

septum absent. *Upper Ordovician (Caradoc)*: western United States.—FIG. 565,3a–b. **S. pantherae*, Caradoc, California; a–e, ventral, dorsal, anterior, posterior, lateral views of conjoined valves, ×6; f, broken ventral interior, ×6; g, broken dorsal interior, ×6; h, dorsal interior, ×6 (Potter, 1990b).

Toxorthis TEMPLE, 1968, p. 20 [**T. proteus*; OD]. Transversely semioval with acute cardinal extremities, strongly unisulcate, coarsely costellate; interareas relatively short; teeth usually as elongate ridges, ventral muscle field subtriangular, undifferentiated; cardinal process absent, simple or as a low, bilobed myophore; platelike brachiophores supported at ends of elongate fulcral plates. [The family Toxorthidae RONG, 1984 has already been erected for this genus and, in fact, predates the

Wangyuiidae. There is some doubt, however, regarding the relationship between *Toxorthis* and *Wangyuia*. The most distinctive familial feature of the latter (and *Bowanorthis*) are the large S-curved brachiophores. Only the proximal parts of the brachiophores of *Toxorthis* are known as all species assigned to the genus are based exclusively on molds. If further study confirms brachiophore similarity, then the Wangyuiidae will become a junior synonym of Toxorthidae.] *Upper Ordovician (Ashgill)*: Great Britain, central China (western Hubei).—FIG. 565,2a–c. **T. proteus*, Ashgill, northwestern England; a, internal mold of ventral valve, ×10; b, internal mold of dorsal valve, ×10; c, external mold of dorsal valve, ×10 (Temple, 1968).

DALMANELLIDINA

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Suborder DALMANELLIDINA Moore, 1952

[*nom. correct.* HARPER, herein, *pro* Dalmanelloidea MOORE in MOORE, LALICKER, & FISCHER, 1952, p. 220; *emend.*, HARPER, herein]

Delthyrium and notothyrium normally open; deltiodont teeth commonly with dental fossettes, supported by variably developed and disposed dental plates; ventral muscle scar normally suboval to cordate and impressed on valve floor, rarely associated with raised structures; cardinalia usually with bilobed, trilobed, or lobate cardinal process and shaft, occasionally modified, rarely simple, ridgelike, or absent, situated on variably developed notothyrial platform; brachiophores as blades, rods, or spikes with convergent or divergent plates onto valve floor, together with fulcral plates, where present, define variably developed sockets; dorsal septa, partitions, and platforms rarely developed, mainly in later taxa; ventral mantle canal system normally lemniscate, rarely saccate; dorsal mantle canal system lemniscate to digitate and pinnate; shell with fibrous secondary layer, punctate (possibly endopunctate). *Lower Ordovician (Arenig)*–*Upper Permian (Tatarian)*.

The punctate orthides were first accorded superfamilial status as the Dalmanellacea by SCHUCHERT and COOPER (1931, p. 245) on the basis of their endopunctate shell structure. The majority of subsequent authors have accepted variants on this term to describe the group. MOORE (in MOORE, LALICKER, & FISCHER, 1952) first raised the taxon to subordinal status. Alternatively, WRIGHT (1965a, p. 328) argued for a single superfamily to contain the punctate orthide genera, to be named the Enteleteacea on grounds of priority (*ex* Enteletinæ WAAGEN, 1884, p. 548; *contra* Dalmanellinae SCHUCHERT, 1913b, p. 382). He recognized, however, that a term associated with the widespread, more generalized, earlier, and probably better-known *Dalmanella* would be more appropriate for the group than one based on the later, aberrant *Enteletes*.

Two superfamilies are recognized cladistically, mainly on the features of the cardinalia. The Dalmanelloidea has a well-developed notothyrial platform, reduced in later taxa, with a cardinal process evolving complex and modified, bilobed, trilobed, and generally lobate morphologies; brachiophores are gen-

erally rodlike or bladelike, with variably inclined plates and variably developed fulcral plates usually in earlier taxa. The dorsal adductor muscle scars are normally quadripartite. The Enteletoidea lacks a well-developed notothyrial platform and has a relatively simple crenulated cardinal process, expanded in some later taxa; high tusklake brachiophores, especially in later genera; well-developed fulcral plates; and convergent brachiophore plates, mainly in earlier forms. The dorsal adductor muscle scars are commonly petaloid. Dorsal septa, partitions, and platforms are variably developed across both superfamilies, mainly in later taxa.

Both superfamilies are well defined and distinct by their first appearances in the Arenig (see Fig. 522). Although cladistic analysis based on morphological data has helped clarify superfamilial groupings herein, it has not resolved the origin of the punctate orthides. Direct ancestral candidates within the plectorthoids have been suggested (HAVLÍČEK, 1977a), but the dalmanellidines and plectorthoids may have shared a common ancestor in the Middle to Upper Cambrian.

Superfamily DALMANELLOIDEA Schuchert, 1913

[*nom. transl.* SCHUCHERT & COOPER, 1931, p. 245, ex Dalmanellinae SCHUCHERT, 1913b, p. 382] [=Rhipidomellacea ALICHOVA, 1960, p. 190]

Normally subequally to unequally biconvex dalmanellidines; costellate ornament usually lacking aditicles except in later taxa; notothyrial platform well developed, reduced in later taxa; cardinalia normally with complex cardinal process having lobate, bilobed, or trilobed myophore, commonly modified as cleft or differentiated; shaft variably developed; brachiophores as thickened rods or blades with plates, when present, convergent or divergent onto valve floor; fulcral plates commonly developed; dorsal muscle scar quadripartite. *Lower Ordovician (Arenig)–Upper Permian (Tatarian).*

Family DALMANELLIDAE Schuchert, 1913

[*nom. transl.* SCHUCHERT & LEVENE, 1929, p. 15, ex Dalmanellinae SCHUCHERT, 1913b, p. 382] [=Wattsellidae SCHUCHERT & COOPER, 1931, p. 246; Onniellidae OPIK, 1933b, p. 14]

Normally subcircular, ventribiconvex, unisulcate, fascicostellate dalmanelloids with short, straight or curved ventral and dorsal interareas; ventral interior normally with suboval, subtriangular to cordate muscle scars, with adductors rarely enclosed by diductors, and divergent dental plates; dorsal interior with variably lobate cardinal process and shaft; brachiophores commonly as simple blades, variably disposed with variably inclined brachiophore plates; fulcral plates common, mainly in earlier taxa; median ridges, septa, partitions, and platforms sporadically developed in dorsal valves; ventral and dorsal mantle canal systems commonly lemniscate. *Lower Ordovician (Arenig)–Upper Devonian (Frasnian).*

Subfamily DALMANELLINAE Schuchert, 1913

[Dalmanellinae SCHUCHERT, 1913b, p. 382; *emend.*, HARPER, herein]

Normally subcircular to subquadrate, usually ventribiconvex dalmanellids with short ventral and dorsal interareas; delthyrium and notothyrium open; internally lacking well-developed median ridges, septa, partitions, and platforms in dorsal valves. *Lower Ordovician (Arenig)–upper Silurian (Ludlow).*

Dalmanella HALL & CLARKE, 1892, p. 205 [**Orthis testudinaria* DALMAN, 1828, p. 115; OD] [=*WattSELLA* BANCROFT, 1928a, p. 55 (type, *W. wattsi*)]. Subcircular, variably biconvex to ventribiconvex valves; ventral interior with dental fossettes, cordate muscle scar, and divergent dental plates; dorsal interior with brachiophore plates convergent onto median ridge; fulcral plates normally present. *Lower Ordovician (Arenig)–lower Silurian (Llandovery):* cosmopolitan.—FIG. 566,2a–f. **D. testudinaria* (DALMAN), Ashgill, Sweden; a–e, ventral, dorsal, posterior, anterior, lateral views of conjoined valves, $\times 2.3$; f, rubber replica of dorsal interior, $\times 4$ (Williams & Wright, 1963).—FIG. 566,2g, b. *D. testudinaria ripae* MITCHELL, Ashgill, Girvan, Scotland; g, internal mold of dorsal valve, $\times 4$; b, internal mold of ventral valve, $\times 4$ (Harper, 1989).—FIG. 566,2i. *D. multiplicata*, Caradoc, Shropshire; internal mold of dorsal valve, $\times 1.5$ (Cocks, new).

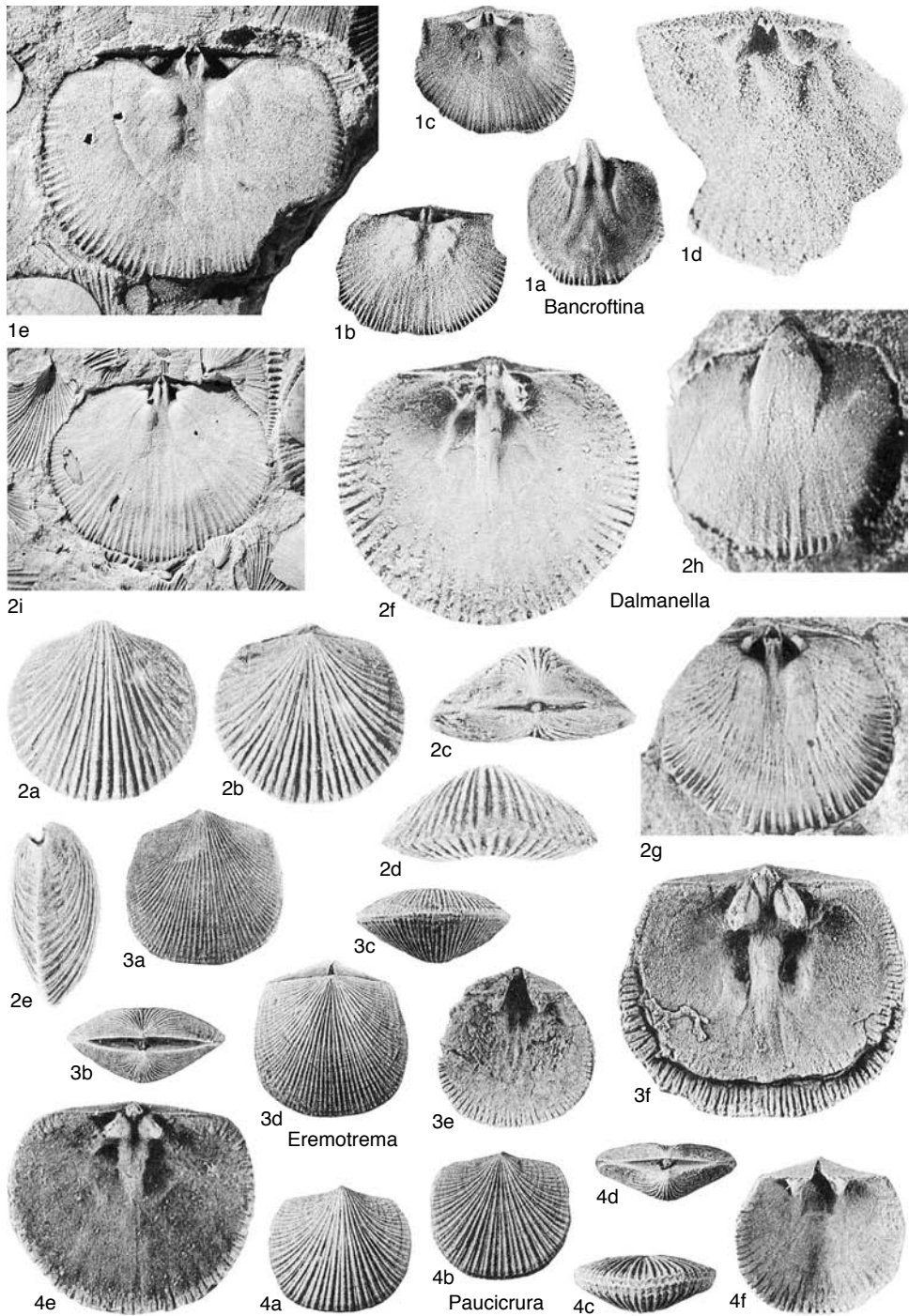


FIG. 566. Dalmanellidae (p. 783–786).

- Bancroftina** SINCLAIR, 1946, p. 295, *nom. nov. pro Raymondella* WHITTINGTON, 1938, p. 249, *non* REED, 1935] [**Raymondella typa* WHITTINGTON, 1938, p. 249; OD; =*R. typa* BANCROFT, 1933, p. 3, *nom. nud.*]. Subquadrate, unequally biconvex to ventribiconvex, nearly rectimarginate valves; ventral interior with bilobed to linear muscle scar and recessive dental plates; dorsal interior with undifferentiated trilobed cardinal process, brachiophores and plates subparallel to hinge line, supported by ancillary struts extending anteriorly from notothyrial platform; fulcral plates rare. *Upper Ordovician (Caradoc)*: Britain, Ireland.—FIG. 566, 1a–d. **B. typa* (WHITTINGTON), Caradoc, Shropshire; *a*, internal mold of ventral valve, $\times 1.5$; *b, c*, internal mold, rubber replica of dorsal valve, $\times 1.5$ (Wright, 1965a); *d*, rubber replica of dorsal interior, $\times 4$ (Williams & Wright, 1963).—FIG. 566, 1e. *B. robusta* (BANCROFT), Caradoc, Shropshire; internal mold of dorsal valve, $\times 2.5$ (Cocks, new).
- Cryptothyris** BANCROFT, 1945, p. 223 [**Resserella paracyclia* BANCROFT, 1928a, p. 56; OD]. Subcircular, markedly ventribiconvex, mainly rectimarginate valves; ventral muscle scar subtriangular to cordate with short diductor scars; dorsal interior with massive brachiophores, plates slightly divergent ventrally; bilobed cardinal process undifferentiated; fulcral plates rare. *Upper Ordovician (Caradoc)*: Britain.—FIG. 567, 1a–e. **C. paracyclia* (BANCROFT), Caradoc, Shropshire; *a*, internal mold of ventral valve, $\times 1.5$ (Hurst, 1979); *b*, internal mold of dorsal valve, $\times 2.5$; *c*, ventral exterior, $\times 2.5$ (Cocks, new); *d*, rubber replica of dorsal exterior, $\times 3$; *e*, internal mold of dorsal valve, $\times 3$ (Williams & Wright, 1963).
- Eremotrema** COOPER, 1956, p. 959 [**E. biconvexum*; OD]. Elongately semioval, ventribiconvex valves; ventral interior with bilobed muscle scar and divergent dental plates; dorsal interior with fissured, trilobed cardinal process and brachiophore plates variably divergent ventrally; fulcral plates rare. *Upper Ordovician (Caradoc)*: eastern North America, Scotland.—FIG. 566, 3a–f. **E. biconvexum*, Caradoc, Virginia; *a–d*, ventral, posterior, anterior, dorsal views of conjoined valves, $\times 2$; *e*, ventral interior, $\times 2$; *f*, dorsal interior, $\times 3$ (Cooper, 1956).
- Howellites** BANCROFT, 1945, p. 203 [**Resserella (Howellites) striata*; OD] [= *Mesodalmanella* HAVLIČEK, 1950, p. 26 (type, *M. flava*)]. Subcircular, ventribiconvex valves; ventral interior with bilobed muscle scar and divergent dental plates; dorsal interior with brachiophore plates variably divergent ventrally and rare fulcral plates. *Upper Ordovician (Caradoc)*: Europe, Morocco.—FIG. 568, 2a–e. **H. striatus* (BANCROFT), Caradoc, Wales; *a*, rubber replica of ventral exterior, $\times 2.5$; *b*, rubber replica of dorsal exterior, $\times 2.5$; *c*, internal mold of ventral valve, $\times 3$; *d*, internal mold of dorsal valve, $\times 3.5$; *e*, rubber replica of dorsal interior, $\times 4$ (Williams, 1963).
- Mirrorthis** ZENG IN WANG & others, 1983, p. 116 [**M. mira*; OD]. Subcircular, small, ventribiconvex valves; ventral interior with divergent dental plates and suboval muscle scar; dorsal interior with bilobed cardinal process, widely divergent brachiophore plates associated with ancillary struts and crucial pits; fulcral plates well developed. *Upper Ordovician (Ashgill)*: Europe, Morocco, China.—FIG. 567, 2a–g. **M. mira*, Ashgill; *a*, internal mold of ventral valve of conjoined internal molds, southern China, $\times 3$; *b*, enlargement of posterior part of conjoined internal molds, southern China, $\times 10$; *c*, internal mold of dorsal valve of conjoined internal molds, southern China, $\times 3$; *d*, enlargement of posterior part of conjoined internal molds, southern China, $\times 10$; *e*, external mold of ventral valve of same specimen, southern China, $\times 3$ (Rong, 1984); *f*, internal mold of dorsal valve, Poland, $\times 6.6$; *g*, internal mold of ventral valve, Poland, $\times 6.6$ (Temple, 1965).
- Onniella** BANCROFT, 1928a, p. 55 [**O. broeggeri*; OD] [= *Soudleyella* BANCROFT, 1945, p. 209 (type, *S. soudleyella*); *Bagnorthis* LEVY & NULLO, 1974, p. 183 (type, *B. garrigoui*)]. Subquadrate, ventribiconvex valves; ventral interior with widely cordate ventral muscle scar and recessive dental plates; dorsal interior with undifferentiated, swollen, bilobed cardinal process; brachiophore plates widely divergent ventrally. *Lower Ordovician (Llanvirn)–lower Silurian (Llandovery)*: cosmopolitan.—FIG. 569, 1a–d. **O. broeggeri*, Caradoc, Shropshire; *a, b*, ventral, dorsal views of conjoined valves, $\times 1.5$; *c*, internal mold of ventral valve, $\times 1.5$ (Cocks, new); *d*, internal mold of dorsal valve, $\times 2.5$ (Hurst, 1979).—FIG. 569, 1e–g. **O. reuschi*, Caradoc, Shropshire; *e*, internal mold of ventral valve, $\times 2$; *f*, internal mold of dorsal valve, $\times 3$ (Cocks, new); *g*, rubber replica of dorsal interior, $\times 1.5$ (Wright, 1965a).
- Onnizetina** HAVLIČEK, 1974, p. 168 [**O. mellina*; OD; = *Orthis trubiniensis* BARRANDE, 1879, pl. 112, case II, fig. 1–3]. Subquadrate, small, biconvex valves with variably inclined dorsal interarea; ventral muscle scar subtriangular; dorsal interior with undifferentiated bilobed cardinal process, high, short bladelike brachiophores, and brachiophore plates slightly divergent ventrally; fulcral plates absent. *Upper Ordovician (Caradoc)*: Bohemia.—FIG. 568, 3a–e. **O. trubiniensis* (BARRANDE), Caradoc, Bohemia; *a, b*, internal mold, rubber replica of dorsal valve, $\times 5.2$; *c*, internal mold of ventral valve, $\times 7.4$; *d, e*, external mold, rubber replica of dorsal valve, $\times 5.2$ (Havliček, 1977a).
- Paucicrura** COOPER, 1956, p. 956 [**Orthis rogata* SARDESON, 1892, p. 331; OD] [= *Cristiferina* COOPER, 1956, p. 961 (type, *C. cristata*); *Sigopallus* LIU & LIU, 1985, p. 232 (type, *S. vicarius*)]. Subquadrate, ventribiconvex, fascicostellate valves; ventral interior with divergent dental plates and bilobed muscle scar; dorsal interior with differentially trilobed cardinal process with median lobe expanded as crest. *Upper Ordovician (Caradoc–Ashgill)*: Britain, North America.—FIG. 566, 4a–e. **P. rogata* (SARDESON), Caradoc, Minnesota; *a–d*, ventral, dorsal, anterior, posterior views of conjoined valves,

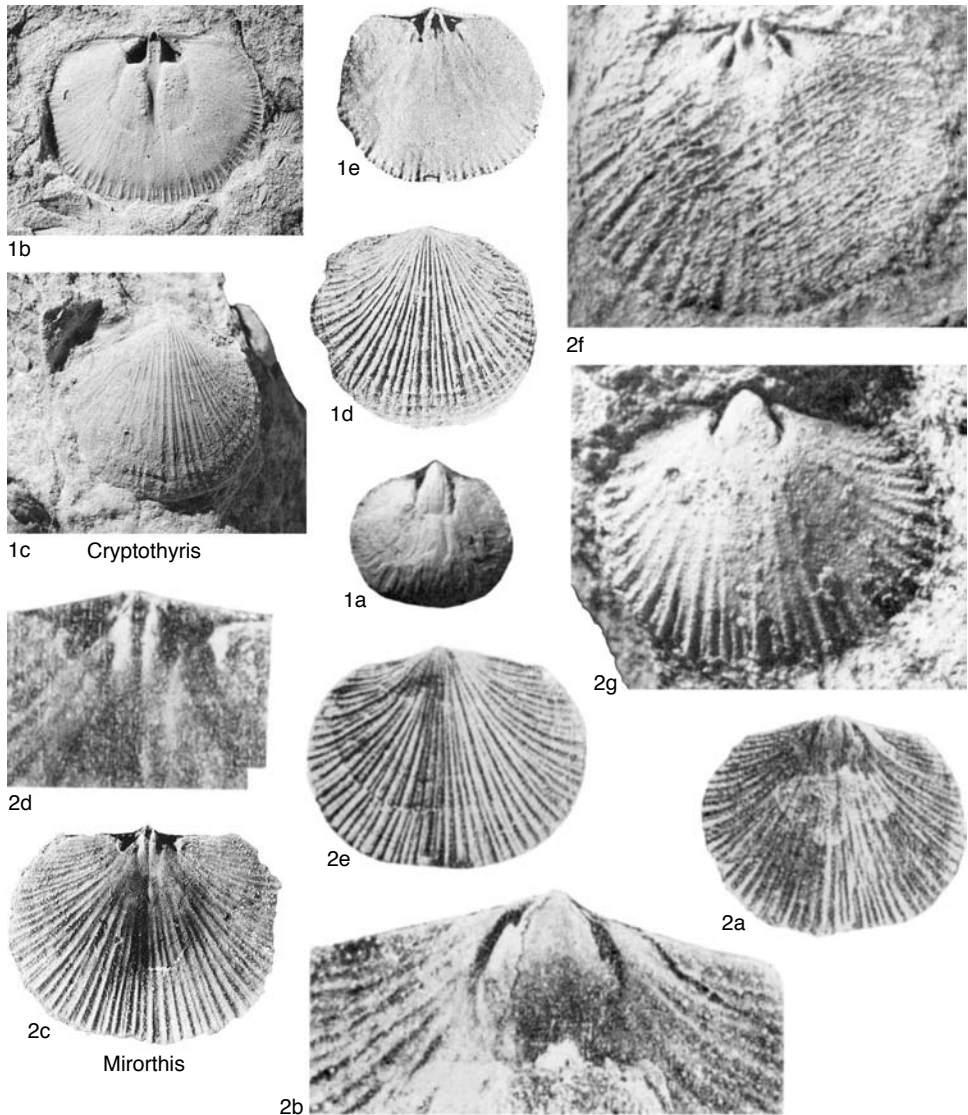


FIG. 567. Dalmanellidae (p. 785).

×2; *e*, dorsal interior, ×3 (Cooper, 1956).—FIG. 566, 4*f*. *P. virginica* COOPER, Caradoc, Virginia; ventral interior, ×3 (Cooper, 1956).

Ravozetina HAVLIČEK, 1974, p. 169 [**Orthis honorata* BARRANDE, 1879, pl. 68, case III, fig. 1,2]. Subquadrate, small, ventribiconvex, coarsely costellate valves with angular ribs; ventral interior with subtriangular muscle scar on callus; dental plates subparallel, pedicle callist well developed; dorsal interior with cardinal process normally as blade or ridge; fulcral plates absent. *Upper Ordovician (Ashgill)*—*upper Silurian (Ludlow)*: Europe.—FIG. 569, 2*a*–*c*. **R. honorata* (BARRANDE), Ashgill,

Bohemia; *a*, internal mold of dorsal valve, ×8; *b*, dorsal exterior, ×10.5; *c*, internal mold of ventral valve, ×8.4 (Havlíček, 1977a).

Trucizetina HAVLIČEK, 1974, p. 169 [**T. subrotundata*; OD]. Subcircular, ventribiconvex to nearly planoconvex, fascicostellate valves; ventral interior with subtriangular muscle scar and divergent dental plates; dorsal interior with ridgelike or bilobed cardinal process; muscle scar bisected by median ridge and confined posterolaterally by pair of divergent ridges extending forward from brachiophore plates; fulcral plates absent. *Upper Ordovician (Ashgill)*: Bohemia.—FIG. 569, 3*a*–*d*. **T. subrotundata*,

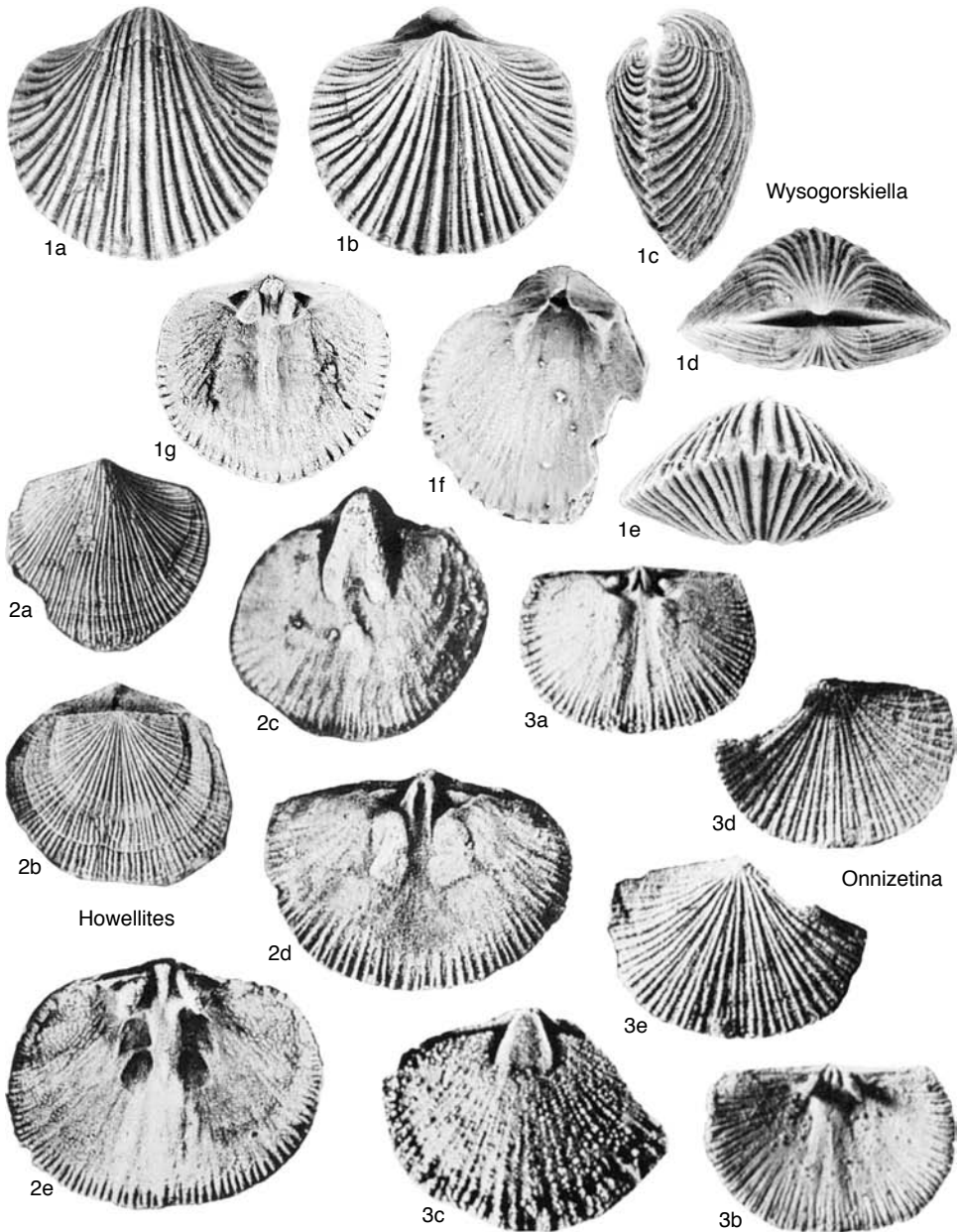


FIG. 568. Dalmanellidae (p. 785–788).

Ashgill, Bohemia; *a*, internal mold of dorsal valve, $\times 2.7$; *b*, rubber replica of dorsal interior, $\times 3.5$; *c*, internal mold of ventral valve, $\times 3$; *d*, dorsal exterior, $\times 4.3$ (Havlíček, 1977a).

Wysogorskiella HINTS, 1975, p. 61 [*W. litviensis*; OD]. Subcircular, ventribiconvex valves; ventral interior with massive teeth, dental fossettes, and diver-

gent dental plates; muscle scar short and cordate; dorsal interior with trilobed cardinal process, massive, erect brachioophores, and fulcral plates; dorsal adductor scars elongate, bisected by well-developed median ridge. *Upper Ordovician (Caradoc–Ashgill)*: eastern Baltic.—FIG. 568, *1a–g*. *W. litviensis*, Caradoc, eastern Baltic; *a–e*, ventral, dorsal, lateral,

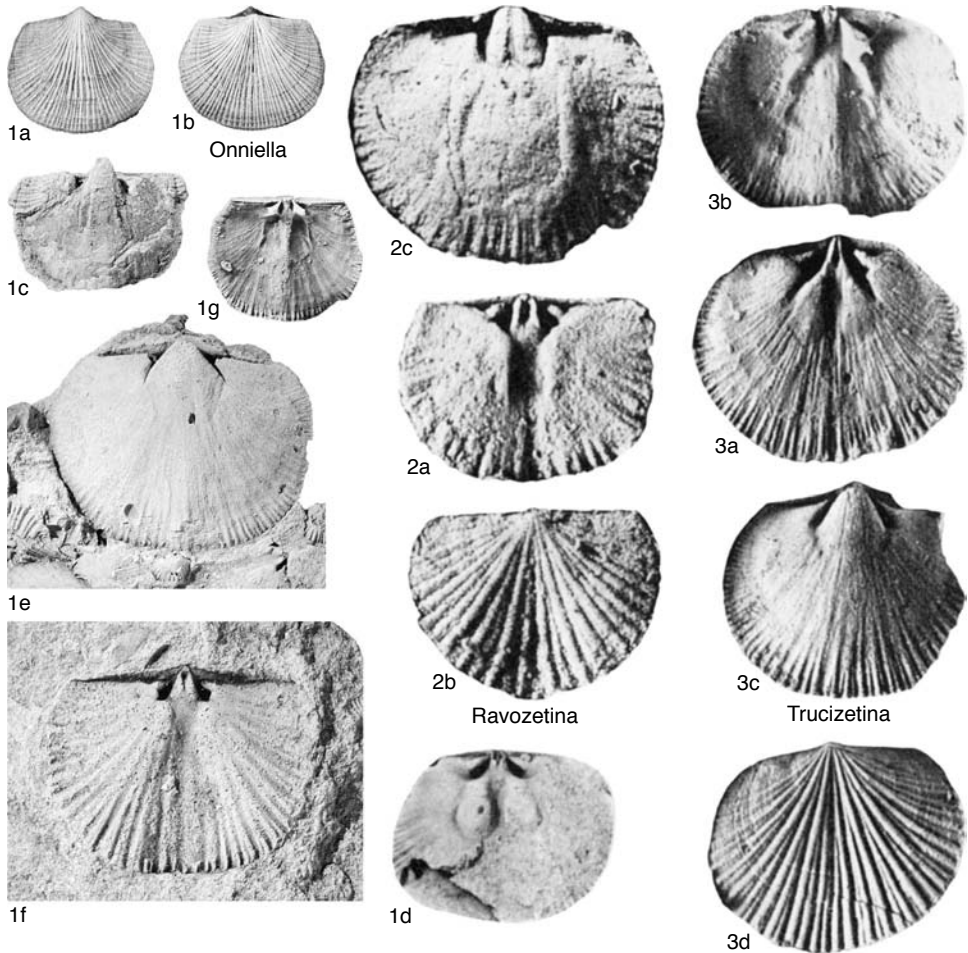


FIG. 569. Dalmanellidae (p. 785–787).

posterior, anterior views of conjoined valves, $\times 7.5$; *f*, ventral interior, $\times 7.7$; *g*, dorsal interior, $\times 7.5$ (Hints, 1975).

Subfamily CORTEZORTHINAE Johnson & Talent, 1967

[Cortezorthinae JOHNSON & TALENT, 1967a, p. 143]

Dalmanellids with ventral interior having linear to quadrate muscle scars; adductor scars fixed in position between surrounding diductors; adductor scars unfacetted and bisected by variably developed median ridge; dorsal interior with well-developed median ridge or septum and widely divergent brachiophores; fulcral plates normally absent. *Lower Devonian (Pragian)–Upper Devonian (Frasnian)*.

Cortezorthis JOHNSON & TALENT, 1967a, p. 143 [*C. maclareni*; OD]. Transversely semioval, ventribiconvex, sharply unisulcate valves; ventral interior with dental fossettes and recessive dental plates; muscle scar cordate; dorsal interior with petaloid muscle scar situated on platform, bisected by long, low median septum, triangular in lateral view, extended forward to near anterior margin; radial ridges well developed on anteromedian areas of both interiors. *Lower Devonian (Pragian)–Middle Devonian (Eifelian)*: North America, Europe.—FIG. 570, 1a–e. **C. maclareni*, Emsian or Eifelian, Ellesmere Island, Arctic Canada; *a*, dorsal interior, $\times 3$; *b*, incomplete dorsal interior, $\times 3$; *c*, ventral interior, $\times 2$; *d, e*, dorsal, ventral views of conjoined pair, $\times 2$ (Johnson & Talent, 1967a).

Cariniferella SCHUCHERT & COOPER, 1931, p. 246 [**Orthis carinata* HALL, 1843b, p. 267; OD]. Transversely semioval, dorsibiconvex, sharply unisulcate valves; ventral and dorsal interareas catacline and

orthocline respectively; ventral interior with bilobed muscle scar; dorsal interior with small, trilobed cardinal process; muscle scar petaloid. *Upper Devonian (Frasnian)*: cosmopolitan.—FIG. 570,3a–f. **C. carinata* (HALL), Frasnian, New York; a, b, internal mold, rubber replica of dorsal valve, $\times 3$; c–f, anterior, posterior, dorsal, ventral views of conjoined pair, $\times 1.25$ (Johnson & Talent, 1967a).—FIG. 570,3g, h. *C. tioga* (HALL), Frasnian, New York; internal mold, rubber replica of ventral valve, $\times 1$ (Johnson & Talent, 1967a).

Reeftonia ALLAN, 1947, p. 436 [**R. marwicki*; OD]. Transversely semioval, biconvex, unisulcate valves; ventral interior with recessive dental plates and cordate muscle scar; dorsal interior with small myophore and short shaft. *Middle Devonian (Emsian)*: Australia, New Zealand.—FIG. 570,2a–d. **R. marwicki*, Emsian, New Zealand; a, b, internal mold, rubber replica of dorsal valve, $\times 1.5$; c, internal mold of ventral valve, $\times 2$; d, internal mold of ventral valve, $\times 1.5$ (Johnson & Talent, 1967a).

Subfamily ISORTHINAE Schuchert & Cooper, 1931

[Isorthinae SCHUCHERT & COOPER, 1931, p. 247; *emend.*, WALMSLEY & BOUCOT, 1975, p. 50]

Ventribiconvex, multicostellate dalmanellids with symmetrically branched median ribs; ventral interior having linear or quadrate muscle field bisected by median ridge; dorsal muscle field, usually long and narrow, confined by raised margins and divided by well-developed median ridge; brachiophores moderately divergent. *lower Silurian (Llandovery)*–*Middle Devonian (Givetian)*.

Isorthis KOZŁOWSKI, 1929, p. 29 [**Dalmanella (Isorthis) szajnochai*; OD]. Subcircular, subequally biconvex, rectimarginate to weakly unisulcate valves; ventral interior with dental fosses; dorsal interior with variably lobate cardinal process and brachiophore plates divergent ventrally. *lower Silurian (Llandovery)*–*Middle Devonian (Givetian)*: cosmopolitan.

I. (Isorthis) KOZŁOWSKI, 1929, p. 29 [**Dalmanella (Isorthis) szajnochai*; OD]. Ventribiconvex to near equally biconvex valves; dorsal interior with small, lobate cardinal process; fulcral plates commonly developed. *lower Silurian (Llandovery)*–*Lower Devonian (Lochkovian)*: cosmopolitan.—FIG. 571,1a–b. **I. (I.) szajnochai* (KOZŁOWSKI), Lochkovian, Podolia; a–e, ventral, dorsal, lateral, posterior, anterior views of conjoined valves, $\times 1$ (Walmsley & Boucot, 1975); f, ventral interior, $\times 2$; g, h, normal, posterior views of dorsal interior, $\times 2$ (Nikiforova, Modzalevskaia, & Bassett, 1985).

I. (Arcualla) WALMSLEY & BOUCOT, 1975, p. 79 [**Orthis arcuaria* HALL & CLARKE, 1892, p. 224; OD]. Differs from *I. (Isorthis)* in having more elongate and indistinct quadripartite dorsal

muscle scar; ventral interior with wide median ridge dividing muscle field. *lower Silurian (Llandovery)*–*Lower Devonian (Lochkovian)*: North America, Sweden, Podolia, central Asia.—FIG. 571,2a–b. **I. (A.) arcuaria* (HALL & CLARKE), Ludlow, Tennessee; a–e, ventral, dorsal, posterior, lateral, anterior views of conjoined valves, $\times 1$; f, ventral interior, $\times 3$; g, dorsal interior, $\times 1$; h, anterior detail of dorsal interior, $\times 5$ (Walmsley & Boucot, 1975).

I. (Ovalla) WALMSLEY & BOUCOT, 1975, p. 75 [**Platystrophia ovalis* PASKEVICIUS, 1962, p. 33; OD]. Differs from *I. (Isorthis)* in having elongate, suboval, and indistinct quadripartite muscle scar; ventral interior with short, narrow median ridge. *lower Silurian (Llandovery)*–*upper Silurian (Pridoli)*: eastern North America, eastern Baltic, Britain.—FIG. 571,3a, b. *I. (O.) mackenziei* WALMSLEY, Llandovery, Welsh Borderlands; a, internal mold of ventral valve, $\times 3.2$; b, internal mold of dorsal valve, $\times 3.2$ (Walmsley & Boucot, 1975).—FIG. 571,3c–g. *I. (O.) scuteformis* WALMSLEY, Ludlow, England; ventral, dorsal, lateral, posterior, anterior views of conjoined valves, $\times 1$ (Walmsley & Boucot, 1975).

Costisorthis HAVLÍČEK, 1974, p. 170 [**Orthis oclusa* BARRANDE, 1848, pl. 19, fig. 2; OD]. Similar to *Isorthis* but multiplicate. *Lower Devonian (Pragian)*–*Middle Devonian (Eifelian)*: Europe.—FIG. 572,1a–c. **C. oclusa* (BARRANDE), Pragian, Bohemia; ventral, dorsal, anterior views of conjoined pairs, $\times 2$ (Havlíček, 1977a).

Levenea SCHUCHERT & COOPER, 1931, p. 246 [**Orthis subcarinata* HALL, 1857, p. 43; OD]. Subcircular, ventribiconvex valves; ventral interior with short subpentagonal muscle field bisected by wide median ridge; dorsal interior with swollen, lobate myophore lacking well-developed shaft and brachiophores expanded medially; deep sockets excavated into valve floor; fulcral plates rare. *lower Silurian (Llandovery)*–*Middle Devonian (Eifelian)*: cosmopolitan.—FIG. 571,4a–c. **L. subcarinata* (HALL), Lochkovian, Tennessee; a, ventral interior, $\times 1.5$; b, dorsal interior, $\times 1.5$; c, enlargement of posterior region, $\times 3.5$ (Schuchert & Cooper, 1932).—FIG. 571,4d–f. *L.* sp. cf. *L. subcarinata*, Lochkovian, Tennessee; ventral, dorsal, posterior views of conjoined valves, $\times 1.5$ (Schuchert & Cooper, 1932).

