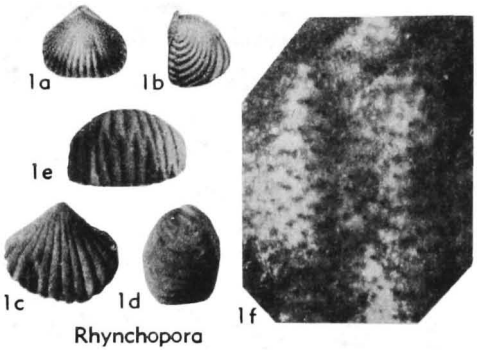


FIG. 517. Rhynchoporidae (p. *H632*).

lupae SHUMARD) (=*Torynechus caelatus* COOPER & GRANT); this can be countered effectively by pointing out that KING's usage of *U. guadalupensis* makes evident that *guadalupensis* is a subsequent spelling with status of an "unjustified emendation" which ranks as a junior objective synonym of *guadalupae* (1961 Code, Art. 33,a,ii). *Uncinuloides* then is tied to a misidentified type-species (Art. 70) calling for adjudication by ICZN; instead, COOPER & GRANT have decided to settle the issue themselves by adopting the disposition given in Art. 70,a,iii, which is to accept the species named by the designator, regardless of the misidentification. Challenge is unlikely and accordingly *Torynechus*, with type-species *T. caelatus*, is here recognized as valid and *Uncinuloides* is left for needed further research.]

Septacamera STEPANOV, 1937, p. 146 [**Camarophoria kutorgae* CHERNYSHEV, 1902, p. 90] [=*Septocamera* LIKHAREV, 1960, p. 249 (*nom. null.*)]. Large (length about 25 mm.), profile rounded subtrigonal, with flattened anterior surface; commissure strongly uniplicate; costae strong, simple, beginning at beaks; valve edges apparently not overlapping. Pedicle valve geniculate near anterior margin; beak short, suberect; foramen open; sulcus shallow, distinct from flanks; interior with posterior part of spondylium sessile, elevated farther forward on relatively high median septum, possibly also braced by pair of short lateral buttress plates. Brachial valve with distinct fold standing above flanks only near anterior edge; interior with large camarophorium on high septum, strongly curved ventrally; presence of intercamarophorial plate uncertain. *?U.Carb., L.Perm.(Sakmar.)*, USSR (Urals - Timan); *L. Perm.(Word equiv.)*, USA(Ore.)-Can.(Arctic).——FIG. 515,*3*. **S. kutorgae* (CHERNYSHEV), L.Perm., Urals; *3a-d*, brach. v., ped.v., lat., ant. views, ×1 (518).

Superfamily RHYNCHOPORACEA Muir-Wood, 1955

[Rhynchoporacea MUIR-WOOD, 1955, p. 91 (erroneously attributed to MOORE, 1952, who classed Rhynchoporacea as suborder)] [Materials for this superfamily prepared by D. J. MCLAREN]

Shell punctate, lacking spondylium or camarophorium. *Miss.-Perm.*

Family RHYNCHOPORIDAE Muir-Wood, 1955

[Rhynchoporidae MUIR-WOOD, 1955, p. 91]

Characters of superfamily. *Miss.-Perm.*

Rhynchopora KING, 1865, p. 124 [**Terebratula Geinitziana* DE VERNEUIL, 1845, p. 83; OD] [=*Rhynchoporina* OEHLERT, 1887, p. 1305 (obj.)]. Subtriangular to subpentagonal; costate; uniplicate; fold on brachial and sulcus on pedicle valve; tongue high; shell flattened anteriorly. Dental plates present; hinge plate entire, supported posteriorly by septum and septalium; crura directed anteriorly. *L.Carb.-Perm.*, Eu.-Asia-N.Am.-S. Am.——FIG. 517,*1a,b*. **R. geinitziana* (DE VERNEUIL), U. Perm., USSR(Russ.platform); *1a,b*, brach.v., lat. views, ×1 (841).——FIG. 517,*1c-f*. *R. triznae* SOKOLSKAYA, L.Carb.(Tournais.), USSR (Kuznetsk basin); *1c-e*, ped.v., lat., ant. views, ×1; *1f*, shell microstructure, ×25 (711a).

SPIRIFERIDA

By A. J. BOUCOT,[1] J. G. JOHNSON,[1] CHARLES W. PITRAT,[2] and R. D. STATON[3]

[[1]California Institute of Technology, [2]University of Massachusetts, and [3]Museum of Comparative Zoölogy at Harvard College]

Order SPIRIFERIDA Waagen, 1883

[*nom. correct.* MOORE in MOORE, LALICKER, & FISCHER, 1952, p. 221 (*pro* order Spiriferacea KUHN, 1949, p. 104, *nom. transl. ex* suborder Spiriferacea WAAGEN, 1883, p. 447)] [*emend.* BOUCOT, JOHNSON, & PITRAT, herein] [Diagnosis prepared by A. J. BOUCOT, J. G. JOHNSON, & R. D. STATON]

Articulate brachiopods with spiral brachidium (except Leptocoeliidae); jugum present or absent. Shell punctate or impunctate, lacking pseudopunctae; mostly biconvex, rarely plano-convex, with relatively large body cavity; cicatrix of attachment uncommon; delthyrium open or closed, circular foramen present or absent. *M.Ord.-Jur.*

Suborder ATRYPIDINA Moore, 1952

[*nom. correct.* BOUCOT, JOHNSON, & STATON, herein (*pro* suborder Atrypacea MOORE, 1952, p. 221)] [=suborder Atrypoidea MUIR-WOOD, 1955, p. 91] [Materials for this suborder prepared by A. J. BOUCOT, J. G. JOHNSON, and R. D. STATON]

Impunctate, mostly biconvex spire-bearing brachiopods, commonly with narrow cardinal margin. Interarea low, obsolescent, or lacking. Pedicle-valve beak may be trun-

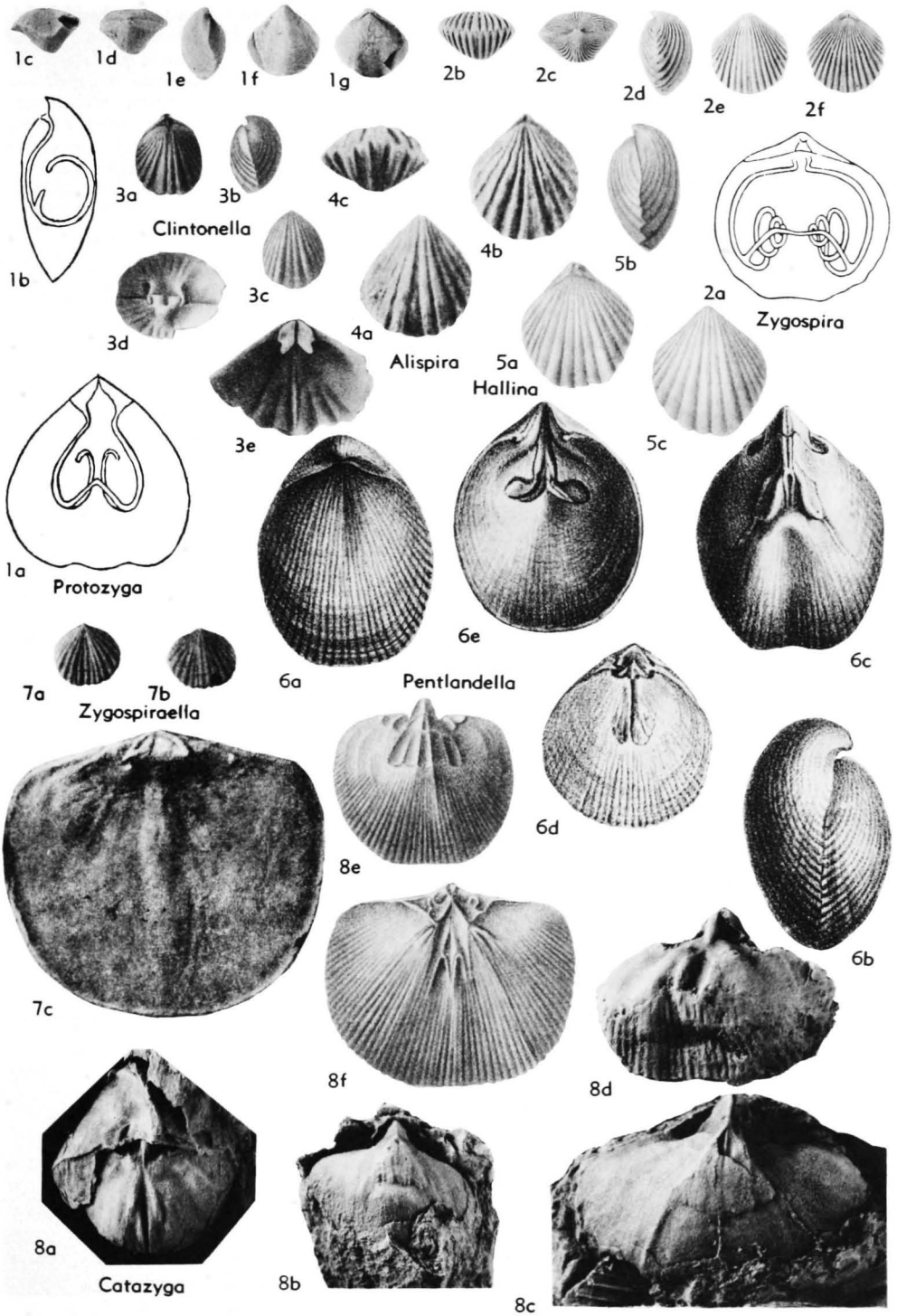


Fig. 518. Atrypidae (Zygospirinae) (p. *H*634, *H*636).

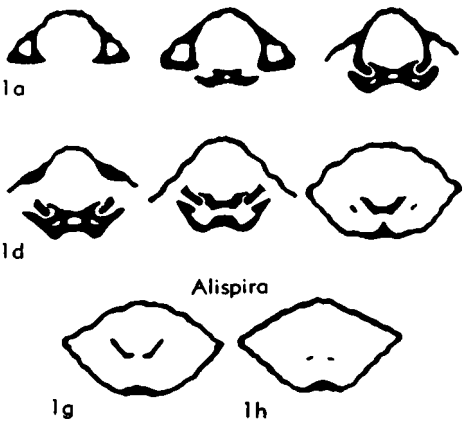


FIG. 519. Atrypidae (Zygospirinae) (p. *H*634).

cated by foramen or foramen may reside within delthyrium. Spiralia directed medially, dorsomedially, or laterally; crura projecting to join primary lamellae of spiralia at posteromedial position, or deflected laterally more or less parallel to plane of commissure to join primary lamellae in posterolateral position; simple jugum commonly present connecting primary lamellae. *M.Ord.-U. Dev.*

Superfamily ATRYPACEA Gill, 1871

[*nom. transl.* SCHUCHERT & LEVENE, 1929, p. 19 (*ex* Atrypidae GILL, 1871, p. 25)]

Spiralia directed medially or dorsomedially. *M.Ord.-U.Dev.*

Family ATRYPIDAE Gill, 1871

[Atrypidae GILL, 1871, p. 25]

Shell plicate or costate. *M.Ord.-U.Dev.*

Subfamily ZYGOSPIRINAE Waagen, 1883

[Zygospirinae WAAGEN, 1883, p. 449] [=Clintonellinae POULSEN, 1943, p. 40]

Primitive small, biconvex forms, costate or multiplicate, growth lines rarely prominent. Deltidial plates conjunct. Spiralia directed medially or dorsomedially; simple jugum present, situated posteriorly or anteriorly. *M.Ord.-L.Sil.*

Zygospira HALL, 1862, p. 154 [**Atrypa modesta* SAY in HALL, 1847, p. 141; OD] [=*Anazyga* DAVIDSON, 1882, p. 128 (type, *Atrypa recurvirostra* HALL, 1847, p. 140)]. Unequally biconvex, elongate or transverse shells, pedicle valve more convex, commonly with ventral fold and dorsal sulcus, simple plications; foramen mesothyridid, deltidial plates conjunct, beak ridges strong and well defined. Dental plates lacking; hinge plates disjunct, parallel medially, diverging ventrally, and supported by myophragm; spiralia directed submedially with dorsal inclination; jugum a simple band curving toward middle of valve, origin of jugum variable, anterior or posterior. *M.Ord.-U. Ord., ?L.Sil.,* Eu.(G.Brit.)-N.Am.——FIG. 518, *2a.* **Z. modesta* (SAY), U.Ord., USA(Ohio); brach.v. int. showing brachidium (diagram.), ×3 (396).——FIG. 518,*2b-f. Z. circularis* COOPER, M. Ord.(Carters F.), USA(Tenn.); *2b-f,* ant., post., lat., ped.v., brach.v. views, ×2 (189).

Alispira NIKIFOROVA, 1961, p. 243 [**A. gracilis*; OD]. Inequally biconvex, elongate, costate shells, pedicle valve more convex; costae increasing in number anteriorly by bifurcation and implantation, crossed by fine, closely spaced growth lines. Dental plates present; conjunct inner hinge plates supported by low crural plates; median septum lacking; spiralia dorsomedially directed; jugum situated posteriorly. *L.Sil.,* Asia.——FIG. 518,*4*; 519,*1.* **A. gracilis*; 518,*4a-c,* ped.v., brach.v., ant. views, ×2; 519,*1a-h,* serial secs., ×5 (602).

Catazyga HALL & CLARKE, 1893, p. 157 [**Athyris headi* BILLINGS, 1862, p. 147; OD] [=*Orthonomaea* HALL, 1893, p. 159 (type, *Orthis? erratica* HALL, 1847, p. 288)]. Inequally biconvex shells, pedicle valve slightly more convex and valves slightly bisulcate; surface finely costellate. Dental plates obsolete; adductor platform developed in pedicle valve; hinge plates essentially as in *Zygospira*; myophragm present; spiralia directed medially; jugum U-shaped, arising well posterior. *M.Ord.-L.Sil.(low. Llandovery),* Eu.(G.Brit.)-N. Am.——FIG. 518,*8a-d. C.* sp., Ashgill., USA (Maine); *8a,b,* post. view, int. mold, ped. int. mold, ×2; *8c,* ped. int. mold, ×3; *8d,* brach. int. mold, ×4 (Boucot, Johnson, & Staton, n).——FIG. 518,*8e,f. C. erratica* (HALL), U.Ord., USA(N.Y.), type-sp. of *Orthonomaea*; *8e,f,* ped.v. and brach.v. int. molds, ×2 (396).

Clintonella HALL & CLARKE, 1893, p. 159 [**C. vagabunda*; OD]. Subequally biconvex shells with simple plications and dorsal fold and ventral sulcus; beak slightly incurved; growth lines imbricate. Short dental plates present; ventral diductor muscle field flabellate, enclosing pair of cordate adductors; hinge plates disjunct, subparallel medially, divided into posterior and anterior lobes, and supported by stout myophragm; spiralia reported to be present (HALL & CLARKE, 1893, p. 160) but their disposition and nature of jugum unknown. *L.Sil.(Clinton),* N.Am.——FIG. 518,*3.* **C. vagabunda,* USA(N.Y.); *3a-c,* brach.v., lat., ped.v. views, ×1; *3d,e,* post. int. (both valves), brach.v. int. showing cardinalia, ×3 (396).

Hallina WINCHELL & SCHUCHERT, 1892, p. 291 [**H. saffordi*; OD]. Externally like *Zygospira,*

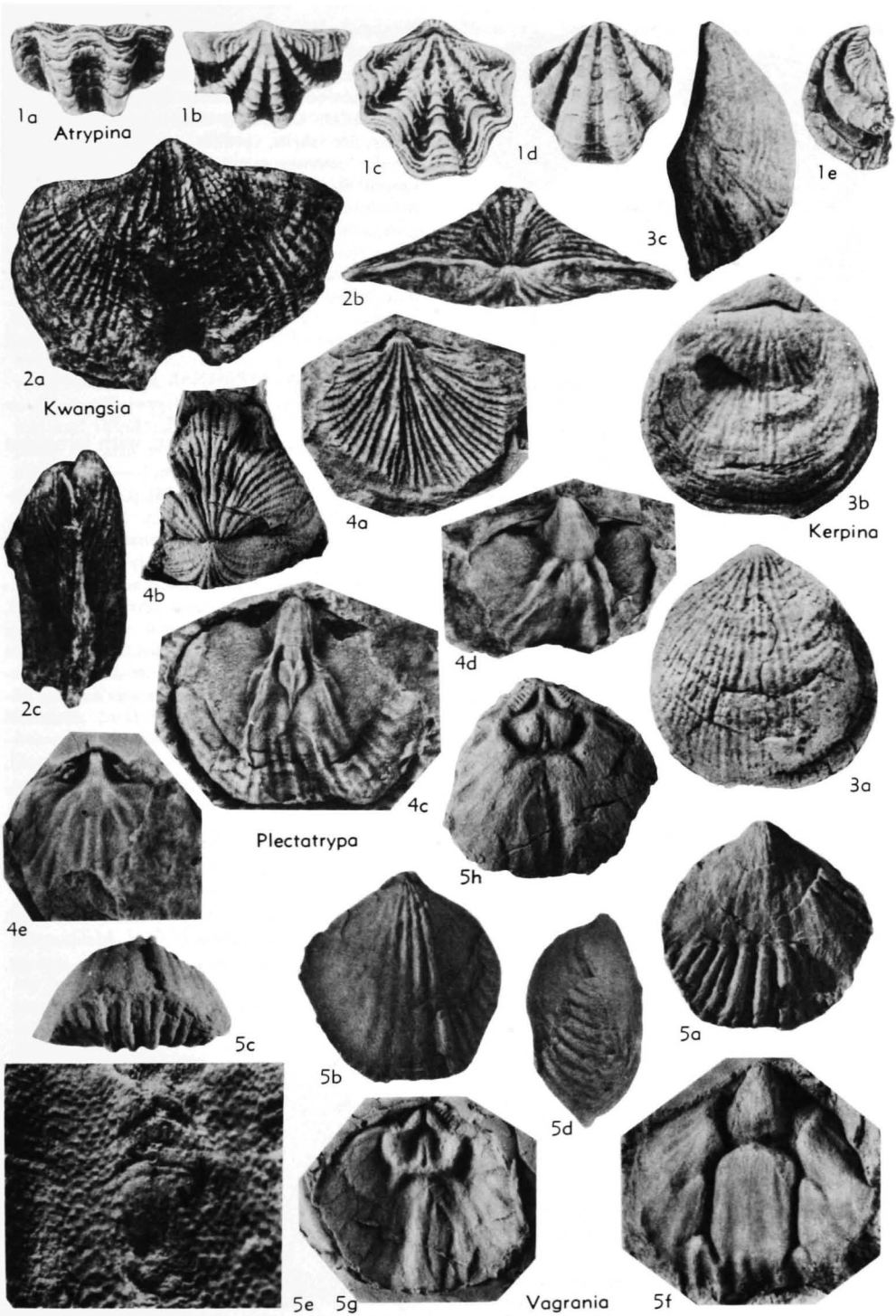


FIG. 520. Atrypidae (Atrypininae) *(1)*, (Carinatininae) *(2-5)* (p. *H*. 636-*H*637).

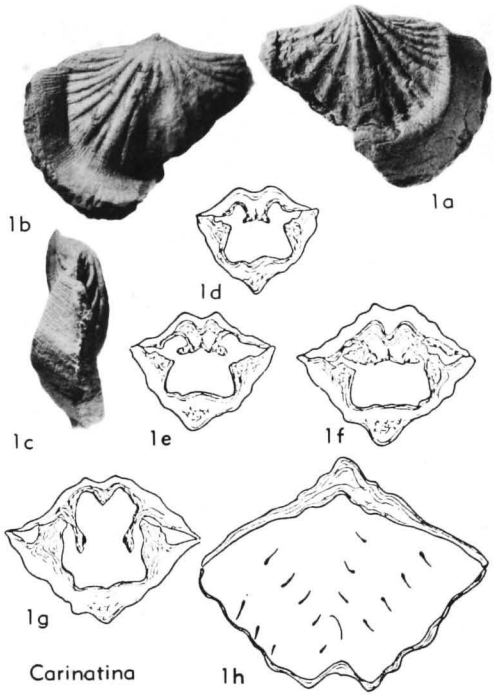


FIG. 521. Atrypidae (Carinatininae) (p. *H636-H637*).

internally like *Protozyga* but jugum U-shaped in *Hallina*. *M.Ord.*, N.Am.——FIG. 518,*5*. **H. saffordi*, Trenton., USA(Tenn.); *5a-c*, brach.v., lat., ped.v. views, ×5 (396).

Pentlandella BOUCOT, 1964, p. 104 [**Rhynchonella pentlandica* HASWELL, 1865, p. 31; OD]. Small suboval costate shells with pedicle valve more convex, costae bifurcated, growth lines subdued; anterior commissure rectimarginate; beak incurved. Dental plates lacking; pedicle valve diductor scars widely divergent anteriorly, impressed into thickened secondary shell material; brachial valve with median septum and septalium. *Sil. (late upper Llandover., ?Wenlock.)*, Eu.(G.Brit.-Est.).——FIG. 518,*6*. **P. pentlandica* (HASWELL), Wales; *6a-e*, brach.v., lat., ped.v. int. mold, brach. v. int. mold, ped.v. int., ×3 (229).

Protozyga HALL & CLARKE, 1893, p. 151 [**Atrypa exigua* HALL, 1847, p. 141; OD]. Unequally biconvex shells, pedicle valve more convex, with beak slightly incurved; brachial valve sulcate; shells may be paucicostate marginally. Dental plates present; hinge plates disjunct, divergent; dorsal myophragm may be present; spiralia slightly submedially directed, making about one volution; jugum simple, short, anteriorly situated. *M. Ord.*, Eu.(G.Brit.)-N.Am.——FIG. 518,*1*. **P. exigua* (HALL), Trenton., USA(N.Y.); *1a,b*, brach. and lat. views of brachidium (diagram.), ×4 (396); *1c-g*, ant., post., lat., ped.v., brach.v. views, ×2 (189).

Zygospiraella NIKIFOROVA, 1961, p. 237 [**Terebratula duboisi* DE VERNEUIL in MURCHISON, 1845, p. 97; OD]. Unequally biconvex or plano-convex subcircular shells, pedicle valve more convex; anterior commissure rectimarginate or with faint ventral fold and dorsal sulcus; surface covered by bifurcating costae and more or less prominent growth lines. Short dental plates may be present; hinge plates discrete, bearing crural lobes; dorsal myophragm may be present; spiralia directed dorsomedially; jugum unknown. *L.Sil.*, N.Am.-Asia. ——FIG. 518,*7*. **Z. duboisi* (DE VERNEUIL), *7a-c*, brach.v., ped.v., ×1, brach.v. int. view, ×3 (602).

Subfamily ATRYPININAE McEwan, 1939

[*nom. transl.* BOUCOT, JOHNSON, & STATON, 1964, p. 808 (*ex* Atrypinidae McEWAN, 1939, p. 619]

Pauciplicate, plano-convex, with lamellose growth lines. *L.Sil.-L.Dev.*

Atrypina HALL & CLARKE, 1893, p. 161 [**Leptocoelia imbricata* HALL, 1857, p. 108; OD]. Inequally biconvex or plano-convex shells, pedicle valve more convex, beak slightly incurved; anterior commissure rectimarginate or deflected ventrally; pauciplicate, plications low and rounded, growth lines lamellose. Dental plates lacking; hinge plates forming bilobed cardinal process that rests on thick myophragm; spiralia directed dorsomedially; jugum posterior, V-shaped, pointing anteriorly. *L.Sil.(U.Llandovery)-L.Dev.*, N.Am.-S. Am.(Venez.)-Eu.(Eng.-Podolia-Boh.-Urals). —— FIG. 520,*1*. *A. hami* AMSDEN, L.Dev.(Haragan), USA(Okla.); *1a-e*, ant., post., brach.v., ped.v., lat. views, ×3 (33).

Subfamily CARINATININAE Rzhonsnitskaya, 1960

[Carinatininae RZHONSNITSKAYA, 1960, p. 261]

Costate biconvex or plano-convex, with conjunct deltidial plates. *U.Ord.-M.Dev.*

Carinatina NALIVKIN, 1930, p. 104 [**Orthis ari-*

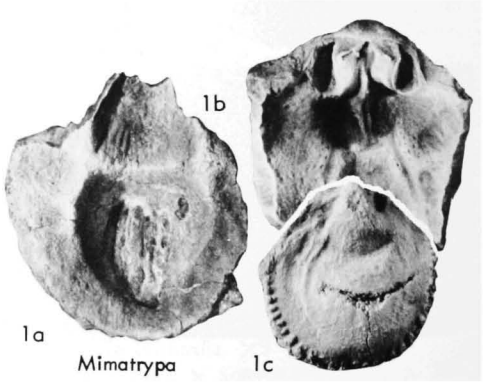


FIG. 521A. Atrypidae (Carinatininae) (p. *H637*).

maspus EICHWALD, 1840, p. 108; OD]. Subequally biconvex, plicate shells with straight hinge line, brachial valve commonly more convex, low ventral fold and dorsal sulcus present; plications commonly irregular and coarse, bifurcating somewhat rarely, but costellate frill may be present; ventral beak straight; deltidial plates conjunct. Dental plates present; hinge plates disjunct; brachidium essentially as in *Atrypa*. *L.Dev.-M.Dev.*, Eu.-Asia-N.Am.——FIG. 521,*1a-c*. **C. arimaspa* (EICHWALD), U.Ems.-Couvin.(Vagran F.), Ural Mts.; *1a-c*, ped.v., brach.v., side view, ×1 (8).——FIG. 521,*1d-h*. *C. minuta* SIEHL, M.Dev.(Greifensteiner Kalk), Ger.; *1d-h*, serial secs., ×4.5 (744).

Kerpina STRUVE, 1961, p. 333 [**K. vineta vineta*; OD]. Resembles *Atrypa*, but with reversed convexity; pedicle valve convex, with nearly straight beak; brachial valve slightly convex or plane; fold and sulcus lacking; broad conjunct deltidial plates fill area between beak ridges. *M.Dev.(U. Eifel.)*, Eu.——FIG. 520,*3*. *K. vineta goniorhyncha* STRUVE, Ger.; *3a-c*, ped.v., brach.v., lat. views, ×2 (788).

Kwangsia GRABAU, 1931, p. 204 [**K. yohi*; OD] [=*Kwangsiella* GRABAU, 1932, p. 54 (obj.)]. Subequally biconvex costate shells with long hinge line; costae increasing anteriorly by bifurcation and crossed by prominent growth lines; well-developed dorsal fold and ventral sulcus present. Interior unknown. *M.Dev.*, China.——FIG. 520,*2*. **K. yohi*; *2a-c*, ped.v., post., lat. views, ×1 (358).

Minatrypa STRUVE, 1964, p. 436 [**Terebratula prisca* var. *flbellata* ROEMER, 1844, p. 66; OD]. Coarsely costate shells of variable shape, subequally biconvex to convexi-plane, concentric growth lines faint or lacking; pedicle valve beak straight or nearly straight with apical foramen posterior to well-developed, conjunct deltidial plates. Dental plates lacking on large specimens, ventral muscle impressions raised anteriorly on transverse platform; brachial valve with ponderous hinge plates and crural lobes flanked by deep sockets, corrugated laterally and commonly lacking longitudinal ridge; adductor scars deeply impressed or defined by muscle-bounding ridges; spiralia and jugum unknown. *M.Dev.*, Eu., N.Am. (Nev.).——FIG. 521A,*1*. **M. flabellata* (ROEMER), Ger.; *1a-c*, ped.v. int., brach.v. int., ped.v. int. mold, ×1.3 (*1a,b*, 932a; *1c*, Boucot, Johnson, & Staton, n).

Nalivkinia BUBLICHENKO, 1928, p. 982 [**Atrypa grünwaldtiaeformis* VON PEETZ, 1901, p. 147; OD]. Elongate, subequally, biconvex, costate shells, costae only rarely increasing in number anteriorly by bifurcation or implantation, fold and sulcus lacking, but anterior commissure commonly deflected dorsally. Dental plates present; hinge plates discrete; sockets noncrenulate; spiralia dorsomedially directed, jugum simple, short, situated posteriorly. *Sil., ?L.Dev.*, Eu.(USSR).——FIG. 524, *1*. **N. gruenwaldtiaeformis* (VON PEETZ); *1a-c*, ped. v., brach.v., ant. views, ×1 (125).

Plectatrypa SCHUCHERT & COOPER, 1930, p. 278 [**Terebratula imbricata* SOWERBY in MURCHISON, 1839, p. 624; OD]. Subequally biconvex, costate shells with dorsal fold and ventral sulcus; growth lines prominent or subdued, costae bifurcating anteriorly; beak incurved, deltidial plates conjunct. Short dental plates present or obsolescent; pedicle valve musculature confined, nonflabellate; hinge plates discrete; median septum lacking; spiralia directed dorsomedially; jugum short, simple, situated posteriorly. *U.Ord.-L.Dev.*, cosmop.——FIG. 520,*4*. **P. imbricata* (SOWERBY), L.Sil.(Llandovery), Can.(N.B.); *4a,b*, ped.v., post. ext.v., ×1.5; *4c-e*, ped. int. mold, ped. int. mold. post. view, brach. int. mold, ×2 (Boucot, Johnson, Staton, n).

Spirigerina D'ORBIGNY, 1849, p. 42 [**Terebratula marginalis* DALMAN, 1828, p. 143; SD ALEKSEEVA, 1960, p. 64] [=*Spirigerina* D'ORBIGNY, 1847, p. 268 *(nom. nud.)*]. Suboval to pentagonal, finely costate, biconvex shells with dorsal fold and ventral sulcus. Dental plates present; pedicle-valve diductor scars elongate, impressed, nonflabellate; hinge plates defining sockets medially and bearing crural lobes; spiralia directed dorsomedially. *Sil.(U.Llandover.-Ludlov.)*, Eu.(Gotl.-G.Brit.)-N.Am.(N.Greenl.).

Vagrania ALEKSEEVA, 1959, p. 389 [**Atrypa kolymensis* NALIVKIN, 1936, p. 17; OD] [=*Dentatrypa* BREIVEL, 1959, p. 57 (type, *Atrypa kolymensis* NALIVKIN, 1936)]. Subequally biconvex, plicate shells, brachial valve commonly more convex; with or without dorsal fold and ventral sulcus; some plications bifurcating anteriorly; fine, nodose, growth lines present; ventral beak straight; conjunct deltidial plates present. Dental plates present, prolonged anteriorly as long ridges; brachial valve adductor scars confined, deeply impressed, non-elongate; cardinalia and brachidium as in *Atrypa*. *?U. Sil.(?Ludlov.), L. Dev.-M. Dev.*, Eu. (Ural Mts.)-Asia-N.Am.(Nev.-Yukon Terr.-Bathurst Is.).——FIG. 520,*5a-e*. **V. kolymensis* (NALIVKIN), U.Ems.-Eifel., Ural Mts.; *5a-d*, ped.v., brach.v., ant., lat. views, ×1; *5e*, view of fine surface ornament, ×7 (8).——FIG. 520,*5f-h*. *Vagrania* sp., Ems:(Stuart Bay F.), Can.(Bathurst Is.); *5f*, ped. int. mold, ×1.5; *5g,h*, cast of brach. int., brach.v. int. mold, ×2 (113).

Zejszneria SIEMIRADZKI, 1922, p. 172 [**Orthisina davyi* BARROIS, 1886, p. 194; OD]. Resembles *Carinatina* externally. Interarea pronounced. Conjunct deltidial plates present in front of a circular foramen. Cardinal process and dorsal myophragm present. Brachidium unknown. May equal *Carinatina*. *M.Dev.*, Eu.

Subfamily ATRYPINAE Gill, 1871

[*nom. transl.* WAAGEN, 1883, p. 448 (*ex* Atrypidae GILL, 1871, p. 25)] [=Punctatrypinae RZHONSNITSKAYA, 1960, p. 262]

Costate biconvex or convexi-plane Atrypidae, commonly with lamellose growth lines. Conjunct deltidial plates lacking. *L. Sil.-U.Dev.*

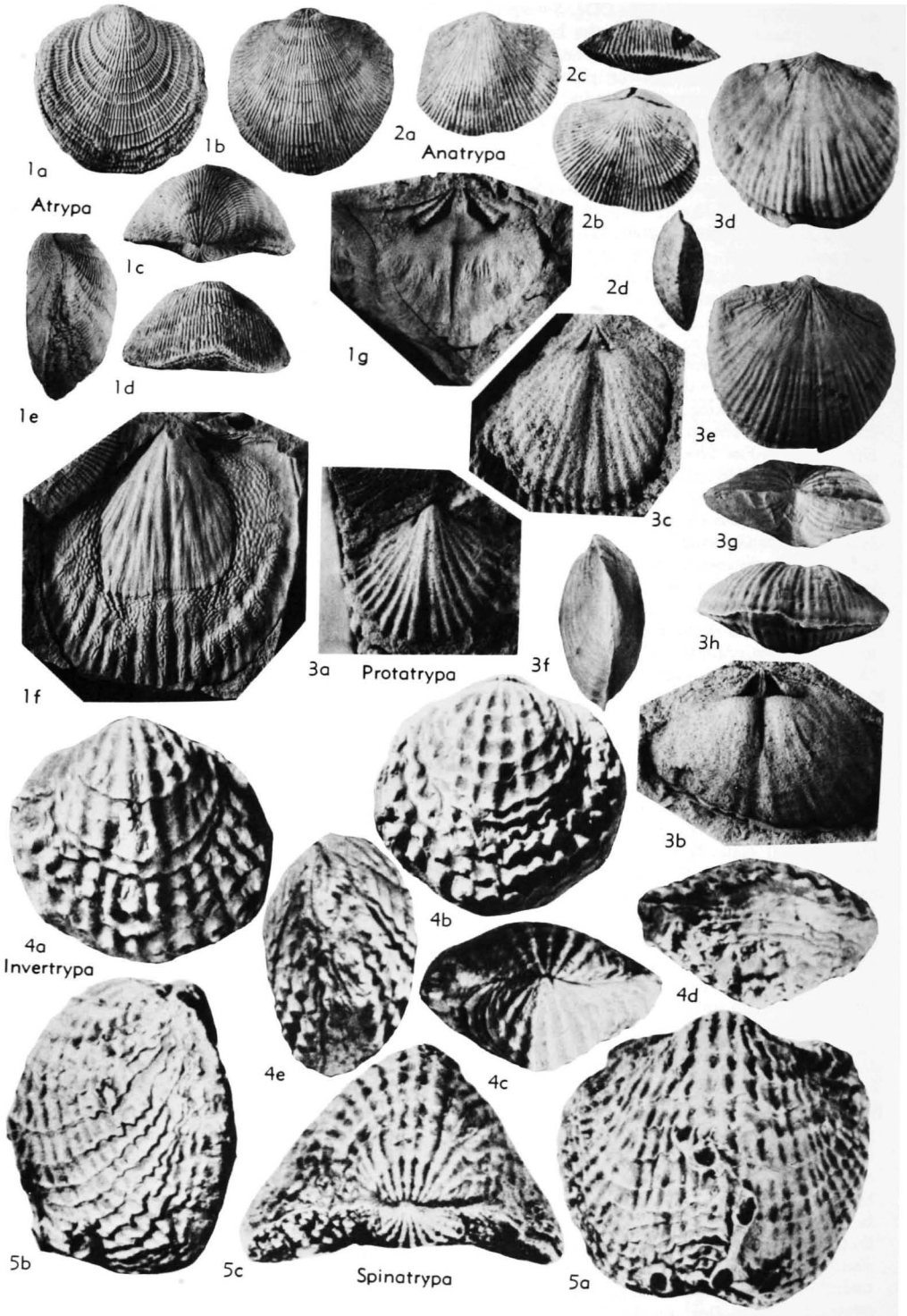


FIG. 522. Atrypidae (Atrypinae) (p. *H*639-*H*641).

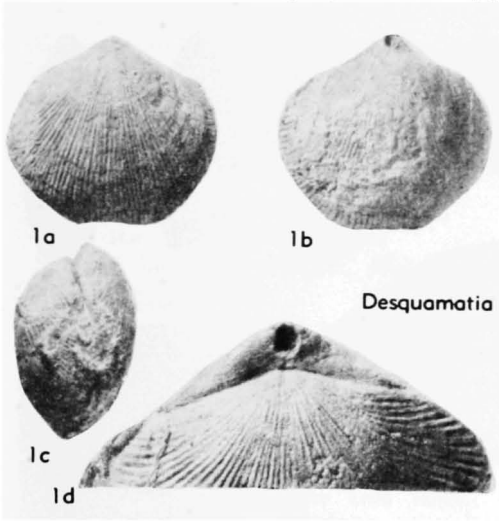


FIG. 522A. Atrypidae (Atrypinae) (p. *H*639).

Atrypa DALMAN, 1828, p. 93 [**Anomia reticularis* LINNÉ, 1758, p. 702 (holotype, SD ALEXANDER, 1949); SD DAVIDSON, 1853, p. 90] [=*Cleiothyris* PHILLIPS, 1841, p. 55; *Mikrothyris* QUENSTEDT, 1868, p. 30]. Unequally biconvex or convexi-plane, costate shells with brachial valve more convex; dorsal fold and ventral sulcus present or absent; anterior commissure rectimarginate or deflected slightly toward brachial valve; costae increasing in number anteriorly by bifurcation and implantation, generally prominent growth lines may develop as frills; ventral beak incurved; interarea lacking; no conjunct deltidial plates in mature specimens. Dental plates short or obsolescent; ventral diductor muscle field flabellate; hinge plates discrete, diverging widely, sockets crenulate; crural lobes present, consisting of horizontal plates that connect outer hinge plates with crural bases; diductor area longitudinally striate; stout myophragm may be present; median septum absent; spiralia directed dorsomedially; jugum simple, short, disposed posteriorly, with jugal processes that may or may not be united posteromedially. *L. Sil.(U. Llandovery) - U. Dev.(Frasn.)*, cosmop. ——FIG. 522,*1a-e*. *A.* sp. cf. **A. reticularis* (LINNÉ), Sil.(Hemse Marl), Gotl.; *1a-e*, ped.v., brach.v., post., ant., lat. views, ×1 (113).——FIG. 522,*1f,g*. *A.* sp., L.Dev.(Stonehouse F.), Nova Scotia; *1f,g*, ped.v. int. mold, brach.v. int. mold post. view, ×1.5 (Boucot, Johnson, & Staton, n).

Anatrypa NALIVKIN, 1941, p. 172 [**Orthis micans* VON BUCH, 1840, p. 56; OD]. Subcircular, biconvex shells, pedicle valve more convex, brachial valve tending to be sulcate and nearly flat; ventral beak straight; delthyrium broad, closed by deltidial plates in front of circular foramen. Dental plates present; brachial interior unknown. *M.Dev. (Givet.)-U.Dev.(Frasn.)*, Eu.——FIG. 522,*2*. **A. micans* (VON BUCH), Pskov beds; *2a-d*, ped.v., brach.v., ant., lat. views, ×1 (594).

Atrypinella KHODALEVICH, 1939, p. 45 [**A. biloba*; OD]. Subequally biconvex, transverse or circular shells with faintly developed ventral fold and dorsal sulcus. Rudimentary dental plates present or lacking; hinge plates discrete, supported by stout median septum forming septalium; spiralia dorsomedially directed, jugum unknown. *L.Dev. (Marginalis beds)*, Eu.(Ural Mts.).

Desquamatia ALEKSEEVA, 1960, p. 421 [**D. khavae*; OD]. Externally like *Atrypa*, but with finer costae and subdued growth lines; ventral beak only slightly incurved; conjunct deltidial plates present. Dental plates well developed; cardinalia and brachidium essentially as in *Atrypa*. *Dev.*, cosmop.——FIG. 522A,*1*. **D. khavae*, M.Dev., USSR(east slope, N.Urals); *1a-c*, ped.v., brach.v., lat. views, ×1; *1d*, post. part of brach.v. view, ×2 (8).

Invertrypa STRUVE, 1961, p. 334 [**Spinatrypa kelusiana* STRUVE, 1956, p. 385; OD]. Resembles *Spinatrypa*, but with reversed convexity; shells inequally biconvex, pedicle valve more convex, fold and sulcus lacking. Rudimentary dental plates may be present. Teeth crenulated; cardinalia essentially as in *Spinatrypa*; spiralia dorsomedially

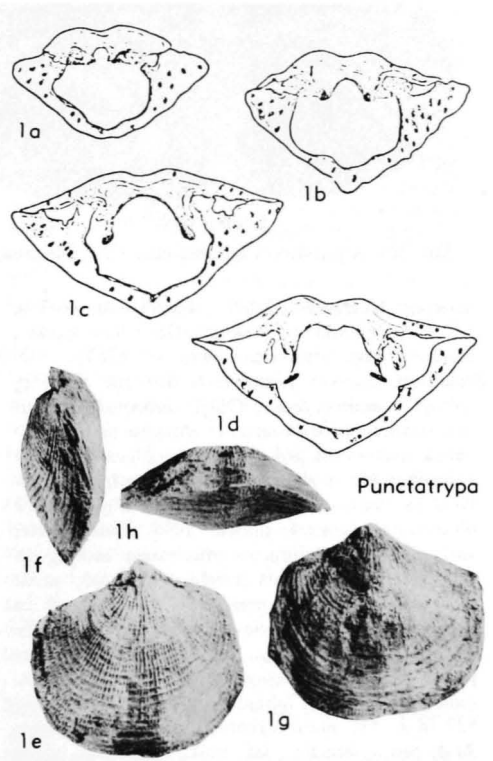


FIG. 523. Atrypidae (Atrypinae) (p. *H*640).

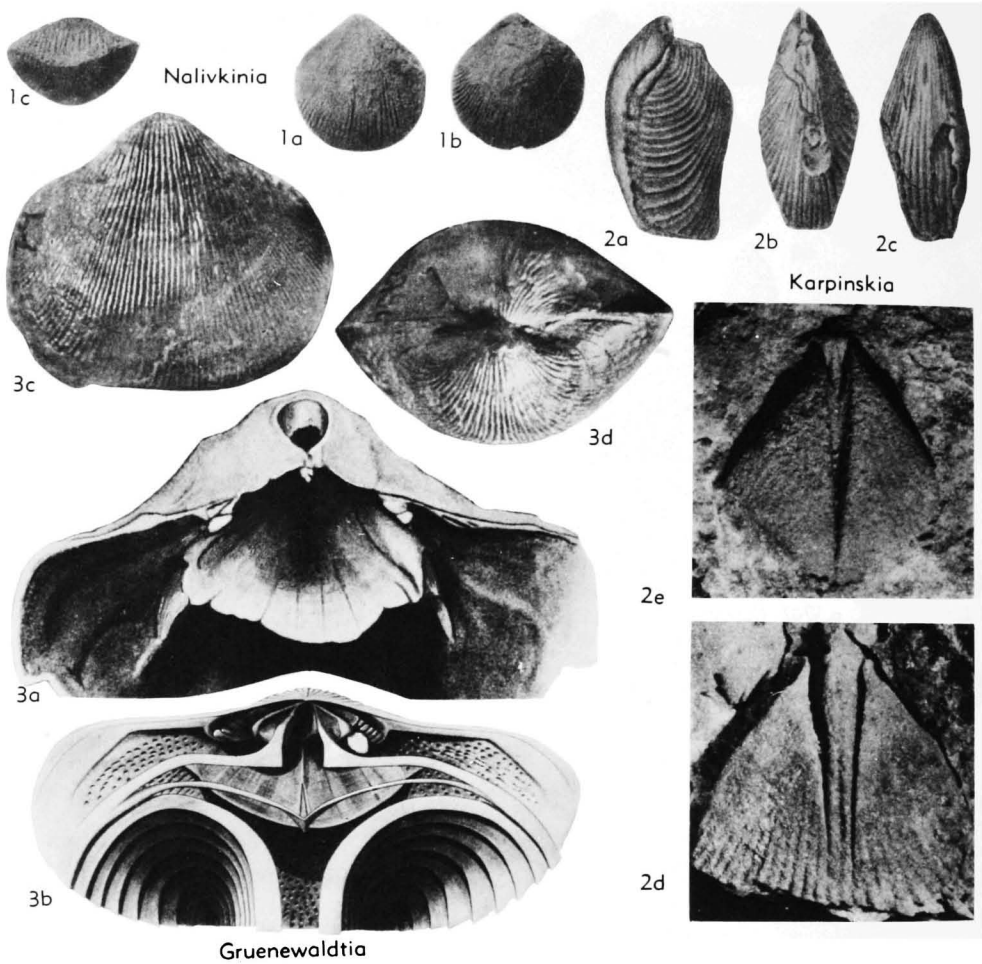


FIG. 524. Atrypidae (Carinatininae) *(1)*, (Karpinskiinae) *(2)*, (Palaferellinae) *(3)* (p. *H*637, *H*641).

directed. *M. Dev. (U. Eifel.),* Eu.-N. Am.——FIG. 522,*4*. **I. kelusiana* (STRUVE), Ger.; *4a-e,* ped.v., brach.v., post., ant., lat. views, ×2 (787).

Protatrypa BOUCOT, JOHNSON, & STATON, 1964, p. 809 [**P. malmoeyensis*; OD]. Subequally biconvex, subcircular, transverse, or elongate shells without a well-developed fold and sulcus; brachial valve may bear a shallow furrow posteriorly; ornament as in *Atrypa*. Dental plates present or obsolescent; ventral muscle field nonflabellate; striated area for diductor attachment lacking in brachial valve; sockets rarely crenulated; stout myophragm may be present; brachidium as in *Atrypa*. *L. Sil.,* Eu.-Asia-N. Am.-S. Am.(Venez.).——FIG. 522,*3a-c*. *P.* sp., Ede Qtzt., Sweden; *3a-c,* ped.v. int. mold, brach.v. int. mold, brach.v. int. mold, ×3 (Boucot, Johnson, & Staton, n).——FIG. 522,*3d-h*. **P. malmoeyensis,* Malmøya, Norway; *3d-h,* ped.v., brach.v., lat., post., ant. views, ×1.5 (113).

Punctatrypa HAVLÍČEK, 1953, p. 8 [**P. nalivkini*; OD]. Biconvex, finely costate shells commonly lacking distinct fold and sulcus, or brachial valve may be slightly sulcate; fine, evenly spaced growth lines crossing costae make evenly reticulate pattern, hollow spine bases situated in concentric rows on growth lamellae at their intersections with costae; ventral beak suberect. Dental plates lacking; hinge plates disjunct; brachidium unknown. *L.Dev.-M.Dev.,* Eu.-Asia.——FIG. 523,*1*. *P.* sp. aff. *P. granulifera* (BARRANDE), M.Dev.(Greifensteiner Kalk), Ger.; *1a-d,* serial secs., ×4.5; *1e-h,* brach.v., lat., ped.v., ant. views, ×1.5 (744).

Spinatrypa STAINBROOK, 1951, p. 196 [*pro Hystricina* STAINBROOK, 1945, p. 49 (*non* MALLOCH, 1932)] [*"*Atrypa hystrix* var. *occidentalis* HALL, 1858" (*errore pro A. aspera* var. *occidentalis* HALL, 1858, p. 515) (=**A. occidentalis, nom. transl.* STAINBROOK, 1938, p. 241); OD]. External conformation like *Atrypa,* but with few rounded

plications crossed by lamellose, spinose growth lines. Internal structures essentially as in *Atrypa*. *L.Dev.(U.Ems.)-U.Dev.(Frasn.)*, cosmop.——FIG. 522,*5*. *S. coriacea* CRICKMAY, M.Dev., Can. (N.W.T.); *5a-c*, brach.v., lat., post. views, ×1 (549).

Subfamily KARPINSKIINAE Poulsen, 1943

[Karpinskiinae POULSEN, 1943, p. 40]

Strongly biconvex, elongate, with long dental plates. *Sil.-M.Dev.*

Karpinskia CHERNYSHEV, 1885, p. 48 [**K. conjugula*; OD] [=*Notoconchidium* GILL, 1950, p. 242 (type, *Pentamerus tasmaniensis* ETHERIDGE, 1883, pl. 2, fig. 1; SD BOUCOT, JOHNSON, & STATON, herein) (=*Notoconchidium* GILL, 1951, p. 187, type, *N. thomasi* GILL, 1951, p. 188; OD, syn. hom.)]. Unequally biconvex, elongate, costate shells of trapezoidal transverse cross section; brachial valve more convex; thickness commonly greater than width posteriorly; ventral lateral slopes abruptly angular. Dental plates long and thick; hinge plates discrete, forming bilobed cardinal process; dorsal median septum may be present; spiralia essentially as in *Atrypa*, jugum unknown. *L. Dev.-M. Dev.*, Eu.(Ural Mts.-Carnic Alps)-Asia-Australia,Tasmania-Victoria). ——FIG. 524,*2a-c*. **K. conjugula*, USSR(Urals); *2a-c*, lat., brach.v., ped.v. views, ×1 (396).——FIG. 524, *2d,e*. *K. thomasi* (GILL), L.Dev., Victoria; *2d,e*, ped.v. int. mold, brach.v. int. mold, ×2 (339).

Subfamily PALAFERELLINAE Spriestersbach, 1942

[*nom. transl.* STRUVE, 1955, p. 211 (*ex* Palaferellidae SPRIESTERSBACH, 1942, p. 187)]

Pedicle valve with raised muscle platform and chamber below. *L.Dev.-M.Dev.*

Gruenewaldtia CHERNYSHEV, 1885, p. 46 [**Terebratula latilinguis* SCHNUR, 1851, p. 7; OD] [=*Palaferella* SPRIESTERSBACH, 1942, p. 187]. Subequally biconvex, costate shells lacking fold and sulcus, but with anterior commissure commonly deflected dorsally; costae bifurcating anteriorly, growth lines subdued; ventral beak strongly incurved. Short dental plates present; muscle platform supported by 2 or more radially disposed septa present in pedicle valve; outer hinge plates crenulate in brachial valve; inner hinge plates present, forming small septalium, supported by short, thin myophragm; crural lobes and brachidium essentially as in *Atrypa*. *M.Dev.(Eifel.)*, Eu.——FIG. 524,*3*. **G. latilinguis* (SCHNUR), Rommersheimer Sch., Ger.; *3a,b*, ped.v. int., brach.v. int., ×3; *3c,d*, ped.v., post. views, ×1.5 (786).

Falsatrypa HAVLÍČEK, 1956, p. 584 [**F. admiranda*; OD]. Small, costate, irregularly subcircular shells lacking fold and sulcus; growth lines strongly lamellose. Dental plates lacking; ventral muscle platform present as in *Gruenewaldtia*; cardinalia and brachidium unknown. *L.Dev.(U.Ems.)*, Eu. (Boh.).

Family LISSATRYPIDAE Twenhofel, 1914

[*nom. transl.* BOUCOT, JOHNSON, & STATON, 1964, p. 811 (*ex* Lissatrypinae TWENHOFEL, 1914, p. 31)]

Shell smooth. *M.Ord.-M.Dev.*

Subfamily LISSATRYPINAE Twenhofel, 1914

[Lissatrypinae TWENHOFEL, 1914, p. 31] [=Glassiinae SCHUCHERT & LEVENE, 1929, p. 20]

Inner hinge plates present. *L.Sil.-M.Dev.*

Lissatrypa TWENHOFEL, 1914, p. 31 [**L. atheroidea*; OD]. Subequally biconvex, suboval or subcircular shells, lenticular in profile, lacking well-developed fold and sulcus; ventral beak incurved. Teeth large, attached to wall of valve; dental plates lacking; hinge plates triangular, ponderous, disjunct, with parallel inner edges, or they may be conjunct and supported by stout myophragm in brachial valve posterior; jugum originating posteriorly. *L.Sil.(U.Llandovery)-L.Dev.(Borszczów)*, N. Am.-Eu.-Australia(Vict.).——FIG. 525,*5a*. *L. leprosa*, L.Dev.(Borszczów), Podolia; brach.v. int. (cardinalia and brachidium), ×6 (487).——FIG. 525,*5b,c*. **L. atheroidea*, Jupiter Cliffs E3, Can. (Anticosti Is.); *5b,c*, ped.v. int. mold, brach.v. int. mold, ×3 (476).

