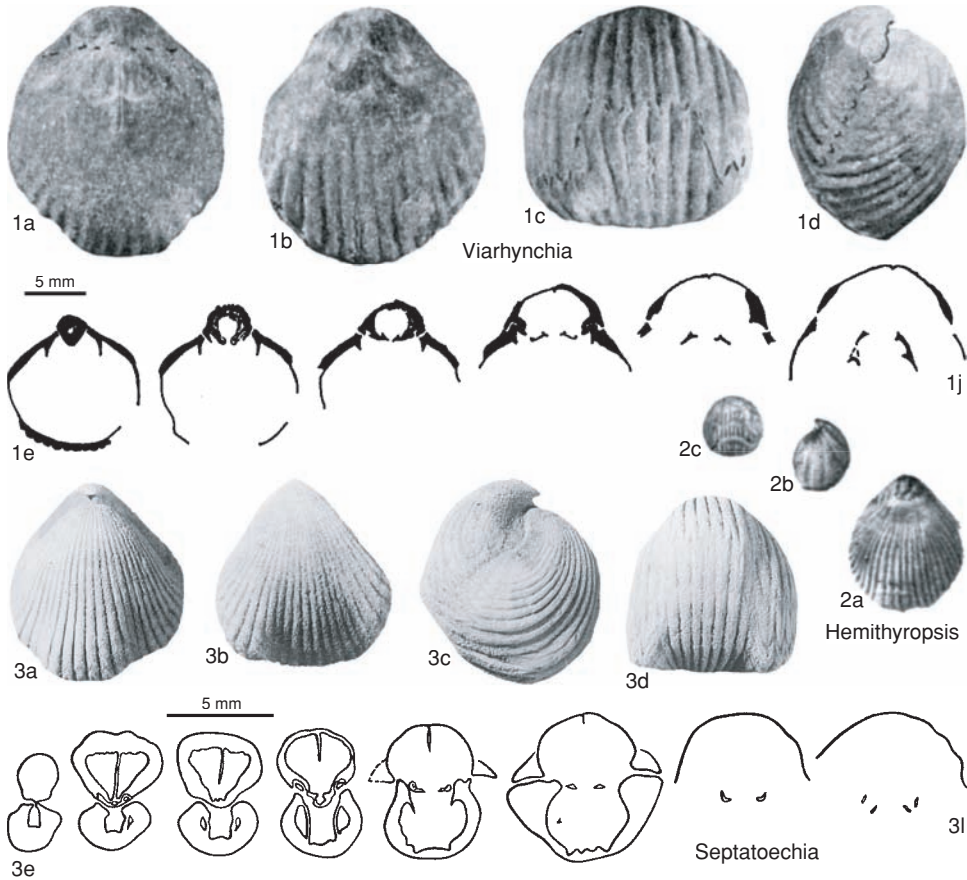


FIG. 925. Tetrarhynchiidae (p. 1364–1365).

western Europe.—FIG. 924, 3a–r. \**R. fischeri fischeri* (ROUILLIER), lower Volgian, Moscow Basin; a–c, dorsal, lateral, anterior views,  $\times 1$ ; d–r, transverse serial sections, distances in mm from ventral umbo, 3.5, 4.8, 5.7, 6.5, 6.9, 7.1, 7.3, 7.4, 7.6, 7.9, 8.5, 9.4, 9.9, 10.2, 10.3 (Makridin, 1964).

### Subfamily VIARHYNCHIINAE new subfamily

[Viarhynchiinae MANCENIDO & OWEN, herein]

Nearly equibiconvex, subspherical Tetrarhynchiidae; densely multicostate, broadly uniplicate, with linguiform extension semicircular to subquadrate, but with dorsal fold only gently raised anteriorly; beak prominent, incurved. Crura distally concave, transitional to canaliform. *Lower Cretaceous (Albian)*–*Upper Cretaceous (Maastrichtian)*.

*Viarhynchia* CALZADA BADIA, 1975, p. 170 [\**Rhynchonella cerdanyolae* BATALLER, 1947, p. 195; OD;

=*Rhynchonella sardanyolae* BATALLER, 1947, p. 195, prevailing spelling is preserved under Article 33.3.1 of ICZN (1999)]. Large, equibiconvex, globulose; costae numerous, strong, rounded; umbo massive, beak slightly incurved, foramen relatively small; uniplicate with dorsal fold poorly developed; ventral sulcus high, shallow with linguiform extension extensive. Dental plates short, ventrally divergent; hinge plates long, dorsally directed, raduliform crura with concave distal ends. Septum reduced to low, median ridge persistent. *Upper Cretaceous (upper Campanian–lower Maastrichtian)*: northeastern Spain.—FIG. 925, 1a–j. \**V. cerdanyolae* (BATALLER), upper Campanian, Catalanian pre-Pyrenees; a–c, lectotype, dorsal, ventral, anterior views, MGSB 6605,  $\times 1$ ; d, lateral view,  $\times 1$ ; e–j, transverse serial sections, distances in mm from ventral umbo, 3.8, 4.4, 4.8, 5.9, 6.6, 7.0 (Calzada Badia, 1975).

*Hemithyropsis* KATS, 1974, p. 254 [\**H. globulosa*; OD]. Shell variable in outline, usually elongate with fold and sulcus weakly developed and beak high, suberect. Hinge plates and socket ridges fused, forming cardinalium; often protruding near

cardinal margin, producing muscle platform. *Upper Cretaceous (Cenomanian–Maastrichtian)*: north of Don basin, Russia.—FIG. 925,2a–c. \**H. globulosa*, lower Maastrichtian, Russia; a, holotype, dorsal view,  $\times 2$ ; b–c, lateral, anterior views,  $\times 1$  (Kats, 1974).

**Septatoechia** LOBACHEVA & TITOVA, 1977, p. 102 [\**S. inflata*; OD]. Large, subtrigonal to subcircular, acutely biconvex; fold and sulcus well developed; costae numerous, rounded, originating from umbonal area, becoming more angular anteriorly; umbo short, beak massive, small, slightly incurved, foramen small, epithyrid, sometimes obscured by deltidial plates. Dental plates subparallel to slightly ventrally convergent; hinge plates short, dorsal septum high, long; crural bases ventrally deflected. Anterior commissure with sulcus high, arcuate, and dorsal fold well defined. *Lower Cretaceous (Albian)–Upper Cretaceous (Maastrichtian)*: France, Spain, Bulgaria, Crimea, Turkmenistan, western Kazakhstan.—FIG. 925,3a–l. \**S. inflata*, upper Maastrichtian, Tuarkyr, Turkmenistan; a–d, holotype, dorsal, ventral, lateral, anterior views, CNIGR 1/10153,  $\times 1$ ; e–l, transverse serial sections, distances in mm from ventral umbo, 2.2, 3.2, 3.4, 3.85, 4.35, 4.7, 5.6, 6.0,  $\times 2.7$  (Lobacheva & Titova, 1977).

### Subfamily CRETIRHYNCHIINAE

Kats, 1974

[*nom. transl.* MANCENIDO & OWEN, herein, *ex* Cretirhynchiidae KATS, 1974, p. 250]

Dorsibiconvex Tetrarhynchiidae, surface finely and densely costellate to capillate; uniplication broad, subrectangular to subquadrate, but with dorsal fold scarcely raised, ventral sulcus wide, shallow, and commonly bearing also a shallow dorsal median sulcus anteriorly; beak suberect to incurved, with beak ridges characteristically sharp. Dorsal median septum variably developed; hinge plates relatively narrow; crura raduliform with concave distal ends. *Lower Cretaceous (?Barremian, Aptian)–Upper Cretaceous (Maastrichtian)*.

**Cretirhynchia** PETTITT, 1950, p. 1 [\**Terebratula plicatilis* J. SOWERBY, 1816 in 1815–1818, p. 37; OD] [= *Cretirhynchia* MAKRIDIN in SARYCHEVA, 1960, p. 257, *nom. null.*]. Medium, transversely oval to subpentagonal; acutely dorsibiconvex; dorsal fold low, broad, flattened, developed anteriorly; well-marked shallow trapezoidal linguiform extension of ventral sulcus dorsally directed; ornament of rounded costellae; umbo small, beak erect. Hinge teeth subquadrate, deeply inserted; dental plates subparallel to slightly ventrally convergent; hinge plates short, triangular; median septum and septalium developed; crura long. [Danian records based on juveniles from Denmark (BAGGE

JOHANSEN, 1987) may refer to early hemithiridids.] *Upper Cretaceous (Cenomanian–upper Maastrichtian)*: Europe, northern Africa, ?Kazakhstan, ?Turkey, ?Turkmenistan, ?Antarctica.—FIG. 926,1a–l. \**C. plicatilis* (J. SOWERBY), upper Chalk, lower Senonian, Northfleet, Kent, England; a–c, topotype, dorsal, lateral, anterior views, BMNH B.79814,  $\times 1$  (new); d–l, transverse serial sections, distances in mm from ventral umbo, 1.7, 2.4, 3.3, 3.5, 3.9, 4.2, 4.4, 6.0, 6.7,  $\times 1$  (Pettitt, 1950).