Peleicostella HAVLÍČEK, 1971b, p. 230 [**Spirifer peleus* BARRANDE, 1879, pl. 74, case IV, fig. 1–3]. Subcircular, fascicostellate, multiplicate valves with capillae; ventral interior with divergent dental plates. *Lower Devonian (Pragian)*–*Middle Devonian (Emsian)*: Bohemia.—FIG. 572,2a–d. **P. peleus* (BARRANDE), Pragian, Bohemia; a, b, ventral, dorsal views of conjoined pair, $\times 2.7$; c, dorsal exterior, $\times 2.1$; d, dorsal interior, $\times 4.4$ (Havlíček, 1977a).

Protocortezorthis JOHNSON & TALENT, 1967a, p. 154 [**Orthis fornicatimcurvata* FUCHS, 1919, p. 58; OD]. Subcircular, ventribiconvex valves; ventral interior with linear muscle scar, bisected by median ridge, and recessive dental plates. Dorsal muscle scar petaloid; fulcral plates variably developed. *middle Silurian (Wenlock)*–*Lower Devonian (Pragian)*:

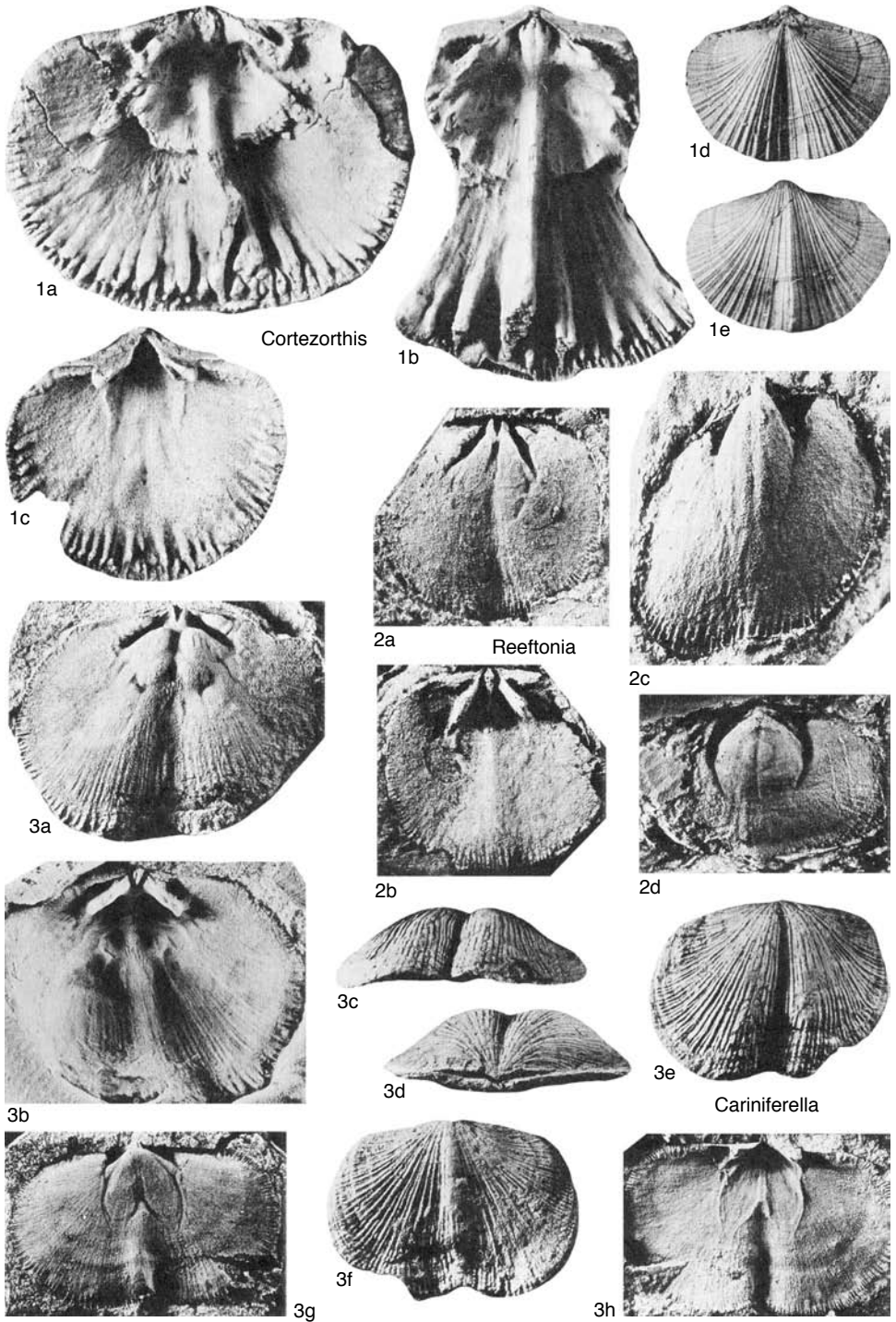


FIG. 570. Dalmanellidae (p. 788–789).

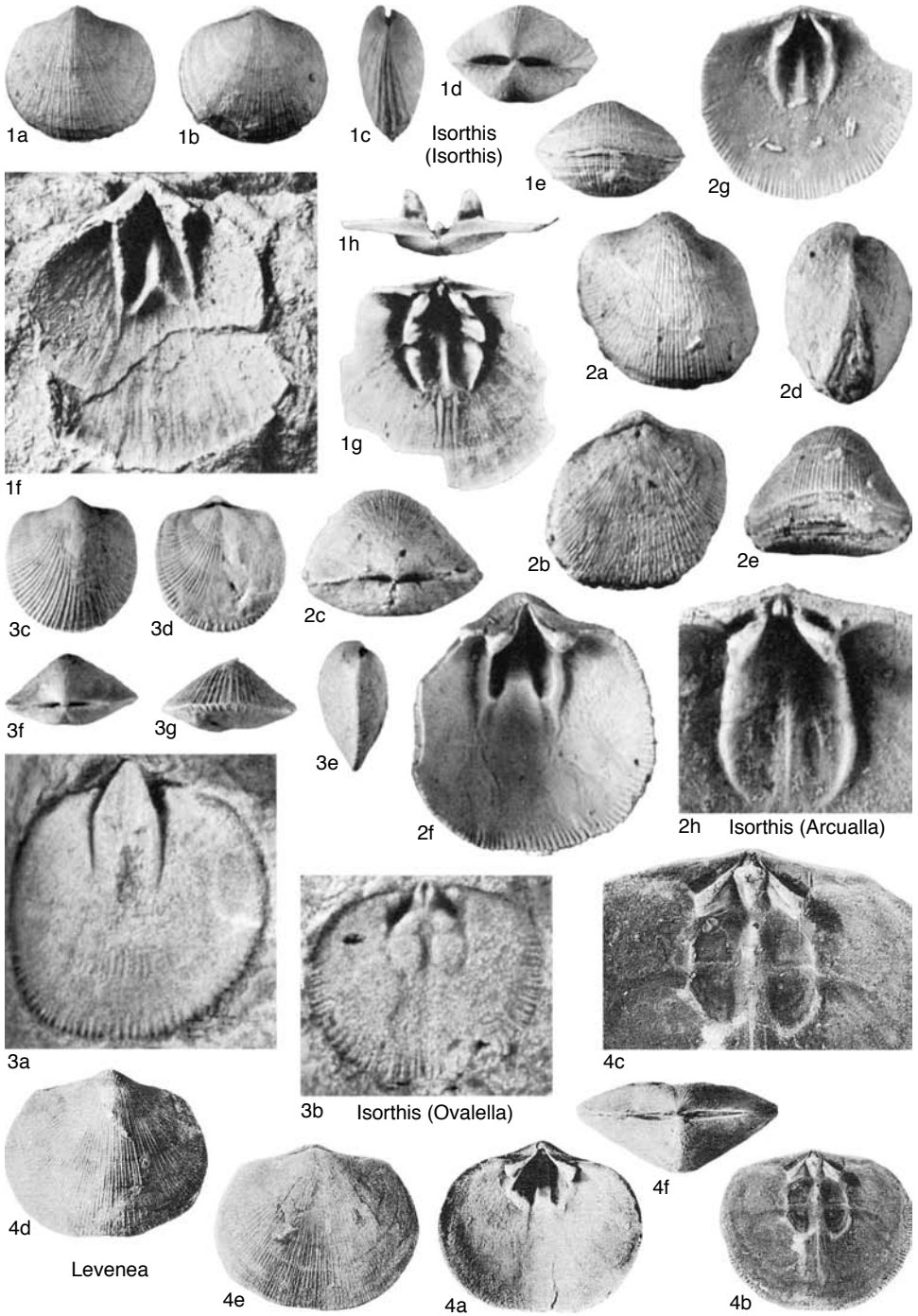


FIG. 571. Dalmanellidae (p. 789).

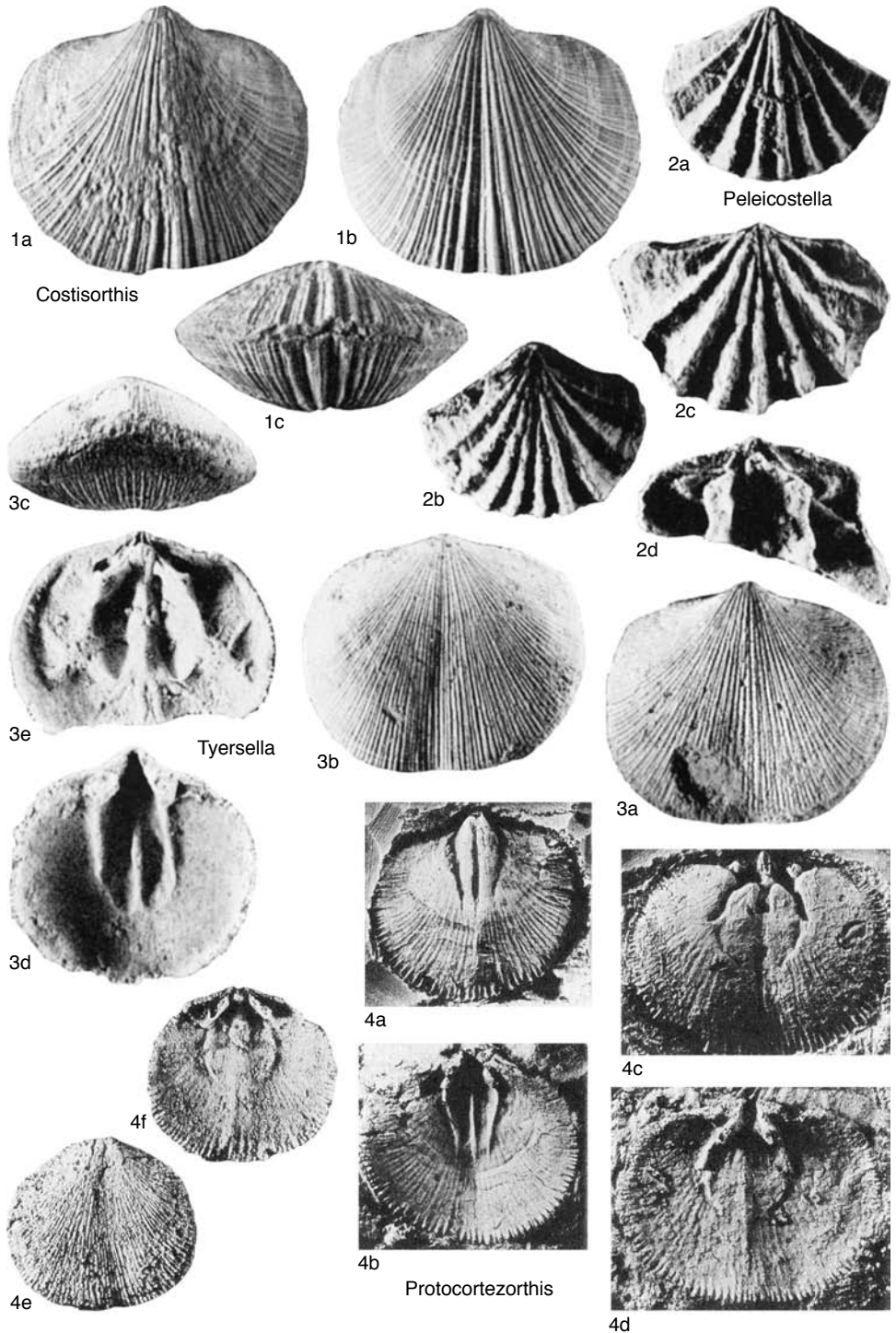


FIG. 572. Dalmanellidae (p. 789–793).

cosmopolitan.—FIG. 572,4a–d. **P. fornicatim-curvata* (FUCHS), Lochkovian, Germany; *a, b*, internal mold, rubber replica of ventral valve, $\times 2$; *c, d*, internal mold, rubber replica of dorsal valve, $\times 2$ (Johnson & Talent, 1967a).—FIG. 572,4e, *f. P. windmillensis* JOHNSON & TALENT, Pragian, central Nevada; exterior, interior of dorsal valve, $\times 1.5$ (Johnson & Talent, 1967a).

Tyersella PHILIP, 1962, p. 197 [**T. typica*; OD]. Subcircular, ventribiconvex valves; ventral interior with divergent dental plates and median ridge; dorsal interior with petaloid muscle scar having elevated margins; deep sockets excavated into valve floor; fulcral plates absent. *middle Silurian (Wenlock)–Middle Devonian (Givetian)*: cosmopolitan.—FIG. 572,3a–e. *T. snajdri* (HAVLÍČEK), Emsian, Bohemia; *a*, ventral view of conjoined valves, $\times 2.1$; *b*, dorsal view of conjoined valves, $\times 1.8$; *c*, anterior view of conjoined valves, $\times 2.1$; *d*, ventral interior, $\times 2$; *e*, dorsal interior, $\times 2.2$ (Havlíček, 1977a).

Subfamily PROKOPIINAE Wright, 1965

[Prokopiinae WRIGHT, 1965a, p. 338; *emend.*, HARPER, herein]

Subcircular, normally small dalmanellids with long ventral interarea, delthyrium open or variably covered; dorsal interior with bilobed cardinal process and shaft, suberect brachiophore plates and dorsal median partition; fulcral plates variably developed. *Lower Devonian (Pragian)–Middle Devonian (Givetian)*.

Prokopia HAVLÍČEK, 1953, p. 6 [**P. bouskai*; OD]. Subcircular valves with delthyrium containing flat apical plate; ventral interarea long, straight; ventral interior with recessive dental plates; dorsal interior lacking fulcral plates. *Lower Devonian (Pragian)–Middle Devonian (Eifelian)*: Bohemia, Germany, Morocco, USA (Nevada).—FIG. 573,2a–b. **P. bouskai*, Pragian, Bohemia; *a–d*, ventral, dorsal, anterior, lateral views of conjoined valves, $\times 10.6$; *e–g*, normal, posterior, oblique views of dorsal interior, $\times 11.2$; *b*, ventral interior, $\times 11.1$ (Havlíček, 1977a).

Eosophragmophora WANG in WANG, YU, & WU, 1974, p. 36 [**E. sinensis*; OD]. Subcircular, medium-sized valves with open delthyrium; dorsal interior lacking fulcral plates. *Lower Devonian (Emsian)*: southern China, Australia (New South Wales).—FIG. 573,1a–f. **E. sinensis*, Emsian, southern China; *a–c*, ventral, dorsal, posterior views of conjoined valves, $\times 2.5$; *d*, ventral interior, $\times 3$; *e, f*, normal, tilted views of dorsal interior, $\times 3$ (Wang & Rong, 1986).

Miniprokopia HAVLÍČEK, 1971b, p. 229 [**M. miniconcha*; OD]. Subcircular, coarsely paucicostellate valves with long, curved ventral interarea; ventral interior with rudimentary dental plates and muscle field on well-developed callus; dorsal interior with subperipheral rim. *Lower Devonian (Pragian)–Middle Devonian (Eifelian)*: Bohemia.—FIG.

573,3a–f. **M. miniconcha*, Pragian, Bohemia; *a–c*, ventral, dorsal, lateral views of conjoined valves, $\times 12.4$; *d, e*, normal, oblique views of dorsal interior, $\times 9.5$; *f*, ventral interior, $\times 13.5$ (Havlíček, 1977a).

Phragmophora COOPER, 1955, p. 50 [**P. schnuri*; OD]. Subquadrate, medium-sized, unisulcate to rectimarginate valves with long, straight ventral interarea; delthyrium covered by variably developed notodeltidium with minute apical foramen; cardinal process bilobed, expanded, and medially cleft; fulcral plates developed in adult shells. *Middle Devonian (Eifelian–Givetian)*: Europe.—FIG. 574,1a–i. **P. schnuri*; *a–d*, ventral, dorsal, anterior, lateral views of conjoined valves, Eifelian, Germany, $\times 1$; *e*, internal mold of ventral valve, Eifelian, Germany, $\times 2$; *f, g*, normal, tilted views of dorsal interior, $\times 2$ (Cooper, 1955); *h*, ventral interior, Givetian, Poland, $\times 5$; *i*, dorsal interior, Givetian, Poland, $\times 5$ (Biernat, 1959).

Protophragmapora ALEKSEEVA, 1967, p. 7 [**P. chotchalsensis*; OD]. Similar to *Phragmophora* but with open delthyrium and simple cardinal process. *Lower Devonian*: northeastern Russia, Australia.—FIG. 574,2a–e. **P. chotchalsensis*, Lower Devonian, northeastern Russia; *a–c*, ventral, dorsal, posterior views of conjoined valves, $\times 1$; *d*, internal mold of ventral valve, $\times 2$; *e*, internal mold of dorsal valve, $\times 1.5$ (Aleksseva, 1967)

Subfamily RESSERELLINAE Walmsley & Boucot, 1971

[Resserellinae WALMSLEY & BOUCOT, 1971, p. 488]

Planoconvex to ventribiconvex, transversely semioval or shield-shaped, multicostellate dalmanellids with asymmetrically branched median ribs and prominent ventral umbo; ventral interior having compact suboval, subtriangular or cordate muscle field; dorsal muscle field confined by variably developed ridges and divided by median ridge; brachiophores and plates widely divergent, cardinal process bilobed; fulcral plates commonly developed. *lower Silurian (Llandovery)–Middle Devonian (Eifelian)*.

Resserella BANCROFT, 1928a, p. 54 [**Orthis canalis* J. DE C. SOWERBY, 1839, p. 630, pl. 13, fig. 12a; OD] [= *Parmorthis* SCHUCHERT & COOPER, 1931, p. 246 (type, *Orthis elegantula* DALMAN, 1828, p. 117)]. Subcircular valves with recessive dental plates and suboval ventral muscle scar. *lower Silurian (Llandovery)–Lower Devonian (Emsian)*: cosmopolitan.—FIG. 575,1a–g. **R. canalis* (J. DE C. SOWERBY), Wenlock–Ludlow, Gotland, Sweden; *a*, ventral interior, $\times 3$; *b*, dorsal interior, $\times 3$; *c–g*, anterior, posterior, lateral, dorsal, ventral views of conjoined pair, $\times 3$ (Walmsley & Boucot, 1971).

Dedzetina HAVLÍČEK, 1950, p. 33 [**Parmorthis (Dedzetina) macrostomoides*; OD]. Subcircular,

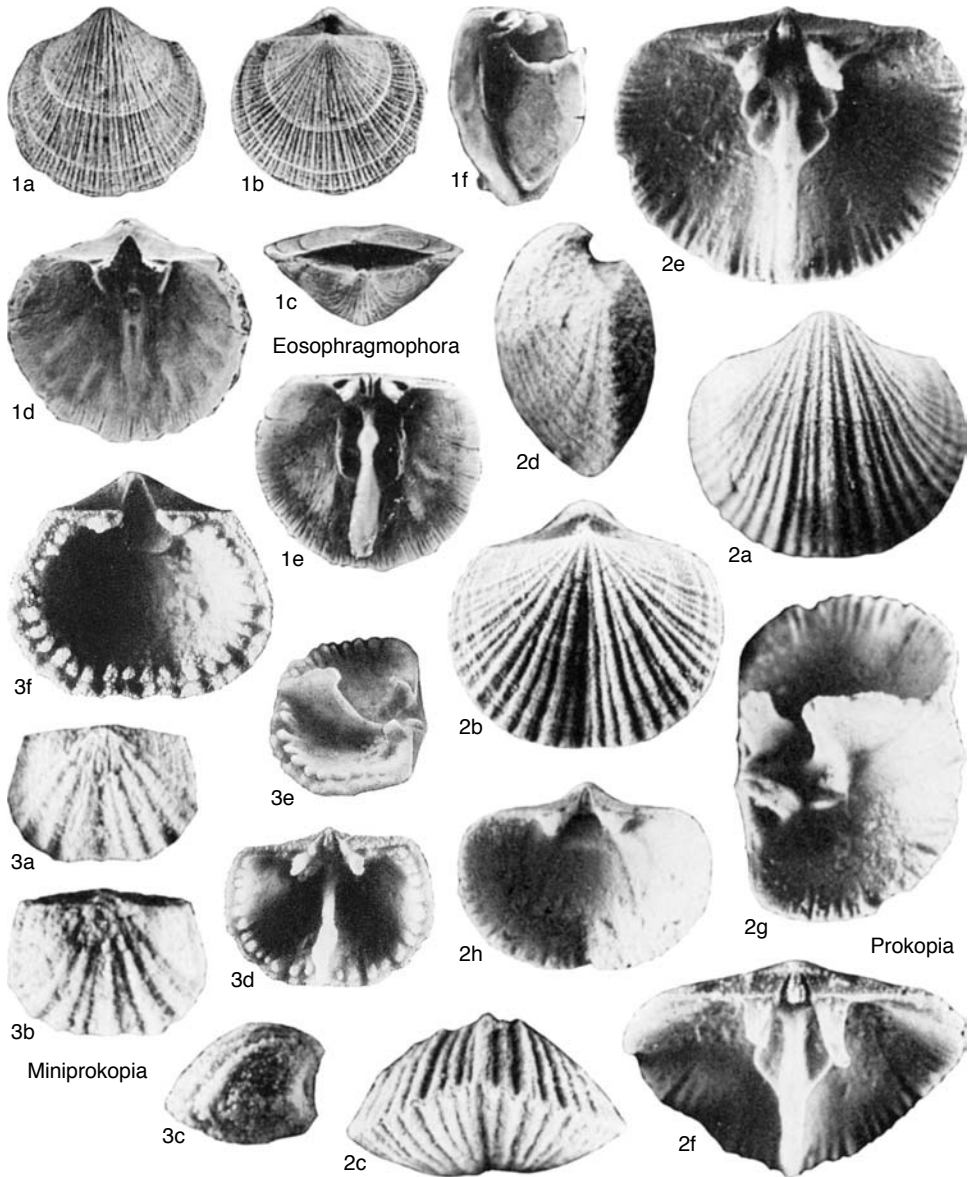


FIG. 573. Dalmanellidae (p. 793).

ventribiconvex, coarsely costellate valves with apical deltidium and hypercline dorsal interarea; ventral interior with recessive dental plates, cordate muscle scar, and well-developed pedicle callist. *Upper Ordovician (Caradoc–Ashgill)*: cosmopolitan.—FIG. 576, 1a–c. **D. macrostomoides* (HAVLÍČEK), Ashgill, Bohemia; a, internal mold of ventral valve, $\times 3.2$; b, internal mold of dorsal valve, $\times 3.4$; c, external mold of dorsal valve, $\times 3.8$ (Havlíček, 1977a).

Fasciostella SCHUCHERT & COOPER, 1931, p. 246 [*Strophomenes gervillii* DEFRANCE, 1828, p. 152; OD]. Subcircular, coarsely fasciostellate valves; ventral interior with recessive dental plates and suboval muscle scar. *Lower Devonian (Lochkovian)–Middle Devonian (Eifelian)*: Europe, Algeria.—FIG. 576, 3a, b. **F. gervillii* (DEFRANCE), Pragian, Bohemia; ventral, dorsal exteriors of conjoined pair, $\times 1.5$ (Schuchert & Cooper, 1932).—FIG. 576, 3c–f. *F. undulata* WALMSLEY & BOUCOT, Lower

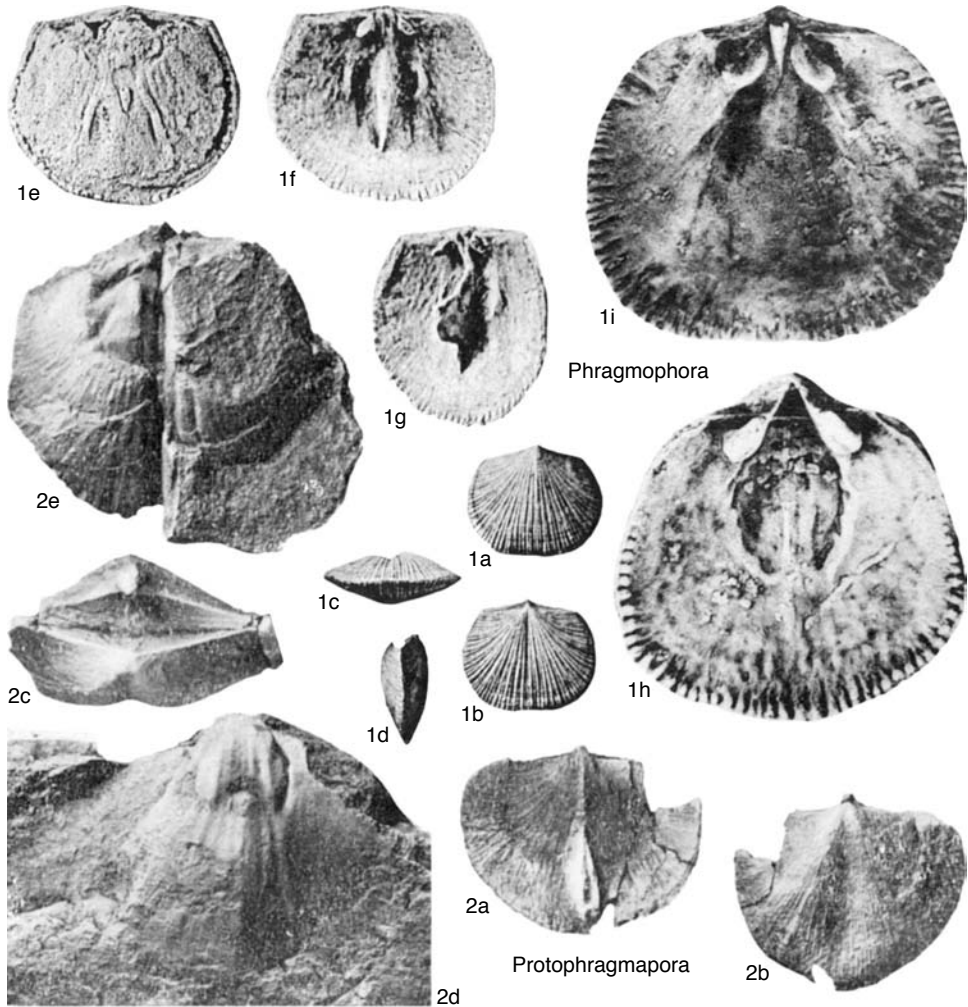


FIG. 574. Dalmanellidae (p. 793).

Devonian, France; *c, d*, internal, external views of dorsal valve, $\times 3$; *e, f*, internal molds of dorsal, ventral valves of conjoined pair, $\times 2$ (Walmsley & Boucot, 1971).

Fascizetina HAVLÍČEK, 1975, p. 232 [**Orthis gervilli konieprusensis* OEHLERT, 1886, p. 46; OD]. Transversely semioval, fascicostellate, multiplicate valves; ventral interior with divergent dental plates. *Lower Devonian (Lochkovian–Emsian)*: Europe, northern Africa.—FIG. 576, 2*a–d*. **F. konieprusensis* (OEHLERT), Pragian, Bohemia; dorsal, ventral, anterior, posterior views of conjoined pair, $\times 2.1$ (Havlíček, 1977a).

Karlicium HAVLÍČEK, 1974, p. 169 [**K. karlicum*; OD]. Subquadrate, small, coarsely costellate valves; dorsal interarea catacline; ventral interior with recessive dental plates and cordate muscle scar; cardinalia

lacking fulcral plates. *Upper Ordovician (Caradoc–Ashgill)*: Bohemia.—FIG. 576, 4*a–c*. **K. karlicum*, Ashgill, Bohemia; *a*, internal mold of ventral valve, $\times 7.8$; *b*, internal mold of dorsal valve, $\times 9.2$; *c*, external mold of dorsal valve, $\times 10.5$ (Havlíček, 1977a).

Molongella SAVAGE, 1974, p. 13 [**M. talenti*; OD] [= *Bouskia* HAVLÍČEK, 1975, p. 233]. Transversely semioval, small, ventribiconvex, sharply unisulcate, coarsely costellate valves; ventral interior with divergent dental plates and bilobed muscle scar on callus. *upper Silurian (Přídolí)–Lower Devonian (Pragian)*: Bohemia, Australia.—FIG. 577, 1*a–c*. **M. talenti*, Pragian, Australia; *a*, internal mold of dorsal valve, $\times 5$; *b*, internal mold of ventral valve, $\times 5$; *c*, rubber replica of ventral exterior, $\times 5$ (Savage, 1974).—FIG. 577, 1*d–g*. *M. lineata* (HAVLÍČEK), Lochkovian,

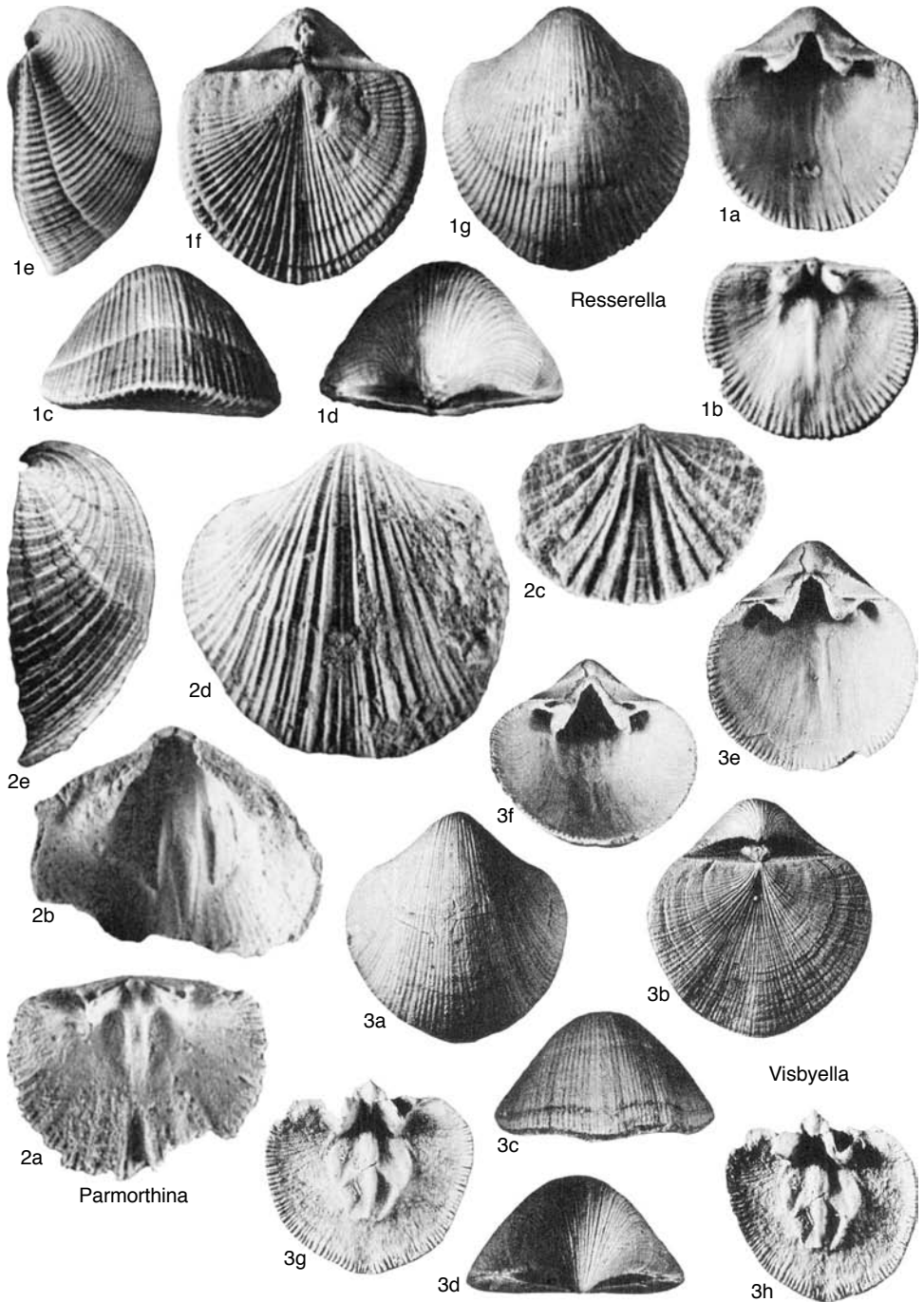


FIG. 575. Dalmanellidae (p. 793–798).

Bohemia; *d*, ventral exterior, $\times 7.1$; *e*, dorsal exterior, $\times 6.8$; *f*, ventral interior, $\times 6$; *g*, dorsal interior, $\times 7.6$ (Havlíček, 1977a).

Parmorthina HAVLÍČEK, 1975, p. 232 [**Parmorthis pragensis* HAVLÍČEK, 1956, p. 539; OD]. Subcircular, fascicostellate, unisulcate to weakly strangulate

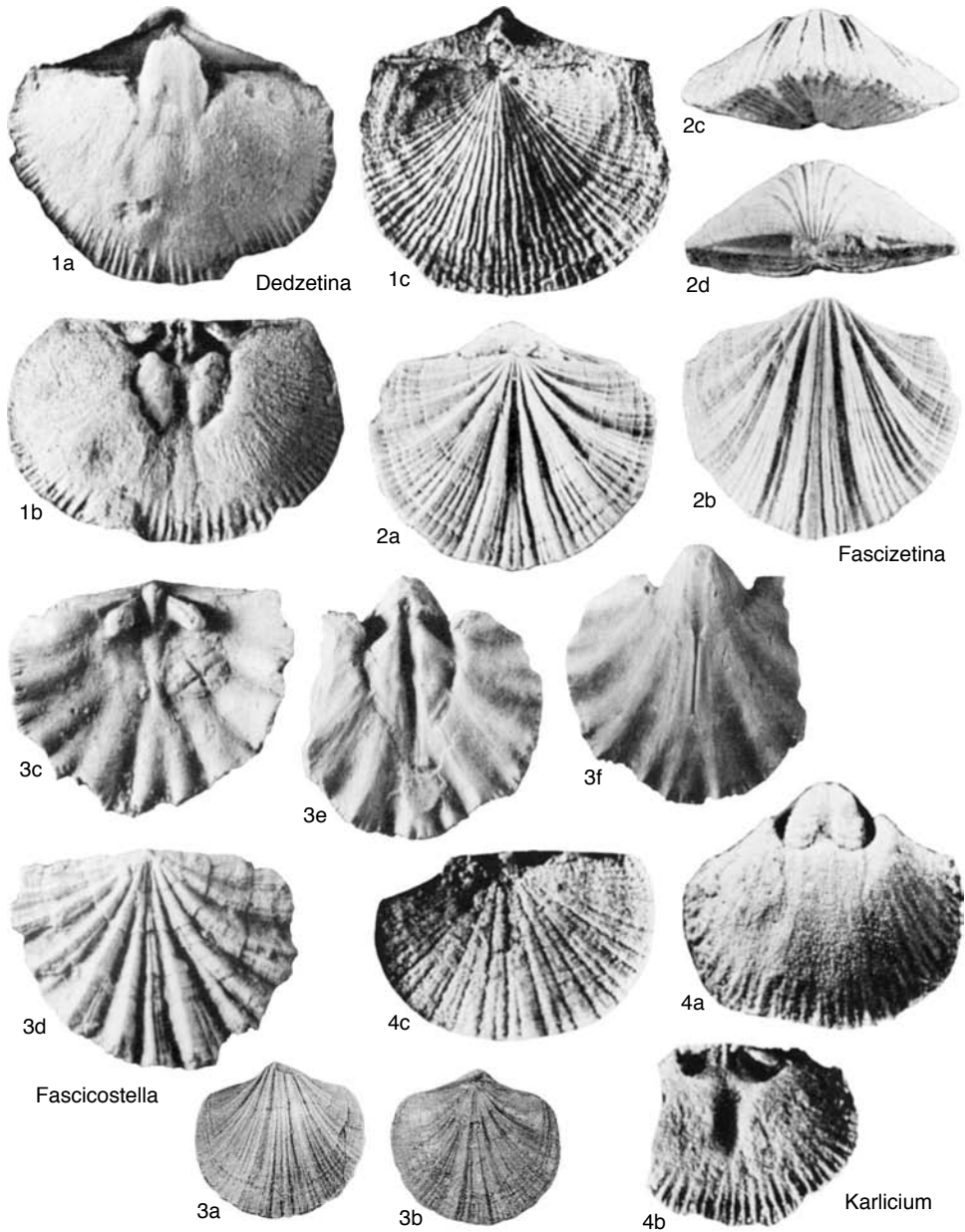


FIG. 576. Dalmanellidae (p. 793–795).

valves; ventral interior with recessive dental plates and cordate muscle scar; cardinalia lacking fulcral plates. *middle Silurian (Wenlock)–Lower Devonian (Emsian)*: Europe, North America.—FIG. 575, 2a–e. **P. pragensis* (HAVLIČEK), Emsian, Bohemia; a, dorsal interior, $\times 2$; b, ventral interior, $\times 2$; c, dorsal exterior, $\times 4.6$; d, e, ventral, lateral views of ventral exterior, $\times 1.8$ (Havlíček, 1977a).

Visbyella WALMSLEY & others, 1968, p. 306 [**Orthis visbyensis* LINDSTRÖM, 1861, p. 366; OD]. Subcircular, small valves with apical deltidium and hyperline dorsal interarea; ventral interior with recessive dental plates and cordate muscle scar; dorsal interior with trilobed, dorsally facing cardinal process and median septum. *lower Silurian (Llandovery)–middle Silurian (Wenlock)*: widespread.—

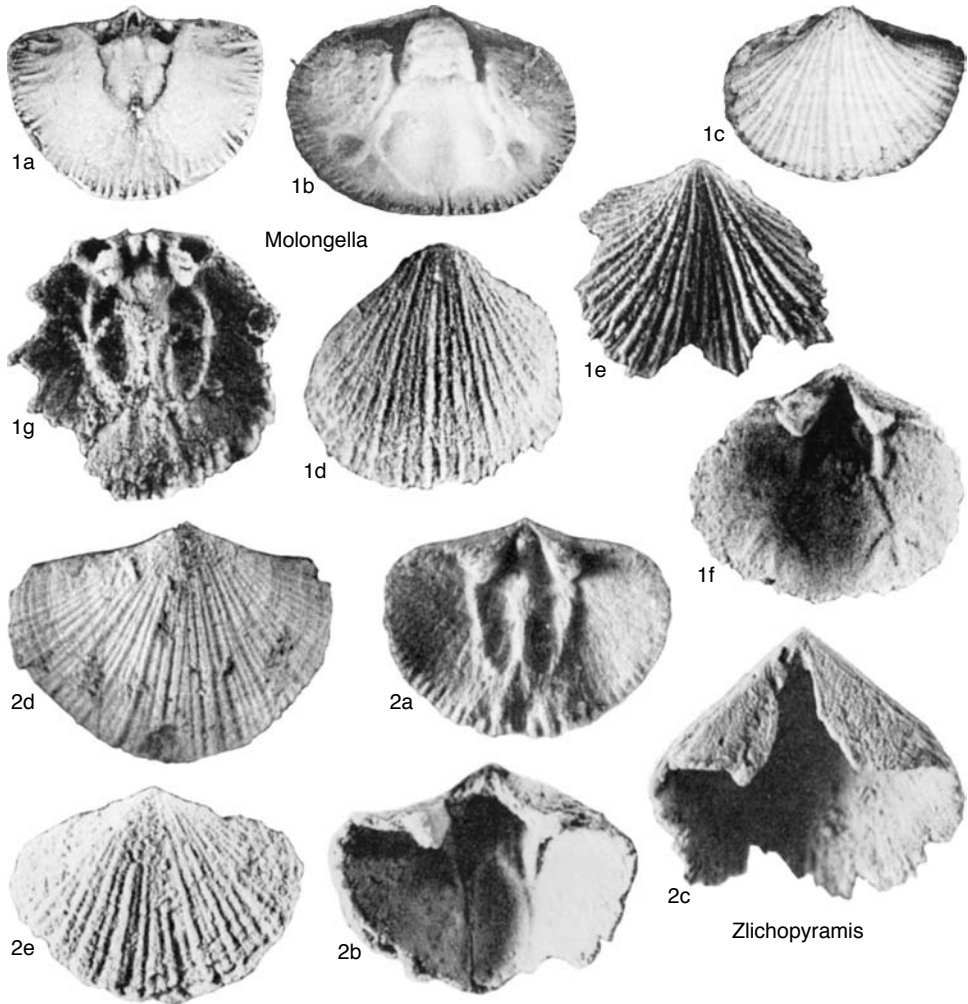


FIG. 577. Dalmanellidae (p. 795–798).