Australina CLARKE, 1913, p. 348 [**A. jachalensis*; OD]. Unequally biconvex or plano-convex subcircular shells with shallow dorsal sulcus; ventral beak suberect, foramen submesothyridid. Dental plates lacking; teeth attached directly to wall of valve; pedicle valve with short myophragm that bifurcates and splays laterally; inner hinge plates disjunct, somewhat ponderous, as in *Lissatrypa*, supported by stout myophragm in brachial posterior; spiralia directed dorsomedially; jugum unknown. *?U.Sil.(Wenlock.)*, S.Am.(Arg.).——FIG. 525,*3*. **A. jachalensis; 3a-h*, serial secs., ×3; *3i,j*, brach.v., ped.v. views, ×1; *3k,l*, brach.v. int., ped. v. int. mold, ×1.5 (147).

Glassia DAVIDSON, 1881, p. 11 [**Atrypa obovata* SOWERBY in MURCHISON, 1839, p. 618; OD]. Subequally biconvex, suboval or subcircular shells, lenticular in profile, with or without dorsal fold and ventral sulcus; Delthyrium covered in apex by small concave plate, as in *Nucleospira*. Dental plates lacking; pedicle valve musculature essentially as in *Meifodia*; inner hinge plates conjunct; stout myophragm present in posterior; spiralia directed medially; jugum simple short, arising posteriorly. *L.Sil.(M.Llandovery)-M.Dev.*, Eu.——FIG. 525,*4a,b*. **G. obovata*, Wenlock, G.Brit.; *4a*, brachidium, ×2; *4b*, serial sec., ×6.5 (396, 744). ——FIG. 525,*4c,d*. *G. sulcata* SIEHL?, M.Dev., Boh.; *4c,d*, brach.v. int. mold, ped.v. int. mold, ×2 (53).

Lissatrypoidea BOUCOT & AMSDEN, 1958, p. 159 [**Nucleospira concentrica* HALL, 1859, p. 223

(*partim*, pl. 28B, fig. 16, =*Lissatrypa decaturensis* AMSDEN, 1949, p. 64) (*non* fig. 19)]. Subequally biconvex, suboval or subcircular shells, lenticular in profile, lacking well-developed fold and sulcus; beak incurved, foramen mesothyridid. Interior structures as in *Lissatrypa* except that hinge plates

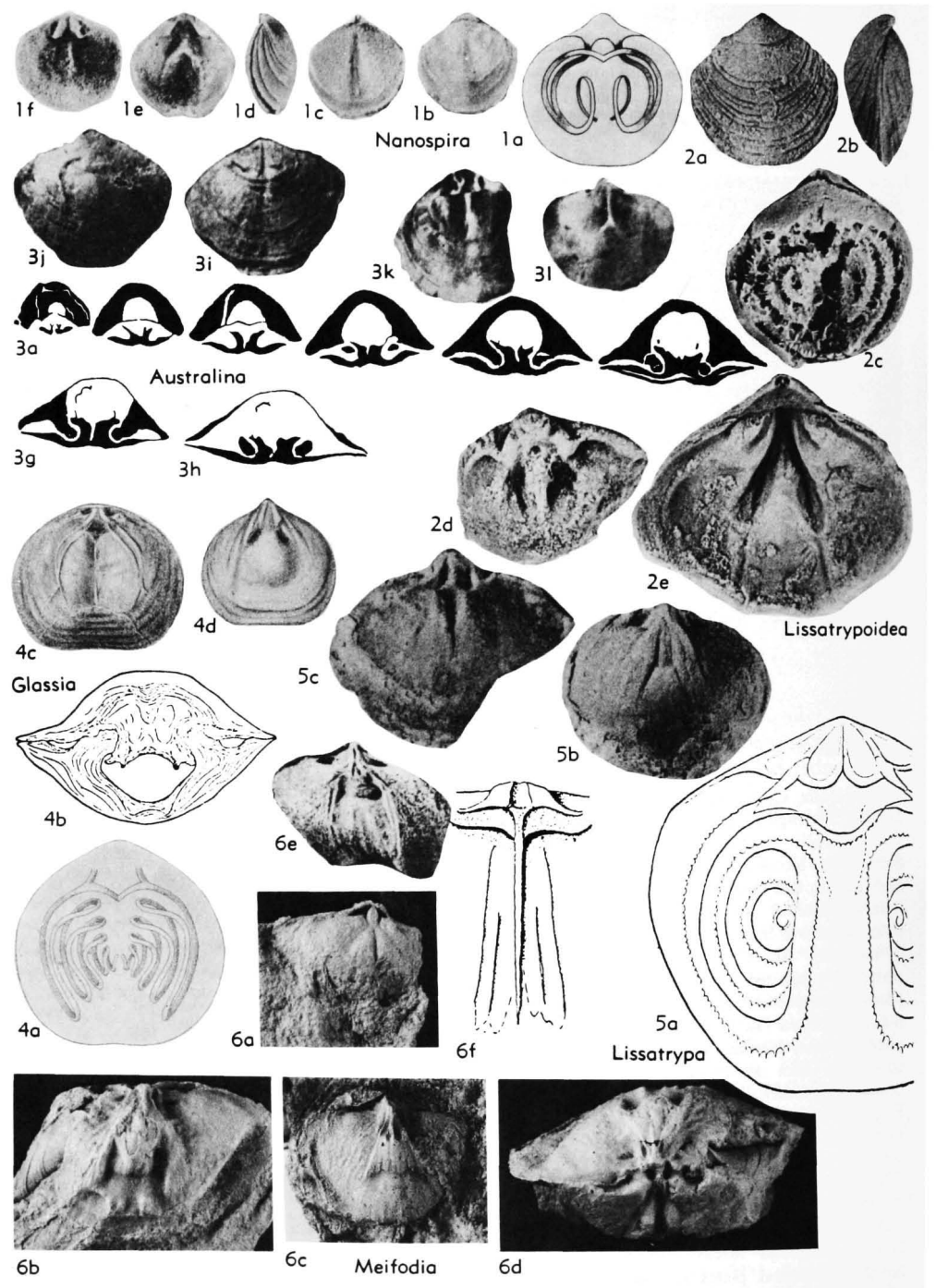


FIG. 525. Lissatrypidae (Lissatrypinae) (p. *H*641-*H*644).

bear stout, bulbous cardinal process. *U.Sil.(Wenlock.-Ludlov.),* N.Am.——Fig. 525,2. **L. concentrica* (Hall), Brownsport F.; *2a,b,* ped.v., lat. views, ×3; *2c-e,* brach.v. int. (brachidium), brach.v. int. (cardinalia), ped.v. int., ×5 (28).

Meifodia Williams, 1951, p. 106 [**Hemithyris subundata* M'Coy, 1851, p. 387; OD] [=*Tyrothyris* Öpik, 1953, p. 15 (type, *T. tyro*)]. Transversely suboval or elongate biconvex shells with brachial valve more convex; dorsal fold and ventral sulcus commonly well developed anteriorly; beaks small, strongly incurved. Dental plates very short, obsolescent or absent; pedicle-valve muscle area modified by adductor on small, raised, trans-

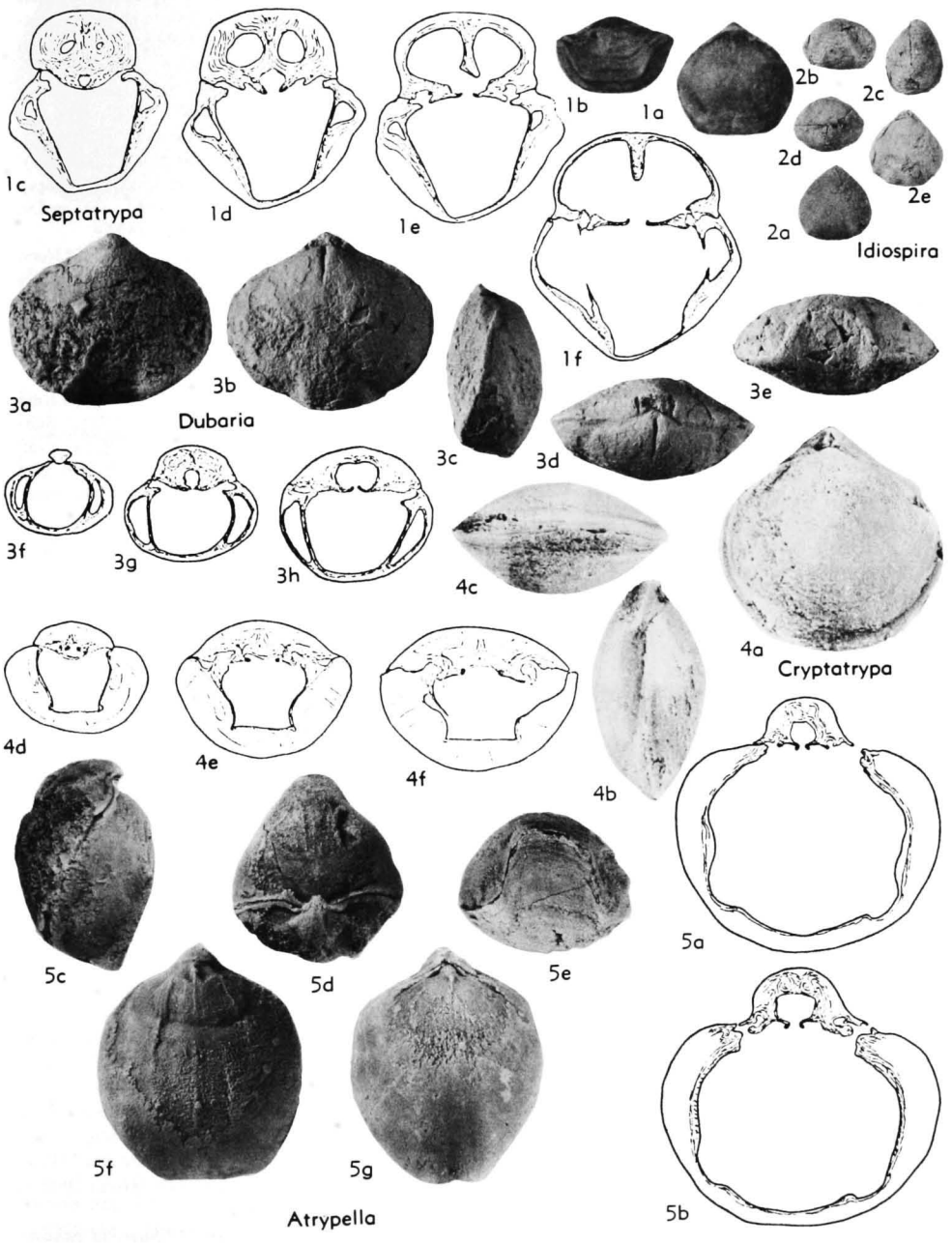


Fig. 526. Lissatrypidae (Septatrypinae) (p. *H*644-*H*645).

verse platform with steep posterior face and gently sloping anterior face; diductor tracks narrow, impressed; inner hinge plates disjunct, parallel medially, commonly supported by stout dorsal myophragm; dental sockets finely crenulate; spiralia directed dorsally. [Differs from *Glassia* principally by disposition of spiralia.]*L.Sil.(Llandovery)*, Eu. - Asia (Sib.) - S. Am.(Venez.)-Australia (Victoria).——Fig. 525,*6a-d*. *M.* sp., L. Sil., S.Am. (Venez.); *6a-d*, brach. int. mold, ped. int. mold, ped. int. mold, int. mold post. view, all ×2 (Boucot, Johnson, & Staton, n).——Fig. 525,*6e,f*. *M. ovalis supercedens* Williams, Wales; *6e*, ped.v. int. mold,×1.5; *6f*, brach.v. int., ×4 (870).

[Öpik inferred the presence of punctae in the shell of *Tyrothyris* from observation of external molds—not internal molds such as commonly provide evidence of punctation. Dr. J. A. Talent (Geological Survey of Victoria) has examined numerous specimens of *T. tyro* without finding in them any indication of punctate shell structure and accordingly has concluded that *Tyrothyris* possesses an impunctate shell, with affinities to *Meifodia* and *Lissatrypa*. He has suggested (letter to J. G. Johnson) that the "punctation" illustrated by Öpik may correspond to the problematic *Cyclopuncta* described and figured by Elias (1958, Jour. Paleontology, v. 32, p. 50).]

Nanospira Amsden, 1949, p. 203 [**N. parvula*; OD]. Unequally biconvex or plano-convex, subcircular shells with shallow dorsal sulcus; ventral beak incurved. Dental plates lacking; teeth attached directly to wall of valve; pedicle valve with short myophragm that bifurcates and splays laterally; hinge plates disjunct, diverging slightly anteriorly; short dorsal myophragm may be present; jugum originating anteriorly, curves laterally to first volution of spiralia to join posteriorly; spiralia consisting of about 1.5 volutions directed submedially with slight dorsal inclination. [The only known species, *N. parvula*, is very small and may be an immature form of *Australina*. The spiralia are too poorly developed to determine the final disposition of their apices.] *U.Sil.(L.Ludlow)*, N. Am. (Okla.). —— Fig. 525,*1*. **N. parvula*, Henryhouse F.; *1a*, brach.v. int. view (brachidium), ×10; *1b-f*, ped.v., brach.v., lat., ped.v. int., brach.v. int. views, ×5 (30).

Subfamily SEPTATRYPINAE Kozlowski, 1929

[Septatrypinae Kozlowski, 1929, p. 176] [*emend.* Boucot, Johnson, & Staton, 1964, p. 812] [=Atrypellinae, Atrypopsinae Poulsen, 1943, p. 40]

Inner hinge plates absent. *M.Ord.-M.Dev.*

Septatrypa Kozlowski, 1929, p. 176 [**S. secreta*; OD]. Unequally biconvex shells with brachial valve more convex, commonly transverse and slightly pentagonal in outline; dorsal fold and ventral sulcus commonly strongly developed anteriorly. Dental plates present; hinge plates disjunct, forming septalium supported by median septum; spiralia dorsomedially directed; jugum unknown. *L.Dev.*, Eu.-Asia.——Fig. 526,*1a,b*. **S. secreta*, Borszczów, Podolia; *1a,b*, brach.v., ant. views, ×1 (487).——Fig. 526,*1c-f*. *S. sapho* (Barrande), Lochkovian, Boh.; *1c-f*, serial secs., ×5.5 (744).

Atrypella Kozlowski, 1929, p. 173 [**Atrypa prunum* Dalman, 1828, p. 133; OD]. Strongly biconvex, elongate or rarely transverse shells with dorsal fold and ventral sulcus commonly distinctly developed anteriorly; ventral beak commonly strongly incurved. Dental plates lacking; pedicle umbonal cavity may be distinctly set off by transverse ridge or platform; ventral diductor tracks broadly divergent, separated by trapezoidal platform; hinge plates discrete, diverging anteriorly; dorsal myophragm may be present; spiralia dorsomedially directed. [May equal *Atrypoidea*.] *U.Sil.-L.Dev.* (Skala), Eu.-Asia (USSR)-N. Am. (Arctic-USA).——Fig. 526,*5a,b*. **A. prunum* (Dalman), Sil., Sweden(Gotl.); *5a,b*, serial secs., ×3 (744). ——Fig. 526,*5c-g*. *A. carinata* Johnson, Sevy Dol., Nev.; *5c-g*, lat., post. int. mold, ant. ped.v. int. mold, brach.v. int. mold, ×1 (454).

Atrypoidea Mitchell & Dun, 1920, p. 271 [**Meristina australis* Dun, 1904, p. 318; OD]. Externally like *Atrypella*. Pedicle valve interior unknown; cardinalia and jugum unknown; spiralia directed dorsomedially. [May equal *Atrypella*.] *?U.Sil.*, Australia.

Cryptatrypa Siehl, 1962, p. 196 [**Terebratula philomela* Barrande, 1847, p. 387; OD]. Subequally biconvex, elongate or transversely oval, lenticular shells lacking well-developed fold and sulcus; ventral beak pointed, slightly incurved, foramen enclosed by deltidial plates. Short or obsolescent dental plates present or lacking; hinge plates discrete, commonly small, flat or concave; spiralia directed dorsally. *L.Sil.(U.Llandovery)-M.Dev.*, Eu.——Fig. 526,*4*. **C. philomela* (Barrande), M.Dev.(Greifensteiner Kalk), Ger.; *4a-c*, brach.v., ant., lat. views, ×3; *4d-f*, serial secs., ×6.5 (744).

Dubaria Termier, 1936, p. 1266 [**D. lantenoisi*; OD] [=*Atrypopsis* Poulsen, 1943, p. 44 (type, *A. varians*); *Rhynchatrypa* Siehl, 1962, p. 199 (type, *Terebratula thetis* Barrande, 1847, p. 349)]. Unequally biconvex shells with brachial valve more convex, commonly transverse and slightly pentagonal in outline; dorsal fold and ventral sulcus commonly strongly developed anteriorly in most species; sulcus may bear several indistinct plications; ventral beak small, incurved. Dental plates present; hinge plates disjunct, diverging slightly anteriorly; dorsal myophragm may be present; apices of spiralia directed dorsally; jugum unknown. [Differs from the externally homeomorphous *Septatrypa* by absence of a dorsal median septum.] *U.Sil.-M.Dev.*, Eu.(Ger.-Czech.)-N.Afr.-Asia-N.Am.(N.Greenl.-Nev.). —— Fig. 526,*3a-e*. **D. lantenoisi*, ?U.Sil., N.Afr.; *3a-e*, ped.v., brach.v. int. mold, lat., post., ant. views, ×1.5 (113).——Fig. 526,*3f-h*. *D. thetis* (Barrande), M.Dev.(U.Eifel.), Ger.(Greifenstein); *3f-h*, ser. secs., ×4.5 (744).

Idiospira Cooper, 1956, p. 690 [**Camerella panderi* Billings, 1859, p. 302; OD]. Subequally bicon-

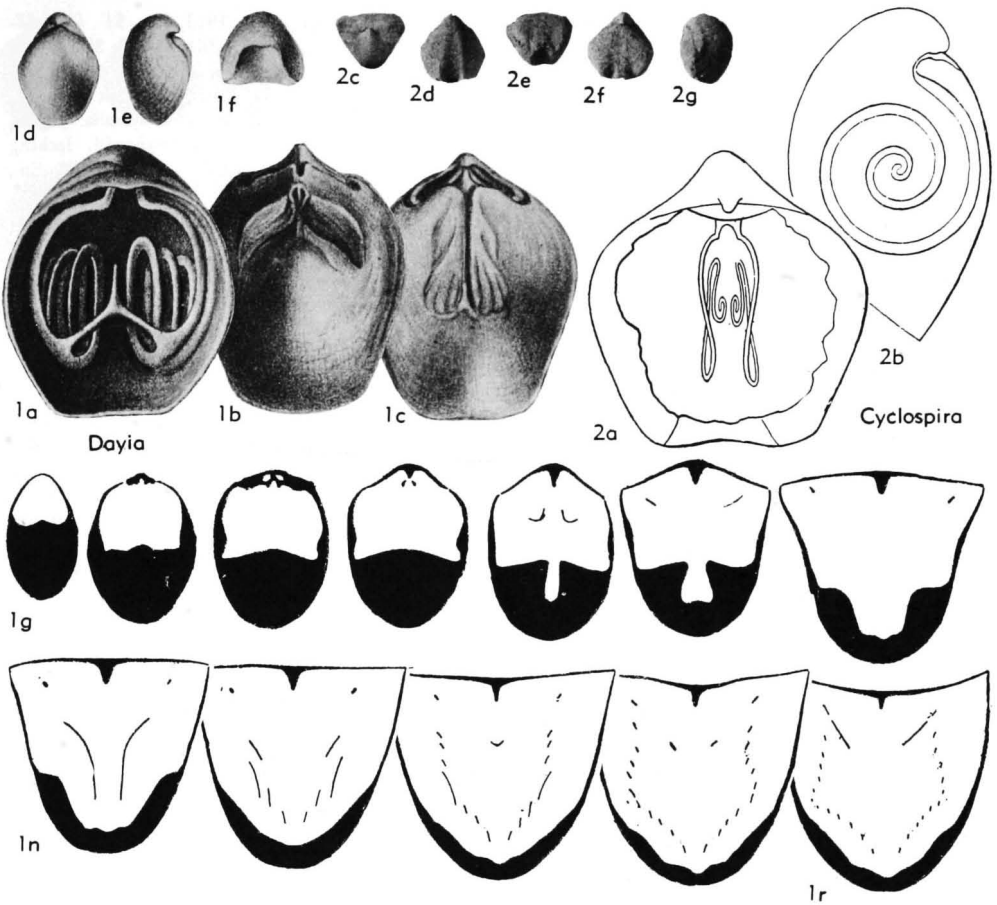


FIG. 527. Dayiidae (Cyclospirinae) *(2)*, (Dayiinae) *(1)* (p. *H*645-*H*646).

vex, commonly elongate shells with dorsal fold and ventral sulcus developed anteriorly; fold and sulcus may be faintly plicate at anterior margin; ventral beak small, incurved. Dental plates present or lacking; hinge plates disjunct; dorsal myophragm may be present; spiralia directed submedially with slight dorsal inclination; jugum short, simple, situated posteriorly. [Differs from *Dubaria* principally by the submedial disposition of apices of the spiralia.] *M.Ord-L.Sil.*, N.Am.-Eu.(G.Brit.)-Asia(Sib.).——FIG. 526,*2*. **I. panderi* (BILLINGS), M.Ord.(Tyrone F.), Ky.; *2a-e*, ped.v., ant., lat., post., brach.v. views, ×1 (189).

Family and Subfamily UNCERTAIN

Loilemia REED, 1936, p. 116 [**L. proxima* REED, 1936, p. 116; OD]. Unequally biconvex or planoconvex shells, pedicle valve more convex, shallow dorsal sulcus. Hinge line very narrow, greatest width anterior to mid-length; pedicle valve with ponderous myophragm that widens anteriorly; brachial-valve interior unknown. *Sil.*, India.

Superfamily DAYIACEA Waagen, 1883

[*nom. transl.* RZHONSNITSKAYA, 1960, p. 264 (*ex* Dayiinae WAAGEN, 1883, p. 486)]

Spiralia directed ventrally, laterally, or planospiral parallel to median plane. *M. Ord.-M.Dev.*

Family DAYIIDAE Waagen, 1883

[*nom. transl.* RZHONSNITSKAYA, 1960, p. 264 (*ex* Dayiinae WAAGEN, 1883, p. 486)]

Smooth shells. *M.Ord.-L.Dev.*

Subfamily CYCLOSPIRINAE Schuchert, 1913

[*nom. transl.* BOUCOT, JOHNSON, & STATON, herein (*ex* Cyclospiridae SCHUCHERT, 1913, p. 410)]

Jugum lacking. *M.Ord., ?L.Sil.*

Cyclospira HALL & CLARKE, 1893, p. 146 [**Orthis bisulcata* EMMONS, 1842, p. 395; OD] [=*Triplecella* WILSON, 1932, p. 399 (type, *T. duplicata*)]. Unequally biconvex shells, pedicle valve more convex; dorsal sulcus and ventral fold modified in

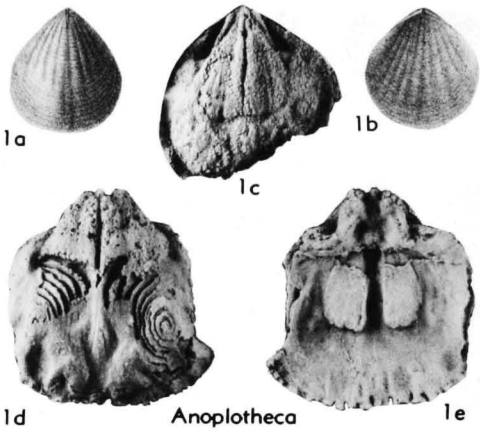


FIG. 528. Anoplothecidae (Anoplothecinae) (p. *H*648).

some by low medial plication. Dental plates, if present, buried in secondary shell material present in umbonal region; hinge plates conjunct; median septum present; spiralia planospiral, with few volutions, jugum lacking. [According to SCHUCHERT & COOPER (729) the pedicle valve musculature resembles that of *Dayia.*]. *M.Ord., ?L.Sil.,* N.Am.-Eu.(Eng.).——FIG. 527,*2*. **C. bisulcata* (EMMONS), M.Ord.(Trenton Ls.), N.Y. *(2a,b,);* M.Ord.(Coburg F.), N.Y. *(2c-g)*; *2a,b,* brach. view (brachidium), lat. (brachidium), ×3; *2c-g,* post., ped.v., ant., brach.v., lat., ×1.5 (189, 396).

Subfamily DAYIINAE Waagen, 1883

[*nom. correct.* SCHUCHERT, 1913, p. 409 (*pro* Dayinae WAAGEN, 1883, p. 486, *nom. imperf.*)] [=Protozeugidae TWENHOFEL, 1914, p. 29]

Jugum present. *U.Sil.(Wenlock.)-L.Dev.*

Dayia DAVIDSON, 1881, p. 291 [**Terebratula navicula* SOWERBY in MURCHISON, 1839, p. 611; OD] [=*Daya* KOKEN, 1896, p. 240 (obj.) *(nom. null.)*]. Unequally biconvex shells, pedicle valve more convex; ventral fold and dorsal sulcus developed most strongly anteriorly; ventral beak strongly incurved; posterior of pedicle valve thickened by secondary shell material. Dental plates absent; teeth crenulate, fixed directly to sides of valve; diductor scars strongly divergent, situated near anterior edge of secondary shell material; hinge plates disjunct, with bilobed cardinal process supported by stout myophragm (according to ALEXANDER, 9); spiralia directed laterally, jugum long, situated anteriorly, and projecting posteriorly with short stem. *U.Sil.-L.Dev. (Skala),* Eu.-Asia-N.Afr.——FIG. 527,*1a-f*. **D. navicula* (SOWERBY); U.Sil.(Ludlow), Br.Is.; *1a-c,* brach.v. int. (brachidium), ped.v. int. mold, brach. v. int. mold, ×3; *1d-f,* brach.v., lat., ant. views, ×1 (229, 396).——FIG. 527,*1g-r*. *D.* sp. cf. **D. navicula*; *1g-r,* serial secs., ×3 (487).

Protozeuga TWENHOFEL, 1913, p. 51 [**Waldheimia? mawei* DAVIDSON, 1881, p. 145; SD TWENHOFEL, 1914, p. 30]. Small, externally like *Dayia.* [CLOUD (1942, p. 145) determined that the type-species possesses laterally directed spiralia. Jugum situated anteriorly, long and U-shaped, lacking the stem present in *Dayia.*] *U.Sil.(Wenlock.),* Eu., (Eng.-Gotl.).

Subfamily AULIDOSPIRINAE Williams, 1962

[*nom. transl.* BOUCOT, JOHNSON, & STATON, 1964, p. 806 (*ex* Aulidospiridae, WILLIAMS, 1962, p. 252)]

Primitive dayiids with rudimentary spiralia coiled in plane parallel to median plane. Shoe-lifter present, jugum lacking. *M.Ord., ?U.Ord.*

Aulidospira WILLIAMS, 1962, p. 252 [**A. trippi*; OD]. Unequally biconvex shells with pedicle valve more convex; brachial valve with broad, shallow sulcus. Dental plates present, attached to ventral side of small, nearly flat, shoe-lifter process; hinge plates discrete; myophragm present, median septum absent. *M.Ord., ?U.Ord.,* Eu.(G.Brit.-?Boh.)-?N.Am.(Que.).

Family ANOPLOTHECIDAE Schuchert, 1894

[*nom. transl.* BOUCOT, JOHNSON, & STATON, 1964, p. 807 (*ex* Anoplothecinae SCHUCHERT, 1894, p. 103)] [=Coelospiridae HALL & CLARKE, 1895, p. 357]

Costate or plicate Dayiacea. *U.Sil.(Wenlock.)-M.Dev.*

Subfamily COELOSPIRINAE Hall & Clarke, 1894

[*nom. transl.* AMOS & BOUCOT, 1963, p. 441 (*ex* Coelospiridae HALL & CLARKE, 1895, p. 357)]

Shells with bifurcating plications. *U.Sil. (Wenlock.)-M.Dev.*

Coelospira HALL, 1863, p. 60 [**Leptocoelia concava* HALL, 1857, p. 107; OD]. Small, unequally biconvex or plano-convex plicate shells, pedicle valve more convex; anterior commissure rectimarginate or deflected slightly ventrally; plications may be flattened on their crests, bifurcating anteriorly in some species. Dental plates lacking; ventral myophragm present; hinge plates discrete, arising directly from posterolateral shell margins; small cardinal process may be slightly bilobate posteriorly, situated between hinge plates; dorsal myophragm may be present in front of cardinal process; spiralia with few volutions and with short axes directed sublaterally and slightly ventrally, jugum arising about midway between crural bases and axes of spiralia, arching ventrally, and joining to form simple stem. *U.Sil.(Wenlock.)-M.Dev.,* ?Asia(Kazakh.)-N. Am.-S. Am.(Venez.). ——FIG. 529,*1*. *C. virginia* AMSDEN, L.Dev.(Haragan), USA(Okla.); *1a-e,* brach.v., ped.v., ant., post., lat. views, ×3 (33).——FIG. 529,*5*. *C.* sp., L.Dev.(Rabbit Hill Ls.), USA(Nev.); *5a,b,* ped.v. int., brach.v. int., ×5 (Boucot, Johnson, & Staton, n).

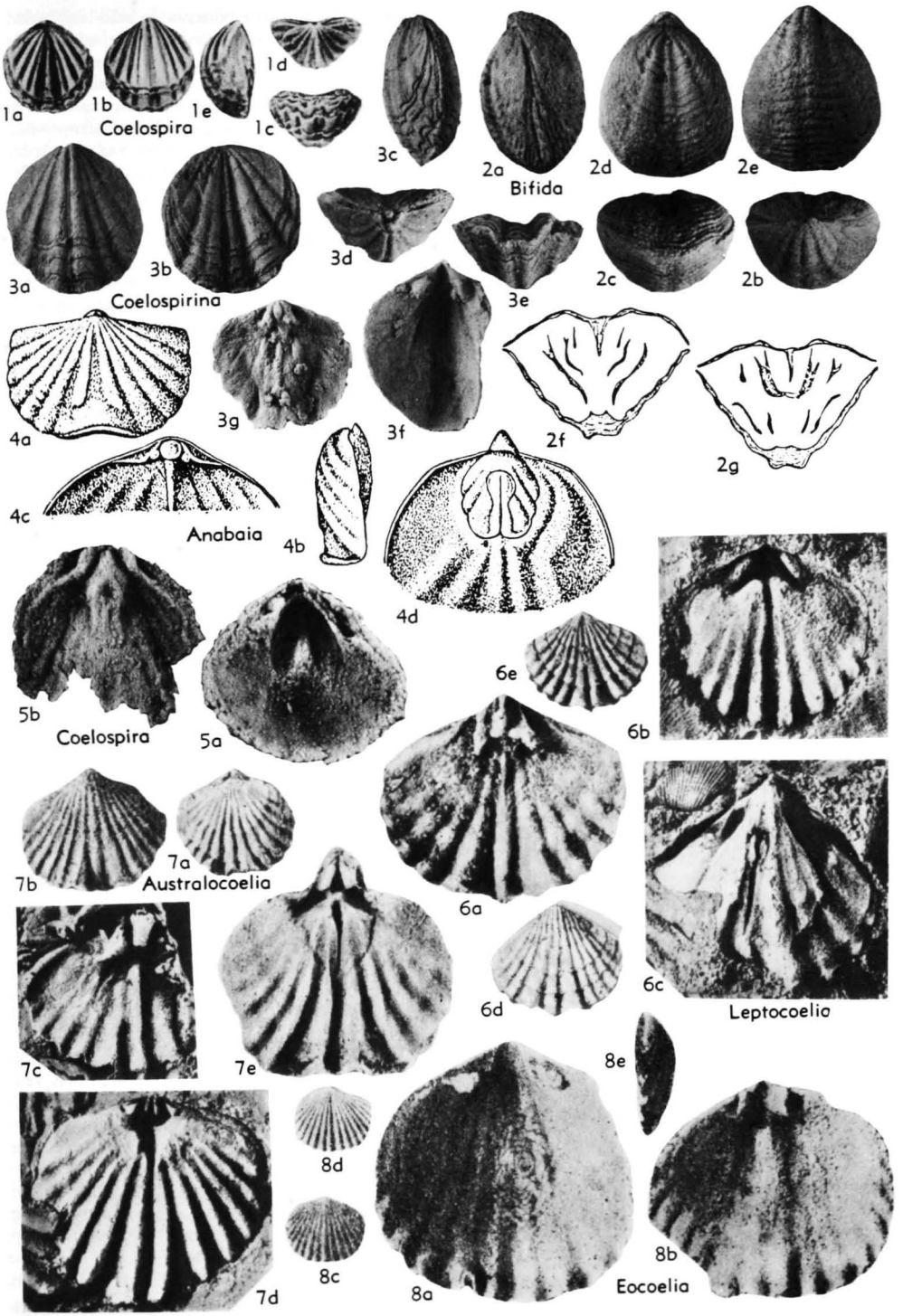


FIG. 529. Anoplothecidae (Coelospirinae) *(1,5)* (Anoplothecinae) *(2,3)*, Leptocoeliidae *(4, 6-8)* (p. *H*646, *H*648-*H*649).

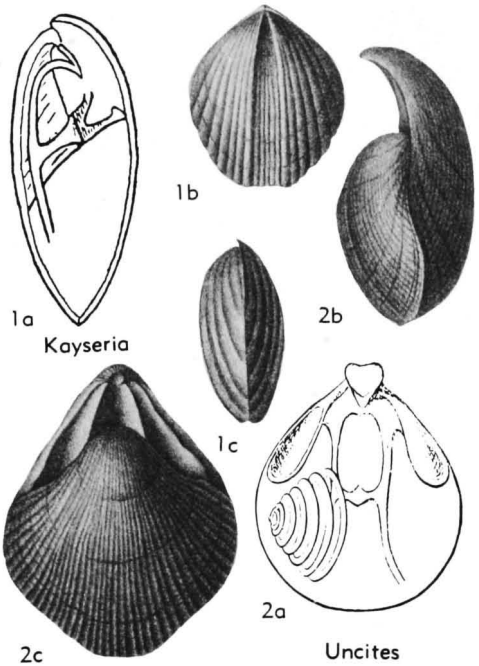


FIG. 530. Kayseriidae *(1)*; Uncitidae *(2)* (p. *H*649).

Subfamily ANOPLOTHECINAE Schuchert, 1894

[Anoplothecinae SCHUCHERT, 1894, p. 103]

Shells with low, rounded plications crossed by lamellose growth lines. *L.Dev.-M.Dev.*

Anoplotheca SANDBERGER, 1855, p. 102 [**Terebratula venusta* SCHNUR, 1853, p. 180; OD (=*Productus lamellosus* SANDBERGER, 1850-56, p. 351)] [=*Hoplotheca* BIGSBY, 1878, p. 36 (type, *T. venusta*)]. Medium-sized lenticular, plano-convex shells with low, rounded plications and lamellose growth lines. Prominent, bilobed cardinal process present; muscle impressions and cardinalia otherwise essentially as in *Bifida*. Spiralia directed ventrally, inclined slightly laterally. *L.Dev.*, Eu. ——FIG. 528,*1a-c*. **A. venusta* (SCHNUR), Ger.; *1a,b*, ped.v., brach.v., ×1 (396); *1c*, ped.v. int. mold, ×2 (113).——FIG. 528,*1d,e*. *A.* sp., U. Ems., Laubacher Schichten, Ger.; *1d,e*, brach.v. and ped.v. int. molds, ×3 (113).

Bifida DAVIDSON, 1882, p. 27 [**Terebratula lepida* D'ARCHIAC & DE VERNEUIL, 1842, p. 368; OD]. Small plano-convex or concavo-convex pauciplicate shells, pedicle valve strongly convex; low rounded plications crossed by lamellose growth lines. Dental plates absent; crural fossettes present on teeth; ventral myophragm present, cardinal process present, dorsal median septum present, attaining greatest height at mid-length; spiralia directed laterally, jugal lamellae arising posterior to mid-length and joining over crest of median septum, giving rise to long stem that projects ventrally to touch pedicle valve; accessory lamellae arising from base of stem and projecting nearly to floor of brachial valve. *L.Dev.-M.Dev.*, Eu.-N.Afr.——FIG. 529,*2*. **B. lepida* (D'ARCHIAC & DE VERNEUIL), M. Dev.(Eifel., Rommersheimer Sh.), Ger.; *2a-e*, lat., post., ant., brach.v., ped.v., ×4; *2f,g*, ser. secs., ×6.5 (113, 744).

Coelospirina HAVLÍČEK, 1956, p. 586 [**C. modica*; OD]. Small, unequally biconvex shells like *Bifida*, but with stronger plications, numerous lamellose growth lines not developed; cardinal process present. *L.Dev.(U.Ems.)*, Eu.(Czech.).——FIG. 529, *3*. **C. modica*, Zlichov Ls.; *3a-g*, ped.v., brach.v., lat., post., ant., ped.v. int., brach.v. int, all ×3 (113).

Family LEPTOCOELIIDAE Boucot & Gill, 1956

[Leptocoeliidae BOUCOT & GILL, 1956, p. 1174]

Shells with simple, strong, unbranched plications; lamellose growth lines present or absent; brachidium unknown. *L.Sil.-M. Dev.*

Leptocoelia HALL, 1857, p. 108 [**L. propria* (=**Atrypa flabellites* CONRAD, 1841, p. 55 =*Leptocoelia propria* HALL, 1857, p. 108); SD OEHLERT, 1887, p. 1324]. Subequally biconvex or plano-convex plicate shells, pedicle valve more convex; dorsal fold and ventral sulcus present; dorsal fold commonly bearing median groove; surface may or may not be covered with lamellose growth lines. Dental plates lacking, teeth crenulate; ventral beak incurved; pedicle-valve diductor scars flabellate, enclosing small, oval adductors; hinge plates flanking notothyrial platform bearing elevated, posteriorly trilobate cardinal process; dorsal myophragm present; brachidium unknown. *L.Dev.-M.Dev.*, N.Am.-S.Am.-Asia.—— FIG. 529,*6*. **L. flabellites* (CONRAD), Glenerie Ls., USA(N.Y.) *(6a,d,e)*; Gaspé Ss., Can.(Quebec) *(6b,c)*; *6a-c*, brach.v. int., brach.v. int. mold, ped.v. int. mold, ×2; *6d,e*, ped.v., brach.v., ×1 (111).

Anabaia CLARKE, 1893, p. 141 [**A. paraia*; OD]. Biconvex, plicate shells with dorsal fold and ventral sulcus, brachial valve commonly more convex; plications on fold and sulcus becoming obsolescent anteriorly on some shells. Musculature in pedicle valve essentially as in *Leptocoelia*; cardinal process present, consisting of simple rounded knob supported by dorsal myophragm and lying between disjunct hinge plates; brachidium unknown. *L.Sil.*, N.Am.-S.Am.(Brazil). —— FIG. 529,*4*. **A. paraia*, Brazil; *4a,b*, brach.v., lat., ×1; *4c,d*, brach.v. int. (cardinalia), ped.v. int. views, ×2 (396).

Australocoelia BOUCOT & GILL, 1956, p. 1174 [**A.*

tourteloti; OD]. Unequally biconvex, plicate shells with dorsal fold and ventral sulcus, pedicle valve more convex; pedicle beak suberect. Dental plates lacking; hinge teeth stout, triangular in cross section; musculature in pedicle valve essentially as in *Leptocoelia*; cardinal process consisting of elevated median ridge, swollen terminally; cardinal process supported by dorsal myophragm; brachidium unknown. *L.Dev.*, S.Am.-S.Afr.-Australia.——FIG. 529,*7*. **A. tourteloti*, Brazil-Arg.; *7a,b*, brach.v., ped.v., ×1; *7c-e*, brach.v. int., brach.v. int. mold, brach.v. int. mold, ×2 (111).

Eocoelia NIKIFOROVA, 1961, p. 252 [**Atrypa hemisphaerica* SOWERBY in MURCHISON, p. 637; OD]. Unequally biconvex or plano-convex, plicate shells, pedicle valve more convex; growth lines subdued; fold and sulcus lacking or subdued. Small, thin, dental plates present or lacking; hinge teeth bearing crural fossette on their median faces; discrete hinge plates bounding notothyrial cavity and notothyrial platform with or without knoblike cardinal process; brachidium unknown. *L.Sil.(L.Landovery)-U.Sil.(Wenlock.)*, Eu.-Asia(Sib.)-N.Am.-S.Am.-Australia.——FIG. 529,*8*. **E. hemisphaerica* (SOWERBY), L.Sil., Sib.; *8a,b*, ped.v. int., brach.v. int., ×4; *8c-e*, ped.v., brach.v., lat. views, ×3 (602).

Family KAYSERIIDAE Boucot, Johnson, & Staton, 1964

[Kayseriidae BOUCOT, JOHNSON, & STATON, 1964, p. 807]

Accessory lamellae arising from the jugum and continuing intercoiled with the primary lamellae of the spiralia to their ends. *M.Dev.*

Kayseria DAVIDSON, 1882, p. 21 [**Orthis lens* PHILLIPS, 1841, p. 65; OD]. Biconvex, bisulcate, elongate-ovate costate shells, lenticular in profile, median costae finer than those on flanks, growth lines crossing ribs at irregular intervals. Ventral myophragm present; dental plates lacking; high triangular median septum extending along posterior part of brachial valve; jugum resting on median septum and produced ventrally as stem that contacts pedicle valve, jugal bifurcations arising from base of stem and accessory lamellae continuing intercoiled with primary volutions of spiralia to their ends. *M.Dev.*, Eu., Asia.——FIG. 530,*1*. **K. lens* (PHILLIPS), G.Brit.; *1a*, lat. (jugum), ×3; *1b,c*, brach.v., lat., views, ×2 (396).

Superfamily UNCERTAIN

Family UNCITIDAE Waagen, 1883

[*nom. transl.* SCHUCHERT & LEVENE, 1929 (*ex* Uncitinae WAAGEN, 1883, p. 494)]

Characters of *Uncites*. *M.Dev.*

Uncites DEFRANCE, 1825, p. 630 [**Terebratulites gryphus* SCHLOTHEIM, 1820, p. 259; OD] [=*Winterfeldia* SPRIESTERSBACH, 1942, p. 197 (type, *U. paulinae* WINTERFELD)]. Biconvex, elongate-oval, costate shells, commonly lacking fold and sulcus; costae bifurcate, crossed by irregularly spaced growth lines; ventral beak attenuate, commonly twisted; foramen may be present behind concave deltidium. Dental plates and ventral myophragm present; cardinal plate supporting large, slightly bilobed cardinal process; hinge plates extending as long lobes along posterolateral margins; crura connecting directly with primary volutions of spiralia, jugum a simple band with low median projection. *M.Dev.*, Eu.-Asia.——FIG. 530,*2*. **U. gryphus* (SCHLOTHEIM), M.Dev., Eu.; *2a-c*, brach.v. int., lat., brach.v. ext., ×1 (229, 396).

Suborder RETZIIDINA Boucot, Johnson, & Staton, 1964

[*nom. correct.* BOUCOT, JOHNSON, & STATON, herein (*pro* suborder Retzioidea BOUCOT, JOHNSON, & STATON, 1964)] [Materials for this suborder prepared by A. J. BOUCOT, J. G. JOHNSON, and R. D. STATON]

Costate and plicate rhynchonelliform shells with crural loops directed medially connecting with laterally directed spiralia. *U.Sil.(Wenlock.)-Trias.*

Superfamily RETZIACEA Waagen, 1883

[*nom. transl.* BOUCOT, JOHNSON, & STATON, 1964, p. 813 (*ex* Retziinae WAAGEN, 1883, p. 486)]

Punctate shells with spiralia directed laterally. *U.Sil.(Wenlock.)-Perm.*

Family RETZIIDAE Waagen, 1883

[*nom. transl.* HALL & CLARKE, 1895, p. 358 (*ex* Retziinae WAAGEN, 1883, p. 486)]

Plications or costae developed evenly across shell. *L.Dev.-Perm.*

Retzia KING, 1850, p. 137 [**Terebratula adrieni* DE VERNEUIL, 1845, p. 471; OD] [=*Trigeria* BAYLE, 1878, pl. 13 (type, *T. adrieni*)]. Subequally biconvex, elongate-oval costate shells commonly without fold and sulcus; median costae same width as costae on flanks; deltidial plates conjunct; foramen permesothyridid. Thin, but prominent dental plates present; pedicle collar well developed; cardinal plate quadrilobate, flattened, posterior lobes extending into umbonal cavity of pedicle valve; cardinal plate supported by median septum; jugum joining and projecting posteroventrally as long stem that gives rise to short pronglike bifurcations. *L.Dev.*, Eu.-Asia(USSR).——FIG. 531,*2*. **R. adrieni* (DE VERNEUIL), Fr.; *2a*, lat. (jugum), ×3; *2b,c*, brach.v., ped.v., ×1 (396).

Acambona WHITE, 1862, p. 27 [**A. prima*; OD]. Subequally biconvex, elongate oval, finely costate shells commonly lacking distinct fold and sulcus; costae may be interrupted by growth lines at

irregular intervals toward anterior, costae on medial regions same width as those on flanks; deltidial plates conjunct. Foramen permesothyridid. Dental plates lacking; pedicle collar present; cardinal plate bilobate posteriorly; jugum unknown. *L.Miss.*, N.Am.——Fig. 531,6. **A. prima*, Osagian

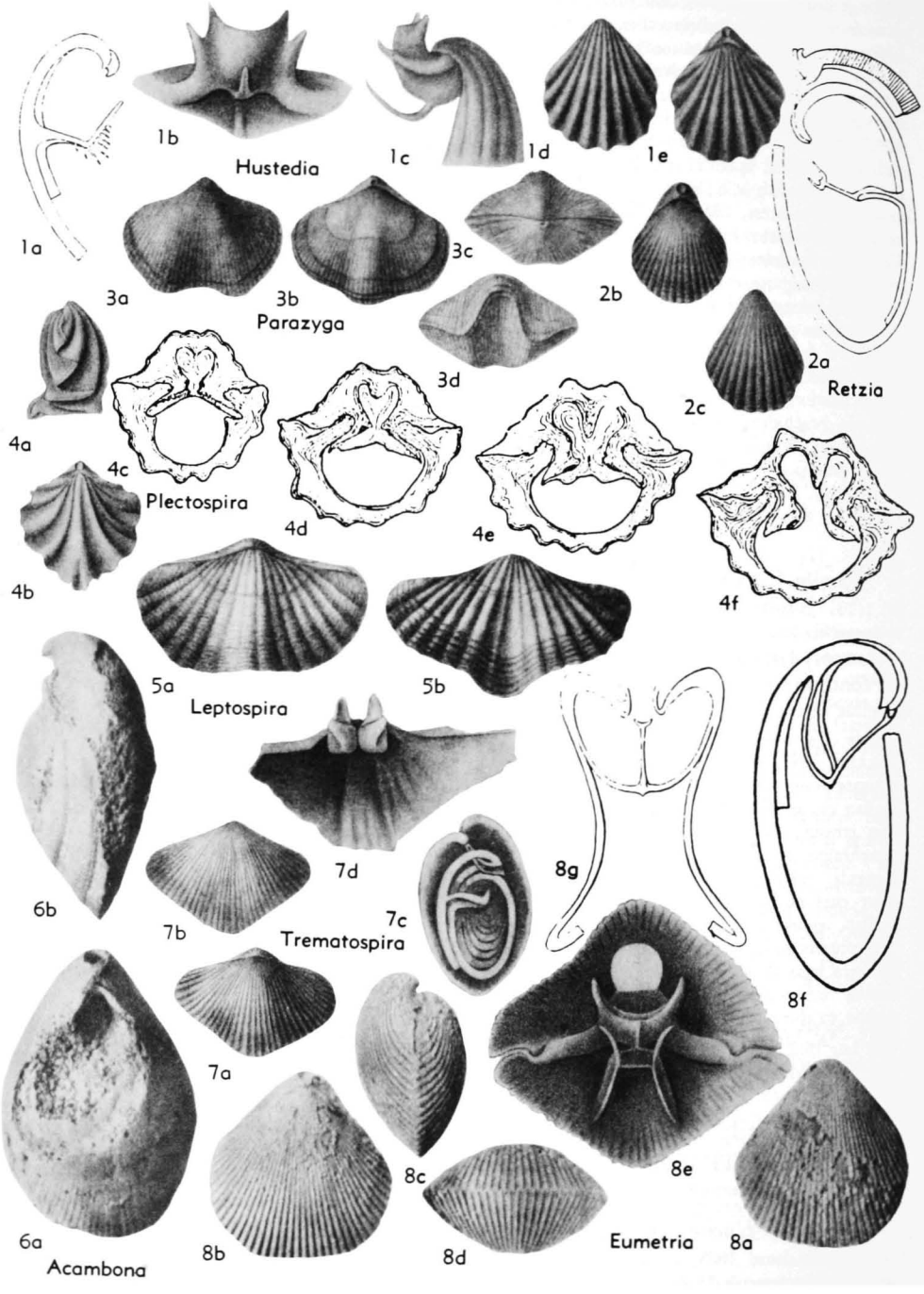


Fig. 531. Retziidae (p. *H649-H652*).

(Burlington Ls.), USA(Iowa); *6a,b,* brach.v., lat. views, ×1 (858).

Eumetria HALL, 1864, p. 54 [**Retzia vera* HALL, 1858, p. 704; OD]. Subequally biconvex, elongate-oval costate shells, commonly without fold and sulcus; median and flank costae same in width; deltidial plates conjunct; foramen permesothyridid. Dental plates lacking; cardinal plate crescent-shaped, with apices pointed posteroventrally; cardinal plate supported by transverse plate connecting crural plates; median septum lacking; limbs of jugum connecting medially and projecting backward as long stem that bifurcates into short stubs. *Miss.*, Eu.-N.Am.——FIG. 531, *8a-d.* **E. vera* (HALL), U.Miss.(Chester.), USA (Ill.); *8a-d,* ped.v., brach.v., lat., ant. views, ×1 (858).——FIG. 531,*8e-g. E. verneuiliana* (HALL), U.Miss.(St. Louis Ls.), USA(Ind.); *8e,* post. int., ×10; *8f,* jugum (lat.), ×4; *8g,* jugum (ped. view), ×4 (396).

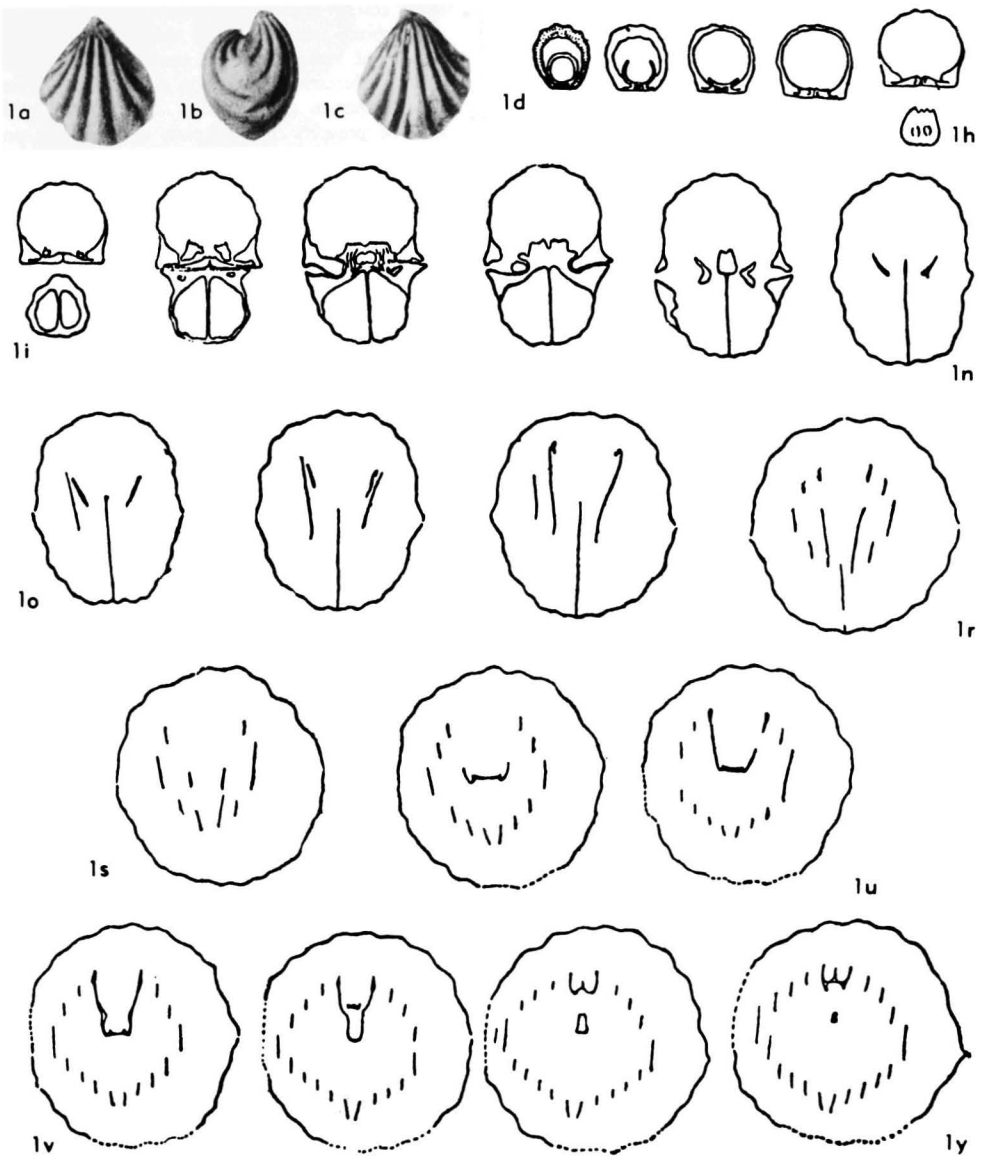


FIG. 531A. Retziidae (p. *H652*).