**Begiarlania** TITOVA, 1992, p. 142 [\**Cretirhynchia begiarlanensis* NEKHRIKOVA, 1967, p. 32; OD]. Small to medium, subpentagonal, moderately dorsibiconvex, dorsal valve with slight umbonal inflation and median fold poorly developed, anteriorly sulcate; ventral valve with broad but shallow sulcus and linguiform extension trapezoidal; umbo short, beak slightly incurved. Pedicle collar present; dental plates subparallel to slightly ventrally convergent; teeth subquadrate, inner and outer socket ridges well developed; hinge plates short, horizontal to slightly ventrally deflected, crura distally concave; median septum or septalium absent. *Upper Cretaceous (Maastrichtian)*: Turkmenistan, western Kazakhstan.—FIG. 926,2a–u. \**B. begiarlanensis* (NEKHRIKOVA), upper Maastrichtian, Tuarkyr, Turkmenistan; a–d, holotype, dorsal, lateral, anterior, ventral views, CNIGR 34/10445,  $\times 1$ ; e–u, transverse serial sections, distances in mm from ventral umbo, 0.75, 1.4, 2.1, 2.5, 2.6, 2.7, 3.2, 3.3, 3.4, 3.5, 3.7, 4.0, 4.2, 4.3, 4.4, 4.5, 5.1, approximately  $\times 1.5$  (Titova, 1992).

**Bohemirhynchia** NEKVASILOVÁ, 1973, p. 78 [\**B. soukupi*; OD]. Medium, heart shaped, dorsibiconvex to almost convexoplane; broadly oval to subpentagonal, uniplicate, bisulcate; multicostate with some bifurcation; beak short, suberect, foramen small, submesothyrid; deltidial plates auriculate. Dental plates ventrally convergent, teeth massive, crenulated; median septum low; thick shelled; crura slightly concave dorsally. *Upper Cretaceous (Cenomanian)*: Slovakia.—FIG. 926,4a–k. \**B. soukupi*, upper Cenomanian, Miscovice; a–c, holotype, dorsal, lateral, anterior views, CGS ON 12/2,  $\times 1.5$ ; d–k, paratype, transverse serial sections, distances in mm from ventral umbo, 1.4, 2.85, 3.25, 3.65, 4.1, 4.7, 5.3, 5.7, CGS ON 12/35,  $\times 1.5$  (Nekvasilová, 1973).

**Burrirhynchia** OWEN, 1962, p. 58 [\**Rhynchonella leightonensis* LAMPLUGH & WALKER, 1903, p. 261; OD]. Small to medium, dorsibiconvex, elongate-triangular to subquadrate. Similar to *Cretirhynchia* but deltidial plates disjunct, hinge plates thinner and longer, and dorsal fold almost imperceptible; broadly uniplicate with linguiform extension extensive, trapezoidal; shell ornament fine, costellate. Dental plates subparallel to slightly convergent; median septum variable; crura moderately long. *Lower Cretaceous (?Barremian, Aptian)–Upper Cretaceous (Cenomanian)*: England, France, Switzerland, Spain, Germany, Poland, Romania, Caucasus, Morocco, Donets basin, Turkmenistan.—FIG. 926,3a–j. \**B. leightonensis* (LAMPLUGH & WALKER), lower Albian, Leighton Buzzard, Bedfordshire,

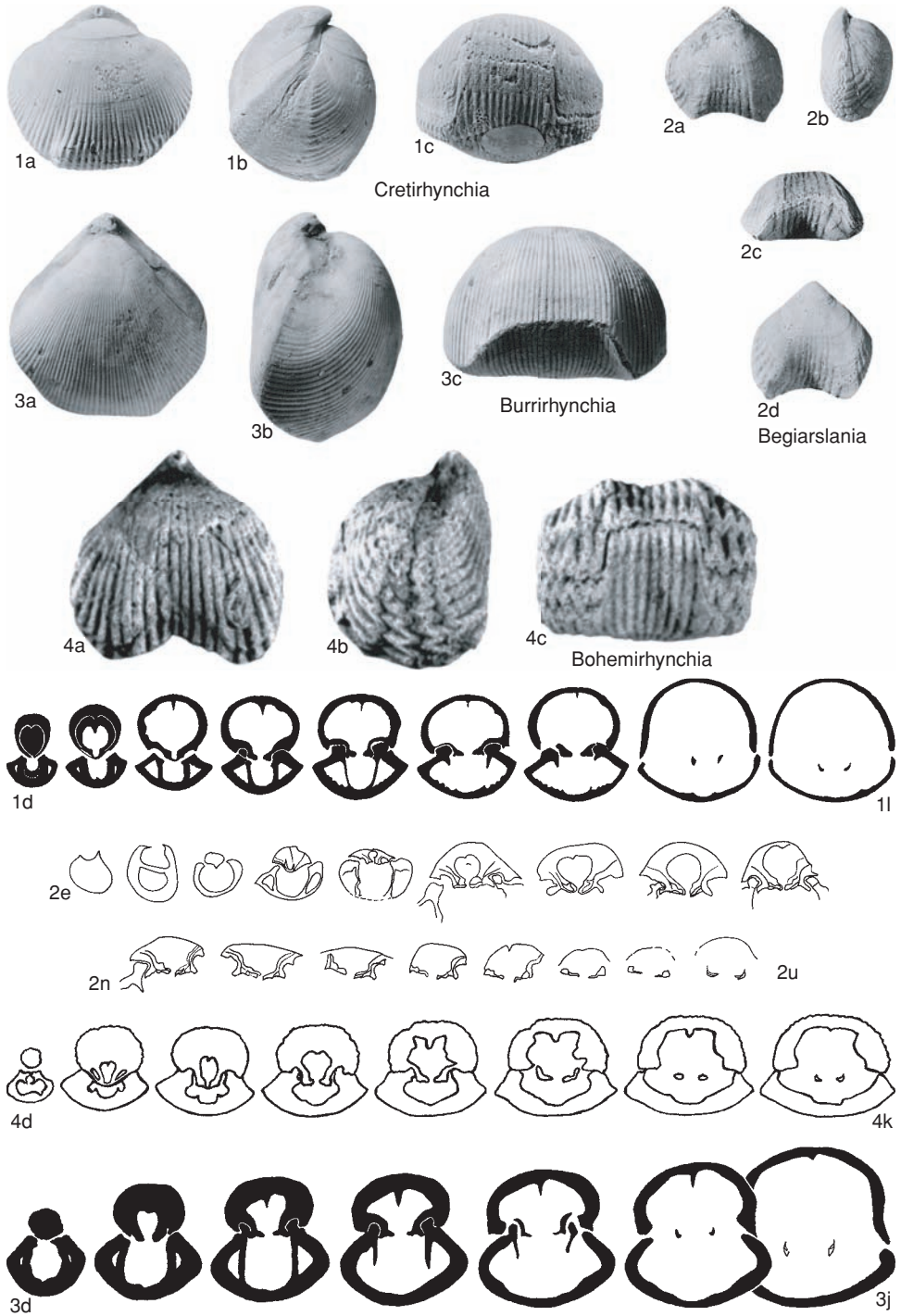


FIG. 926. Tetrarhynchiidae (p. 1365–1367).

United Kingdom; *a*, dorsal view, BMNH B.26573,  $\times 1.5$ ; *b-c*, lateral, anterior views, BMNH B.26573,  $\times 1.65$  (new); *d-j*, transverse serial sections, distances in mm from ventral umbo, 1.5, 2.5, 2.9, 3.1, 3.4, 4.0, 4.5,  $\times 1.5$  (Owen, 1956).

### Family NOTOSARIIDAE new family

[Notosariidae MANCENIDO & OWEN, herein]

Trilobate, sharply costate Hemithiridoidea; uniplicate; smooth stage may be variably developed; squama and glotta obsolete; ornament often lamellose, imbricate, even passing into spinose. Crura curved raduliform, distally flattened to concave; cardinal process overhanging, ledgelike, bilobed biconcave. Two pairs of metanefridia; intestines with curved distal end and terminal expansion; conoidal spiroloph bearing up to 8 whorls. *Upper Cretaceous (Campanian)–Holocene*.