FIG. 575, 3a–b. **V. visbyensis* (LINDSTRÖM), Llandovery, Gotland; a–d, ventral, dorsal, anterior, posterior views of conjoined valves, $\times 3$; e, f, normal, tilted views of ventral interior, $\times 3$; g, h, normal, tilted views of dorsal interior, $\times 3$ (Walmsley & others, 1968).

Zlichopyramis HAVLÍČEK, 1975, p. 233 [**Z. tibicen*; OD]. Transversely semioval, ventribiconvex valves, unisulcate and imbricate; ventral interarea subpyramidal with apical deltidium; ventral interior with recessive dental plates and cordate muscle scar; dorsal interior with anterior adductor scars larger than posterior pair. *Lower Devonian (Emsian)*: Bohemia.—FIG. 577, 2a–e. **Z. tibicen*, Emsian, Bohemia; a, dorsal interior, $\times 4.1$; b, ventral interior, $\times 5.7$; c, posterior view of ventral valve showing interarea,

$\times 4.2$; d, ventral exterior, $\times 4$; e, dorsal exterior, $\times 4.1$ (Havlíček, 1977a).

Subfamily TEMPLEELLINAE new subfamily

[Templeellinae HARPER, herein]

Subcircular dalmanellids with long ventral interarea; ventral muscle field cordate; dorsal interior with short, anteriorly vaulted cruralium; strong median septum bisects and extends forward from cruralium; cardinal process bilobed or trilobed. *Upper Ordovician (Ashgill)*—*lower Silurian (Llandovery)*.

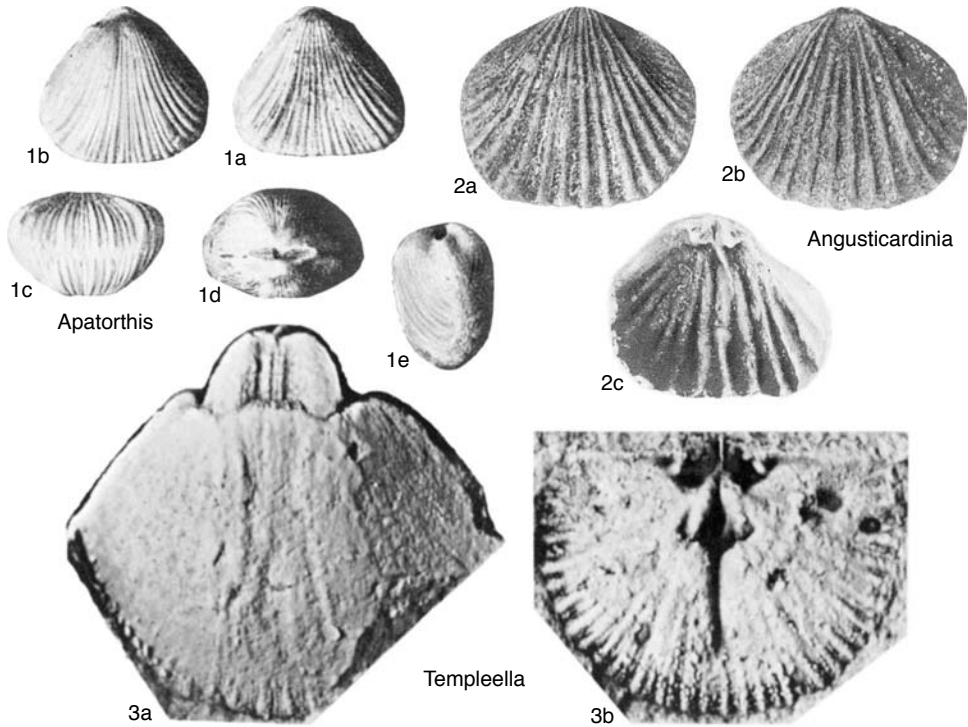


FIG. 578. Dalmanellidae and Angusticardiinae (p. 799).

Templeella ROZMAN & RONG, 1993, p. 36 [**T. gobiensis*; OD]. Subcircular, concavoconvex valves with hypercline dorsal interarea; dorsal interior with strongly divergent brachiophores. *Upper Ordovician (Ashgill)*—*lower Silurian (Llandovery)*: Britain, Mongolia.—FIG. 578,3a,b. **T. gobiensis*, Llandovery, southwestern Mongolia; *a*, internal mold of ventral valve, $\times 10$; *b*, internal mold of dorsal valve, $\times 12$ (Rozman & Rong, 1993).

Family ANGUSTICARDINIIDAE Schuchert & Cooper, 1931

[*nom. transl.* WRIGHT, 1965a, p. 343, ex Angusticardiiniinae SCHUCHERT & COOPER, 1931, p. 243] [=Apatorthidae ÖPIK, 1933b, p. 5]

Normally biconvex, uniplicate, coarsely costellate dalmanelloids with short hinge lines; both interareas short and curved, ventral apsacline, dorsal anacline; delthyrium and notothyrium open; ventral interior with small teeth and strong dental plates; dorsal interior with brachiophore plates convergent onto median septum; cardinal process ridgelike or absent. *Lower Ordovician (Arenig)*—*Upper Ordovician (Ashgill)*.

Angusticardinia SCHUCHERT & COOPER, 1931, p. 244 [**Porambonites recta* PANDER, 1830, p. 97; OD]. Subcircular, weakly uniplicate valves occasionally with small alae; dorsal interior with simple, ridge-like cardinal process, short brachiophores, and well-developed median septum bisecting small, quadripartite adductor scar. *Lower Ordovician (Arenig)*: Russia.—FIG. 578,2a–c. **A. recta* (PANDER), Arenig, Russia; *a, b*, ventral, dorsal views of conjoined pair, $\times 3$; *c*, dorsal interior, $\times 3$ (Schuchert & Cooper, 1932).

Apatorthis ÖPIK, 1933b, p. 5 [**A. punctata*; OD]. Subtriangular to rostrate, uniplicate valves with small, well-developed alae; shell surface granular; dorsal interior lacking cardinal process. *Ordovician (Llanvirn–Ashgill)*: eastern Baltic.—FIG. 578,1a–e. **A. punctata*, Caradoc, eastern Baltic; ventral, dorsal, anterior, posterior, lateral views of conjoined pair, $\times 1.3$ (Öpik, 1933b).

Family DICOELOSIIDAE Cloud, 1948

[*nom. correct.* ROGER, 1952, p. 82, *pro* Dicoelosiidae CLOUD, 1948a, p. 374] [=Bilobitidae SCHUCHERT & COOPER, 1931, p. 246]

Small strangulate valves with variably ventribiconvex to concavoconvex longitudinal profiles and costellate radial ornament;

brachiophores long, bladellike, often hooked proximally. *Upper Ordovician (Caradoc)–Upper Devonian (Frasnian)*.

Dicoelosia KING, 1850, p. 106 [*Anomia biloba* LINNÉ, 1767, p. 1154; OD] [= *Dicaelosia* KING, 1850, p. 106; = *Bilobites* QUENSTEDT, 1869, p. 550, obj., non RAFINESQUE, 1831, nec D'ORBIGNY, 1839, nec BRONN, 1848]. Bilobed, multicostellate valves with long, curved ventral interarea; ventral muscle scar cordate; cardinalia with lobate process and shaft; fulcral plates absent. *Upper Ordovician (Caradoc)–Lower Devonian (Emsian)*: cosmopolitan.—FIG. 579, 1a–h. **D. biloba* (LINNÉ), Wenlock, Gotland, Sweden; a–e, ventral, dorsal, posterior, anterior, lateral views of conjoined valves, ×5; f, g, interior, exterior of ventral valve, ×7.5; h, dorsal interior, ×6 (Wright, 1968a).

Epitomyonia WRIGHT, 1968b, p. 128 [*E. glypha*; OD]. Bilobed, multicostellate valves with long, curved ventral interarea; ventral muscle scar cordate; cardinalia with lobate myophore and shaft continuous with higher dorsal median septum extending almost to anterior margin, bisecting dorsal platform; fulcral plates absent. *Upper Ordovician (Ashgill)–upper Silurian (Ludlow)*: Baltic, Bohemia, Britain, Italy, North America, Spain, Scandinavia, central Asia.—FIG. 579, 2a–g. **E. glypha*; a–e, posterior, anterior, dorsal, lateral, ventral views of conjoined pair, ×6; f, g, normal, oblique views of dorsal interior, ×6 (Wright, 1968b).

Teichertina VEEVERS, 1959, p. 37 [*T. fitzroyensis*; OD]. Cordate, fascicostellate, imbricate valves with subpyramidal ventral interarea and narrowly divergent notothyrium; wide hinge line with acute cardinal extremities; ventral muscle scar oval; cardinalia with bilobed cardinal process and shaft continuous with dorsal median ridge; fulcral plates present. *Middle Devonian (Eifelian)–Upper Devonian (Frasnian)*: Bohemia, Moravia, USA (Nevada), Western Australia, China.—FIG. 579, 3a–b. **T. fitzroyensis*, Frasnian, Fitzroy basin, Western Australia; a–e, ventral, dorsal, lateral, anterior, posterior views of conjoined valves, ×5; f, g, anterior, posterior views of ventral interior, ×5; h, dorsal interior, ×5 (Johnson, 1972).

Family HARKNESSELLIDAE

Bancroft, 1928

[*nom transl.* ALICHOVA, 1960, p. 192, ex Harknessellinae BANCROFT, 1928b, p. 173; *emend.*, WRIGHT, 1965a, p. 339] [= *Wulongellidae* ZHU, 1985, p. 36]

Usually subquadrate, biconvex, and unisulcate with mucronate hinge line and angular costellae; ventral interarea apsacline, dorsal interarea anacline to orthocline; ventral interior with suboval to cordate muscle scars; dorsal interior with rudimentary notothyrial platform containing deep diductor pits and lobate myophore and shaft; brachiophores

variably disposed, fulcral plates normally present. *Lower Ordovician (Llanvirn)–lower Silurian (Llandovery)*.

Harknessella REED, 1917, p. 862 [*Orthis vespertilio*]. DE C. SOWERBY, 1839, p. 640; OD]. Biconvex, medium-sized, unisulcate valves with acute cardinal extremities and fascicostellate ornament; dorsal interior with parallel to divergent bladellike brachiophores and divergent plates; brachiophore plates variably attached to fulcral plates. *Upper Ordovician (Caradoc)*: Europe.—FIG. 580, 1a–e. **H. vespertilio* (SOWERBY), Caradoc, England; a, rubber replica of ventral exterior, ×1; b, c, internal mold of dorsal valve, rubber replica, ×1 (Wright, 1965a); d, internal mold of ventral valve, ×2; e, internal mold of dorsal valve, ×2 (Bancroft, 1945).

Hordeleyella BANCROFT, 1928b, p. 178 [*H. plicata*; OD]. Dorsibiconvex, small, sharply unisulcate valves with obtuse cardinal extremities and coarsely fascicostellate ornament; ventral interior with small suboval to rhomboidal muscle field; dorsal interior with parallel to divergent brachiophore blades; cardinal process small and lobate, crural pits and fulcral plates well developed. *Lower Ordovician (Llanvirn)–Upper Ordovician (Caradoc)*: Europe, China, Morocco, Sweden, eastern Baltic.—FIG. 580, 3a–e. **H. plicata*, Caradoc, England; a, rubber replica of ventral exterior, ×1; b, rubber replica of dorsal exterior, ×1; c, internal mold of ventral interior, ×1; d, e, internal mold, rubber replica of dorsal valve, ×1 (Wright, 1965a).

Kampella BAARLI, 1988, p. 1116 [*K. guttula*; OD]. Biconvex, small, multicostellate, weakly unisulcate to rectimarginate valves with obtuse cardinal extremities and short hinge line; ventral interior with projecting dental plates and short cordate to bilobed muscle scar; dorsal interior with widely divergent brachiophore blades, swollen semioval cardinal process, and fulcral plates. [BAARLI (1988) assigned her new genus to the Heterorthidae but compared it with both *Heterorthina* and *Onniella*. The cardinalia and ventral muscle scars are, however, more typical of the Harknessellidae than those of the heterorthids where it is now provisionally placed.] *lower Silurian (Llandovery)*: Norway.—FIG. 581, 1a–d. **K. guttula*, Llandovery, Oslo Region; a, internal mold of ventral valve, ×2.5; b, c, internal mold, rubber replica of dorsal valve, ×3; d, external mold of ventral valve, ×3 (Baarli, 1988).

Reuschella BANCROFT, 1928b, p. 180 [*R. semiglobata*; OD]. Dorsibiconvex, large, sharply unisulcate valves with acute cardinal extremities and coarsely costellate ornament; dorsal interior with widely divergent brachiophore blades. *Upper Ordovician (Caradoc–Ashgill)*: Europe, eastern Baltic, Argentina, eastern USA, central Asia.—FIG. 580, 2a–e. **R. semiglobata*, Caradoc, England; a, internal mold of ventral valve, ×1.5 (Cocks, new); b, c, internal mold, rubber replica of dorsal valve, ×1; d, detail of posterior region of replica of dorsal interior, ×2.5; e, rubber replica of dorsal exterior, ×1 (Wright, 1965a).—FIG. 580, 2f. *R. hordeleyensis* BANCROFT,

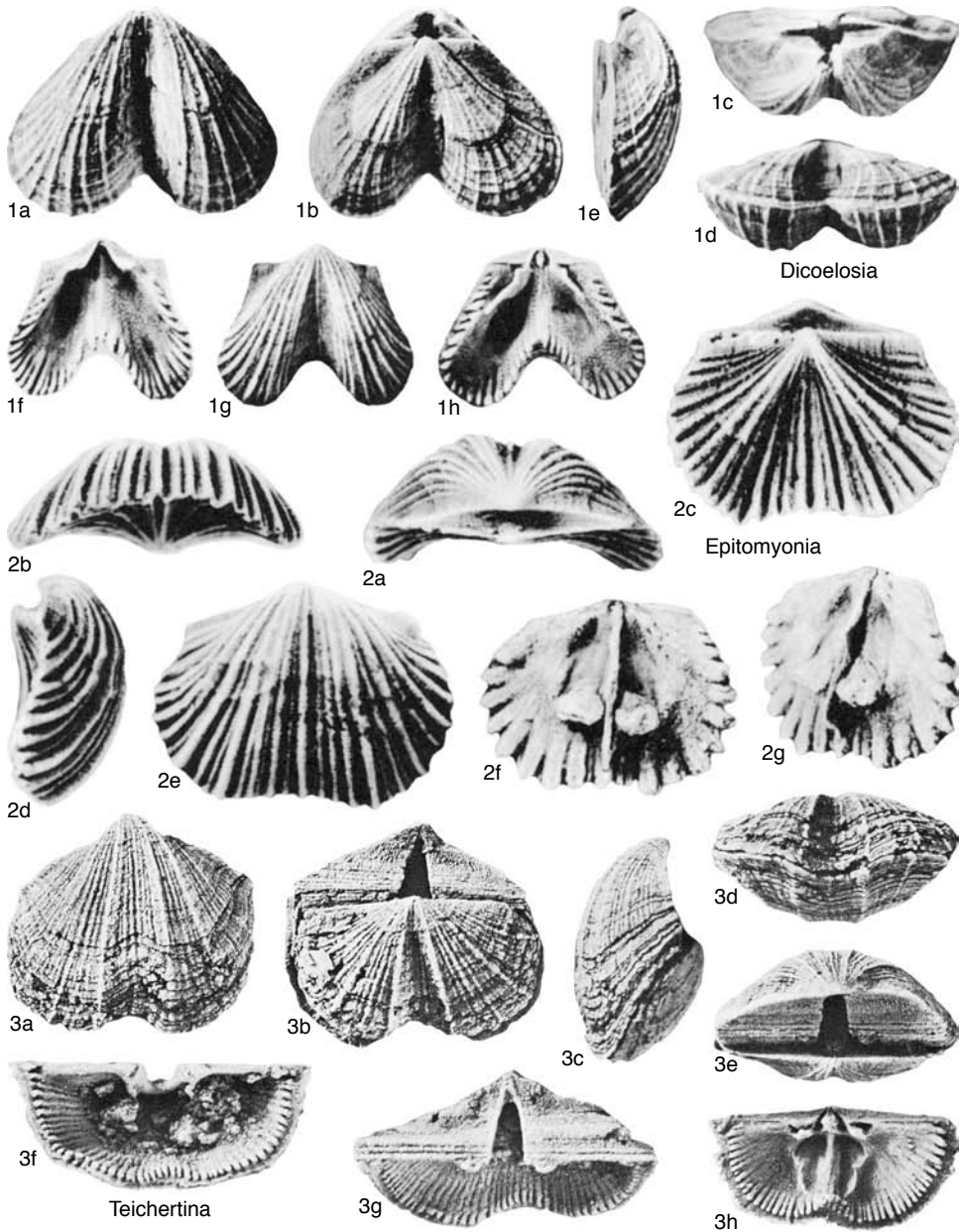


FIG. 579. Dicoelosiidae (p. 800).

Caradoc, England; internal mold of dorsal valve, $\times 1.5$ (Cocks, new).

Smeathenella BANCROFT, 1928b, p. 177 [*S. barnagensis*; OD]. Dorsibiconvex, medium sized, sharply unisulcate valves with flattened profiles and multicostellate ornament; dorsal interior with parallel to divergent brachioophore blades, lacking

fulcral plates. *Upper Ordovician (Caradoc)*: Welsh Borderlands.—FIG. 581, 2a, b. **S. barnagensis*, Caradoc, England; a, internal mold of ventral valve, $\times 1$; b, internal mold of dorsal valve, $\times 1$ (Wright, 1965a).—FIG. 581, 2c. *S. strophomenoides* BANCROFT, Caradoc, England; rubber replica of ventral exterior, $\times 2$ (Bancroft, 1945).

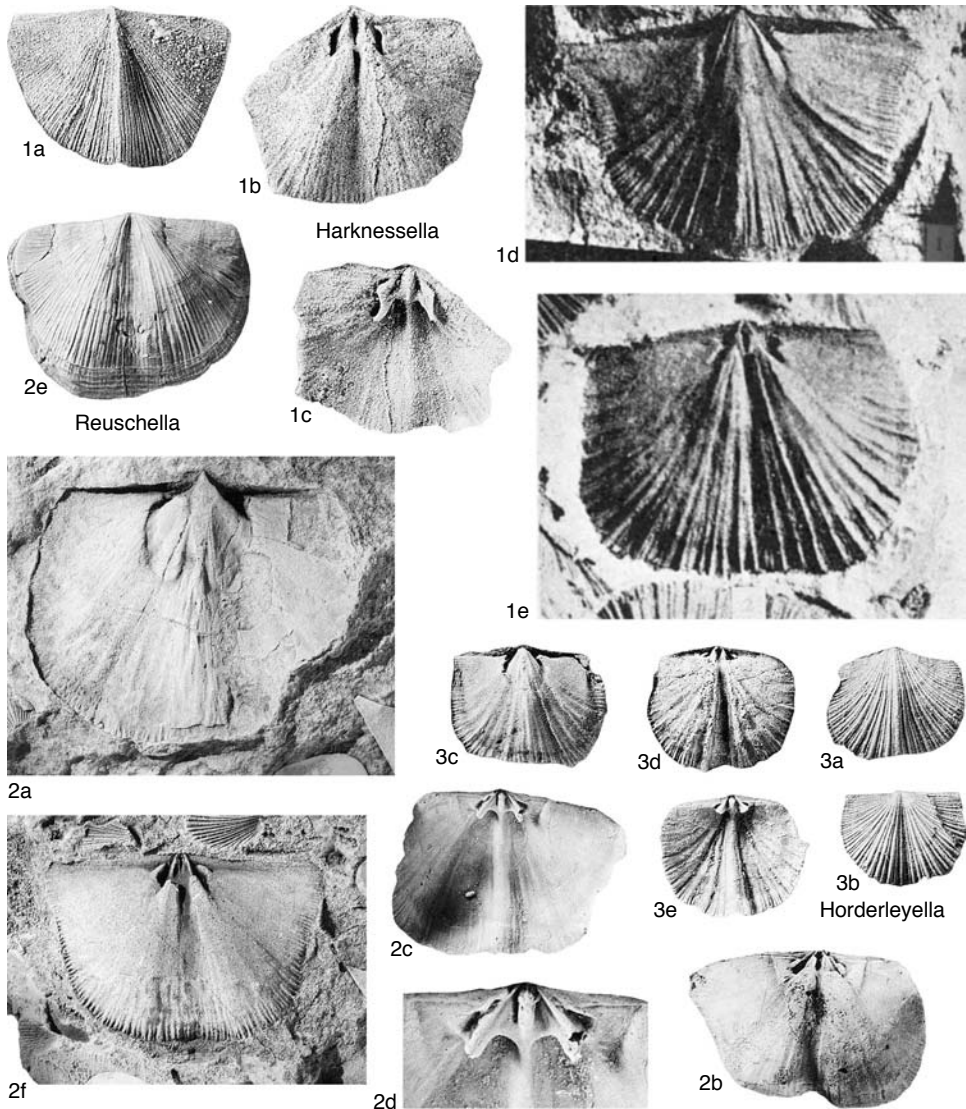


FIG. 580. Harknessellidae (p. 800–801).

Wulongella ZHU, 1985, p. 36 [**W. convexiplanus*; OD]. Convexoconcave, medium sized, rectimarginate valves with obtuse cardinal extremities and parvicostellate ornament; ventral interior with short divergent dental plates and subtriangular muscle field; dorsal interior with widely divergent brachio-phores and bases together with cleft cardinal process; muscle field bisected by median ridge; subperipheral rims developed in both ventral and dorsal interiors. [This genus, previously associated with both *Dolerorthis* and *Eostrophomena* (ZHU, 1985), is provisionally included within the Harknessellidae; under this arrangement the *Wulongellidae* ZHU, 1985 is a junior synonym of the Harknessellidae.] *Upper Ordovician (Caradoc-*

Ashgill): northeastern China.—FIG. 581, 3a–d. **W. convexiplanus*, upper Caradoc–lower Ashgill, Hinggang Ling, northeastern China; a, c, ventral and dorsal internal molds together with rubber replicas of b, d, dorsal and ventral valves, $\times 2.5$ (Rong, new).

Family HETERORTHIDAE Schuchert & Cooper, 1931

[Heterorthidae SCHUCHERT & COOPER, 1931, p. 246; *emend.*, HARPER, herein]

Normally transversely semioval to subquadrate, large, rectimarginate dalmanel-

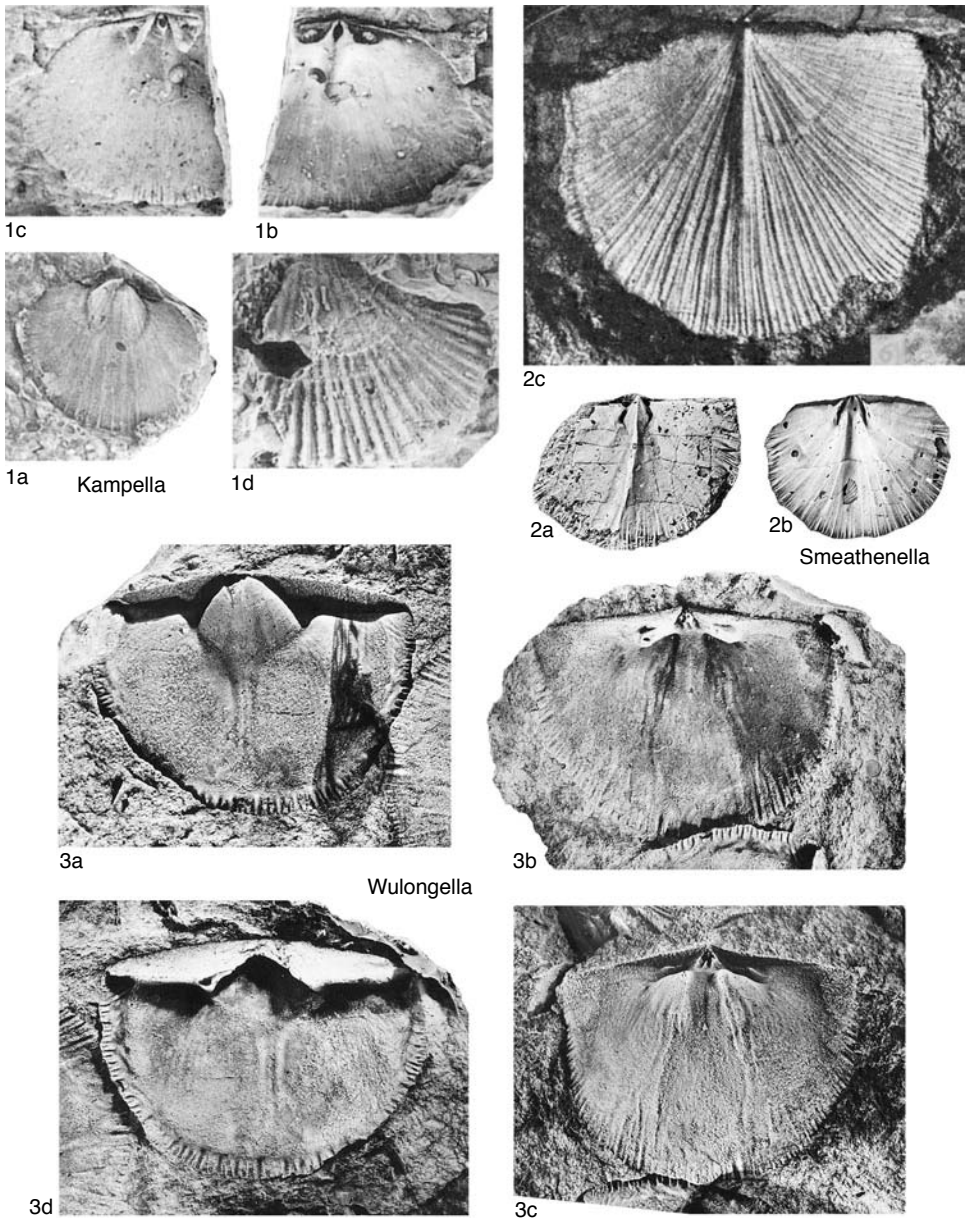


FIG. 581. Harknessellidae (p. 800–802).

loids with aditicules variably developed; ventral interior with extended, flabellate diductor muscle scar, anterior ends commonly widely splayed, not enclosing adductor scar; dorsal interior usually with lobate, commonly modified cardinal process, brachiophores as thickened rods, lacking plates; fulcral plates absent; dorsal mantle

canal system normally lemniscate, ventral system probably lemniscate. *Lower Ordovician (Arenig)—middle Silurian (Wenlock).*

Heterorthis HALL & CLARKE, 1892, p. 202 [**Orthis clytie* HALL, 1861b, p. 90; OD]. Subquadrate, large, rectimarginate, concavoconvex to planoconvex, multicostellate valves; notothyrium partly covered by well-developed chilidium; ventral interior with projecting dental plates and extended, flabellate

- muscle scars; dorsal interior with lobate cardinal process, tripartite on posteroventral surface; subperipheral rim developed in adults. *Upper Ordovician (Caradoc)*: Europe, North America.—FIG. 582,1a–d. **H. clytie* (HALL), Caradoc, Kentucky; *a, b*, ventral, dorsal views of conjoined valves, $\times 1.5$; *c*, ventral interior, $\times 1.5$; *d*, dorsal interior, $\times 1.5$ (Schuchert & Cooper, 1932).—FIG. 582,1e–g. *H. alternata* (J. DE C. SOWERBY), Caradoc, Shropshire; *e*, internal mold of ventral valve, $\times 1.5$; *f*, internal mold of dorsal valve, $\times 1.5$; *g*, rubber replica of dorsal exterior, $\times 1.5$ (Williams, 1963).
- Arenorthis** HAVLIČEK, 1970a, p. 29 [**A. arenaria*; OD]. Large, ventribiconvex valves, unisulcate, fascicostellate; ventral interior with projecting dental plates; dorsal interior with lobate cardinal process, posteroventral face tripartite. *Upper Ordovician (Ashgill)*: Morocco.—FIG. 582,2a–d. **A. arenaria*, Ashgill, Morocco; *a, b*, internal mold, rubber replica of dorsal valve, $\times 1.5$; *c*, internal mold of ventral valve, $\times 1.5$; *d*, rubber replicas of ventral and dorsal exteriors, $\times 1.5$ (Havliček, 1970a).
- Cacemia** MITCHELL, 1974, p. 394 [**Orthis ribeiroi* SHARPE in RIBEIRO, 1853, p. 152; OD]. Small, transversely semioval, mucronate valves with acute to extended cardinal extremities; ventral interior with divergent dental plates; dorsal interior with widely divergent brachiophores; lobate cardinal process, medially cleft. *Lower Ordovician (Llanvirn)*: Portugal, France.—FIG. 583,1a–c. **C. ribeiroi* (SHARPE), Llanvirn, Portugal; internal mold, rubber replica of ventral valve, rubber replica of ventral exterior, $\times 2$ (Mitchell, 1974).—FIG. 583,1d, e. *C. sp. aff. C. ribeiroi*, Llanvirn, Portugal; internal mold, rubber replica of dorsal valve, $\times 4$ (Mitchell, 1974).
- Cilinella** HAVLIČEK, 1970a, p. 16 [**Svobodaina svobodai* HAVLIČEK, 1950, p. 41; OD]. Dorsibiconvex, transversely semioval, rectimarginate, fascicostellate valves; ventral interior with divergent dental plates and bilobed muscle scar, semiflabellate; dorsal interior with high, bladeliike brachiophores. *Upper Ordovician (Caradoc)*: Bohemia.—FIG. 584,1a–c. **C. svobodai* (HAVLIČEK), Caradoc, Bohemia; *a*, internal mold of ventral valve, $\times 2$; *b, c*, internal mold, rubber replica of dorsal valve, $\times 2$ (Havliček, 1970a).
- Heterorthella** HARPER, BOUCOT, & WALMSLEY, 1969, p. 79 [**H. maebli*; OD]. Planoconvex to concavoconvex valves; dorsal interior with high, simple, bladeliike cardinal process. *lower Silurian (Llandovery)—middle Silurian (Wenlock)*: Canada (Nova Scotia), Bolivia, Brazil.—FIG. 583,2a–e. **H. maebli*, Wenlock, Nova Scotia; *a, b*, internal mold, rubber replica of dorsal valve, $\times 1.5$; *c*, internal mold of ventral valve, $\times 1.5$; *d*, rubber replica of ventral interior, $\times 1.5$; *e*, rubber replica of dorsal exterior, $\times 1.5$ (Harper, Boucot, & Walmsley, 1969).
- Heterorthina** BANCROFT, 1928a, p. 59, *nom. nov. pro Bekkerella* ROSENSTEIN, 1943, p. 471, *non* REED, 1935 (type, *Bekkerella bekkeri* ROSENSTEIN, 1943) [**H. praeculta*; OD]. Transverse, planoconvex, unisulcate, fascicostellate valves; ventral interior with cordate to bilobed muscle scar; dorsal interior with lobate, medially cleft, cardinal process and widely divergent brachiophores. *lower Silurian (Llandovery)—middle Silurian (Wenlock)*: Europe.—FIG. 584,3a, b. **H. praeculta*, Caradoc, Shropshire; *a*, internal mold of ventral valve, $\times 1.5$; *b*, rubber replica of dorsal interior, $\times 1.5$ (Wright, 1965a).
- Incorthis** HAVLIČEK & BRANISA, 1980, p. 18 [**I. boliviana*; OD]. Subcircular, subequally biconvex, unisulcate valves; ventral interior with subtriangular to bilobed muscle scar; dorsal interior with simple ridgelike cardinal process on low notothyrial platform and divergent bladeliike brachiophores; fulcral plates incipient. [HAVLIČEK and BRANISA (1980) tentatively assigned *Incorthis* to the Orthidae. Although no details of the shell structure are known, *Incorthis* bears similarities to the early heterorthid *Tissintia* and accordingly is provisionally included within that family.] *Lower Ordovician (Arenig)*: Bolivia.—FIG. 583,3a–d. **I. boliviana*, Arenig, Bolivia; *a*, internal molds of dorsal (above) and ventral (below) valves, $\times 2$; *b*, rubber replicas of two valve exteriors, $\times 1.4$; *c*, internal mold of dorsal interior, $\times 3.4$; *d*, rubber replicas of dorsal interior (above) and valve exterior (below), $\times 2.6$ (Havliček & Branisa, 1980).
- Marionites** COOPER & MUIR-WOOD, 1951, p. 195, *nom. nov. pro Marionella* BANCROFT, 1928b, p. 181, *non* COBB, 1922 [**Marionella typa* BANCROFT, 1928b, p. 181; OD]. Transversely semioval, convexiplane to convexoconcave, resupinate, unisulcate valves; ventral interior with divergent dental plates and quadrate to linear muscle scar; dorsal interior with simple, slightly swollen cardinal process. *Upper Ordovician (Caradoc)*: Britain, Bohemia.—FIG. 585,1a–d. **M. typa* (BANCROFT), Caradoc, Shropshire; *a*, rubber replica of ventral interior, $\times 1$; *b, c*, internal mold, rubber replica of dorsal interior, $\times 1$; *d*, rubber replica of ventral exterior, $\times 1$ (Williams, 1965b).
- Svobodaina** HAVLIČEK, 1950, p. 38 [**Orthis ellipsoides* BARRANDE, 1848, p. 204; SD HAVLIČEK, 1977a, p. 122; =*Orthis inehyta* BARRANDE, 1879, pl. 67, case I] [=*Svobodiana* ALICHOVA, 1960, p. 192; *Planobarknessella* HAVLIČEK, 1950, p. 42 (type, *P. planidorsal*)]. Transversely semioval, large, dorsibiconvex, unisulcate, fascicostellate valves; ventral interior with divergent dental plates; dorsal interior with complex multifid cardinal process in adults. *Upper Ordovician (Caradoc)*: Europe.—FIG. 584,2a–d. **S. ellipsoides*, Caradoc, Bohemia; *a*, internal mold of ventral valve, $\times 1.5$; *b, c*, internal mold, rubber replica of dorsal valve, $\times 1.5$; *d*, external mold of dorsal valve, $\times 1.5$ (Havliček, 1977a).
- Tafaltia** HAVLIČEK, 1970a, p. 17 [**T. occidentalis*; OD]. Similar to *Heterorthis* but with subcircular, ventribiconvex valves lacking childium. *Lower Ordovician (Llanvirn)—Upper Ordovician (Caradoc)*: Bohemia, France, Morocco.—FIG. 584,4a–d. **T. occidentalis*, Caradoc, Morocco; *a, b*, internal mold, rubber replica of dorsal valve, $\times 2.3$; *c*, external mold of dorsal valve, $\times 2.4$; *d*, internal molds of ventral (upper) and dorsal valve (lower), $\times 2.4$ (Havliček, 1970a).
- Tarfaya** HAVLIČEK, 1971a, p. 32 [**T. marocana*; OD]. Subcircular, ventribiconvex valves; ventral interior

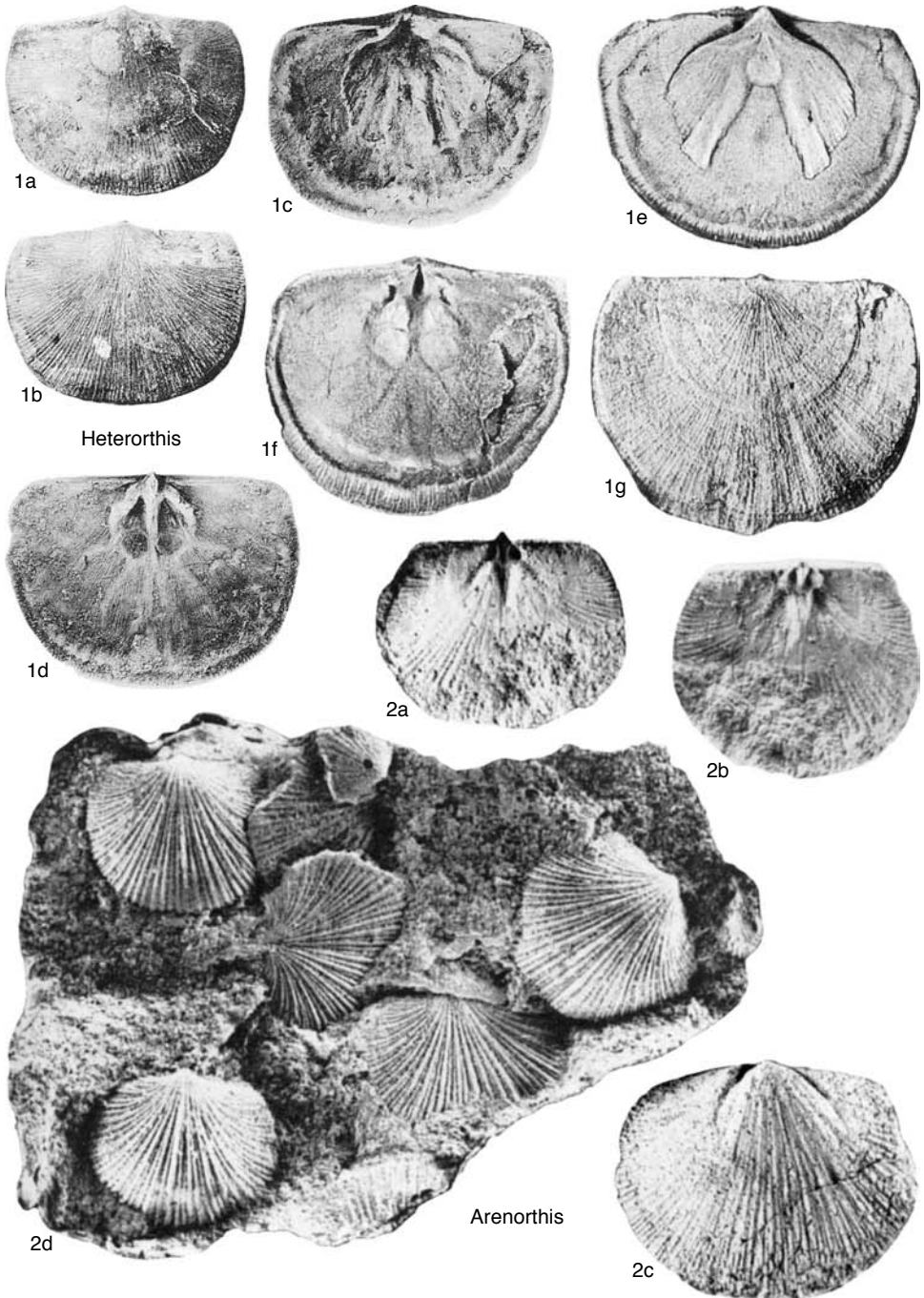


FIG. 582. Heterorthidae (p. 803–804).