Hustedia HALL & CLARKE, 1893, p. 120 [**Terebratula mormoni* MARCOU, 1858; OD]. Subequally biconvex, elongate-oval, costate shells, commonly lacking fold and sulcus; costae on medial regions same width as costae on flanks; deltidial plates conjunct; foramen permesothyridid. Dental plates lacking; pedicle collar present; cardinal process large, recurved posteriorly, bilobate on extremity, and bearing lateral pronglike crura projecting into umbonal cavity of pedicle valve; single pronglike stem, recurved backward, arising medially near base of cardinal plate; jugal lamellae rising anteroventrally to join; then projecting backward as simple stem; spines projecting backward from jugal stem. *Carb.-Perm.*, Eu.-N.Am.-S.Am.(Brazil-Peru)-Asia(India).——FIG. 531,*1*. **H. mormoni* (MARCOU), Penn., Mo.; *1a*, lat. (jugum), ×4; *1b,c*, ant. (cardinal plate), lat. (cardinal plate), ×5; *1d,e*, ped.v., brach.v., ×2 (396).

Leptospira BOUCOT, JOHNSON, & STATON, 1964, p. 814 [**Trematospira costata* HALL, 1859, p. 210; OD]. Externally shaped like *Trematospira*, but pauciplicate. Internally like *Rhynchospirina*. *L. Dev., ?M.Dev.*, N.Am.——FIG. 531,*5*. **L. costata* (HALL), New Scotland F., USA(N.Y.); *5a,b*, brach.v., ped.v., ×1 (396).

Neoretzia DAGIS, 1963, p. 130 [**Retzia superbescens* BITTNER, 1890, p. 281; OD]. Biconvex shells with few subangular plications and radially grooved interspaces laterally; pedicle valve beak nearly straight, deltidial plates conjunct. Pedicle collar present, dental plates lacking; brachial valve with cardinal plate supporting bilobed cardinal process and supported by high, thin median septum; jugum wtih M-shaped median blade on ventral side and with saddle-shaped jugal stem; apices of spiralia directed laterally. *Trias.*, Eu.-Asia.——FIG. 531A,*1*. **R. superbescens* (BITTNER), Eu.(Crimea-Caucasus); *1a-c*, brach.v., lat., ped.v. views, ×1; *1d-y*, ser. transv. secs., ×3 (212a).

Parazyga HALL & CLARKE, 1893, p. 127 [**Atrypa hirsuta* HALL, 1857, p. 168; SD SCHUCHERT, 1897, p. 301]. Subequally biconvex, transversely oval or elongate costate shells, commonly with dorsal fold and ventral sulcus; costae simple, bearing fine spines; conjunct deltidial plates present or lacking. Dental plates present; incomplete pedicle collar present; cardinal plate quadrilobate as in *Trematospira* but less elevated and with anterior lobes only poorly defined by medial cleft; dorsal myophragm present; jugum as in *Trematospira*. *M.Dev.*, N.Am.——FIG. 531,*3*. **P. hirsuta* (HALL), M.Dev.(Hamilton.), USA(N.Y.); *3a-d*, ped.v., brach.v., post., ant. views, ×1 (396).

Plectospira COOPER, 1942, p. 288 [*pro Ptychospira* HALL & CLARKE, 1893, p. 112 (*non* SLAVIK, 1869)] [**Terebratula ferita* VON BUCH, 1834, p. 96; OD]. Subequally biconvex, pauciplicate shells of lenticular outline, dorsal fold commonly consisting of elevated median plication; deltidial plates conjunct. Dental plates absent; cardinal plate essentially as in *Homoeospira*; median septum present; jugal lamellae joined and projecting posteroventrally as simple stem. *L.Dev.-M.Dev.*, Eu.-Asia.——FIG. 531,*4*. **P. ferita* (VON BUCH), M. Dev., Ger.; *4a,b*, lat., brach.v. views, ×2; *4c-f*, serial secs., ×6.5 (396, 744).

Trematospira HALL, 1859, p. 207 [**Spirifer multistriatus* HALL, 1857, p. 59; SD HALL & CLARKE, 1893, p. 126]. Subequally biconvex, transverse-oval, costate shells, commonly with dorsal fold and ventral sulcus; costae subangular, approximately of same width in medial regions as on flanks, bifurcating anteriorly; deltidial plates conjunct; foramen mesothyridid. Short dental plates may be present; cardinal plate quadrilobate, posterior lobes projecting into pedicle cavity; small cardinal process may be developed between posterior lobes, as in *Rhynchospirina*; median septum absent; myophragm may be present; jugum essentially as in *Rhynchospirina*. *L.Dev.*, N.Am.——FIG. 531,*7*. **T. multistriata* (HALL), L.Dev.(New Scotland), USA(N.Y.); *7a-c*, brach.v., ped.v., lat. (jugum) views, ×1; *7d*, brach.v. int. (cardinalia), ×3 (396).

Family RHYNCHOSPIRINIDAE Schuchert & LeVene, 1929 (1894)

[Rhynchospirinidae SCHUCHERT & LEVENE, 1929, p. 22 (1894); =Rhynchospirinae SCHUCHERT, 1894, p. 105] [The family-group name Rhynchospirinidae, based on the junior synonym of the replaced homonym *Rhynchospira*, is to be cited under its own author and date, but for purposes of priority takes the date of the replaced family name. Likewise, the type-genus, *Rhynchospirina*, takes the date of the name (*Rhynchospira* HALL) which it replaces (Code, Art. 39)]

Costae of second order originating medially in front of the beak or with medial costae finer than on flanks. *U.Sil.-L.Dev.*

Rhynchospirina SCHUCHERT & LEVENE, 1929, p. 121 (1859) [*pro Rhynchospira* HALL, 1859, p. 29 (*non* EHRENBERG, 1845)] [**Waldheimia formosa* HALL, 1857, p. 88; OD] [=*Rhyncospira* HALL, 1859, p. 213 (*nom. null.*); *Retziella* NIKIFOROVA, 1937, p. 57 (type, *R. weberi*)]. Externally like *Homoeospira*; deltidial plates conjunct; foramen mesothyridid to permesothyridid. Short dental plates may be present; incipient pedicle collar variably developed or absent; cardinal plate trapezoidal, projecting posteriorly into umbonal cavity of pedicle valve; crural bases stout and flattened, projecting ventrally; cardinal plate supported by median septum; jugal lamellae rising ventrally to join, then projects backward as short trough-shaped stem, or stem may be lacking. *U.Sil.-L.Dev.*, Eu.-N.Am.-Asia.——FIG. 532,*1a*. **R. formosa* (HALL), L.Dev., USA(N.Y.); lat. view showing jugum, ×4 (396).——FIG. 532,*1b-e*. *R. maxwelli* AMSDEN, L.Dev., USA(Okla.); *1b-d*, brach.v., ped.v., ant. views, ×2; *1e*, brach.v. int., ×3 (33).

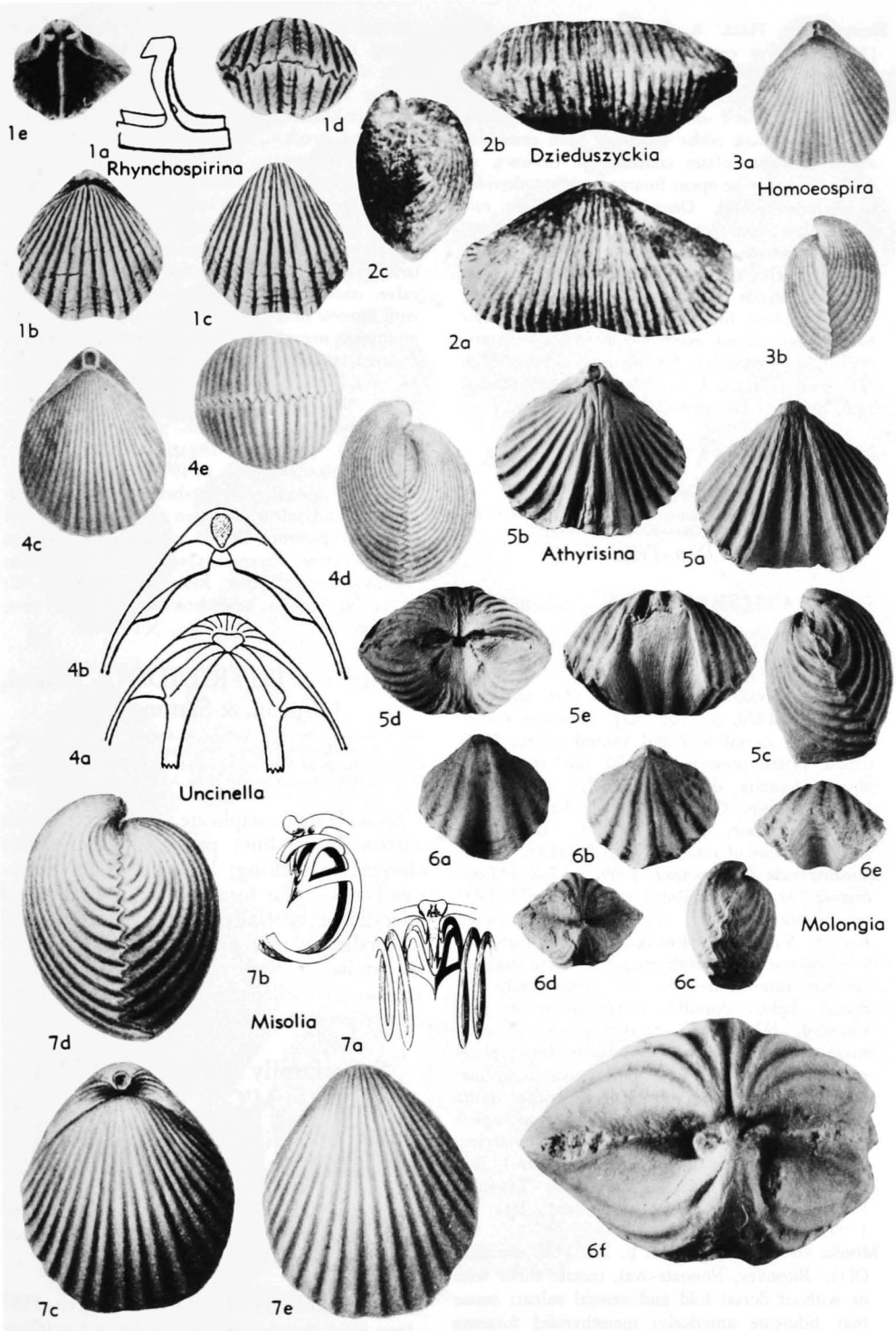


Fig. 532. Rhynchospirinidae *(1,3)*; Athyrisinidae *(2,4-7)* (p. *H652*, *H654*).

Homoecospira HALL & CLARKE, 1893, p. 112 [**Rhynchospira evax* HALL, 1863, p. 213; SD SCHUCHERT, 1897, p. 231]. Subequally biconvex, elongate-oval costate shells, with or without poorly defined fold and sulcus, or shells may be faintly bisulcate; median costae narrower than costae on flanks; deltidial plates conjunct or disjunct, or delthyrium may be open; foramen submesothyridid to permesothyridid. Dental plates lacking; cardinal plate conjunct posteriorly, but disjunct, divergent anteriorly; small, linear cardinal process posteriorly; cardinal plate not extending into pedicle cavity, as in *Rhynchospirina*, supported by median septum that does not reach to anterior half of shell; jugum essentially as in *Rhynchospirina*. *U.Sil.(Wenlock.)*, Eu.-N.Am.——FIG. 532,*3*. **H. evax* (HALL), U.Sil.(Waldron), USA(Ind.); *3a,b*, brach.v., lat. views, ×1 (396).

Superfamily ATHYRISINACEA Grabau, 1931

[*nom. transl.* BOUCOT, JOHNSON, & STATON, 1964, p. 814 (*ex* Athyrisininae GRABAU, 1931, p. 509)]

Impunctate. *M.Dev.-Trias.*

Family ATHYRISINIDAE Grabau, 1931

[*nom. transl.* BOUCOT, JOHNSON, & STATON, 1964, p. 815 (*ex* Athyrisininae GRABAU, 1931, p. 509)]

Characters of superfamily. *M.Dev.-Trias.*

Athyrisina HAYASAKA, 1920, p. 176 [**A. squamosa* HAYASAKA, 1920, p. 176; OD]. Biconvex costate shells with dorsal fold and ventral sulcus. Short dental plates present; brachial median septum absent. Spiralia directed laterally; jugum unknown. *M.Dev.*, China.——FIG. 532,*5*. **A. minor* HAYASAKA; *5a-e*, ped.v., brach.v., lat., post., and ant. views of int. mold, ×1.5 (113).

Dzieduszyckia SIEMIRADZKI, 1909, p. 768 [**Terebratula (?) kielcensis* ROEMER, 1866, p. 671; OD] [=*Zigania* NALIVKIN, 1937, opp. p. 112 *(nom. nud.)*]. Subequally biconvex, bisulcate, commonly transverse shells with crenulate, rectimarginate anterior commissure, or with commissure deflected slightly dorsally; costae coarse or fine, rounded, bifurcating anteriorly; ventral beak straight or slightly incurved. Short dental plates present; cardinal plate present, supported by median septum in posterior half of valve; crura forming loops subparallel to median plane; apices of spiralia directed toward posterolateral margins; jugum unknown. *U.Dev.(?Frasn.-Famenn.)*, Eu.-N.Afr.——FIG. 532,*2*. **D. intermedia* TERMIER, Famenn., N.Afr.; *2a-c*, brach.v., ant., lat., ×1 (799).

Misolia VON SEIDLITZ, 1913, p. 172 [**M. misolica;* OD]. Biconvex, elongate-oval, costate shells with or without dorsal fold and ventral sulcus; costae may bifurcate anteriorly; mesothyridid foramen present below conjunct deltidial plates. Cardinal plate not pierced apically, but bearing low bilobed cardinal process on its posterior portion; jugum giving rise to dorsally directed bifurcations at point of joining, jugum pointed anteriorly, but lacking saddle. *Trias.*, Indonesia.——FIG. 532,*7*. **M. misolica*; *7a,b*, ped. and lat. views of jugum, ×2; *7c-e*, brach.v., lat., ped.v. views, ×1 (735).

Molongia MITCHELL, 1921, p. 546 [**M. elegans*, p. 547; OD]. Small, subequally biconvex, pauciplicate shells; unplicate sulcus present in pedicle valve, medially grooved fold present in brachial valve; beak moderately incurved, foramen circular. Short thin dental plates present in pedicle valve, musculature not impressed; brachial valve with discrete hinge plates diverging anterolaterally; prominent myophragm present posteriorly; spiralia directed laterally. Shell substance impunctate. *U. Sil.* or *L.Dev.*, Australia (New S. Wales).——FIG. 532,*6*. **M. elegans*; *6a-e*, ped.v., brach.v., lat., ant. views, ×1.5; *6f*, post. view of int. mold, ×5 (113).

Uncinella WAAGEN, 1883, p. 494 [**U. indica*; OD]. Biconvex, suboval, costate shells commonly lacking fold and sulcus; foramen as in *Misolia*; small deltidium present. Dental plates lacking; hinge plates discrete, diverging; spiralia as in *Retzia*; jugum unknown. *Perm.*, India.——FIG. 532,*4*. **U. indica*; *4a,b*, ped.v. beak, brach.v. beak, ×2; *4c-e*, brach.v. ext., lat., ant. views, ×1 (845).

Suborder ATHYRIDIDINA Boucot, Johnson, & Staton, 1964

[*nom. correct.* BOUCOT, JOHNSON, & STATON, herein (*pro* suborder Athyridoidea BOUCOT, JOHNSON, & STATON, 1964, p. 815)] [=suborder Rostrospiracea MOORE, 1952, p. 221] [Materials for this suborder prepared by A. J. BOUCOT, J. G. JOHNSON, and R. D. STATON]

Smooth or pauciplicate, impunctate, with narrow hinge line; pedicle-valve interarea obsolete or lacking; beak commonly truncated by circular foramen. Spiralia directed laterally or ventrally; crura project parallel to median plane; primary lamellae invariably united by more or less elaborate jugum; accessory lamellae arising from jugum commonly present. *U.Ord.-Jur.*

Superfamily ATHYRIDACEA M'Coy, 1844

[*nom. correct.* BOUCOT, JOHNSON, & STATON, 1964, p. 815 (*pro* Athyracea M'COY, 1844, *nom. transl.* WILLIAMS, 1956, p. 284 (*ex* Athyridae M'COY, 1844, p. 104, *emend.* DAVIDSON, 1881) *pro* Rostrospiracea SCHUCHERT & LEVENE, 1929 (invalid name not based on a family group)]

Spiralia directed laterally; crura united with primary lamellae by pair of S-shaped loops. *U.Ord.-Trias.*

Family MERISTELLIDAE Waagen, 1883

[*nom. transl.* HALL & CLARKE, 1895, p. 358 (*ex* Meristellinae WAAGEN, 1883, p. 449)]

Imperforate medially depressed cardinal

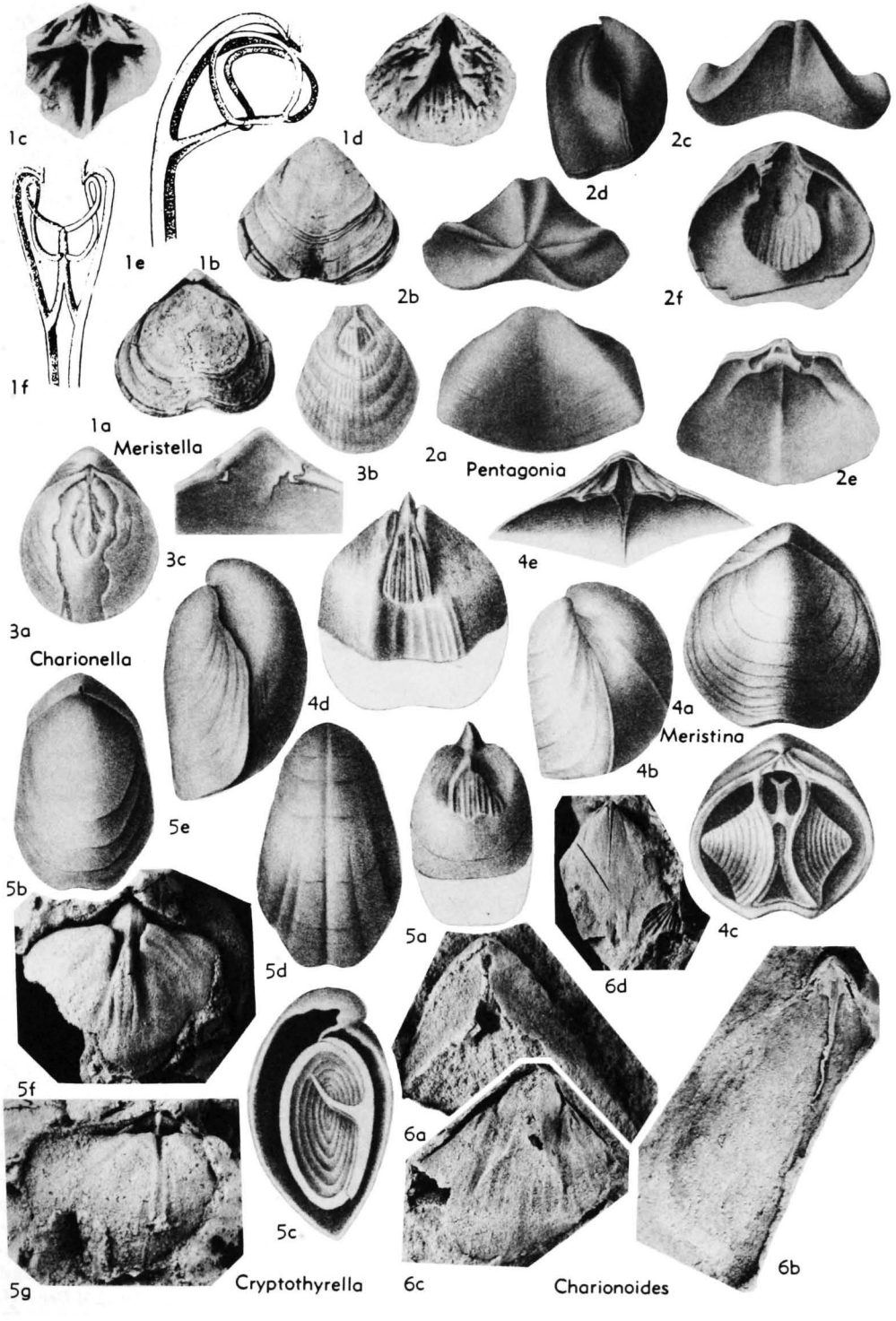


FIG. 533. Meristellidae (Meristellinae) (p. *H*656).

plate present, commonly forming septalium; jugal saddle not developed. Lamellar expansions at growth lines not developed. *U.Ord.-Miss.*

Subfamily MERISTELLINAE Waagen, 1883

[Meristellinae Waagen, 1883, p. 449]

Jugal stem present with bifurcations present or absent; pedicle-valve muscle field triangular, impressed, and longitudinally striate. *U.Ord.-U.Dev.*

Meristella Hall, 1859, p. 78 [**Atrypa laevis* Vanuxem, 1842, p. 120; SD S. A. Miller, 1889, p. 354]. Unequally biconvex shells, commonly longer than wide; interarea obscure; ventral beak strongly incurved at maturity, commonly concealing foramen; deltidial plates may be exposed in early growth stages; dorsal fold and ventral sulcus may occur, or sulcation may affect only anterior commissure, or valves may be nonsulcate. Dental plates obsolescent; ventral muscle scar flaring strongly laterally, commonly deeply impressed into secondary shell material; cardinal plate strong, variable, triangular to subquadrate in outline; commonly concave on upper surface and depressed to form broad septalium; median septum originating beneath cardinal plate and extending part way to anterior margin; jugum produced backward as stem that bifurcates and recurves dorsally, then anteriorly, to reunite with stem. *L.Dev.*, N.Am.——Fig. 533,*1a-d*. *M. atoka* Girty, L.Dev.(Haragan), USA(Okla.); *1a,b*, brach.v., ped.v. views, ×1; *1c*, brach.v. int., ×3; *1d*, ped. v. int., ×2 (33).——Fig. 533,*1e,f*. *M. walcotti* Hall & Clarke, L.Dev., Can.(Ont.); *1e,f*, lat. and ped.v. views showing jugum, ×3 (396).

Charionella Billings, 1861, p. 148 [**Atrypa scitula* Hall, 1843, p. 171; OD]. External features, pedicle-valve interior, and jugum as in *Meristella*; cardinal plate simple, imperforate, depressed, and sessile; dorsal myophragm may be present; differs from *Meristella* by absence of dorsal median septum. *L. Dev.(L. Ems.)-U. Dev.(Tully)*, N.Am. ——Fig. 533,*3*. **C. scitula* (Hall), M.Dev., Can. (Ont.); *3a,b*, brach.v. (shell partly removed), ped. int. mold, ×1; *3c*, brach.v. int. (cardinal plate), ×3 (396).

Charionoides Boucot, Johnson, & Staton, 1964, p. 817 [**Meristella doris* Hall, 1860, p. 84; OD]. Biconvex, elongate shells commonly lacking well-defined fold and sulcus; ventral beak with round foramen posterior to triangular delthyrium; cardinal shoulders angular, defining broad palintrope; ventral beak slightly incurved. Short dental plates present; ventral muscle field not strongly impressed; brachial valve bearing posteriorly sessile cruralium elevated on short median septum anteriorly; spiralia and jugum unknown. Differs from *Charionella* in shape of ventral beak and in presence of dorsal median septum. *L.Dev.(Ems.)-M.Dev.*, E.N.Am.——Fig. 533,*6*. *C.* sp. cf. **C. doris* (Hall), L.Dev., Tomhegan F., USA(Maine); *6a*, brach.v. view (ped. beak), ×3; *6b,c*, brach.v. int., ped.v. int. mold, ×2; *6d*, brach. int. mold, ×1 (113).

Cryptothyrella Cooper, 1942, p. 233 [**Whitfieldella quadrangularis* Foerste, 1906, p. 327; OD]. Large, elongate, smooth shells, subequally biconvex or with pedicle valve more convex, ventral beak incurved, dorsal fold and ventral sulcus absent or only poorly developed. Ventral interior with long subparallel dental plates bounding deeply impressed muscle field; umbonal cavities may bear chevron-like corrugations; brachial valve with sockets set widely apart, large flat cardinal plate present with sessile septalium medially, prominent myophragm present, no median septum; jugum united and projecting backward as simple stem. *U. Ord. (Ashgill.)-up. L. Sil.(C₂, up. Llandover.)*, N.Am.-S.Am.(Venez.), Eu.-Asia(Sib. platform).——Fig. 533,*5a-e*. *C. cylindrica* (Hall), L.Sil. (*Platymerella* Z.); *5a-e*, ped.v. int. mold, brach.v., lat. int., ped.v., lat. views, all ×1 (396). ——Fig. 533,*5f,g*. *C.* sp., L.Sil., S.Am.(Venez.); *5f,g*, ped.v. int. mold, ×2, brach.v. int. mold, ×3 (Boucot, Johnson, & Staton, n).

Meristina Hall, 1867, p. 299 [**Meristella maria* Hall, 1863, p. 212; OD] [=*Whitfieldia* Davidson, 1882, p. 107 (type, *Atrypa tumida* Dalman, 1828, p. 134)]. External configuration and internal shell structures similar to *Meristella* but with narrow ventral muscle field and dental plates extending forward as distinct ridges that bound muscle area; jugum united and projecting backward as stem, bifurcating into 2 short stubs that may or may not recurve to rejoin jugum. *Sil.-U. Dev.(Tully)*, cosmop.——Fig. 533,*4*. **M. maria* (Hall), U.Sil.(Waldron), USA(Ind.); *4a-d*, brach.v., lat., brach.v. int. (brachidium), ped.v. int. mold, ×1; *4e*, brachial int. (cardinal plate), ×2 (396).

Pentagonia Cozzens, 1846, p. 158 [**P. peersii* (=**Atrypa unisulcata* Conrad, 1841, p. 56); OD] [=*Goniocoelia* Hall, 1861, p. 101 (type, *G. uniangulata*, =*Atrypa unisulcata*)]. Biconvex shells of pentagonal outline; pedicle valve with very broad sulcus and abrupt lateral slopes; brachial valve with broad rounded fold commonly with narrow medial groove. Pedicle valve muscle impressions essentially as in *Meristella*; short dental plates present; dorsal median septum continuing posteriorly as faint median ridge on cardinal plate which arises vertically from bottom of valve so as to present erect, concave anterior face, top of cardinal plate extended posteriorly as scoop-shaped concavity; spiralia conforming with contracted interior cavity of shell; nature of jugal bifurcations unknown. *L.Dev.(Ems.)-M.Dev.*, N. Am.-S. Am.(Colom.-Venez.).——Fig. 533,*2*. **P. unisulcata* (Conrad), M.Dev.(Onondaga), USA

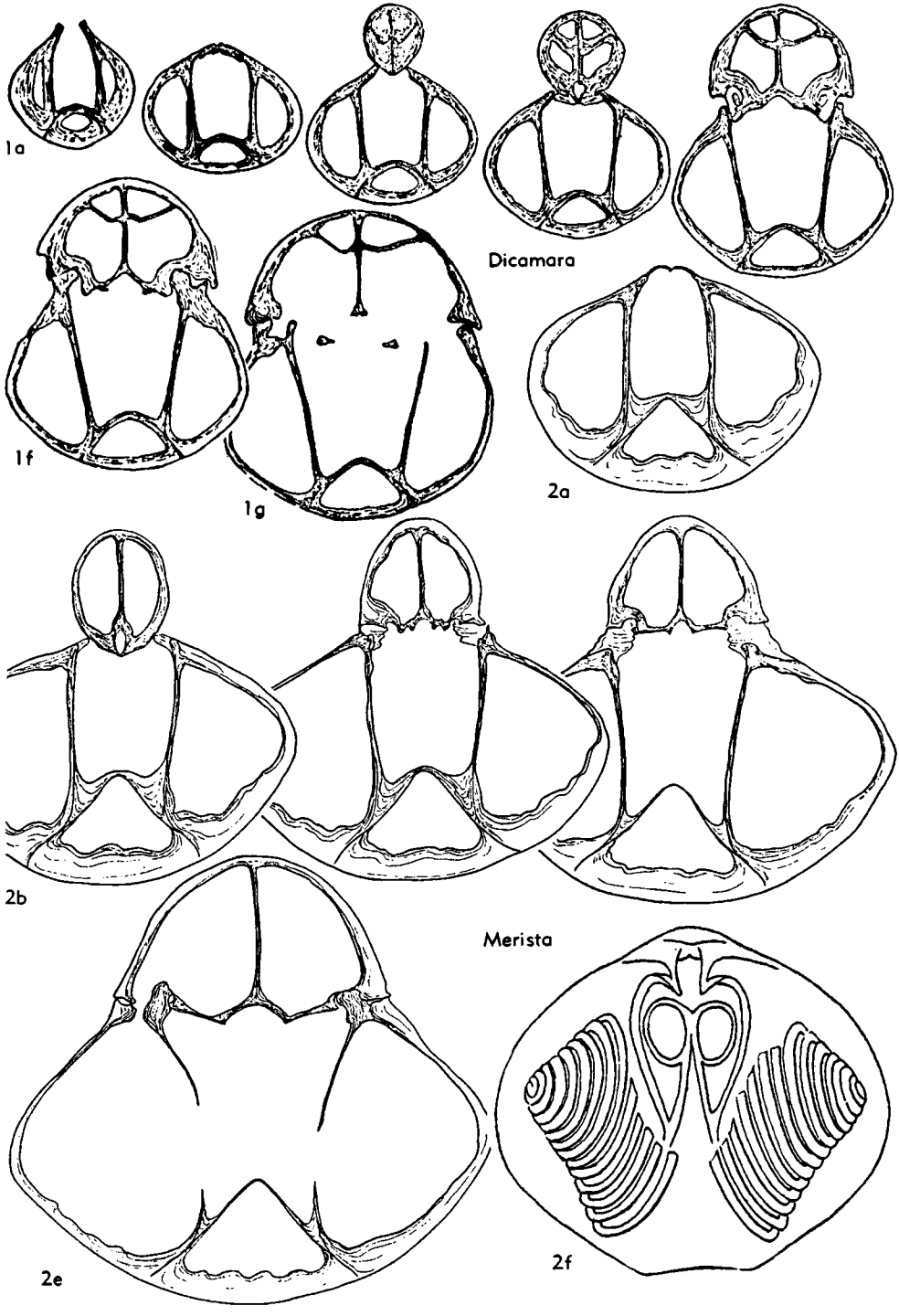


FIG. 534. Meristellidae (Meristinae) (p. *H658*).

(N.Y.); *2a-f*, ped.v., post., ant., lat., brach.v. int., ped.v. int., ×1 (396).

Subfamily MERISTINAE Hall & Clarke, 1895

[*nom. transl.* Schuchert & LeVene, 1929, p. 22 (*ex* Meristidae Hall & Clarke, 1895, p. 345)]

Jugal bifurcations present; shoe-lifter process present in pedicle valve. *L.Sil.-M. Dev.*

Merista Suess in Davidson, 1851, p. 150 [**Terebratula herculea* Barrande, 1847, p. 382; OD] [=*Camarium* Hall, 1859, p. 486 (type, *C. typum*)]. Biconvex, elongate or transverse shells with dorsal fold and ventral sulcus commonly developed anteriorly. Dental plates short or may be produced anteriorly as thickened ridges that unite with outer part of medially placed shoe-lifter process along its lateral edges, shoe-lifter process with form of posteriorly plunging roof-shaped plate; cardinal plate depressed to form septalium supported by median septum; jugum united to form stem, then bifurcating posteriorly and recurving to rejoin in front of jugal stem, loops thus differing from *Meristella* by not rejoining at stem. *U.Sil.(Wenlock.)-M.Dev.*, Eu.-N. Am.-S. Am.(Venez.).——Fig. 534,*2f*. *M. typa* Hall, U.Sil.(L.Kayser), USA(Md.); brach.v. int. (jugum), ×2 (396).——Fig. 534,*2a-e*. **M. herculea* (Barrande), L.Dev., Boh.; *2a-e*, serial secs., ×4.5 (744).

Dicamara Hall & Clarke, 1893, p. 73 [**Atrypa plebeia* Sowerby, 1840, pl. 56, fig. 12,13 (=*Terebratula scalprum* Roemer, 1844, p. 68); OD]. Externally like *Merista*. Pedicle valve with shoe-lifter process as in *Merista*; brachial valve with shoe-lifter divided and pierced by median septum. [Differs mainly from *Merista* in presence of brachial-valve shoe-lifter.] *M.Dev.*, Eu.——Fig. 534,*1*. **M. plebeia* (Sowerby), Eifel(Gerolstein), Ger.; *1a-g*, serial secs., ×4.5 (744).

Subfamily CAMAROPHORELLINAE Schuchert & LeVene, 1929

[Camarophorellinae Schuchert & LeVene, 1929, p. 22]

Jugal bifurcations present, spondylium in pedicle valve. *M.Dev.-Miss.*

Camarophorella Hall & Clarke, 1893, p. 215 [**Pentamerus lenticularis* White & Whitfield, 1862, p. 295; OD]. Transversely subovate or elongate, biconvex shells, with or without dorsal fold and ventral sulcus; growth lines may be crossed by irregular, fine radial lines. Dental plates converging to form spondylium which rests on short median septum and is supported laterally by mystrochial plates; cardinal plate deeply concave, supported by thickened median septum; adductor muscle platform raised above floor of brachial valve in form of shoe-lifter penetrated by median septum, as in *Dicamara*; jugum consisting of inverted troughlike structure resting on median septum, projecting backward as stem that bifurcates and recurves dorsally, then anteriorly to rejoin near its base. *U.Dev.(Louisiana Ls.)-Miss.*, N.Am.——Fig. 535,*3*. *C. mutabilis* Hyde, L.Miss., USA(Ohio); *3a,b*, ped.v., lat. views showing jugum, ×4; *3c,d*, umbonal region int., ped.v. int., ×2 (440).

Camarospira Hall & Clarke, 1893, p. 82 [**Camarophoria eucharis* Hall, 1867, p. 368; OD] [=*Rowleyella* Weller, 1911, p. 448 (type, *Terebratula fabulites* Rowley, 1900, p. 265)]. Externally like *Merista*. Dental plates converging to form spondylium which rests on short median septum; cardinal plate supported by median septum; jugum unknown. *M.Dev.-Miss.*, N.Am.——Fig. 535,*2*. **C. eucharis* (Hall), M.Dev., USA (Ind.); *2a-d*, brach.v., ped.v., lat. views, transv. sec., ×1 (396).

Subfamily HINDELLINAE Schuchert, 1894

[Hindellinae Schuchert, 1894, p. 106 (*emend.* Boucot, Johnson, & Staton, 1964, p. 818]

Inner hinge plates in plane of commissure, separated by narrow fissure in most species; hinge plates not depressed to form septalium, as in other meristellid subfamilies; jugal bifurcations absent; pedicle-valve diductor muscle field poorly impressed; longitudinal striations lacking. *U.Ord.-L.Dev.*

Hindella Davidson, 1882, p. 130 [**Athyris umbonata* Billings, 1862, p. 144; OD]. Subcircular, transverse, elongate-ovate, subequally biconvex shells, with or without dorsal fold and ventral sulcus. Pedicle valve with long subparallel dental plates; cardinal plate depressed medially; long low median septum present; jugum originating in front of axis of spiralia and projecting backward at low angle, joining to project as short stem. *L.Sil.(Ellis Bay)*, N.Am.——Fig. 535,*4*. **H. umbonata* (Billings), L.Sil., Can.(Anticosti Is.);*4a*, brach.v. int. and brachidium, ×3 (229); *4b-d*, ped.v., brach.v., lat. views, ×1 (818).

Hyattidina Schuchert, 1913, p. 415 [*pro Hyattella* Hall & Clarke, 1893, p. 61 (*non* Lendenfeld, 1889)] [**Atrypa congesta* Conrad, 1842, p. 265; OD]. Biconvex shells with or without ventral sulcus and dorsal fold that may be strongly accentuated by bounding furrows. Short dental plates occupying apex of pedicle valve; diductor tracks linear, impressed, slightly divergent; hinge plates triangular, medially divided by narrow fissure or may be anteriorly conjunct; median septum lacking; jugum united and projecting backward, without jugal stem. *?U.Ord.(English Head F.), L.Sil.(Clinton.)-U.Sil.(Greenfield Dol.)*, N.Am.-Eu.(Eng.).——Fig. 535,*1*. **H. congesta* (Conrad), L.Sil.(Clinton.), USA(N.Y.); *1a-c*, ped.v. int. mold, post. int. mold, brach.v. int. showing brachidium, ×2; *1d*, brach.v. int. showing hinge plates, ×5 (396).

Whitfieldella Hall & Clarke, 1893, p. 58 [**Atrypa nitida* Hall, 1843; OD]. Biconvex, elongate trig-

onal, with or without faint sulcus on both valves. Short dental plates; pedicle-valve musculature only slightly impressed; inner hinge plates partly covering septalium supported by median septum that projects only short distance anteriorly; jugum united and projecting backward as simple stem. *Sil., ?L.Dev.*, Eu.-N.Am.——Fig. 535,*5a-d*. *W. upsilon* (Barrande), Sil., Boh.; *5a-d*, serial secs., ×4.5 (744).——Fig. 535,*5e-h*. **W. nitida* (Hall), U.Sil.(Waldron Sh.), USA(Ind.); *5e-h*, ped.v., brach.v., lat., ant. views, ×1 (Tillman, n).

Family ATHYRIDIDAE M'Coy, 1844

[*nom. correct.* Boucot, Johnson, & Staton, 1964, p. 817 (*pro* Athyridae M'Coy, 1844, p. 104, *emend.* Davidson, 1881, p. 4)] [Athyridae proposed by Phillips, 1841, p. 54 for *Producta* and *Calceola* is not an available group name under Article 11e of the International Code]

Smooth or pauciplicate shells commonly with cardinal plate pierced apically, not depressed to form septalium; jugal saddle may occur and lamellar expansions may be developed at growth lines. *U.Sil.(Wenlock.)-Trias.*

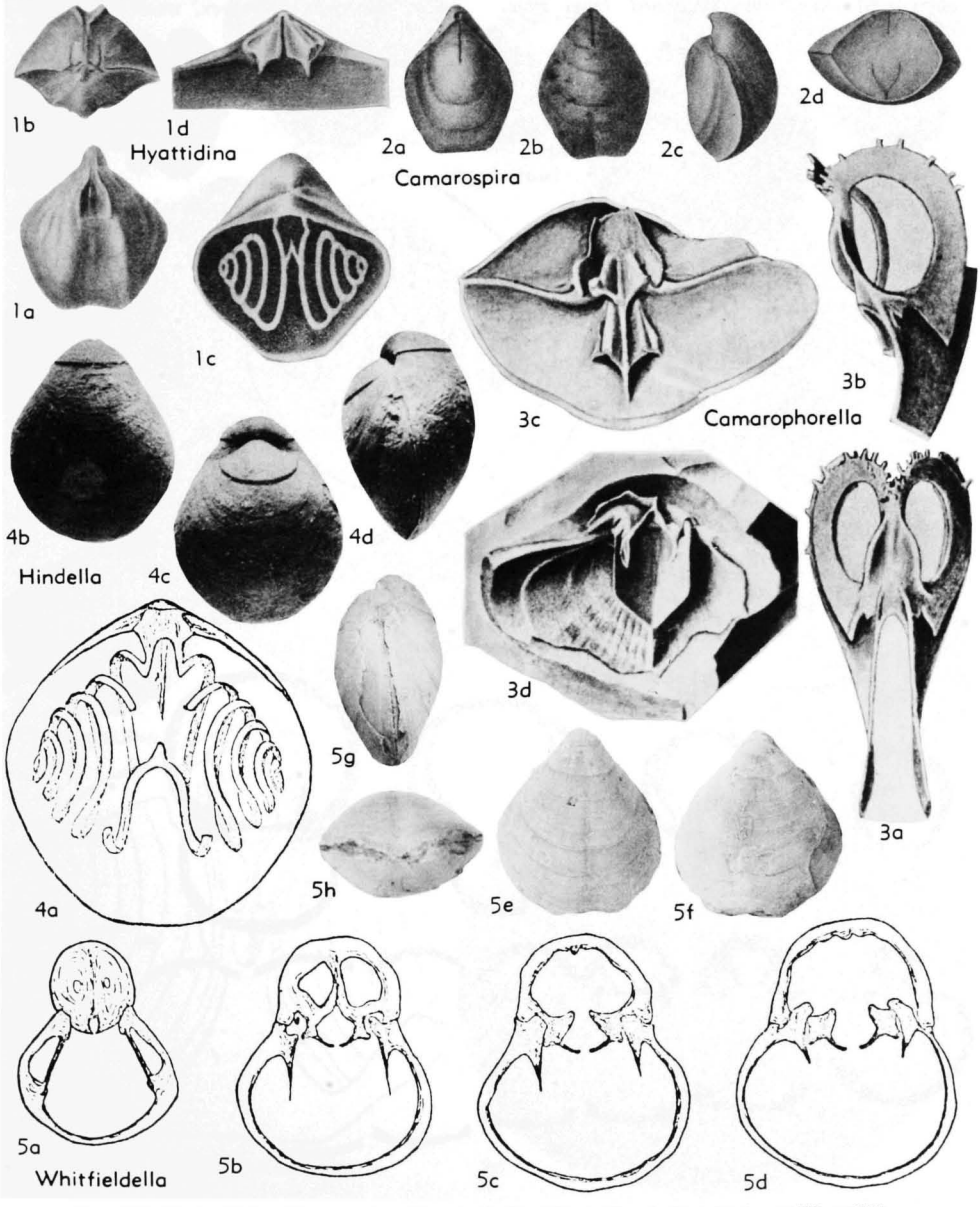


Fig. 535. Meristellidae (Camarophorellinae) *(2-3)*, (Hindellinae) *(1,4-5)* (p. *H*658-*H*659).

Subfamily PROTATHYRIDINAE Boucot, Johnson, & Staton, 1964

[Protathyridinae Boucot, Johnson, & Staton, 1964, p. 819]

Primitive athyridids lacking jugal saddle; cardinal plate pierced apically. *U.Sil.(Wenlock.)-M.Dev.*

Protathyris Kozlowski, 1929, p. 223 [**P. praecursor*; OD]. Subequally biconvex, elongate shells, with or without dorsal fold and ventral sulcus. Dental plates present, confined to apex; ventral muscle scars only faintly impressed; hinge plates divided apically by small fissure, conjunct anteriorly; dorsal myophragm may be present; jugum joined, to form stem that projects backward, bifurcating and extending into proximity with primary lamellae. *?U. Sil. (?Wenlock.), L. Dev.*, Eu.-N.Am.——Fig. 536,*1a. P. "didyma"* (Dalman), U.Sil., Eng.; ped.v. int. mold, ×2 (229). ——Fig. 536,*1b-l. *P. praecursor*, L.Dev.(Czortków), Podolia; *1b*, brach.v. view, ×1; *1c-k*, serial secs., ×3; *1l*, brachidium, ×6 (487).

Buchanathyris Talent, 1956, p. 36 [**B. westoni*; OD]. Subequally biconvex, transversely oval or

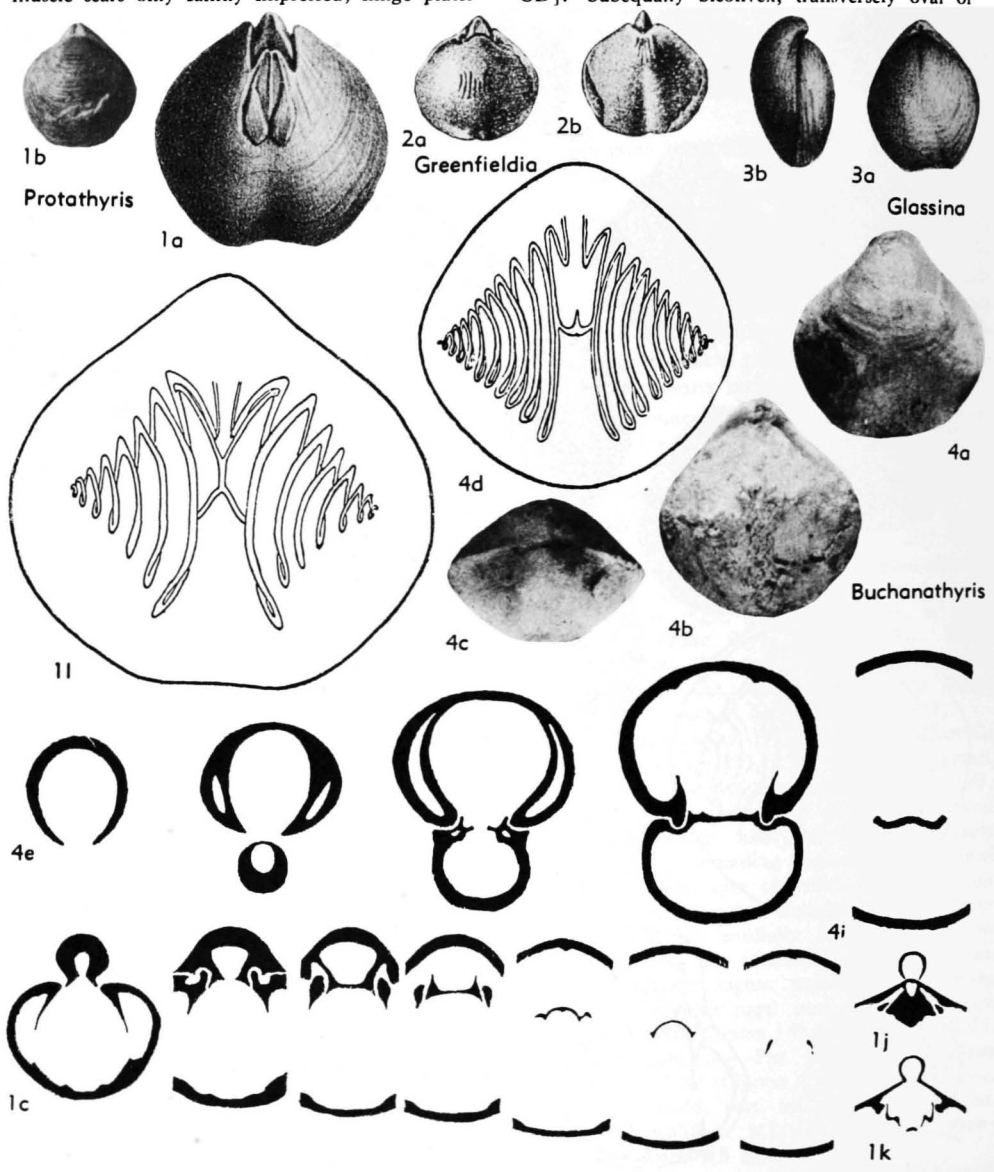


Fig. 536. Athyrididae (Protathyridinae) (p. *H660-H662*).

elongate shells, with or without faintly developed dorsal fold and ventral sulcus. Dental plates present; cardinal plate essentially flat, perforated, as in *Athyris*; jugum united and pointed backward, lacking jugal stem, saddle, or bifurcations. *L.Dev. (Ems.) - M.Dev.*, Australia.——Fig. 536,*4*. **B. westoni*; *4a-c*, ped.v., brach.v., post. views, ×1.5; *4d*, brachidium, ×3; *4e-i*, serial secs., ×5 (796).

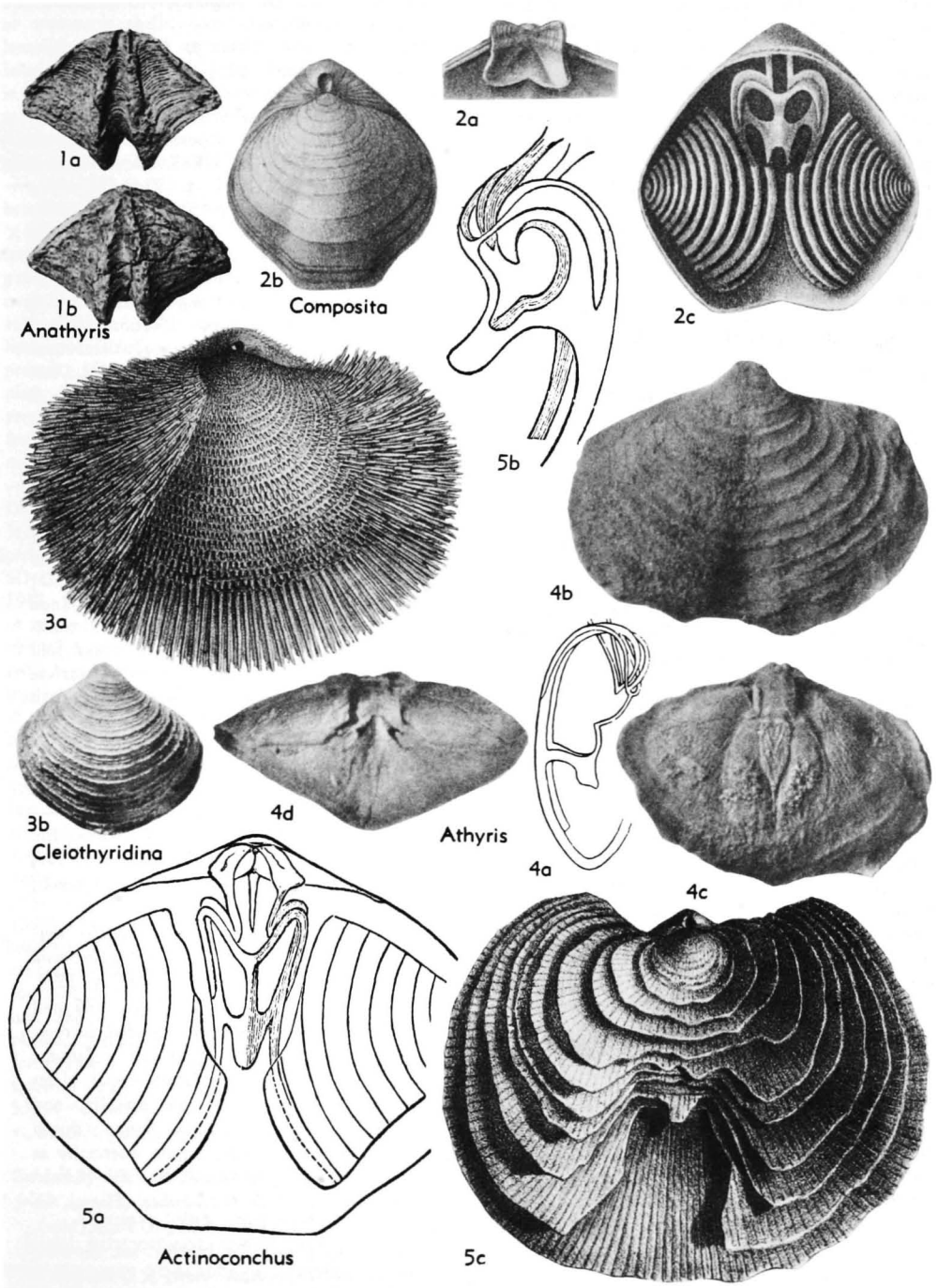


Fig. 537. Athyrididae (Athyridinae) (p. *H662-H663*).