**Notosaria** COOPER, 1959, p. 48 [\**Terebratula nigricans* G. B. SOWERBY, 1846, p. 91; OD]. Subpentagonal, uniplicate, dorsal fold low; costate, growth lines developing anteriorly, beak nearly straight to suberect; large hypothyril foramen, deltidial plates disjunct. Median dorsal ridge low; cardinal process wide, transversely triangular. [Living species range from intertidal to upper bathyal.] *Paleogene (Eocene)–Holocene*: New Zealand, *lower Oligocene–Holocene*; Poland, *middle Miocene*; Belgium, *Pliocene*; Antarctica (Seymour Island), *Eocene*.—FIG. 927,4*a–e*. \**N. nigricans nigricans* (SOWERBY), Holocene, New Zealand; *a–c*, dorsal, lateral, anterior, USNM 111018b,  $\times 1$ ; *d*, ventral interior showing large foramen and massive teeth; *e*, dorsal interior showing bilobed cardinal process and crura, USNM 111018a,  $\times 4$  (Cooper, 1959).

?**Paraplicirhynchia** BITNER, 1996, p. 76 [\**P. gazdzickii*; OD]. Medium size, subcircular to broadly oval, nearly equibiconvex, weakly uniplicate; marginal costae, many developing anteriorly after distinctive smooth stage; beak prominent, foramen large, hypothyril, deltidial plates disjunct. Transverse, bilobed cardinal process; short, low median dorsal ridge; dental plates reduced in adults. *Paleogene (Eocene)*: Antarctica (Seymour Island).—FIG. 927,1*a–e*. \**P. gazdzickii*, *lower Eocene*, middle Eocene; *a–c*, dorsal, lateral, ventral views,  $\times 1.5$ ; *d*, ventral interior,  $\times 3$ ; *e*, holotype, dorsal interior, ZPAL Bp.XXXVII/107,  $\times 3$  (Bitner, 1996).

**Plicirhynchia** ALLAN, 1947b, p. 493 [\**Rhynchonella plicigera* VON IHERING, 1897, p. 270; OD]. Subtrigonal-subpentagonal, dorsibiconvex, uniplicate; striate posteriorly, marginal costae developing anteriorly; beak long, pointed, foramen large, hypothyril, deltidial plates conjunct. Bilobed cardinal process; short, low median dorsal ridge. *Paleogene (Eocene)*: Argentina, ?Antarctica (Seymour and Cockburn Islands).—FIG. 927,3*a–e*. \**P. plicigera*

(VON IHERING), Argentina; *a–c*, dorsal, lateral, anterior views,  $\times 1$ ; *d*, umbonal detail showing foramen, thick deltidial plates, and faint umbonal striation, USNM 549346a,  $\times 4$ ; *e*, oblique dorsal interior showing crura and bilobed cardinal process, USNM 549346c,  $\times 4$  (Cooper, 1959).

?**Protegulorhynchia** OWEN, 1980, p. 129 [\**P. meridionalis*; OD]. Small, subcircular to broadly oval; uniplicate, dorsal fold poorly developed; shell ornament costellate with marked concentric growth lines becoming more lamellose anteriorly; ventral sulcus shallow with narrow but acutely arcuate anterior commissure and poorly defined linguiform extension; beak sharp, short, suberect; beak ridges distinct, foramen small. *Upper Cretaceous (Campanian)*: Antarctica, southern India.—FIG. 927,2*a–c*. \**P. meridionalis*, lower Campanian, James Ross Island, Antarctica; holotype, dorsal, lateral, anterior views, BMNH BB.76770,  $\times 1.5$  (Owen, 1980).

**Tegulorhynchia** CHAPMAN & CRESPIN, 1923, p. 175 [\**Rhynchonella squamosa* HUTTON, 1873, p. 37; OD]. Trigonal to subpentagonal, uniplicate, dorsal fold low; ornament of strong costae that are lamellose and often with hollow spines; beak long, straight; foramen large, hypothyril; deltidial plates usually conjunct. Crura short; dorsal median septum short, low. *Paleogene (lower Paleocene)–Neogene (Miocene)*: Australasia, Antarctica.—FIG. 927,5*a–c*. \**T. squamosa* (HUTTON), upper Oligocene, Duntroonian, northern Otago, New Zealand; dorsal, lateral, anterior views, OU NZ DL20,  $\times 2$  (Lee, 1980).

### ?Family SEPTIRHYNCHIIDAE Muir-Wood & Cooper, 1951

[Septirhynchidae MUIR-WOOD & COOPER, 1951, p. 5]

Usually large, equibiconvex Rhynchonellida, pentameroid in appearance; postero-lateral commissure with dorsally convex squama-glotta junction; fully costate to almost smooth (with few gentle radial flutings). With late ontogenetic development of recurved cardinal process in dorsal valve and of median septum in ventral valve; simple raduliform crura, fairly long and high dorsal median septum. [Although its family/subfamily rank has been questioned, this is a highly distinctive group of the mid-Jurassic Ethiopian province.] *Middle Jurassic (upper Bathonian–Callovian)*.

**Septirhynchia** MUIR-WOOD, 1935, p. 106 [\**Rhynchonella azaisi* COTTREAU, 1925, p. 581; OD]. Very large, equibiconvex, with low dorsal fold; fully costate, with many coarse unbranching costae; planareas smooth, lateral, increasing at the expense of lateral costae; uniplication broad, multidentate

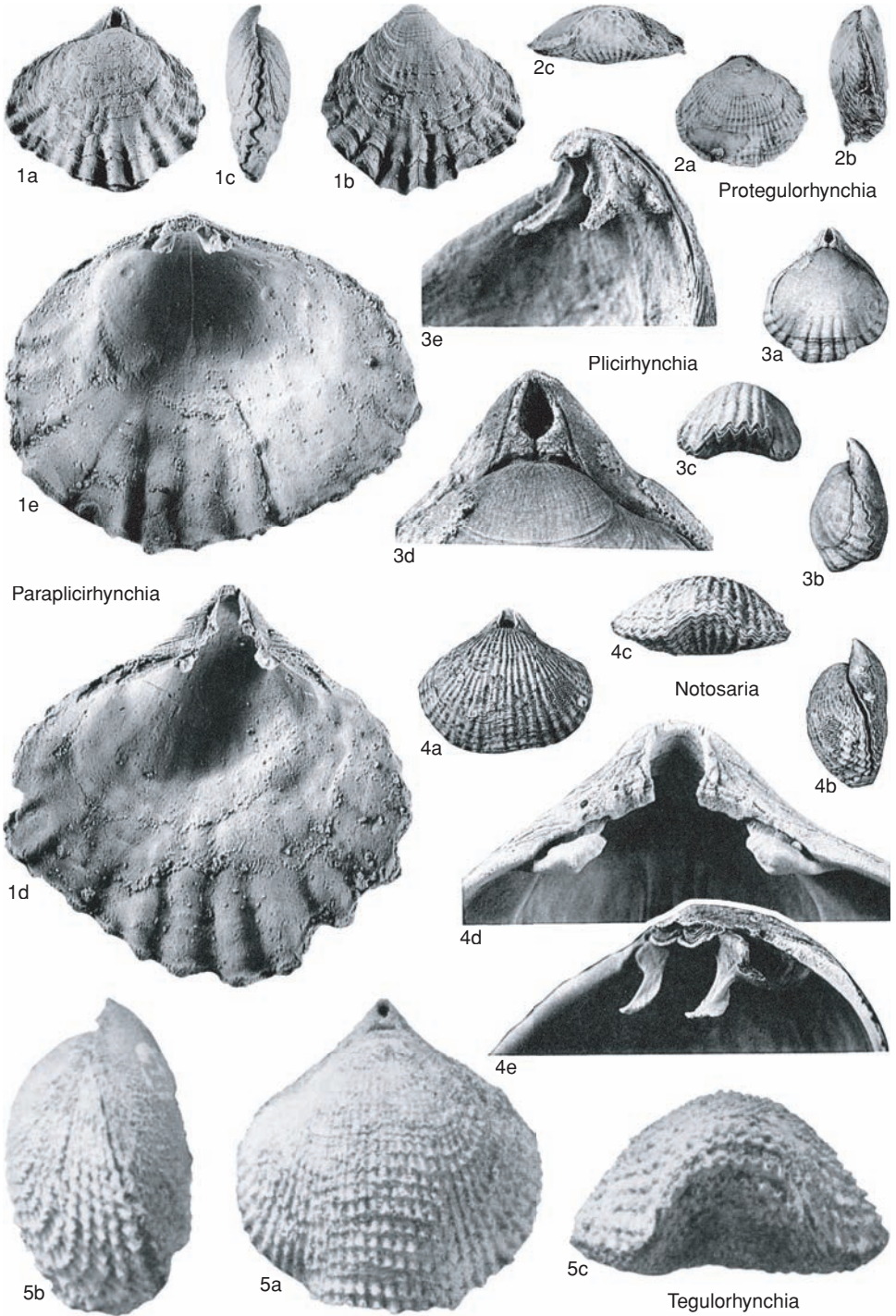


FIG. 927. Notosariidae (p. 1367).