with short subtriangular to suboval muscle scar; dorsal interior with simple, ridgelike cardinal process, continuous with short median septum; mantle

canal systems saccate. Lower Ordovician (*Arenig*): Morocco.—FIG. 585, 2a–d. **T. marocana*, Arenig, Morocco; a, internal mold of ventral valve, $\times 2.5$; b,

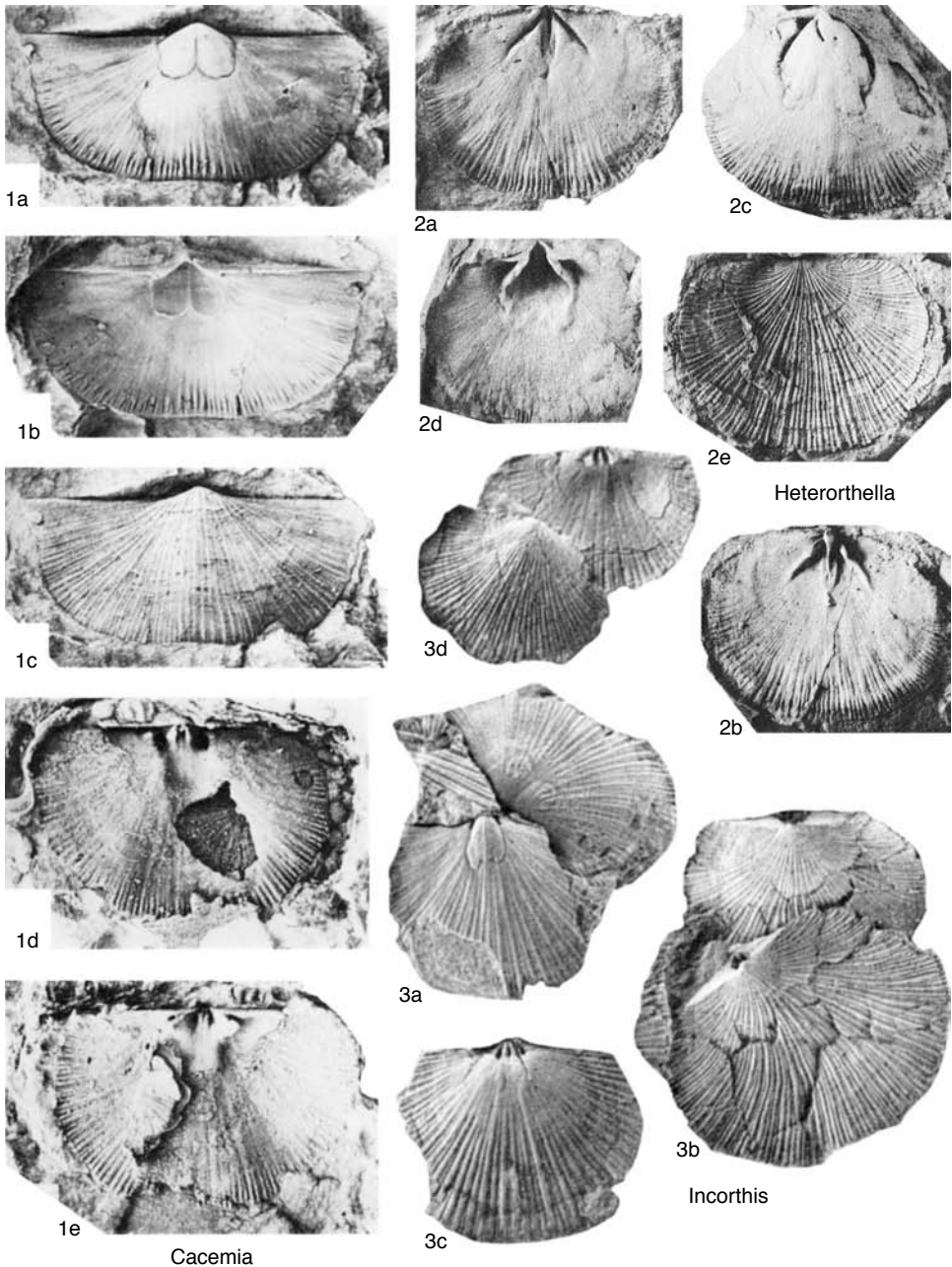


FIG. 583. Heterorthidae (p. 804).

internal mold of dorsal valve, $\times 1.5$; *c*, rubber replica of ventral exterior, $\times 2$; *d*, rubber replica of dorsal exterior, $\times 1.9$ (Havliček, 1971a). *Tissintia* HAVLIČEK, 1970a, p. 14 [**T. convergens*; OD]. Subcircular, commonly small, ventribiconvex, fascicostellate valves; dorsal interior with bilobed,

medially cleft, cardinal process and brachiophores convergent onto valve floor and extended forward as ridges; dorsal muscle scar bisected by median ridge. *Lower Ordovician (Llanvirn)—Upper Ordovician (Caradoc)*: Morocco, Bolivia, Wales.—FIG. 584, 5a–c. **T. convergens*, Llanvirn, Morocco; *a*, in-

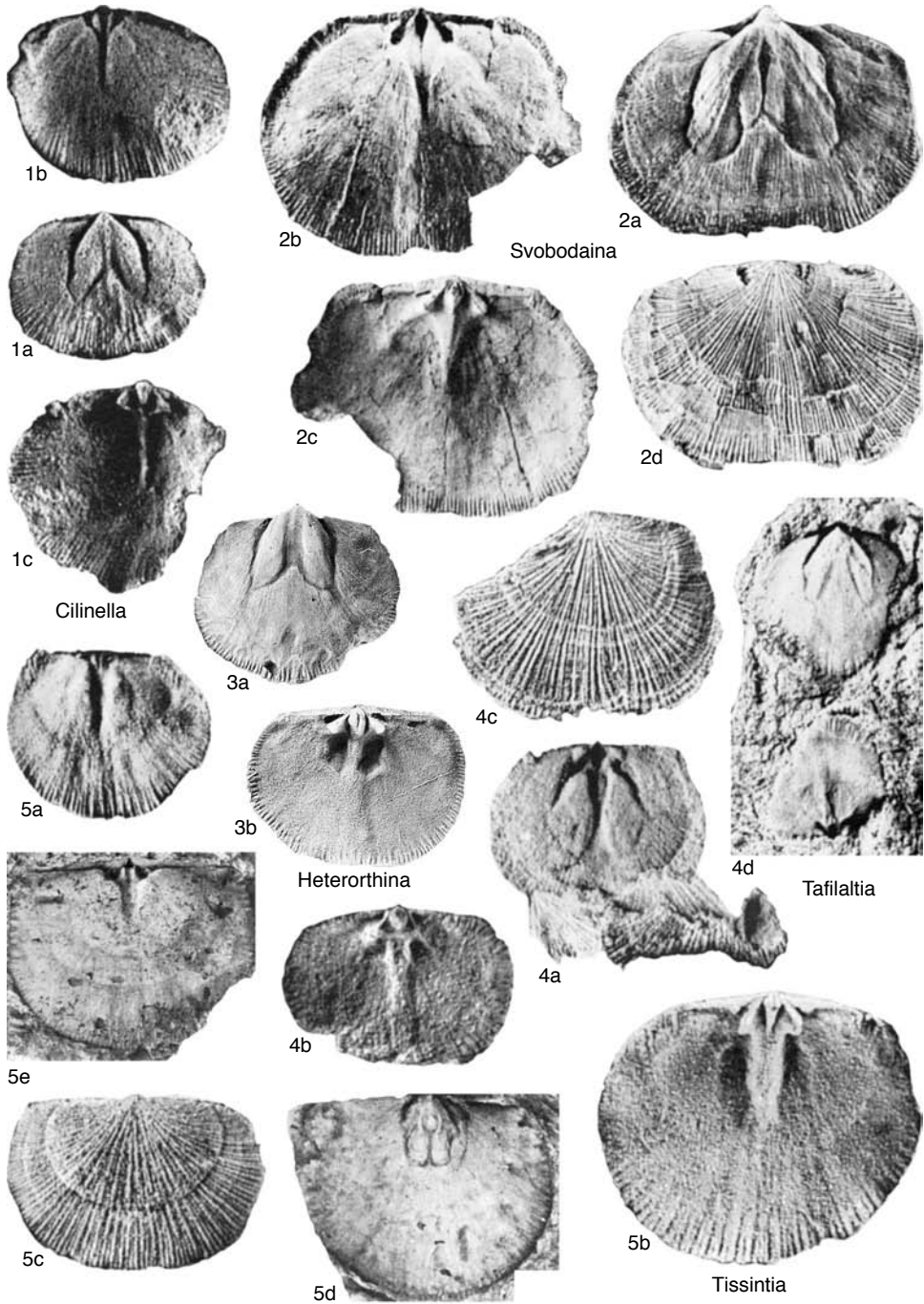


FIG. 584. Heterorthidae (p. 804–807).

ternal mold of dorsal valve, $\times 2$; *b*, rubber replica of dorsal interior, $\times 3.3$; *c*, rubber replica of dorsal exterior, $\times 4.1$ (Havlíček, 1970a).—FIG. 584, *5d, e*.

T. plana (WILLIAMS), Llanvirn, Wales; *d*, internal mold of ventral valve, $\times 1.5$; *e*, internal mold of dorsal valve, $\times 1.5$ (Lockley & Williams, 1981).

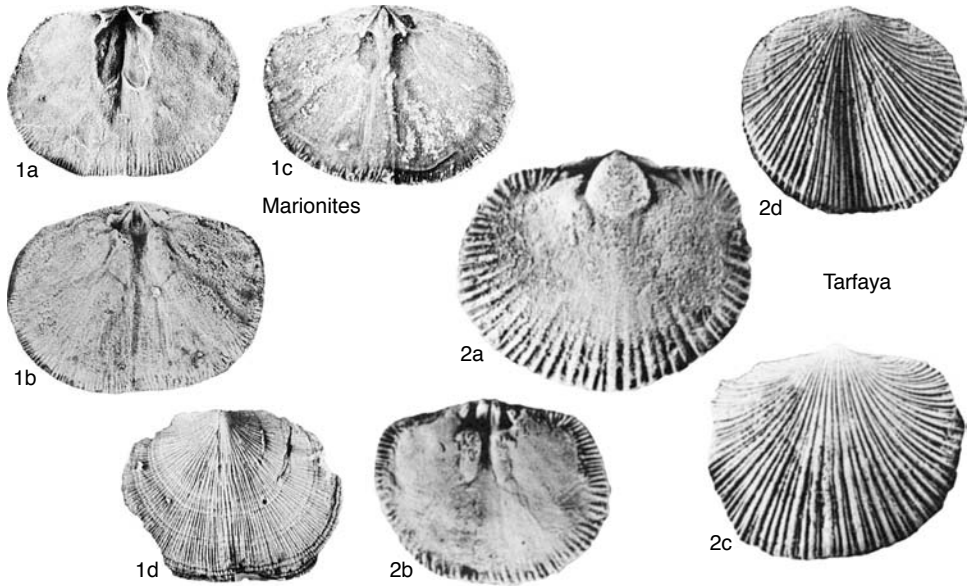


FIG. 585. Heterorthisidae (p. 804–806).

Family HYPSONYONIIDAE Wright, 1965

[Hypsomyoniidae WRIGHT, 1965a, p. 339]

Ventribiconvex dalmanelloids with open delthyrium and notothyrium; ventral interior with receding dental plates; dorsal interior with bilobed cardinal process and shaft, widely divergent rodlike brachiophores with plates subparallel to hinge and lacking fulcral plates; cruralium develops from valve floor, in front of brachiophores, supported on high septum. *Middle Devonian (Eifelian)*–*Upper Devonian (Frasnian)*.

Hypsomyonia COOPER, 1955, p. 52 [*H. stainbrooki*; OD]. Transversely semioval, small, unisulcate valves with long curved ventral interarea. *Middle Devonian (Eifelian)*–*Upper Devonian (Frasnian)*: North America, Europe, Western Australia.—FIG. 586, 1a–g. **H. stainbrooki*, Frasnian, Iowa; a–e, ventral, dorsal, posterior, anterior, lateral views of conjoined valves, $\times 5$; f, g, normal, tilted views of dorsal interior, $\times 7.5$ (Cooper, 1955).

Family KAYSERELLIDAE Wright, 1965

[Kayserebellidae WRIGHT, 1965a, p. 336]

Ventribiconvex dalmanelloids with long, curved ventral interarea and open delthyrium; ventral interior with short, widely cor-

date muscle field; dorsal interior with bilobed cardinal process and long, slender shaft continuous with median septum extending forward to near anterior margin; brachiophore plates convergent onto septum to form short, narrow septalium. *Middle Devonian (Eifelian)*.

Kaysarella HALL & CLARKE, 1892, p. 259 [*Orthis lepida* SCHNUR, 1854, p. 218; OD]. Subcircular, fascicostellate valves; ventral interior with recessive dental plates and well-developed pedicle callist; dorsal interior with fulcral plates. *Middle Devonian (Eifelian)*: Germany, Moravia, USA (New York).—FIG. 586, 2a–e. **K. lepida* (SCHNUR), Eifelian, Germany; ventral, dorsal, posterior, anterior, lateral views of conjoined valves, $\times 2$ (Cooper, 1955).—FIG. 586, 2f–i. *K. americana* COOPER, Eifelian, New York; f, internal mold of ventral valve, $\times 3$; g, rubber replica of dorsal exterior, $\times 3$; h, i, internal mold, rubber replica of dorsal valve, $\times 3$ (Cooper, 1955).

Family MYSTROPHORIDAE Schuchert & Cooper, 1931

[Mystrophoridae SCHUCHERT & COOPER, 1931, p. 246]

Medium-sized dalmanelloids normally with long, straight apsacline ventral interarea; delthyrium and notothyrium usually open; ventral interior with bilobed ventral muscle scar and well-developed pedicle callist; dorsal interior normally with bilobed

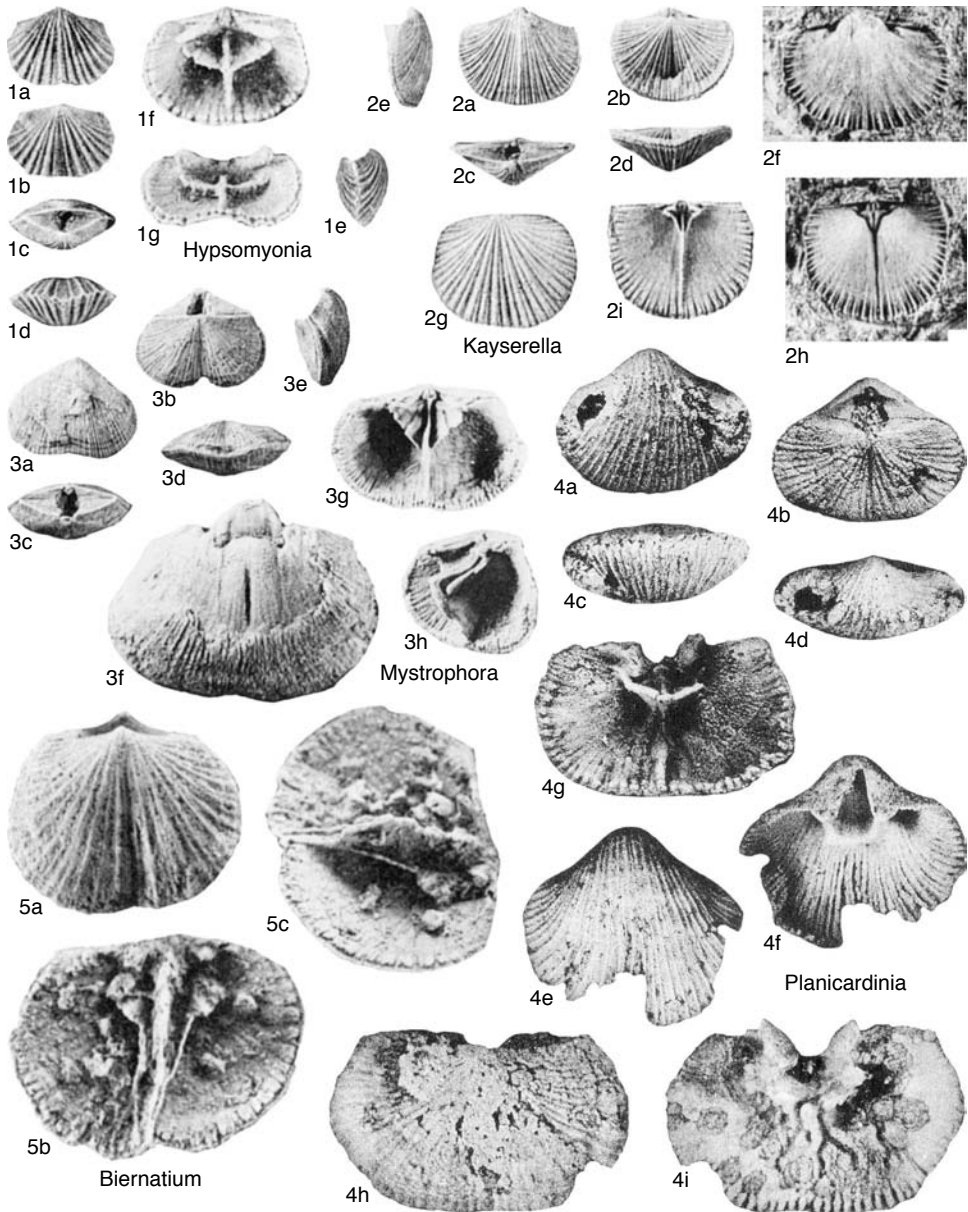


FIG. 586. Hypsomyoniidae, Kayserellidae, and Mystrophoridae (p. 808–810).

cardinal process and shaft continuous with median partition supporting variably inclined cruralium, probably containing quadripartite dorsal muscle scar. *Lower Devonian (Pragian)–Upper Devonian (Frasnian)*.

Mystrophora KAYSER, 1871, p. 612 [*Orthis areola* QUENSTEDT, 1871, p. 589; SD WILLIAMS & BREGER, 1916, p. 61]. Transversely semioval, unisulcate valves with ventral median ridge; dorsal interior with complex cruralium comprising 4 fused plates; fulcral plates present. *Middle Devonian (Eifelian)*: Germany, Burma.—FIG. 586, 3a–b. **M. areola*

(QUENSTEDT), Eifelian, Germany; *a-e*, ventral, dorsal, posterior, anterior, lateral views of conjoined valves, $\times 1$; *f*, partly exfoliated internal mold of ventral valve, $\times 2$; *g, h*, normal, tilted views of dorsal interior, $\times 2$ (Cooper, 1955).

Biernatium HAVLÍČEK, 1975, p. 234 [**Skenidium fallax* GÜRICH, 1896, p. 235; OD]. Transversely semioval, coarsely costellate valves with narrowly divergent delthyrium variably open or closed by apical plate; ventral interarea subpyramidal, apsacline to catacline; ventral interior with recessive dental plates; dorsal interior with ridgelike cardinal process and long rodlike brachiophores; cruralium long, narrowing anteriorly; fulcral plates absent. *Lower Devonian (Pragian)*–*Upper Devonian (Frasnian)*: Europe, Burma, Western Australia.—FIG. 586, 5*a-c*. **B. fallax* (GÜRICH), Givetian, Moravia; *a*, dorsal view of conjoined valves, $\times 4.4$; *b, c*, normal, tilted views of dorsal interior, $\times 4.2$ (Havlíček, 1977a).

Planocardinia SAVAGE, 1968, p. 628 [**P. carroli*; OD]. Transversely semioval valves with long, curved, anacline ventral interarea; dorsal interarea hypercline; dorsal interior with cruralium perpendicular to valve floor. *Lower Devonian (Pragian)*: southeastern Australia.—FIG. 586, 4*a-i*. **P. carroli*, Pragian, New South Wales; *a-d*, ventral, dorsal, anterior, posterior views of conjoined valves, $\times 6.5$; *e, f*, ventral exterior, interior, $\times 6.5$; *g*, dorsal interior, $\times 6.5$; *h, i*, dorsal exterior, interior, $\times 6.5$ (Savage, 1968).

Family PAURORTHIDAE Öpik, 1933

[Paurorthidae ÖPIK, 1933b, p. 11]

Normally small, ventribiconvex dalmanelloids with curved, apsacline ventral interarea and shorter anacline dorsal interarea; delthyrium usually open, rarely constricted by lateral plates; notothyrium open; ventral interior with subtriangular muscle scar normally on callus extended forward as low, broad median ridge; dorsal interior with simple, variably divergent brachiophores; cardinal process ridgelike or absent on low notothyrial platform; fulcral plates usually absent; ventral mantle canal system saccate, dorsal system lemniscate to digitate. *Lower Ordovician (Arenig)*–*Upper Ordovician (Caradoc)*.

Paurorthis SCHUCHERT & COOPER, 1931, p. 243 [**Orthambonites parva* PANDER, 1830, p. 83; OD] [= *Paurorthisina* RUBEL, 1961a, p. 187 (type, *P. resima*)]. Subcircular, weakly unisulcate with fascicostellate radial ornament; quadripartite dorsal muscle scars with bilobed anterior scars larger than posterior pair. *Lower Ordovician (Arenig)*–*Upper Ordovician (Caradoc)*: cosmopolitan.—FIG.

587, 1*a-d*. **P. parva* (PANDER), upper Arenig–lower Llanvirn, Russia; *a, b*, ventral, dorsal views of conjoined valves, $\times 3$; *c*, ventral interior, $\times 3$; *d*, dorsal interior, $\times 3$ (Schuchert & Cooper, 1932).—FIG. 587, 1*e*. *P. sp. cf. P. inflata* RUBEL, upper Arenig–lower Llanvirn, eastern Baltic; ventral interior, $\times 5.8$ (Hints, 1975).—FIG. 587, 1*f*. *P. savalensis* HINTS, Caradoc, Estonia; dorsal interior, $\times 9$ (Hints, 1975).

Cyclomyonia COOPER, 1956, p. 974 [**C. peculiaris*; OD]. Differs from *Paurorthis* in having fine multicostellate ornament, and petaloid dorsal muscle scars. *Upper Ordovician (Caradoc)*: eastern USA.—FIG. 587, 2*a-e*. **C. peculiaris*, Caradoc, Alabama; *a*, ventral exterior, $\times 2$; *b*, ventral interior, $\times 3$; *c, d*, exterior, interior views of dorsal valve, $\times 4$; *e*, broken dorsal interior showing cardinalia, $\times 4$ (Cooper, 1956).

Nereidella WANG, 1955b, p. 338 [**N. typa*; OD]. Differs from *Paurorthis* in having transversely semioval outline and brachiophores, extended, widely divergent, and parallel to hinge line. *Lower Ordovician (Arenig–Llanvirn)*: southern China, Bohemia.—FIG. 587, 3*a-f*. **N. typa*, Arenig, southern China; *a-d*, ventral, dorsal, posterior, and lateral views of conjoined valves, $\times 3$; *e*, ventral interior, $\times 2.5$; *f*, dorsal interior, $\times 3.5$ (Wang, 1955a).

Family PLATYORTHIDAE Harper, Boucot, & Walmsley, 1969

[*nom. transl.* HARPER, herein, ex Platyorthinae HARPER, BOUCOT, & WALMSLEY, 1969, p. 81]

Medium-sized, usually rectimarginate, planoconvex to biconvex and multicostellate, variably aditculate dalmanelloids commonly with short hinge line; ventral interior with large diductor scars usually enclosing adductors; dorsal interior normally with complex, trilobed cardinal process; fulcral plates usually absent. *Lower Ordovician (Llanvirn)*–*Middle Devonian (Eifelian)*.

Platyorthis SCHUCHERT & COOPER, 1931, p. 246 [**Orthis planoconvexa* HALL, 1859a, p. 168; OD]. Subcircular, biconvex valves with aditcules; ventral interarea long, curved, and orthocone, dorsal interarea vestigial; ventral interior with quadrate muscle scar and median ridge; dorsal interior with brachiophores as spikelike rods with divergent plates; muscle scar with anterior scars larger than posterior pair. *upper Silurian (Pridoli)*–*Middle Devonian (Eifelian)*: cosmopolitan.—FIG. 588, 1*a-e*. **P. planoconvexa* (HALL), Emsian, eastern North America; *a-c*, dorsal, ventral, lateral views of conjoined valves, $\times 1$; *d*, ventral interior, $\times 1.5$; *e*, dorsal interior, $\times 1.5$ (Schuchert & Cooper, 1932).

Crozonorthis MÉLOU, 1976, p. 700 [**C. musculosa*; OD]. Subquadrate, dorsibiconvex valves with wide hinge line and obtuse cardinal extremities; ventral interior with quadrate muscle scar with scalloped

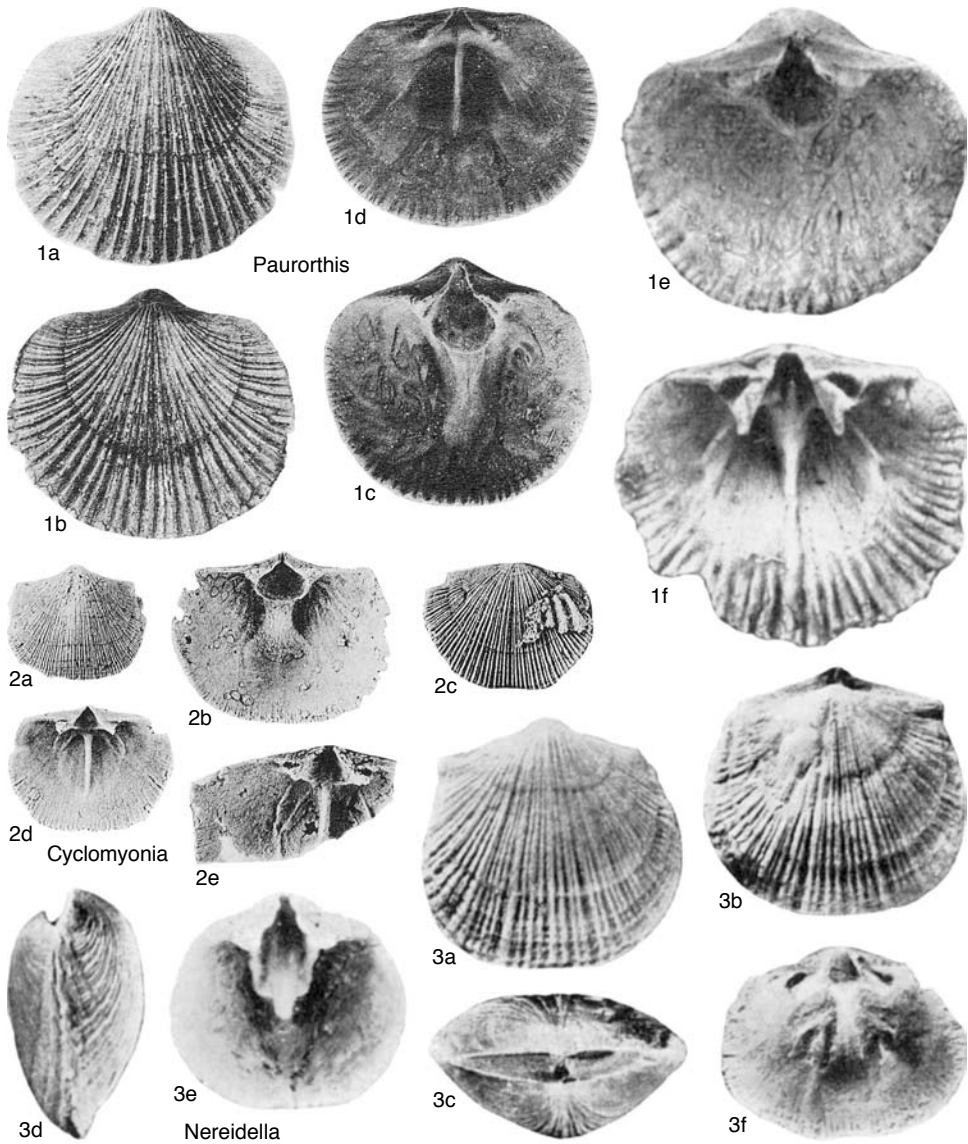


FIG. 587. Paurorthidae (p. 810).

margins on thickened callus bisected by median ridge; dorsal interior with brachiophores as parallel to divergent rods; posterior scars larger than anterior pair. *Lower Ordovician (Llanvirn)*: France, Iberia. —FIG. 588,2a–e. **C. musculosa*, Llanvirn; a, b, internal mold, rubber replica of ventral valve, Brittany, $\times 4$; c, rubber replica of ventral exterior, Brittany, $\times 4$; d, e, internal mold, rubber replica of dorsal valve, La Alameda, $\times 4$ (Mélou, 1976).

Diceromyonia WANG, 1949, p. 35 [**Orthis tersa* SARDESON, 1892, p. 331; OD]. Subcircular, unisul-

cate valves with short, straight, anacline ventral interarea and vestigial dorsal interarea; dorsal interior with brachiophores as widely divergent rods, lacking plates; anterior muscle scars larger than posterior pair. *Upper Ordovician (Ashgill)*: North America. —FIG. 588,3a–c. **D. tersa* (SARDESON), Ashgill, Iowa; dorsal, ventral, lateral views of conjoined valves, $\times 1.5$ (Harper, Boucot, & Walmsley, 1969). —FIG. 588,3d. *D. sp. cf. D. ignota* (SARDESON), Ashgill, Wyoming; ventral interior, $\times 1.5$ (Harper, Boucot, & Walmsley, 1969). —FIG.

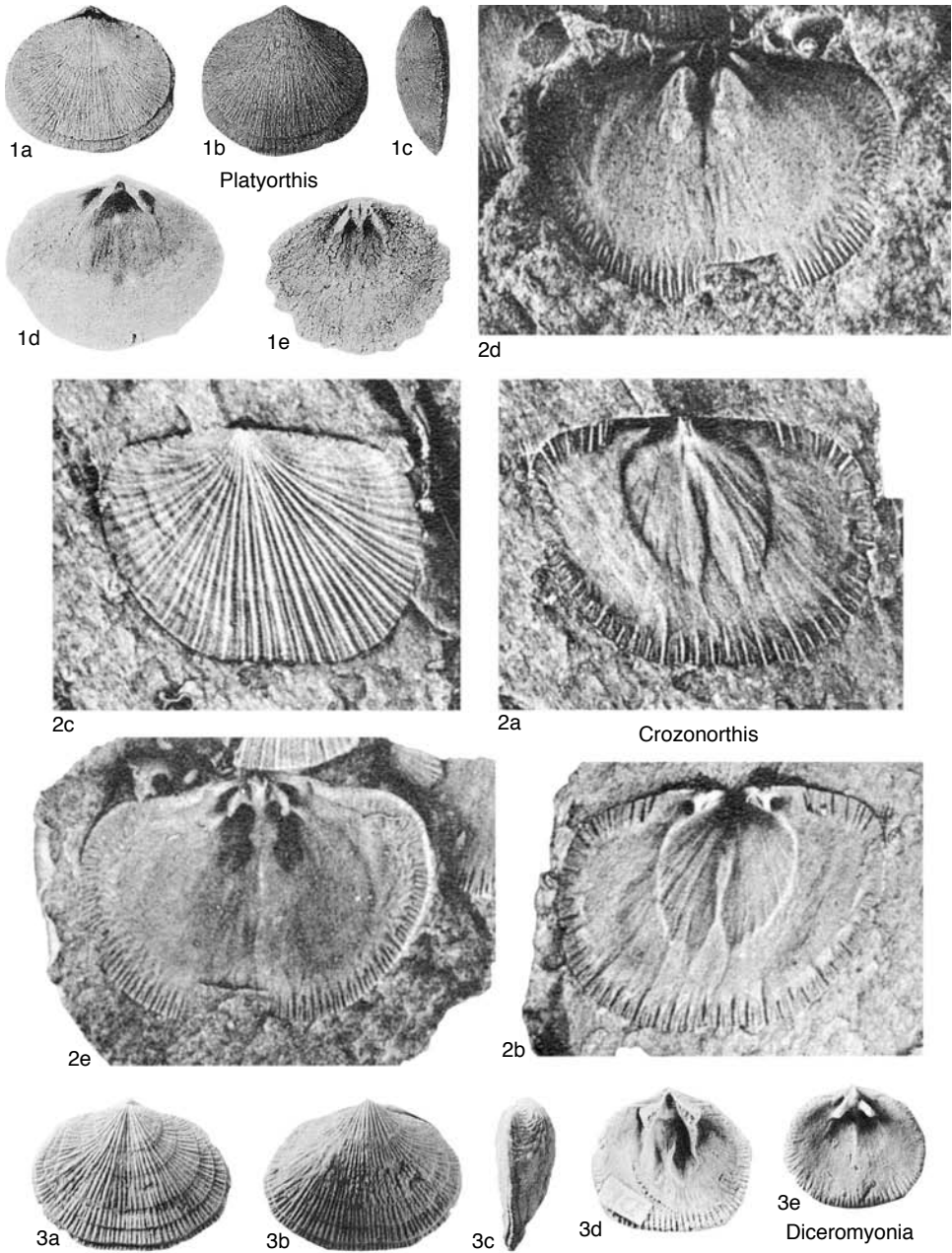


FIG. 588. Platyorthidae (p. 810–812).

588.3e. *D.* sp. cf. *D. tersa*, Ashgill, Illinois; dorsal interior, $\times 1.5$ (Harper, Boucot, & Walmsley, 1969).
Elsaella ALICHOVA, 1960, p. 192 [**Bekkerella beckeri* ROSENSTEIN, 1943, p. 474; OD]. Subcircular, biconvex, coarsely costellate, imbricate valves with

aditicles; ventral interarea short and curved, dorsal interarea short, curved, and orthocone; ventral interior with extended muscle scar; dorsal interior with brachiophores as parallel to divergent rods with divergent plates; muscle scars having larger anterior

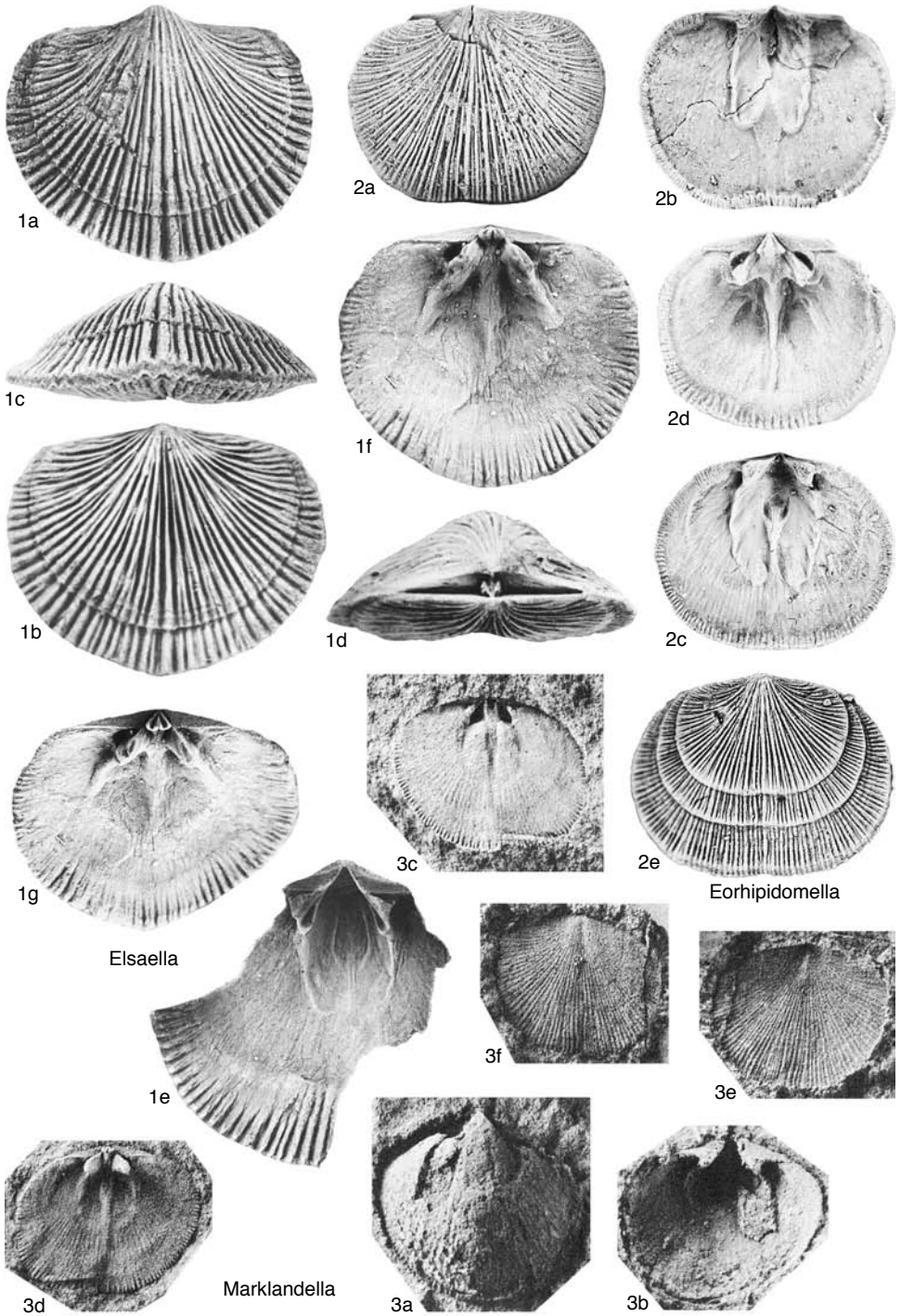


FIG. 589. Platyorthidae (p. 812–814).

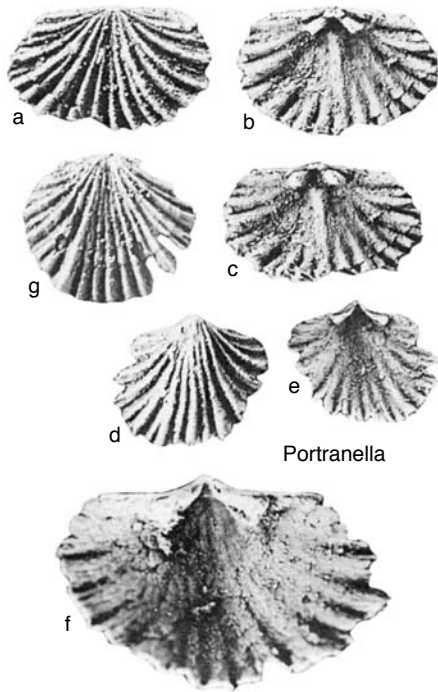


FIG. 590. Portranellidae (p. 814).

pair and bisected by low, short median ridge. *Upper Ordovician (Ashgill)*: eastern Baltic, Russia.—FIG. 589, 1a–e. **E. bekkeri* (ROSENSTEIN), Ashgill, northern Estonia; a–d, ventral, dorsal, anterior, posterior views of conjoined valves, $\times 4.7$; e, ventral interior, $\times 4.6$ (Hints, 1975).—FIG. 589, 1f, g. *E. sp. cf. E. bekkeri*, Ashgill, eastern Baltic; normal, tilted views of dorsal interior, $\times 3.2$ (Hints, 1975).

Orhipidomella HINTS, 1971, p. 267 [**E. ovalis*; OD]. Subquadrate, dorsibiconvex, imbricate valves with short, curved, orthocline ventral interarea and vestigial dorsal interarea; ventral interior with linear muscle scar on thickened callus bisected by median ridge; dorsal interior with brachiophores as parallel to divergent rods with divergent plates; anterior muscle scars larger than posterior pair bisected by median ridge. *Upper Ordovician (Caradoc)*: Russia.—FIG. 589, 2a–e. **E. ovalis*, Caradoc, Russia; a, b, external, internal views of ventral valve, $\times 3.3$; c, ventral interior, $\times 3.3$; d, dorsal interior, $\times 3.3$; e, dorsal exterior, $\times 3.3$ (Hints, 1975).