Glassina HALL & CLARKE, 1893, p. 98 [**Terebratula laeviuscula* SOWERBY in MURCHISON, 1839, p. 631; OD]. Small, elongate, subequally biconvex shells resembling *Protathyris*. Jugum taking form of backward inclined X, lacking jugal stem present in *Protathyris*. *U.Sil.(Wenlock.-L.Ludlow)*, Eu. ——FIG. 536,*3*. **G. laeviuscula* (SOWERBY); Eng.; *3a,b*, brach.v., lat. views, ×2 (229).

Greenfieldia GRABAU, 1910, p. 148 [**G. whitfieldi*; OD]. Subequally biconvex, elongate shells, with or without dorsal fold and ventral sulcus. Dental plates present; confined to apex; muscle scars only faintly impressed; hinge plate medially divided by narrow fissure, or may be anteriorly conjunct; jugum unknown. [May equal *Protathyris*.] *U.Sil.*, N.Am.——FIG. 536,*2*. **G. whitfieldi*, Greenfield Dol., USA(Mich.); *2a,b*, brach.v. int. mold, ped. v. int. mold, ×1 (364).

Subfamily ATHYRIDINAE M'Coy, 1844

[*nom. correct.* BOUCOT, JOHNSON, & STATON, 1964, p. 819 (*pro* Athyrinae M'COY, 1844, *nom. transl.* WAAGEN, 1883, p. 450 (*ex* Athyridae M'COY, 1844, p. 104, *emend.* DAVIDSON, 1881, p. 4)]

Jugal saddle present, jugal bifurcations terminating between 1st and 2nd volutions of spiralia. *L.Dev.-Trias.*

Athyris M'COY, 1844, p. 146 [**Terebratula concentrica* VON BUCH, 1834, p. 123; SD KING, 1850, p. 136] [=*Cliothyris* AGASSIZ, 1846, p. 90; *Spirithyris* QUENSTEDT, 1868, p. 30; *Euthyris* QUENSTEDT, 1869, p. 442 (type, *T. concentrica*); *Cleidothyris* PAETEL, 1875, p. 45]. Biconvex, transverse or elongate shells, with or without dorsal fold or ventral sulcus; dorsal fold may bear median furrow and flanks may bear pair of broad plications; broad lamellar expansions which may be developed at growth lines, may bear fine radially arranged spines. Dental plates present; ventral myophragm may occur; cardinal plate of variable shape, pierced apically, free, flat, concave, or medially crested; dorsal myophragm may be present; jugum united to form saddle-shaped plate that projects forward, saddle narrowing posteriorly into stem with bifurcations that arise beneath stem or at its posterior terminus and recurve dorsally, terminating between 1st and 2nd volutions of spiralia. *L.Dev.-Trias.*, cosmop.——FIG. 537,*4a*. *A. vittata* HALL, M.Dev., USA(N.Y.); *4a*, lat. (jugum), ×3 (396).——FIG. 537,*4b-d*. *A. lamellosa* (LÉVEILLÉ), L.Miss., USA(Mo., Ill.); *4b-d*, ped.v. ext., ped.v. int. mold, posterior int. mold, ×1 (858).

Actinoconchus M'COY, 1844, p. 149 [**Spirifera planosulcata* PHILLIPS, 1836, p. 220 (=*A. paradoxus* M'COY, 1844, p. 149); OD]. Subequally biconvex, transversely oval, commonly without well-developed dorsal fold and ventral sulcus; broad lamellar expansions developed at growth lines, lamellae traversed by close-set fine radial grooves, but spines not developed. Dental plates present; ventral myophragm may be present; brachial valve internal structures essentially as in *Cleiothyridina*. *Carb.*, Eu.——FIG. 537,*5*. **A. planosulcata* (PHILLIPS), Eng.; *5a,b*, brach.v. int. (brachidium), ×2, lat. (jugum), ×3 (229); *5c*, brach.v. ext., ×1 (229).

Anathyrella KHALFIN, 1961, p. 476 [**Anathyris ussovi* KHALFIN, 1933; OD]. Like *Anathyris* externally but with widely flaring flanks, sulcus in pedicle valve and fold in brachial valve. Apically perforate cardinal plate reportedly present in brachial valve. *U.Dev.*, USSR(Kuznetzk Basin).

Anathyris VON PEETZ, 1901, p. 134 [**Spirifera phalaena* PHILLIPS, 1841, p. 71; SD SCHUCHERT & LEVENE, 1929, p. 29]. Biconvex plicate shells with lamellose growth lines; ventral sulcus present, dorsal fold deeply plicate; lateral slopes bearing 1 or 2 broad, rounded troughs which may be separated by narrow cusplike plications. Dental plates present; cardinal plate concave; dorsal myophragm may be present; jugum unknown. *L.Dev.-U.Dev.*, Eu.-Asia(USSR). —— FIG. 537,*1*. *A. ezquerrai* (DE VERNEUIL & D'ARCHIAC), L.Dev., Eu.; *1a,b*, ped.v., brach.v. views, ×1 (171). [=*Plicathyris* KHALFIN, 1946 (type, *Athyris sibirica* V. KHALFIN, 1940).]

Cleiothyridina BUCKMAN, 1906, p. 324 [*pro Cleiothyris* KING, 1850, p. 137 (*non* PHILLIPS, 1841)] [**Spirifer de roissyi* LÉVEILLÉ, 1835, p. 39 (=*Athyris royssii* DAVIDSON, 1860, p. 84); OD] [=*Cliothyris* HALL & CLARKE, 1893, p. 90 (*non* AGASSIZ, 1846)]. Subequally biconvex, transversely suboval shells, commonly with dorsal fold and ventral sulcus developed anteriorly; surface covered with broad lamellar expansions at growth lines, lamellae projecting anteriorly as long flat spines, which are broader and flatter than in *Athyris*. Dental plates present; cardinal plate small, triangular, pierced apically; jugum essentially as in *Athyris*. *U.Dev.-Perm.*, cosmop.—— FIG. 537,*3a*. **C. deroissii* (LÉVEILLÉ), Carb., Eu. (Eng.); brach.v. ext., ×1.5 (229).——FIG. 537, *3b*. *C. pectinifera* (D'ORBIGNY), U.Perm., Greenl.; ped.v. view, ×1 (269).

Composita BROWN, 1849, p. 131 [**Spirifer ambiguus* SOWERBY, 1823, p. 105; OD] [=*Seminula* HALL & CLARKE, 1893, p. 93 (*non* M'COY, 1844, p. 158)]. Biconvex shells with dorsal fold and ventral sulcus, or fold may bear medial furrow; lateral slopes may bear indistinct low plications; growth lines not lamellose. Short dental plates present; cardinal plate perforate apically, and may develop posteriorly extended flanges; dorsal myophragm may be present; jugum essentially as in *Athyris*. *U.Dev.(Famenn.)-Perm.*, Eu.-N.Am.-Australia.——FIG. 537,*2*. *C. subtilita* (HALL), U. Miss.(Chester.), USA(Ky.) *(2a)*; U.Penn.(Mo.), USA(Mo.-Iowa) *(2b,c)*; *2a*, brach.v. int. showing card. plate, ×5; *2b*, brach.v. view, ×1; *2c*, ped.v. int. showing brachidium, ×3 (396). [=*?Inia-*

thyris BESNOSSOVA, 1963, p. 312 (type, *I. topkensis*); *?Pseudopentagonia* BESNOSSOVA, 1963, p. 315 (type, *P. injensis*).]

Leptathyris SIEHL, 1962, p. 212 [**L. gryphis*; OD] Subequally biconvex, small, subcircular, elongate or transverse shells, commonly faintly bisulcate; lamellar expansions at growth lines not known. Internally, like *Athyris,* except that cardinal plate is deeply depressed and medially crested; stout myophragm may be developed. Differs from *Meristospira* in presence of depressed cardinal plate. *L. Dev.(Ems.)-M. Dev.,* Eu.-N. Am.(Nev.). ——FIG. 538,*4*. **L. gryphis,* M.Dev., Ger.; *4a-c,* brach.v., lat., ant. views, ×3; *4d-f,* serial secs., ×6.5 (744).

Meristospira GRABAU, 1910, p. 158 [**M. michiganense*; OD]. Small, subcircular or transversely oval biconvex shells with or without faintly developed dorsal fold and ventral sulcus; growth lines not lamellose; few low plications may be present. Short dental plates present; cardinal plate free, pierced apically; dorsal myophragm present; spiralia and jugum unknown. Differs from *Athyris* principally in presence of free cardinal plate. [May equal *Composita.*] *M.Dev.,* N.Am. ——FIG. 538,*2*. **M. michiganense,* Amherstberg Dol., USA(Mich.); *2a,* post. int. mold both valves, ×3; *2b,c,* lat., ped.v. int. mold, ×2 (364).

Spirigerella WAAGEN, 1883, p. 450 [**S. derbyi*; SD OEHLERT, 1887, p. 1300] [=*Athyrella* RENZ, 1913, p. 620 *(nom. nud.)*]. Biconvex, elongate, or transversely suboval shells with dorsal fold and ventral sulcus, depth of broad sulcus tending to reduce convexity of pedicle valve; surface lacking lamellar expansions or spines. Dental plates, if present, buried in secondary shell material that is strongly developed in umbonal cavities; cardinal plate large, free, recurved posteriorly, and apically perforated; median septum lacking; jugum as in *Athyris,* but with median septum on saddle extending backward as far as jugal stem. *Perm.,* India-S.Am.——FIG. 538,*3*. **S. derbyi,* India; *3a,b,* lat. (jugum), brach.v. int., ×3; *3c-f,* brach.v., ped.v., lat., ant. views, ×1 (845).

Triathyris COMTE, 1938, p. 45 [**Terebratula mucronata* DE VERNEUIL, 1850, p. 171; SD BOUCOT, JOHNSON, & STATON, herein]. External configuration like *Anathyris* but with lateral slopes nonplicate, median plication on each valve raised to form anterior projection. Interior structures unknown. *L. Dev.(U. Ems.),* Eu.(Spain). —— FIG. 538,*1*. **T. mucronata* (DE VERNEUIL); *1a,b,* ped. v., brach.v. views, ×1 (171).

Subfamily DIPLOSPIRELLINAE Schuchert, 1894

[*nom. correct.* SCHUCHERT, 1913, p. 418 (*pro* Diplospirinae SCHUCHERT, 1894, p. 106, *nom. imperf.*)]

Jugal bifurcations continuing intercoiled with primary volutions of spiralia to their ends. *Trias.*

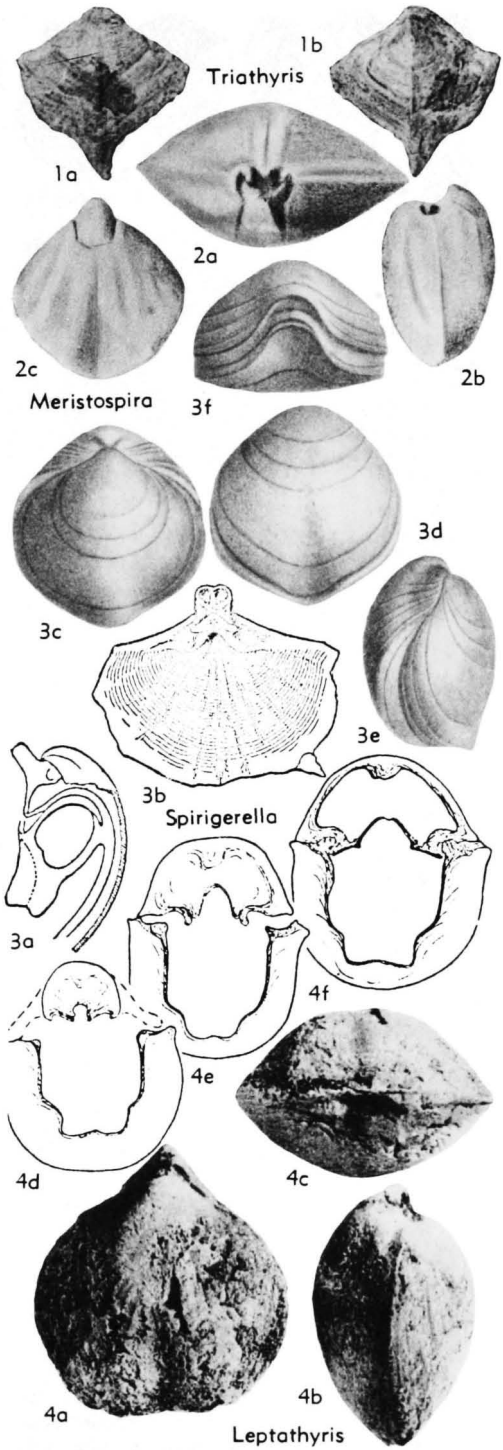


FIG. 538. Athyrididae (Athyridinae) (p. *H663*).

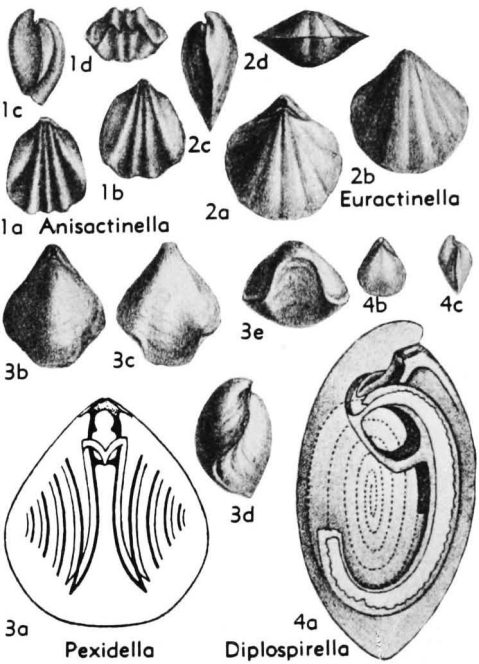


FIG. 539. Athyrididae (Diplospirellinae) (p. *H*664).

Diplospirella BITTNER, 1890, p. 297 [**Terebratula wissmanni* MÜNSTER, 1841, p. 64; OD]. Small, biconvex, transversely oval or pentagonal shells, with or without faintly sulcate brachial valve. Jugal lamellae united and projecting backward as stem that bifurcates, accessory lamellae produced by bifurcation continuing between primary volutions of spiralia to their ends. *Trias.*, Eu.(Aus.).——FIG. 539,*4*. **D. wissmanni* (MÜNSTER); *4a*, lat. (jugum), ×4; *4b,c*, brach.v., lat. views, ×1 (76).

Anisactinella BITTNER, 1890, p. 302 [**Terebratula quadriplecta* MÜNSTER, 1841, p. 58; OD]. Small, biconvex shells with broad, plicate dorsal fold and ventral sulcus; flanks smooth. Cardinal plate well developed; jugum as in *Dioristella*, but accessory lamellae continuing intercoiled with primary spiral volutions to their ends. *Trias.*, Eu.(Aus.).——FIG. 539,*1*. **A. quadriplecta* (MÜNSTER); *1a-d*, brach.v., ped.v., lat., ant. views, ×1 (76).

Euractinella BITTNER, 1890, p. 302 [**Terebratula contraplecta* MÜNSTER, 1841, p. 59; OD]. Biconvex, suboval shells lacking fold and sulcus; low rounded plications may be developed in corresponding position on each valve. Accessory lamellae of jugum continuing intercoiled wtih primary spiral volutions to their ends. *Trias.*, Eu.(Aus.).——FIG. 539,*2*. **T. contraplecta* (MÜNSTER); *2a-d*, brach.v., ped.v., lat., ant. views, ×2 (76).

Pexidella BITTNER, 1890, p. 300 [**Spirifer strohmayeri* SUESS, p. 27; OD]. Small, biconvex, elongate-oval shells, commonly with dorsal fold and ventral sulcus; may be thickened by secondary shell material in umbonal region. Jugum situated posteriorly, giving rise directly to accessory lamellae which continue between primary volutions of spiralia to their ends. *Trias.*, Eu.(Aus.).——FIG. 539,*3*. **P. strohmayeri* (SUESS); *3a*, ped.v. view showing brachidium, ×2; *3b-e*, brach.v., ped.v., lat., ant. views, ×1 (76).

Subfamily UNCERTAIN

Amphitomella BITTNER, 1890, p. 298 [**Terebratula hemisphaeroidica* KLIPSTEIN, 1843, p. 222; OD]. Smooth, biconvex shells, with ventral median septum; cardinal plate strong, divided; dorsal median septum strongly developed to meet ventral median septum; jugum as in *Athyris*, but lacking saddle, jugal bifurcations terminating anteriorly, between 1st and 2nd volutions of spiralia. *Trias.*, Eu.(Aus.).——FIG. 540,*8*. **A. hemisphaeroidica* (KLIPSTEIN); lat. (jugum), ×4 (76).

Anomactinella BITTNER, 1890, p. 300 [**Terebratula flexuosa* MÜNSTER, 1841, p. 59; OD]. Finely plicate, biconvex shells, with plications in corresponding position on each valve, plications strong anteriorly, umbones smooth. Jugal bifurcations short, not extending beyond origin of 1st volution of spiralia. *Trias.*, Eu.(Aus.).——FIG. 540,*3*. **A. flexuosa* (MÜNSTER); *3a,b*, brach.v., ped.v. views, ×1 (76).

Dioristella BITTNER, 1890, p. 299 [**Terebratula indistincta* VON BEYRICH, 1862, p. 34; SD HALL & CLARKE, 1895, p. 775]. Smooth, biconvex, elongate-oval shells, commonly nonsulcate. Jugum extending ventrally to join, then long jugal stem projecting abruptly backward, jugal bifurcations curving dorsally, then bending abruptly to rejoin jugal stem at its origin *Trias.*, Eu.(Aus.).——FIG. 540,*2*. **D. indistincta* (VON BEYRICH); *2a*, lat. (jugum), ×3; *2b-e*, ped.v., lat., brach.v., ant. views, ×1 (76).

Janiceps FRECH, 1901, p. 551 [**Athyris peracuta* STACHE, 1878, pl. 6, fig. 4; SD SCHUCHERT & LEVENE, 1929, p. 70]. Small trigonal shells, pointed at posterior and anterolateral extremities, each valve bearing medially plicate fold. Interior unknown. *U.Perm.*, Eu.(Aus.).——FIG. 540,*4*. **J. peracuta* (STACHE); *4a,b*, ped.v., brach.v. views, ×1 (312).

Pentactinella BITTNER, 1890, p. 300 [**Terebratula quinquecostata* MÜNSTER, 1841, p. 59; SD HALL & CLARKE, 1895, p. 783]. Plicate, biconvex shells, with plication in corresponding position on each valve, medial part of each valve with plication rather than furrow. Interior unknown. *Trias.*, Eu.(Aus.).——FIG. 540,*1*. **P. quinquecostata* (MÜNSTER); *1a,b*, brach.v., ant. views, ×1 (76).

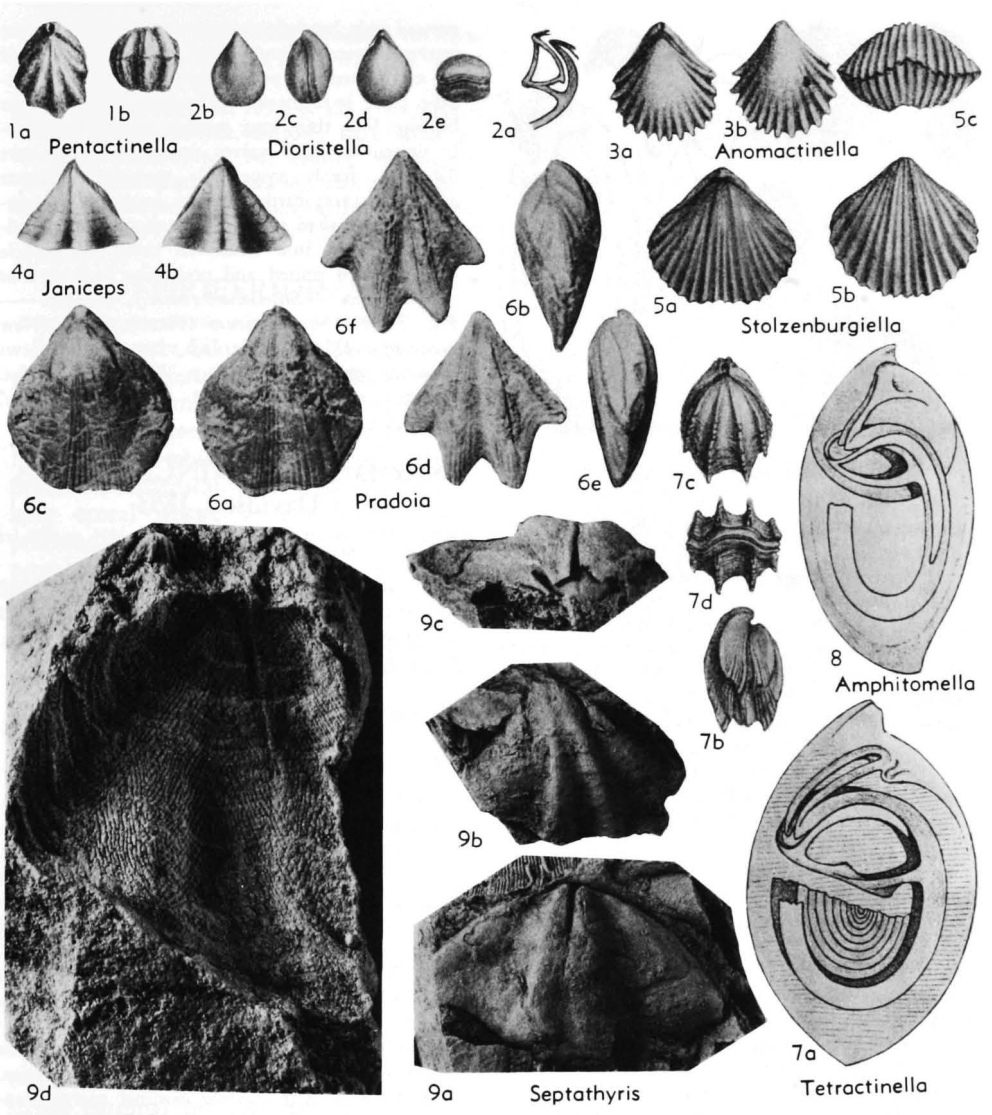


FIG. 540. Athyrididae (Subfamily Uncertain) (p. *H*664-*H*666).

Pradoia COMTE, 1938, p. 43 [**Terebratula torenoi* DE VERNEUIL & D'ARCHIAC, 1845, p. 460; SD BOUCOT, JOHNSON, & STATON, herein]. Externally like *Athyris* or *Anathyris* but lacking strong regular concentric lamellae, surface covered instead by fine radiating lines which may bifurcate anteriorly. Dental plates and perforate cardinal plate present; spiralia directed laterally. *L.Dev.(U.Ems.)*, Eu.(Spain).——FIG. 540,*6a-c*. **P. torenoi* (DE VERNEUIL & D'ARCHIAC); *6a-c*, ped.v., lat., brach. v. views, ×1 (171).——FIG. 540,*6d-f*. *P. collettei* (DE VERNEUIL); *6d-f*, ped.v., lat., brach.v. views, ×1 (171).

Septathyris BOUCOT, JOHNSON, & STATON, 1964, p. 819 [**Athyris aliena* DREVERMANN, 1904, p. 258; OD]. Resembles *Anathyris* in external configuration but lacks lamellose growth lines, ornament consisting of fine irregular lines that diverge from plications and join in interspaces to form zigzag pattern, or intersection of lines may not meet in the furrows. Short dental plates present; cardinal plate broad, slightly concave, not known to be pierced apically; cardinal plate supported by median septum that does not continue to anterior; spiralia and jugum unknown. *L.Dev.(Siegen.-L. Ems.)*, Eu.-N.Afr.——FIG. 540,*9*. **S. aliena*

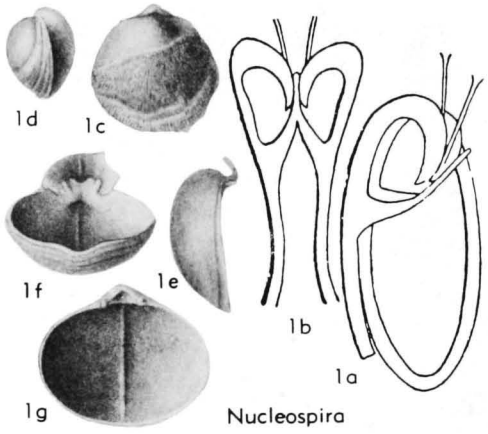


FIG. 541. Nucleospiridae (p. *H666*).

(DREVERMANN), Siegen., Ger.; *9a,* brach. int. mold, ×1; *9b,* ped. int. mold, ×1.5; *9c,* brach. int. mold post. view, ×2; *9d,* brach. ext. mold, ×3 (113).

Stolzenburgiella BITTNER, 1903, p. 508 [**S. bukowskii*; OD]. Biconvex, elongate or transverse, plicate shells resembling *Tetractinella,* but with fine secondary plications developed between primary plications in corresponding position on each valve; secondary plications may increase anteriorly by implantation; dorsal fold and ventral sulcus may be present. Spiralia with few volutions. *Trias.,* Eu.(Aus.).——FIG. 540,*5*. **S. bukowskii*; *5a-c,* brach.v., ped.v., ant. views, ×2 (80).

Tetractinella BITTNER, 1890, p. 300 [**Terebratulites trigonellus* VON SCHLOTHEIM, 1820, p. 271; SD HALL & CLARKE, 1895, p. 783]. Small, biconvex shells externally resembling *Anathyris,* but lacking regularly lamellose growth lines, commonly with 4 narrow cusplike plications in corresponding positions on each valve. Dental plates present; jugum joined, forming rudimentary saddle, jugal stem projecting ventrally, bifurcating to form short accessory lamellae. *Trias.,* Eu.(Aus.).——FIG. 540,*7*. **T. trigonella* (VON SCHLOTHEIM); *7a,* lat. (jugum), ×4; *7b-d,* lat., brach.v., ant. views, ×1 (76).

Family NUCLEOSPIRIDAE Davidson, 1881

[Nucleospiridae DAVIDSON, 1881, p. 4]

Smooth athyridaceans with free, imperforate, cardinal plate; jugum lacking bifurcations. *U.Sil.-L.Carb.(Miss.).*

Nucleospira HALL, 1859, p. 24 [**Spirifer ventricosus* HALL, 1857, p. 57; OD]. Small, subequally biconvex, subcircular shells; surface may be covered by numerous fine, irregularly spaced spinules; narrow, poorly defined dorsal fold and ventral sulcus may be present, or sulcation may be expressed only by deflection of anterior commissure; interarea narrow and low, commonly obscured by small incurved pedicle-valve beak; small concave plate in apex of delthyrium. Dental plates lacking; low, thin, long median septum commonly present in each valve; ventral diductor scars flabellate, feebly impressed, enclosing elongate adductor scars; cardinal plate imperforate, originating normal to plane of commissure and bending backward into delthyrial cavity of pedicle valve; jugum united and projecting backward as simple stem. *U.Sil.-L.Carb.(Miss.),* cosmop.——FIG. 541,*1*. **N. ventricosa* (HALL), L.Dev.(New Scotland), USA(N.Y.); *1a,b,* lat., ped.v. views showing jugum, ×4; *1c-g,* brach.v., lat., lat. (brach.v. only), brach.v. int. (ant. view), ped.v. int., ×2 (396).

Superfamily KONINCKINACEA Davidson, 1853

[*nom. transl.* BOUCOT, JOHNSON, & STATON, 1964, p. 820 (*ex* Koninckidae DAVIDSON, 1853, p. 92)]

Spiralia directed ventrally; jugum giving rise to bifurcations that are intercoiled with primary volutions of spiralia to their ends. *Trias.-Jur.*

Family KONINCKINIDAE Davidson, 1853

[Koninckinidae DAVIDSON, 1853, p. 92]

Concavo-convex shells. *Trias.-Jur.*

Koninckina SUESS in DAVIDSON, 1853, p. 92 [**Productus leonhardi* WISSMANN, 1841, p. 18; OD]. Concavo-convex, smooth, alate shells. Spiralia lacking marginal spinules. *Trias.,* Eu.(Aus.).——FIG. 542,*4a-i*. *K. leopoldi austriae* BITTNER; *4a,* ped.v. view (brachidium), ×2; *4b-i,* ser. secs., ×2 (76).——FIG. 542,*4j,k*. **K. leonhardi* (WISSMANN); *4j,k,* ped.v., post. views, ×1 (76) [p. *H*904].

Amphiclina LAUBE, 1865, p. 28 [**Producta dubia* MÜNSTER, 1841, p. 68; OD]. Concavo-convex, smooth shells with narrow cardinal margin; anterior and lateral margins thickened. *Trias.,* Eu.(Aus.).——FIG. 542,*2*. *A. amoena* BITTNER; *2a-c,* ped.v., lat., ant. views, ×1 (76).

Amphiclinodonta BITTNER, 1888, p. 288 [**A. liasina*; OD]. Concavo-convex, smooth shells with narrow cardinal margin, resembling *Amphiclina,* but bearing submarginal rows of thickened articulating tubercles as in *Koninckodonta.* Spiralia bearing marginal spines. *Trias.-Jur.,* Eu.(Aus.).——FIG. 542,*1*. *A. carnica* BITTNER, Trias., Aus.; *1a-c,* ped.v., lat., post. views, ×1 (76).

Koninckella MUNIER-CHALMAS, 1880, p. 280 [**Leptaena liasina* BOUCHARD, 1847, fig. 2; OD]. Concavo-convex, smooth, alate shells resembling *Koninckina,* but bearing marginal spinules on spiralia; cardinal process present. *Trias.-Jur.,* Eu.

(Aus.).——FIG. 542,*3*. *K. fastigata* BITTNER; Trias., Aus.; *3a-d*, brach.v., lat., ped.v., ant. views, ×1 (76).

Koninckodonta BITTNER, 1893, p. 137 [**K. fuggeri*; OD]. Concavo-convex, smooth, alate shells resembling *Koninckina*, but bearing submarginal rows of thickened articulating tubercules, as in *Amphiclinodonta*. *Trias.*, Eu.(Aus.).——FIG. 542, *5*. **K. fuggeri*; brach.v. int. (brachidium), ×2 (78).

SPIRIFERIDINA

[Materials for this suborder prepared by CHARLES W. PITRAT]

In the Lower Silurian two groups of impunctate spiriferoids make their appearance nearly simultaneously. The Eospiriferinae, which seem to have appeared slightly earlier and which are judged to be more primitive structurally, are characterized by long crural plates, a nonstriate cardinal process, and micro-ornament of rather prominent radial striae. The somewhat later Acrospiriferinae may have been derived from the Eospiriferinae or they may have arisen separately from a primitive group of spire-bearers. In any case they possess a distinctly different sort of brachial valve, with shorter crural plates and a longitudinally striate cardinal process, as well as fimbriate micro-ornament.

The superfamily Cyrtiacea, as here interpreted, includes the Eospiriferinae and their impunctate derivatives, the Cyrtiinae and the Ambocoeliidae. The Eospiriferinae and Cyrtiinae are thought to be very closely related, since the two groups are substantially the same except for overall shell shape and modifications of the delthyrium. The position of the Ambocoeliidae is not quite so certain. However, the presence of a nonstriate cardinal process and well-developed crural plates points to the Eospiriferinae as their progenitors. The highly variable micro-ornament of the Ambocoeliidae neither confirms nor denies the postulated relationship.

Nearly half the recognized genera of the Spiriferidina are placed in the superfamily Spiriferacea, which was initiated in the Early Silurian with appearance of the Acrospiriferinae. As evolution of the Spiriferacea unfolded, most of the characters so distinctly expressed in the ancestral Acrospiriferinae became modified and specializations appeared. The primitive fimbriate micro-

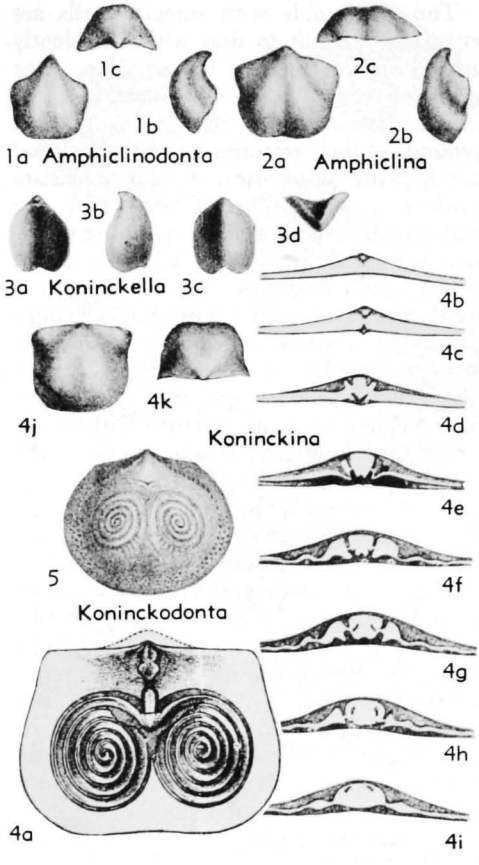


FIG. 542. Koninckinidae (p. *H666-H667*).

ornament gave rise to a bewildering variety of radial striae, concentric growth lamellae, granules, pustules, spines, and various combinations of them. The crural plates, short or absent in the Acrospiriferinae, became so variable that apparently they are useless in later groups for classification above the generic level. Even the typically impunctate shell developed punctae in one group (Syringothyridinae). Aside from radial macro-ornament, which occurs also in many of the Cyrtiacea, and the spiral brachidium universally common to spiriferoids, the only feature of importance found in all Spiriferacea is the longitudinally striate cardinal process. Indeed, the assumption that this feature is of critical importance is the main basis for the suprageneric classification here proposed.

The spiriferoids with smooth shells are especially difficult to deal with confidently at the higher levels of classification. One group of them, the Ambocoeliidae, is placed in the Cyrtiacea on the reasonably firm grounds of their retention of well-developed crural plates and possession of a nonstriate cardinal process. The others, which are segregated, perhaps artificially, in the superfamily Reticulariacea, have a longitudinally striate cardinal process which bespeaks a spiriferacean ancestry. The Reticulariidae display a micro-ornament of concentric growth lamellae upon which uniramous spines or granules are generally superposed. This micro-ornament, together with observation that the Recticulariidae appear in the Upper Silurian or Lower Devonian, suggests an ancestor among the Delthyrididae. The Elythidae, which appeared in the Middle Devonian, comprise a rather closely knit group of smooth spiriferoids, characterized by a micro-ornament of fine double-barreled spines. They are probably derived from the Reticulariidae. The remaining group of essentially smooth spiriferoids, the Martiniidae, possess a micro-ornament of surficial pits. It seems likely that they were derived from the Reticulariidae in Early Carboniferous time, although the possibility of other (even polyphyletic) origin cannot be discounted.

Punctate shell structure is found in three distinct groups of spiriferoids. One occurrence, in late Paleozoic Syringothyridinae, has already been mentioned, this group being classed with the Spiriferacea on the basis of overall similarity of the shell with those of the impunctate Spinocyrtiidae and Licharewiinae. Another group, the Suessiacea, which appeared in the Silurian, evidently either arose from the Cyrtiidae or was independently derived from some primitive spire-bearer, as evidenced by the nonstriate cardinal process. The origin of the third group, the Spiriferinacea, which appeared in the Early Carboniferous, is also somewhat problematical. The main evidence for the general assumption that the Spiriferinacea were derived from the Suessiacea appears to be the presence in both groups of punctation—a character of dubious reliability. Such a relationship has the disadvantage of requiring separate derivation of the striate cardinal process in the Spiriferinacea and the Spiriferacea. It seems more likely that the Spiriferinacea were developed from some Late Devonian or Early Carboniferous spiriferacean. Of all the known spiriferaceans, the mucrospiriferid *Tylothyris,* on the basis of general shell form and possession of a well-developed ventral median septum, seems to be the most plausible candidate for recognition as ancestor.

Suborder SPIRIFERIDINA Waagen, 1883

[*nom. correct.* PITRAT, herein (*pro* suborder Spiriferacea WAAGEN, 1883, p. 447)]

Smooth, plicate, or costate, generally transverse Spiriferida with rather long hinge line; pedicle valve interarea generally well developed, bearing delthyrium which is usually either fully open or constricted by disjunct deltidial plates. Spiralia directed laterally or posterolaterally, with primary lamellae directed parallel and close to sagittal plane, either separate or connected by simple jugum; area of diductor attachment on brachial valve smooth in primitive forms, deeply striate longitudinally in advanced and more typical forms. Shell substance either punctate or impunctate. *L.Sil.-L.Jur.*

Superfamily CYRTIACEA Frederiks, 1919 (1924)

[*nom. transl.* PITRAT, herein (*ex* Cyrtiinae FREDERIKS, 1919 (1924), p. 312)]

Form, macro- and micro-ornament highly variable. Pedicle valve interior with or without dental plates, generally lacking median septum; brachial valve interior with crural plates and nonstriate cardinal process. Shell substance impunctate. *L.Sil.-Perm.*

Family CYRTIIDAE Frederiks, 1919 (1924)

[*nom. transl.* IVANOVA, 1959, p. 55 (*ex* Cyrtiinae FREDERIKS, 1919 (1924), p. 312] [=Eospiriferinae SCHUCHERT & LEVENE, 1929, p. 20]

Form variable, fold and sulcus present, generally smooth, some genera with minor ribbing; lateral slopes smooth, plicate, or costate, micro-ornament consisting of prominent capillae crossed by growth lines, providing intersections which rarely are nodose but never spinose; delthyrium provided with deltidial plates in varying stages of development. Interior of pedicle valve

with well-developed, generally long dental plates; brachial valve interior with long crural plates. *L. Sil. (Llandover.)-M. Dev. (Couvin.).*

Subfamily CYRTIINAE Frederiks, 1919 (1924)

[*emend.* Boucot, 1963, p. 701]

Pedicle valve pyramidal; interarea very high; delthyrium narrow, in small specimens occupied by disjunct deltidial plates, in larger specimens by conjunct deltidial plates with or without third plate at base, delthyrium of very large specimens completely closed by deposits of secondary material. *L.Sil.(U.Llandover.)-Dev.(Ems.-?Couvin.).*

Cyrtia Dalman, 1828, p. 92 [**Anomites exporrectus* Wahlenberg, 1821, p. 64; SD Davidson, 1853, p. 83]. Entire shell smooth. *Sil.(U.Llandover.-Ludlov.),* N. Am.; *Sil. (U. Llandover.) - Dev. (Ems.-?Couvin.),* Eu.——Fig. 543,*1*. **C. exporrecta* (Wahlenberg), U. Llandover., Sweden (Gotl.); *1a-e,* brach.v., ped.v., post., ant., lat. views, ×2 (104).

Plicocyrtia Boucot, 1963, p. 704 [**Cyrtia petasus* Barrande, 1848, p. 183; OD]. Similar to *Cyrtia,* but with 1 to 3 low rounded lateral plications separated by shallow U-shaped depressions. *Sil.(U. Wenlock.-?Ludlov.),* Eu.-Asia.——Fig. 543,*3*. **P. petasus* (Barrande), Czech.; *3a-c,* brach.v., lat., ped.v. views, ×1; *3d-e,* brach.v. and ped.v. int. molds, ×2 (104).

?Tannuspirifer Ivanova, 1960, p. 267 [**Spirifer pedaschenkoi* Chernyshev, 1937, p. 51; OD]. Small; shape as in *Cyrtia*; lateral slopes plicate; fold and sulcus profound, bald; micro-ornament consisting of radial striae only; data on interior wanting. *Sil.,* USSR.——Fig. 543,*2*. **T. pedaschenkoi* (Chernyshev); *2a,b,* ped.v. ant., ped.v. post. views, ×1.5 (448).

Subfamily EOSPIRIFERINAE Schuchert & LeVene, 1929

[Eospiriferinae Schuchert & LeVene, 1929, p. 20 (*emend.* Boucot, 1963, p. 685)]

Pedicle valve convex but not pyramidal; interarea not abnormally high; delthyrium triangular, not unusually narrow, occupied by deltidial plates which are generally disjunct. *L.Sil.(Llandover.)-M.Dev.(Couvin.).*

Eospirifer Schuchert, 1913, p. 411 [**Spirifer radiatus* J. de C. Sowerby, 1840, p. 245 (=*Spirifer lineatus* J. de C. Sowerby, 1825, p. 151) (*non Conchyliolites anomites lineatus* Martin, 1809, =*Terebratula? lineata* J. Sowerby, 1822); OD]. Medium-sized, moderately transverse, wholly nonplicate; hinge line ranging from one-half to almost equal maximum width; fold and sulcus well developed. *Sil.(Llandover.-Ludlov.),* cosmop.; *L.*

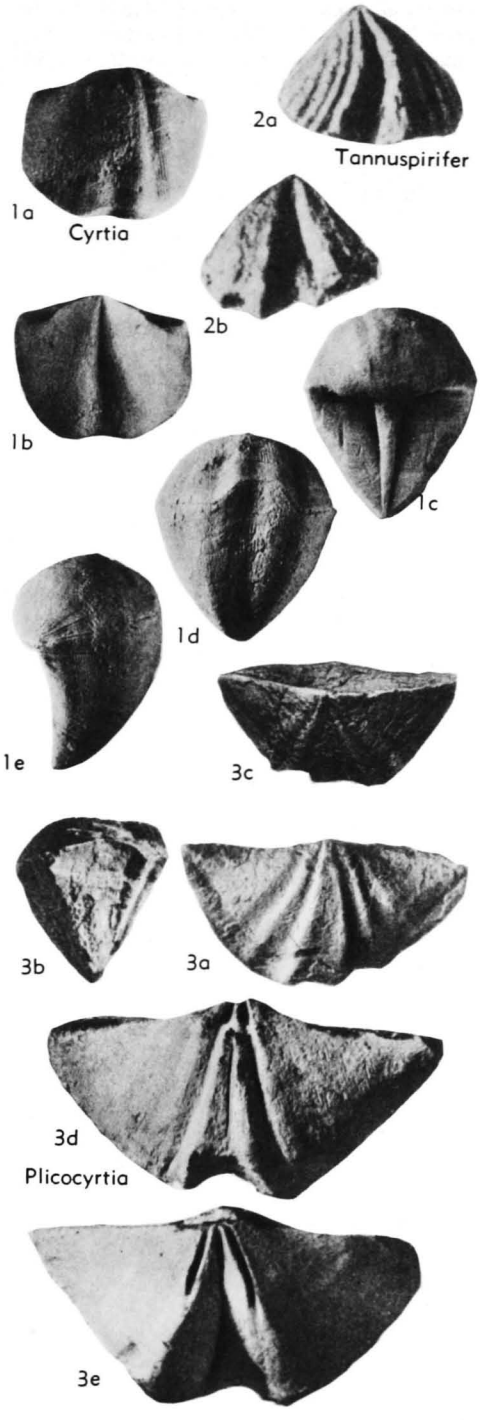


Fig. 543. Cyrtiidae (Cyrtiinae) (p. *H669*).

Dev.(Gedinn.-Ems.), Eu.-Asia.——FIG. 544,*1*. **E. radiatus* (SOWERBY), Sil., Sweden(Gotl.); *1a-e*, ant., lat., post., brach.v., ped.v. views, ×1; Sil., USA(Ill.); *1f-g*, post. int. mold, ped.v. int. mold, ×1 (104).

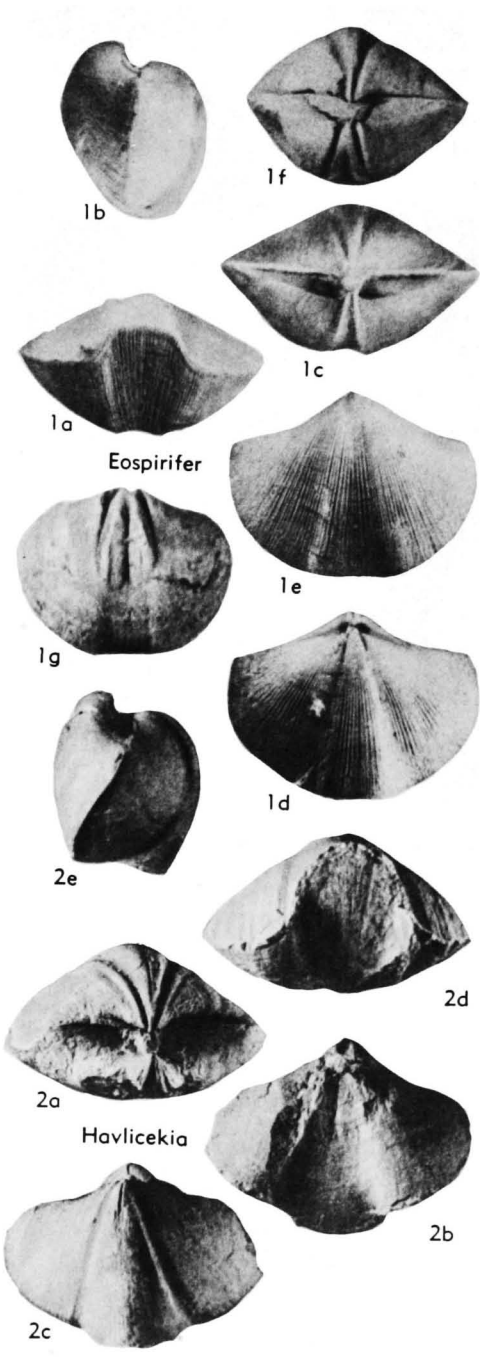


FIG. 544. Cyrtiidae (Eospiriferinae) (p. *H669-H670*).

[The name *Conchyliolites anomites lineatus* was published by MARTIN (1809) for a form now included in *Phricodothyris*. J. SOWERBY (1822) referred to this species as *Terebratula? lineata* (MARTIN). Somewhat later J. DE C. SOWERBY (1825) published the name *Spirifer lineatus* for the fossil which is now the type of *Eospirifer*. By 1840 he recognized that MARTIN's species was a spire-bearer, and therefore, according to practice of the time, belonged in *Spirifer*. Thus, *Spirifer lineatus* J. DE C. SOWERBY, 1825, became a junior homonym of *Spirifer lineatus* (MARTIN), 1809, a situation which was corrected in 1840 when SOWERBY substituted *Spirifer radiatus* for the invalid *Spirifer lineatus* J. DE C. SOWERBY, 1825. In 1848 the I.C.Z.N. invalidated the work of MARTIN. Subsequently the Commission (1956) ruled that the fossil which MARTIN had named *Conchyliolites anomites lineatus* should be credited to SOWERBY in the original combination *Terebratula? lineata* J. SOWERBY, 1822, thereby retaining the priority of this fossil over *Spirifer lineatus* J. DE C. SOWERBY, 1825. Although *Terebratula? lineata* J. SOWERBY, 1822, and *Spirifer lineatus* J. DE C. SOWERBY, 1825, are not now regarded as belonging to the same genus, the fact that they were once so treated requires permanent suppression of *Spirifer lineatus* J. DE C. SOWERBY, 1825, and the substitution of *Spirifer radiatus* J. DE C. SOWERBY, 1840 (Code, Art. 59c)]

Havlicekia BOUCOT, 1963, p. 693 [**Spirifer secans* BARRANDE, 1848, p. 168; OD]. Lateral slopes weakly plicate in early growth stages, smooth thereafter; fold and sulcus smooth, wide, and in late growth stages very deep, resulting in markedly uniplicate anterior commissure. *Sil.(Wenlock.)-Dev.(Ems.)*, cosmop.——FIG. 544,*2*. *H.* sp., Lochkov Ls., Czech.; *2a-e*, post., ped.v., brach.v., ant., lat. views, ×1 (104).

Janius HAVLÍČEK, 1957, p. 247 [**Spirifer nobilis* BARRANDE, 1848, p. 184; OD]. Lateral slopes with about 3 anteriorly bifurcating plications, separated by U-shaped furrows; fold and sulcus either smooth or with single median costa in sulcus and single median groove in fold; micro-ornament of radial striae and fine concentric growth lines with nodose intersections. *Sil. (U. Wenlock.-Ludlov.)*, N. Am.-Eu.; *Sil. (Ludlov.) - Dev. (Couvin.)*, Asia. ——FIG. 545,*4*. **J. nobilis* (BARRANDE), U.Sil. (Ludlov.), Boh.; *4a-b*, brach.v., ped.v. views, ×1 (411).

Macropleura BOUCOT, 1963, p. 690 [**Delthyris macropleurus* CONRAD, 1840, p. 207; OD]. Large, rather transverse, with hinge line almost equal to maximum width; lateral slopes with 3 to 6 simple plications separated by broad, rounded depressions; plications very strong posteriorly, in some shells tending to weaken anteriorly; fold and sulcus broad, smooth, rather low, but producing strongly uniplicate anterior commissure. *Sil. (Wenlock.)-Dev.(Gedinn.)*, N.Am.; *Sil.(Llandover.) - Dev. (Couvin.)*, Eu.-Asia.——FIG. 545,*3*. **M. macropleura* (CONRAD), L.Dev.(Helderberg.), USA(N.Y.) *(3a-e)*; L.Dev. (Birdsong F.), USA (Tenn.) *(3f)*; L.Dev.(Helderberg.), USA(Md.) *(3g)*; *3a-e*, brach.v., ant., post., ped.v., lat. views, ×0.7; *3f*, ped.v. int., ×1; *3g*, brach.v. int., ×2 (104).

Nikiforovaena BOUCOT, 1963, p. 697 [**Spirifer (Eospirifer) ferganensis* NIKIFOROVA, 1937, p. 48; OD]. Lateral costae rounded, separated by U-shaped depressions; fold with one or more promi-

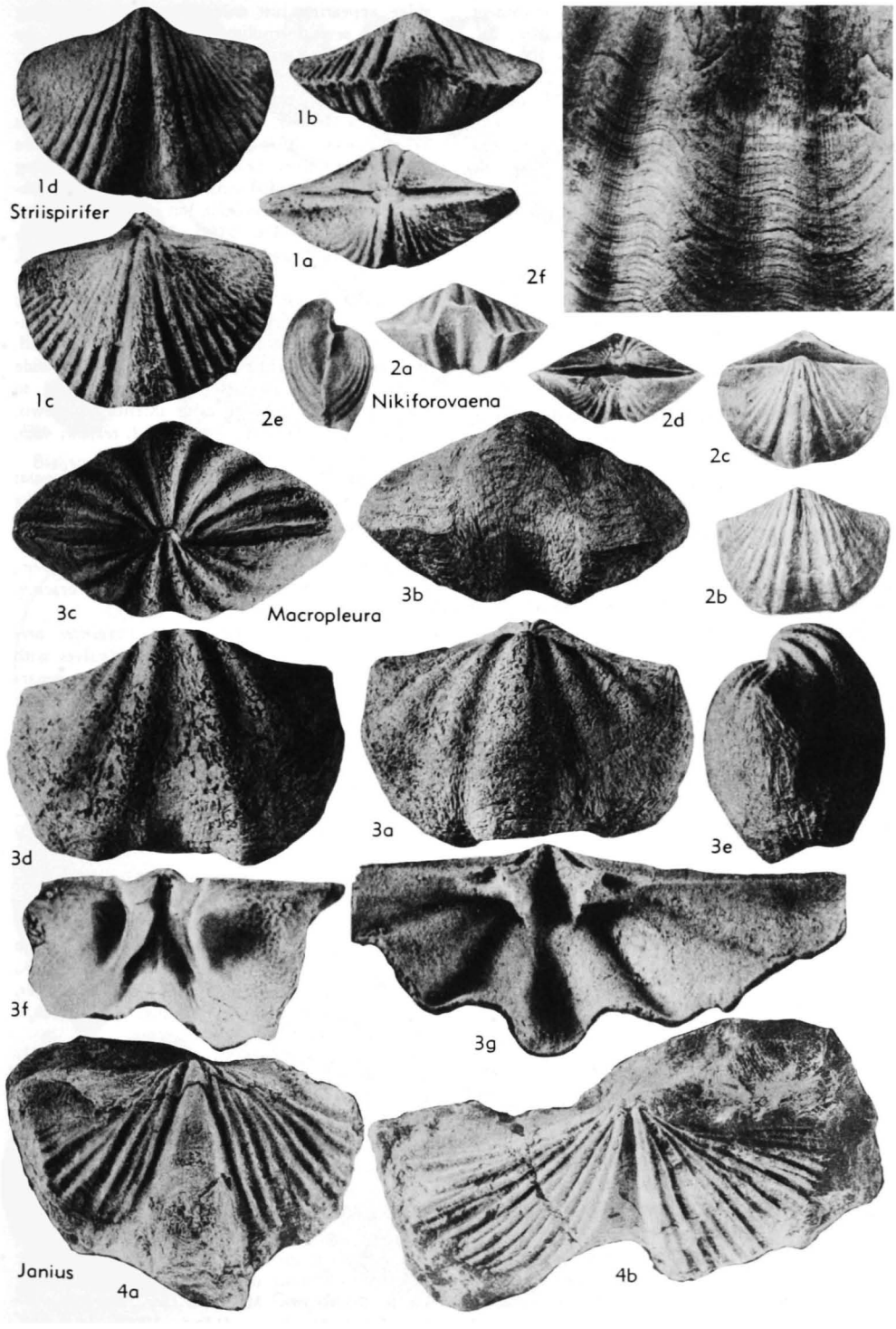


Fig. 545. Cyrtiidae (Eospiriferinae) (p. *H670*, *H672*).

nent grooves; sulcus with one or more prominent plications; otherwise similar to *Striispirifer*. *Sil. (?Wenlock.-Ludlov.)*, Asia-Australia.——Fig. 545, *2*. **N. ferganensis* (Nikiforova), USSR; *2a-e*, ant., ped.v., brach.v., post., lat. views, ×1; *2f*, surface, ×5 (104).