anteriorly; beak prominent, greatly incurved in adult, concealing minute foramen and deltidial plates (disjunct in juvenile, later fused). Strong dental plates; ventral median septum well developed in adult, but absent or low ridge in juvenile; dorsal median septum of similar height and length throughout ontogeny; septalium present in juvenile then overturned and concealed by adult cardinal process, formed by recurved calcite sheets partly enveloping dorsal umbo and septalium; crura simple raduliform, sometimes depressed in cross section; teeth and sockets smooth. *Middle Jurassic* (?upper Bathonian, Callovian): Tunisia, Somalia, Ethiopia, Kenya, Sinai, Syria, Oman, ?Iran, ?Madagascar, ?Lebanon.—FIG. 928a–b. \**S. azaisi* (COTTREAU), ?Callovian (rather than Kimmeridgian), Somalia; a, dorsal view, BMNH B.46235, ×1 (Feldman, 1987); b, holotype, sagittal section, Harrar, Ethiopia, MNHN, ×1 (Cottreau, 1925).—FIG. 928c–v. *S. numidiensis* MANCEÑIDO & WALLEY, Callovian, Tunisia; c–g, holotype, dorsal, lateral, anterior, ventral, posterior views, BMNH BB.76530, ×1; h–m, paratype, transverse serial sections extending from 0.0 to 3.5 mm from ventral umbo; n–v, paratype, distances in mm from ventral umbo, 3.1, 4.7, 7.2, 8.8, 10.2, 11.8, 12.8, 14.2, 15.0 (Manceñido & Walley, 1979).

**Heteromychus** COOPER, 1989, p. 41–42 [\**H. magnificus*; OD]. Large, oval, subequibiconvex, uniplacate, with median sulcus shallow and dorsal fold low, ill-defined; steep, rounded lateral slopes; beak small, closely appressed on dorsal umbo; lateral planareas present; fully costate, with numerous, dense, blunt costae. Long, strong dental plates, ventral median septum not developed, or just a ridge in adult; with dorsal median septum long, septalium

small, shallow, and cardinal process large, backward growing. [Sections remarkably similar to those of young *S. numidiensis*; kept as separate genus on COOPER's claim of its being adult but lacking ventral median septum; otherwise it might be a subgenus or immature form of *Septirhynchia*. Family reallocation based on this reinterpretation.] *Middle Jurassic* (upper Bathonian–Callovian): Saudi Arabia, ?Africa.—FIG. 929, 1a–v. \**H. magnificus*, Saudi Arabia; a–c, holotype, dorsal, lateral, posterior views, USNM 380576, ×1; d–v, transverse serial sections, distances in mm from ventral umbo, 0.4, 1.3, 1.9, 2.1, 2.5, 3.4, 3.7, 4.0, 4.2, 4.4, 4.6, 4.9, 5.3, 5.6, 6.1, 6.5, 7.3, 8.1, 8.4, USNM 380655 (Cooper, 1989).

**Lessinirhynchia** VÖRÖS, 1995, p. 55, *nom. nov. pro Lessiniella* VÖRÖS, 1993, p. 52, *non* PAVAN, 1941, Insecta [\**Lessiniella benettii* VÖRÖS, 1993, p. 53; OD]. Large, equibiconvex, strongly gibbose, pyriform; umbones massive, beaks strongly incurved; dorsal fold and ventral sulcus weak, anterior commissure round uniplacate to parasulcate; planareas well developed; deltidial plates fused. Dental plates and pedicle collar present; cardinal process formed by bladellike extension of dorsal umbo; septalium slightly overturned; dorsal median septum well developed, long; crura raduliform, crural bases emerge dorsally; teeth and sockets crenulated; ventral median septum absent. *Middle Jurassic* (Callovian): southern Alps (northern Italy).—FIG. 929, 2a–o. \**L. benettii* (VÖRÖS), Verona; a–d, holotype, dorsal, lateral, posterior, ventral views, MFLV CC100 Cv-B, ×1; e–o, paratype, transverse serial sections, distances in mm from ventral umbo, 4.7, 6.4, 7.9, 8.2, 8.8, 9.1, 9.5, 10.8, 11.4, 12.2, 13.2, MFLV CC99 Cv-B (Vörös, 1993).

## UNCERTAIN

MIGUEL O. MANCEÑIDO,<sup>1</sup> ELLIS F. OWEN,<sup>2</sup> and SUN DONG-LI<sup>3</sup>

<sup>1</sup>La Plata Natural Sciences Museum, Argentina; <sup>2</sup>formerly of The Natural History Museum; and <sup>3</sup>Nanjing Institute of Geology and Palaeontology

### Superfamily UNCERTAIN

**Barzellinia** DE GREGORIO, 1930b, p. 8 [\**B. primogenita*; M]. Shell tumid, equilateral, rounded, equibiconvex, terebratuliform; ornamented with very fine, radial, equidistant striae; ventral umbo very small, incurved. [This genus has been regarded as a subjective synonym of *Halorella* BITTNER, 1884, p. 107, yet it seems advisable to stress its uncertain systematic affinities.] ?*Upper Triassic* or ?*Lower Jurassic*: Italy (Sicily).—FIG. 930, 5a–d. \**B. primogenita*; dorsal, lateral, anterior, ventral views, ×1 (de Gregorio, 1930b).

**Isjuminelina** MAKRIDIN in SARYCHEVA, 1960, p. 254 [\**Rhynchonella pseudodecorata* ROLLIER, 1917, p. 139, *sensu* MAKRIDIN, 1964, p. 176, *non* ROLLIER, 1917; =*Isjuminella isjunica* MAKRIDIN, 1955, facing p. 86, fig. 4] [=*Isjuminella* MAKRIDIN, 1955, p. 85, *partim*]. Rounded-pentagonal, medium size with

costae radial; sulcus and fold not strong. Median dorsal septum high, comparably short, strongly fused with massive crural bases, pseudodeltidium possibly present; crura very short, thick, hook shaped, sometimes with disjunct septalium; hinge teeth large, crenulated, on very short thick dental plates, fused to valve almost along its whole length; teeth sockets deep with strong crenulations, delimited by massive, almost parallel inner socket ridges. Muscle scars occupying about one-third inner surface of dorsal valve; anterior adductors deep, transverse-elongated or semioval, converging to anterior part of septum; ventral muscle scars pear shaped, wide, occupying one-half its inner surface. [Family allocation has been dependent upon dual interpretation of misidentified type species. Preferred action for stability is to fix taxonomic species actually involved in the misidentification under ICZN, 1999, Article 70.30.2. This would allow inclusion among