Marklandella HARPER, BOUCOT, & WALMSLEY, 1969, p. 82 [**M. giraldi*; OD]. Transversely semioval valves with aditucules; ventral interarea short and curved, dorsal interarea short, curved, and anacline; ventral interior with parallel dental plates and cordate muscle scar; dorsal interior with brachiophores as widely divergent rods lacking plates; anterior and posterior muscle scars subequal. *middle Silurian (Wenlock)–upper Silurian (Ludlow)*: Canada (Nova

Scotia), Wales.—FIG. 589, 3a–f. **M. giraldi*, Wenlock–Ludlow, southern Wales; a, b, internal mold, rubber replica of ventral valve, $\times 1.5$; c, d, internal mold, rubber replica of dorsal valve, $\times 1.5$; e, f, external mold, rubber replica of dorsal valve, $\times 1.5$ (Harper, Boucot, & Walmsley, 1969).

Family PORTRANELLIDAE new family

[Portranellidae HARPER, herein]

Coarsely costellate dalmanelloids with reduced notothyrial platform and lateral lobes of trilobed cardinal process extending over posteromedian surfaces of rodlike, divergent brachiophores; plates divergent; fulcral plates absent. *Upper Ordovician (Ashgill)*.

Portranella WRIGHT, 1964, p. 167 [**P. angulocostellata*; OD]. Subcircular with obtuse cardinal angles; ventral interior with suboval muscle scar impressed on callus. *Upper Ordovician (Ashgill)*: Ireland, Wales, Belgium, Spain.—FIG. 590a–g. *P. angulocostellata*, Ashgill, eastern Ireland; a–c, exterior, normal, tilted views of dorsal interior, $\times 2.7$; d, e, exterior, interior of ventral valve, $\times 2.5$; f, tilted view of ventral interior, $\times 5.3$; g, dorsal exterior, $\times 1.9$ (Wright, 1964).

Family PROSCHIZOPHORIIDAE

Boucot, Gauri, & Johnson, 1966

[*nom. transl.* HARPER, herein, ex Proschizophoriinae BOUCOT, GAURI, & JOHNSON, 1966, p. 158]

Normally transversely semioval, unisulcate dalmanelloids with long, curved ventral interarea; ventral interior normally with large cordate muscle scar and divergent dental plates; dorsal interior with complex, lobate cardinal process; fulcral plates commonly absent. *middle Silurian (Wenlock)–Lower Devonian (Emsian)*.

Proschizophoria MAILLIEUX, 1912, p. 177 [**Orthis personata* ZEILER, 1857, p. 48; OD]. Transversely semioval, large, convexoconcave, unisulcate valves; ventral muscle scar suboval to subtriangular; dorsal interior with massive lobate cardinal process, lacking fulcral plates; posterior adductor scars larger than anterior pair. *Lower Devonian (Lochkovian–Pragian)*: Europe, Altai Mountains, Canada (Nova Scotia), Kazakhstan, Morocco, New Zealand, China, Turkey.—FIG. 591, 1a–f. **P. personata* (ZEILER), Pragian, Siegerland, Germany; a, b, internal mold, rubber replica of ventral valve, $\times 1$; c–e, normal, posterior views of internal mold, rubber replica of dorsal valve, $\times 1$; f, external mold of ventral valve, $\times 1$ (Boucot, Gauri, & Johnson, 1966).

Baturria CARLS, 1974, p. 167 [**Orthis edgelliana* DAVIDSON, 1869, p. 228; OD]. Subcircular, medium-sized, dorsibiconvex, rectimarginate valves;

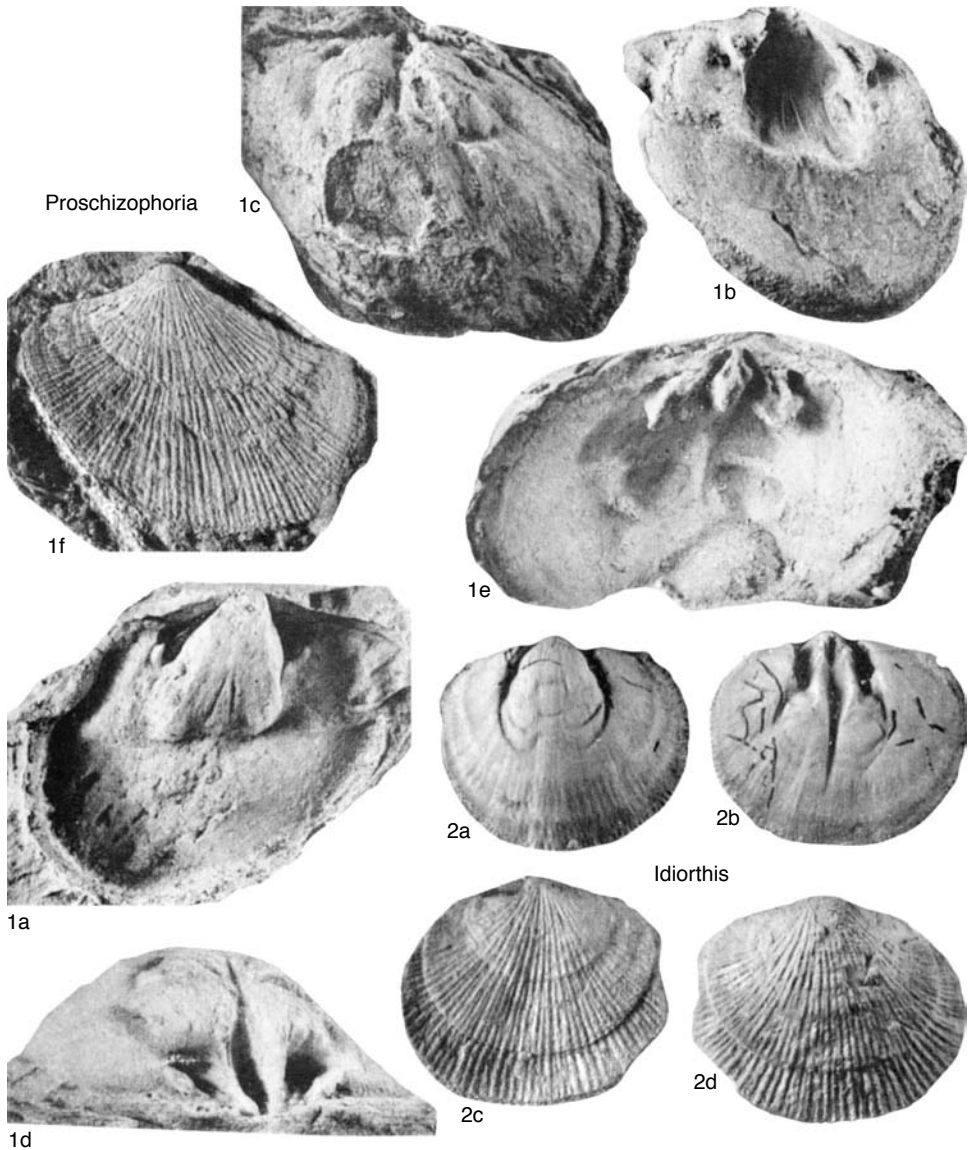


FIG. 591. Proschizophoriidae (p. 814–817).

ventral interior with pseudospondylium and cordate muscle scar; dorsal interior with bilobed cardinal process; posterior adductor scars larger than anterior pair. *middle Silurian (Wenlock)–Lower Devonian (Lochkovian)*: Bohemia, Britain, Mexico, Morocco, Spain, Venezuela.—FIG. 592,2a–g. **B. edgelliana* (DAVIDSON), Wenlock, Wales; a–e, ventral, dorsal, anterior, posterior, lateral views of conjoined valves, $\times 1.5$; f, ventral interior, $\times 1.5$; g, dorsal interior, $\times 1.5$ (Bassett, 1972).

Cordatomyonia BOUCOT, GAURI, & JOHNSON, 1966, p. 164 [**C. shupeii*; OD]. Transversely semioval, medium-sized, ventribiconvex, weakly unisulcate valves; ventral interior with pseudospondylium, well-developed pedicle callist and cordate muscle scar; dorsal interior with bilobed cardinal process; anterior adductor scars larger than posterior pair. *Lower Devonian (Lochkovian)*: USA (Maryland). —FIG. 592,1a–g. **C. shupeii*, Lochkovian, Maryland; a–d, ventral, dorsal, anterior, lateral views of

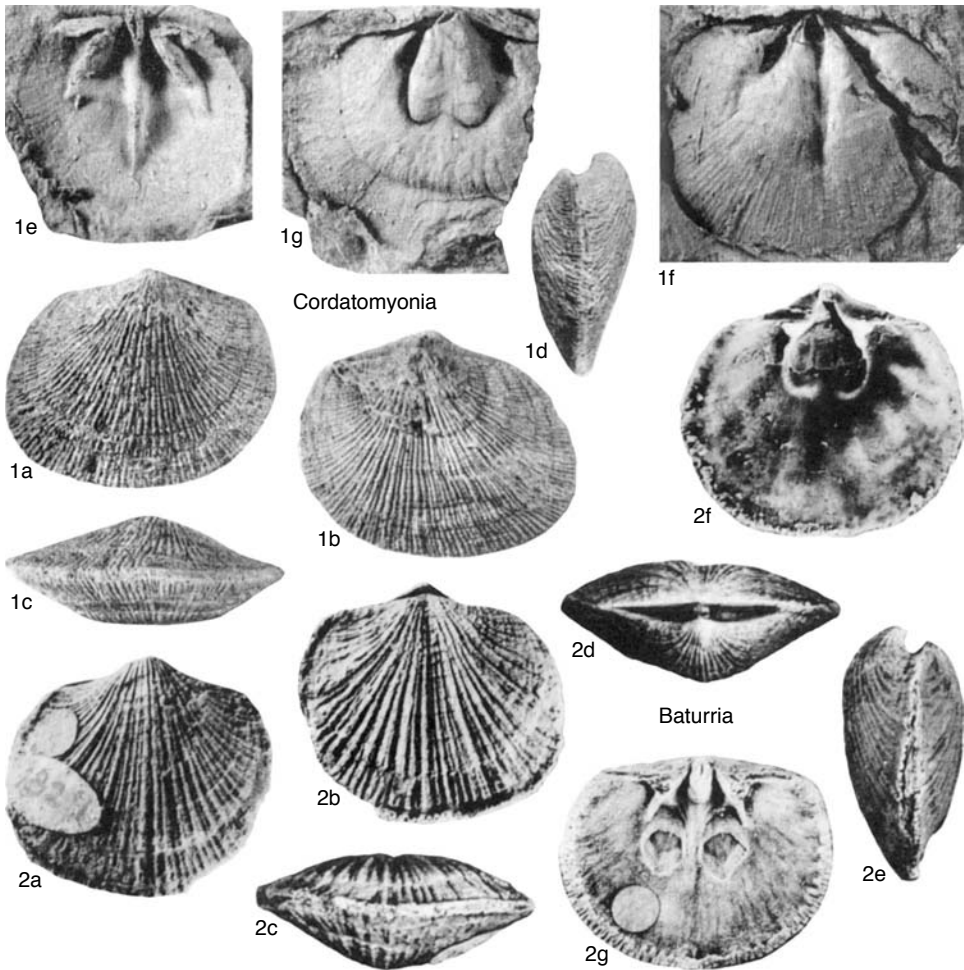


FIG. 592. Proschizophoriidae (p. 814–816).

conjoined valves, $\times 1.5$; *e*, rubber replica of dorsal interior, $\times 1.5$; *f*, internal mold of dorsal valve, $\times 1.5$; *g*, internal mold of ventral valve, $\times 1.5$ (Boucot, Gauri, & Johnson, 1966).

Elegesta VLADIMIRSKAYA in KULKOV, VLADIMIRSKAYA, & RYBKINA, 1985, p. 66 [**E. nifikiforovae*; OD]. Medium-sized, rectimarginate, dorsibiconvex valves; dorsal interior with simple cardinal process, swollen posteriorly; brachiophore plates widely divergent; ventral interior with rounded subtriangular to subcordate muscle scar. *middle Silurian (Wenlock)*: Tuva.—FIG. 593, 2*a–f*. **E. nifikiforovae*, Wenlock, Tuva; *a–d*, ventral, dorsal, anterior, lateral views of conjoined internal molds, $\times 2$; *e*, ventral exterior, $\times 2$; *f*, dorsal exterior, $\times 2$ (Kulkov, Vladimirskaia, & Rybkina, 1985).

Fulcriphoria CARLS, 1974, p. 176 [**F. navarrae*; OD]. Subcircular, large, dorsibiconvex, rectimarginate

valves; dorsal interior with bilobed cardinal process; posterior adductor scars larger than anterior pair; ventral interior with pseudo-spondylium, well-developed pedicle callist, and cordate muscle scar. *Lower Devonian (Lochkovian–Emsian)*: Belgium, France, Spain.—FIG. 593, 1*a–e*. **F. navarrae*, Emsian; *a–c*, lateral, dorsal, posterior views of internal mold of dorsal valve, Iberian Chains, $\times 1.3$; *d*, internal mold of dorsal valve, Pyrenees, $\times 1.3$; *e*, internal mold of ventral valve, Pyrenees, $\times 1.3$ (Carls, 1974).

Idiorthis MCLEARN, 1924, p. 56 [**I. matura*; OD]. Transversely semioval, medium-sized, planoconvex, unisulcate valves; ventral muscle scar cordate; dorsal interior with trilobed cardinal process on well-developed notothyrial platform; anterior adductor scars larger than posterior pair. *middle Silurian (Wenlock)–upper Silurian (Ludlow)*: Canada (Nova

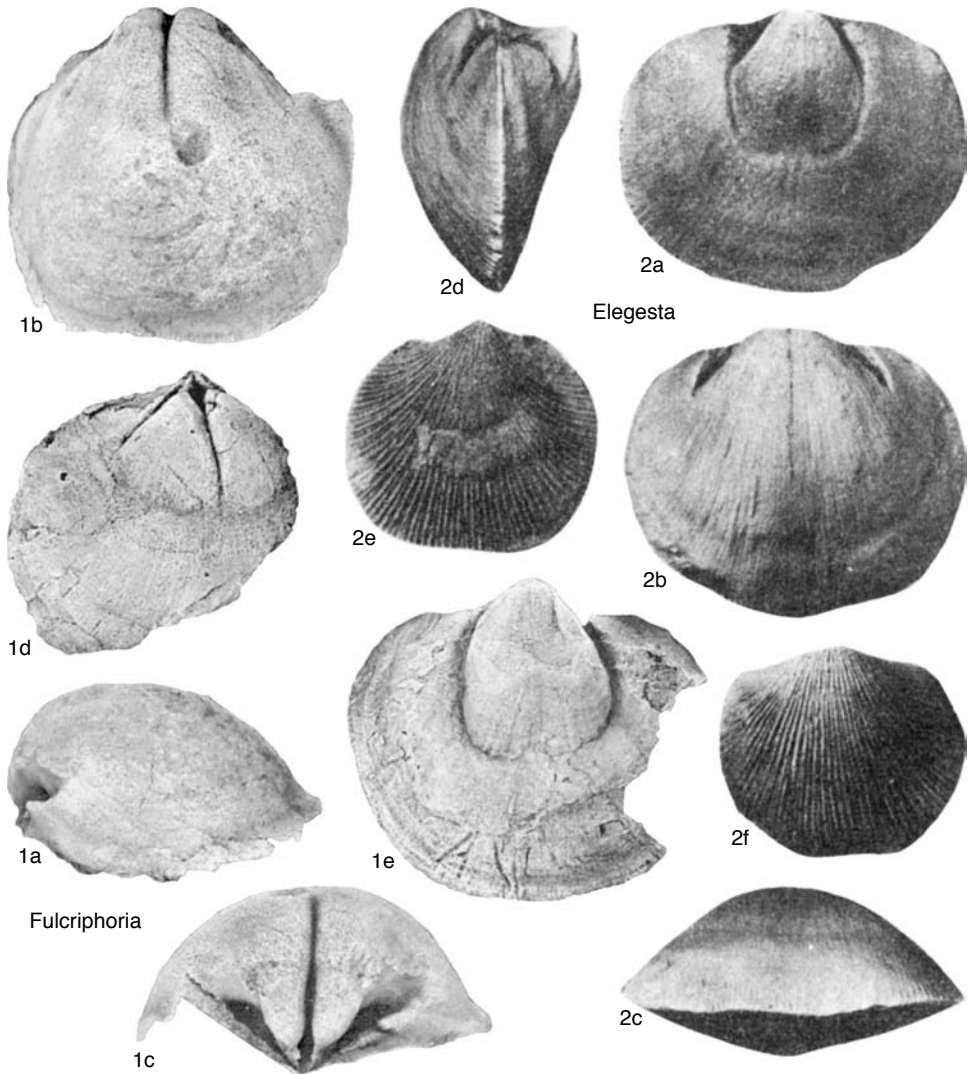


FIG. 593. Proschizophoriidae (p. 816).

Scotia).—FIG. 591,2a–d. **I. matura*, Wenlock–Ludlow, Arisaig, Nova Scotia; *a*, internal mold of ventral valve, $\times 1.5$; *b*, internal mold of dorsal valve, $\times 1.5$; *c, d*, dorsal, ventral views of conjoined pair, $\times 1.5$ (Boucot, Gauri, & Johnson, 1966).

Family RHIPIDOMELLIDAE Schuchert, 1913

[Rhipidomellidae SCHUCHERT, 1913b, p. 382]

Normally subcircular, large, unisulcate dalmanelloids with aditicules; ventral interarea, usually long and curved; dorsal inter-

area vestigial; ventral interior with recessive dental plates, median ridge and extended to quadrate diductor scars with scalloped margins, normally enclosing adductors scars; dorsal interior with variably lobate cardinal process, short brachiophores, extended in later taxa, with erect plates; notothyrial platform reduced; fulcral plates absent; ventral and dorsal mantle canal systems lemniscate. *Upper Ordovician (Ashgill)–Upper Permian (Tatarian)*.

Subfamily RHIPIDOMELLINAE
Schuchert, 1913

[*nom. transl.* HARPER, herein, ex Rhipidomellidae SCHUCHERT, 1913b, p. 382]

Normally subcircular, large, rhipidomellids with well-developed hinge line; ventral interarea, usually long and curved; dorsal interarea vestigial; ventral interior with recessive dental plates associated with strong subtriangular teeth. *Upper Ordovician (Ashgill)*—*Upper Permian (Tatarian)*.

Rhipidomella OEHLERT, 1890, p. 366, *nom. nov. pro Rhipidomys* OEHLERT, 1887b, p. 1288, *non* WAGNER, 1844 [**Terebratula michelini* LÉVEILLÉ, 1835, p. 39; OD] [= *Blairiella* MILLER & GURLEY, 1897, p. 6, *nom. nud.*]. Dorsibiconvex, rectimarginate to weakly unisulcate valves; notothyrium covered by chilidial plates in later species; ventral interior with extended, flabellate muscle scars, bisected in front of adductor scar by short median ridge; dorsal interior with brachiophores supported by adventitious shell. *Middle Devonian (Eifelian)*—*Upper Permian (Tatarian)*: cosmopolitan.—FIG. 594, 2a–f. **R. michelini* (LÉVEILLÉ), Viséan, Belgium; a–d, ventral, dorsal, posterior, lateral views of conjoined valves, $\times 1$; e, ventral interior, $\times 1$; f, dorsal interior, $\times 1$ (Wright, 1965a).

Ambonorthella BASSETT, 1972, p. 66 [**A. hancocki*; OD]. Elongately semioval, biconvex, rectimarginate valves with short, curved ventral interarea; ventral interior with divergent dental plates; dorsal interior with widely divergent brachiophores and subperipheral rim. *middle Silurian (Wenlock)*: Britain.—FIG. 594, 1a–e. **A. hancocki*, Wenlock, southern Wales; a, b, internal mold, rubber replica of ventral valve, $\times 1.5$; c, d, internal mold, rubber replica of dorsal valve, $\times 1.5$; e, rubber replica of dorsal exterior, $\times 1.5$ (Bassett, 1972).

Aulacella SCHUCHERT & COOPER, 1931, p. 246 [**Orthis eifelensis* SCHNUR, 1854, p. 213; OD]. Dorsibiconvex, unisulcate valves; ventral interior with bilobed muscle scar and median ridge, bifurcate anteriorly in front of muscle field; dorsal interior with trilobed cardinal process on low notothyrial platform. *Middle Devonian (Eifelian)*—*Lower Carboniferous (Tournaisian)*: Europe.—FIG. 594, 3a–d. **A. eifelensis* (SCHNUR), Eifelian; a, b, ventral, dorsal views of conjoined valves, Germany, $\times 1.5$ (Schuchert & Cooper, 1932); c, dorsal interior, Poland, $\times 1$; d, ventral interior, Poland, $\times 2.5$ (Biernat, 1959).

Clavodalejina HAVLÍČEK, 1977a, p. 227 [**C. clavigera*; OD]. Ventribiconvex, rectimarginate valves; ventral interarea long and narrow, apsacline; ventral interior with divergent dental plates, suboval to subtriangular muscle scar, lacking median ridge; dorsal interior with large muscle scar, elevated peripherally and bisected by wide median ridge expanded in front of muscle field to form peglike swelling. *Lower Devonian (Emsian)*: Bohemia.—FIG. 594, 4a–e. **C.*

clavigera, Emsian, Bohemia; a, ventral exterior, $\times 4.4$; b, detail of ventral interarea, $\times 4.3$; c, d, normal, oblique views of dorsal interior, $\times 4.4$; e, dorsal interior, $\times 5.8$ (Havlíček, 1977a).

Dalejina HAVLÍČEK, 1953, p. 5 [**D. banusi*; OD] [= *Rhipidomelloides* BOUCOT & AMSDEN, 1958, p. 165 (type, *Rhipidomella henryhousensis* AMSDEN, 1951, p. 74)]. Dorsibiconvex, unisulcate valves with short, curved ventral interarea; ventral interior with rudimentary dental plates and extended, often flabellate, muscle scars; median ridge absent. *middle Silurian (Wenlock)*—*Lower Devonian (Emsian)*: cosmopolitan.—FIG. 595, 1a–e. **D. banusi*, Pragian, Bohemia; a–c, ventral, dorsal, anterior views of conjoined valves, $\times 7.1$; d, ventral interior, $\times 6.8$; e, dorsal interior, $\times 5.9$ (Havlíček, 1977a).

Discomyorthis JOHNSON, 1970a, p. 84 [**Orthis musculosa* HALL, 1857, p. 46; OD]. Convexiplane, resupinate, large valves internally similar to *Dalejina* but ventral interior with very large, pentagonal diductor scars with scalloped margins. *Lower Devonian (Pragian)*: western USA.—FIG. 595, 5a–d. **D. musculosa* (HALL), Pragian, Nevada; posterior, lateral, external, internal views of ventral valve, $\times 1$ (Johnson, 1970a).

Mendacella COOPER, 1930, p. 380 [**Orthis uberis* BILLINGS, 1866, p. 42; OD]. Ventribiconvex, rectimarginate valves; ventral interior with short, widely divergent dental plates; dorsal interior with brachiophores widely divergent relative to brachiophore plates; fulcral plates present. *Upper Ordovician (Ashgill)*—*middle Silurian (Wenlock)*: cosmopolitan.—FIG. 596, 4a–e. **M. uberis* (BILLINGS), Ashgill, Anticosti Island; a–c, ventral, dorsal, anterior views of conjoined valves, $\times 2$ (Wright, 1965a); d, ventral interior, $\times 2$; e, dorsal interior, $\times 2$ (Schuchert & Cooper, 1932).

Peridalejina HAVLÍČEK, 1973, p. 337 [**Dalejina periens* HAVLÍČEK, 1956, p. 542]. Small, biconvex valves with variable transverse profile; ventral interarea short, straight; ventral interior with rudimentary dental plates and cordate muscle scar. *Middle Devonian (Eifelian)*: Bohemia.—FIG. 595, 3a–f. **P. periens* (HAVLÍČEK), Eifelian, Bohemia; a–d, ventral, dorsal, posterior, anterior views of conjoined valves, $\times 7.2$; e, ventral interior, $\times 8.4$; f, dorsal interior, $\times 9$ (Havlíček, 1977a).

Pseudodicoelosia BOUCOT & AMSDEN, 1958, p. 162 [**Rhipidomella oklahomensis* AMSDEN, 1951, p. 76; OD]. Bilobed, small, ventribiconvex, unisulcate valves with extended, flabellate ventral muscle scar. *middle Silurian (Wenlock)*: USA (Oklahoma, Tennessee).—FIG. 595, 2a–g. **P. oklahomensis* (AMSDEN), Wenlock, south central Oklahoma; a–e, ventral, dorsal, lateral, posterior, anterior views of conjoined valves, $\times 3$; f, ventral interior, $\times 5$; g, dorsal interior, $\times 5$ (Amsden, 1951).

Pseudomendacella ZHANG, 1989a, p. 69 [**P. boucoti*; OD]. Dorsibiconvex, circular, uniplicate valves with bilobed to linear ventral muscle scar and small, nonlobate cardinal process. *middle Silurian (Wenlock)*: Canadian Arctic, United States (California), Venezuela.—FIG. 596, 3a–f. **P. boucoti*, Wenlock,

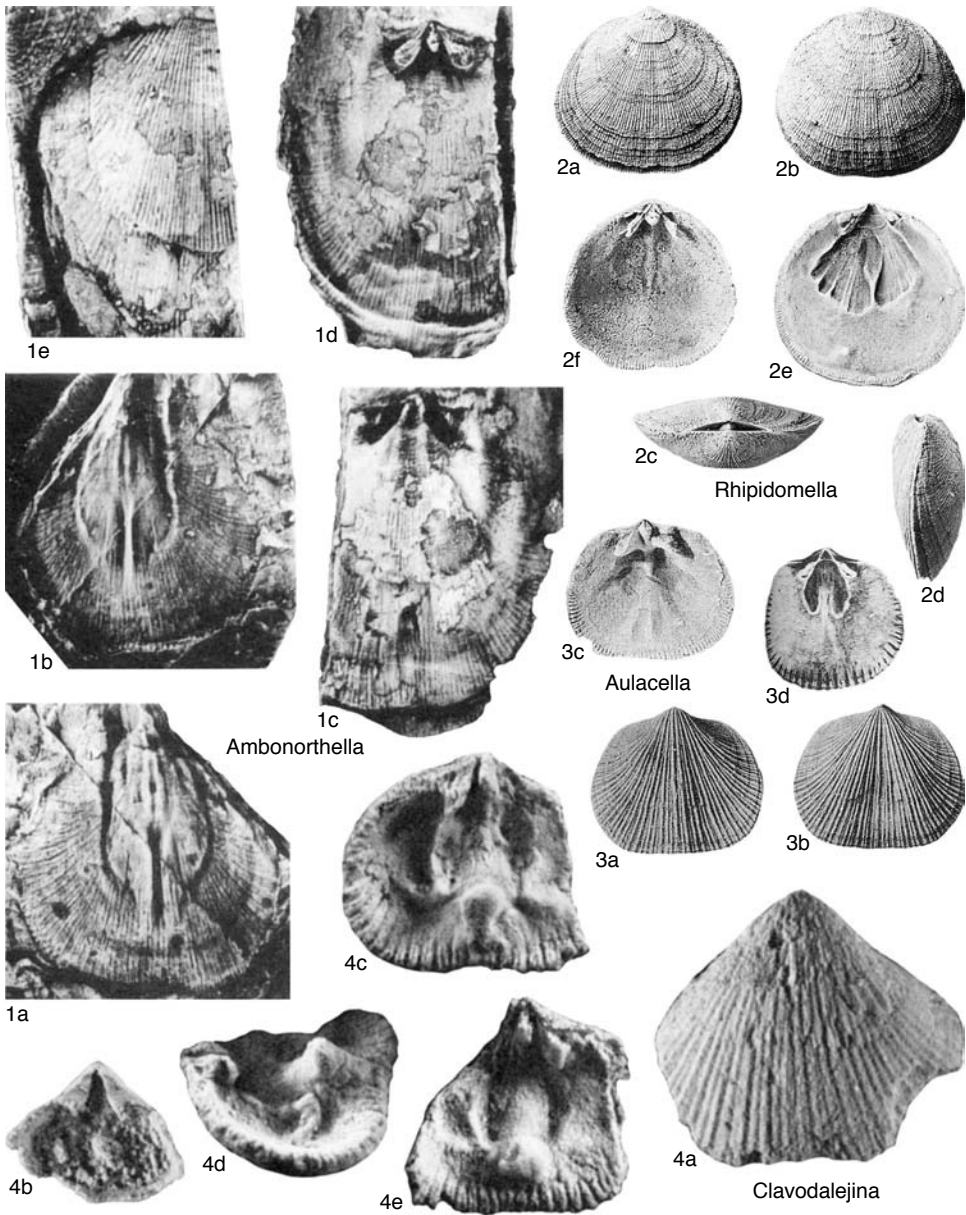


FIG. 594. Rhipidomellidae (p. 818).

Arctic Canada; *a, b*, ventral exterior, interior, $\times 2$; *c, d*, dorsal exterior, interior, $\times 2$; *e*, detail of cardinalia, muscle field, $\times 5$; *f*, ventral interior, $\times 1$ (Zhang, 1989a).

Stainbrookia COOPER & DUTRO, 1982, p. 39 [*Orthis infera* CALVIN, 1878, p. 728; OD]. Subquadrate, biconvex, small valves modified from uniusulate to uniplicate during ontogeny; ventral interior with

quadrate to linear muscle scar, well-developed median ridge, bifurcate anteriorly in front of muscle field; dorsal interior with trilobate cardinal process, widely divergent brachiophores, muscle scars confined and supported by ridges; median ridge well developed. Upper Devonian (Frasnian): USA (Iowa, New Mexico).—FIG. 596, 1a–g. **S. infera* (CALVIN), Frasnian, Iowa; *a–e*, ventral, dorsal,

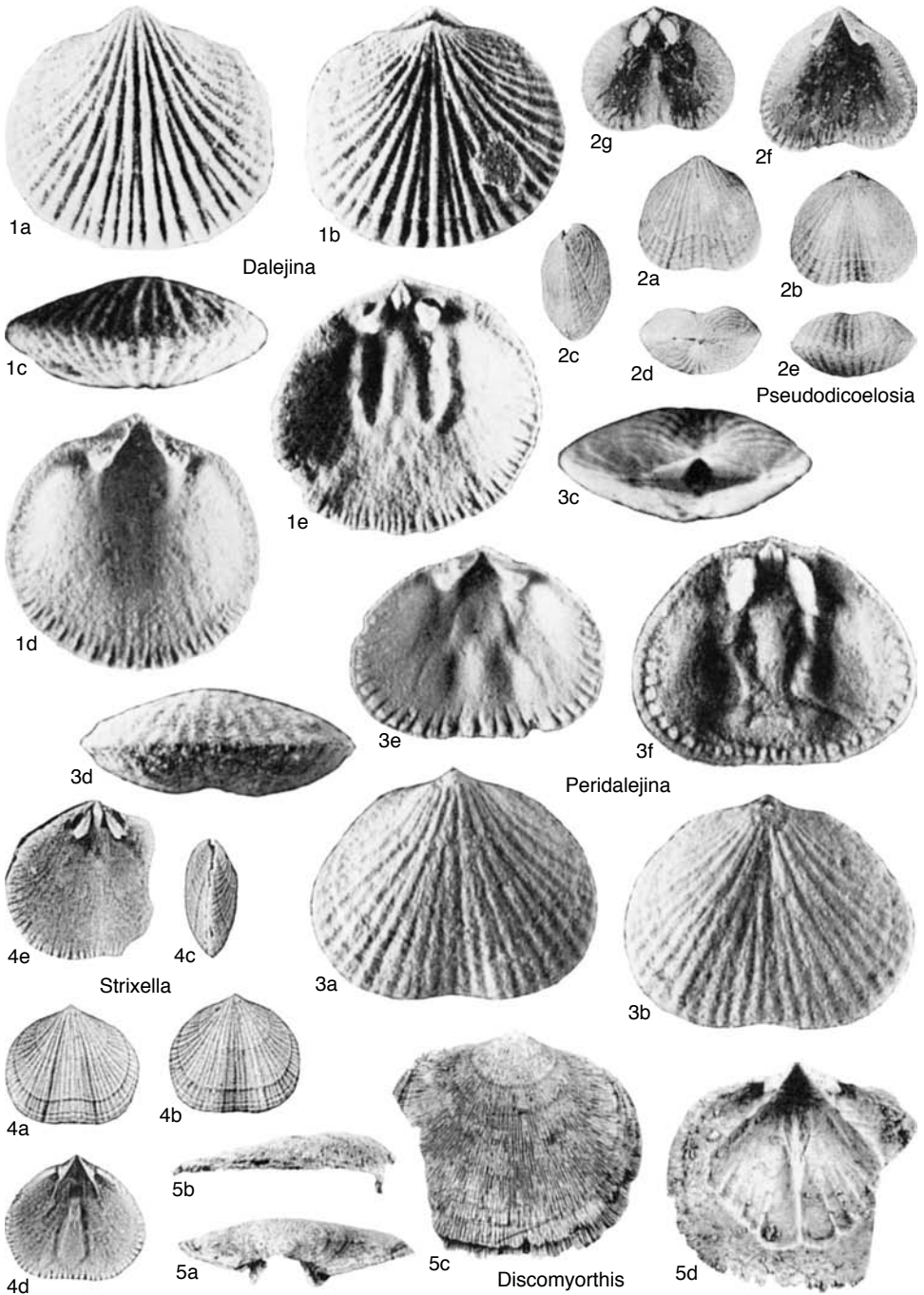


FIG. 595. Rhipidomellidae (p. 818–821).

anterior, posterior, lateral views of conjoined valves, $\times 2$; *f*; dorsal interior, $\times 2$; *g*, ventral interior, $\times 2$ (Cooper & Dutro, 1982).

Strixella BOUCOT & AMSDEN, 1958, p. 170 [**Rhipidomella acutisulcata* AMSDEN, 1951, p. 75; OD]. Subquadrate, biconvex, sharply unisulcate, imbric-

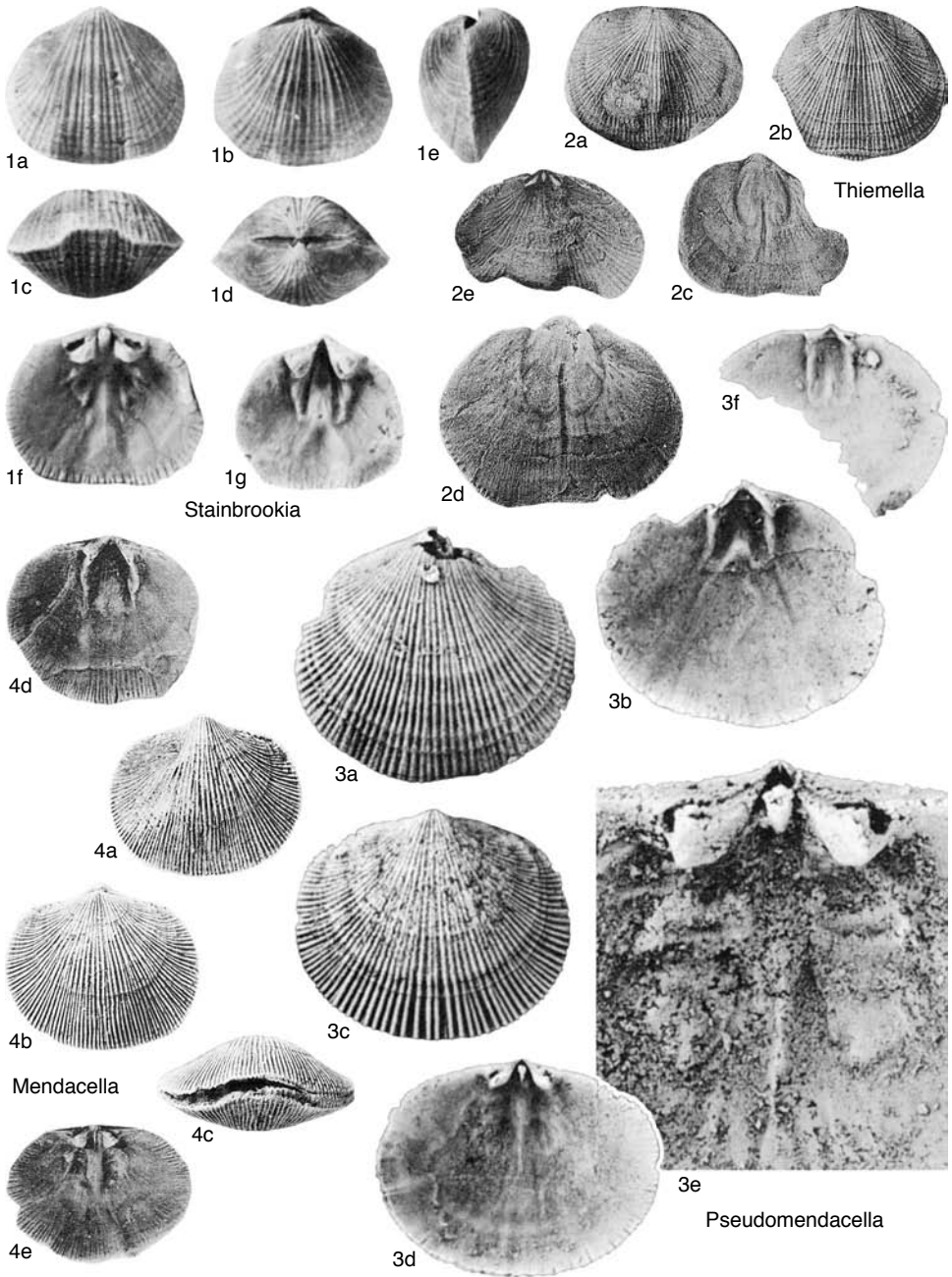


FIG. 596. Rhipidomellidae (p. 818–822).

cate valves with divergent ventral adductor scars and lacking dorsal median ridge. *middle Silurian* (Wenlock): eastern and central USA.—FIG. 595, 4a–e. **S. acutisulcata* (AMSDEN), Wenlock, south central Oklahoma; a–c, ventral, dorsal, lateral

views of conjoined valves, $\times 2$; d, ventral interior, $\times 2$; e, dorsal interior, $\times 3$ (Boucot & Amsden, 1958).

Thiemella WILLIAMS, 1908, p. 59 [**T. villenovia*; OD]. Dorsibiconvex, sharply unisulcate valves; ventral

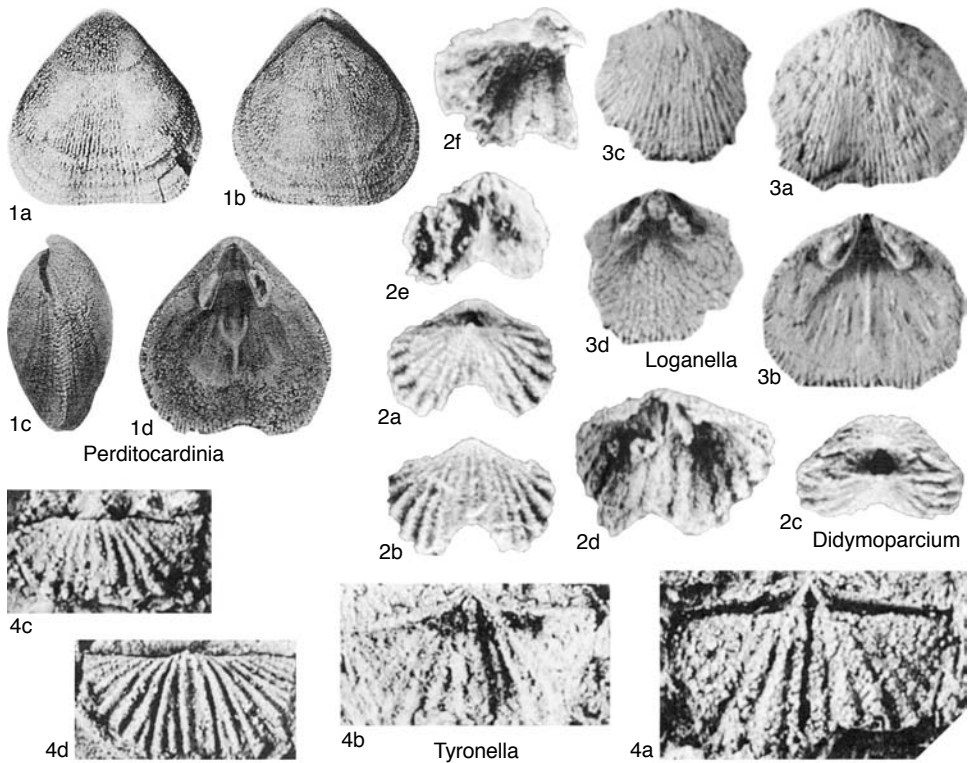


FIG. 597. Rhipidomellidae and Tyronellidae (p. 822–823).

interior with convergent dental plates, subcordate muscle scar and long median ridge; dorsal interior with delicate cardinalia including small myophore and shaft and thin brachiophores; anterior scars larger than posterior pair. *Upper Devonian (Frasnian)*–*Lower Carboniferous*: eastern USA, Germany.—FIG. 596, 2a–e. **T. villenovia*, Frasnian, New York; a, rubber replica of ventral exterior, $\times 1.5$; b, rubber replica of dorsal exterior, $\times 1.5$; c, internal mold of ventral valve, $\times 1.5$; d, internal mold of ventral valve, $\times 2$; e, rubber replica of dorsal interior, $\times 1.5$ (Schuchert & Cooper, 1932).