Striispirifer Cooper & Muir-Wood, 1951, p. 195 [*pro Schuchertia* Frederiks, 1926, p. 406 (*non* Gregory, 1899)] [**Delthyris niagarensis* Conrad, 1842, p. 261; OD]. Like *Eospirifer* except lateral slopes with numerous well-defined costae separated by narrow V-shaped grooves; fold and sulcus smooth. *Sil.(U.Llandover.-Ludlov.)*, N.Am.; *Sil. (Llandover.) - M. Dev.(Couvin.)*, Eu.——Fig. 545,*1*. **S. niagarensis* (Conrad), M.Sil.(Clinton.), USA(N.Y.); *1a-d*, post., ant., brach.v., ped.v. views, ×2 (104).

Family AMBOCOELIIDAE George, 1931

[*nom. transl.* Ivanova, 1959, p. 56 (*ex* Ambocoeliinae George, 1931, p. 42)]

Generally small; unequally biconvex to plano-convex; generally approximately equidimensional to moderately transverse; hinge line commonly slightly less than maximum width; fold and sulcus generally present but variably expressed, bald; lateral slopes generally bald, less commonly plicate; pedicle valve interior commonly without dental plates; brachial valve interior with crural plates, and generally with nonstriate cardinal process. *?U.Sil., L.Dev.-Perm.*

Ambocoelia Hall, 1860, p. 71 [**Orthis umbonata* Conrad, 1842, p. 264; OD]. Small; pedicle valve strongly convex, with prominent incurved beak, large interarea with open delthyrium; brachial valve semicircular, weakly convex; hinge line slightly less than maximum width; pedicle valve with narrow sulcus; brachial valve without fold; anterior commissure rectimarginate; macro-ornament lacking; micro-ornament consisting of concentric growth lamellae and very weak capillae. Pedicle valve interior without dental plates; brachial valve interior with adductor scars placed anteriorly; crural plates distinct; cardinal process rather large, bifid, nonstriate. *L.Dev.-Miss.*, cosmop.——Fig. 546,*1*. **A. umbonata* (Conrad), M.Dev., USA(N.Y.); *1a-c*, brach.v., lat., ped.v. views, ×1.5; *1d,e*, ped.v. int., brach.v. int., ×3 (396).

?Alaskospira Kirk & Amsden, 1952, p. 61 [**A. dunbari*; OD]. Small; unequally biconvex; moderately transverse, with hinge line almost equal to maximum width; macro-ornament wanting; micro-ornament consisting of concentric growth lamellae and radial striae; pedicle valve interior with prominent median ridge or platform extending nearly to anterior margin, lacking dental plates; brachial valve interior with low median ridge appearing just anterior to beak, extending forward several millimeters, then replaced by shallow depression. *U.Sil.*, Alaska.——Fig. 546,*2*. **A. dunbari*; *2a-m*, transv. secs., ×2; *2n-q*, lat., ped.v., brach.v., ant. views, ×2 (476).

Ambothyris George, 1931, p. 42 [**Spirifera infima* Whidbourne, 1893, p. 108; OD]. Pedicle valve with feebly curved beak; micro-ornament lacking or consisting of radial striae only; otherwise seemingly similar to *Ambocoelia*, but interior unknown. *M.Dev.*, Br.I.——Fig. 546,*5*. **A. infima* (Whidbourne); *5a-d*, ped.v., brach.v., ant., lat. views, ×4.5 (334).

Attenuatella Stehli, 1954, p. 343 [**A. texana*; OD]. Pedicle valve narrow, long, markedly convex; beak greatly attenuated, strongly incurved. Pedicle valve interior with strong, rather wide median ridge; otherwise seemingly similar to *Crurithyris* but brachial valve interior unknown. *L.Perm.*, W.Tex.——Fig. 546,*4*. **A. texana*; *4a,b*, ped.v. int., ped.v. ext., ×4.5 (773).

Bisinocoelia Havlíček, 1953, p. 7 [**B. bisinuata*; OD]. Brachial valve interior with erect, rodlike crural bases set far apart and embedded in thickened valve floor which bears prominent Y-shaped ridge; otherwise similar to *Crurithyris*. *L.Dev.*, Czech.——Fig. 546,*3*. **B. bisinuata*, *3a*, brach.v. int., ×8; *3b*, brach.v. ext., ×3 (411).

Crurithyris George, 1931, p. 42 [**Spirifer urei* Fleming, 1828, p. 376; OD]. Both valves with very weak sulci; anterior commissure rectimarginate; micro-ornament consisting of concentric growth lamellae only; cardinal process triangular, tuberculate; brachial valve interior with adductor scars in normal position; otherwise similar to *Ambocoelia*. *Dev.-Perm.*, cosmop.——Fig. 546,*6*. **C. urei* (Fleming), L.Carb., Br.I.; *6a-d*, ped.v., brach.v., lat. views and brach.v. int. mold, ×9 (334).

Echinocoelia Cooper & Williams, 1935, p. 844 [**E. ambocoelioides*; OD]. Cardinal process stout, bilobed; micro-ornament consisting of concentric growth lamellae, each bearing row of short, fine spines; otherwise similar to *Crurithyris*. *M.Dev.*, E.N.Am.——Fig. 547,*5*. **E. ambocoelioides*, Tully, USA(N.Y.); *5a-c*, brach.v. ext., brach.v. int., ped.v. views, ×2 (198).

Emanuella Grabau, 1923, p. 192 [**Nucleospira takwanensis* Kayser, 1883, p. 86; OD]. Both valves markedly convex, pedicle valve somewhat more so; beaks feebly incurved; anterior commissure weakly uniplicate. *M.Dev.-U.Dev.*, cosmop.——Fig. 547,*8*. **E. takwanensis* (Kayser), M.Dev., China; *8a-c*, brach.v., lat., ant. views, ×3 (358).

?Ilmenia Nalivkin, 1941, p. 186 [**I. altovae*; OD]. Micro-ornament consisting of both capillae and concentric growth lamellae; pedicle valve interior with distinct dental plates; otherwise similar to *Crurithyris*. *M.Dev.-U.Dev.*, Eu.-Asia.——Fig. 547,*1*. **I. altovae*, U.Dev., USSR; *1a-d*, ped.v., brach.v., ant., lat. views, ×1 (594).

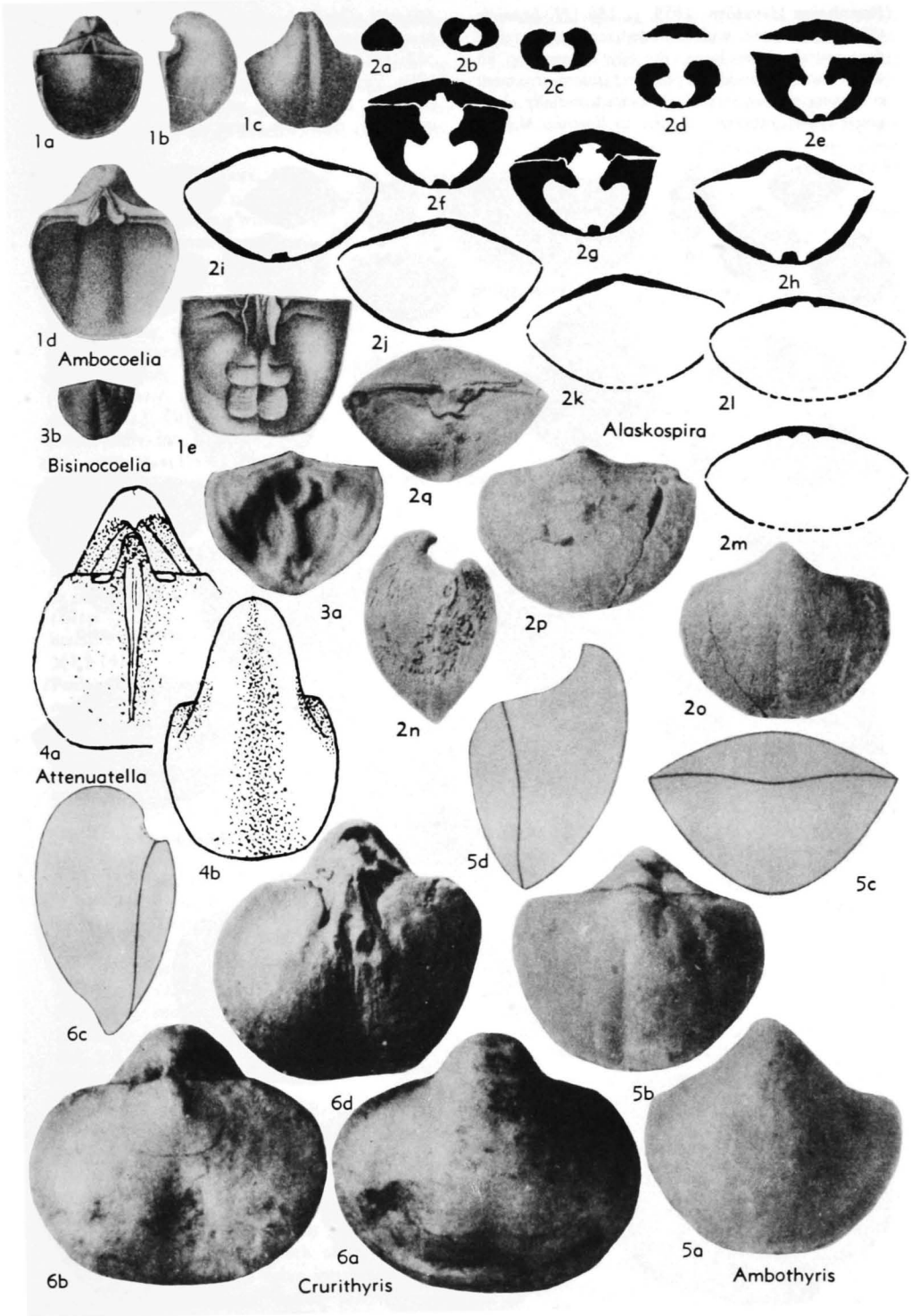


FIG. 546. Ambocoeliidae (p. *H672*).

?Ilmenispina HAVLÍČEK, 1959, p. 180 [**I. hanaica*; OD]. Transverse, with rounded cardinal extremities; crural plates large, dorsally convergent, in some forming sessile septalium; micro-ornament consisting of fine, irregularly placed, radially elongated spines; otherwise similar to *Ilmenia*. *M.Dev.* (*Givet.*), Czech.——FIG. 547,2. **I. hanaica*; *2a-e*, brach.v. int., ped.v., brach.v., ant., lat. views, ×2 (411).

Ladjia VEEVERS, 1959, p. 125 [**L. saltica*; OD]. Anterior commissure rectimarginate to weakly uniplicate; micro-ornament consisting of conspicu-

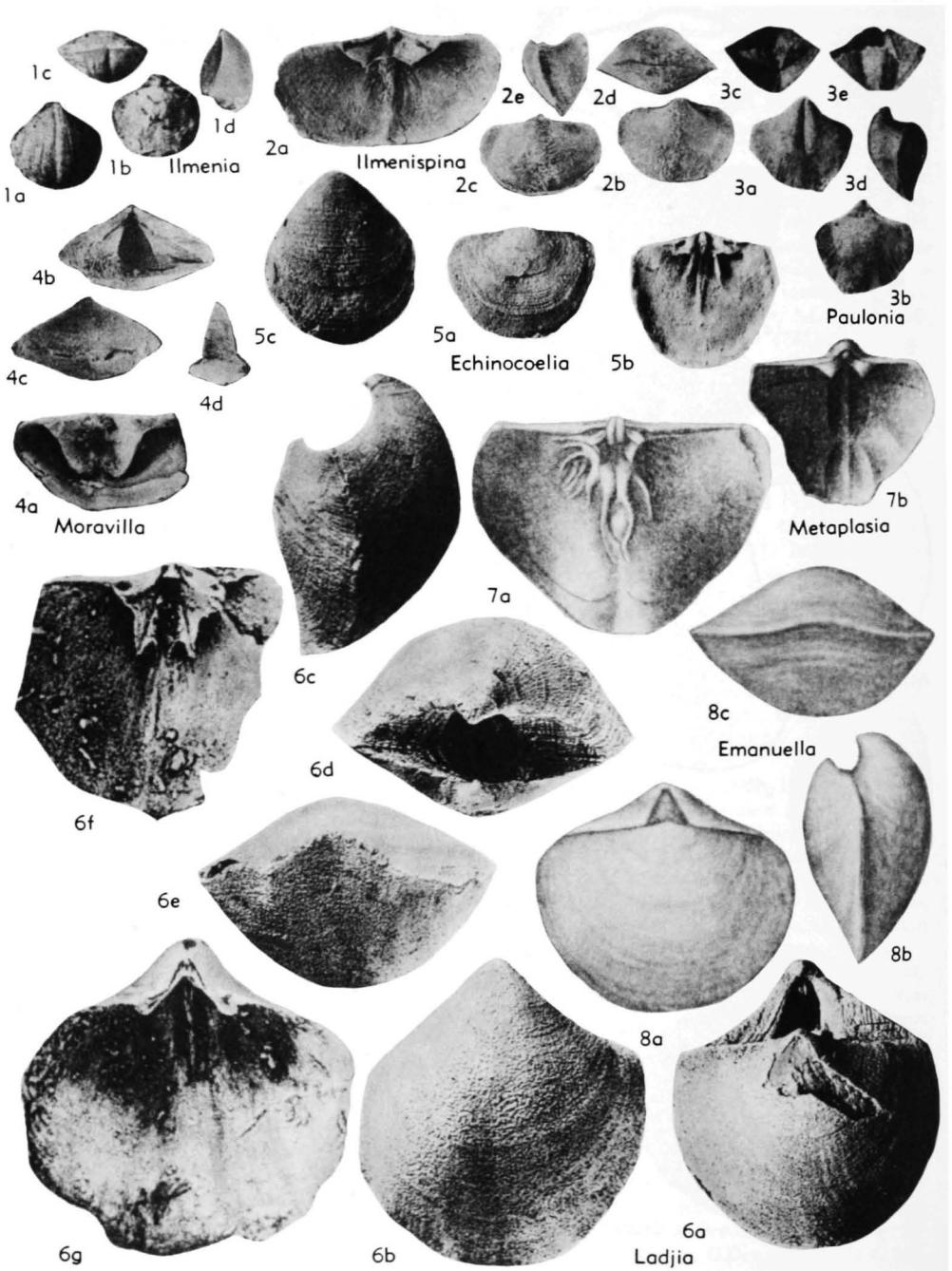


FIG. 547. Ambocoeliidae (p. *H672*, *H674-H675*).

ous radial striae and concentric growth lamellae; brachial valve interior with low, triangular, possibly striate cardinal process; otherwise similar to *Crurithyris*. *U.Dev.(Frasn.)*, W.Australia.——Fig. 547,*6*. **L. saltica*; *6a-e*, brach.v., ped.v., lat., post., ant. views, ×3; *6f,g*, brach.v. int., ped.v. int., ×4.5 (838).

Metaplasia Hall & Clarke, 1894, p. 56 [**Spirifer pyxidatus* Hall, 1859, p. 428; OD]. Rather small; moderately transverse, with hinge line approximately equal to maximum width; fold and sulcus weak; lateral slopes generally with 1 or 2 broad, low plications; micro-ornament consisting of concentric growth lamellae only; pedicle valve interior lacking dental plates; brachial valve interior with crural plates which reach floor of valve near mid-line; cardinal process bilobed. *Dev. (Siegen.-Ems.)*, N.Am.——Fig. 547,*7*. **M. pyxidata* (Hall), Oriskany, USA(N.Y.); *7a-b*, brach. v. int., ped.v. int., ×3 (396).

?**Moravilla** Havlíček, 1953, p. 4 [**M. ficneri*; OD]. Extremely transverse, with hinge line equal to maximum width; pedicle valve hemipyramidal; brachial valve weakly convex; crural plates very long, extending almost to anterior margin, strongly divergent dorsally and meeting valve floor close to mid-line; otherwise similar to *Ilmenia*. *M.Dev. (Givet.)*, Czech.——Fig. 547,*4*. **M. ficneri*; *4a*, brach.v. int., ×3; *4b-d*, post., ant., lat. views, ×1.5 (411).

?**Paulonia** Nalivkin, 1925, p. 267 [**Spirifer ranovensis* Peetz, 1893, p. 53; OD]. Rather small; unequally convex; slightly transverse, with rounded cardinal extremities; fold and sulcus distinct; entire surface with numerous, fine costae; micro-ornament consisting of papillae; pedicle valve interior lacking dental plates and median septum; brachial valve interior unknown. *L.Carb.*, USSR. ——Fig. 547,*3*. **P. ranovensis* (Peetz); *3a-e*, ped.v., brach.v., post., lat., ant. views, ×1 (752).

Plicoplasia Boucot, 1959, p. 19 [**P. cooperi*; OD]. Pedicle valve with strongly biplicate fold; brachial valve with sulcus bearing median plication; lateral plications very strong; otherwise similar to *Metaplasia*. *L.Dev.*, N. Am.-S. Am.-Afr.——Fig. 548,*3*. **P. cooperi*, Oriskany, USA(N.Y.); *3a-f*, brach. v. int., lat., ant., ped.v., brach.v., ped.v. int., ×3 (99).

?**Prosserella** Grabau, 1910, p. 139 [**P. modestoides*; SD Schuchert & LeVene, 1929, p. 101] [=*?Rhynchospirifer* Paulus, 1957, p. 51 (type, *R. halleri*)]. Biconvex; approximately equidimensional; pedicle valve beak prominent, somewhat incurved; interarea rather high with open delthyrium; anterior commissure rectimarginate to weakly uniplicate; macro-ornament lacking; micro-ornament a reticulate network of concentric and radial elements. Pedicle valve interior with long, parallel, closely spaced dental plates; brachial valve interior with crural plates which, in some species, converge, forming septalium supported by median septum. *L.Dev.(Ems.)-M.Dev.(Givet.)*, Eu.-N.Am.——Fig. 548,*4a-c*. **P. modestoides*, L.Dev., USA(Mich.); *4a-c*, ped.v. post. int. mold; ped.v. int. mold, ped.v. lat. int. mold, ×1 (364). ——Fig. 548,*4d*. *P. subtransversa* (Grabau), L. Dev., USA(Mich.); brach.v. int., ×2 (364).—— Fig. 548,*4e,f*. *P. halleri* (Paulus), M.Dev., Ger.; *4e*, brach.v. int., ×3; *4f*, ped.v. int. mold, ×1.5; *4g-i*, brach.v., post., lat., ×2.2 (637).

Pustulatia Cooper, 1956, p. 769 [*pro Vitulina* Hall, 1860, p. 72 (*non* Swainson, 1840); *Pustulina* Cooper, 1942, p. 228 (*non* Quenstedt, 1857)] [**Vitulina pustulosa* Hall, 1860; OD]. Micro-ornament consisting of radial striae which may be interrupted to form radially aligned pustules; otherwise similar to *Plicoplasia* except for slightly more numerous lateral plications. *Dev.*, N.Am.-S.Am.-Afr.——Fig. 548,*2*. **P. pustulosa* (Hall), M.Dev., USA(N.Y.); 2a, ped.v., ×2; *2b*, brach.v., ×3; *2c*, brach.v. int., ×2 (178).

?**Quasimartinia** Havlíček, 1959, p. 179 [**Q. rectimarginata*; OD]. Exterior similar to *Ambocoelia*, but seemingly lacking micro-ornament; pedicle valve interior with neither dental plates nor median septum; brachial valve interior lacking crural plates. *L.Dev.*, Boh.——Fig. 548,*1*. **Q. rectimarginata*; *1a-d*, ped.v., brach.v., ant., lat., ×2 (411).

Spinoplasia Boucot, 1959, p. 18 [**S. gaspensis*; OD]. Micro-ornament consisting of growth lamellae bearing fine spines; cardinal process simple; otherwise similar to *Metaplasia*. *L.Dev.*, E.Can. (Gaspé). —— Fig. 548,*5*. **S. gaspensis*; *5a,b*, brach.v. int. mold, brach.v. mold, ×10 (99).

Superfamily SUESSIACEA Waagen, 1883

[*nom. transl.* Pitrat, herein (*ex* Suessiinae Waagen, 1883, p. 498)]

Pedicle valve hemipyramidal, with high interarea; brachial valve weakly convex; radial macro-ornament absent, confined to lateral slopes or present over entire shell; pedicle valve interior with median septum which either supports spondylium or is expanded at its posterodorsal margin; brachial valve interior with nonstriate cardinal process; shell substance commonly punctate. *Sil.-L.Jur.*

Family CYRTINIDAE Frederiks, 1912

[*nom. transl.* Stehli, 1954, p. 350 (*ex* Cyrtininae Frederiks, 1912)]

Generally rather small and equidimensional, with weakly convex brachial valve and hemipyramidal pedicle valve; interarea large, triangular; delthyrium generally open or with convex pseudodeltidium; costae or plications either absent, present only on

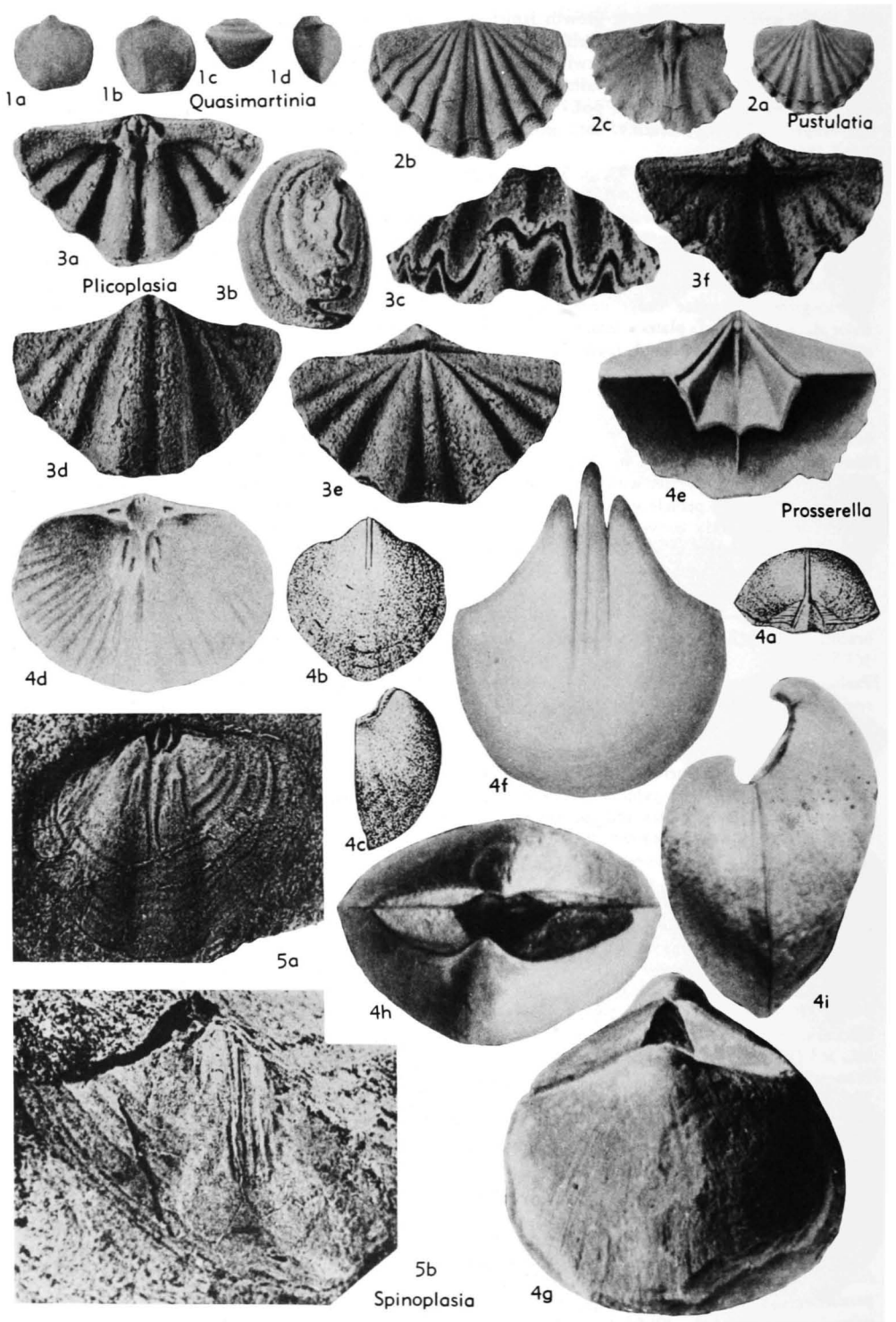


FIG. 548. Ambocoeliidae (p. *H675*).

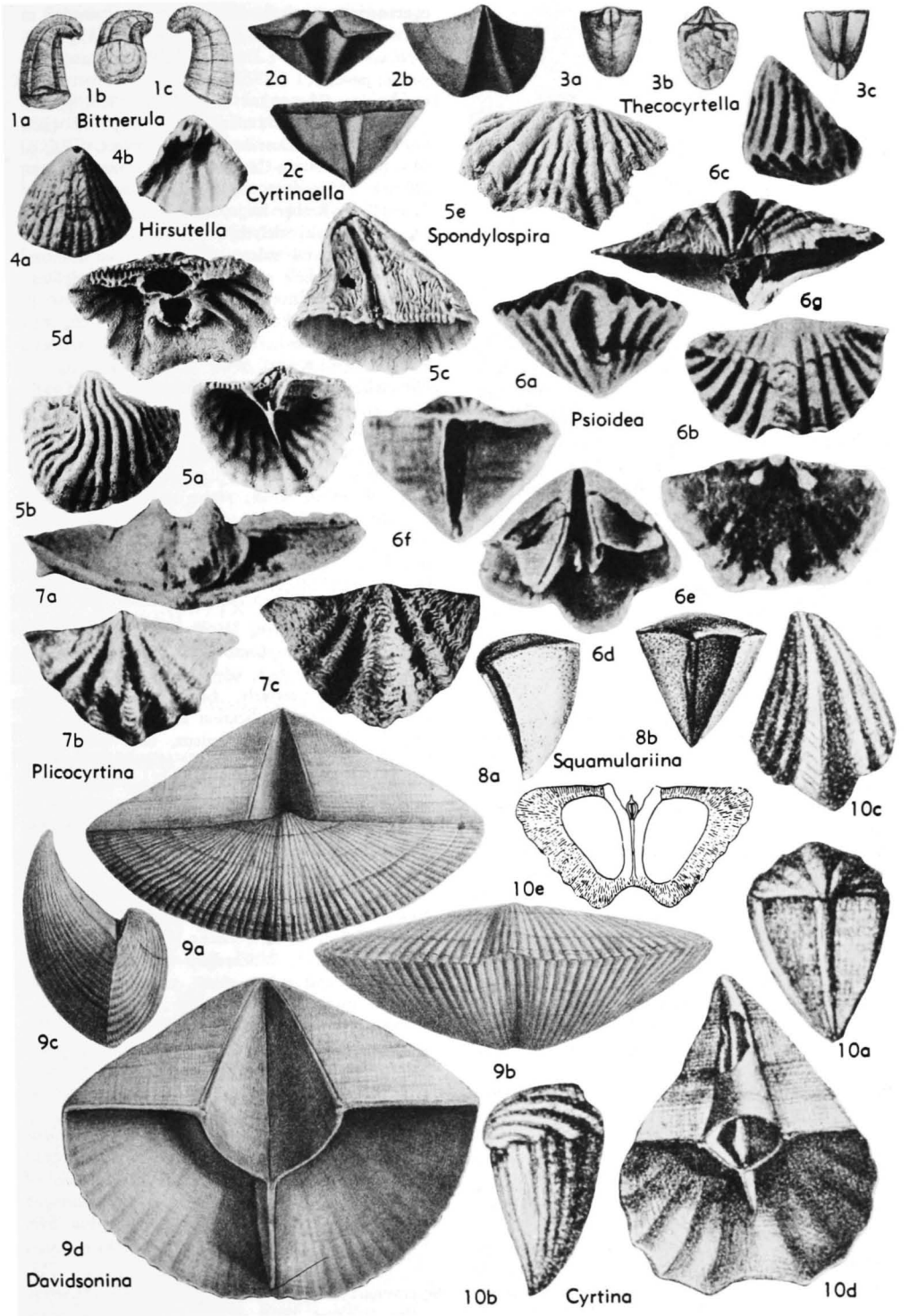


FIG. 549. Cyrtinidae (p. *H678-H679*).

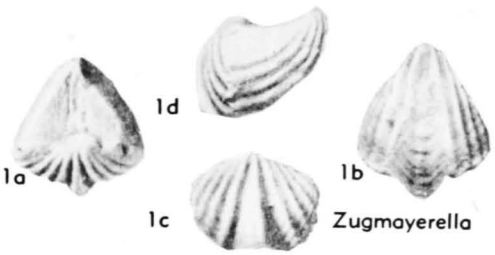


FIG. 549A. Cyrtinidae (p. *H679*).

lateral slopes, or present over entire shell; micro-ornament highly variable; pedicle valve interior with dental plates and median septum uniting to form spondylium, with or without tichorhinum; brachial valve interior with nonstriate cardinal process, complete jugum; shell substance generally punctate. *Sil.-U.Trias.*

Cyrtina DAVIDSON, 1858, p. 66 [**Calceola heteroclita* DEFRANCE, 1828, p. 306; SD HALL & CLARKE, 1894, p. 44] [=*Spinocyrtina* FREDERIKS, 1916, p. 18 (type, *Cyrtia hamiltonensis* HALL, 1857); *Cyrtinaellina* FREDERIKS, 1926, p. 414 (type, *Cyrtina acutirostris* SHUMARD, 1855)]. Small to medium-sized; almost equidimensional; pedicle valve hemipyramidal, in some deformed; brachial valve weakly convex; interarea very high; delthyrium covered by convex pseudodeltidium bearing large foramen near apex; lateral slopes with several distinct plications; fold and sulcus bald; micro-ornament consisting of concentric growth lamellae in various stages of expression; pedicle valve interior with prominent spondylium with tichorhinum; shell substance punctate. *Sil.-Perm.* ——FIG. 549,*10*. **C. heteroclita* (DEFRANCE), M. Dev., W.Eu.; *10a-c*, ant., lat., ped.v., ×1.5; *10d*, ped.v. int., ×3 (229); *10e*, transv. sec., ?×2 (613). [Fixation of type-species is usually credited to DALL (1877, p. 24), though he merely stated *Cyrtina heteroclita* (DEFRANCE) to be the "first species." The first unequivocal designation of the type-species seems to be that of HALL & CLARKE (1894, p. 44).]

Bittnerula HALL & CLARKE, 1894, p. 764 [**Cyrtina zitteli* BITTNER, 1890, p. 117; OD]. Pedicle valve highly deformed; lateral slopes bald; otherwise seemingly similar to *Cyrtina*, but detailed structure of spondylium not known. *U.Trias.*, Eu. ——FIG. 549,*1*. **B. zitteli* (BITTNER); *1a-c*, post., brach.v., lat., ×1 (76).

Cyrtinaella FREDERIKS, 1916, p. 18 [**Cyrtina biplicata* HALL, 1857, p. 165; OD] [=*?Pyramidalia* NALIVKIN, 1947, p. 124 (type, *Spirifera simplex* PHILLIPS, 1841, p. 71)]. Lateral slopes bald; micro-ornament consisting of capillae and concentric growth lamellae; otherwise similar to *Cyrtina*. *Dev.*, N.Am., ?Eu.——FIG. 549,*2*. **C. biplicata* (HALL), L.Dev., USA(N.Y.); *2a-c*, ant., ped.v., post., ×1 (392).

Davidsonina SCHUCHERT & LEVENE, 1929, p. 120 [*pro Cyrtinopsis* FREDERIKS, 1916, p. 17 (*non* SCUPIN, 1896); *Davidsonella* FREDERIKS, 1926, p. 413 (*non* MUNIER-CHALMAS, 1880; *nec* WAAGEN, 1885)] [**Spirifera septosa* PHILLIPS, 1836, p. 216; OD]. Rather large, transverse; interarea not unusually high; delythyrium open; both lateral slopes, fold, and sulcus with numerous bifurcating costae; pedicle valve interior with spondylium, lacking tichorhinum; otherwise similar to *Cyrtina*. *L.Carb.*, Eu.-Asia.——FIG. 549,*9*. **D. septosa* (PHILLIPS), Visean, Br.I.; *9a-d*, brach.v., ant., lat., ped.v. int., ×0.7 (229).

?Hirsutella COOPER & MUIR-WOOD, 1951, p. 195 [*pro Hirsutina* KIRCHNER, 1933, p. 106 (*non* TUTT, 1909)] [**Spirifer? hirsutus* ALBERTI, 1864, p. 156; OD]. General shape cyrtiniform; delthyrium partly closed by disjunct deltidial plates; fold and sulcus weak; entire shell costate, costae on fold and sulcus being somewhat weaker than those on lateral slopes; pedicle valve interior with spondylium; shell substance impunctate. *M.Trias.*, Ger.——FIG. 549,*4*. **H. hirsuta* (ALBERTI); *4a,b*, ped.v. ext., ped.v. int., ×1 (475).

Plicocyrtina HAVLÍČEK, 1956, p. 608 [**Cyrtina (Plicocyrtina) sinuplicata* HAVLÍČEK, 1956; OD]. Lateral plications few, very strong; sulcus narrow, deep, bald posteriorly, but developing single, prominent, median plication anteriorly; fold considerably broader than sulcus, bald posteriorly, bearing shallow depression anteriorly; micro-ornament consisting of very strong imbricating growth lamellae; otherwise similar to *Cyrtina*. *Dev.(?Couvin.)*, Eu.-?N.Afr.——FIG. 549,*7*. **P. sinuplicata*, Bohem.; *7a-c*, brach.v. post., ped.v., brach.v., ×1.5 (408).

Psioidea HECTOR, 1879, p. 538 [**Spiriferina nelsonensis* TRECHMANN, 1918, p. 223; SD MARWICK, 1953, p. 39] [=*?Lepismatina* WANG, 1955, p. 353 (type, *L. hsui*)]. Moderately to markedly transverse; fold and sulcus sharp, narrow, bald; delthyrium open; otherwise similar to *Cyrtina*. *Trias.*, N.Am.-Australia-?Asia-?Eu.——FIG. 549,*6g*. **P. nelsonensis* (TRECHMANN), Carn., N.Z.; post., ×1 (536).——FIG. 549,*6a-f*. *P. hsui* (WANG), M.Trias., China; *6a-f*, ant., brach.v., lat., ped.v. int., brach.v. int., post., ×1 (852).

Spondylospira COOPER, 1942, p. 232 [**S. reesidei*; OD]. Fold and sulcus plicate; delthyrium open; hinge line denticulate; descending lamellae of spiralia supported by calcareous net; otherwise similar to *Cyrtina*. *Trias.*, W.N.Am.——FIG. 549, *5*. **S. reesidei*, U.Trias., USA(Idaho); *5a-e*, ped.v. int., ped.v., ant., brach.v. int., brach.v., ×1 (178).

Squamulariina FREDERIKS, 1916, p. 19 [**Cyrtina parva* GÜRICH, 1896, p. 266; OD]. Micro-ornament of fine papillae; otherwise seemingly similar

to *Cyrtinaella,* but internal features poorly known. *M.Dev.,* Pol.——FIG. 549,*8*. **S. parva* (GÜRICH); *8a,b,* lat., post., ×2.5 (373).

Thecocyrtella BITTNER, 1892, p. 15 [*pro Cyrtotheca* BITTNER, 1890, p. 116 (*non* HICKS, 1872)] [**Cyrtotheca ampezzana* BITTNER, 1890, p. 116; OD]. Very small; pedicle valve very high, curved; micro-ornament consisting of concentric growth lamellae only; delthyrium completely closed by pseudodeltidium; shell substance probably impunctate; otherwise similar to *Cyrtinaella. U.Trias.,* W. Eu.——FIG. 549,*3*. **T. ampezzana* (BITTNER); *3a-c,* ped.v., ped.v. int., post., ×3 (76).

Zugmayerella DAGIS, 1963, p. 99 [**Spiriferina koessenensis* ZUGMAYER, 1882; OD]. Fold and sulcus smooth; otherwise similar to *Spondylospira. U.Trias.,* Eu.——FIG. 549A,*1*. **Z. koessenensis* (ZUGMAYER); *1a-d,* post., ped.v., brach.v., lat., ×1 (212a).

Family SUESSIIDAE Waagen, 1883

[*nom. transl.* PITRAT, herein (*ex* Suessiinae WAAGEN, 1883, p. 498)]

Shells externally cyrtiniform, with hemipyramidal pedicle valve and weakly convex brachial valve; pedicle valve interior with prominent median septum which is horizontally expanded at its posterodorsal margin; brachial valve interior with very large hinge plate, apparently bearing adductor muscle scars; shell substance seemingly impunctate. *L.Jur.*

Suessia DESLONGCHAMPS, 1854, p. 6 [**S. costata*; SD DAVIDSON, 1854, p. 28]. Entire shell plicate; delthyrium open; pedicle valve interior with dental plates reduced to teeth ridges. *L.Jur.,* Eu.——FIG. 550,*1*. **S. costata; 1a-c,* post., ped.v. post., brach.v. int., ×? (397).

Superfamily SPIRIFERACEA King, 1846

[*nom. transl.* SCHUCHERT, 1896, p. 333 (*ex* Spiriferidae KING, 1846, p. 28)]

Shell form variable but generally rather transverse with either angular or narrowly rounded cardinal extremities and hinge line equal to or slightly less than maximum width; lateral slopes invariably costate or plicate; fold and sulcus generally present, tending to be bald in earlier forms, costate or plicate in later ones; pedicle valve interior with or without dental plates, commonly without median septum; brachial valve interior with striate cardinal process, with or without crural plates; shell substance generally impunctate. *L.Sil.-U.Perm.*

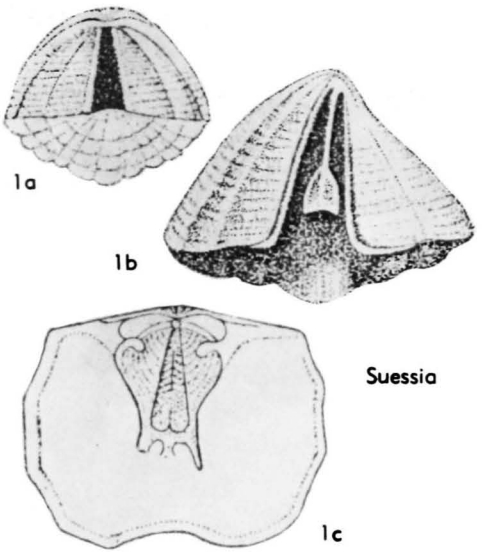


FIG. 550. Suessiidae (p. *H679*).

Family DELTHYRIDIDAE Waagen, 1883

[*nom. correct.* PITRAT, herein (*pro* Delthyridae WAAGEN, 1883, *nom. transl.* IVANOVA, 1959, p. 56, *ex* Delthyrinae WAAGEN, 1883, p. 507)] [Formerly the family group taxon Delthyrididae has been attributed to PHILLIPS, 1841 (p. 54). However, under the International Code (1961), Article 11e, in order to be available a family group name when first published must be based on the name then valid for a contained genus. PHILLIPS, 1841 (p. 68), synonymized *Spirifera* PHILLIPS, 1836, and *Delthyris* DALMAN, 1828, and retained the former name in his description of species. However, *Spirifera* PHILLIPS, 1836, is an "unjustified emendation" of *Spirifer* SOWERBY, 1816, and is hence a junior objective synonym. Thus effectively PHILLIPS synonymized *Spirifer* and *Delthyris* and although both names were available, only *Spirifer* was valid. Consequently Delthyridae PHILLIPS, 1841, is not an available family group name, for the conditions of Article 11e are not satisfied.]

Biconvex, weakly to strongly transverse; lateral slopes plicate or costate; fold and sulcus smooth or with median rib in sulcus and median groove on fold; micro-ornament typically consisting of distinct growth lamellae upon which are superposed capillae that become fimbriate at anterior margin of each growth lamella, more rarely consisting of capillae only or of teardrop-shaped granules; interior of pedicle valve generally with well-developed dental plates, some with distinct median septum but none with delthyrial plate; brachial-valve interior with area of diductor attachment deeply striate longitudinally, resulting in comblike cardinal process; crural plates absent or short; shell substance impunctate. *L.Sil.(Llandover.)-M.Dev.(Couvin.).*

Subfamily DELTHYRIDINAE Phillips, 1841

[*nom. correct.* Pitrat, herein (*ex* Delthyrinae Waagen, 1883, p. 507)]

Lateral slopes with few, strong plications;

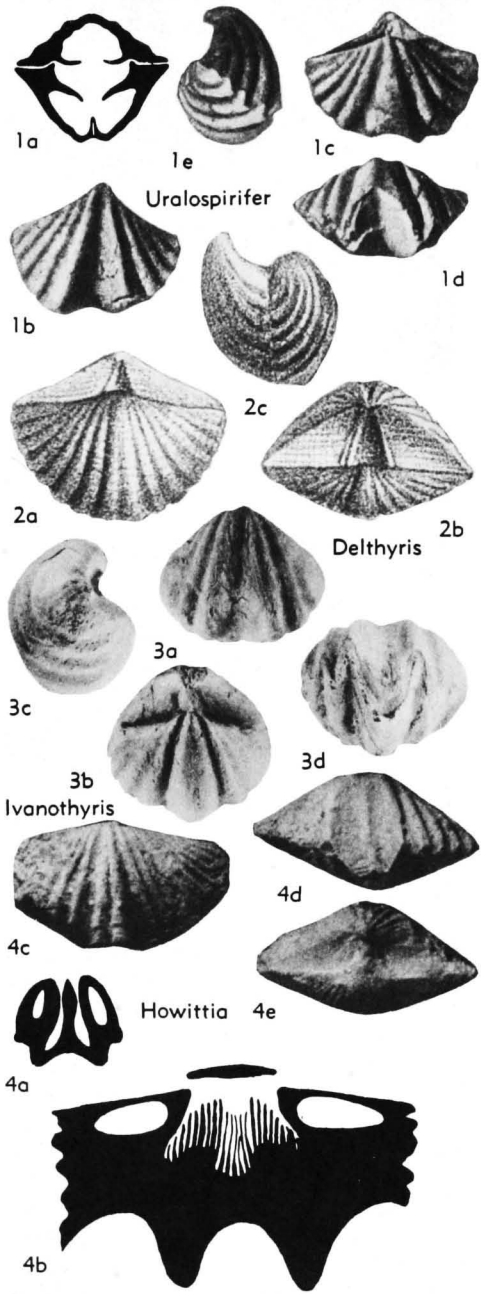


Fig. 551. Delthyrididae (Delthyridinae) (p. *H*680-*H*681).

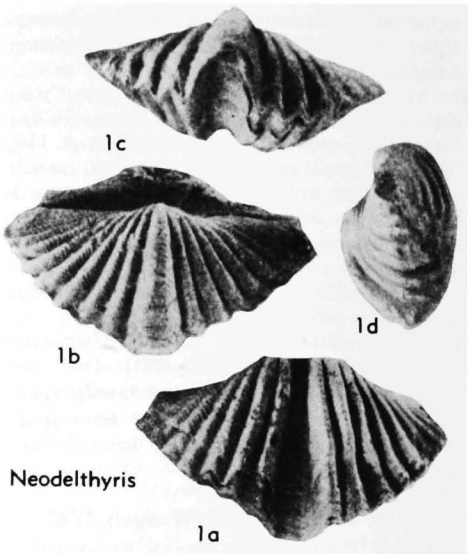


Fig. 552. Delthyrididae (Delthyridinae) (p. *H*681).

micro-ornament consisting of subdued growth lamellae and capillae which become fimbriate at anterior margin of each growth lamella; interior of pedicle valve with well-developed median septum, and commonly strong dental plates; brachial-valve interior with or without crural plates. *U.Sil.(Wenlock.)-M.Dev.(Couvin.).*

Delthyris Dalman, 1828, p. 120 [**D. elevata*; OD] [=*Quadrifarius* Fuchs, 1929, p. 195 (type, *Delthyris loculata* Fuchs, 1923, p. 854)]. Pedicle-valve interior with well-developed dental plates and high, narrow median septum; interior of brachial valve with short crural plates. *U.Sil.(Wenlock.)-L.Dev.(Gedinn.),* Eu.——Fig. 551,*2*. **D. elevata,* Sil., Br.I.; *2a-c,* brach.v., post., lat., ×1.5 (229).

?**Howittia** Talent, 1956, p. 34 [**Spirifer howitti* Chapman, 1905, p. 18; OD]. Rather small; moderately transverse with slightly rounded cardinal extremities; lateral slopes with several rather strong simple plications; fold with prominent median groove; sulcus with from 1 to 3 plications; micro-ornament consisting of growth lamellae and fine capillae with papillae; pedicle valve interior with strong dental plates and short, high median septum; brachial valve interior lacking crural plates. *?M.Dev.(Couvin.),* Australia. ——Fig. 551,*4*. **H. howitti* (Chapman); *4a,* transv. sec. ped.v., ×3; *4b,* transv. sec. brach.v., ×10; *4c-e,* brach.v., ant., post., ×1.5 (796).

Ivanothyris Havlíček, 1957, p. 438 [**Spirifer gibbosus* Barrande, 1879, p. 99; OD]. Brachial-valve interior without crural plates; pedicle-valve interior with median septum thickened posteriorly,

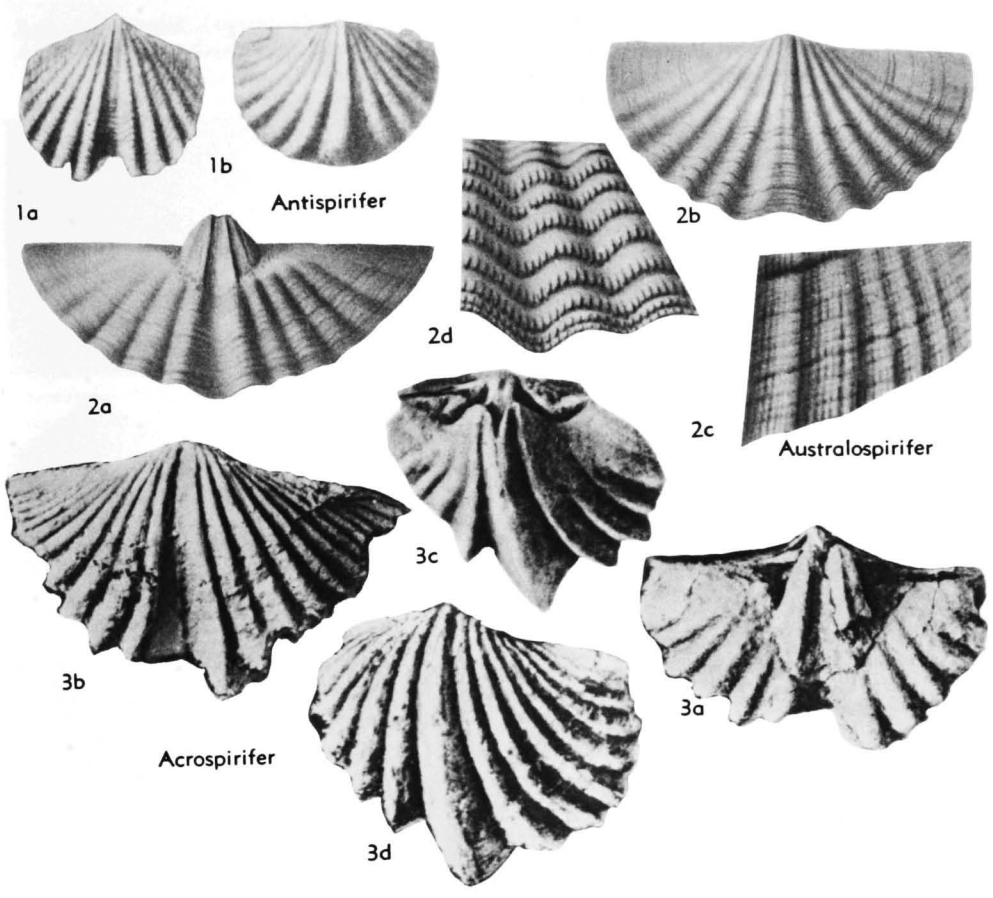


FIG. 553. Delthyrididae (Acrospiriferinae) (p. *H*681-*H*683).

and muscle field deeply impressed owing to deposition of secondary material in umbonal cavities; otherwise like *Delthyris*. *?L.Dev.(Gedinn.)*, Boh. ——FIG. 551,*3*. **I. gibbosa* (BARRANDE); *3a-d*, ped.v., brach.v., lat., ant., ×1 (411).

?Neodelthyris HOU, 1963, p. 413 [**N. sinensis*; OD]. Large; extremely transverse; plications sharp, rather numerous, confined to lateral slopes; pedicle valve interior with thick dental plates, very short median septum; brachial valve lacking crural plates and cardinal prcoess. *M.Dev.(Couvin.)*, China.——FIG. 552,*1*. **N. sinensis*; *1a-d*, ped.v., brach.v., ant., lat., ×1 (433c).

Uralospirifer HAVLÍČEK, 1959, p. 142 [**Spirifer (Delthyris) mansy* KHODALEVICH, 1951, p. 96; OD]. Like *Delthyris* except pedicle valve with dental plates reduced to teeth ridges and brachial valve without crural plates. *Dev.(Coblenz.-Couvin.)*, USSR.——FIG. 551,*1*. **U. mansy* (KHODALEVICH); 1a, transv. sec., ?mag. (411); *1b-e*, ped.v., brach.v., ant., lat., ×1 (467).

Subfamily ACROSPIRIFERINAE
Termier & Termier, 1949

[Acrospiriferinae TERMIER & TERMIER, 1949, p. 96]

Lateral plications generally few, strong, angular in early forms, tending to become weaker and more numerous in later forms; micro-ornament primitively as in Delthyridinae, in advanced forms consisting of capillae or teardrop-shaped granules; interior of pedicle valve with well-developed dental plates, without median septum; brachial-valve interior generally without crural plates. *L.Sil.(Llandover.)-U.Dev.(Frasn.)*.

Acrospirifer HELMBRECHT & WEDEKIND, 1923, p. 952 [**Spirifer primaeva* STEININGER, 1853, p. 72; SD WEDEKIND in SALOMON, 1926, p. 202]. Lateral plications fairly numerous, very strong, angular; micro-ornament as in *Howellella*; umbonal cavities of pedicle valve filled with secondary mate-

rial, muscle field deeply impressed, dental plates short; brachial-valve interior without crural plates. *L.Dev.(Siegen.-Ems.)*, cosmop.——Fig. 553,3.