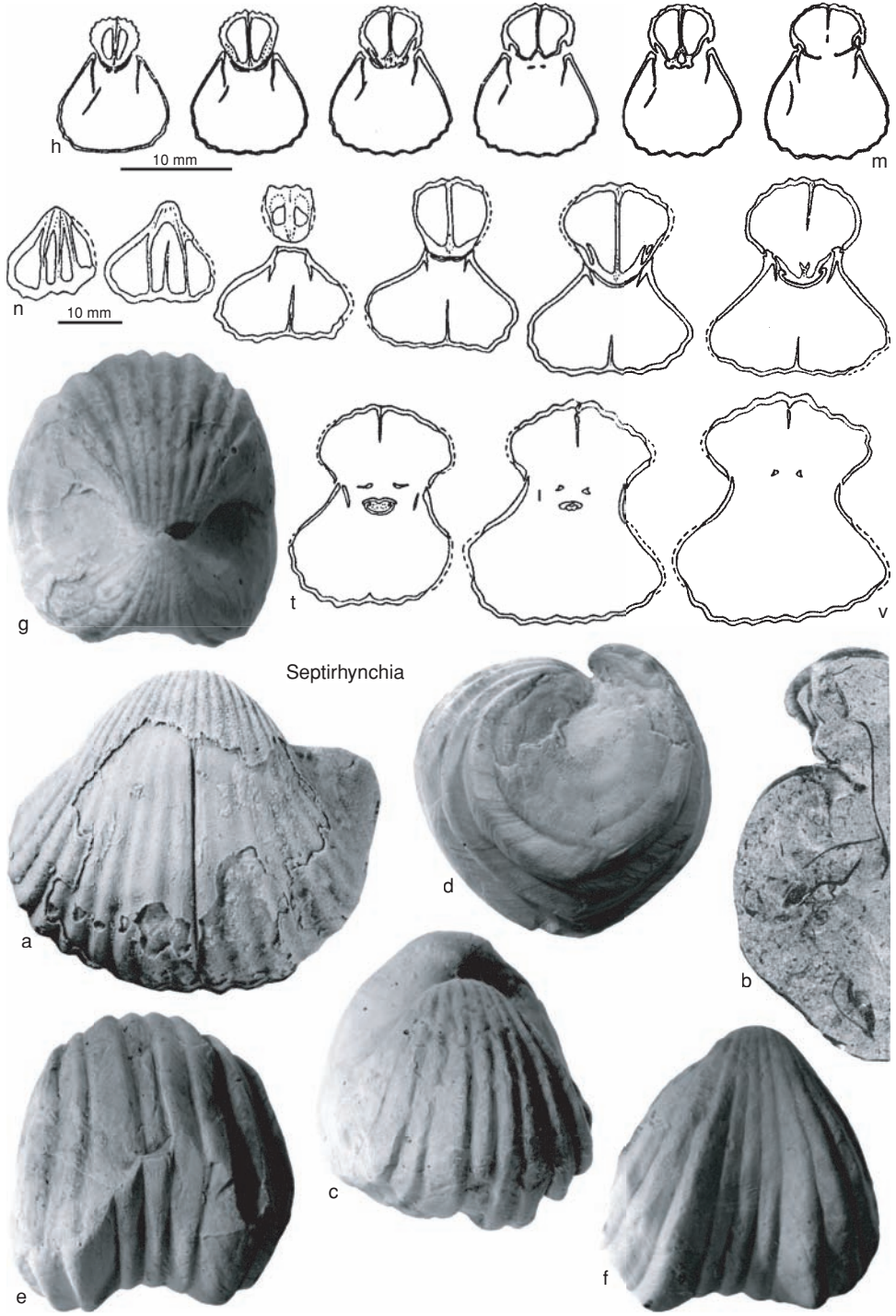


FIG. 928. Septirhynchiidae (p. 1367-1369).

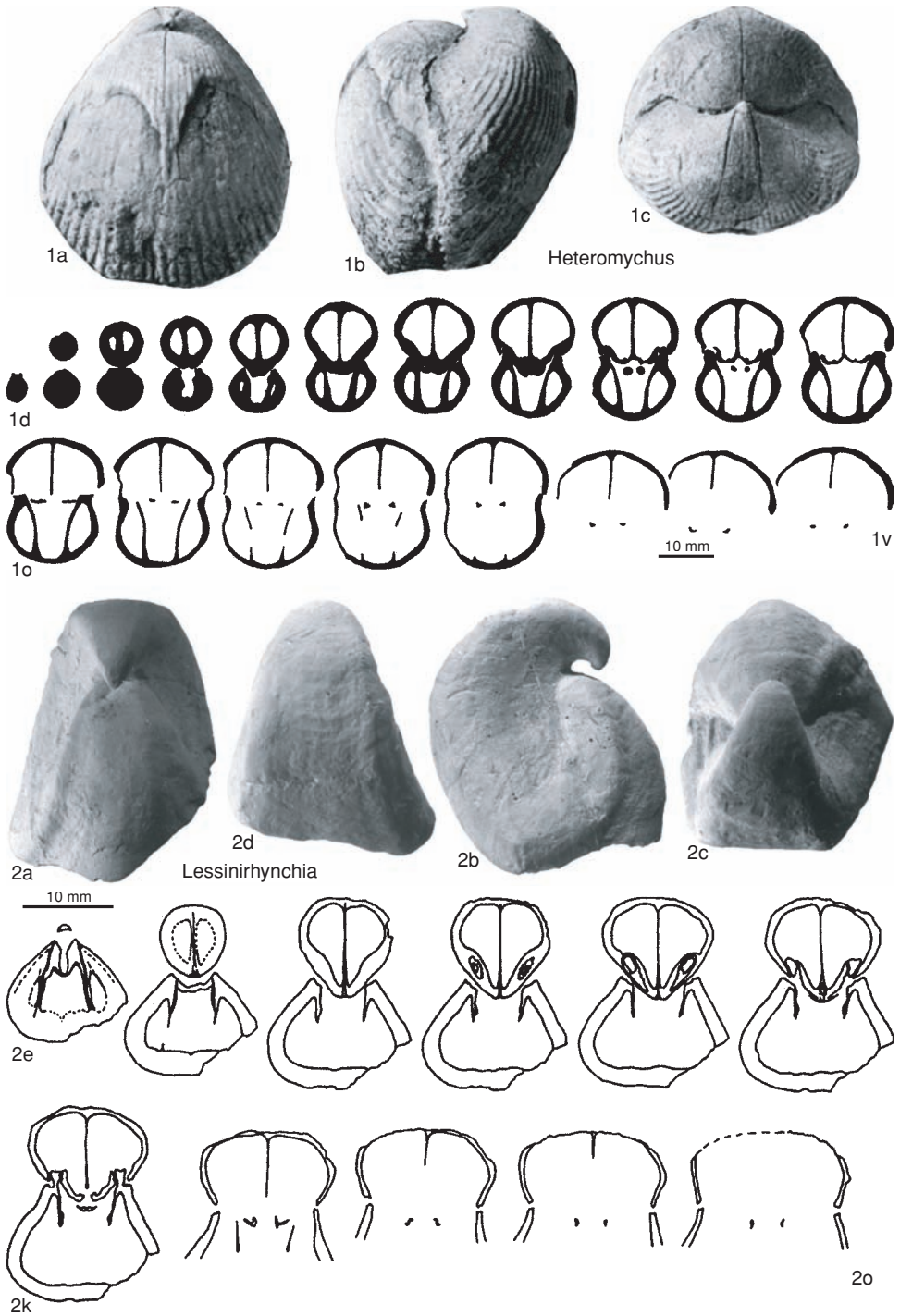


FIG. 929. *Septirhynchiidae* (p. 1369).



- Isjuminellinae.] *Upper Jurassic (Oxfordian)*: Europe, Russia (Donetz basin, ?Crimea ?Caucasus).—FIG. 930,4a–c. \**I. isjumica* (MAKRIDIN), upper Oxfordian, Kharkov, Russia; dorsal, lateral, anterior views,  $\times 1$  (Makridin, 1964).
- Sacothyropsis** CHEN & others, 1986, p. 76 [\**S. jiangdaensis*; OD]. Small, elongate, rounded triangular, moderately dorsibiconvex, smooth; thickest just beyond midlength, widest anteriorly; carinate ventral valve; ventral beak small, incurved; foramen permesothryd; beak ridges angular; anterior commissure plicosulcate; dorsal sulcus shallow, widening anteriorly and split by blunt median fold. Pedicle collar present; hinge plates divided, extending horizontally; dental plates, septum, and septalium absent. [Originally referred to Zeilleriidae, *Sacothyropsis* was regarded by SUN as a *nomen dubium*, with possible affinities to Norellidae.] *Upper Triassic*: Tibet.—FIG. 930,3a–i. \**S. jiangdaensis*; a–d, holotype, dorsal, lateral, anterior, ventral views, CIGMR SC 248,  $\times 2$ ; e–i, transverse serial sections, distances in mm from ventral umbo, 0.4, 0.7, 1.0, 1.7, 2.2 (Chen & others, 1986).
- Yunshannella** LI & GU, 1982, p. 54 [\**Y. triphylla*; OD] [= *Yunshanella* LI & GU, 1982, p. 57, *nom. null.*; *Yunshanella* SHI & GRANT, 1993, p. 18, *nom. null.*]. Shell medium size; nearly flabelliform in outline; apical angle about 90°; feebly biconvex in profile; fold low, sulcus shallow; plicae rounded and ornamented with dense, radial, elongate, thin tubercles; other characters as in *Septaliphoria*. [Genus based on inadequate material, thus almost unrecognizable; uncertain if alleged tubercles are indeed diagnostic shell microtexture or an artifact; age originally referred to Callovian–Oxfordian, but now considered as Lower Cretaceous; presently regarded by SUN as a *nomen dubium*.] *Lower Cretaceous*: northeastern China.—FIG. 930,2a–b. \**Y. triphylla*, Lower Cretaceous (rather than Callovian or Oxfordian), Heilongjiang; a, paratype, dorsal view, SIGM MBr 77009,  $\times 2$ ; b, holotype, ventral view, SIGM MBr 81009,  $\times 1$  (Li & Gu, 1982).

## NOMINA DUBIA

NORMAN M. SAVAGE

[University of Oregon]

### NOMINA DUBIA

The following genera are considered *nomina dubia*, in most instances because the type material is insufficiently well preserved or insufficiently well described to warrant generic status at this time.