Subfamily PERDITOCARDINIINAE new subfamily

[Perditocardiinae HARPER, herein]

Rostrate rhipidomellids lacking both interareas; ventral interior with massive teeth and dental fossettes; muscle scar flabellate; dorsal interior with deep sockets. *Lower Devonian (Pragian)*–*Lower Permian*.

Perditocardinia SCHUCHERT & COOPER, 1931, p. 246 [**Orthis dubia* HALL, 1858b, p. 12; OD]. Dorsibiconvex, unipliicate valves with short hinge line;

ventral interior with massive, elongate teeth and dental fossettes, extending anteriorly; muscle scar extended and flabellate. *Lower Carboniferous (Viséan)*–*Lower Permian*: cosmopolitan.—FIG. 597, 1a–d. **P. dubia* (HALL), Viséan, Indiana; a–c, ventral, dorsal, lateral views of conjoined valves, $\times 1$; d, ventral interior, $\times 1$ (Schuchert & Cooper, 1932).

Loganella BOUCOT & AMSDEN, 1958, p. 164 [**Rhipidomella lehuquetiana* CLARKE, 1905, p. 144; OD]. Biconvex, unisulcate valves; ventral interior with massive teeth and dental fossettes; muscle scar flabellate; dorsal interior with deep sockets; lobate cardinal process fused to brachiophores. *Lower Devonian (Pragian)*: eastern Canada.—FIG. 597, 3a–d. **L. lehuquetiana* (CLARKE), Pragian, Gaspé; a, b, ventral exterior, interior, $\times 2$; c, d, dorsal exterior, interior, $\times 2$ (Boucot & Amsden, 1958).

Family TYRONELLIDAE Mitchell, 1977

[Tyronellidae MITCHELL, 1977, p. 64]

Small, transversely semioval, coarsely costellate dalmanelloids; ventral interior with free spondylium confined to delthyrial chamber; cardinalia with lobate myophore and shaft continuous with median septum ex-

tending forward from rudimentary notothyrial platform. *Upper Ordovician (Ashgill)–Lower Devonian (Emsian)*.

Tyronella MITCHELL, 1977, p. 64 [**T. killeyensis*; OD]. Small, biconvex, transversely semioval valves with acute cardinal extremities and coarsely costellate ornament. *Upper Ordovician (Ashgill)*: Northern Ireland, eastern Canada.—FIG. 597,4a–d. **T. killeyensis*, Ashgill, Northern Ireland; *a*, internal mold of dorsal valve, $\times 11.5$; *b*, rubber replica of dorsal valve, $\times 10$; *c*, internal mold of ventral valve, $\times 10$; *d*, rubber replica of dorsal exterior, $\times 10$ (Mitchell, 1977).

Didymoparcium LENZ, 1977, p. 62 [**D. costata*; OD]. Small, ventribiconvex, strangulate valves with obtuse cardinal extremities and coarsely costellate ornament. [This genus has been tentatively assigned to the Dicoelosiidae on the basis of its bilobed and emarginate outline (LENZ, 1977). It differs markedly, however, from contemporary dicoelosiids, kaysereids, and mystrophorids in having a free spondylium. Here it is tentatively associated with *Tyronella* on the basis of the internal similarities between both genera.] *Lower Devonian (Emsian)*: Arctic Canada.—FIG. 597,2a–f. **D. costata*, Emsian, Canadian Arctic; *a–c*, dorsal, ventral, posterior views of conjoined valves, $\times 10$; *d*, dorsal interior, $\times 10$; *e*, dorsal interior, $\times 10$; *f*, ventral interior, $\times 10$ (Lenz, 1977).

Superfamily ENTELETOIDEA Waagen, 1884

[*nom. transl.* ALICHOVA, 1960, p. 193, ex Entelelinae WAAGEN, 1884, p. 548; *emend.*, HARPER, herein]

Commonly subequally biconvex dalmanellidines; costellate ornament commonly with aditicules; notothyrial platform reduced or absent, developed as variable cavity; cardinalia normally with simple, rarely lobate, crenulated myophore and shaft; brachiophores high and long, commonly tusklike with plates usually convergent in earlier taxa; fulcral plates normally present. *Lower Ordovician (Arenig)–Upper Permian (Tatarian)*.

Family ENTELETIDAE Waagen, 1884

[*nom. transl.* LICHAREV & ALICHOVA in ALICHOVA, 1960, p. 194, ex Entelelinae WAAGEN, 1884, p. 548; *emend.*, HARPER, herein]

Normally large, dorsibiconvex, plicate, imbricate enteletoids with long, curved ventral interarea; ventral interior with strong, subparallel to convergent dental plates and extended muscle scar bisected by median

ridge or septum; pedicle callist reduced or absent; dorsal interior with well-developed median septum. *Carboniferous (Namurian)–Upper Permian (Tatarian)*.

Enteletes FISCHER DE WALDHEIM, 1825, p. 6 [**Enteletes glabra* FISCHER DE WALDHEIM, 1830, pl. 26, fig. 6, 7; SM] [= *Anteletes* D'ORBIGNY, 1847–1849, p. 348; *Syntrilasma* MEEK & WORTHEN, 1866, p. 277 (type, *Spirifer hemiplicatus* HALL, 1852); *Syntrielsma* MEEK & WORTHEN, 1866, p. 321]. Sharply uniplicate, capillate valves; ventral interior with high, flat, subparallel to slightly convergent dental plates, bisected by high, thin median septum; dorsal interior with well-developed tusklike brachiophores defining deep, tubular sockets; cardinal process variably expanded. *Carboniferous (Namurian)–Upper Permian (Tatarian)*: widespread.—FIG. 598,1a–c. *E. lamarcki* (FISCHER DE WALDHEIM), Namurian, Russia; ventral, dorsal, lateral views of conjoined valves, $\times 1$ (Schuchert & Cooper, 1932).—FIG. 598,1d–m. *E. wordensis* (R. E. KING), Kazanian, western Texas; *d–g*, ventral, lateral, posterior, anterior views of conjoined valves, $\times 1$; *h–j*, normal, tilted, lateral views of ventral interior, $\times 1$; *k–m*, normal, tilted, lateral views of dorsal interior, $\times 1$ (Cooper & Grant, 1976).

Enteletella LICHAREV, 1926, p. 719 [**E. nikschtitchi*; OD]. Sharply uniplicate valves, similar to *Enteletes* but with convergent dental plates onto median ridge forming spondylium simplex. *Lower Permian*: Russia (Caucasus).—FIG. 599,4. **E. nikschtitchi*, Lower Permian, Caucasus; lateral view of conjoined valves, $\times 1$ (Schuchert & Cooper, 1932).

Enteletina SCHUCHERT & COOPER, 1931, p. 247 [**Enteletes latesinuatus* WAAGEN, 1884, p. 559; OD]. Sharply unisulcate valves with convergent dental plates. *Upper Permian*: central Asia.—FIG. 599,1a–c. **E. latesinuatus* (WAAGEN), Permian, Salt Ranges; *a*, ventral interior, $\times 1$; *b*, dorsal exterior, $\times 1$; *c*, dorsal interior, $\times 1$ (Schuchert & Cooper, 1932).

Mapingtichia LI in LI, YANG, & FENG, 1986, p. 217 [**M. longliensis*; OD]. Sharply unisulcate valves with divergent anterior parts of dental plates and widely divergent brachiophore plates. *Lower Permian*: China.—FIG. 599,3a–c. **M. longliensis*, Lower Permian, southern China; *a, b*, internal, anterior views of ventral valve, $\times 1$; *c*, dorsal view of valve, $\times 1$ (Li, Yang, & Feng, 1986).

Parenteletes KING, 1931, p. 48 [**P. cooperi*; OD]. Sharply unisulcate valves, similar to *Enteletina* but with divergent dental plates and cella under anterior extension of ventral median septum; sockets elongate. *Carboniferous (Namurian)–Upper Permian (Tatarian)*: Europe, central Asia, North America.—FIG. 598,2a–b. **P. cooperi*, Asselian, western Texas; *a–e*, ventral, dorsal, anterior, posterior, lateral views of conjoined valves, $\times 1$; *f, g*, normal, tilted views of ventral interior, $\times 1$; *b*, oblique view of dorsal interior, $\times 1$ (Cooper & Grant, 1976).

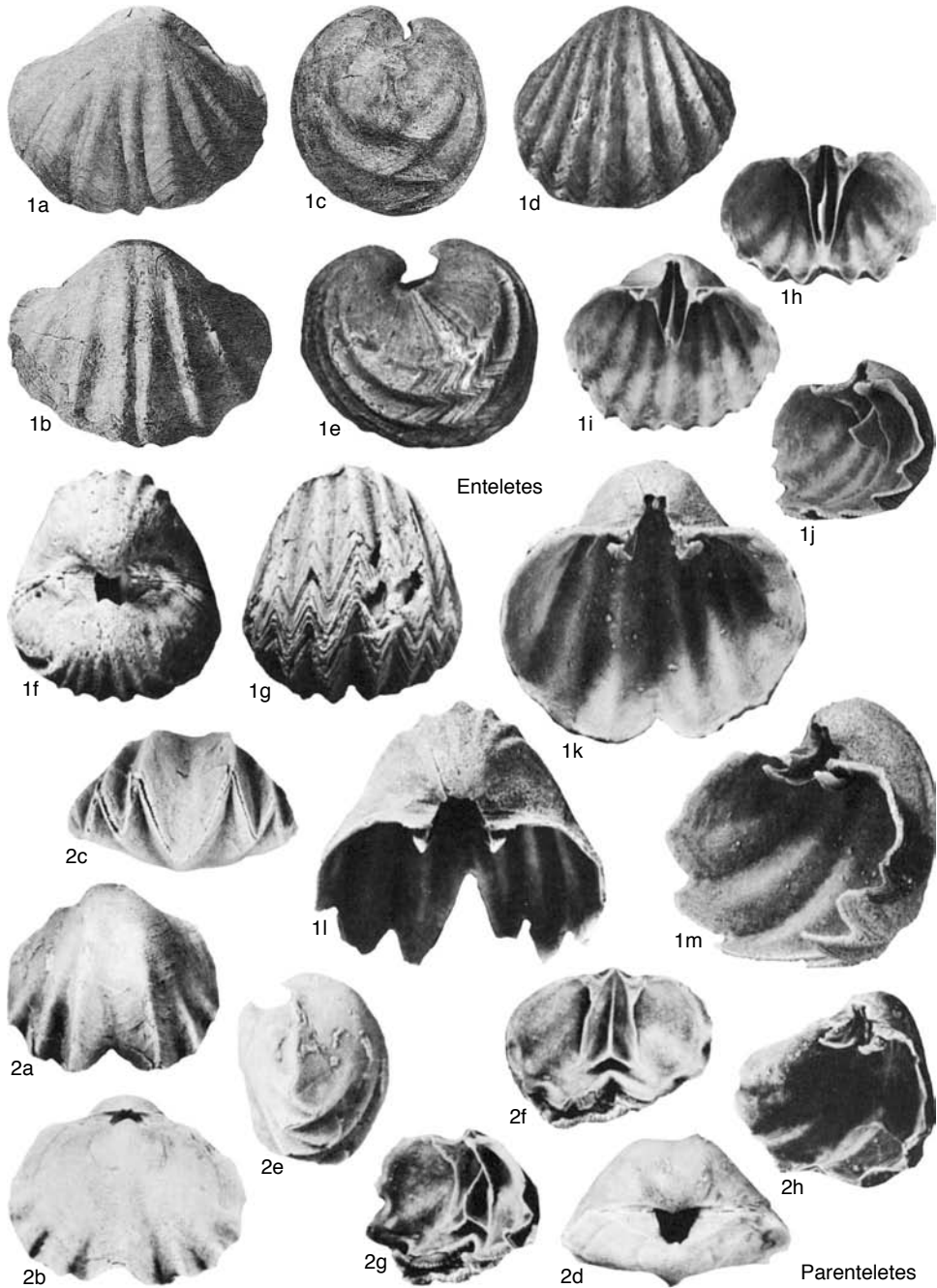


FIG. 598. Enteletidae (p. 823).

Peltichia JIN & LIAO in JIN & SUN, 1981, p. 129
 [**Parenteles sinensis zigzag* HUANG, 1933, p. 13;
 OD]. Unisulcate, medium-sized valves with parallel
 dental plates and well-developed median septum.
Upper Permian (Tatarian): southern China, Tibet.

—FIG. 599, 2a–e. **P. zigzag* (HUANG), Tatarian,
 southern China; a–e, ventral, dorsal, lateral, poste-
 rior, anterior views of conjoined pair, ×1 (Shen,
 Tazawa, & Shi, 1999). —FIG. 599, 2f, *P. transver-*
sus (HUANG), Tatarian, southern China; f, internal

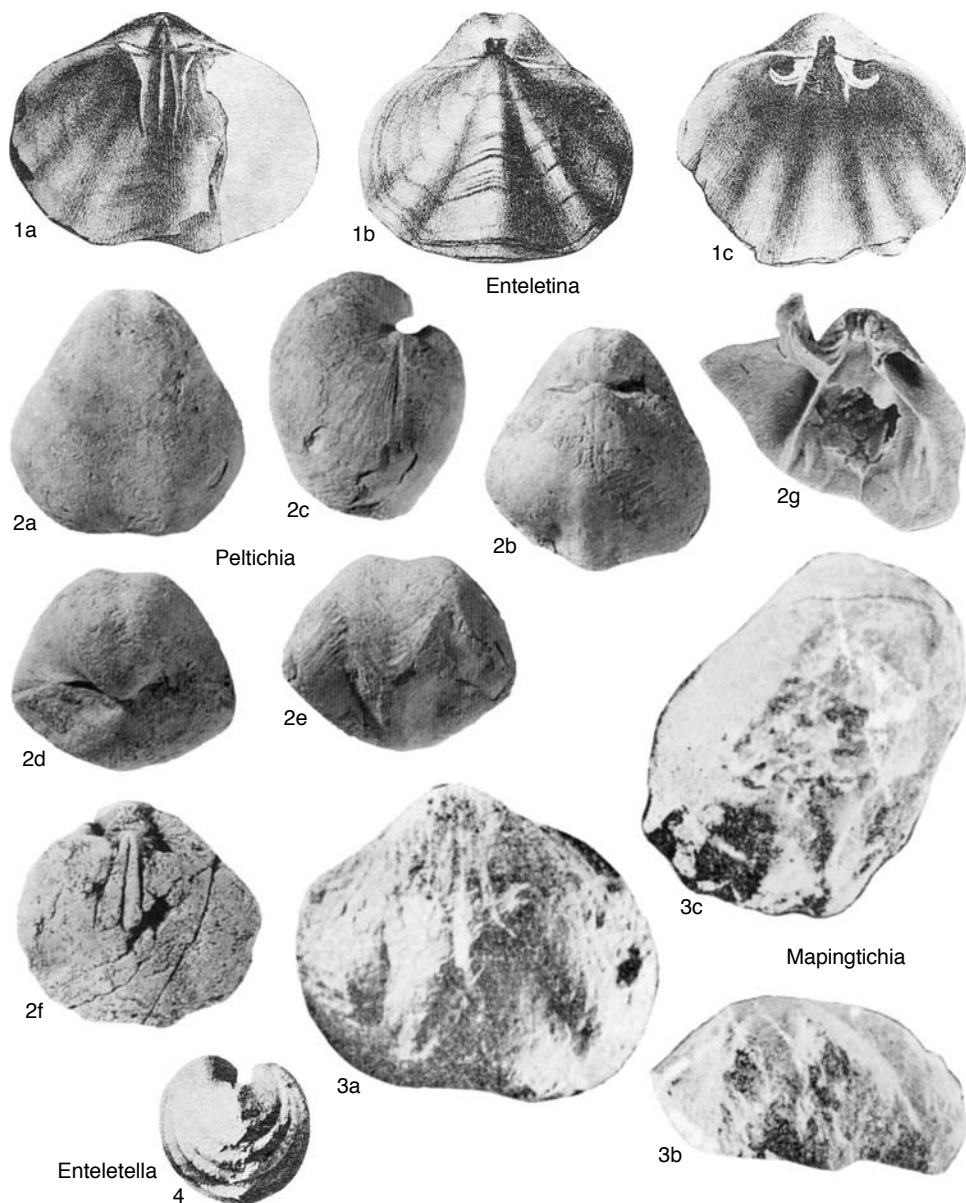


FIG. 599. Enteletidae (p. 823–825).

mold of ventral valve; g, dorsal interior, $\times 1$ (Shen, Tazawa, & Shi, 1999).

Family DRABOVIIDAE Havlíček, 1950

[*nom. transl.* ALICHOVA, 1960, p. 193, *ex* Draboviinae HAVLÍČEK, 1950, p. 45; *emend.*, HARPER, herein]

Normally ventribiconvex, rectimarginate, multicostellate enteletoids with aditicules; ventral and dorsal interareas apsacline and

anacline, respectively; ventral muscle scar suboval to subtriangular; dental plates divergent; dorsal interior with extensions of brachiophore plates commonly convergent forward onto median ridge; anterior muscle scars usually larger than posterior pair; fulcral plates present. *Lower Ordovician (Arenig)–Upper Devonian (Frasnian)*.

Subfamily DRABOVIINAE
Havlíček, 1950

[Draboviinae HAVLÍČEK, 1950, p. 45; *emend.*, HARPER, herein]

Draboviids lacking well-developed dorsal median septum or partition. *Lower Ordovician (Arenig)–Upper Devonian (Frasnian)*.

Drabovia HAVLÍČEK, 1950, p. 45 [**Orthis redux* BARRANDE, 1848, pl. 18, fig. 7; OD] [= *Crassiorina* HAVLÍČEK, 1950, p. 36 (type, *Orthis notata crassior* BARRANDE, 1879)]. Subquadrate, biconvex, coarsely costellate valves with long straight ventral interarea; ventral interior with well-developed pedicle callist. *Upper Ordovician (Caradoc–Ashgill)*: Europe, northern Africa.—FIG. 600,4a–e. **D. redux* (BARRANDE), Caradoc, Bohemia; *a*, internal mold of dorsal valve, $\times 1.8$; *b*, internal mold of ventral valve, $\times 2.1$; *c*, internal mold of ventral valve, $\times 1.8$; *d*, rubber replica of dorsal exterior, $\times 2.5$ (Havlíček, 1977a); *e*, internal molds of two dorsal valves, $\times 1.5$ (Cocks, new).

Boticium HAVLÍČEK & MERGL, 1982, p. 43 [**B. boticense*; OD]. Similar to *Pionodema* but subcircular, small valves with short hinge line and short, deeply impressed subtriangular to bilobed muscle scar, confined laterally by long subparallel dental plates with adductor field impressed on callus; brachio-phore plates subparallel and median ridge variably developed. *Upper Ordovician (Ashgill)*: Bohemia.—FIG. 600,3a–d. **B. boticense*, Ashgill, Bohemia; *a, b*, normal, tilted views of internal mold of ventral valve, $\times 3.6$; *c*, internal mold of dorsal interior, $\times 3.6$; *d*, external mold of ventral valve, $\times 4$ (Havlíček & Mergl, 1982).

Dalmanellopsis KHALFIN, 1948, p. 208 [**D. septiger*; OD]. Similar to *Salopina*, transversely semioval valves with short curved ventral interarea, parallel to divergent rodlike brachio-phores and ventral median ridge; but with dorsal median septum extending forward from muscle scar to near anterior commissure. *Lower Devonian*: Altai Mountains.—FIG. 600,1a, b. **D. septiger*, Lower Devonian, Altai Mountains; internal mold, rubber replica of dorsal valve, $\times 3$ (Boucot, Gauri, & Johnson, 1966).

Destombesium HAVLÍČEK, 1971a, p. 58 [**D. pectiniferum*; OD]. Transversely semioval, dorsibiconvex valves similar to *Pionodema* with large bilobed ventral diductor scar and lobate cardinal process, but commonly with several pairs of small, parallel plates arising from floor of apical part of notothyrial cavity. *Upper Ordovician (Caradoc–Ashgill)*: northern Africa.—FIG. 601,2a–d. **D. pectiniferum*, Caradoc, Morocco; *a*, internal molds of two ventral valves (top left and top right), one external mold of dorsal valve (bottom left) and internal mold of dorsal valve (bottom right), $\times 1.5$; *b*, internal mold of dorsal valve, $\times 3$; *c*, posterior view of internal mold of dorsal valve, $\times 1.5$; *d*, posterior views of internal mold of two dorsal valves, $\times 1.5$ (Havlíček, 1971a).

Diorthelasma COOPER, 1956, p. 997 [**D. parvum*; OD]. Transversely semioval, small, sharply unisulcate valves lacking adductives; ventral interarea long, straight; ventral interarea with wide, cordate muscle scar and median ridge; dorsal interior with convergent brachio-phore plates and petaloid muscle scar; cardinal process with uncrenulated myophore. *Upper Ordovician (Caradoc)*: USA, Scotland.—FIG. 601,3a–e. **D. parvum*, Caradoc, Alabama; *a, b*, ventral, dorsal views of conjoined valves, $\times 4$; *c, d*, normal, tilted views of dorsal interior, $\times 4$; *e*, ventral interior, $\times 4$ (Cooper, 1956).

Drabovinella HAVLÍČEK, 1950, p. 50 [**Orthis draboviensis* BARRANDE, 1879, pl. 61, case V; OD]. Transversely semioval, large, biconvex, rectimarginate, coarsely costellate valves; ventral interarea long, straight; ventral interior with subtriangular to bilobed, narrow muscle scar; dorsal interior with petaloid muscle scar and cardinal process with uncrenulated myophore and parallel brachio-phore plates. *Upper Ordovician (Caradoc)*: Bohemia, northern Africa.—FIG. 602,1a–f. **D. draboviensis* (BARRANDE), Caradoc, Bohemia; *a, b*, dorsal, posterior views of conjoined internal molds, $\times 2.2$; *c*, ventral view of conjoined internal molds, $\times 1.8$; *d*, internal mold of dorsal valve, $\times 1.7$; *e*, internal mold of dorsal valve, $\times 2$; *f*, partly exfoliated dorsal valve, $\times 1.3$ (Havlíček, 1977a).

Eodiorthelasma XU & LIU, 1984, p. 188 [**Diorthelasma striata* XU in XU, RONG, & LIU, 1974, p. 148; OD]. Small, ventribiconvex, unisulcate, fascicostellate or multicostellate valves; ventral interior with small subtriangular muscle field with long diductor and short adductor scars and short dental plates; dorsal interior with small cardinal process, narrow posteriorly, expanded anteriorly where continuous with median ridge; muscle field petaloid with elongate adductor scars. *Lower Ordovician (Arenig)*: southwestern China.—FIG. 600,2a–d. **E. striata* (XU), Arenig, southwestern China; *a*, internal mold of ventral valve, $\times 5$; *b*, internal mold of dorsal valve, $\times 5$; *c*, internal mold of dorsal valve, $\times 5$; *d*, external mold of dorsal valve, $\times 5$ (Xu & Liu, 1984).

Fascifera ULRICH & COOPER, 1942, p. 620 [**F. subcarinata*; OD]. Transversely semioval, biconvex, unisulcate, fascicostellate valves; ventral interarea short, curved; dorsal interarea orthocline; ventral interarea with well-developed dental fossettes; muscle scar extended and bisected by median ridge; dorsal interior with lobate cardinal process and brachio-phore plates normally convergent onto median ridge. *Upper Ordovician (Caradoc)–lower Silurian (Llandovery)*: North America.—FIG. 603,2a–g. **F. subcarinata*, Caradoc, Tennessee; *a–e*, ventral, dorsal, anterior, posterior, lateral views of conjoined valves, $\times 2$; *f*, ventral interior, $\times 2$; *g*, dorsal interior, $\times 2$ (Cooper, 1956).—FIG. 603,2h, i. *F. stonensis* (SAFFORD), Caradoc, Tennessee; normal, tilted views of dorsal interior, $\times 2$ (Cooper, 1956).

Hirnantia LAMONT, 1935, p. 313 [**Orthis sagittifera* M'COY, 1851, p. 398; OD] [= *Villicundella* LEVY &

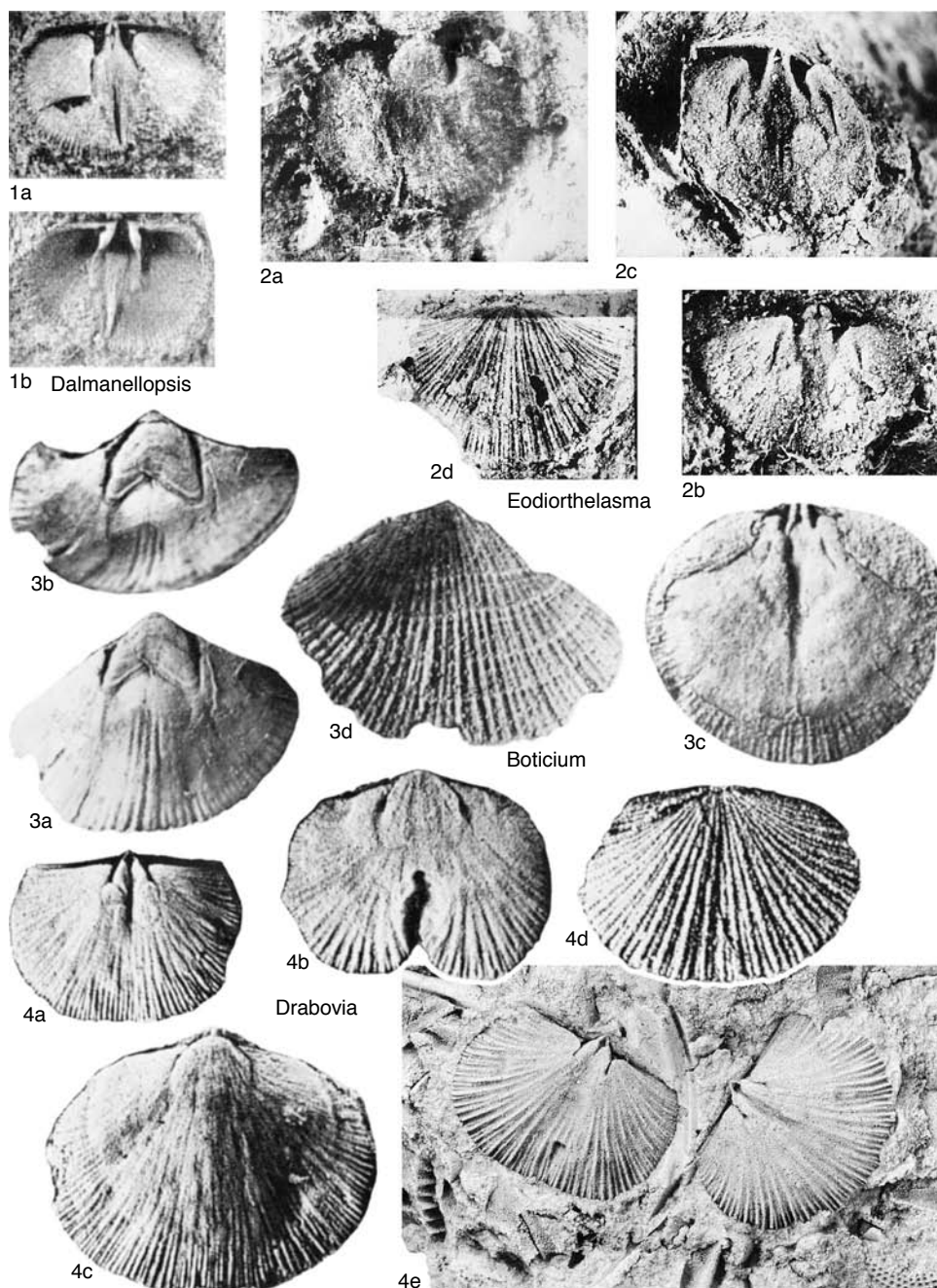


FIG. 600. *Draboviidae* (p. 826).

NULLO, 1974, p. 178]. Subcircular, dorsibiconvex, rectimarginate to weakly unisulcate valves with long straight ventral interarea; ventral interior with

subtriangular to suboval muscle scar; dorsal interior with small myophore and long shaft. *Upper Ordovician (Caradoc)–lower Silurian (Llandovery)*:

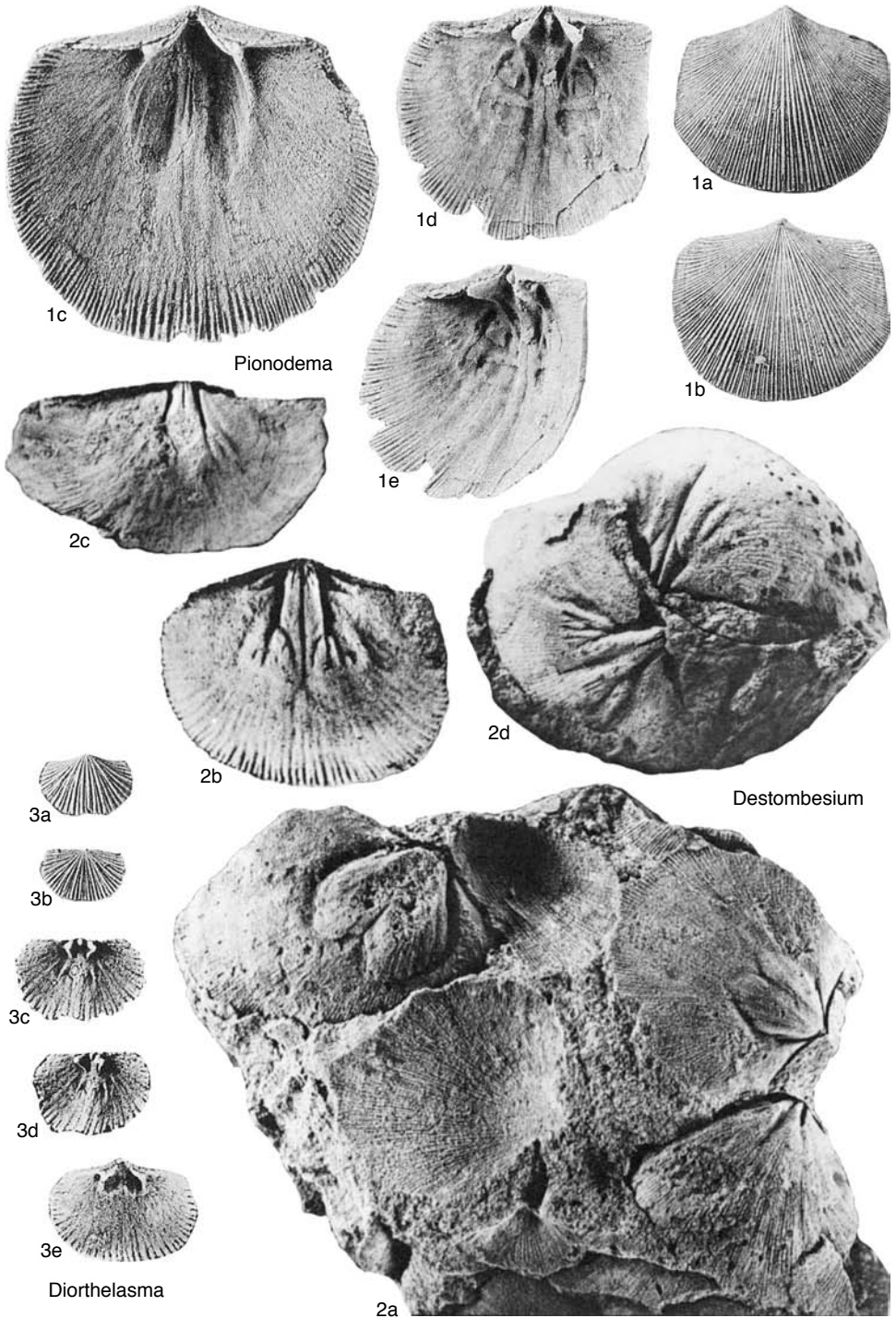


FIG. 601. Draboviidae (p. 826–831).

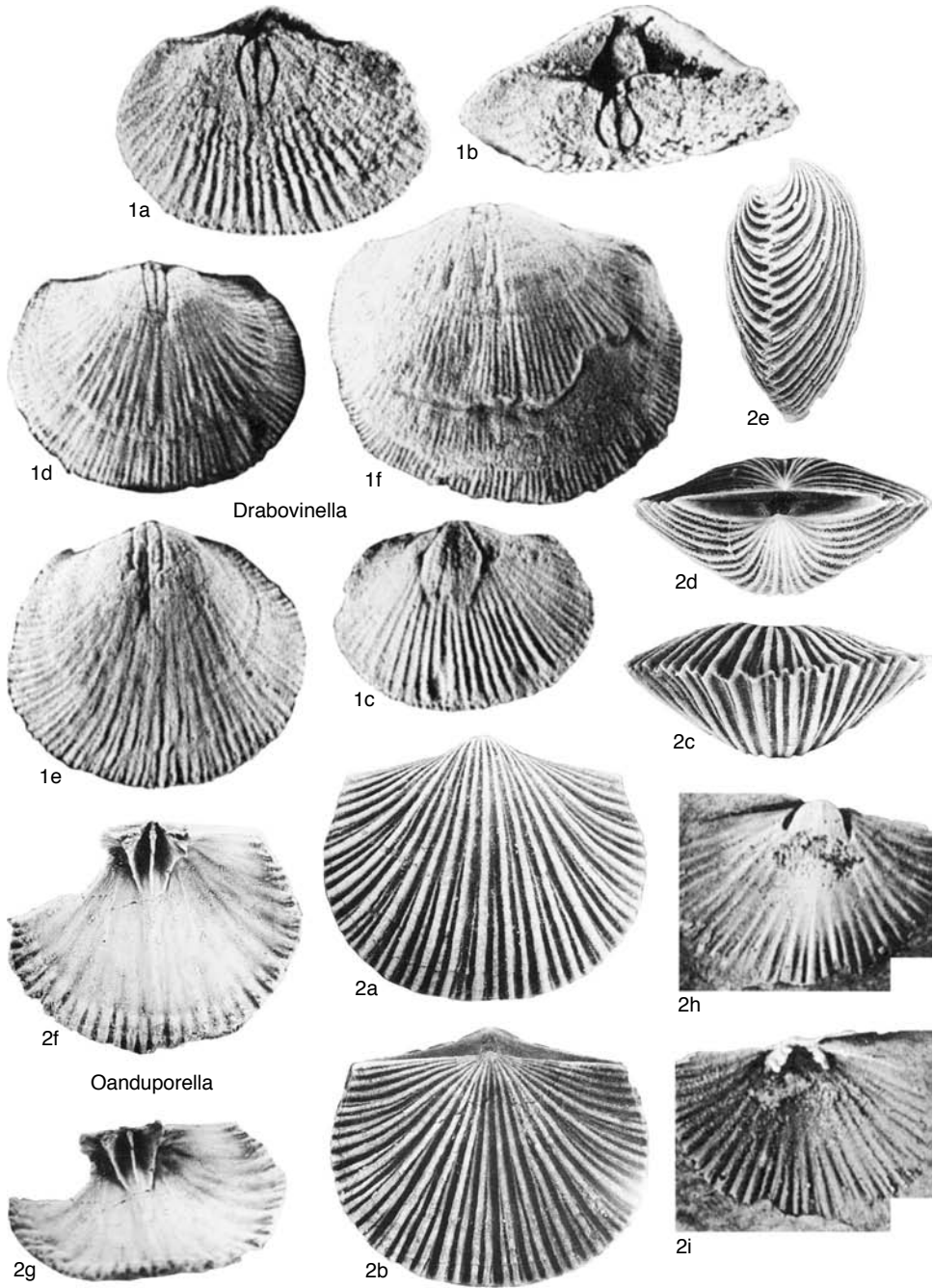


FIG. 602. Draboviidae (p. 826–831).

cosmopolitan.—FIG. 603, 1a–g. **H. sagittifera* (M'COY), Ashgill; a, b, normal, posterior views of internal mold of dorsal valve, Scotland, $\times 2$; c, rub-

ber replica of dorsal exterior, Scotland, $\times 2$ (Harper, 1989); d, internal mold of ventral valve, Bohemia, $\times 1.5$; e, internal mold of dorsal valve, Bohemia,

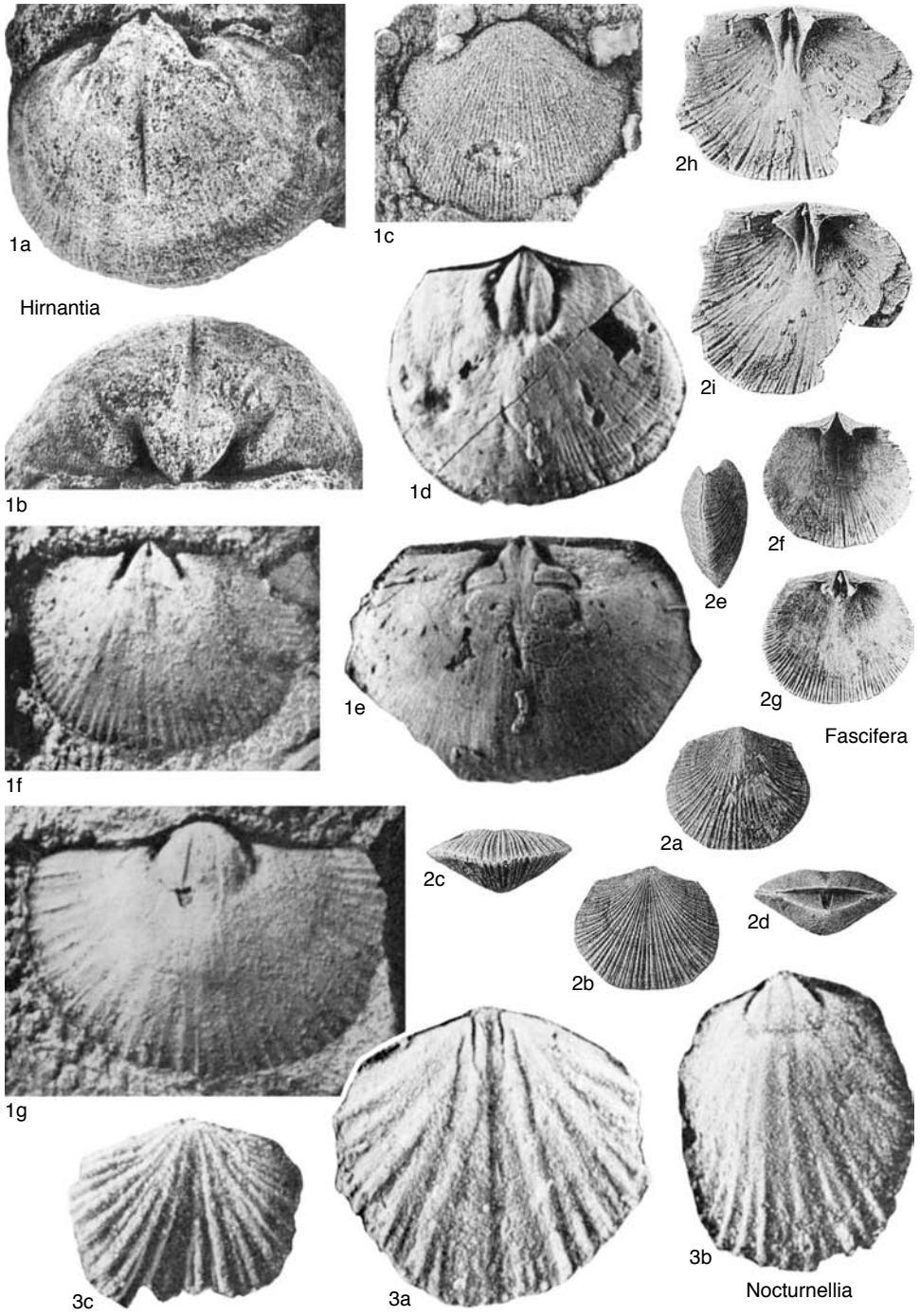


FIG. 603. Draboviidae (p. 826–831).