**A. primaevus* (Steininger), Siegen., Ger.; *3a-d*, ped.v. int. mold, ped.v., brach.v. int. mold, brach. v., ×1 (528).

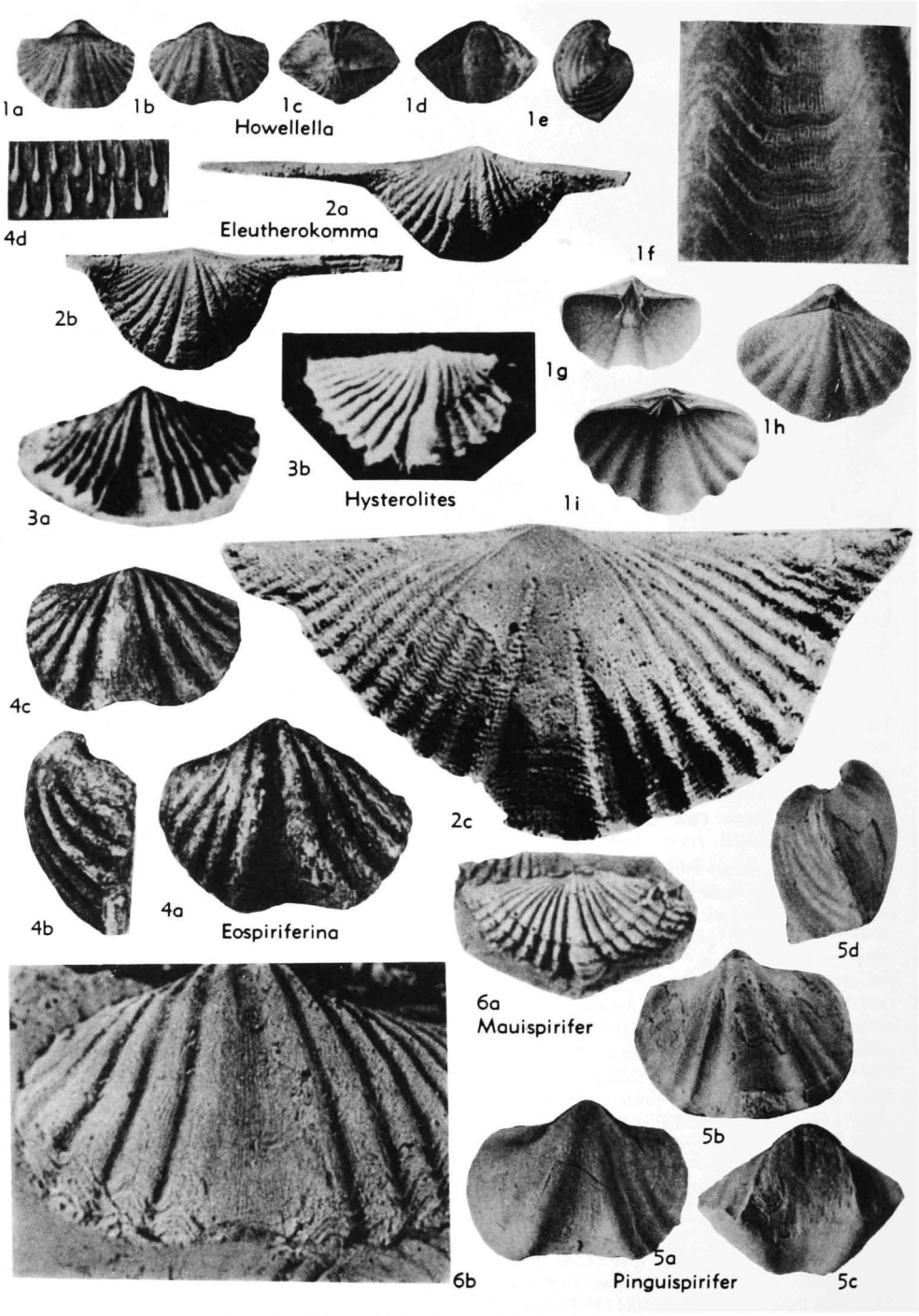


Fig. 554. Delthyrididae (Acrospiriferinae) (p. *H683*).

Antispirifer WILLIAMS, 1916, p. 114 [**A. harroldi*; OD]. Pedicle valve essentially flat; brachial valve convex; otherwise like *Acrospirifer*. *L.Dev.*, USA (Maine).——FIG. 553,*1*. **A. harroldi; 2a,b*, ped. v., brach.v., ×1.5 (883).

Australospirifer CASTER, 1939, p. 159 [**Spirifer kayserianus* CLARKE, 1913, p. 252; OD]. Lateral plications few, distinct, rounded; micro-ornament in 2 stages, initially as in *Howellella*, later with radial striae only; interiors of both valves as in *Acrospirifer*. *L.Dev.*, S.Am.——FIG. 553,*2*. **A. kayserianus* (CLARKE), Brazil; *2a,b*, ped.v. int. mold, brach.v., ×0.7; *2c,d*, mature ornament, immature ornament, ×5 (165).

?**Eleutherokomma** CRICKMAY, 1950, p. 219 [**E. hamiltoni*; OD]. Small to medium-sized; biconvex; extremely transverse with acuminate cardinal extremities; lateral slopes with rather numerous well-defined plications; fold and sulcus distinct, bald or with single median costa in sulcus; micro-ornament consisting of prominent closely spaced concentric growth lamellae and capillae; pedicle valve interior with strong dental plates, lacking median septum. *M.Dev.(Givet.)-U.Dev.(Frasn.)*, N.Am.——FIG. 554,*2a,b*. **E. hamiltoni*, Waterways F., Alta.; *2a,b*, ped.v., brach.v., ×2 (202).——FIG. 554,*2c*. *E. beardi*, ?Frasn., Alta.; brach.v. ext. mold, ×6 (202).

?**Eospiriferina** GRABAU, 1931, p. 494 [**Spiriferina (Eospiriferina) lachrymosa*; OD]. Lateral plications coarse, few; micro-ornament consisting of posteriorly tapering teardrop-shaped pustules; pedicle valve interior with well-developed, divergent dental plates, lacking median septum; presence of punctae not established. *M.Dev.*, China. ——FIG. 554,*4*. **E. lachrymosa* (GRABAU); *4a-c*, ped.v., lat., brach.v., ×2; *4d*, micro-ornament, ×10 (358).

Howellella KOZLOWSKI, 1946, p. 295 [*pro Crispella* KOZLOWSKI, 1929, p. 190 (*non* GRAY, 1870)] [**Terebratula crispus* HISINGER, 1826, pl. 7, fig. 4 (*non Anomia crispa* LINNÉ, 1758), =*Delthyris elegans* MUIR-WOOD, 1925, p. 89; OD]. Lateral plications few; micro-ornament of capillae becoming fimbriate at anterior edges of growth lamellae; pedicle-valve interior with well-developed dental plates; brachial-valve interior with short crural plates. *L.Sil.(U.Llandover.)-Dev.(L. Gedinn.)*, cosmop.——FIG. 554,*1g-i*. *H. elegans* (MUIR-WOOD), M.Sil. (Niagaran), E.USA; *1g-i*, ped.v. int., brach.v., brach.v. int., ×2 (178).——FIG. 554,*1a-f*. *H. angustiplicatus* KOZLOWSKI, U. Sil.(Ludlov.), Pol.; *1a-e*, brach.v., ped.v., post., ant., lat., ×1; *1f*, surface, ×7 (487).

[Formerly both *Anomia crispa* LINNÉ, 1758, and *Terebratula crispus* HISINGER, 1826, were regarded as belonging to *Delthyris* MUIR-WOOD (1925, p. 89-91) proposed *Delthyris elegans* as a substitute for *Delthyris crispa* (HISINGER). According to the Zoological Code (Art. 59,c) the substitution stands, even though the two species are not now considered congeneric.]

Hysterolites VON SCHLOTHEIM, 1820, p. 247 [**H. hystericus*; SD DALL, 1877, p. 38]. Pedicle-valve interior with rather long, thin dental plates, umbonal cavities not filled with secondary material, muscle field not deeply impressed; otherwise seemingly similar to *Acrospirifer*, but interior of brachial valve poorly known. *L.Dev.(Siegen.)*, Ger.——FIG. 554,*3*. **H. hystericus; 3a,b*, ped.v. int. mold, brach.v., ×1.5 (528).

Mauispirifer ALLAN, 1947, p. 445 [**M. hectori*; OD]. Micro-ornament consisting of capillae, interrupted only locally by growth lamellae; otherwise similar to *Acrospirifer*. *L.Dev.*, N.Z.——FIG. 554,*6*. **M. rectori*; *6a*, brach.v., ×1; *6b*, ped.v., ×3 (27).

?**Pinguispirifer** HAVLÍČEK, 1957, p. 246 [**Spirifer infirmus* BARRANDE, 1879, p. 47; OD]. Medium-sized to large; rather transverse, with rounded cardinal extremities; fold and sulcus well developed, bald; lateral slopes with several low plications; micro-ornament consisting of fine capillae only; pedicle valve interior with dental plates short or obsolete; brachial valve interior lacking crural plates. *L.Dev.-M.Dev.*, Boh.——FIG. 554,*5*. **P. infirmus* (BARRANDE); *5a-d*, ped.v., brach.v., ant., lat., ×1 (411).

Spinella TALENT, 1956, p. 21 [**S. buchanensis*; OD]. Lateral slopes with numerous, simple, rather low, rounded plications; micro-ornament consisting of very numerous teardrop-shaped granules; interiors of both valves similar to those of *Acrospirifer*. *M.Dev.(?Couvin.)*, Australia.——FIG. 555,*1*. **S. buchanensis; 1a-d*, ped.v., brach.v., post., ant., ×1.5; *1e*, surface, ×10.5; *1f*, transv. sec., ×1; *1g*, cardinalia, enl. (796).

Subfamily KOZLOWSKIELLININAE Boucot, 1957

[*nom. correct.* BOUCOT, 1958, p. 1031 (*pro* Kozlowskiellinae BOUCOT, 1957, p. 317)]

Lateral slopes with few, very strong plications; micro-ornament consisting of strong growth lamellae which tend to bend outward and become frilly at their anterior margins, and capillae which become fimbriate at edges of frills; interior of pedicle valve with well-developed dental plates, and generally median septum; brachial-valve interior with short crural plates. *U.Sil.(Wenlock.)-L.Dev.(Ems.)*.

Kozlowskiellina BOUCOT, 1957 (1958), p. 1031 [*pro Kozlowskiella* BOUCOT, 1957, p. 317 (*non* PRIBYL, 1953)] [**Kozlowskiella strawi* BOUCOT, 1957, p. 318; OD] [=*Megakozlowskiella* BOUCOT, 1957, p. 322 (type, *Spirifer perlamellosus* HALL, 1857, p. 57); *Megakozlowskiellina* AMSDEN & VENTRESS, 1963, p. 114 (*nom. van.*)]. Pedicle valve with well-developed median septum; brachial valve with deeply striate, bilobed cardinal process. [Although *Kozlowskiellina* was proposed in 1958 as a replacement for the preoccupied *Kozlowskiella* BOUCOT, 1957, it takes the

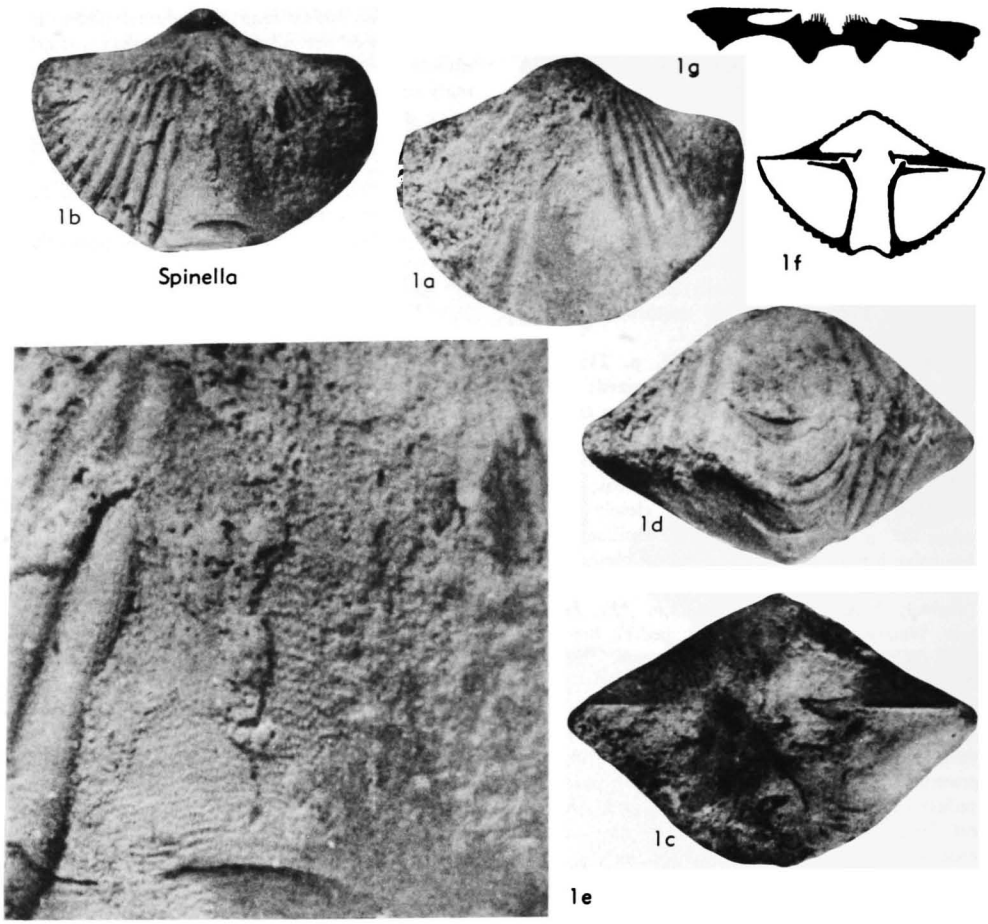


FIG. 555. Delthyrididae (Acrospiriferinae) (p. *H*683).

date 1957, because it is the basis for a subfamily (Code, Art. 39,a).] *U.Sil.-L.Dev.*, N.Am.; *Sil. (Wenlock.-Ludlov.)*, Eu.; *L.Dev.*, Australia.—— FIG. 556,*1a-e*. **K. strawi* (BOUCOT), Wenlock., Br.I.; *1a-e*, post., ant., lat., brach.v., ped.v., ×4 (97).——FIG. 556,*1f,g*. *K.* sp. (BOUCOT), L.Dev. (Haragan), USA(Okla.); brach.v., brach.v. int., ×3 (97).——FIG. 556,*1h*. *K. raricosta* (CONRAD), L.Dev.(Onondaga), USA(N.Y.); oblique post. int., ×2 (97).

Hedeina BOUCOT, 1957, p. 323 [**Anomia crispa* LINNÉ, 1758, p. 702; OD]. Pedicle valve without median septum; brachial valve with simple, striate cardinal process; otherwise like *Kozlowskiellina. U. Sil. (Wenlock.-Ludlov.)*, N.Am.-Eu. —— FIG. 556,*2*. **H. crispa* (LINNÉ), Ludlov., Gotl.; *2a-e*, post., ant., lat., brach.v., ped.v., ×3 (97).

Subfamily PARASPIRIFERINAE Pitrat, n.subfam.

Lateral plications very numerous, generally low, but distinct, simple or bifurcating; micro-ornament as in Delthyridinae; interior of pedicle valve with dental plates, but without median septum; brachial-valve interior without crural plates. *L.Dev. (Siegen.)-M.Dev.(Couvin.)*.

Paraspirifer WEDEKIND in SALOMON, 1926, p. 198 [**Spirifer cultrijugatus* ROEMER, 1844, p. 70; OD]. Large, slightly transverse to equidimensional, with maximum width at mid-length; brachial valve highly convex, pedicle valve less so; lateral costae numerous, low, straplike, mostly simple, but those near fold or sulcus bifurcating anteriorly; fold smooth, broad, very strong, carinate; sulcus smooth, wide, V-shaped. *L.Dev.(Ems.)-M.Dev. (Couvin.)*, cosmop.——FIG. 557,*1a,b*. **P. cultrijugatus* (ROEMER), Ems., Ger.; *1a,b*, ped.v., post., ×0.7 (37[illegible]).——FIG. 557,*1c-e*. *P. acuminatus* (CONRAD), L.Dev. (Onondaga), E.USA; *1c-e*, brach.v., ant., lat., ×0.7 (178).

Brachyspirifer WEDEKIND in SALOMON, 1926, p. 198 [**Spirifer carinatus* SCHNUR, 1853, p. 202; OD]. Medium-sized, subequally biconvex, transverse; hinge line slightly less than maximum width; in-

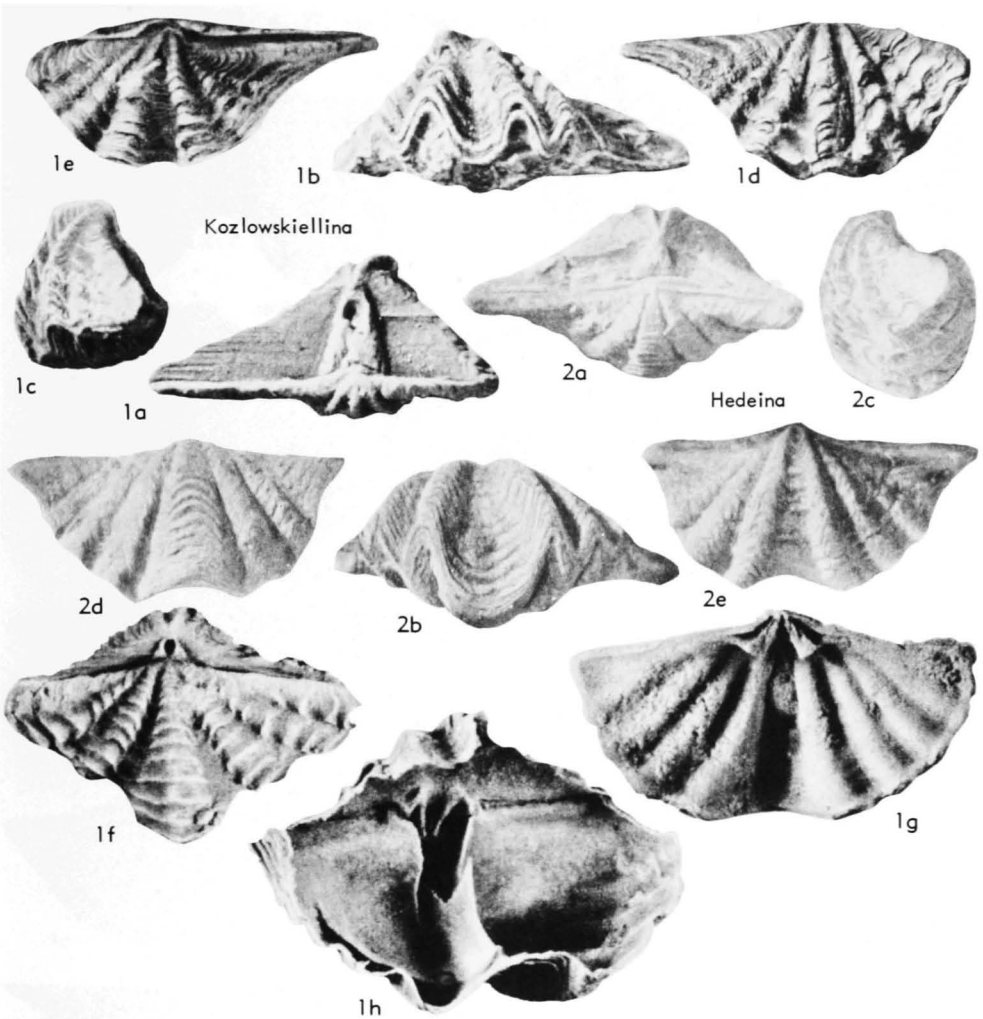


FIG. 556. Delthyrididae (Kozlowskiellininae) (p. *H*683-*H*684).

terarea high with wide delthyrium; lateral plications numerous, distinct, simple; fold and sulcus well developed, smooth; fold carinate; sulcus V-shaped. *L.Dev.(Siegen.-Ems.)*, Eu.——FIG. 557,*2*. **B. carinatus* (SCHNUR), Siegen., Ger.; *2a-c*, brach. v. int. mold, lat. int. mold, ped.v. int. mold, ×1 (721).

Euryspirifer WEDEKIND in SALOMON, 1926, p. 202 [**Terebratulites paradoxus* VON SCHLOTHEIM, 1813, p. 28; OD] [=*?Rostrospirifer* GRABAU, 1931, p. 407 (type, *Spirifer tonkinensis* MANSUY, 1908, p. 41)]. Extremely transverse with highly acuminate cardinal extremities; interarea low; otherwise similar to *Brachyspirifer*. *L.Dev.(Ems.)-M.Dev.*, Eu.-Asia.——FIG. 557,*3*. **E. paradoxus* (VON SCHLOTHEIM), Ems., Ger.; *3a-c*, brach.v. int. mold, ped.v. int. mold, post. int. mold, ×1 (721).

Subfamily CYRTINOPSINAE Boucot, 1957

[*nom. transl.* PITRAT, herein (*ex* Cyrtinopsidae BOUCOT, 1957, p. 38)]

Lateral slopes plicate; micro-ornament consisting of very prominent growth lamellae crossed by short radial crenulations; pedicle valve interior with dental plates converging to form spondylium supported by 3-layered septum. *M.Dev.(Couvin.)*.

Cyrtinopsis SCUPIN, 1896, p. 247 [*non* FREDERIKS, 1916, p. 17] [**Spirifer tundosus* SCHNUR, 1853, p. 204; OD]. Medium-sized; transverse; markedly and unequally biconvex with highly arched beak and rather high interarea on pedicle valve; lateral slopes with numerous, rounded plications; fold and sulcus distinct, broad, lacking macro-ornament; brachial valve interior with short

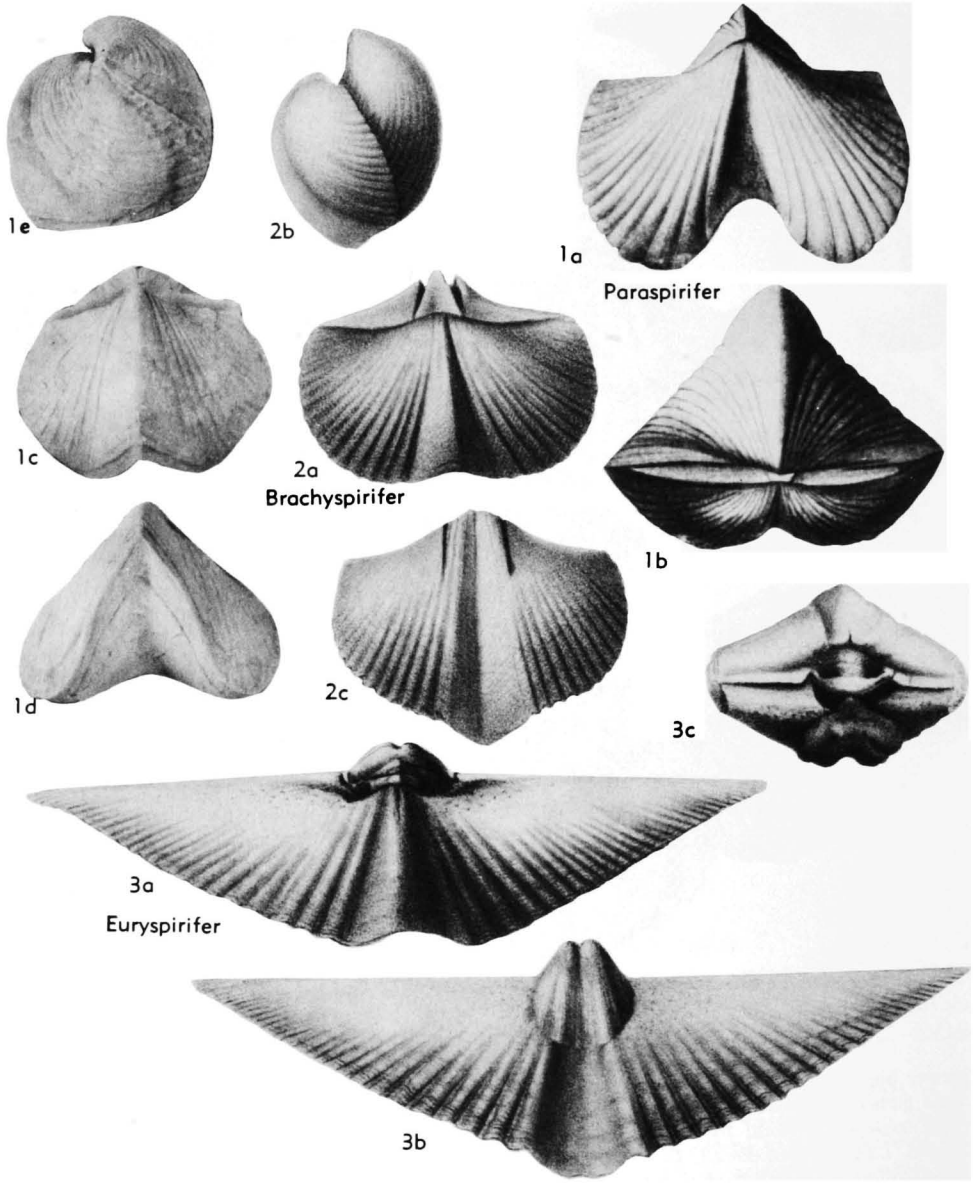


FIG. 557. Delthyrididae (Paraspiriferinae) (p. *H*684-*H*685).

crural plates. *M.Dev.(Couvin.)*, W.Eu.——FIG. 558,*1*. **C. undosa* (SCHNUR); *1a-d*, lat., ant., brach.v., post., ×1; *1e*, ornament, ×3; *1f*, transv. sec. showing spondylium, ×5 (96).

Family MUCROSPIRIFERIDAE Pitrat, n.fam.

Biconvex, generally strongly transverse; lateral slopes plicate; fold and sulcus smooth or with median ridge in sulcus and median groove on fold; micro-ornament consisting of strong, imbricating growth lamellae; interior of pedicle valve with short dental plates or teeth ridges, rarely with distinct median septum, commonly with apical callus; interior of brachial valve generally with comblike cardinal process; crural plates lacking or short; shell substance impunctate. *L.Dev.(Ems.)-L.Carb.(Visean)*.

Mucrospirifer GRABAU, 1931, p. 408 [**Delthyris mucronata* CONRAD, 1841, p. 54; OD] [=*Lamelli-*

spirifer NALIVKIN, 1937, p. 87, obj.]. Highly transverse; cardinal extremities commonly mucronate; lateral plications numerous; fold and sulcus bald or with single median ridge in sulcus; pedicle valve interior with short dental plates; median septum wanting. *M.Dev.(Couvin.-Givet.)*. cosmop.——FIG. 559,*6*. **M. mucronatus* (CONRAD), Hamilton, USA(N.Y.); *6a,b,* ped.v., brach. v., ×1 (178).

Amoenospirifer HAVLÍČEK, 1957, p. 436 [**Spirifer thetidis* BARRANDE, 1848, p. 24; OD]. Moderately transverse; pedicle valve interior with dental plates reduced to teeth ridges; otherwise similar to *Brevispirifer*. *M.Dev.(Couvin.)*, Boh.——FIG. 559,*3*. **A. thetidis* (BARRANDE); *3a-d,* ped.v., brach.v., lat., ant., ×1.5 (411).

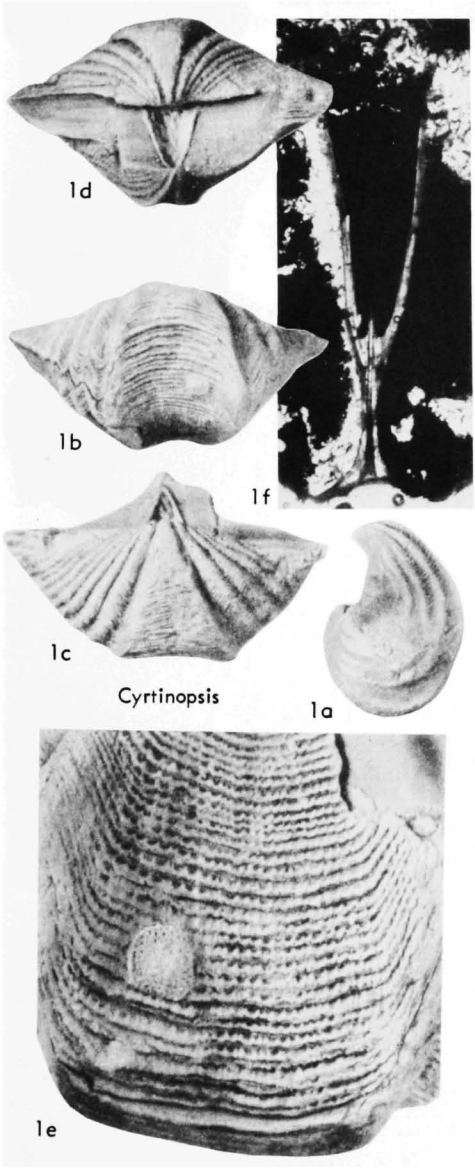


FIG. 558. Delthyrididae (Cyrtinopsinae) (p. *H685-H686*).

Brevispirifer COOPER, 1942, p. 231 [**Spirifer gregaria* CLAPP, 1857, p. 127; OD]. Length and width subequal; lateral plications few; fold and sulcus bald or with median ridge in sulcus and median groove on fold; otherwise similar to *Mucrospirifer*. *L. Dev.(Ems.)-M. Dev.(Couvin.)*, N.Am.——FIG. 559,*4*. **B. gregarius* (CLAPP), Onondaga, USA (N.Y).; *4a-c,* lat., brach.v., brach.v. int., ×1 (178).

Strophopleura STAINBROOK, 1947, p. 324 [**Spirifer notabilis* KINDLE, 1909, p. 26; OD]. Small, rather transverse; lateral plications numerous, unusually strong and almost perpendicular to hinge line near cardinal extremities; fold and sulcus strong, narrow, bald except for median ridge in sulcus and median groove on fold of some specimens; pedicle valve interior with teeth ridges, without median septum. *U.Dev.(Ouray Ls.)*, USA(Colo.-N.Mex.); *?Tournais.*, Australia.——FIG. 559,*1*. **S. notabilis* (KINDLE), U.Dev., Colo.; *1a,b,* post., brach.v., ×2 (469).

Tylothyris NORTH, 1920, p. 195 [**Cyrtia laminosa* M'COY, 1844, p. 137; OD] [=*Welleria* MAILLIEUX, 1931, p. 35 *(nom. nud.)* (*non* ULRICH & BASSLER, 1923; *nec* ROTAI, 1941); *?Bouchardopsis* MAILLIEUX, 1933, p. 80 (type, *Spirifer bouchardi* MURCHISON, 1840, p. 253) *(nom. nud.)*]. Rather transverse; lateral plications numerous, distinct; fold and sulcus bald or with median ridge in sulcus and median groove on fold; pedicle valve interior with distinct dental plates and well-developed median septum. [*Welleria* MAILLIEUX, 1931, is an unavailable name, for MAILLIEUX failed to designate a type-species. *Bouchardopsis* MAILLIEUX, 1933, was not accompanied by a statement of differentiating characters or by a bibliographic reference to such a statement and is therefore a *nom. nud.*]*?M.Dev.(Givet.)*, *U.Dev.(Frasn.)-L. Carb.(Visean)*, cosmop.——FIG. 559,*2*. **T. laminosa* (M'COY), Tournais., Br.I.; *2a,b,* ped.v., brach. v., ×1; *2c,* ped.v. int., ×1.5; *2d,* transv. sec., ?×1 (all 607).

Family FIMBRISPIRIFERIDAE Pitrat, n.fam.

Biconvex; weakly to moderately transverse; fold and sulcus distinct; entire surface covered with rather numerous anteriorly bifurcating costae; micro-ornament consisting of numerous concentric growth lamellae, each bearing fringe of minute spines; shell substance impunctate. *L.Dev.(Ems.)-M.Dev.(Givet.)*.

Fimbrispirifer Cooper, 1942, p. 231 [**Spirifer venustus* Hall, 1860, p. 82; OD]. Pedicle valve interior with strong dental plates; brachial valve interior with short crural plates. *L.Dev.(Ems.)-M.Dev.(Givet.)*, N.Am.——Fig. 559,*5*. **F. venustus* (Hall), M.Dev., USA(N.Y.); *5a*, micro-ornament, ×2; *5b*, brach.v., ×1 (178).

Family SPINOCYRTIIDAE Ivanova, 1959

[*nom. transl.* Pitrat, herein (*ex* Spinocyrtiinae Struve, 1963, *nom. correct. pro* Spinocyrtinae Ivanova, 1959, p. 59)] [=Guerichellinae Paeckelmann, 1931, p. 24 *(partim)*]

Biconvex, moderately to strongly transverse; lateral slopes generally with numer-

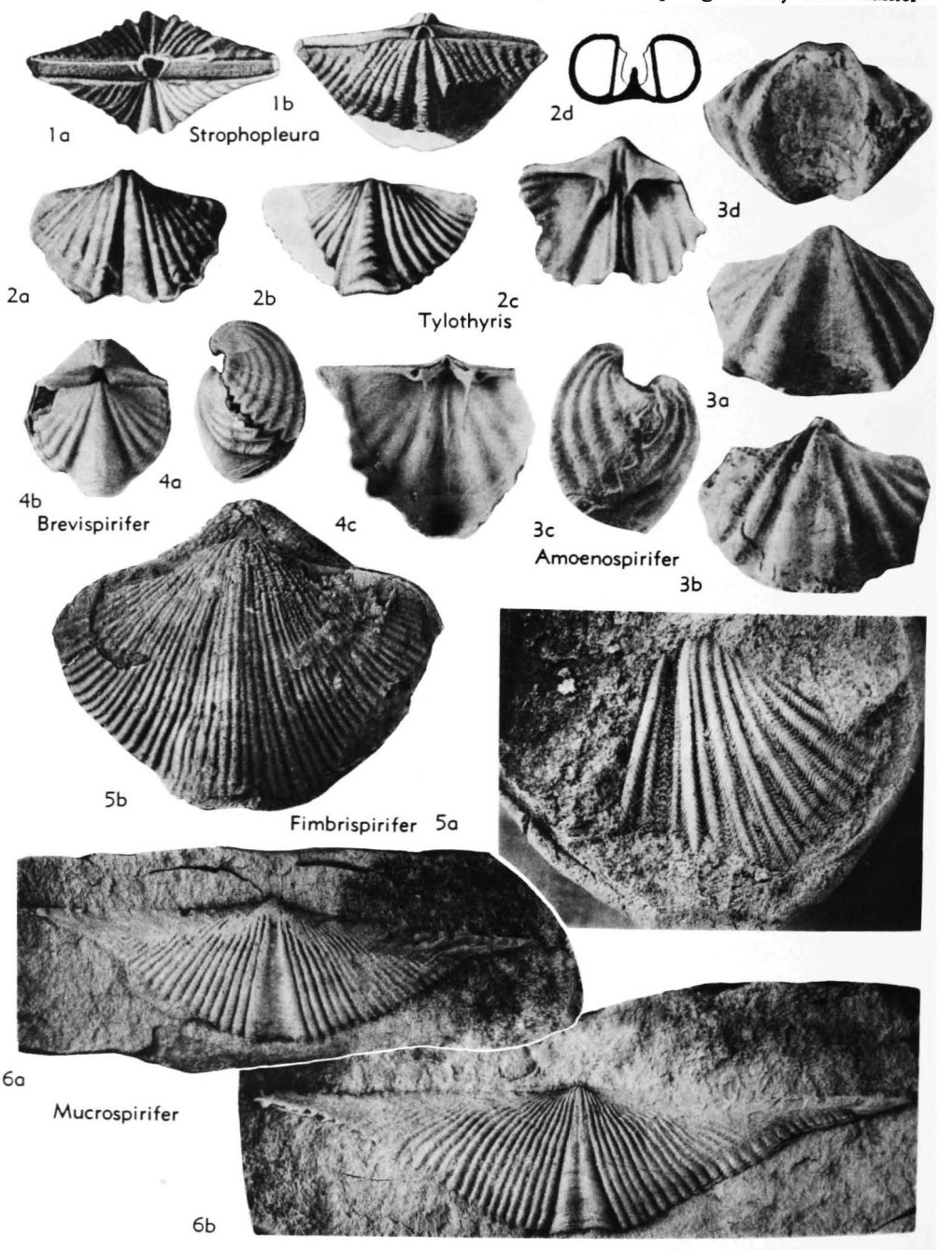


Fig. 559. Mucrospiriferidae *(1-4,6)*; Fimbrispiriferidae *(5)* (p. *H686-H688*).

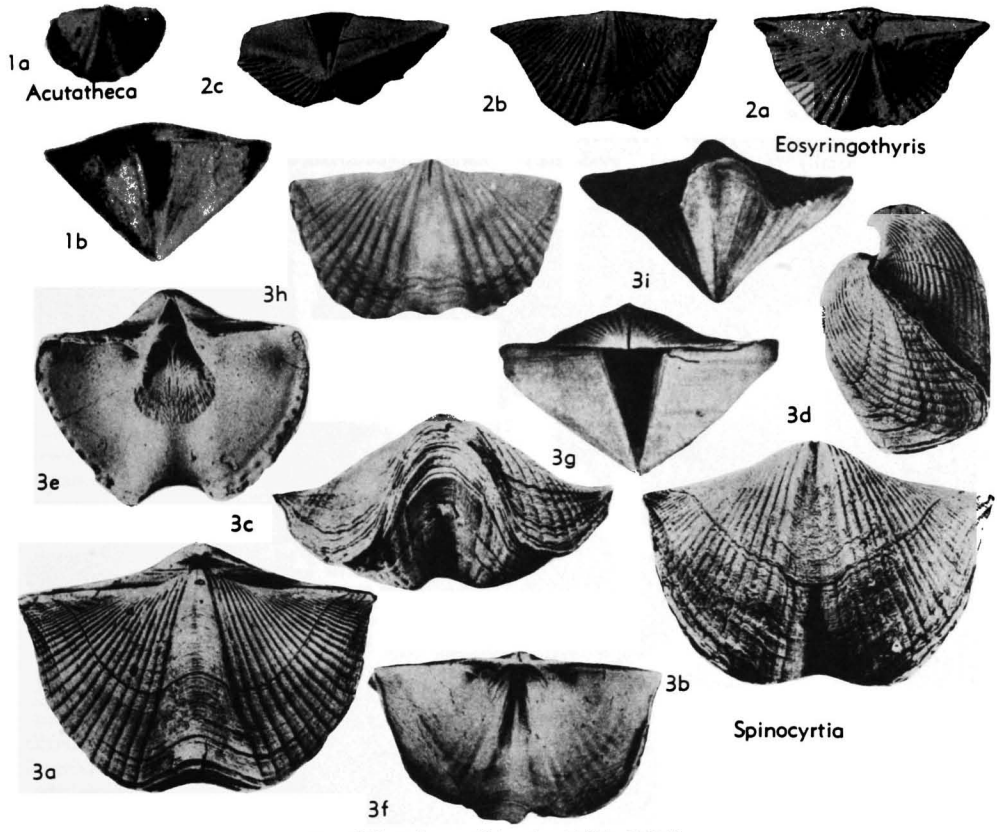


FIG. 560. Spinocyrtiidae (p. *H*689, *H*691).

ous distinct nonbifurcating plications; fold and sulcus commonly bald, but rarely with incipient plication; micro-ornament variable; interior of pedicle valve wtih distinct dental plates and delthyrial plate, without median septum; brachial valve interior lacking crural plates; shell substance impunctate. *L.Dev.(Ems.)-U.Dev.(Frasn.).*

Guerichellinae is invalid by virtue of failure to satisfy provisions of the Zoological Code (Art. 11e) which states that a family-group name "must, when first published, be based on the name then valid for a contained genus. . . ." The genus *Guerichella* PAECKELMANN, 1931, is, and has always been, a junior objective synonym of *Adolfia* GÜRICH, 1909.

Spinocyrtia FREDERIKS, 1916, p. 18 [**Delthyris granulosa* CONRAD, 1839, p. 65; SD FREDERIKS, 1926, p. 411] [=*?Platyrachella* FENTON & FENTON, 1924, p. 158 (type, *Spirifera macbridei* CALVIN, 1883, p. 433)]. Generally large, transverse; lateral plications numerous; fold and sulcus bald; micro-ornament consisting of rather weak concentric growth lamellae and stronger capillae from summits of which rise minute teardrop-shaped granules; interarea of pedicle valve consisting of central area bearing horizontal and vertical striae, and marginal areas with horizontal striae only. *M. Dev. (Couvin.)-U. Dev. (Frasn.),* cosmop.——FIG. 560,*3a-f*; 561,*4*. **S. granulosa* (CONRAD), M.Dev.(Hamilton), USA(N.Y.); 560, *3a-f,* brach.v., ped.v., ant., lat., ped.v. int., brach. v. int., ×0.7; 561,*4,* ornament, ×5 (272).——FIG. 560,*3g-i*. *S. macbridei* (CALVIN), U.Dev., USA(Iowa); *3g-i,* post., brach.v., ant., ×1 (296).

?Acutatheca STAINBROOK, 1945, p. 55 [**A. propria*; OD]. Small; moderately transverse; pedicle valve hemipyramidal with high interarea ornamented as in *Spinocyrtia,* and narrow delthyrium closed apically by delthyrial cover; lateral slopes with several low, rounded plications; fold and sulcus distinct, bald; micro-ornament consisting of concentric growth lamellae and capillae; pedicle valve interior with short, divergent dental plates, seemingly lacking delthyrial plate. *U.Dev.,* N. Am.——FIG. 560,*1*. **A. propria,* USA(Iowa); *1a,* ped.v., ×1.5; *1b,* post., ×3 (768).

Adolfia GÜRICH, 1909, p. 136 [**Spirifer deflexus* ROEMER, 1843, p. 13; SD SCHUCHERT & LEVENE, 1929, p. 27] [=*Guerichella* PAECKELMANN, 1913, p. 299 (obj.); *Gürichia* WEDEKIND in SALOMON, 1926, p. 198 *(nom. null.)*; *?Plectospirifer* GRABAU, 1931, p. 379 (type, *Spirifer (Plectospirifer) heimi*)]. Generally medium-sized, moderately transverse; lateral plications fairly numerous; fold and sulcus bald or with incipient plication; microornament as in *Spinocyrtia* except for fanlike divergence of radial striae in some. *L.Dev.(Ems.)-U.Dev.(Frasn.)*, N.Am.-Eu.-Asia.——FIG. 561,*1*. **A. deflexa* (ROEMER), Frasn., Ger.; *1a-d*, ped.v., brach.v., post., lat., ×1 (831).

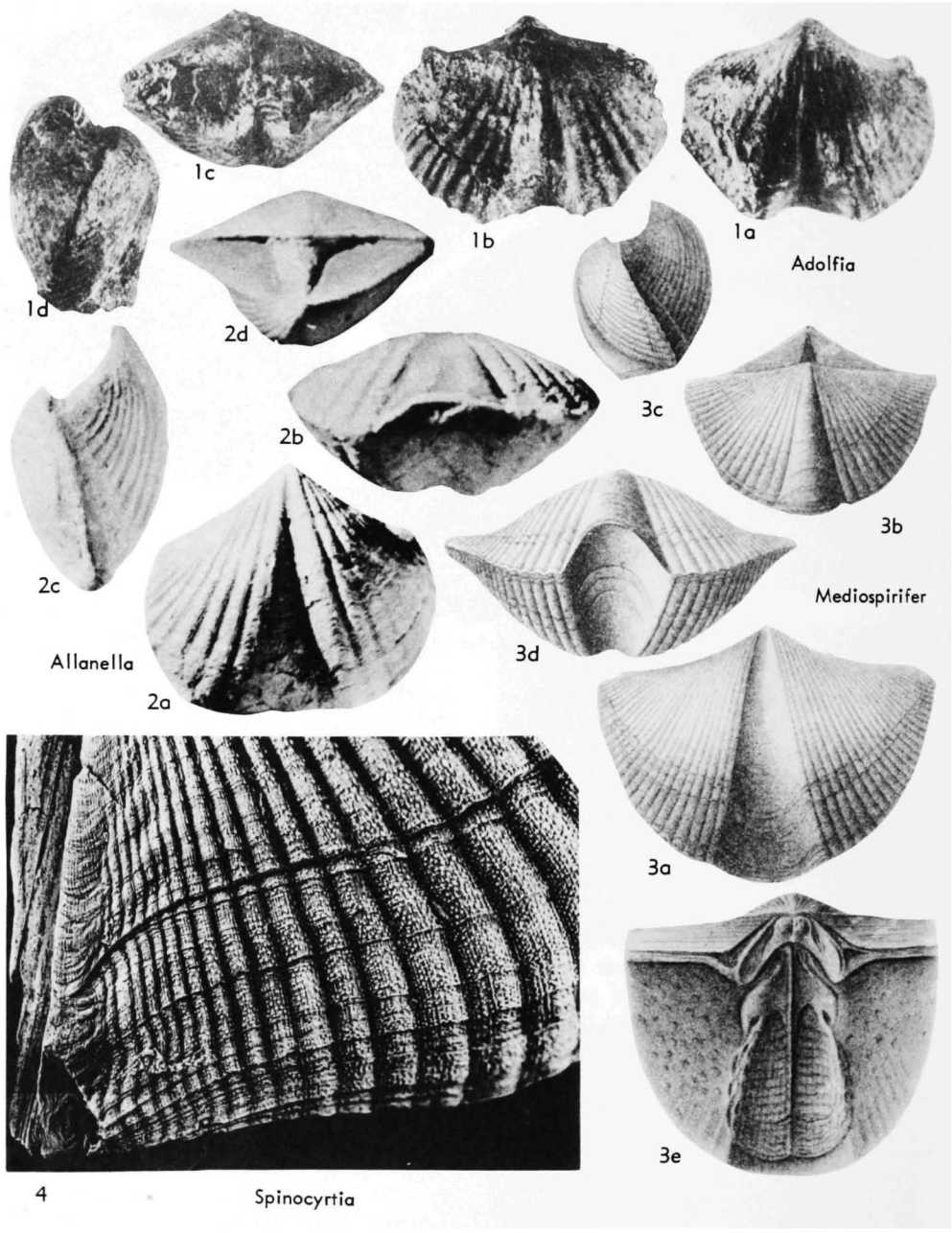


FIG. 561. Spinocyrtiidae (p. *H689-H691*).

[In erecting the genus *Adolfia*, GÜRICH included the species *A. deflexa* and *A. bifida*, but did not choose a type. PAECKELMANN (1913) proposed *Guerichella* expressly as a replacement for *Adolfia* which he erroneously believed to be a junior homonym; again no type was designated. FREDERIKS (1926) accepted the name *Guerichella* and stated the type to be *G. angustistellata*, an action which is invalid because *G. angustistellata* was not mentioned in GÜRICH's original description of *Adolfia*. SCHUCHERT & LEVENE (1929) listed both genera, indicated their synonymy, but then, unaccountably, stated that the type of *Adolfia* is *A. deflexa* and that of *Guerichella* is *G. angustistellata*. Despite the ambiguity of their entries, SCHUCHERT & LEVENE were the first to designate a legally eligible type-species for *Adolfia*, *A. deflexa*, and that species must also be regarded as the type of *Guerichella*.]

Alatiformia (*see* p. *H*903).

Allanella CRICKMAY, 1953, p. 5 [**Spirifer allani* WARREN, 1944, p. 123; OD] [=*Allanaria* CRICKMAY, 1953 (obj.)]. Rather small, weakly transverse; lateral plications fairly numerous; fold and sulcus bald; micro-ornament of concentric growth lamellae and capillae. *M.Dev.(Givet.)*, W.Can. ——FIG. 561,*2*. **A. allani* (WARREN); *2a-d*, ped. v., ant., lat., post., ×2 (206).

[In the text of CRICKMAY's article (1953, p. 5) the genus *Allanella* was erected. To the flyleaf of the publication is affixed a section entitled "Addendum" in which CRICKMAY pointed out the existence of the genus *Alanella* BOUČEK, 1936, which he erroneously believed invalidated his use of *Allanella*. In this same section CRICKMAY proposed substitution of *Allanaria* for *Allanella*. According to the Rules (Art. 24) choice of one of two or more names simultaneously published for the same taxon is to be made by the first reviser. To the present time there has not been a "first reviser" in the meaning of the Rules (Art. 24,a,i). Therefore, as such first reviser, I now choose the name *Allanella*, relegating *Allanaria* to the status of a junior objective synonym.]

Chimaerothyris (*see* p. *H*903).

Eosyringothyris STAINBROOK, 1943, p. 431 [**Spirifera aspera* HALL, 1858, p. 508; OD]. Pedicle valve hemipyramidal with very high interarea; delthyrial plate terminating anterodorsally in short spine; otherwise similar to *Spinocyrtia*. *M.Dev.*, N.Am.——FIG. 560,*2*. **E. aspera* (HALL), Cedar Valley Ls., USA(Iowa); *2a-c*, ped.v., brach.v., post., ×1 (767).

Mediospirifer BUBLICHENKO, 1956, p. 102 [**Delthyris medialis* HALL, 1843, p. 208 (=**Delthyris audacula* CONRAD, 1842, p. 262); OD]. Micro-ornament of widely spaced growth lamellae only; otherwise similar to *Spinocyrtia*. *M.Dev.(Hamilton)*, USA(N.Y.).——FIG. 561,*3*. **M. audacula* (CONRAD); *3a-d*, ped.v., brach.v., lat., ant., ×1; *3e*, brach.v. int., ×2 (396).

Family SYRINGOTHYRIDIDAE Frederiks, 1926

[*nom. correct* PITRAT, herein (*pro* Syringothyridae FREDERIKS, 1926 (*nom. imperf.*) *nom. transl.* IVANOVA, 1959, p. 55, *ex* Syringothyrinae FREDERIKS, 1926, p. 411)]

Typically biconvex, large, transverse, with high interarea on pedicle valve; lateral slopes with numerous nonbifurcating plications; fold and sulcus commonly bald, rarely with weak plication; micro-ornament variable; interior of pedicle valve generally with well-developed dental plates and delthyrial plate, in some with syrinx; shell substance

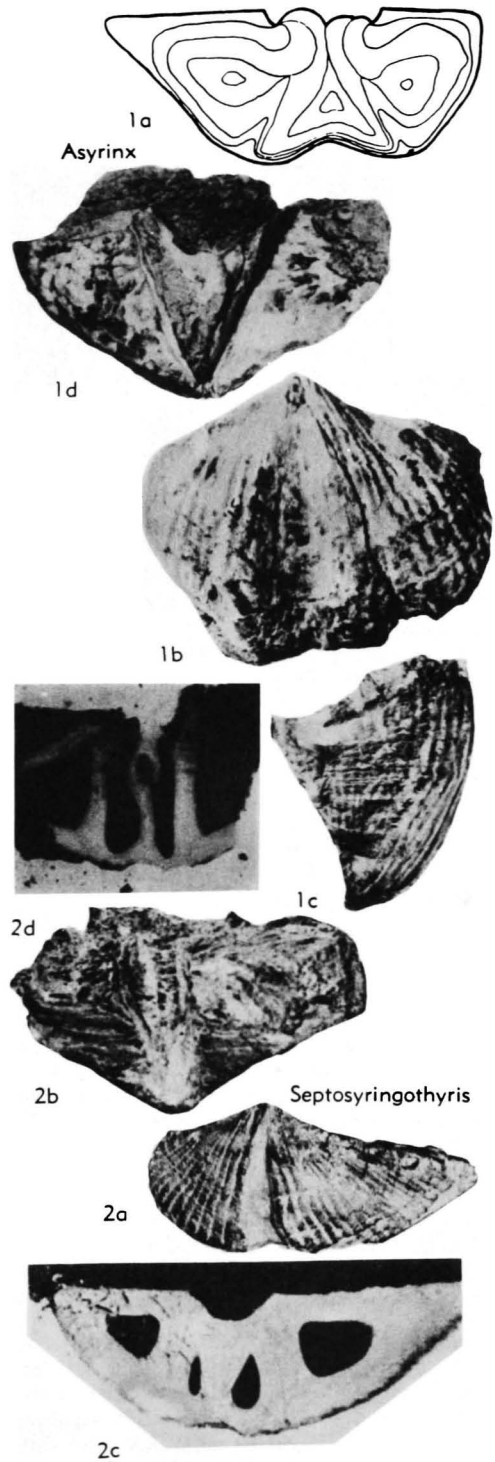


FIG. 562. Syringothyrididae (Syringothyridinae) (p. *H*692).

punctate in earlier forms, becoming impunctate in later ones. *U.Dev.-U.Perm.*

Subfamily SYRINGOTHYRIDINAE Frederiks, 1926

[*nom. correct.* PITRAT, herein (*pro* Syringothyrinae FREDERIKS, 1926, p. 411)]

Generally rather large, transverse; interarea of pedicle valve commonly high, consisting of central area with horizontal and vertical markings, and marginal areas with horizontal markings only; lateral slopes with numerous nonbifurcating plications; fold and sulcus distinct, generally bald; micro-ornament somewhat variable, typically consisting of a textile-like pattern of intersecting capillae and concentric growth lamellae, in some complicated by pustules; pedicle valve interior generally with well-developed dental plates; delthyrial plate commonly present, in some bearing syrinx on its dorsal surface; shell substance normally punctate. *U.Dev.-Perm.*

Syringothyris WINCHELL, 1863, p. 6 [**S. typa* (=**Spirifer carteri* HALL, 1857, p. 170); SD ICZN Opinion 100, 1928, p. 377] [=*Syringopleura* SCHUCHERT, 1910 (type, *Spirifer randalli* SIMPSON, 1890, p. 441); *Prosyringothyris* FREDERIKS, 1916, p. 51 (type, *P. northi*); *Protosyringothyris* FREDERIKS, 1918, p. 88 *(nom. null.)*]. Fold and sulcus bald; micro-ornament of minute pustules; pedicle valve interior with long dental plates, delthyrial plate and syrinx, lacking median septum. *U.Dev.(Famenn.)-Miss.*, cosmop.——FIG. 563,*1a,b*. **S. carteri* (HALL), Burlington Ls., USA (Iowa); *1a,b*, post., ant., ×0.7 (858).——FIG. 563,*1c-f*. *S. texta* (HALL), Keokuk F., USA(Ind.); *1c-f*, ped. v. int., brach.v., ped.v. int. mold, transv. sec., ×0.7 (396).