- Anchorhynchia** JIN & YE, 1979, p. 101 [\**A. madoensis*; OD]. [Poor description and poor figures. Best considered *nomen dubium* until better data available.] *Upper Permian (Changhsingian)*: China.
- Areella** ERLANGER, 1992, p. 51 [\**A. burunica*; OD]. [Poor photographs. Single, very poor interior section. Best considered *nomen dubium* until additional data available.] *Lower Devonian (Emsian)*: Mongolia.
- Asiarhynchia** SU, 1980, p. 294 [\**Zlichorhynchus asiaticus* HAMADA, 1971, p. 63; OD]. [Poor material and single schematic section. Best considered *nomen dubium* until additional data available.] *Lower Devonian (Emsian)*: northern China.
- Beichuanella** CHEN, 1978a, p. 338 [\**B. uniplicata* CHEN, 1978a, p. 339; OD]. [HOU Hong-fei (unpublished manuscript, 1992) stated that CHEN (1978a) misassigned the type species to Stenosismataceae, mistaking callus for spondylium and septalium for camarophorium. HOU Hong-fei recommended restudy of type specimens and states that it is a doubtful genus. See also p. 1223 herein.] *Middle Devonian (Eifelian)*: China.
- Beichuanrhynchus** CHEN, 1990, p. 7 [\**Kwangsi-rhynchus beichuanensis* CHEN, 1979, p. 7; OD]. Shell small, subpentagonal, strongly biconvex; strong fold and sulcus anteriorly; pronounced, rounded tongue; costae simple, restricted to anterior half of shell; dental plates short, merge with shell wall; hinge plates divided; median septum, septalium, cardinal process absent; crura unknown. [Poor photographs and poor sections. Best considered *nomen dubium*.] *Lower Devonian*: China.
- Borealirhynchia** SU, 1976, p. 194 [\**B. delerensis*; OD]. Medium to large with outline subtriangular to subpentagonal; moderately biconvex with lateral and anterior margins not vertical; beak suberect; fold and sulcus strong, arising at umbones; anterior commissure uniplicate, high; plicae strong, extending from umbones, covering flanks as well as fold and sulcus; dental plates long, strong; ventral muscle field broad, lachrymal outline; dorsal median septum strong, extending about one-third valve length; septalium absent. [Poor material and sections. Best considered *nomen dubium* at present. Assigned to Uncinulidae by SU, 1976, p. 191, but to Trigonirhynchidae by SU, 1980, p. 295, and to Camarotoechiidae in translation sent to SAVAGE by SU (1990).] *Lower Devonian (Lochkovian–Emsian)*: northern China.
- Camarotoechioides** RZHONSNITSKAIA, 1978, p. 178 [\**Camarotoechia lazutkini* RZHONSNITSKAIA, 1955, p. 246; OD]. [Poor figures. No internal information, no sections. Best considered *nomen dubium*.] *Lower Devonian*: central Asia.
- Chivatschella** ZAVODOWSKY, 1968, p. 125 [\**C. orotchensis*; OD]. [The material is unlikely to be adequate to justify diagnosis of a new genus. Best considered *nomen dubium*. Assigned to Wellerellidae

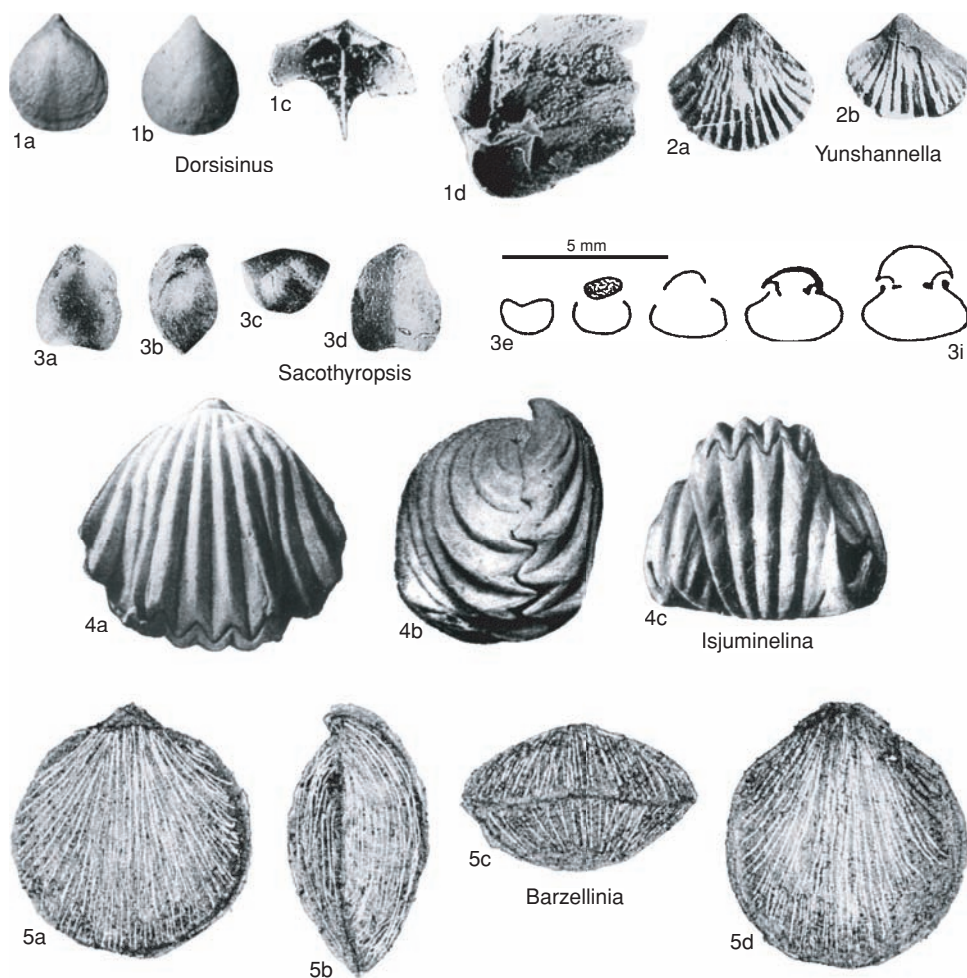


FIG. 930. Uncertain (p. 1369–1373).

by ZAVODOWSKY, 1968, p. 125.] *Upper Permian*: northeastern Asia.

**Corrugatimediostrum** SARTENAER, 1970a, p. 23 [\**Terebratula rocky-montana* MARCOU, 1858, p. 50; OD]. [Holotype poorly illustrated and interior uncertain, therefore difficult to assign to family or genus. Best considered *nomen dubium*.] *Upper Carboniferous (Westphalian)*: North America.

**Donella** ROTAL, 1931, p. 21 [\**D. minima*; OD]. Shell small; outline rounded, elongate oval; dorsibiconvex, dorsal valve slightly inflated anteriorly; beak erect; foramen closed by dorsal beak; fold and sulcus weak, broad, with short sinus in anterior part of fold, otherwise surface smooth. [Based on few specimens. No interior figures or sections. Best considered *nomen dubium*. Assigned to Pugnacidae in 1965 *Treatise*.] *Lower Carboniferous*: central Asia.

**Dorsisinus** SANDERS, 1958, p. 53 [\**Centronella louisianensis* WELLER, 1914, p. 241; OD]. Shell very small with outline elongate oval and profile equibi-

convex. Beak straight to suberect; delthyrium triangular, incipient deltidial plates present anteriorly, leaving small foramen. Ventral fold and dorsal sulcus gentle, from umbones, anterior commissure sulcate. Shell surface smooth. Dental plates vertical, moderately long. Septalium short; hinge plates divided; dorsal median septum high, extending to midlength; crura long. [Insufficient material to justify new genus or to determine superfamily. Internal information poor. Best considered *nomen dubium*.] *Lower Carboniferous (Tournaisian)*: USA (Mississippi Valley), Mexico.—FIG. 930, 1a–d. \**D. louisianensis* (WELLER); a–b, dorsal and ventral views, Kinderhookian, Louisiana Limestone, USA, ×4 (Weller, 1914); c, dorsal valve interior, lower Mississippian, Sonora, Mexico, ×3; d, interior of conjoined posterior fragment, lower Mississippian, Sonora, Mexico, ×4 (Sanders, 1958).