- ×1.7 (Havlíček, 1977a); *f*, internal mold of dorsal valve, Poland, ×3.3; *g*, internal mold of ventral valve, Poland, ×6.6 (Temple, 1965).
- Kinnella** BERGSTRÖM, 1968, p. 11 [**Hirnantia? kielanae* TEMPLE, 1965, p. 401; OD]. Subcircular, small, dorsibiconvex, rectimarginate valves; ventral interarea subpyramidal, apsacline to procline; ventral interior with suboval muscle scar; dorsal interior with bilobed, crenulated cardinal process. *Upper Ordovician (Ashgill)–lower Silurian (Llandovery)*: cosmopolitan.—FIG. 604,1a–f. **K. kielanae* (TEMPLE), Ashgill, Poland; *a*, internal mold of ventral valve, ×6.6; *b*, internal mold of dorsal valve, ×6.6; *c–e*, normal, lateral, posterior views of rubber replica of ventral exterior, ×6.6 (Temple, 1965); *f*, rubber replica of dorsal interior with attached ventral exterior, Sweden, ×1 (Bergström, 1968).
- Megasalopina** BUCOT, GAURI, & JOHNSON, 1966, p. 166 [**Dalmanella (Mystrophora) elevata* WILLIAMS & BREGER, 1916, p. 62; OD]. Subcircular, large valves with well-developed ventral median ridge and swollen cardinal process. *Lower Devonian (Lochkovian)*: USA.—FIG. 604,2a–e. **M. elevata* (WILLIAMS & BREGER), Lochkovian, Maine; *a, b*, internal mold, rubber replica of dorsal valve, ×1.5; *c, d*, internal mold, rubber replica of ventral valve, ×1.5; *e*, rubber replica of dorsal exterior, ×1.5 (Boucot, Gauri, & Johnson, 1966).
- Nocturnellia** HAVLÍČEK, 1950, p. 53 [**Orthis nocturna* BARRANDE, 1879, pl. 152, case IV]. Subcircular, small, unisulcate, fascicostellate valves, lacking aditicles; ventral interarea short, straight; dorsal interior with petaloid muscle scar contained by subparallel ridges; cardinal process ridgelike, uncrenulated. *Lower Ordovician (Arenig)*: Bohemia.—FIG. 603,3a–c. **N. nocturna* (BARRANDE), Arenig, Bohemia; *a*, internal mold of dorsal valve, ×8.3; *b*, internal mold of ventral valve, ×7.7; *c*, rubber replica of dorsal exterior, ×8.7 (Havlíček, 1977a).
- Oanduporella** HINTS, 1975, p. 19 [**O. reticulata*; OD]. Subquadrate, rectimarginate valves with honeycomb-like array of pits; ventral interarea short, straight; ventral interior with cordate muscle scar; dorsal interior with small, crenulated myophore and long shaft; adductor scar petaloid and elongate. *Upper Ordovician (Caradoc)*: eastern Baltic, Ireland.—FIG. 602,2a–i. **O. reticulata*, Caradoc; *a–e*, ventral, dorsal, anterior, posterior, lateral views of conjoined valves, eastern Baltic, ×5; *f, g*, normal, tilted views of dorsal interior, eastern Baltic, ×5.5 (Hints, 1975); *b, i*, internal mold, rubber replica of ventral interior, eastern Ireland, ×5 (Harper & others, 1985).
- Orthiella** LJASCHENKO, 1985, p. 11 [**O. devoniana*; OD]. Transversely oval, biconvex, uniplicate, small, coarsely costellate valves. *Upper Devonian (Frasnian)*: Siberia (Timan).—FIG. 604,3a–c. **O. devoniana*, Frasnian, Timan; *a, b*, exterior, interior of ventral valve, ×5; *c*, exterior of dorsal valve, ×5 (Ljaschenko, 1985).
- Pionodema** FOERSTE, 1912, p. 139, *nom. nov. pro Bathyoceilia* FOERSTE, 1909b, p. 221, *non* AMYOT & SERVILLE, 1843 [**Orthis subaequata* CONRAD, 1843, p. 333; OD]. Transversely semioval, dorsibiconvex valves with short, curved ventral interarea and orthocline dorsal interarea; ventral interior with extended muscle scar bisected by median ridge; dorsal interior with small, lobate cardinal process and thin shaft on low notothyrial platform; brachiophore plates converge anteriorly onto median ridge. *Upper Ordovician (Caradoc–Ashgill)*: North America, Europe.—FIG. 601,1a–e. **P. subaequata* (CONRAD), Caradoc, Missouri; *a, b*, ventral, dorsal views of conjoined valves, ×2; *c*, ventral interior, ×2; *d, e*, normal, tilted views of dorsal interior, ×2 (Cooper, 1956).
- Protomendacella** HAVLÍČEK, 1970a, p. 31 [**P. eos*; OD]. Dorsibiconvex valves; ventral interior with extended muscle scar having narrow, linear adductor field and long, narrowly divergent dental plates; dorsal interior with bilobed myophore and strong shaft commonly extended forward as short septum; high brachiophores with short plates convergent onto valve floor extend anteriorly as ridges laterally confining posterior areas of adductor muscle scar. [In the absence of well-preserved exteriors, HAVLÍČEK (1970a) tentatively included *Protomendacella* within the Rhipidomellidae on the basis of internal similarities with *Mendacella*. But he also noted similarities with the draboviid *Hirnantia*. The ventral and dorsal muscle fields together with the cardinalia suggest placement within the Draboviidae.] *Upper Ordovician (Caradoc)*: Morocco.—FIG. 605,1a, b. **P. eos*, Caradoc, Morocco; *a*, internal mold of ventral valve, ×2; *b*, internal mold of dorsal valve, ×2.1 (Havlíček, 1970a).
- Salopina** BUCOT, 1960a, p. 3 [**Orthis lunata* J. DE C. SOWERBY, 1839, p. 611; OD] [= *Salopinella* YANG & RONG, 1982, p. 433 (type, *S. minuta*)]. Transversely semioval valves with short, curved ventral interarea; ventral interior with cordate muscle scar bisected by variably developed median ridge. *Upper Ordovician (Ashgill)–Middle Devonian (Eifelian)*: cosmopolitan.—FIG. 605,4a–f. **S. lunata* (SOWERBY), Ludlow, England; *a, b*, internal mold, rubber replica of ventral valve, ×3; *c, d*, internal mold, rubber replica of dorsal valve, ×3; *e, f*, rubber replicas of dorsal, ventral exteriors of conjoined valves, ×2 (Walmsley, Boucot, & Harper, 1969).
- Sphenophragmus** IMBRIE, 1959, p. 365 [**S. nanus*; OD]. Subcircular, planoconvex valves with short, curved ventral and dorsal interareas; ventral interarea with cordate muscle scar and well-developed dental fosses; dorsal interior with elongate sockets and lobate myophore. *Middle Devonian (Givetian)*: North America.—FIG. 605,3a–f. **S. nanus*, Givetian, Michigan; *a–c*, ventral, dorsal,

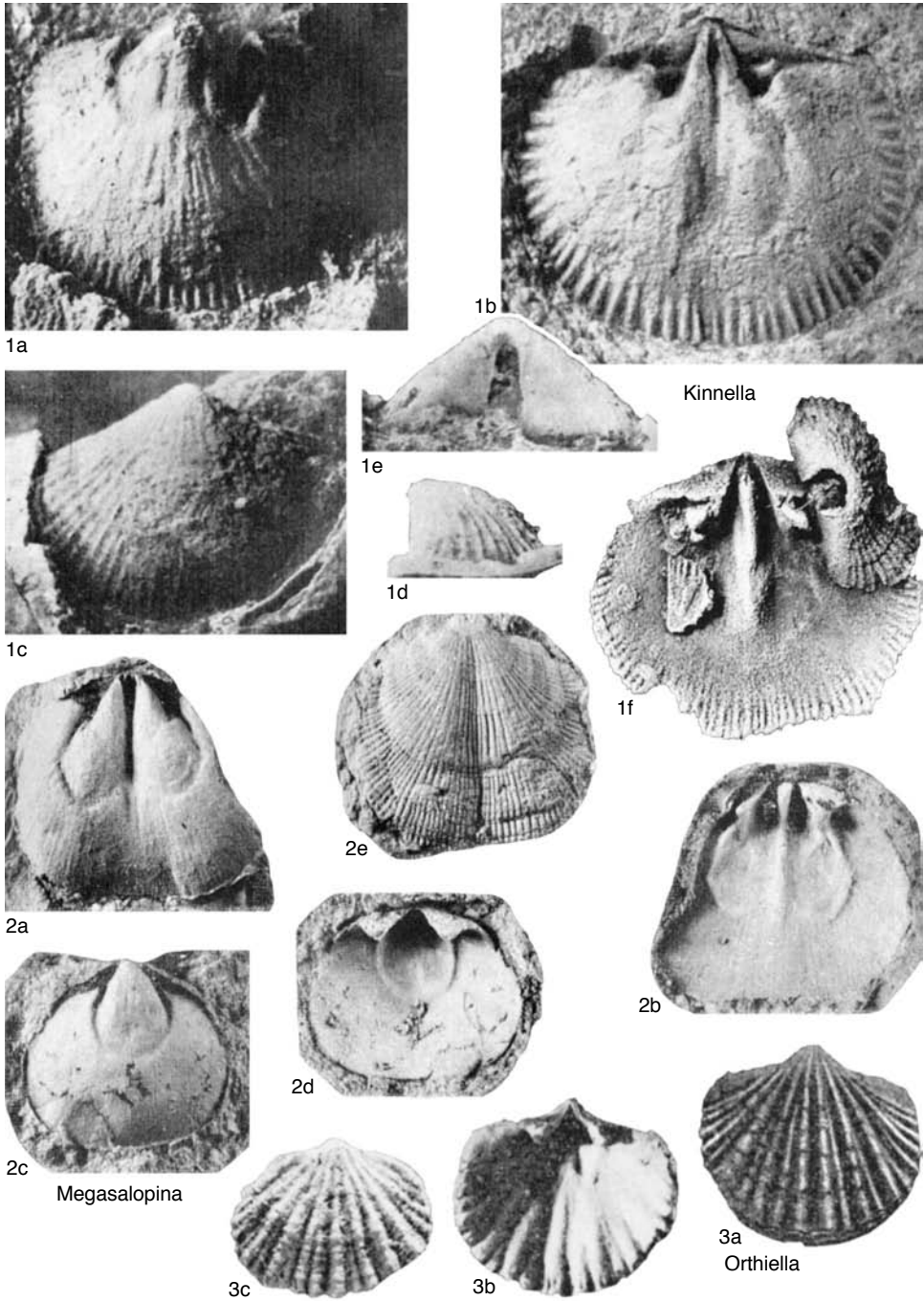


FIG. 604. Draboviidae (p. 831).

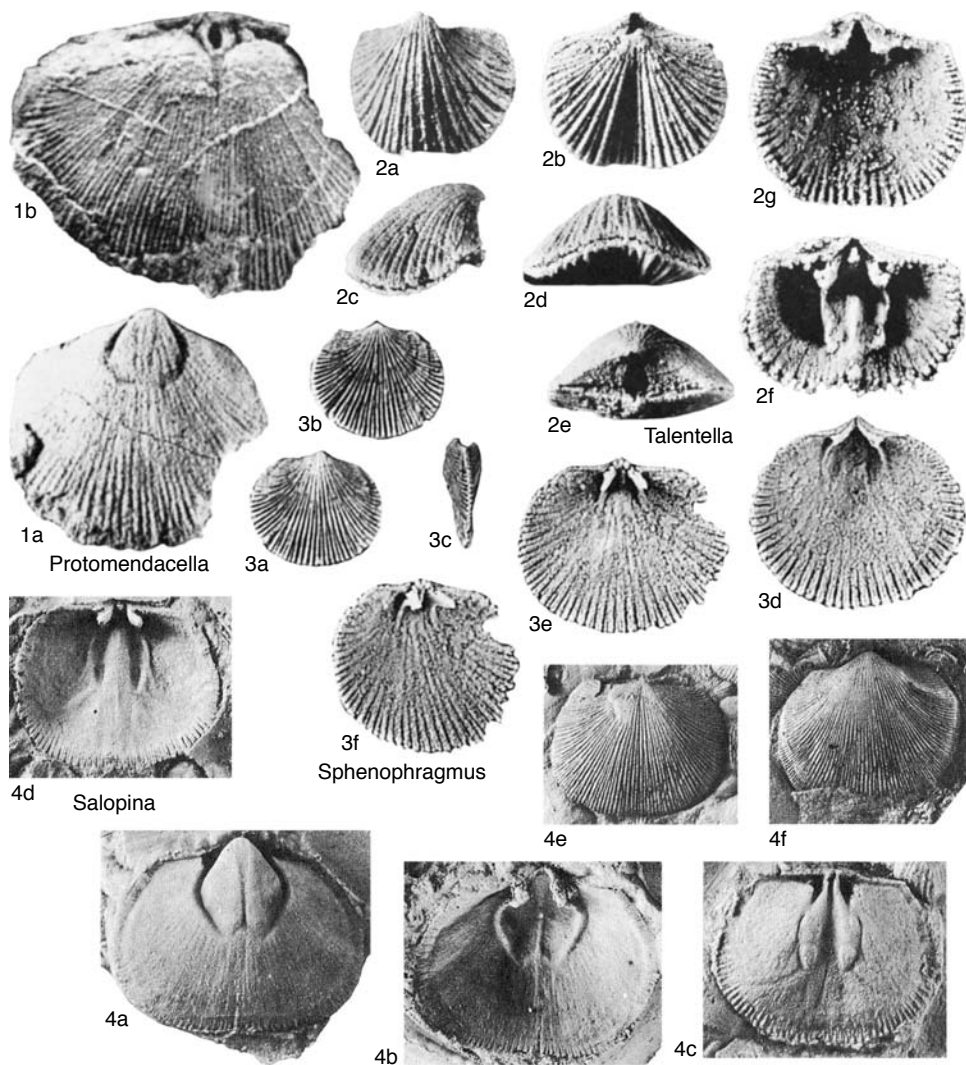


FIG. 605. Draboviidae (p. 831–833).

lateral views of conjoined pair, $\times 2$; *d*, ventral interior, $\times 4$; *e, f*, normal, oblique views of dorsal interior, $\times 4$ (Imbrie, 1959).

Talentella JOHNSON, 1990, p. 489 [**Salopina submurifer* JOHNSON, BOUCOT, & MURPHY, 1973, p. 26; OD]. Small valves similar to *Salopina* but with short undivided ventral muscle scar and narrow elongate dorsal diductor scars bisected by long median ridge. *upper Silurian (Přídolí)–Lower Devonian (Pragian)*: USA (Maine, Nevada), Arctic and northwestern Canada, eastern Australia, Podolia.—FIG. 605, 2*a–g*. **T. submurifer* (JOHNSON, BOUCOT, &

MURPHY), Lochkovian, Nevada; *a–e*, ventral, dorsal, lateral, anterior, posterior views of conjoined valves, $\times 5$; *f*, dorsal interior, $\times 7$; *g*, ventral interior, $\times 5$ (Johnson, Boucot, & Murphy, 1973).

Subfamily MONELASMINIINAE
new subfamily

[Monelasmminiinae HARPER, herein]

Small draboviids with well-developed dorsal median septum or partition. *Lower*

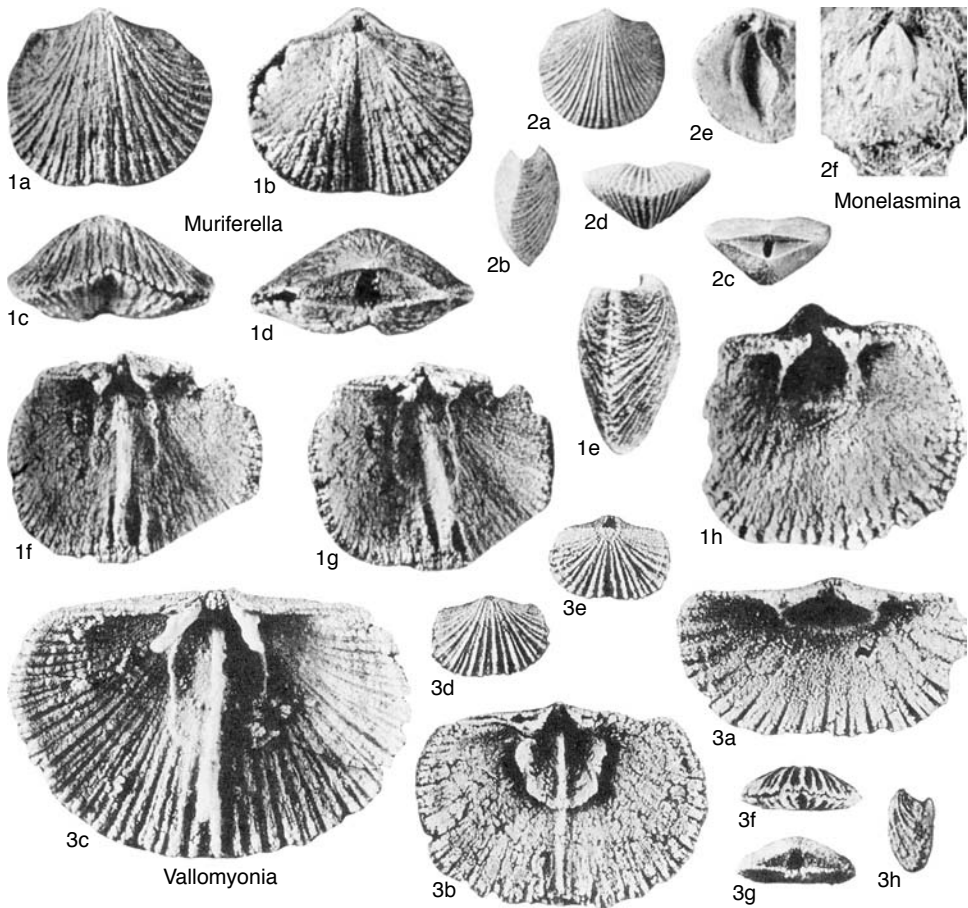


FIG. 606. Draboviidae (p. 834).

Devonian (Pragian)—Upper Devonian (Frasnian).

Monelasmina COOPER, 1955, p. 53 [*Orthis deshayesi* RIGAUX, 1873, p. 50; OD]. Subcircular, small, sharply unisulcate valves with long straight ventral interarea; ventral interior with well-developed dental fosses and recessive dental plates; dorsal interior with bilobed cardinal process, deep sockets and median partition. *Upper Devonian (Frasnian)*: Canada, Europe.—FIG. 606,2a-f. **M. deshayesi* (RIGAUX), Frasnian, France; a-d, ventral, lateral, posterior, anterior views of conjoined pair, $\times 3$; e, oblique view of dorsal interior, $\times 4$; f, internal mold of ventral valve, $\times 3$ (Cooper, 1955).

Muriferella JOHNSON & TALENT, 1967b, p. 44 [**M. masurskyi*; OD]. Transversely semioval, small valves, similar to *Salopina*; ventral interarea short, straight;

dorsal interior with well-developed median septum and uncrenulated cardinal process. *Lower Devonian (Pragian—Emsian)*: USA (Nevada), Australia (Victoria), Bohemia.—FIG. 606,1a-b. **M. masurskyi*, Emsian, Nevada; a-e, ventral, dorsal, anterior, posterior, lateral views of conjoined pair, $\times 4$; f,g, normal, oblique views of dorsal interior, $\times 6$; h, ventral interior, $\times 7$ (Johnson & Talent, 1967b).

Vallomyonia JOHNSON, 1966a, p. 158 [**Skenidium devonicum* WALCOTT, 1884, p. 116; OD]. Similar to *Muriferella* but with smaller dental plates, dorsal partition, and strong ridges confining dorsal adductor muscle field. *Middle Devonian (Eifelian—Givetian)*: USA (Nevada).—FIG. 606,3a-b. **V. devonicum* (WALCOTT), Eifelian, Nevada; a, ventral interior, $\times 6$; b, dorsal interior, $\times 4$; c, interior of dorsal valve, $\times 8$; d-h, ventral, dorsal, anterior, posterior, lateral views of conjoined valves, $\times 5$ (Johnson, 1966a).

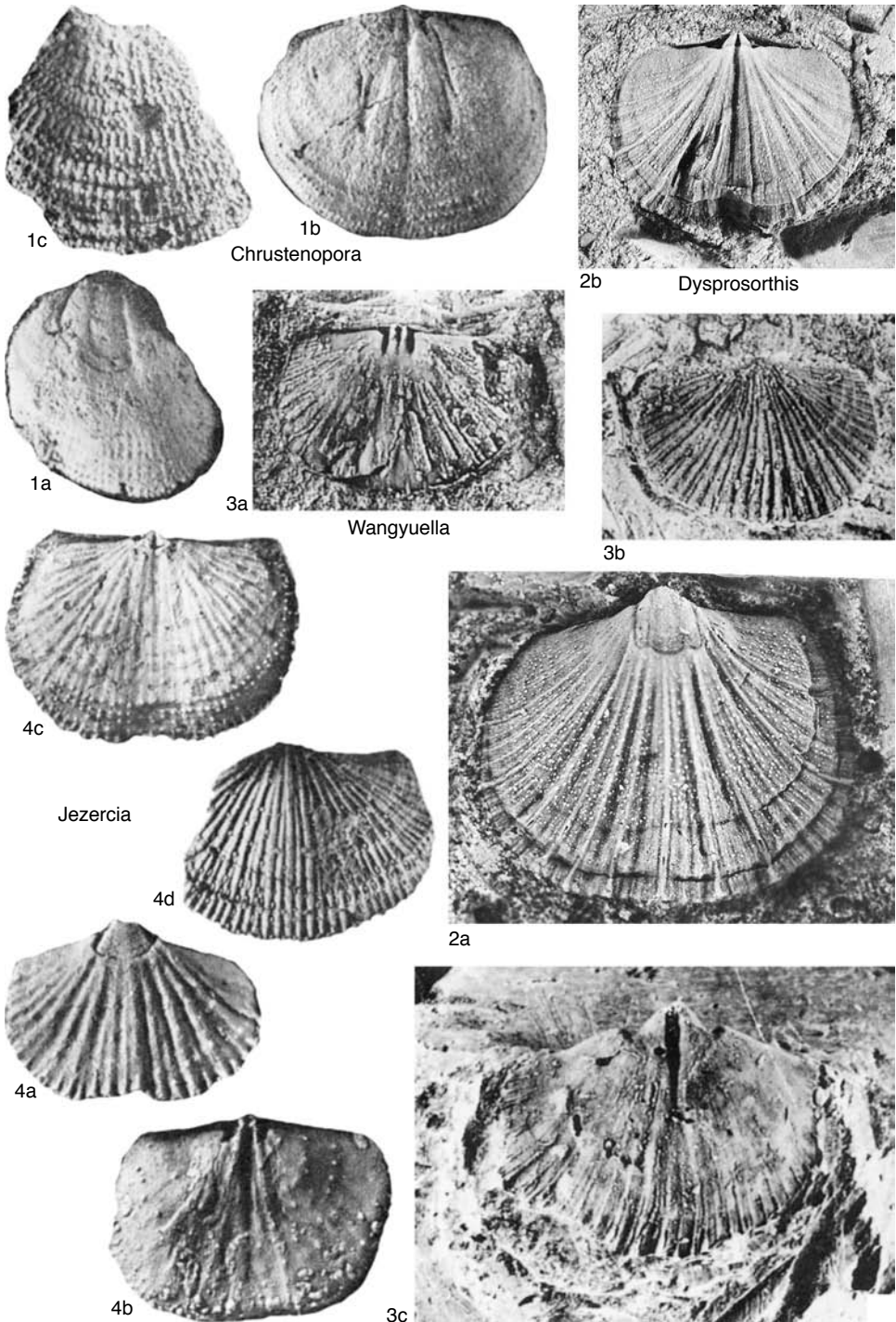


FIG. 607. Chrustenoporidae (p. 836).

Family CHRUSTENOPORIDAE
Havlíček & Mergl, 1982

[*nom. transl.* BAARLI, 1988, p. 1124, ex Chrustenoporinae HAVLÍČEK & MERGL, 1982, p. 39]

Normally unequally biconvex, rectimarginate, fascicostellate to multicostellate enteletoids commonly with aditicles; ventral and dorsal interareas both short and apsacline and anacline, respectively; ventral muscle scar suboval to subtriangular; dental plates divergent; dorsal interior with short cardinalia comprising crenulated cardinal process and widely divergent brachiophores having short, subparallel plates; anterior muscle scars usually larger than posterior pair and separated by oblique transverse ridges; fulcral plates commonly present. *Upper Ordovician (Caradoc)–lower Silurian (Llandovery)*.

Chrustenopora HAVLÍČEK, 1968, p. 123 [**C. imbricata*; OD]. Subcircular, biconvex valves with multicostellate and imbricate radial and concentric ornaments; ventral interior with median groove; dorsal muscle scar linear. *Upper Ordovician (Caradoc)–lower Silurian (Llandovery)*: Bohemia, southern Norway. —FIG. 607,1a–c. **C. imbricata*, Caradoc, Bohemia; *a*, internal mold of ventral valve, $\times 3$; *b*, internal mold of dorsal valve, $\times 2.1$; *c*, external mold of dorsal valve, $\times 3.5$ (Havlíček, 1977a).

Dysprosorthis RONG, 1984, p. 133 [**D. sinensis*; OD]. Small, biconvex, fascicostellate valves; ventral interarea short, curved; ventral interior with subtriangular to suboval muscle scar and rudimentary teeth and dental plates; dorsal interior with short cardinalia including small cardinal process and very widely divergent brachiophores; muscle scar petaloid. *Upper Ordovician (Ashgill)*: England, Ireland, Morocco, China. —FIG. 607,2a, b. **D. sinensis*, Ashgill, southwestern China; *a*, internal mold of ventral valve, $\times 8$; *b*, internal mold of dorsal valve, $\times 6$ (Rong, new).

Jezerzia HAVLÍČEK & MERGL, 1982, p. 40 [**J. ostiaria*; OD]. Transversely semioval, biconvex to dorsibiconvex valves with coarse, fascicostellate ornament; ventral interior with subtriangular muscle scar; dorsal interior with crenulated, ridgelike cardinal process continuous with median ridge; dorsal muscle scar petaloid. *Upper Ordovician (Ashgill)–lower Silurian (Llandovery)*: Bohemia, southern Norway, Podolia, Sardinia, Spain, Ukraine. —FIG. 607,4a–d. **J. ostiaria*, Ashgill, Bohemia; *a*, internal mold of ventral valve, $\times 6$; *b*, internal mold of dorsal valve, $\times 5$; *c, d*, internal, external molds of dorsal valve, $\times 4$ (Havlíček & Mergl, 1982).

Wangyuella ZHAN & RONG, 1995, p. 551 [**W. ventribiconvexa*; OD]. Transverse, small valves with

long, apsacline ventral interarea; ventral interior with short dental plates and small subtriangular muscle scar; dorsal interior with short cardinalia having bilobed, crenulated myophore and subparallel brachiophore plates. *Upper Ordovician (Ashgill)*: eastern China. —FIG. 607,3a–c. **W. ventribiconvexa*, Ashgill, eastern China; *a, b*, internal, external molds of dorsal valve, $\times 8$; *c*, internal mold of ventral valve, $\times 5$ (Zhan & Rong, 1995).

Family LINOPORELLIDAE
Schuchert & Cooper, 1931

[Linoporellidae SCHUCHERT & COOPER, 1931, p. 247]

Normally subcircular, medium-sized, multicostellate enteletoids with variably developed aditicles; ventral interarea normally short, curved, and apsacline, dorsal interarea shorter, curved, and anacline; ventral interior with raised, variably cordate muscle scar and pedicle callist; dorsal interior with brachiophore plates convergent onto median ridge to form septalium; cardinal process usually simple; dorsal adductors with posterior scars larger than anterior pair; fulcral plates present; ventral mantle canal system probably saccate, dorsal lemniscate. *Lower Ordovician (Llanvirn)–Lower Devonian (Emesian)*.

Linoporella SCHUCHERT & COOPER, 1931, p. 247 [**Orthis punctata* DE VERNEUIL, 1848a, p. 343; OD]. Biconvex, unisulcate valves with radial rows of intercostellate pits; ventral interior with projecting dental plates and median ridge bisecting elongate muscle scar; cardinalia with swollen myophore and shaft, adductor scar elongately oval. *lower Silurian (Llandovery)–upper Silurian (Ludlow)*: Europe, eastern North America. —FIG. 608,1a–g. **L. punctata* (DE VERNEUIL), Wenlock, Gotland; *a, b*, dorsal, lateral views of conjoined valves, $\times 2$ (Wright, 1965a); *c, d*, external, internal views of ventral valve, $\times 1.5$; *e*, posterior part of dorsal interior showing cardinalia, $\times 2$ (Schuchert & Cooper, 1932); *f*, normal view of dorsal valve of conjoined pair, $\times 2$; *g*, enlarged view of dorsal valve of conjoined pair, $\times 5$ (Amsden, 1974).

Cycladigera HAVLÍČEK, 1971b, p. 230 [**Orthis palliata* BARRANDE, 1848, pl. 19, fig. 6; OD]. Large, biconvex, rectimarginate valves lacking aditicles; ventral interior with long, divergent dental plates, confining large, oval diductor muscle scar bisected by median ridge; adductor scar long and narrow; dorsal interior with simple, ridgelike cardinal process, located in deep notothyrial cavity and continuous anteriorly with prominent median septum. *Lower Devonian (Pragian–Emesian)*: Europe. —FIG. 608,3a–e. **C.*

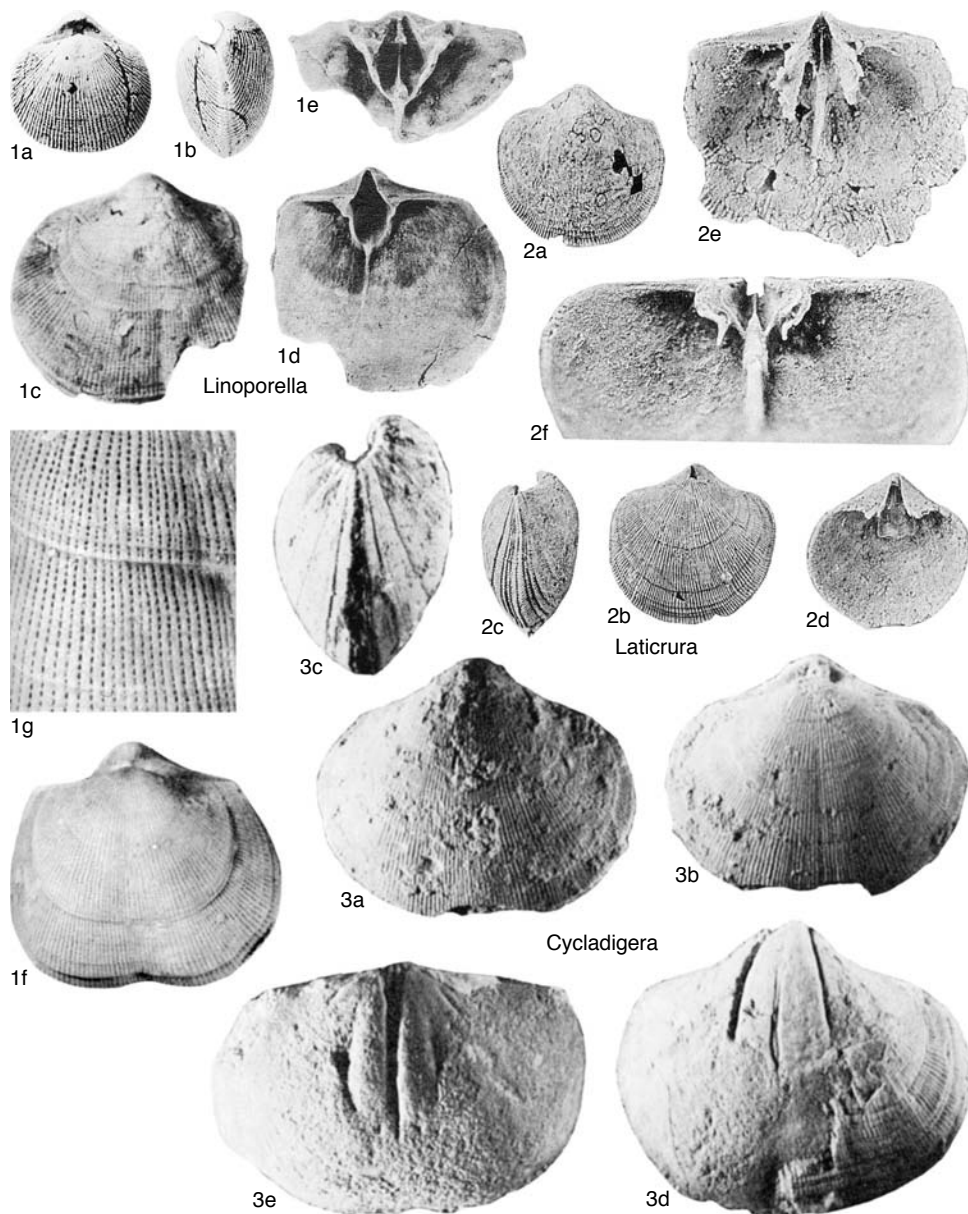


FIG. 608. Linoporellidae (p. 836–838).

*palliat*a (BARRANDE), Pragian, Bohemia; *a*–*c*, ventral, dorsal, lateral views of conjoined valves, $\times 1.5$; *d*, internal mold of ventral valve, $\times 1.4$; *e*, internal mold of dorsal valve, $\times 1.5$ (Havlíček, 1977a). *Elasmothyris* COOPER, 1956, p. 983 [**E. concinnula*; OD]. Small, transversely semioval valves with

aditicles; profiles ventribiconvex and unisulcate; ventral muscle scar on raised plate adjacent to divergent dental plates; cardinalia with expanded myophore and shaft and widely divergent brachiophores. Upper Ordovician (Caradoc); eastern USA.—FIG. 609,2*a*–*f*. **E. concinnula*, Caradoc,

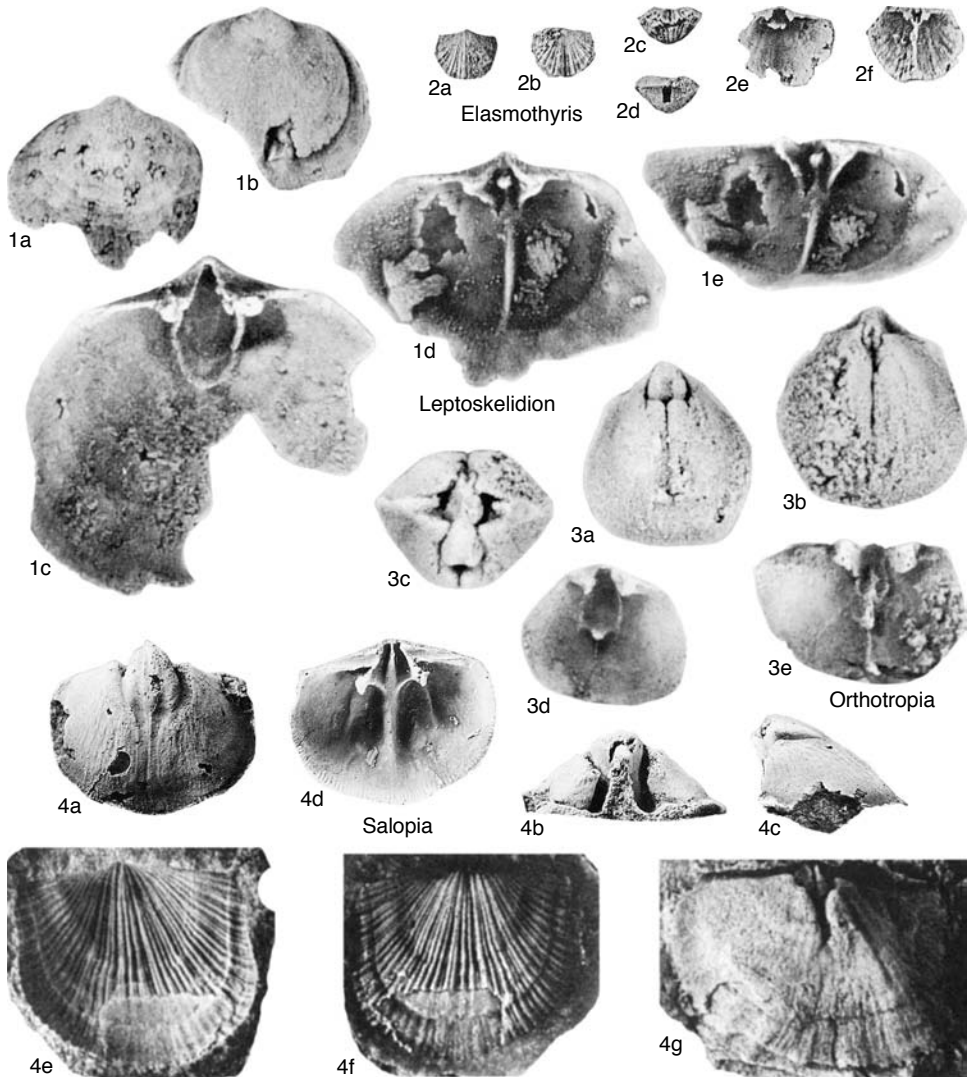


FIG. 609. Linoporellidae (p. 837–839).

Alabama; *a–d*, ventral, dorsal, anterior, posterior views of conjoined valves, $\times 5$; *e*, ventral interior, $\times 8$; *f*, dorsal interior, $\times 8$ (Cooper, 1956).

Laticrura COOPER, 1956, p. 979 [**L. pionodema*; OD]. Ventribiconvex, rectimarginate valves with occasional adticules; ventral interior with convergent dental plates; dorsal interior with simple, ridgelike cardinal process and large brachiophores, sigmoidal in section. *Upper Ordovician (Caradoc–Ashgill)*: eastern North America, Scotland, Ireland.—FIG. 608, *2a–f*. **L. pionodema*, Caradoc, Virginia; *a–c*, ventral, dorsal, lateral views of conjoined valves, $\times 2$; *d*, ventral interior, $\times 2$; *e*, dorsal interior, $\times 4$; *f*, pos-

terior part of dorsal interior showing cardinalia, $\times 6$ (Cooper, 1956).