Asyrinx HUDSON & SUDBURY, 1959, p. 46 [**A. haushensis*; OD]. Pedicle valve interior with dental plates reduced to teeth ridges, lacking delthyrial plate and syrinx; delthyrial cavity with thick callus deposits simulating dental plates. *L. Perm.*, Arabia.——FIG. 562,*1*. **A. haushensis*; *1a*, transv. sec., ×1; *1b-d*, ped.v., lat., post., ×0.7 (438).

Asyrinxia CAMPBELL, 1957, p. 80 [**Spirifera lata* M'COY, 1847, p. 223; OD]. Sulcus with several very weak plications; interior of pedicle valve with neither delthyrial plate nor syrinx; otherwise similar to *Syringothyris*. *L.Carb.(U.Tournais.)*, Australia(New S. Wales)-?Japan. —— FIG. 563,*3*. **A. lata* (M'COY), Australia; *3a-c*, ped.v. int. mold, ped.v. interarea, brach.v. post., ×1 (140).

?Plicatosyrinx MINATO, 1952, p. 168 [**P. singulare*; OD]. Fold and sulcus plicate; pedicle valve with syrinx, lacking dental plates and median septum; shell substance impunctate. [The genus is based on a single specimen which is so badly deformed that the cardinal extremities have been shoved against the beak. Morphology as well as systematic position are in doubt.] *L.Carb.*, Japan.

Pseudosyringothyris FREDERIKS, 1916, p. 51 [**P. karpinskii*; OD]. Pedicle valve interior with syrinx incompletely developed, consisting of pair of longitudinally directed parallel thickenings on underside of delthyrial plate; otherwise similar to *Syringothyris*. *L.Perm.*, USSR.——FIG. 563,*2*. **P. karpinskii*; *2a*, ped.v. post., ×0.7; *2b*, transv. sec., ×2 (314).

Pseudosyrinx WELLER, 1914, p. 404 [**P. missouriensis*; OD]. Pedicle valve interior lacking syrinx; otherwise similar to *Syringothyris*. *Miss.*, cosmop.; *?Perm.*, Arabia.——FIG. 563,*4*. **P. missouriensis*, L.Miss.(Burlington Ls.), USA(Mo.); *4a,b*, ant., post., ×1 (858). [*?=Verkhotomia* SOKOLSKAYA, 1963, p. 280 (type, *V. plenoides*).]

Septosyringothyris VANDERCAMMEN, 1955, p. 2 [**S. demaneti*; OD]. Pedicle valve with conspicuous median septum; otherwise similar to *Syringothyris*. *L.Carb.*, Eu.-S.Am.——FIG. 562,*2*. **S. demaneti*, Belg.; *2a*, ped.v., ×1; *2b*, ped.v. int., ×3; *2c,d*, transv. secs., ×5 (828).

Subfamily LICHAREWIINAE Slusareva, 1958

[Licharewiinae SLUSAREVA, 1958, p. 582]

Biconvex, generally large, transverse, with high interarea; lateral slopes with numerous, distinct, nonbifurcating plications; fold and sulcus generally bald, rarely with weak plication; micro-ornament of concentric growth lamellae with or without capillae; interior of pedicle valve generally with dental plates and delthyrial plate, lacking syrinx; shell substance impunctate. *U. Carb.-U.Perm.*

Some members of this group are morphologically indistinguishable from some of the Spinocyrtiidae. They are excluded from the Spinocyrtiidae because of the long hiatus between disappearance of this family in the late Devonian and appearance of similar Licharewiinae in the Late Carboniferous. It is considered likely that the Licharewiinae were derived from the Syringothyridinae, being merely heterochronous homeomorphs of the Spinocyrtiidae, but it must be admitted that future work may reveal a direct connection between Spinocyrtiidae and Licharewiinae, in which case the two groups would have to be merged.

Licharewia EINOR, 1939, p. 69 [**Spirifer stuckenbergi* NETSCHAJEW, 1900, p. 18; OD] [=*Permospirifer* KULIKOV, 1950, p. 5 (type, *Spirifer keyserlingi* NETSCHAJEW, 1911, p. 84); *Rugulatia* SOKOLSKAYA, 1952, p. 187 (type, *Spirifer rugula-*

tus KUTORGA, 1842, p. 22)]. Fold and sulcus generally bald, but rarely with several weak costae; micro-ornament largely concentric, but rarely with weak capillae; interior of pedicle valve with strong, thick, anteriorly diverging dental plates and delthyrial plate, lacking median septum. *U.Perm.*, USSR.——FIG. 565,*4*. **L. stuckenbergi* (NETSCHAJEW); *4a,b*, ped.v., brach.v., ×1 (448).——FIG. 564,*2a,b*. *L. keyserlingi* (NETSCHAJEW), *2a,b*, ped.v., brach.v., ×1 (598).——

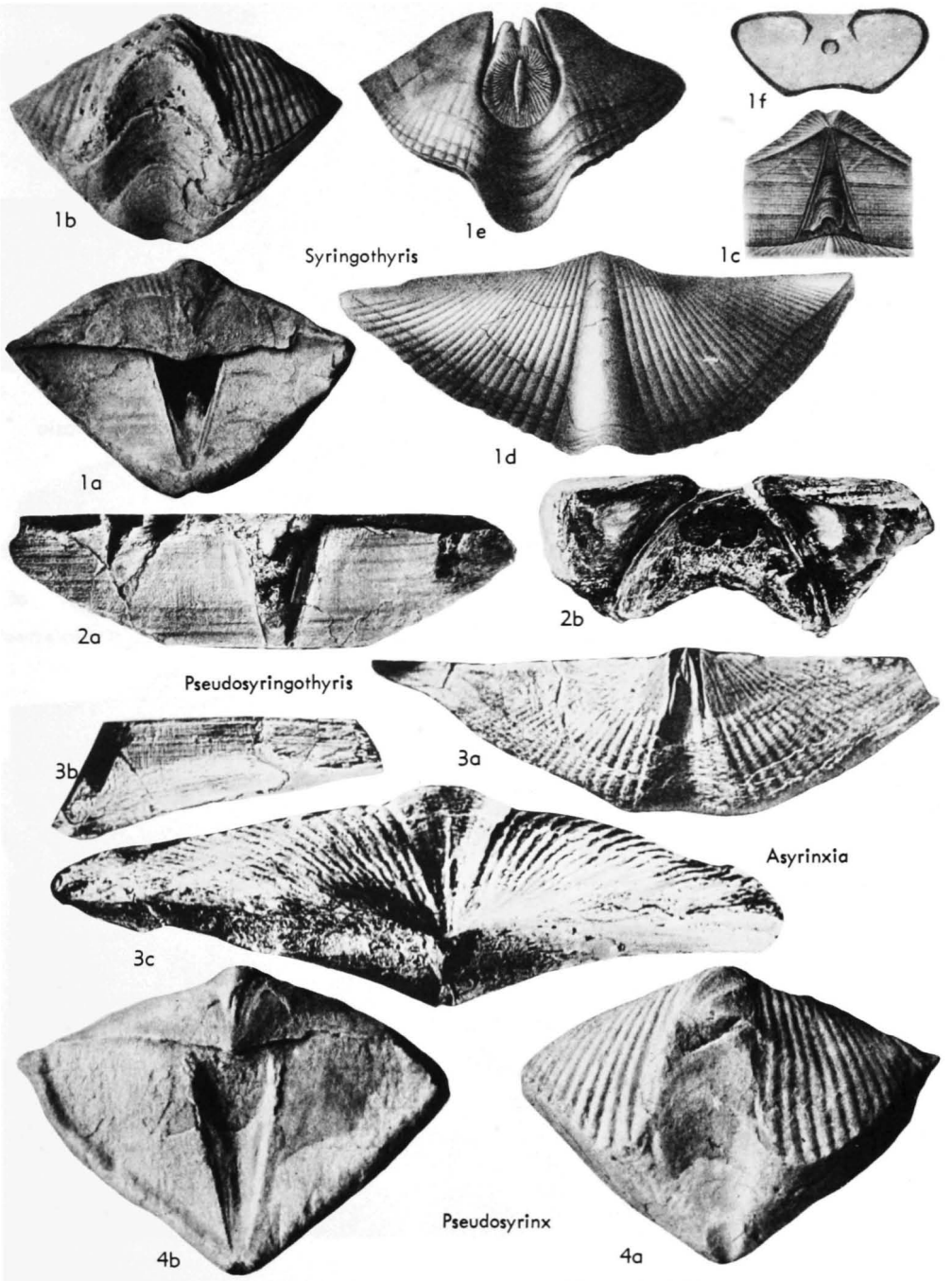


FIG. 563. Syringothyrididae (Syringothyridinae) (p. *H692*).

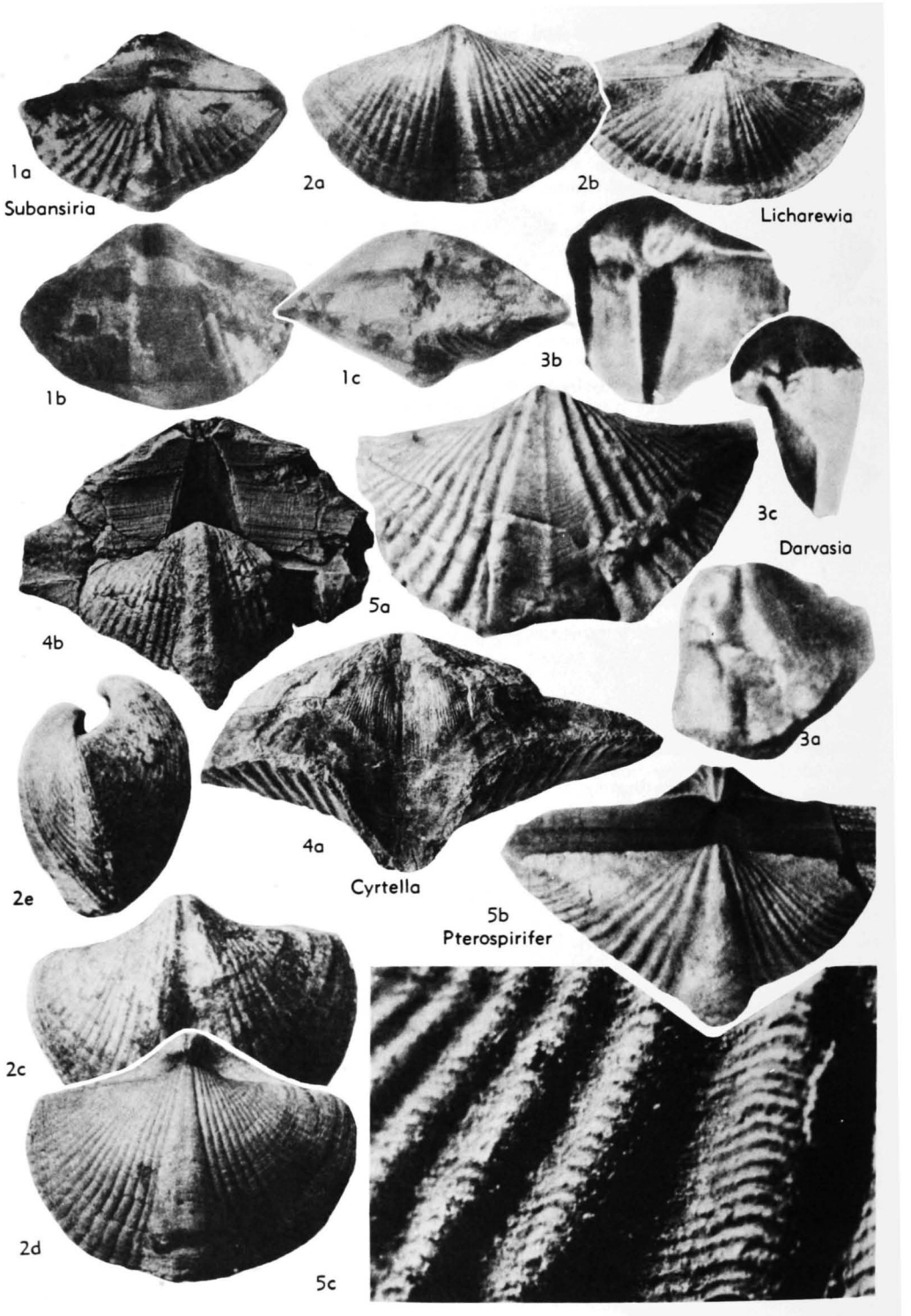


FIG. 564. Syringothyrididae (Licharewiinae) (p. *H*692-*H*693, *H*696).

FIG. 564,*2c-e*. *L. rugulatus* (KUTORGA); *2c-e*, ped. v., brach.v., lat., ×1 (598).

?Alispirifer CAMPBELL, 1961, p. 434 [**A. laminosus*; OD]. Highly transverse; hinge line denticulate; lateral slopes with distinct rounded plications; fold and sulcus well developed, bald except for median plication in sulcus of some; microornament consisting of concentric growth lamellae and unusually distinct capillae; pedicle valve interior with dental plates almost obscured with callus; median septum lacking; presence of delthyrial plate not established. *U.Carb.*, Australia-

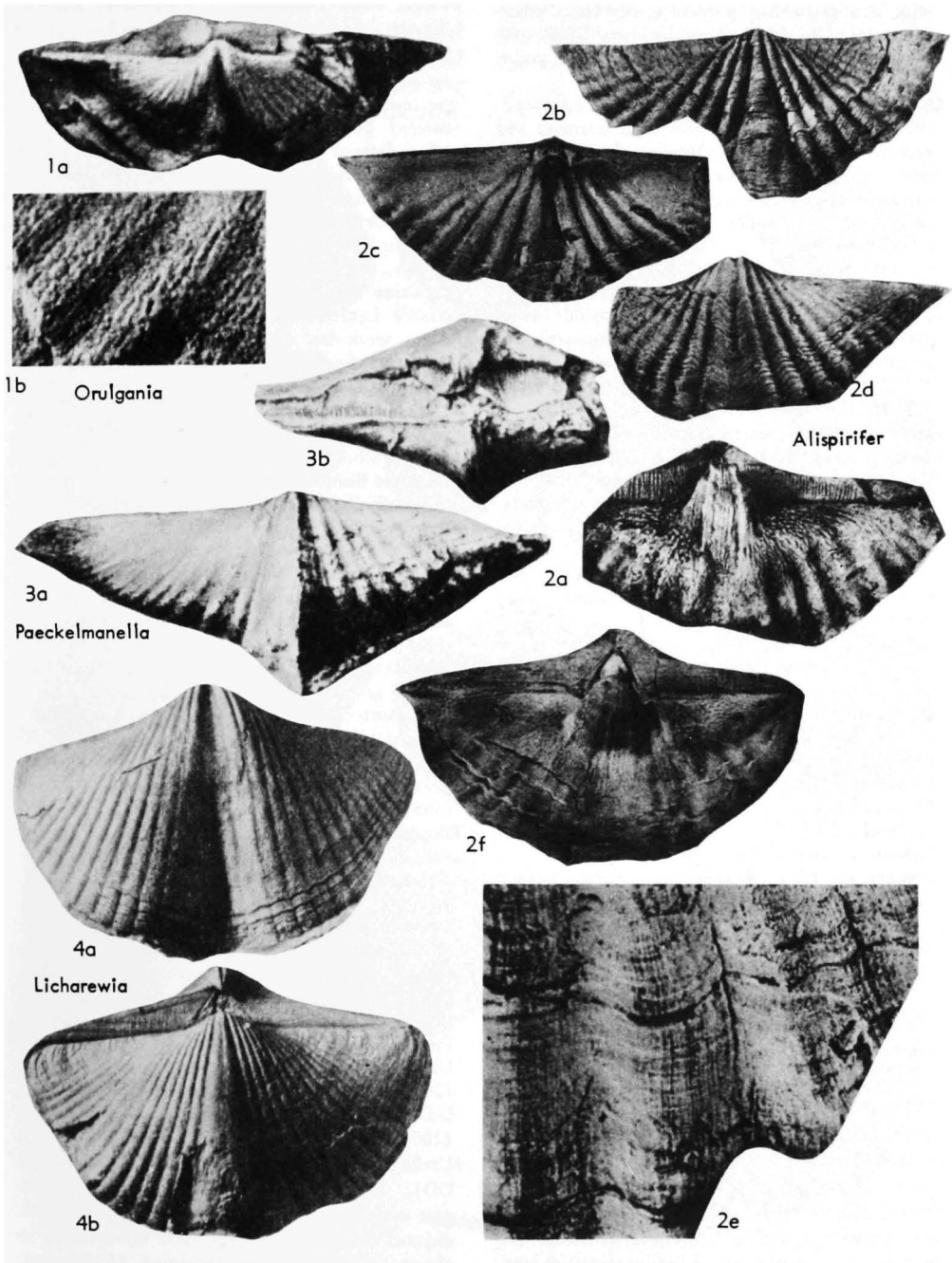


FIG. 565. Syringothyrididae (Licharewiinae) (p. *H*692-*H*693, *H*695-*H*696).

Arg.——FIG. 565,*2*. **A. laminosus*, New S. Wales; *2a-d,f*, ped.v. int. mold, brach.v., brach.v. int., ped.v., ped.v. int., ×1; *2e*, micro-ornament, ×7 (143).

Cyrtella FREDERIKS, 1919 (1924), p. 312 [**Cyrtia kulikiana* FREDERIKS, 1916, p. 43; OD]. Fold with narrow median groove; sulcus bald; otherwise similar to *Licharewia*. *L.Perm.*, USSR.——FIG. 564,*4*. **C. kulikiana* (FREDERIKS); *4a,b*, ped.v. ant., brach.v. post., ×0.7 (314).

Darvasia LIKHAREV, 1934, p. 212 [**D. edelsteini*; OD]. Pedicle valve with very high interarea and narrow, open delthyrium; interior of pedicle valve with well-developed dental plates connected near valve floor by delthyrial plate; median septum present, almost reaching delthyrial plate. *L.Perm.*, E.USSR.——FIG. 564,*3*. **D. edelsteini*; *3a-c*, ped. v., post., lat., ×1.5 (448).

Orulgania SOLOMINA & CHERNYAK, 1961, p. 61 [**O. naumovi*; OD]. Fold and sulcus bald; dental plates thin, very long, tending to converge anteriorly; otherwise similar to *Licharewia*. *U.Carb.*, N.USSR.——FIG. 565,*1*. **O. naumovi*; *1a*, ped.v., ×1; *1b*, ornament, ×10 (759).

Paeckelmanella LIKHAREV, 1934, p. 212 [**Spirifer dieneri* CHERNYSHEV, 1902, p. 535; OD]. Highly transverse, with moderately high interarea; fold bald, carinate; sulcus with weak median costa; pedicle valve interior with well-developed dental plates and delthyrial plate and long, high median septum; hinge line denticulate. *L.Perm.*, USSR. ——FIG. 565,*3*. **P. dieneri*; *3a,b*, brach.v., post., ×1 (448).

Pterospirifer DUNBAR, 1955, p. 128 [**Spirifer alatus* VON SCHLOTHEIM, 1813, p. 58; OD]. Fold bald; sulcus with weak median costa; lateral plications prominent; micro-ornament of very conspicuous growth lamellae and obscure capillae; delthyrial plate weak or absent; otherwise similar to *Licharewia*. *U.Perm.*, Eu.-Greenl.——FIG. 564,*5*. **P. alatus* (VON SCHLOTHEIM), Greenl.; *5a,b*, ped. v., brach.v., ×1.5; *5c*, ornament, ×7.5 (269).

?**Subansiria** SAHNI & SRIVASTAVA, 1956, p. 212 [**S. ranganensis*; OD]. Pedicle valve interior lacking delthyrial plate; otherwise similar to *Licharewia*. *?U.Carb.*, India.——FIG. 564,*1*. **S. ranganensis*; *1a-c*, brach.v., ped.v., post., ×0.7 (701).

Family COSTISPIRIFERIDAE Termier & Termier, 1949

[*nom. transl.* PITRAT, herein (*ex* Costispiriferinae TERMIER & TERMIER, 1949, p. 98)] [=Theodossiinae IVANOVA, 1959, p. 61 *(partim)*]

Biconvex, weakly to moderately transverse; lateral slopes with moderately to very numerous simple costae; fold and sulcus generally indistinct, poorly delineated from lateral slopes, provided with costae which are indistinguishable from lateral costae except for tendency toward bifurcation; micro-ornament of distinct capillae and weak growth lamellae in some; pedicle valve interior with dental plates, lacking delthyrial plate and median septum; brachial valve interior with longitudinally striated area of diductor attachment, with or without crural plates; shell substance impunctate. *L.Dev. (Siegen.)-U.Dev.(Frasn.), ?L.Carb.*

Costispirifer COOPER, 1942, p. 232 [**Spirifer arenosus planicostatus* SWARTZ, 1929, p. 56; OD]. Costae moderately numerous, flat-topped; delthyrium covered by short, flat pseudodeltidium; pedicle valve interior with short, thick dental plates, and dense callus deposits in delthyrial and umbonal cavities; brachial valve lacking crural plates. *L.Dev.(Oriskany)*, N.Am. —— FIG. 566,*3*. *C. arenosus* (CONRAD), USA(Pa.); *3a,b*, ped.v., brach.v., ×1 (178).

?**Eudoxina** FREDERIKS, 1929, p. 382 [**Spirifer medius* LEBEDEV, 1912, p. 18; OD]. Fold and sulcus weak but distinct; entire shell with very numerous, fine costae; pedicle valve interior with dental plates reduced to teeth ridges, lacking median septum; brachial valve interior unknown. *L.Carb.*, USSR.——FIG. 566,*4*. **E. media* (LEBEDEV); brach.v., ×1.5 (448).

Lazutkinia RZHONSNITSKAYA, 1951, p. 151 [**Spirifer (Yavorskiella) mamontoviensis* LAZUTKIN in YAVORSKY, 1940, p. 44; OD] [=*Yavorskiella* LAZUTKIN in YAVORSKY, 1940, p. 44 *(nom. nud.)*]. Strongly biconvex with prominent, curved beak on pedicle valve; hinge line very short; fold and sulcus poorly defined, narrow; entire shell provided with rather numerous costae; micro-ornament consisting of both capillae and concentric growth lamellae; pedicle valve interior with short dental plates, lacking median septum; brachial valve interior with distinct septalium. *M. Dev.*, USSR.——FIG. 566,*1*. **L. mamontoviensis* (LAZUTKIN); *1a-d*, ant., brach.v., ped.v., lat., ×1 (465).

Theodossia NALIVKIN, 1925, p. 267 [**Spirifer anossofi* DE VERNEUIL, 1845, p. 153; OD] [=*Vandergrachtella* CRICKMAY, 1953, p. 7 (type, *V. arcuum*)]. Costae very numerous, rounded; delthyrium open; pedicle valve interior generally with thin, anteriorly diverging dental plates. *M.Dev. (Givet.)*, USSR; *U.Dev.*, cosmop.——FIG. 566, *2a,b*. **T. anossofi* (DE VERNEUIL), U.Dev., W. USSR; *2a,b*, ped.v., brach.v., ×1.5 (448).—— FIG. 566,*2c-f*. *T. hungerfordi* (HALL), U.Dev., USA(Iowa); *2c-f*, post., lat., brach.v., ped.v., ×1 (296).——FIG. 566,*2g-i*. *T. arcuum* (CRICKMAY), U.Dev., W.Can.; *2g-i*, brach.v., ped.v., lat., ×1 (206).

?**Urella** RZHONSNITSKAYA, 1960, p. 402 [**U. asiatica*; OD]. Medium-sized; equidimensional or elongate oval; hinge line very short; delthyrium with disjunct deltidial plates; fold and sulcus weak to absent; macro-ornament consisting of rounded, simple or branching costae; micro-ornament com-

prising capillae only; pedicle valve interior with long, thin dental plates. *M.Dev.*, USSR.

Family CYRTOSPIRIFERIDAE Termier & Termier, 1949

[*nom. transl.* Besnossova, 1958 (*ex* Cyrtospiriferinae Termier & Termier, 1949, p. 99)]

Biconvex, generally transverse; lateral slopes commonly with numerous simple costae, more rarely with fewer or bifurcating costae; fold and sulcus generally distinct, with bifurcating costae; micro-ornament commonly consisting of distinct capillae and concentric growth lamellae, some with pustules; pedicle valve interior with dental plates and delthyrial plate, lacking median septum; shell substance impunctate. *?M. Dev., U.Dev.(Frasn.)-L.Carb.(Visean).*

Cyrtospirifer Nalivkin in Frederiks, 1919 (1924), p. 312 [**Spirifer verneuili* Murchison, 1840, p. 252; OD] [=*Sinospirifer* Grabau, 1931, p. 241

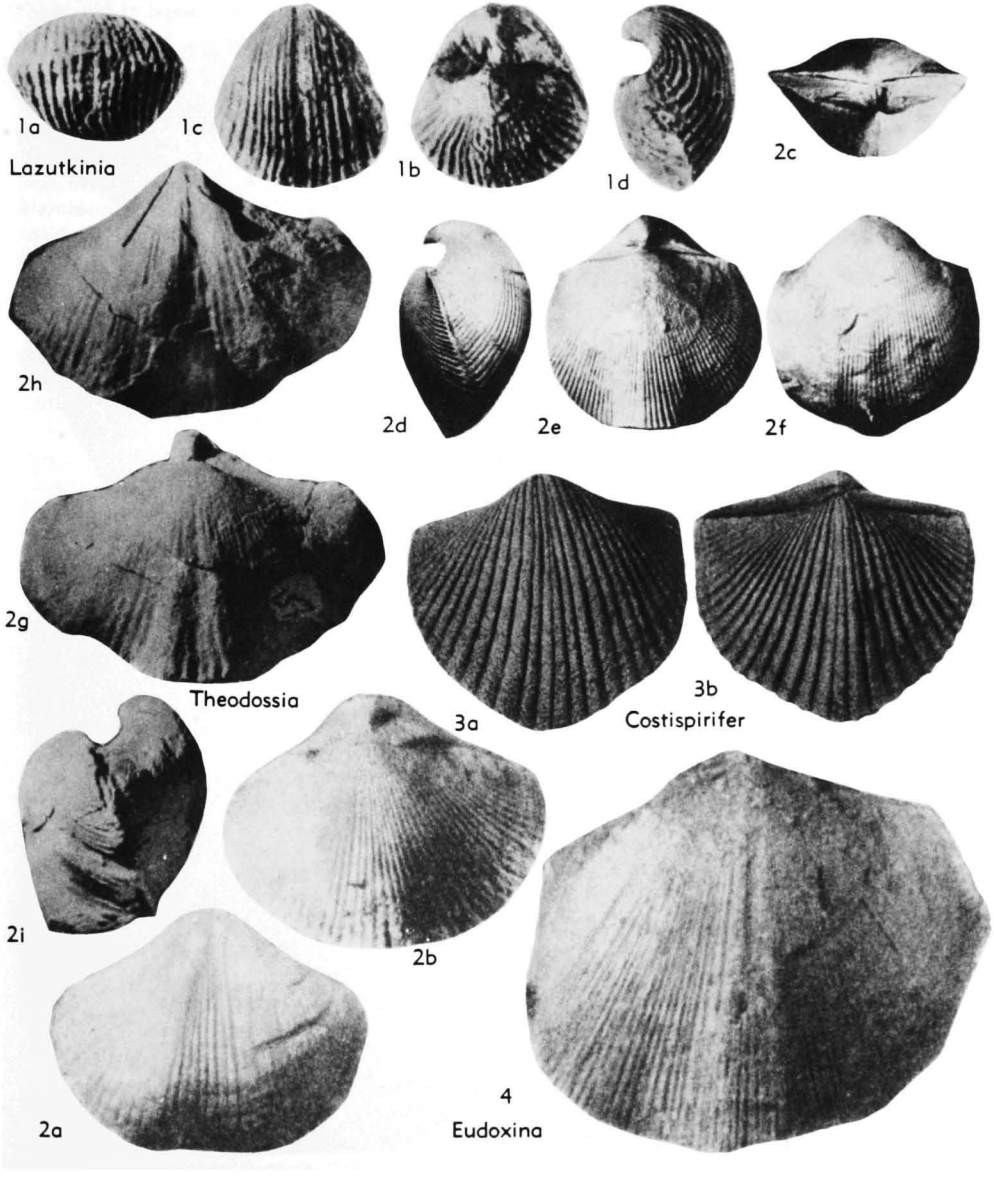


Fig. 566. Costispiriferidae (p. *H*696).

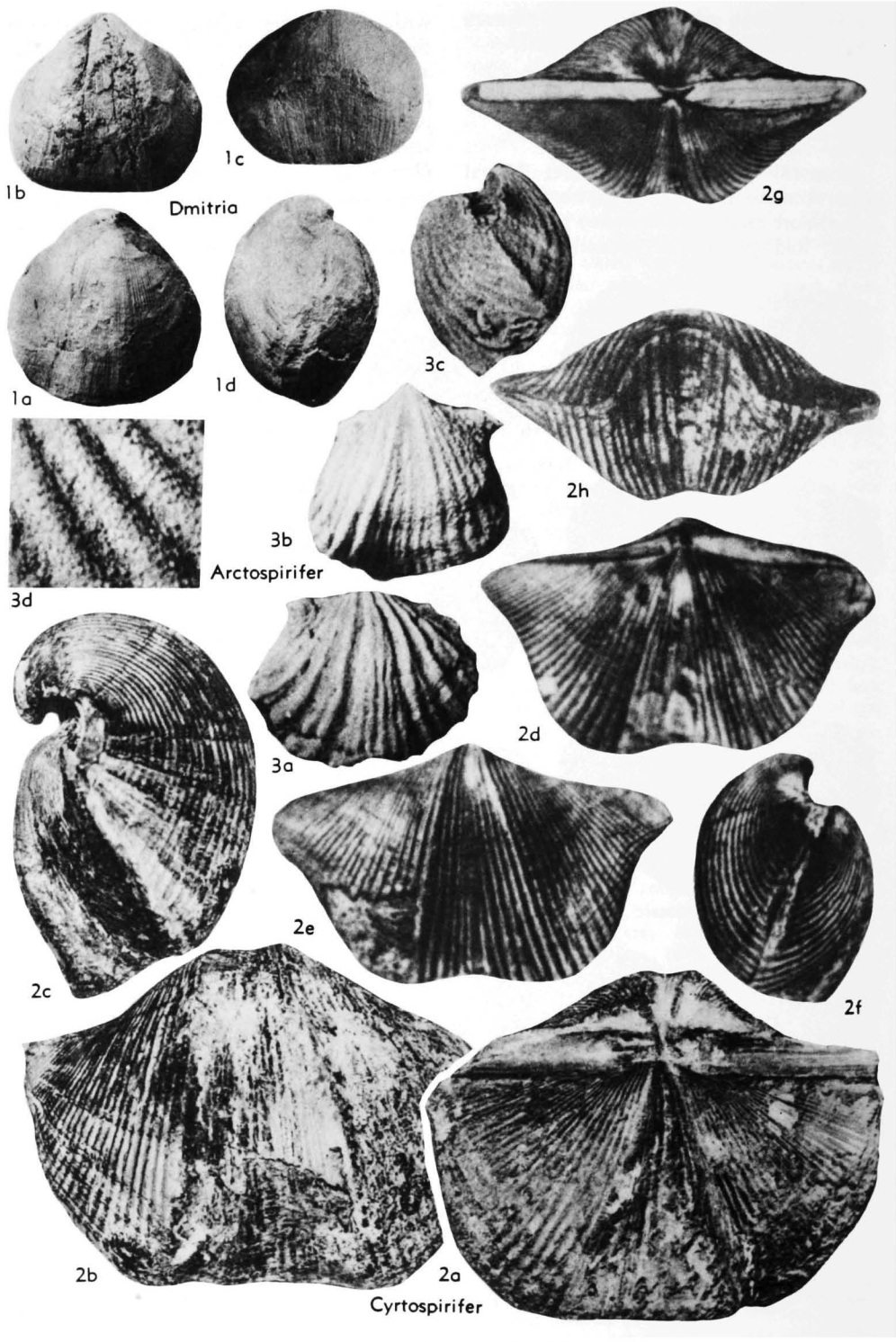


FIG. 567. Cyrtospiriferidae (p. *H*697, *H*699-*H*700).

(type, *Spirifer (Sinospirifer) sinensis* GRABAU, 1931, =*Spirifer chinensis* GRABAU, 1923); *Centrospirifer* TIEN, 1938, p. 111 (type, *Spirifer (Sinospirifer) chaoi* GRABAU, 1931); *Hunanospirifer* TIEN, 1938 (type, *Spirifer (Hunanospirifer) wangi* TIEN, 1938); *Deothossia* GATINAUD, 1949, p. 488 (type, *Spirifer (Sinospirifer) anossofioides* GRABAU, 1931); *Eurytatospirifer* GATINAUD, 1949, p. 487 (type, *Spirifer disjunctus* SOWERBY, 1840); *Grabauispirifer* GATINAUD, 1949, p. 413 (type, *Spirifer (Sinospirifer) archiaciformis* GRABAU, 1931); *Iubagraspirifer* GATINAUD, 1949, p. 487 *(nom. vet.)*; *Iugrabaspirifer* GATINAUD, 1949, p. 487 *(nom. vet.)*; *Lamarckispirifer* GATINAUD, 1949, p. 489 (type, *Spirifer (Sinospirifer) hayasakai* GRABAU, 1931); *Martellispirifer* GATINAUD, 1949, p. 487 *(nom. vet.)*; *Mirtellaspirifer* GATINAUD, 1949, p. 488 *(nom. vet.)*; *Yrctospirifer* GATINAUD, 1949, p. 488 *(nom. vet.)*; *Liraspirifer* STAINBROOK, 1950, p. 381 (type, *L. tricostatus* STAINBROOK, 1950); *Regelia* CRICKMAY, 1952, p. 3 (type, *Cyrtospirifer glaucus* CRICKMAY, 1952)]. Generally transverse, with hinge line equal to maximum width; fold and sulcus strong; costae very numerous on lateral slopes and on fold and sulcus, simple on lateral slopes, bifurcating on fold and sulcus; micro-ornament consisting of rather weak growth lamellae and radial striae; delthyrium generally open; pedicle valve interior with well-developed, anteriorly diverging dental plates, delthyrial plate, lacking median septum; brachial valve interior without crural plates. *U. Dev.-L.Miss.*, cosmop.——FIG. 567,*2a-c*. **C. verneuili* (MURCHISON), Frasn., Belg.; *2a-c*, brach.v., ped.v., lat., ×1 (834).——FIG. 567,*2d-h*. *C. chinensis* (GRABAU), U.Dev., China; *2d-h*, brach. v., ped.v., lat., post., ant., ×1.5 (358).

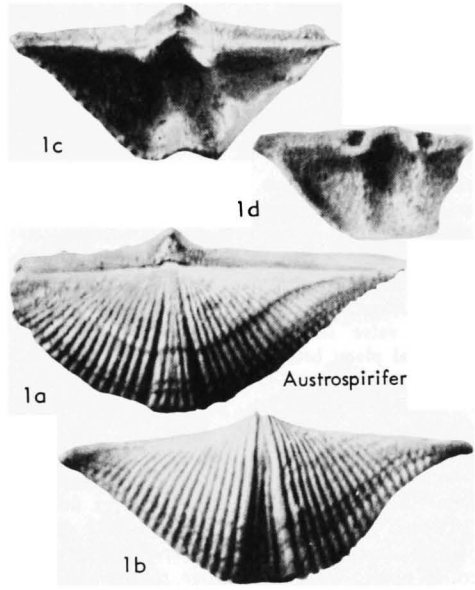


FIG. 568. Cyrtospiriferidae (p. *H*700).

[In a series of papers which reported results of a statistical study of the bifurcation patterns of costae in the sulci of several spiriferoids, GATINAUD (1949) erected numerous new taxa, ostensibly at the genus level. Eleven genera, one of them new, were divided into subgenera, sections, and subsections according to the scheme below.

Genus *Sinospirifer* GRABAU, 1931
Genus *Cyrtospirifer* NALIVKIN, 1919 (1924)
Subgenus *Grabauispirifer* GATINAUD, 1949
Section *Grabauispirifer, s.s.*
Subsection *Grabauispirifer, s.s.*
Subsection *Iubagraspirifer* GATINAUD, 1949
Section *Iugrabaspirifer* GATINAUD, 1949
Subgenus *Eurytatospirifer* GATINAUD, 1949
Subgenus *Cyrtospirifer, s.s.*
Section *Martellispirifer* GATINAUD, 1949
Subsection *Martellispirifer, s.s.*
Subsection *Mirtellaspirifer* GATINAUD, 1949
Section *Cyrtospirifer, s.s.*
Subsection *Cyrtospirifer, s.s.*
Subsection *Yrctospirifer* GATINAUD, 1949
Genus *Deothossia* GATINAUD, 1949
Genus *Theodossia* NALIVKIN, 1925
Subgenus *Platyspirifer* GRABAU, 1931
Subgenus *Theodossia, s.s.*
Genus *Tenticospirifer* TIEN, 1938
Subgenus *Tenticospirifer, s.s.*
Subgenus *Lamarckispirifer* GATINAUD, 1949
Genus *Hunanospirifer* TIEN, 1938
Genus *Cyrtiopsis* GRABAU, 1923
Subgenus *Cyrtiopsis, s.s.*
Section *Cyrtiopsis, s.s.*
Section *Alphacyrtiopsis* GATINAUD, 1949
Section *Betacyrtiopsis* GATINAUD, 1949
Section *Paracyrtiopsis* GATINAUD, 1949
Subgenus *Grabauicyrtiopsis* GATINAUD, 1949
Subgenus *Sinocyrtiopsis* GATINAUD, 1949
Genus *Spirifer* SOWERBY, 1816
Genus *Neospirifer* FREDERIKS, 1919 (1924)
Section *Neospirifer, s.s.*
Section *Alphaneospirifer* GATINAUD, 1949
Section *Betaneospirifer* GATINAUD, 1949
Genus *Choristites* FISCHER, 1825
Section *Choristites, s.s.*
Section *Alphachoristites* GATINAUD, 1949
Section *Betachoristites* GATINAUD, 1949
Genus *Spiriferella* CHERNYSHEV, 1902

In my opinion, GATINAUD's single-minded attention to the details of sulcal costae has resulted in a fragmentation of spiriferoid genera which is taxonomically absurd. Hence, all taxa introduced by GATINAUD which are available nomenclaturally are here placed in subjective synonymy with previously established genera. This is done with full realization that some of the taxa are likely to be revived in future and may be shown to be taxonomically valid on the basis of numerous characters not considered by GATINAUD.——¶Several of the GATINAUD taxa appear to contravene provisions of the International Code of Zoological Nomenclature (1961). Article 42 (a) states that the "genus group, which is next below the family-group and next above the species-group in the hierarchy of classification, includes the categories genus and subgenus." The Code does not explicitly forbid the use of additional genus-group categories, but no provision is made for them. The case against recognition of GATINAUD's sections and subsections becomes stronger when one compares the wording quoted above for the genus-group with parallel wording for the family-group. According to Art. 35 (a), "The family group includes the categories tribe, subfamily, family, and superfamily and any supplementary categories required." Presumably, the phrase "any supplementary categories required" would have been included in the paragraph on the genus-group, had there been any intention of allowing categories other than genus and subgenus. Art. 42(d) also bears upon the problem. It states that "a uninominal name proposed for a primary subdivision of a genus, even if the subdivision is designated by a term such as 'section' or 'division,' has the status in nomenclature of a subgeneric name, provided the name satisfies relevant provisions of Chapter IV." This provision would appear to rescue several of GATINAUD's taxa (e.g., *Alphaneospirifer*) which are primary subdivisions of genera. However, in several cases, GATINAUD's sections and subsections are secondary and tertiary subdivisions of genera,

not primary ones. The clear implication is that these secondary and tertiary subdivisions are not to be regarded as subgenera. In summary, the Code seems to outlaw any genus-group name other than genus and subgenus, and to imply that several of GATINAUD's taxa cannot be regarded either as genera or subgenera. Under the circumstances the following taxa are considered to be unavailable names: *Iubagraspirifer, Iugrabaspirifer, Martellispirifer, Mirtellaspirifer, Yrctospirifer, Alphacyrtiopsis, Betacyrtiopsis, Paracyrtiopsis.*]

Arctospirifer STAINBROOK, 1950, p. 382 [**A. constrictus*; OD]. Hinge line short in most specimens, but in some with earlike extensions; lateral plications few, very strong; plications of fold and sulcus smaller, more numerous; micro-ornament consisting of radially aligned pustules; pedicle valve interior with dental plates and delthyrial plate; brachial valve interior unknown. *?U.Dev.(Aplington F.)*, Iowa.——FIG. 567,*3*. **A. constrictus*; *3a-c*, brach.v., ped.v., lat., ×1.5; *3d*, ornament, ×6 (770).

Austrospirifer GLENISTER, 1955, p. 58 [**A. variabilis*; OD]. Rather small, very transverse; delthyrium almost completely closed by convex delthyrial cover; pedicle valve interior with weak dental plates or teeth ridges; brachial valve interior with crural plates; otherwise similar to *Cyrtospirifer*. *U.Dev.(Frasn.)*, W.Australia.——FIG. 568,*1*. **A. variabilis*; *1a-d*, brach.v., ped.v., ped.v. int., brach.v. int., ×2 (352).

Cyrtiopsis GRABAU, 1923, p. 194 [**C. davidsoni*; SD GRABAU, 1931, p. 424] [=*Alphacyrtiopsis* GATINAUD, 1949, p. 490 *(nom. vet.)*; *Betacyrtiopsis* GATINAUD, 1949, p. 490 *(nom. vet.)*; *Grabauicyrtiopsis* GATINAUD, 1949, p. 490 (type, *Cyrtiopsis graciosa* GRABAU, 1923); *Paracyrtiopsis* GATINAUD, 1949, p. 490 *(nom. vet.)*; *Sinocyrtiopsis* GATINAUD, 1949, p. 491 (type, *Cyrtiopsis transversa* GRABAU, 1931); *Uchtospirifer* LYASHENKO, 1957, p. 885 (type, *U. nalivkini*)]. Very strongly biconvex; hinge line somewhat less than maximum width; interarea of pedicle valve rather high with delthyrium closed by prominent, convex pseudodeltidium; pedicle valve interior with long dental plates; otherwise similar to *Cyrtospirifer*. *U.Dev.*, cosmop.——FIG. 569,*3*. *C. intermedia* GRABAU, China; *3a-e*, brach.v., ped.v., lat., post., ant., ×3 (358). [For comments on genera erected by GATINAUD (1949), see note following *Cyrtospirifer*, p. *H*697.]

Dmitria SIDYACHENKO, 1961, p. 80 [**Spirifer (Cyrtospirifer) romanowskii* NALIVKIN, 1930, p. 127; OD]. Rather large, inflated; length and width approximately equal; hinge line much less than maximum width; fold and sulcus weak, generally reflected only in slight uniplication of anterior margin; lateral costae numerous, fine, simple; costae of fold and sulcus very numerous, fine, tending to bifurcate; interior similar to *Cyrtospirifer*. *U.Dev.(Famenn.)*, USSR.——FIG. 567, *1*. **D. romanowskii; 1a-d*, brach.v., ped.v., ant., lat., ×0.7 (591).

?Indospirifer GRABAU, 1931, p. 359 [**Spirifer padaukpinensis* REED, 1908, p. 101; OD]. Medium-sized; moderately transverse, with slightly rounded cardinal extremities; fold and sulcus distinct; entire surface covered with strong, generally simple plications; micro-ornament consisting of distinct capillae which originate in grooves and diverge fan-wise onto plications; pedicle valve interior with strong dental plates, lacking median septum; presence of delthyrial plate not established. *M.Dev.-U.Dev.*, cosmop.——FIG. 569,*1*. *I. padaukpinensis maoerhchuanensis* GRABAU, M.Dev., China; *1a-e*, brach.v., ped.v., lat., post., ant., ×1.5; *1f*, micro-ornament, ×9 (358).——FIG. 570,*6*. *I. varians* (FENTON), U. Dev., Iowa; micro-ornament, ×10 (295).

Platyspirifer GRABAU, 1931, p. 355 [**Schizophoria paronai* MARTELLI, 1902, p. 365; OD]. Length and width subequal; cardinal extremities rounded, yielding rather short hinge line; fold and sulcus weak; lateral slopes, fold, and sulcus with very numerous, fine costae; otherwise seemingly similar to *Cyrtospirifer*, but interior unknown. *?U. Dev.*, China.——FIG. 569,*2*. **P. paronai* (MARTELLI); *2a-e*, brach.v., ped.v., lat., post., ant., ×1.5 (358).

Prospira MAXWELL, 1954, p. 35 [**P. typa*; OD]. Similar to *Cyrtospirifer* except for narrow fold and sulcus with costae tending toward obsolescence. *L.Carb.(U.Tourn.-Visean)*, Australia-Japan-?Eu.-?N.Am.——FIG. 570,*2*. **P. typa*, Queensl.; ped.v., ×1 (541).

?Schizospirifer GRABAU, 1931, p. 353 [**Spirifer aperturatus* var. *latistriatus* FRECH, 1911, p. 53; OD]. Somewhat resembling *Cyrtospirifer*, but with coarser costae, some of which branch on lateral slopes; interior unknown. *?M.Dev.*, China. ——FIG. 570,*5*. **S. latistriatus* (FRECH); *5a-e*, brach.v., ped.v., lat., post., ant., ×1.5 (358).

Sphenospira COOPER, 1954, p. 330 [**Spirifera alta* HALL, 1866, p. 246; OD]. Very similar to *Syringospira* but with longer dental plates, less elaborate frill; blisters lacking. *U.Dev.*, E.N.Am.——FIG. 570,*7*. **S. alta* (HALL); post., ×1 (183).

Sulcatospirifer MAXWELL, 1954, p. 11 [**S. primus*; OD]. Fold divided by prominent, rather wide median groove; costae of fold and sulcus very obscure; micro-ornament consisting of concentric growth lamellae, capillae, and pustules. *U. Dev.(Famenn.)*, Australia.——FIG. 570,*1*. **S. primus*; ped.v. mold, ×2 (539).

Syringospira KINDLE, 1909, p. 28 [**S. prima*; OD]. Pedicle valve hemipyramidal; lateral slopes with simple costae; fold and sulcus present, costate; micro-ornament consisting of radially elongate pustules; shell substance overgrown so as to produce prominent frill or flange which serves to greatly increase size of interarea; pedicle valve interior with short dental plates, prominent delthyrial plate and stegidium in old specimens; umbonal cavities filled with blister-like plates. *U.Dev. (Percha Sh.)*, W.N.Am.——FIG. 570,*4*. **S. prima*; *4a-c*, ant., lat., post., ×2; *4d*, post., ×2 (183).

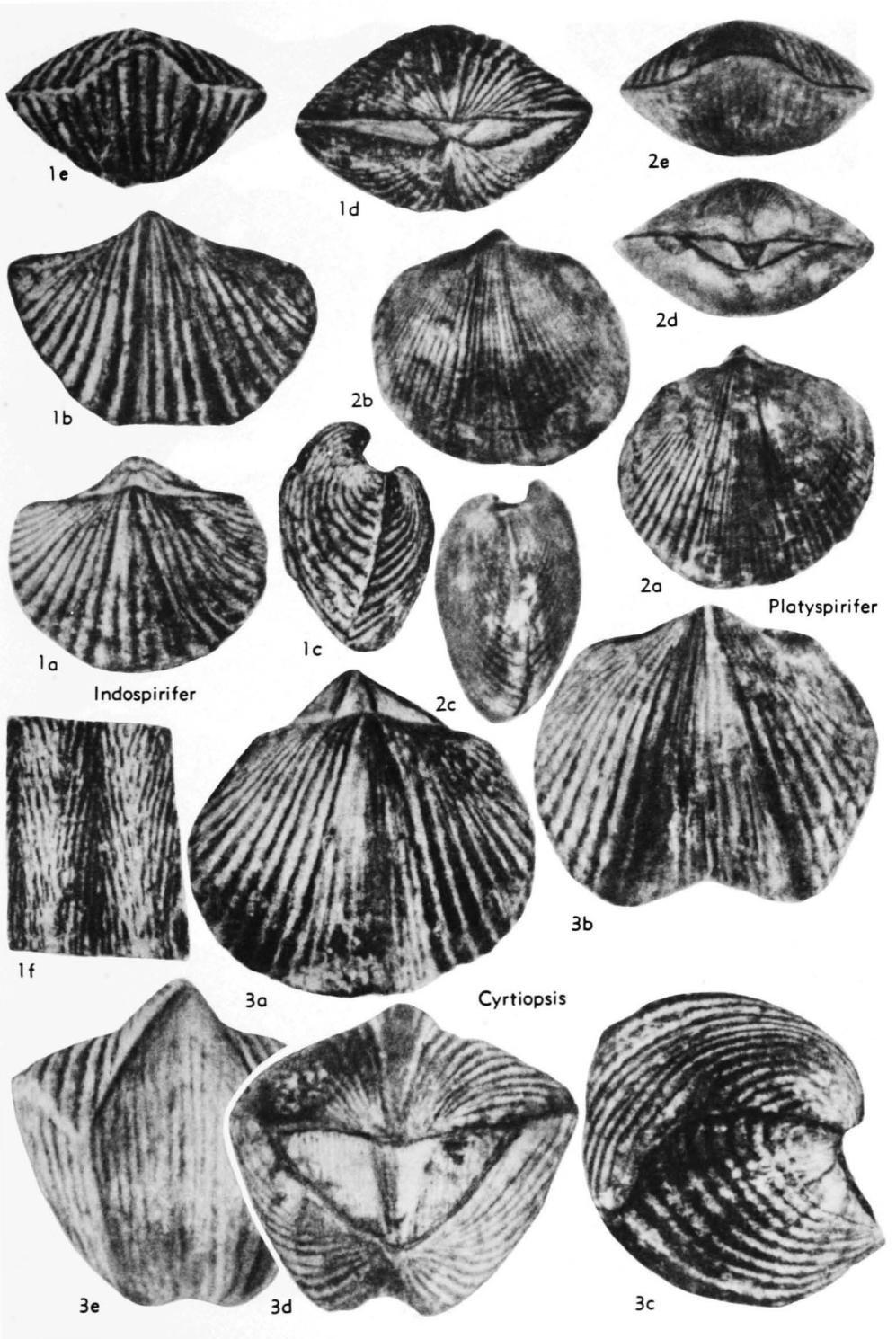
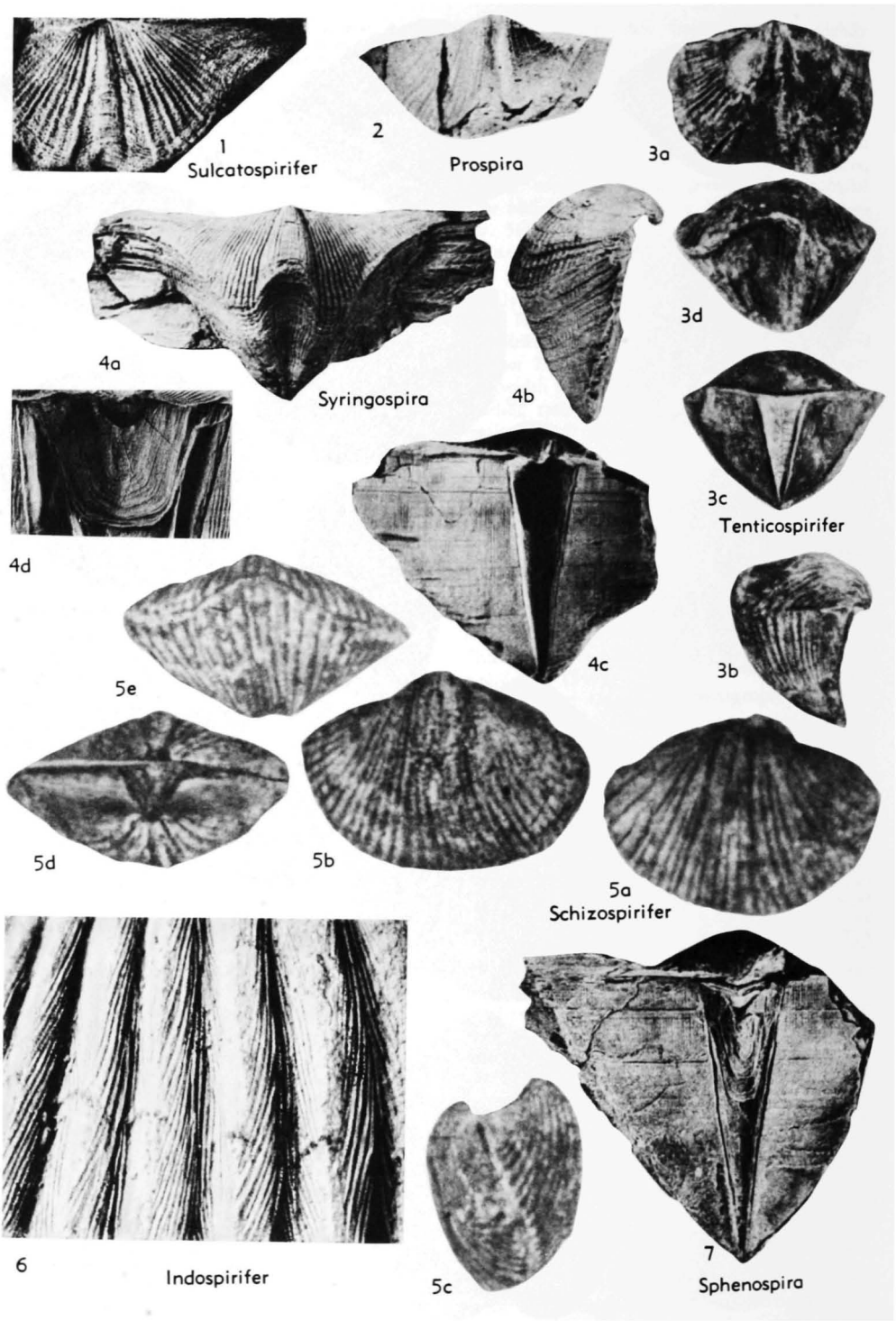


FIG. 569. Cyrtospiriferidae (p. *H*700).