**Ferganotoechia** RZHONSNITSKAIA in RZHONSNITSKAIA, KULIKOVA, & PETROSYAN, 1978, p. 68

- [\**Camerotoechia* (?) *ferganica* NALIVKIN, 1930b, p. 72; OD]. [Mentioned by RZHONSNITSKAIA as new genus based on *C. (?) ferganica* but not described. Original photographs of NALIVKIN inadequate for type species; also there are no internals or sections. Best considered *nomen dubium*.] *Lower Devonian–Middle Devonian*: central Asia, Urals.
- Globidorsum** JIN, 1988, p. 215 [*G. basale*; OD]. [No interior figures. Only single specimen figured to show exterior. Best considered *nomen dubium* until additional data available.] *Middle Devonian (Eifelian)*: southern China.
- Glyptorhynchia** SHEN & HE, 1994, p. 452 [\**G. lens*; OD]. [Poor figures. Few specimens. May not be rhynchonellid. Best considered *nomen dubium* until adequate description and information about interiors is available.] *Upper Permian (Changhsingian)*: southern China.
- Hypoleiorhynchus** LINNIK, 1976, p. 64 [\**Hypothyridina* (?) *schelonica* NALIVKIN, 1941, p. 163; OD]. [Need topotype material for sectioning because published sections very inadequate. Interiors unknown. Best considered *nomen dubium* until better data available.] *Upper Devonian (Frasnian)*: Belarus, European Russia.
- Langkawia** HAMADA, 1969b, p. 261 [\**L. jonesae*; OD]. [Poor mold material comprising only 2 dorsal valves, poorly described and figured. Best considered *nomen dubium* until more data available. Assigned to Camarotoechiidae by HAMADA, 1969b, p. 260.] *Upper Devonian or Lower Carboniferous*: Malay Peninsula.
- Laosia** MANSUY, 1913, p. 83 [\**L. dussaulti*; OD]. [No sections or other internal figures have been published. Best regarded as *nomen dubium*. Assigned to family Uncertain in 1965 *Treatise* (MOORE, 1965).] *Permian*: Indo-China.
- Leiorhynchoides** DOVGAL, 1953, p. 140 [\**L. gratianovae*; OD]. [No sections or other internal figures have been published. Best regarded as *nomen dubium*. Assigned to family Uncertain in 1965 *Treatise* (MOORE, 1965).] *Middle Devonian*: Altai.
- Linxiangxiella** YANG, 1984, p. 230 [\**L. typica*; OD]. [Poor photographs. Only 2 transverse sections. May not be rhynchonellid. Best considered *nomen dubium* until more data available. Assigned to family Uncertain by YANG, 1984, p. 230, but assigned to Hypothyridininae by YANG in English translation sent in letter. Does not seem to be a genus of Uncinulinae or Uncinulidae.] *Upper Devonian (Famennian)*: southern China.
- Miaohuangrhynchus** YANG in YANG & others, 1977, p. 374 [\**M. uncinuliformis*; OD]. Small; foramen small, circular; marginal spines not evident; dental plates perhaps close to shell walls; septalium perhaps not present; hinge plate may be divided; dorsal median septum short, possibly stout; cardinal process may be absent. [Poor photographs; only single poor quality transverse section; no reliable information about internal features; best considered *nomen dubium* until more data available; assigned to Rhynchotrematidae by YANG (YANG & others, 1977, p. 374).] *Lower Devonian (Emsian)*: southern China.
- Mongolirhynchia** HOU & ZHAO, 1976, p. 191 [\**M. delitescens*; OD]. [Poor photographs. No figures of interior of type species. Descriptions based on interior of different species (*M. simplex*) from different formation and different region (West Qinling, Fu, 1983b). Best considered *nomen dubium* until better data available to justify genus status. Assigned to Uncinulidae (HOU & ZHAO, 1976, p. 191).] *Silurian (Ludlow–Pfidoli)*: Mongolia, northern China.
- Nantanella** GRABAU, 1936, p. 70 [\**N. mapingensis*; OD]. [Poor photographs and section. Assigned to Stenoscismatacea by GRABAU, 1936, and by TONG, 1978. Regard as *nomen dubium* until better data available, otherwise as Stenoscismatoidea. Assigned to family Uncertain in 1965 *Treatise* (MOORE, 1965).] *Lower Permian*: China.
- Neimongolella** ZHANG Yan, 1981a, p. 385 [\**N. paraplicata*; OD]. Shell medium size; weakly biconvex; foramen present; fold and sulcus very weak; anterior commissure almost rectimarginate; straight plications extending from beak to commissure; dental plates straight, vertical, distinct; septalium perhaps absent; hinge plates may be divided; dorsal septum absent; cardinal process may be absent; crura long, laterally flattened. [Photographs and sections quite good but HOU Hong-fei (unpublished manuscript, 1993) stated: “*Neimongolella* is similar to *Kwangsirhynchus* HOU & XIAN, 1975, . . . because specimens of *Neimongolella* are too few and have been poorly preserved, it is not enough that has been established a new genus at condition. Thus, *Neimongolella* should be abandoned and to have assigned in *nomen dubium*.” Because of this it seems best to consider the genus a *nomen dubium* until better data available or (less acceptably) as a synonym of the coeval *Kwangsirhynchus*. Assigned to Pugnacidae by ZHANG Yan, 1981a, p. 385.] *Lower Devonian (Emsian)*: northern China.
- Paratetratomia** YANG in YANG & others, 1977, p. 394 [\**P. xiangzhouensis*; OD]. [Poor photographs. Only single poor transverse section. Genus not used. Best considered *nomen dubium* until better data available. Assigned to family Uncertain by YANG in YANG & others, 1977, p. 394.] *Middle Devonian (Givetian)*: southern China.
- Paryphorhynchopora** SIMORIN, 1956, p. 245 [\**Pugnoides korsakpaica* NALIVKIN, 1937, p. 77; OD]. Size medium; outline subpentagonal; dorsibiconvex profile with inflated anterior; beak suberect; anterior commissure uniplicate, high, rounded; plicae angular, from umbones; shell surface with radial striae; dental plates present; septalium deep, V-shaped; dorsal median septum short. [Good photographs but no interior figures. Genus name appears to have been ignored. It is not listed in Russian treatise (ORLOV, 1960), nor in 1965 *Treatise* (MOORE, 1965). No references apart from original publication of SIMORIN. Best considered *nomen dubium* until better internal data available.] *Lower Carboniferous (Tournaisian)*: Kazakhstan.
- Payuella** GRABAU, 1934, p. 150 [\**P. obscura*; OD]. [Seems that genus name not used except in original publication of GRABAU. Only holotype figured. No

- description or figures of interior. Best considered a *nomen dubium* until better data available. Assigned to family Uncertain in 1965 *Treatise* (MOORE, 1965).] *Lower Permian*: southern China.
- Perakia** HAMADA, 1969a, p. 7 [\**P. undulata*; OD]. [Type material poorly preserved and insufficient for generic or even superfamily assignment. Best considered *nomen dubium* until better data available.] *Lower Devonian–Middle Devonian (Emsian–Eifelian)*: Malaya.
- Platyglossariorhynchus** SARTENAER, 1970a, p. 8 [\**Pugnax proteus* TORLEY, 1934, p. 73; OD]. [Exterior photographs of TORLEY (1934) suitable but interior features unknown. Only reference seems to be original publication of SARTENAER, 1970a, who stated interior imperfectly known and did not provide sections or other figures. Best considered *nomen dubium* until better data available.] *Middle Devonian (middle Givetian–upper Givetian)*: Germany, North America.
- Plekonina** WATERHOUSE, 1986a, p. 65 [\**P. spissatella*; OD]. [Material insufficiently figured for genus description. Only 2 views of crushed holotype. Interior unknown. Best considered *nomen dubium* until better data available. Assigned to Wellerellidae by WATERHOUSE, 1986a, p. 64.] *Upper Carboniferous or Lower Permian*: Dresden Formation, eastern Australia (Bowen Basin, Queensland).
- Protorhyncha** HALL & CLARKE, 1893, p. 180 [\**Atrypa dubia* HALL, 1947, p. 21; OD]. [Probably not a rhynchonellid (see COOPER, 1956a, p. 618, also 1965 *Treatise* [MOORE, 1965], p. 597). Types lost. Interior unknown. Best considered *nomen dubium* until better data available.] *Ordovician (Champlainian)*: eastern USA (New York).
- Pseudopugnax** LICHAREW, 1956, p. 56 [\**P. planissima*; OD]. [Poor exterior photographs. Poor sections. Surface appears to be weakly costate or even spinose. Cannot be placed into superfamily. Genus name used in original publication in 1956 but no other use since then. Best considered *nomen dubium* until better data available. Assigned to Septalariinae in 1965 *Treatise* (MOORE, 1965) but occurs in Upper Permian, whereas there are no known septalariids after Devonian.] *Upper Permian*: northern Caucasus.
- Pugnacina** ZUONG & RZHONSNIKAIA in ZUONG & RZHONSNIKAIA & others, 1968, p. 43 [\**P. baoi*; OD]. [Only single specimen (holotype) figured showing exterior. No interiors figured. No basis for erecting new genus. Best considered *nomen dubium* until additional data available. Assigned to Uncinulidae by ZUONG and RZHONSNIKAIA, 1968, p. 41.] ?*Lower Devonian*, ?*Middle Devonian* (?*lower Eifelian*): Vietnam.
- Rhynchotretaoides** SEVERGINA, 1967, p. 136 [\**R. aincus*; OD]. [SEVERGINA (1967, p. 136–137) described and illustrated the exterior of the type species. No illustrations of interior then or subsequently. ROZMAN (1981, p. 158) illustrated interior of species he called *Rhynchotretaoides bairimicus* sp. nov. There is no way to decide whether this is same genus without interior information of type species. Best treated as *nomen dubium* until more information available.] *Upper Ordovician*: central Asia.
- Rhynchotretina** KHALFIN, 1948, p. 175 [\**R. aequivalvis*; OD]. Small, outline subtriangular elongate with angle acute apical; almost equibiconvex; fold or sulcus absent; rectimarginate; beak short, straight; plicae weak, from midlength; dental plates short, convergent ventrally; septalium may be absent; hinge plates may be divided; dorsal median septum long. [Letter from GRATSIANOVA (March 16, 1994) said she is sure this genus is invalid because of insufficient material—KHALFIN had only 2 conjoined shells, 1 of which was broken posteriorly and what was left of it was used for the few serial sections. The other is the holotype. Regard it as a *nomen dubium*. Assigned to Camarotoechiinae in 1965 *Treatise* (MOORE, 1965).] *Lower Devonian*: Altai.
- Rhynoleichus** ABRAMOV & GRIGORJEW, 1983, p. 95 [\**R. delenjaensis*; OD]. Medium to large, subpentagonal to transversely ovate; dorsibiconvex with lateral and anterior slopes gentle; beak erect; fold and sulcus very wide; anterior commissure uniplicate, rounded, very wide, resulting in narrow alate flanks; plicae wide, rounded, weak on fold and sulcus, very weak on flanks; dental plates very short, strongly divergent ventrally; septalium short; hinge plates divided; dorsal median septum short, low. [Only 7 specimens total assigned to type species, only 3 poorly preserved specimens from type locality. Serial sections poor. Similar to Leiorhynchoidea, but material too poor to determine features. Best treated as *nomen dubium* at present.] *Upper Carboniferous*: Taimyr, Russia.
- Salairotoechia** RZHONSNIKAIA, 1968d, p. 123 [\**Nudirostra? pseudocarens* KULKOV, 1960, p. 174; OD]. [No figures of interior of type species. Not enough information to warrant new genus. Best treated as *nomen dubium* at present.] *Middle Devonian (Eifelian)*: Kuznets Basin.
- Sichuanrhynchus** TONG, 1978, p. 243 [\**S. sulcatus*; OD]. Shell small to medium; subpentagonal to subcircular; strongly inflated and subtetrahedral; beak incurved; fold and sulcus strong; uniplicate tongue; surface smooth; interior uncertain. [No figures of interiors. Best treated as *nomen dubium* at present.] *Upper Carboniferous*: southern China.
- Straelenia** MAILLIEUX, 1935, p. 10 [\**Rhynchonella Dunensis* DREVERMANN, 1902, p. 108; OD; =*Rhynchonella Dannenbergi* KAYSER mut. nov. minor DREVERMANN, 1902, p. 107] [=*Dinapophysia* MAILLIEUX, 1935, p. 5 (type, *Orthis papilio* KRANTZ, 1857, p. 156, OD)]. [Material poorly preserved. Could be genus of Camarotoechioidea. Need fuller description and better topotype specimens. Probably best treated as *nomen dubium* until additional work done.] *Lower Devonian (Emsian)*: western Europe, northern Africa.
- Tanerhynchia** ALLAN, 1947a, p. 442 [\**Eatonia parki* ALLAN, 1935, p. 22; OD]. Genus poorly known; size medium, outline transversely subcircular; profile weakly biconvex; dorsal fold and ventral sulcus