Leptoskelidion AMSDEN, 1974, p. 47 [**L. septulosum*; OD]. Biconvex, rectimarginate valves with adticules; valve exterior imbricate, lacking well-defined radial ornament; ventral interior with convergent dental plates confining oval muscle field; cardinalia with swollen myophore and shaft. *Upper Ordovician (Ashgill)*: eastern North America, Scandinavia, Russia.—FIG. 609, *1a–e*. **L. septulosum*, Ashgill, Missouri; *a*, ventral exterior, $\times 3$; *b*, dorsal exterior, $\times 3$; *c*, ventral interior, $\times 5$; *d, e*, normal, tilted views of dorsal interior, $\times 5$ (Amsden, 1974).

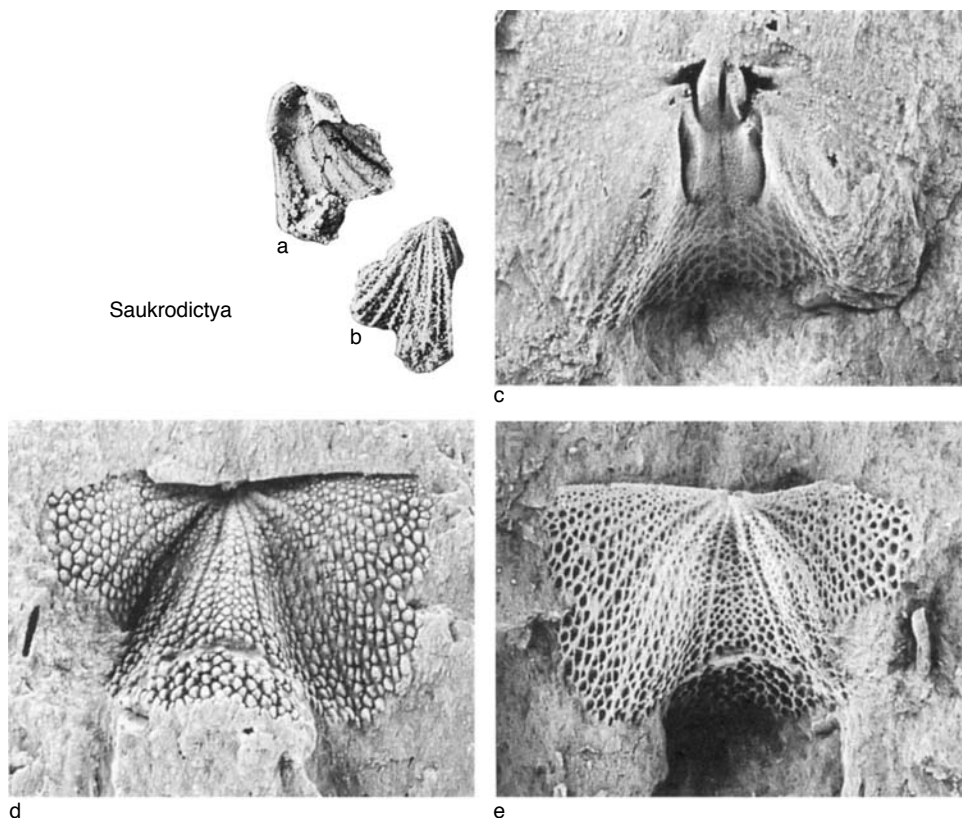


FIG. 610. Saukrodictyidae (p. 839–840).

Orthotropia HALL & CLARKE, 1894b, p. 943 [**O. dolomitica*; M]. Ventribiconvex, unisulcate valves; ventral interior with projecting dental plates and median ridge; cardinal process simple, ridgelike. *middle Silurian* (Wenlock): USA (Wisconsin).—FIG. 609,3a–e. **O. dolomitica*, Wenlock, Wisconsin; a–c, ventral, dorsal, posterior views of conjoined internal molds, $\times 2$; d, e, rubber replicas of same ventral, dorsal interiors, $\times 2$ (Amsden, 1974).

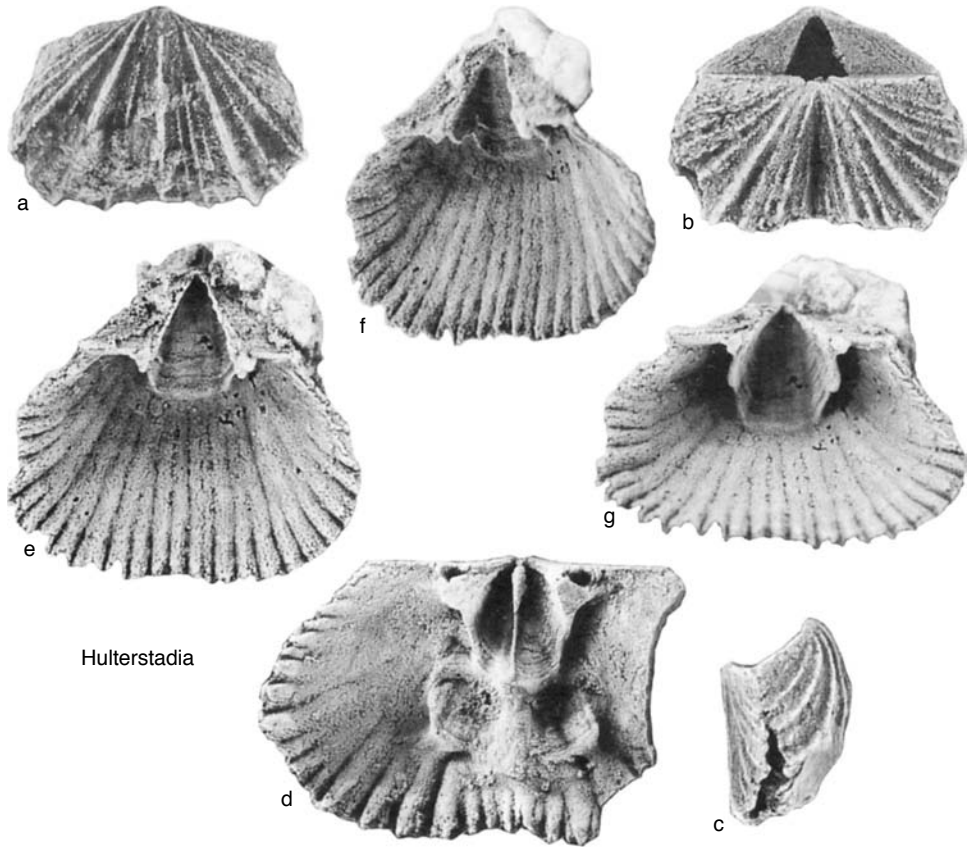
Salopia WILLIAMS in WHITTINGTON & WILLIAMS, 1955, p. 409 [**Orthis salteri* DAVIDSON, 1871, p. 255; OD]. Biconvex, rectimarginate valves with high, nearly catacline ventral interarea; ventral interior with convergent dental plates; cardinalia with simple, ridgelike cardinal process. *Lower Ordovician* (Llanvirn)—*Upper Ordovician* (Caradoc): Britain. —FIG. 609,4a–d. **S. salteri* (DAVIDSON), Caradoc, England; a–c, ventral, posterior, lateral views of internal mold of ventral valve, $\times 2$; d, rubber replica of dorsal interior, $\times 2$ (Wright, 1965a). —FIG. 609,4e–g. *S. abbreviata* HARPER & BRENCHLEY, Caradoc, northern Wales; e, f; external mold, rubber replica of ventral valve, $\times 2$; g, internal mold of dorsal valve, $\times 2$ (Harper & Brenchley, 1993).

Family SAUKRODICTYIDAE Wright, 1964

[Saukrodictyidae WRIGHT, 1964, p. 218; *emend.*, HARPER, herein]

Small, normally ventribiconvex and multicostellate enteletoids with honeycomb-like array of intercostal pits; long, curved ventral interarea; cardinalia with weak myophore and shaft and spikelike brachiophores; notothyrial floor extended forward as septalium; fulcral plates present. *Upper Ordovician* (Caradoc)—*lower Silurian* (Llandovery).

Saukrodictya WRIGHT, 1964, p. 218 [**S. hibernica*; OD]. Transversely semioval, unisulcate valves with short septalium. *Upper Ordovician* (Caradoc)—*lower Silurian* (Llandovery): Britain, Ireland, Belgium, Baltic states, Bohemia, Sardinia, Spain, Siberia. —FIG. 610a, b. **S. hibernica*, Ashgill, Ireland; interior, exterior of broken ventral valve, $\times 5$ (Wright,



Hulterstadia

FIG. 611. Saukrodictyidae (p. 840).

1964).—FIG. 610*c–e*. *S. phillipi* (DAVIDSON), Ashgill, Wales; internal mold, external mold, rubber replica of dorsal valve, $\times 8$ (Wright, 1993a).

Hulterstadia WRIGHT, 1993a, p. 73 [**Orthis cor* WIMAN, 1907, p. 9; OD]. Cordate, strangulate valves with long septalium. *Upper Ordovician (Ashgill)*: Sweden.—FIG. 611*a–g*. **H. cor* (WIMAN), Ashgill, Sweden; *a–c*, ventral, dorsal, lateral views of conjoined valves, $\times 8$; *d*, dorsal interior, $\times 8$; *e–g*, normal and tilted views of ventral interior, $\times 8$ (Wright, 1993a).

Family SCHIZOPHORIIDAE Schuchert & LeVene, 1929

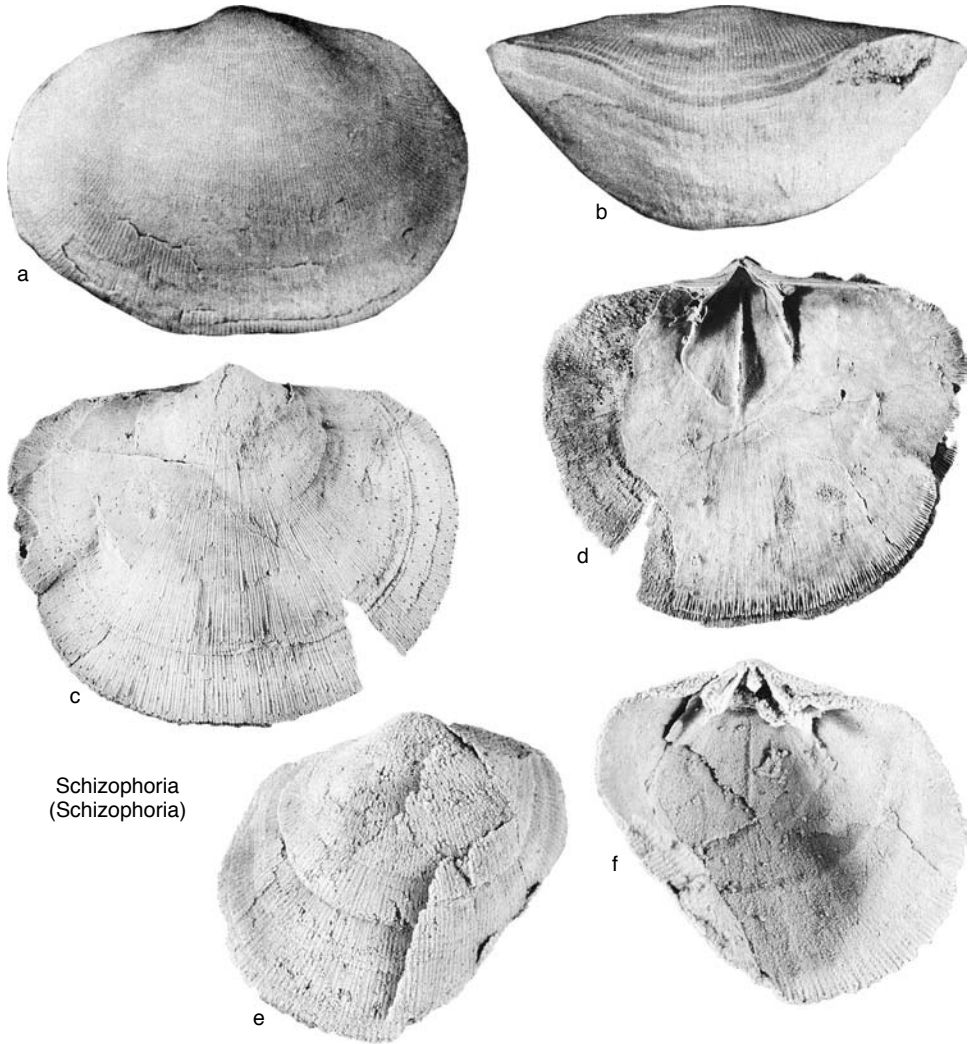
[*nom. transl.* SCHUCHERT & COOPER, 1932, p. 139, *ex* Schizophoriinae SCHUCHERT & LEVENE, 1929, p. 15]

Normally large, dorsibiconvex, multicostellate enteletoids; ventral interior with variably developed median septum, bisecting

bilobed to cordate muscle scar; pedicle callist present; dorsal interior with petaloid adductor field confined posterolaterally by brachiophore plates. *middle Silurian (Wenlock)–Upper Permian (Tatarian)*.

Schizophoria KING, 1850, p. 106 [**Conchyliolithus (Anomites) resupinatus* MARTIN, 1809, pl. 49, fig. 13–14; OD]. Normally transversely semioval, weakly uniplicate valves; ventral interior with strong teeth and dental plates extending forward as ridges laterally confining ventral muscle field; dorsal interior with prominent, crenulated cardinal process. *Lower Devonian (Lochkovian)–Lower Carboniferous (Viséan)*: cosmopolitan.

S. (Schizophoria) KING, 1850, p. 106 [**Conchyliolithus (Anomites) resupinatus* MARTIN, 1809, pl. 49, fig. 13–14; OD]. Dorsibiconvex *Schizophoria* with divergent dental plates confining bilobed to widely cordate ventral muscle field; dorsal



Schizophoria
(Schizophoria)

FIG. 612. Schizophoriidae (p. 840–841).

diductor scar petaloid and equidimensional. [LAZAREV (1976) established two subgenera for this widespread and common mid-Paleozoic genus; *Paraschizophoria* is based on the *S. woodi* BOND and *S. antiqua* SOLLE group and *Pocockia* on the *S. gibbera* (PORTLOCK), *S. linguata* (QUENSTEDT), and *S. annectans* POCOCK group, established by POCOCK (1968). As many of the diagnostic features of each subgenus are manifest in the main *Schizophoria* lineage, their use is restricted.] Lower Devonian (Lochkovian)—Lower Carboniferous (Viséan): cosmopolitan.—FIG.

612*a,b*. **S. (S.) resupinata* (MARTIN), Viséan, Isle of Man; dorsal, anterior views of conjoined valves, $\times 1.5$ (Pocock, 1968).—FIG. 612*c-f*. *S. (S.) resupinata lata* DEMANET, Viséan, western Ireland; *c,d*, exterior, interior of ventral valve, $\times 0.85$; *e,f*, exterior, interior of dorsal valve, $\times 2$ (Jeffrey, new).

S. (Paraschizophoria) LAZAREV, 1976, p. 110 [**Schizophoria woodi*; OD]. Similar to *S. (Schizophoria)* but imbricate with narrow ventral and dorsal muscle fields. Lower Devonian (Lochkovian)—Lower Carboniferous (Viséan):

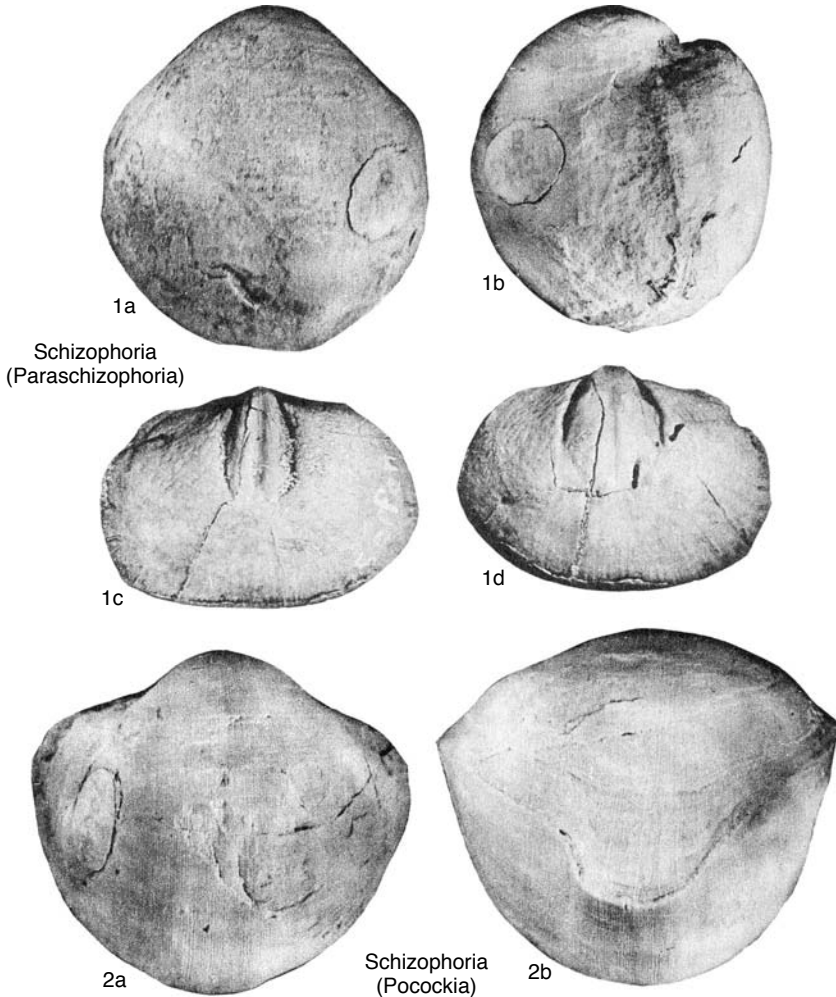


FIG. 613. Schizophoriidae (p. 841–842).

- Europe.—FIG. 613, *1a, b*. **S. (P.) woodi*, Viséan, Isle of Man; dorsal, lateral views of conjoined pair, $\times 1.5$ (Pocock, 1968).—FIG. 613, *1c, d*. *S. (P.) antiqua* SOLLE, Emsian, Germany; ventral, dorsal views of conjoined internal molds, $\times 1.5$ (Pocock, 1966).
- S. (*Pocockia*) LAZAREV, 1976, p. 112 [*Atrypa (Porambonites) gibbera* PORTLOCK, 1843, p. 460; OD]. Similar to *S. (Schizophoria)* but with geniculate ventral valve and narrow, linear ventral muscle field confined by parallel dental plates; dorsal diductor scar elongate. *Lower Carboniferous (Tournaisian–Viséan)*: Europe.—FIG. 613, *2a, b*. **S. (Pocockia) gibbera* (PORTLOCK),

Viséan, northern Ireland; dorsal, anterior views of conjoined valves, $\times 1.5$ (Pocock, 1968).

Acosarina COOPER & GRANT, 1969, p. 2 [**A. dorsisulcata*; OD]. Transversely semioval, medium-sized, biconvex valves; ventral interior with small teeth, large fossettes, and short dental plates; dorsal interior with widely divergent brachioophore plates and deep sockets. *Upper Carboniferous–Upper Permian*: USA (Texas, New Mexico), China, Thailand, Venezuela.—FIG. 614, *1a–i*. **A. dorsisulcata*, middle Permian, Texas; *a–e*, ventral, dorsal, anterior, posterior, lateral views of conjoined valves, $\times 1$; *f*, ventral interior, $\times 2$; *g, b*, normal, tilted views of dorsal interior, $\times 2$; *i*, dorsal interior, $\times 2$ (Cooper & Grant, 1976).

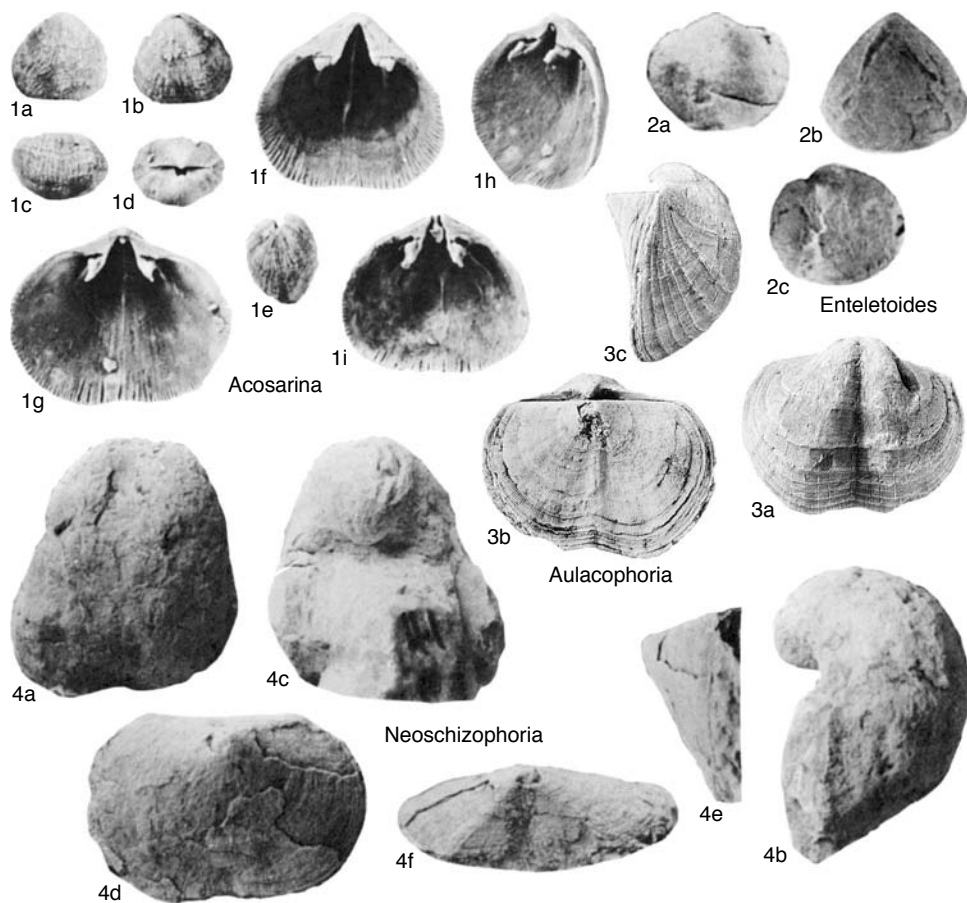


FIG. 614. Schizophoriidae (p. 842–843).

Aulacophoria SCHUCHERT & COOPER, 1931, p. 247 [**Orthis keyserlingia* DE KONINCK, 1843, p. 230; OD]. Similar to *Schizophoria* but planoconvex, sharply unisulcate with commonly flat, catacline ventral interarea. Lower Carboniferous–Upper Carboniferous: Europe, Urals.—FIG. 614, 3a–c. **A. keyserlingia* (DE KONINCK), lower Carboniferous, England; ventral, dorsal, lateral views of conjoined valves, $\times 1$ (Wright, 1965a).

Enteletoides STUCKENBERG, 1905, p. 59 [**E. rossicus*; OD]. Similar to *Schizophoria* but small with extravagantly developed dental plates and ventral median septum. Carboniferous: Russia, central Asia, China.—FIG. 614, 2a–c. *E. shuichengensis*, Upper Carboniferous, southern China; dorsal, ventral, lateral views of conjoined valves, $\times 1$ (Ching & Liao, 1974).

Eschizophoria RONG & YANG, 1980, p. 286 [**Schizophoria hesta* RONG & YANG in RONG, XU, & YANG, 1974, p. 202; OD]. Small, biconvex valves; ventral

interior with long, thin median ridge bisecting muscle scar; dorsal interior with delicate cardinalia, brachiophores narrowly divergent. upper Silurian (Ludlow)–Lower Devonian (Pragian): China, Canada, central Asia, Podolia, USA.—FIG. 615, 1a–c. **E. hesta* (RONG & YANG), Ludlow, southern China; ventral, dorsal, lateral views of conjoined pair, $\times 1$ (Rong, new).

Neoschizophoria YANAGIDA, 1983, p. 103 [**N. otai*; OD]. Similar to *Schizophoria* but unisulcate with flat, procline ventral interarea and modified cardinal process. Lower Carboniferous (Viséan)–Upper Carboniferous (Namurian): southwestern Japan.—FIG. 614, 4a–f. **N. otai*, Viséan–Namurian, southwestern Japan; a–c, dorsal, lateral, ventral views of dorsal exterior, $\times 1$; d–f, ventral, lateral, posterior views of ventral exterior, $\times 2$ (Yanagida, 1983).

Orthotichia HALL & CLARKE, 1892, p. 213 [**Orthis? morganiana* DERBY, 1874, p. 29; OD]

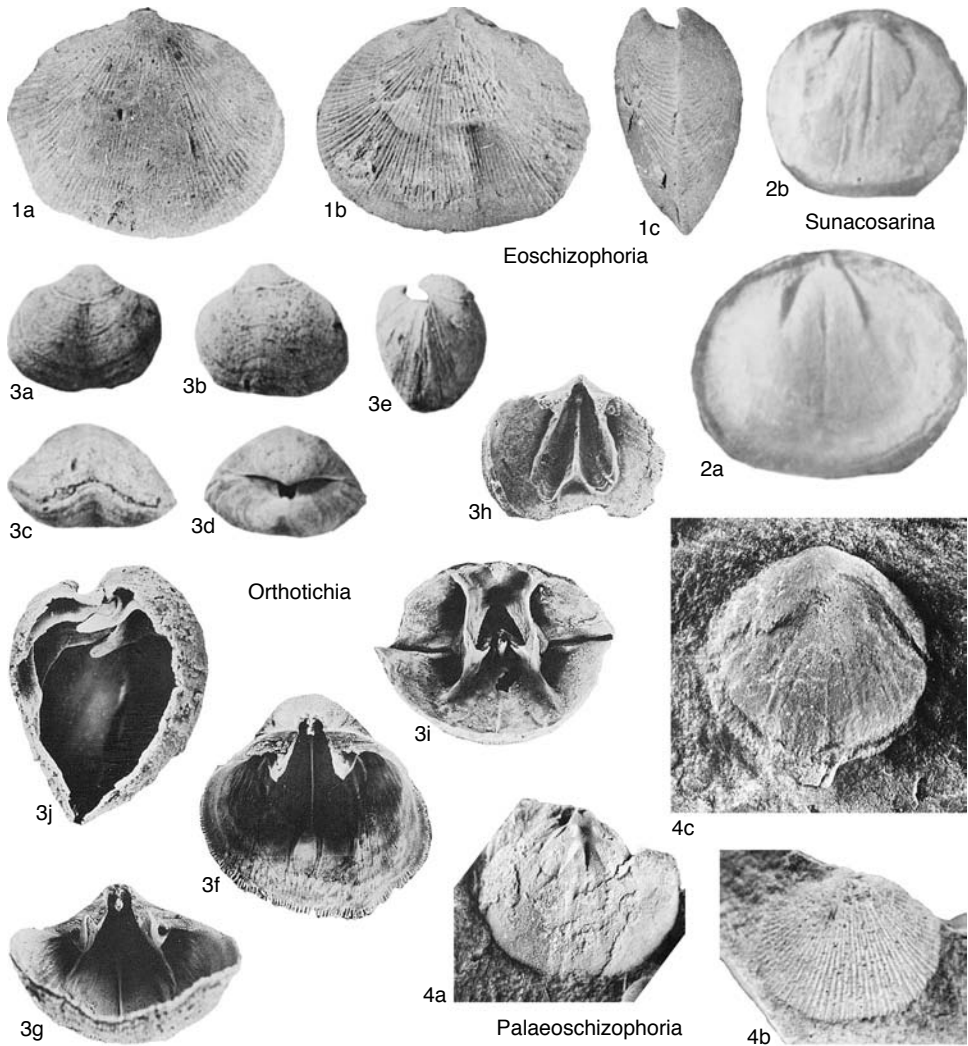


FIG. 615. Schizophoriidae (p. 843–844).

[=*Orthotichina* CHERNYSCHEV, 1914, pl. VII, fig. 1]. Similar to *Schizophoria* but more finely costellate with strong dental plates extending forward, as high ridges, to in front of muscle field together with well-developed ventral median septum. *Upper Carboniferous* (Namurian)—*Upper Permian* (Tatarian): widespread.—FIG. 615, 3a–j. *O. kozlowskii* KING, middle Permian, Texas; a–e, ventral, dorsal, anterior, posterior, lateral views of conjoined valves, $\times 1$; f, g, normal, tilted views of dorsal interior, $\times 2$; h, ventral interior, $\times 2$; i, posterior view of conjoined valves, $\times 2$; j, lateral view of conjoined valves, $\times 2$ (Cooper & Grant, 1976).

Palaeoschizophoria FU, 1982, p. 108 [*P. latisepta*; OD]. Transversely semioval, weakly uniplicate valves; ventral interior with short dental plates; dor-

sal interior with short, ridgelike cardinal process and short brachiophore plates. *middle Silurian* (Wenlock): northwestern China, western USA (California).—FIG. 615, 4a–c. *P. latisepta*, Wenlock, northwestern China; a, internal mold of dorsal interior, $\times 1$; b, latex replica of ventral exterior, $\times 1$; c, partly exfoliated ventral valve, $\times 1$ (Rong, new).

Sunacosarina LIANG, 1990, p. 355 [*S. campana*; OD]. Circular, small, convexiplane valves; ventral interior with short, widely divergent dental plates and short high median ridge extending forward to front of muscle field; dorsal interior with delicate, ridgelike cardinal process. *Lower Permian*: China.—FIG. 615, 2a, b. *S. campana*, Lower Permian, China; a, internal mold of dorsal valve, $\times 2$; b, internal mold of ventral valve, $\times 2$ (Liang, 1990).

UNCERTAIN

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Suborder UNCERTAIN

- Apatoskenidioides** LIU, ZHU, & XUE, 1985, p. 22 [**A. rarus*; OD]. Small, subquadrate with subrectangular cardinal extremities, ventribiconvex, costellate, sharply unisulcate; thin dental plates; cardinal process ridgelike, brachiophore bases convergent. [The specimens on which this genus was founded and which have no skenidiid affinities are too generalized in their morphology to permit more than their tentative identification as plectorthoids. They could be young shells.] *Lower Ordovician (Llanvirn)*: northeastern China.
- Bajanorthis** ANDREEVA, 1968, p. 73 [**B. tukolandica*; OD]. Small, biconvex, subcircular, fascicostellate, capillate, and filate shells with subtriangular ventral muscle scar and small teeth supported by recessive dental plates; dorsal interior unknown. [It is presently not possible to check the validity of this poorly known genus except to concur that it is an orthoid, probably an orthoid or eoorthid.] *Upper Cambrian*: Siberia.—FIG. 616,1a–c. *B. tukolandica*, Upper Cambrian, northwestern Siberia; ventral, dorsal, lateral views of conjoined valves, $\times 2$ (Andreeva, 1968).
- Humaella** ZHU, 1982, p. 53 [**H. huangbanjensis*; OD]. Small, subcircular with acute cardinal extremities, biconvex, unisulcate, multicostellate; apsacline ventral and anacline dorsal interareas moderately long; teeth undescribed, dental plates recessive, ventral muscle scar short, subovoid with pedicle callist; cardinal process wide, undifferentiated, brachiophores divergent, dorsal median septum long, high; posterior pair of quadripartite dorsal adductor scars larger than anterior pair. [The description of this genus is too generalized to permit a more precise identification of the specimens than orthoid. The mold of an apparently high dorsal septum, however, suggests some affinity with such stocks as the cremnorthids, although *Humaella* is older than other genera assigned to the family. The genus is also listed by L. R. M. COCKS and RONG JIA-YU, herein, as a junior synonym of ?*Akelina* SEVERGINA, 1967. This ambiguity should be resolved when the shell structure of one or preferably both genera is known.] *Lower Ordovician*: China (Da Hingan Ling).—FIG. 616,2a,b. **H. huangbanjensis*, Tremadoc, Da Hingan Ling; *a*, internal mold of ventral valve, $\times 4$; *b*, internal mold of dorsal valve, $\times 4$ (Zhu, 1982).
- Lebediorthis** SEVERGINA, 1984, p. 46 [**L. rarus*; OD]. *Lebediorthis*, erected for specimens from the *Lower Ordovician* of Siberia (Gorno Altai), was assigned by its author to the Cremnorthidae notwithstanding the absence of a differentiated cardinal process and a high dorsal median septum, which are diagnostic of that family. In fact, these small shells could be either ranorthids or nanorthids dependent on their cardinalia, which are inadequately described and illustrated. *Lower Ordovician (Arenig)*: Gorno Altai.—FIG. 616,4a,b. **L. rarus*, Arenig, Gorno Altai; *a*, internal mold of ventral valve, $\times 4$; *b*, internal mold of dorsal valve, $\times 4$ (Severgina, 1984).
- Malinella** ANDREEVA, 1982, p. 55 [**M. tavelensis*; OD]. Biconvex, subquadrate, multicostellate shells with pseudodeltidium; ventral muscle scar narrowly triangular, teeth (undescribed) supported by dental plates; cardinal process simple, brachiophores massive; dorsal adductor scars quadripartite with anterior pair slightly elongate; mantle canal system in both valves saccate, with subparallel *vascula media*. [The species on which this genus was founded is too generally described and too poorly illustrated to warrant a more precise identification than orthoid. ANDREEVA (1982, p. 55) compared the internal features with those of *Ranorthis*, which, however, is characterized by divergent *vascula media* in the ventral valve. There is also the possibility that the ventral valve with the pseudodeltidium does not belong with the other figured specimens.] *Upper Ordovician (Caradoc)*: Siberia (Tuva).—FIG. 616,5a–d. **M. tavelensis*, Caradoc, Tuva; *a*, internal mold of ventral valve, $\times 3$; *b*, internal mold of dorsal valve, $\times 3$; *c*, ventral exterior, $\times 3$; *d*, view of ventral interarea, $\times 4$ (Andreeva, 1982).
- Nugnecella** LEVY & NULLO, 1975, p. 28 [**N. rafaensis*; OD]. Small, subequally biconvex, subquadrate ramicostellate; pseudodeltidium reported; teeth small, subtriangular, supported by divergent dental plates, ventral muscle field subtriangular; cardinal process ridgelike, brachiophores strongly divergent, sockets elongate with two(?) radiating ridges. [*Nugnecella* was identified by its authors as a billingselloid presumably on the basis of a reported pseudodeltidium. Other described (and illustrated) features, however, are more typically orthoid; and there is a possibility that the type specimens include representatives of more than one stock.] *Upper Ordovician (Ashgill)*: Argentina.
- Ottadalenites** HARPER in BRUTON & HARPER, 1981, p. 165 [**O. incertus*; OD]. Large, transversely semioval with acute cardinal extremities, convexiplane, rectimarginate; anacline dorsal interarea short, planar, notothyrium with small chilidium; notothyrial platform shallow with ridgelike cardinal process and short, widely divergent brachiophores; dorsal musculature, mantle canal system, ventral interior unknown. [Despite the obscurity of much of its interior, this unusual genus is more likely to be an orthoid than a plectambonitoid, although it has some similarities to the orthoidlike taffids. The size and profile of the specimens may be diagnostic of an early plectorthoid or plaesiomyid notwithstanding the chilidium; ventral interiors are required to confirm this.] *Lower Ordovician (Arenig–Llanvirn)*: Norway.—FIG. 616,6a–d. **O. incertus*, Arenig–

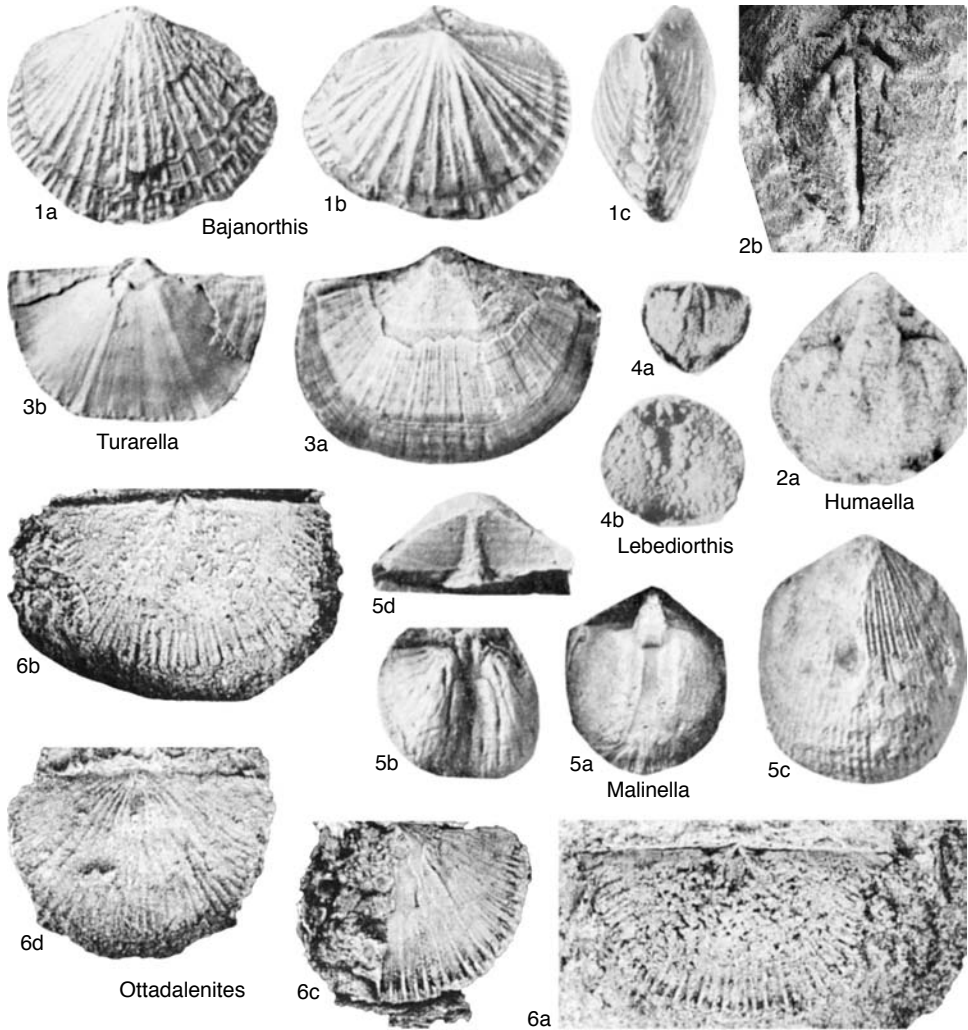


FIG. 616. Uncertain (p. 845–846).

Llanvirn, south central Norway; *a, b*, internal mold, rubber replica of dorsal valve, $\times 1$; *c*, partly exfoliated ventral valve, $\times 1$; *d*, rubber replica of dorsal exterior, $\times 1$ (Bruton & Harper, 1981).

Turarella ANDREEVA, 1987, p. 34 [**T. alleri*; OD]. Transversely semioval, dorsibiconvex, multicostellate; ventral muscle field small, suboval with wide, undifferentiated adductor track longer than flanking diductor scars and divergent *vascula media*; dorsal interior unknown. [In the absence of any information on the dorsal interior including the articulatory apparatus, these specimens could be allocated to several orthoid families, having some similarity, for example, with such unrelated genera as *Bohemiella* and *Pleurorthis*. Indeed, the genus should be suppressed until dorsal interiors confirm that it is not a synonym of one of these or some other, better-

described taxon.] *Upper Cambrian*: Siberia.—FIG. 616, *3a, b*. **T. alleri*, Upper Cambrian, Siberia; *a*, partly exfoliated ventral exterior, $\times 4$; *b*, internal mold of ventral valve, $\times 4$ (Andreeva, 1987).

Zhejiangorthis LIANG in LIU, XU, & LIANG, 1983, p. 268 [**Z. zhejiangensis*; OD]. Medium size, sub-circular, planoconvex, coarsely costellate, ventral interarea nearly catacline, dorsal interarea ortho-cline; delthyrium and notothyrium open; teeth supported by dental plates, ventral adductor track not enclosed by longer, diductor scars; cardinal process differentiated into shaft and myophore, brachio-phores subparallel. [The specimens on which this genus was founded may be dinorthis, but the diagnosis is presently too ambiguous to be useful, especially in the absence of internal details.] *Upper Ordovician*: China (Zhejiang Province).