- weak posteriorly, moderately strong anteriorly; costae poorly known, appearing simple and low; dental plates not evident; ventral muscle area weakly impressed, myophragm weak; dorsal median septum short and stout; cardinal process with erect shaft and rugose myophore. [Type material inadequate to base new genus. Probably belongs to Eatonidae. Best treated as *nomen dubium* until better material described.] *Lower Devonian (Emsian)*: New Zealand, Antarctica.
- Togaella** SEVERGINA, 1960b, p. 409 [\**T. grandis*; OD]. [Poor material. Unless better topotype material becomes available, best regarded as a *nomen dubium*. Also see KULKOV & SEVERGINA, 1989, for additional (poor) illustrations of internal and external molds; they assigned the genus to the Rhynchotrematidae.] *Ordovician*: Altai, Mongolia.
- Trilobatoechia** XIAN, 1990, p. 44 [\**T. daxinensis*; OD]. [Poor material, no sections. Unless better topotype material becomes available, best regarded as a *nomen dubium*.] *Lower Devonian (Emsian)*: southern China.
- Uralotoechia** SAPELNIKOV, 1963b, p. 17 [\**U. vagranensis*; OD]. [Assigned to Hypothyridinidae by SAPELNIKOV, 1963b, p. 17 but seems an unlikely age for members of that group. Photographs and sections not adequate to warrant new genus. Probably best regarded as *nomen dubium* until new topotype sections available.] *Silurian (upper Ludlow)*: Northern Urals.
- Wulungguia** ZHANG Yan, 1981b, p. 91 [\**W. wulungguensis*; OD]. Outline elongate; margins of fold and sulcus sudden; dental plates very short; septalium very short, without cover. [Assigned to Rhynchotrematidae in ZHANG Chuan & ZHANG Zi-Xin, 1981, p. 90, but to Trigonirhynchiidae in an English translation of unknown origin. This genus is poorly described and figured and seems best treated as *nomen dubium* until better topotype material is described.] *Upper Ordovician*: China.
- Yanbianella** TONG, 1978, p. 238 [\**Y. dorsiconvexa*; OD]. Size small; outline transversely subovate; moderately biconvex; ventral beak erect to incurved; costae strong anteriorly, umbones smooth; short septalium without cover. [Assigned to Trigonirhynchiidae by TONG, 1978, p. 239. Photographs and sections of type material very poor.] *Carboniferous*: southern China.
- Yarirhynchia** JIN & SUN, 1981, p. 147 [\**Y. concava*; OD]. Very small; outline subcircular; profile weakly biconvex; fold and sulcus not evident; short septalium without cover. [Assigned to Trigonirhynchiidae by JIN & SUN, 1981, p. 145. Described and figured material seems inadequate as basis for genus. Best treated as *nomen dubium* until additional data available.] *Lower Carboniferous*: Tibet.
- Yingtangella** BAI & YING in YOH & BAI, 1978, p. 54 [\**Y. sulcatilis* (HOU), 1963, p. 417; OD]. [Assigned to Rhynchoporidae by BAI & YING in YANG & others, 1977, p. 397, *nomen nudum*. Poor illustrations. Inadequate information for new genus. Best treated as *nomen dubium* until more data available. May be terebratulid.] *Lower Devonian*: southern China.

## UNAVAILABLE GENERA

MIGUEL O. MANCENIDO and ELLIS F. OWEN

[La Plata Natural Sciences Museum, Argentina; and formerly of The Natural History Museum]

### UNAVAILABLE GENERA MENTIONED IN PRINT (manuscript, nomina nuda, etc.)

- Almogilabinella** GEORGESCU (in press) in GEORGESCU, 1993, p. 43, with type species *A. almogilabini* GEORGESCU (in press). *Middle Jurassic*.
- Crurirhynchella** XU & LIU, 1983, p. 83, for "*Crurirhynchia*" *subfissicostata* YANG & XU, 1966, p. 27. [Possibly referable to *Caucasorhynchia* DAGYS, 1963, p. 66]. *Middle Triassic*.
- Dingleirhynchia** GEORGESCU (in press), in GEORGESCU, 1993, p. 43, with type species *D. dinglei* GEORGESCU (in press). *Middle Jurassic*.
- Holcothyroides** DAGYS, 1974, p. 89, for *Rhynchonella delicatula* BITTNER, 1890, p. 17 and *Rhynchonella deliciosa* BITTNER, 1890, p. 155. [Probably a *lapsus pro Holcorhynchella* DAGYS, 1974, p. 110.] *Middle Triassic*.
- Orbigyrhynchia** MICHALÍK, 1992, p. 61 [*nom. null.*, personal communication, 1995]. *Paleogene (Danian)*.
- Postcirpa** SMIRNOVA, 1984, p. 54 [further details unknown; might refer to *Neocirpa* PROZOROVSKAIA, 1985, p. 110].
- Septalirhynchia** XU & LIU, 1980, p. 37, further in XU & LIU, 1983, p. 83, for "*Septaliphoria*" *tienchungensis* YANG & YIN, 1962, p. 93 and "*S.*" *rhomba* YANG & YIN, 1962, p. 95. [Possibly referable to *Costirhynchopsis* or *Eoseptaliphoria*]. *Middle Triassic*.
- Septocruralia** MAKRIDIN, 1954, p. 103. [Further details unknown; might refer to *Pracyclothyris* MAKRIDIN, 1955, p. 84.]
- Tuwaqirhynchia** NAZER [1970, unpublished manuscript deposited in a library], p. 45, in ALMÉRAS, 1987, p. 177, with type species *T. arabiensis* NAZER [1970, unpublished manuscript deposited in a library]. [Most likely a synonym of *Conarosia* COOPER, 1989, p. 20.] *Middle Jurassic*.
- Vindobonella** PEARSON [1967, unpublished manuscript deposited in a library], in SIBLIK, 1988, p. 51, with type species *V. katzeri* PEARSON [1967, unpublished manuscript deposited in a library; SIBLIK also mentions "museum labels."] *Upper Triassic* [in need of proper validation].