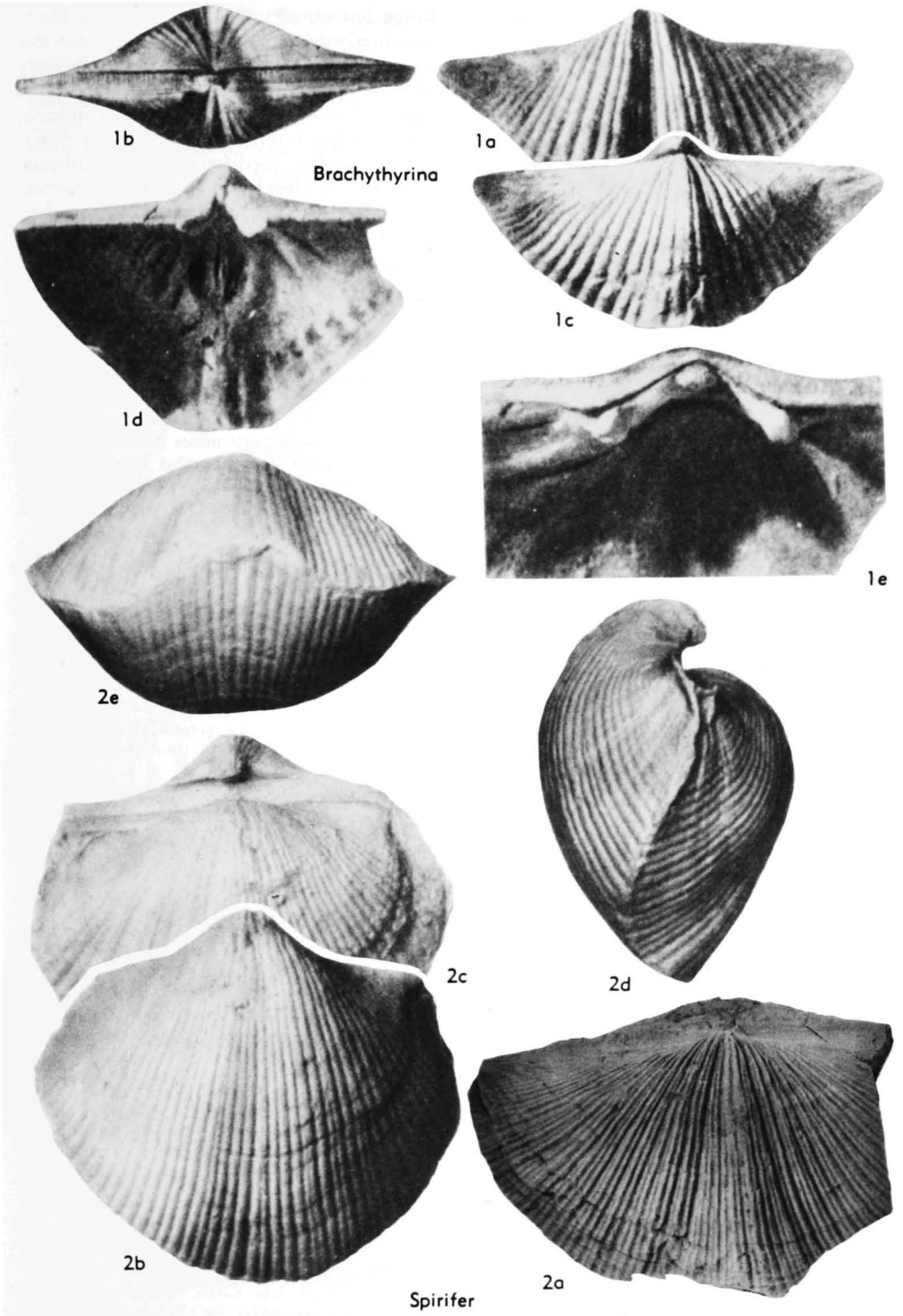


Fig. 571. Spiriferidae (p. *H*704).

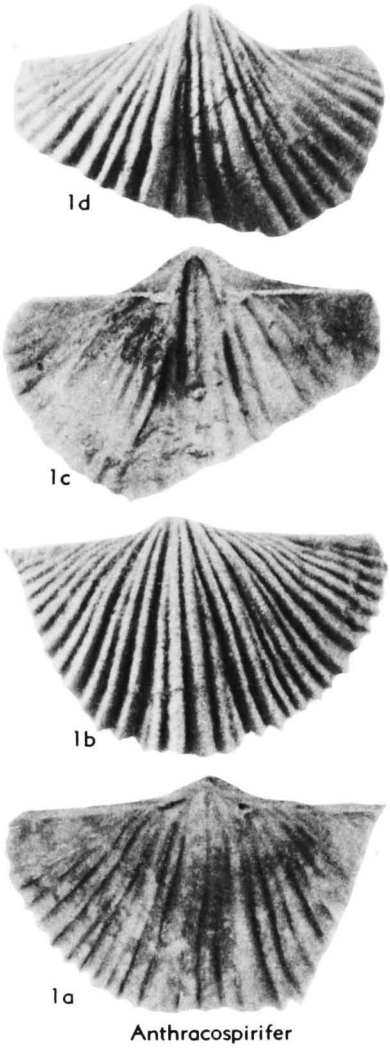


FIG. 572. Spiriferidae (p. *H*704).

Tenticospirifer TIEN, 1938, p. 113 [**Spirifer tenticulum* DE VERNEUIL, 1845, p. 159; OD]. Pedicle valve hemipyramidal, with large, high, essentially equilateral interarea; otherwise similar to *Cyrtospirifer*. *?M.Dev., U.Dev.*, cosmop.——FIG. 570,*3*. **T. tenticulum* (DE VERNEUIL), U.Dev., USSR; *3a-d*, ped.v., lat., post., ant., ×1 (811).

Family SPIRIFERIDAE King, 1846

[Spiriferidae KING, 1846, p. 28]

Biconvex; slightly to markedly transverse; cardinal extremities rounded in some, making hinge line somewhat less than maximum width, more typically angular, with hinge line equal to maximum width, hinge commonly denticulate; lateral plications few to numerous, rarely simple, more commonly bifurcating, in some becoming fasciculate; fold and sulcus commonly distinct, plicate; pedicle valve interior generally with dental plates, lacking median septum; delthyrial plate weakly developed or lacking; brachial valve interior rarely with crural plates; shell substance impunctate. *L.Carb.-Perm.*

Spirifer SOWERBY, 1816, p. 41 [**Conchyliolithus (Anomia) striatus* MARTIN, 1793, pl. 23; SD ICZN Opinion 100, 1928, p. 377] [=*Spiriferus* DE BLAINVILLE, 1827, p. 291 *(nom. van.)*; *Spirifera* PHILLIPS, 1836, p. 216 *(nom. van.)*; *?Lytha* FREDERIKS, 1919 (1924), p. 298 (type, *Spiriferella? tschernyschewiana* FREDERIKS, 1916)]. Biconvex; almost equidimensional to moderately transverse; cardinal extremities generally rounded, providing hinge line somewhat less than maximum width; lateral plications numerous, generally bifurcating adjacent to fold and sulcus, elsewhere generally simple, rarely somewhat fasciculate; fold and sulcus with numerous bifurcating plications; micro-ornament typically consisting of obscure concentric growth lamellae and capillae; pedicle valve interior with short, stout dental plates, lacking median septum and delthyrial plate; brachial valve interior without crural plates. *Carb.*, cosmop.——FIG. 571,*2a*. **S. striatus* (MARTIN), L.Carb., Br.I.; brach.v., ×0.7 (Sadlick, n). ——FIG. 571,*2b-e*. *S. gregeri* WELLER, Miss. (Chouteau Ls.), USA(Mo.); *2b-e*, ped.v., brach.v., lat., ant., ×1.5 (858).

Anthracospirifer LANE, 1963, p. 387 [**A. birdspringensis*; OD]. Lateral costae strong, few; otherwise similar to *Unispirifer*. *Penn.*, N.Am. ——FIG. 572,*1*. **A. birdspringensis*, Morrow., Nev.; *1a-d*, brach.v. int., brach.v., ped.v. int., ped.v., ×2 (502a).

Brachythyrina FREDERIKS, 1929, p. 385 [*pro Anelasma* IVANOV, 1925, p. 33 (*non* DARWIN, 1851; *nec* SOERENSEN, 1873; *nec* COSSMANN, 1889)] [**Spirifer strangwaysi* DE VERNEUIL, 1845, p. 164; OD] [=*Anelasmina* SEMIKHATOVA, 1939, p. 324 (obj.); *Elinoria* COOPER & MUIR-WOOD, 1951, p. 195 (*pro Elina* FREDERIKS, 1924, p. 321, *non* BLANCHARD, 1852, *nec* FERRARI, 1878) (type, *Spirifer rectangulus* KUTORGA, 1844, p. 90)]. Micro-ornament consisting of rather weak concentric growth lamellae; pedicle valve interior with dental plates reduced to teeth ridges; otherwise similar to *Unispirifer*. *L.Carb.-Perm.*, Eu.-Asia.——FIG. 571,*1a-c*. **B. strangwaysi* (DE VERNEUIL), U.Carb. (Moscov.), USSR; *1a-c*, ped.v., post., brach.v., ×1.5 (448).——FIG. 571,*1d,e*. *B. strangwaysi lata* CHAO, U.Carb. (Moscov.), USSR; *1d,e*, ped.v. int., ×1.5; brach.v. int., ×6 (448).

Fusella M'Coy, 1844, p. 128 [**Spirifera fusiformis* Phillips, 1836, p. 217; OD]. Extremely transverse; lateral slopes with about 8 rounded plications; fold with about 3 weaker plications; sulcus bald; otherwise seemingly similar to *Unispirifer*. *L.Carb.*, Br.I.——Fig. 573,2. **F. fusiformis* (Phillips); *2a,b*, ant., post. (oblique), ×1.5 (640).

[The type-species of *Fusella* is so poorly known that the generic characters cannot be regarded as well established. Until this situation is remedied, it seems best to confine use of the name *Fusella* to the type-species. Other species commonly placed in *Fusella* seem assignable to *Unispirifer*.]

Grantonia Brown, 1953, p. 60 [**G. hobartensis*; OD]. Generally similar to *Neospirifer* but fasciculate plications stronger, less numerous, and shell greatly thickened with callus. *Perm.*, Tasmania.——Fig. 573,*3*. **G. hobartensis*; *3a-c*, post. (oblique), ped.v. post., ped.v. int., ×1 (123).

Imbrexia Nalivkin, 1937, p. 105 [**Spirifer imbrex* Hall, 1858, p. 601; OD]. Micro-ornament consisting of imbricate growth lamellae without capillae; otherwise seemingly similar to *Unispirifer*, but type-species poorly known. *L.Carb.*, cosmop.——Fig. 573,*5*. **I. imbrex* (Hall), Miss. (Burlington Ls.), USA(Iowa); brach.v., ×1.5 (858).

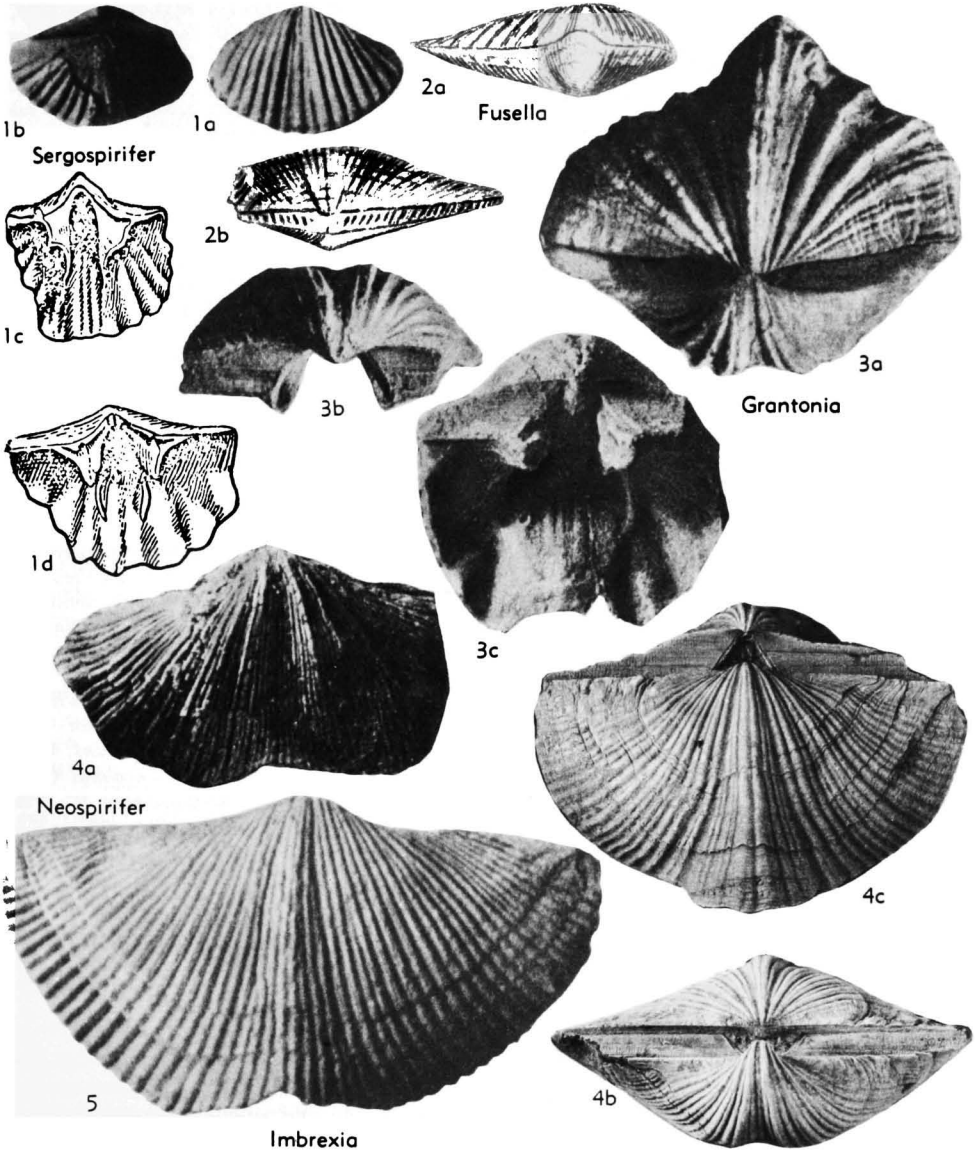


Fig. 573. Spiriferidae (p. *H*705-*H*706).

Neospirifer FREDERIKS, 1919 (1924), p. 311 [*non* NIKITIN, 1900, p. 385, *nom. nud.*] [**Spirifer fasciger* KEYSERLING, 1846, p. 231; OD] [=*Alphaneospirifer* GATINAUD, 1949, p. 491 (type, *Spirifer mahaensis* HUANG, 1933); *Betaneospirifer* GATINAUD, 1949, p. 491 (type, *Spirifer moosakhailensis* DAVIDSON, 1862)]. Generally rather large, transverse; cardinal extremities commonly angular; hinge line equal or almost equal to maximum shell width, typically denticulate; lateral slopes with numerous fasciculate plications; fold and sulcus distinct, plicate; micro-ornament consisting of distinct concentric growth lamellae and rather obscure capillae; pedicle valve interior with short dental plates; brachial valve interior without crural plates. [For comment on taxa of GATINAUD, *see* entry following *Cyrtospirifer*.] *U.Carb.-Perm.*, cosmop.——FIG. 573,*4a*. **N. fasciger* (KEYSERLING), L.Perm., USSR; ped.v., ×1 (123).——FIG. 573,*4b,c*. *N. cameratus* (MORTON), M.Penn., USA(Ohio); *4b,c*, post., brach.v., ×1 (178).

Sergospirifer IVANOVA in SARYCHEVA & SOKOLSKAYA, 1952, p. 190 [**Spirifer okensis* NIKITIN, 1890, p. 28; OD]. Rather small; moderately transverse; cardinal extremities rounded; hinge line slightly less than maximum width; lateral slopes with 6 to 8 prominent, simple costae; fold and sulcus rather obscure, bearing 3 or 4 bifurcating costae; pedicle valve interior with long, thin, widely separated, essentially parallel dental plates; brachial valve interior with very well-developed crural plates. *U.Carb.*, USSR.——FIG. 573,*1*. **S. okensis* (NIKITIN); *1a,b*, ped.v., brach.v., ×1; *1c,d*, ped.v. int., brach.v. int., ×1.5 (711).

Trigonotreta KOENIG, 1825, p. 3 [**T. stokesi*; SD HALL & CLARKE, 1894, p. 8]. Lateral plications strong, few; each lateral plication tending to bifurcate once, doubled plications remaining in genetic pairs; otherwise similar to *Neospirifer*. *Perm.*, Tasmania.——FIG. 574,*1*. **T. stokesi, 1a-d*, brach.v., ped.v., lat., ped.v. int., ×1 (123).

Unispirifer CAMPBELL, 1957, p. 67 [**Spirifer striatoconvolutus* BENSON & DUN, 1920, p. 350; OD] [=*?Grandispirifer* YANG, 1959, p. 116 (type, *G. mylkensis*)]. Biconvex; rather strongly transverse; hinge line equal to maximum shell width, denticulate; lateral costae numerous, mostly simple, but some bifurcating, never fasciculate; fold and sulcus narrow, with several distinct, bifurcating costae; micro-ornament consisting of distinct capillae; pedicle valve interior with stout dental plates; brachial valve interior lacking crural plates. *L.Carb.(Tournais.-Visean)*, cosmop. ——FIG. 575,*1a-c*. **U. striatoconvolutus* (BENSON & DUN), Tournais., Australia(New S. Wales); *1a-c*, post., ped.v., brach.v., ×1 (140).——FIG. 575,*1d-f*. *U. mylkensis* (YANG), Visean, China; *1d-f*, ped.v., brach.v., post., ×4.7 (898).

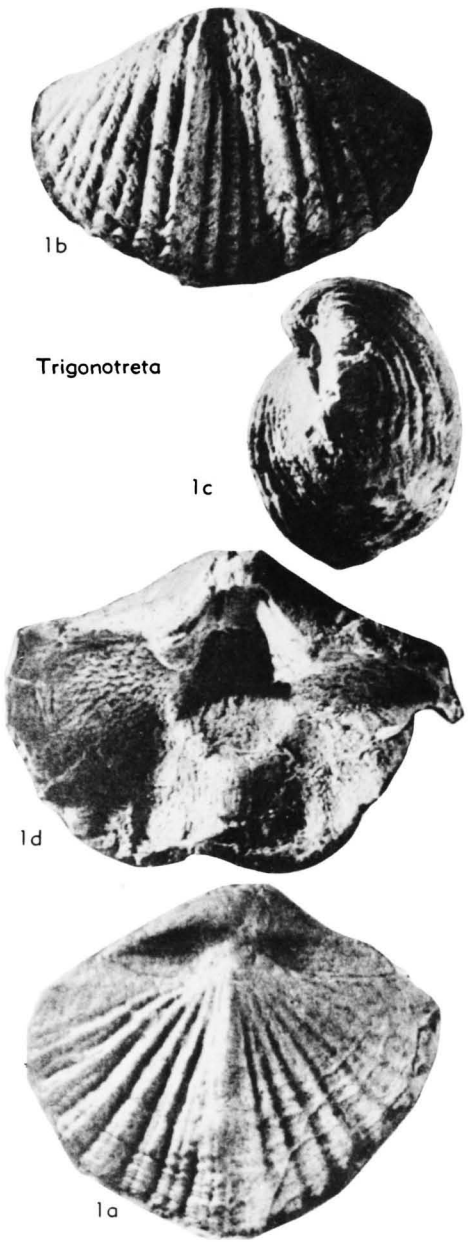


FIG. 574. Spiriferidae (p. *H706*).

Family BRACHYTHYRIDIDAE Frederiks, 1919 (1924)

[*nom. transl. et correct.* PITRAT, herein (*ex* Brachythyrinae FREDERIKS, 1919 (1924), p. 316)]

Shell markedly biconvex; hinge line generally short, commonly denticulate; interarea generally distinct, triangular or trapezoidal; fold and sulcus almost always present, with bifurcating costae or plications which in some shells are obscure; lateral

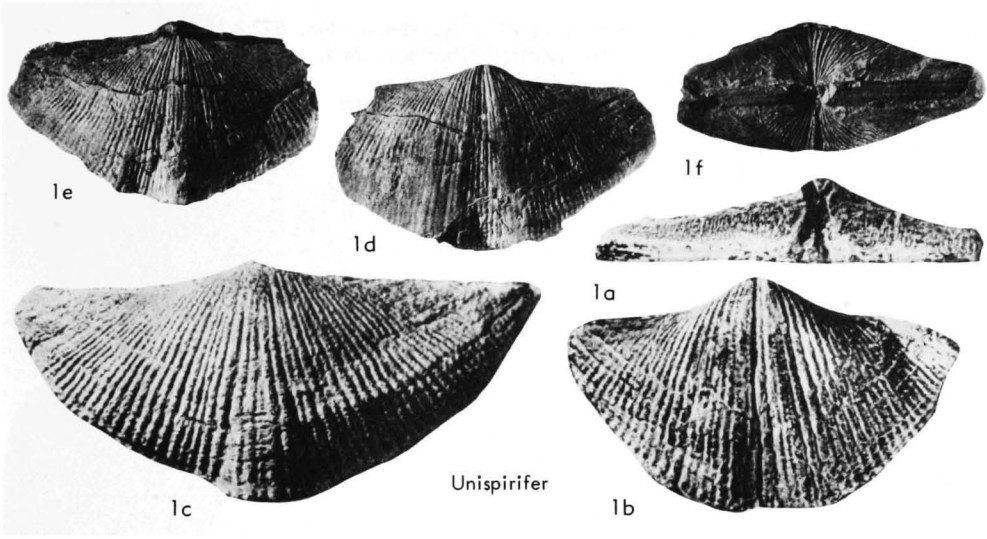


FIG. 575. Spiriferidae (p. *H706*).

slopes invariably with costae or plications, generally bifurcating, but more rarely simple; micro-ornament variable; pedicle valve interior with dental plates or teeth ridges; lacking delthyrial plate and median septum; brachial valve interior with or without crural plates; shell substance impunctate. *?U.Dev., L.Carb.-Perm.*

Brachythyris M'COY, 1844, p. 128 [**Spirifera ovalis* PHILLIPS, 1836, p. 219; OD] [=*Ovalia* NALIVKIN, 1937, p. 107 (obj.)]. Biconvex; hinge much less than maximum shell width, nondenticulate; interarea triangular; lateral plications few, broad, low, simple; fold and sulcus distinct, with well-developed plications in some, more typically with plications weak or obsolete; pedicle valve interior with teeth ridges, lacking dental plates. *?U.Dev., L.Carb.*, cosmop.——FIG. 576,*3a-c*. **B. ovalis* (PHILLIPS), Visean, Br.I.; *3a-c*, brach.v., ped.v., lat., ×1 (229).——FIG. 576,*3d-f*. *B. subcardiiformis* (HALL), Miss.(Salem Ls.), USA(Ill.); *3d-f*, ped.v., lat., brach.v., ×1 (858).

?Cancellospirifer CAMPBELL, 1953, p. 10 [**C. maxwelli*; OD]. Biconvex; equidimensional to slightly transverse, with rounded cardinal extremities; hinge line less than maximum shell width; lateral slopes with about 7 distinct, rounded, simple costae; fold and sulcus well defined, bearing 2 or 3 very weak costae; micro-ornament consisting of imbricate growth lamellae and capillae, together producing cancellated effect; pedicle valve interior with dental plates; brachial valve interior lacking crural plates. *Perm.(Ingelara Beds)*, Australia(Queensl.).——FIG. 576,*4*; 577,*3*. **C. maxwelli*; 576,*4a,b*, ped.v., brach.v., ×1.5; 577,*3*, ornament, ×10 (139).

Choristitella IVANOV & IVANOVA, 1937, p. 163 [**Choristites podolskensis* IVANOV, 1926, p. 17; OD]. Interarea triangular; dental plates short, commonly greatly thickened with callus; otherwise similar to *Choristites*. *U.Carb.*, USSR.——FIG. 576,*5*. **C. podolskensis* (IVANOV); *5a,b*, ped.v., ped.v. post., ×1 (447).

Choristites FISCHER DE WALDHEIM, 1825, p. 7 [**C. mosquensis*; SD BUCKMAN, 1908, p. 30] [=*Neomunella* OZAKI, 1931, p. 24 (type, *Spirifer (Neomunella) chaoi* OZAKI, 1931); *Yatsengina* SEMIKHATOVA, 1936, p. 216 (type, *Y. plana*); *Alphachoristites* GATINAUD, 1949, p. 492 (type, *Choristites bisulcatiformis* SEMIKHATOVA, 1934); *Betachoristites* GATINAUD, 1949, p. 492 (type, *Choristites kschemyschensis* SEMIKHATOVA, 1941); *Jatsengina* IVANOVA, 1960, p. 270 *(nom. null.)*]. Strongly biconvex; hinge line generally slightly less than maximum width; beak of pedicle valve strong, curved; interarea trapezoidal; hinge line denticulate; lateral costae generally very numerous, straplike, with narrow interspaces, those nearest fold and sulcus bifurcating, marginal ones simple; fold and sulcus rather shallow, with poorly defined margins, bearing numerous bifurcating costae; micro-ornament of capillae and concentric growth lines; pedicle valve interior with rather long, close-set, almost parallel dental plates which intersect muscle field; brachial valve interior without crural plates. [For comments on genera of GATINAUD (1949), see note following *Cyrtospirifer* (p. *H697*).] *L.Carb.-L.Perm.*, cosmop.——FIG. 577,*1*. **C. mosquensis*, U.Carb. (Moscov.), USSR; *1a-c*, ped.v., brach.v., lat., ×1 (448).——FIG. 576,*6*. **C.* sp.; ped.v. int., ×1 (447).

Ectochoristites CAMPBELL, 1957, p. 71 [**E. wattsi*;

OD]. Pedicle valve interior with short, thick dental plates; brachial valve interior with short crural plates; otherwise similar to *Choristites. L.Carb. (Tournais.), ?U.Carb.(Namur.),* Australia - ?N. Am.-?Eu.——Fig. 577,2. **E. wattsi,* Tournais., Australia; *2a-d,* ped.v., brach.v., lat., ant., ×1 (140).

Eliva Frederiks, 1919 (1924), p. 319 [**Spirifer*

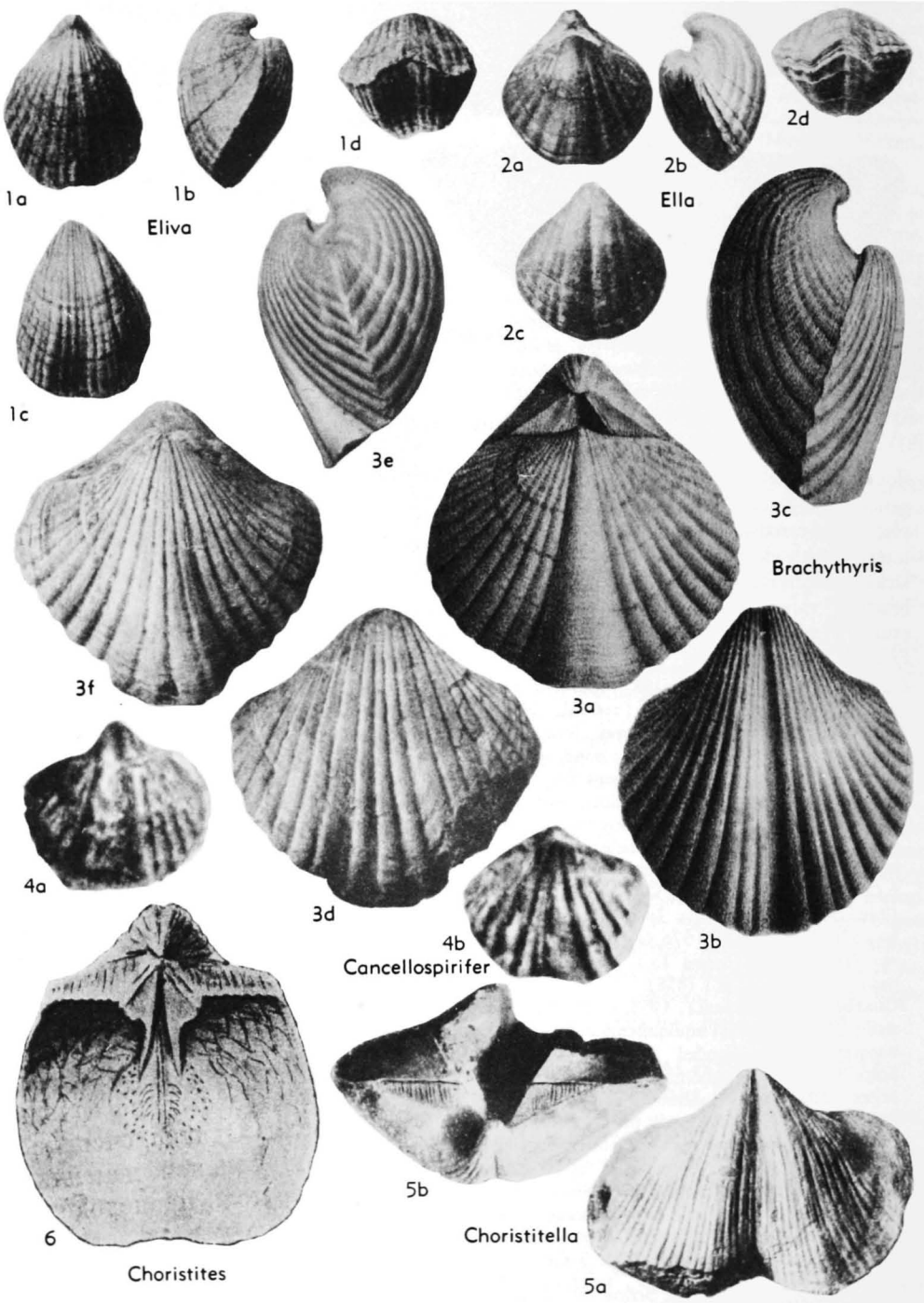


Fig. 576. Brachythyrididae (p. H707-H709).

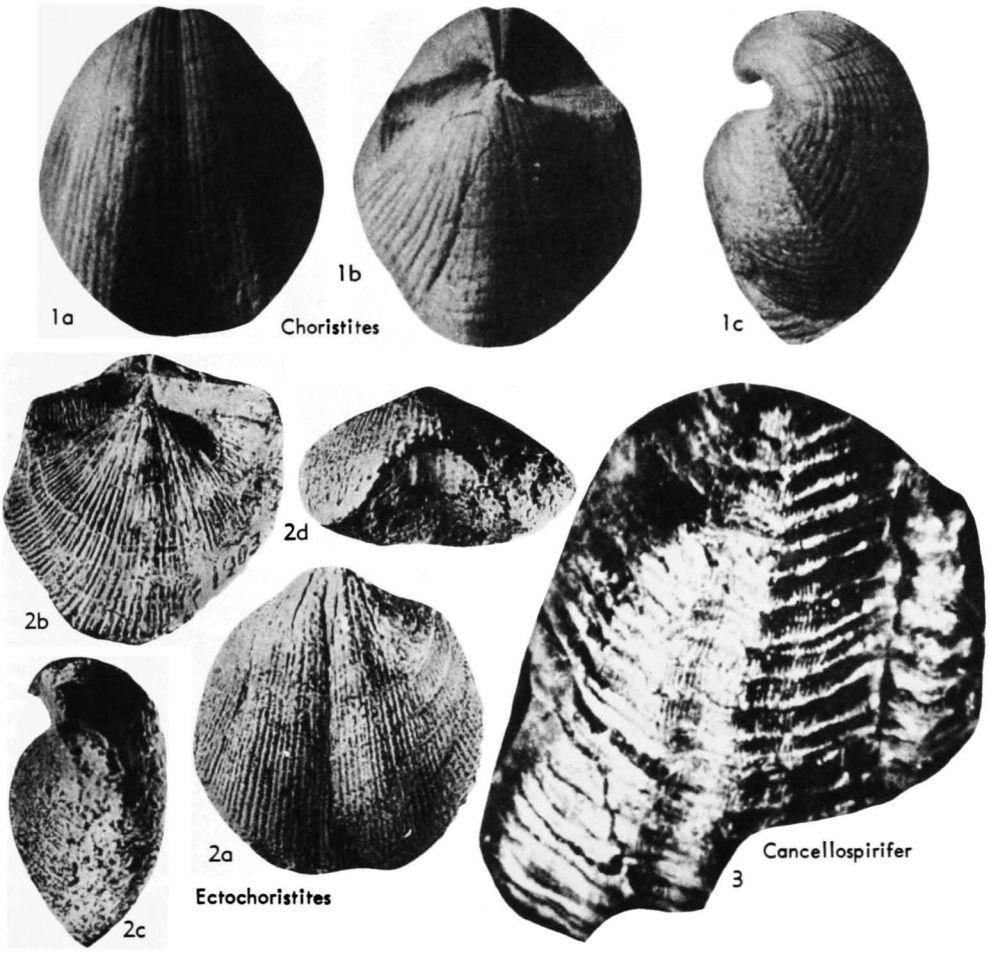


FIG. 577. Brachythyrididae (p. *H*707-*H*708).

lyra KUTORGA, 1844, p. 92; OD]. Similar to *Spiriferella* but plications more numerous and dental plates reduced to teeth ridges. *L.Perm.*, USSR.——FIG. 576,*1*. **E. lyra* (KUTORGA); *1a-d*, brach.v., lat., ped.v., ant., ×1 (158).

Ella FREDERIKS, 1918, p. 87 [**Martinia simensis* CHERNYSHEV, 1902, p. 569; OD]. Small; lateral costae few, simple; dental plates reduced to teeth ridges; otherwise similar to *Purdonella*. *L.Perm.*, USSR.——FIG. 576,*2*. **E. simensis* (CHERNYSHEV); *2a-d*, brach.v., lat., ped.v., ant., ×1 (158).

Eochoristites CHU, 1933, p. 28 [**E. neipentaiensis*; OD]. Moderately biconvex; fold and sulcus weak, rather narrow; lateral costae generally simple; interarea triangular; hinge nondenticulate; brachial valve interior with short, thin crural plates; otherwise similar to *Choristites*. *L.Carb.*, Asia.——FIG. 578,*3*. **E. neipentaiensis*, Kinling Ls., SE.China; *3a-e*, ped.v., brach.v., lat., post., ant., ×1 (161).

Palaeochoristites SOKOLSKAYA, 1941, p. 26 [**Spirifer cinctus* KEYSERLING, 1847, p. 229; OD]. Fold and sulcus lacking; brachial valve interior with rather long crural plates; otherwise similar to *Eochoristites*. *L.Carb.*, USSR.——FIG. 578,*4*. **P. cinctus* (KEYSERLING); *4a-e*, ped.v., brach.v., post., ant., lat., ×1 (752).

Purdonella REED, 1944, p. 218 [*pro Munella* FREDERIKS, 1919 (1924), p. 314 (*non* BONNIER, 1896)] [**Spirifer nikitini* CHERNYSHEV, 1902, p. 542; OD]. Interarea triangular; hinge nondenticulate; otherwise similar to *Choristites*. *Perm.*, Asia-Arctic. ——FIG. 578,*5*. **P. nikitini* (CHERNYSHEV), L. Perm., USSR; *5a-d*, brach.v., lat., ped.v., ant., ×0.7(158).

Spiriferella CHERNYSHEV, 1902, p. 121 [**Spirifer saranae* DE VERNEUIL, 1845, p. 169; OD] [=*Elivina* FREDERIKS, 1919 (1924), p. 315 (=*Dienerina* OZAKI, 1931, p. 25; type, *Spirifer tibetanus* DIENER, 1897); *Blasispirifer* KULIKOV, 1950, p. 6 (type, *Spirifer blasii* DE VERNEUIL, 1845)]. Pedicle valve highly convex; brachial valve less so; hinge generally very short, nondenticulate; lateral plica-

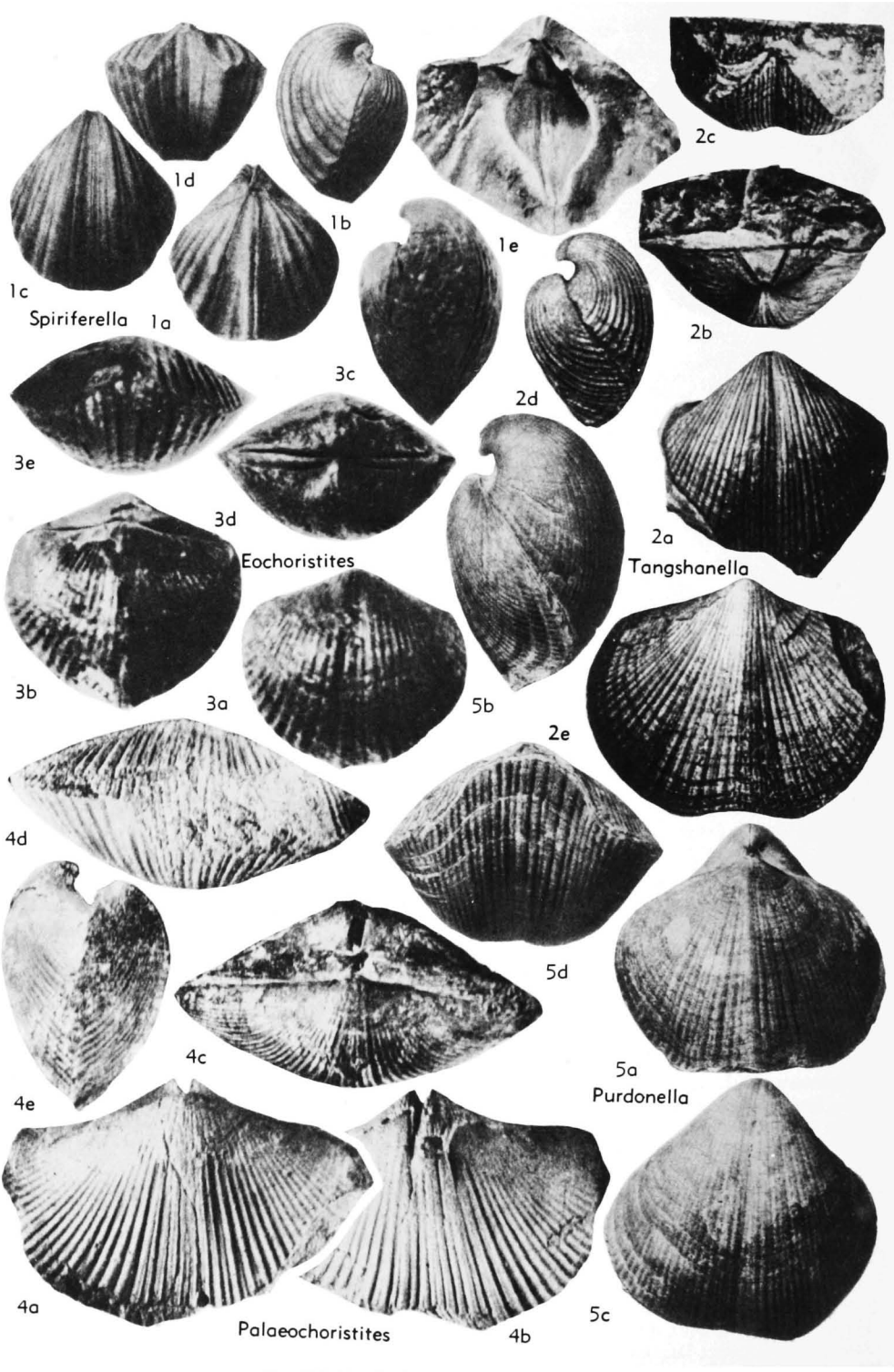


FIG. 578. Brachythyrididae (p. *H*709, *H*711).

tions few, very strong, bifurcating; fold and sulcus ranging from well defined and almost bald to poorly defined with strong plications; pedicle valve interior with well-developed dental plates, commonly thickened with callus, deeply impressed muscle field; brachial valve interior unknown. *U.Carb.-Perm.*, cosmop.——FIG. 579,*2*. **S. saranae* (DE VERNEUIL), L.Perm., USSR; *2a*, ped.v., ×1; *2b*, ornament, ×15 (448).——FIG. 578,*1a-d*. *S. tibetana* (DIENER), L.Perm., Tibet; *1a-d*, brach.v., lat., ped.v., ant., ×1 (158).——FIG. 578,*1e*. *S. keilhavii* (VON BUCH), U.Perm., Greenl.; ped.v. int., ×1 (269).

Tangshanella CHAO, 1929, p. 57 [**T. kaipingensis*; OD]. Pedicle valve interior with dental plates reduced to teeth ridges; otherwise similar to *Choristites*. *U.Carb.*, China.——FIG. 578,*2*. **T. kaipingensis*, Penchi Series; *2a-e*, ped.v., post., ant., lat., brach.v., ×1 (154).

Family UNCERTAIN

Thomasaria STAINBROOK, 1945, p. 57 [**T. altumbona*; OD]. Rather small; weakly transverse, with slightly rounded cardinal extremities; brachial valve moderately convex; pedicle valve hemipyramidal, with high interarea; macro-ornament lacking; micro-ornament consisting of fine growth lamellae which give rise to fine spines; delthyrium high and narrow, constricted by pair of plates similar to conjunct or disjunct deltidial plates but occupying position of delthyrial plate; pedicle valve interior with long dental plates which diverge anteriorly and ventrally; brachial valve interior with short crural plates, striate cardinal process. *U.Dev.(Frasn.)*, N.Am.(Iowa-N. Mex.).——FIG. 579,*1*. **T. altumbona*, Iowa; *1a-f*, ped.v., brach.v., post., ant., lat., transv. sec. ped.v., ×1 (768).

Superfamily SPIRIFERINACEA Davidson, 1884

[*nom. transl.* IVANOVA, 1959, p. 57 (*ex* subfam. Spiriferinidae DAVIDSON, 1884, p. 354)]

Shell rather variable, but typically small, rather transverse, biconvex, with distinct fold and sulcus and plicate lateral slopes; micro-ornament variable, consisting of growth lamellae, capillae, spines, and granules in various combinations; interior of pedicle valve with well-developed median septum, and commonly with dental plates; shell substance generally, but not invariably, punctate, *L.Carb.-L.Jur.*

Family SPIRIFERINIDAE Davidson, 1884

[*nom. transl.* IVANOVA, 1959, p. 57 (*ex* subfam. Spiriferinidae DAVIDSON, 1884, p. 354)]

Characters of superfamily. *L.Carb.-L.Jur.*

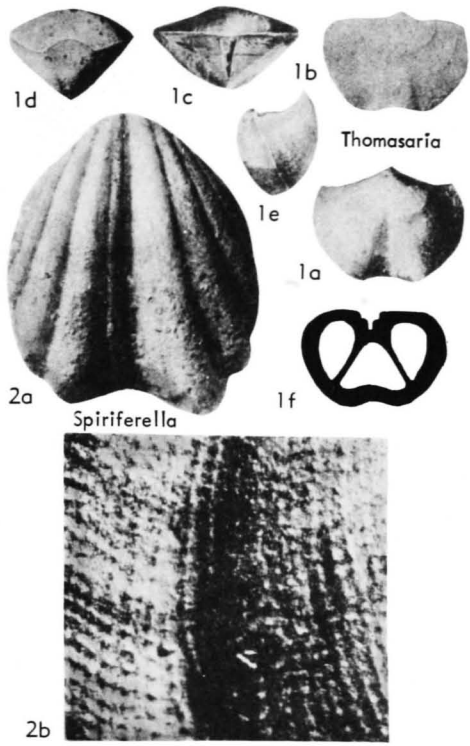


FIG. 579. Brachythyrididae *(2)*; Family Uncertain *(1)* (p. *H*711).

Spiriferina D'ORBIGNY, 1847, p. 268 [**Spirifer walcotti* SOWERBY, 1823, p. 106; SD DALL, 1877, p. 64]. Shell small to medium-sized, equidimensional to moderately transverse; cardinal extremities rounded; lateral slopes ranging from smooth to coarsely plicate; fold and sulcus generally distinct in plicate forms, commonly obscure or wanting in smooth forms; micro-ornament of growth lamellae and numerous fine, tubular spines; punctate. *Trias.-L.Jur.*, cosmop.——FIG. 580,*5*. **S. walcotti* (SOWERBY), Lias., Br.I.; *5a,b*, brach.v., ant., ×1 (229).

[No nominal species were assigned to *Spiriferina* when the genus was erected by D'ORBIGNY (1847). Later D'ORBIGNY (1849) assigned 11 species to the genus, including *Spirifer walcotti* SOWERBY, 1823, but not including *Terebratulites rostratus* VON SCHLOTHEIM, 1822; no type-species was designated. DALL (1877) stated the type to be *S. rostratus* (SCHLOTHEIM)=*S. walcotti* (SOWERBY), attributing this information to DAVIDSON (1856, p. 161). I have been unable to locate the DAVIDSON reference, and I believe it to be erroneous, inasmuch as both before and after 1856, DAVIDSON maintained that *S. walcotti* and *S. rostratus* were separate species. In any case, DALL's designation of *S. rostratus* as type and his synonymizing of it with *S. walcotti*, one of the eligible species, makes the latter the type, despite the fact that the synonymy appears to be in error (Code, Art. 69a,iii,iv)]

?Acanthospirina SCHUCHERT & LEVENE, 1929, p. 119 [*pro Acanthospira* WELLER, 1914, p. 418 (*non* REINSCH, 1877)] [**Spirifer acicutilifera* ROWLEY, 1893, p. 307; OD]. Very small; moderately

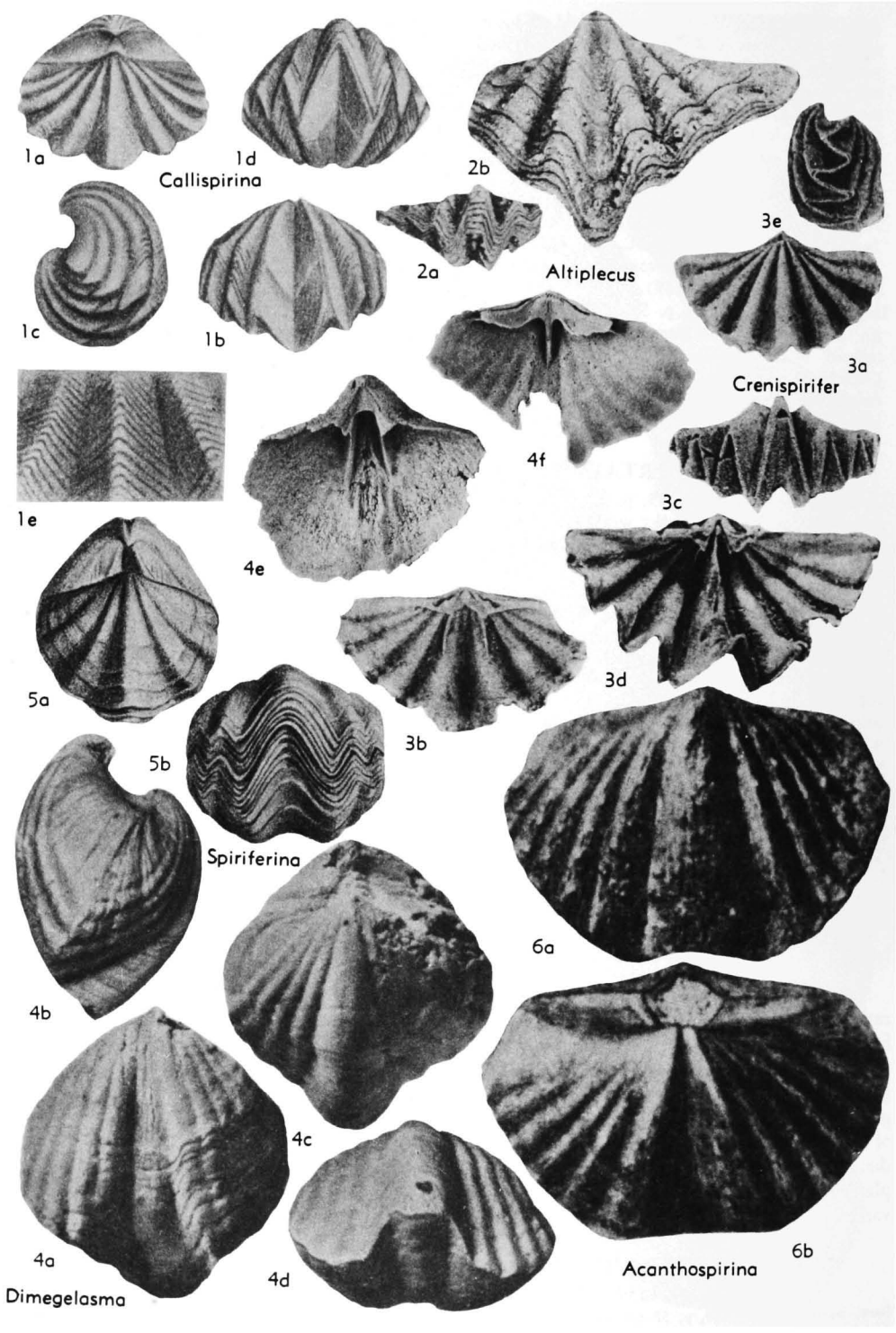


FIG. 580. Spiriferinidae (p. *H*711, *H*713-*H*714).

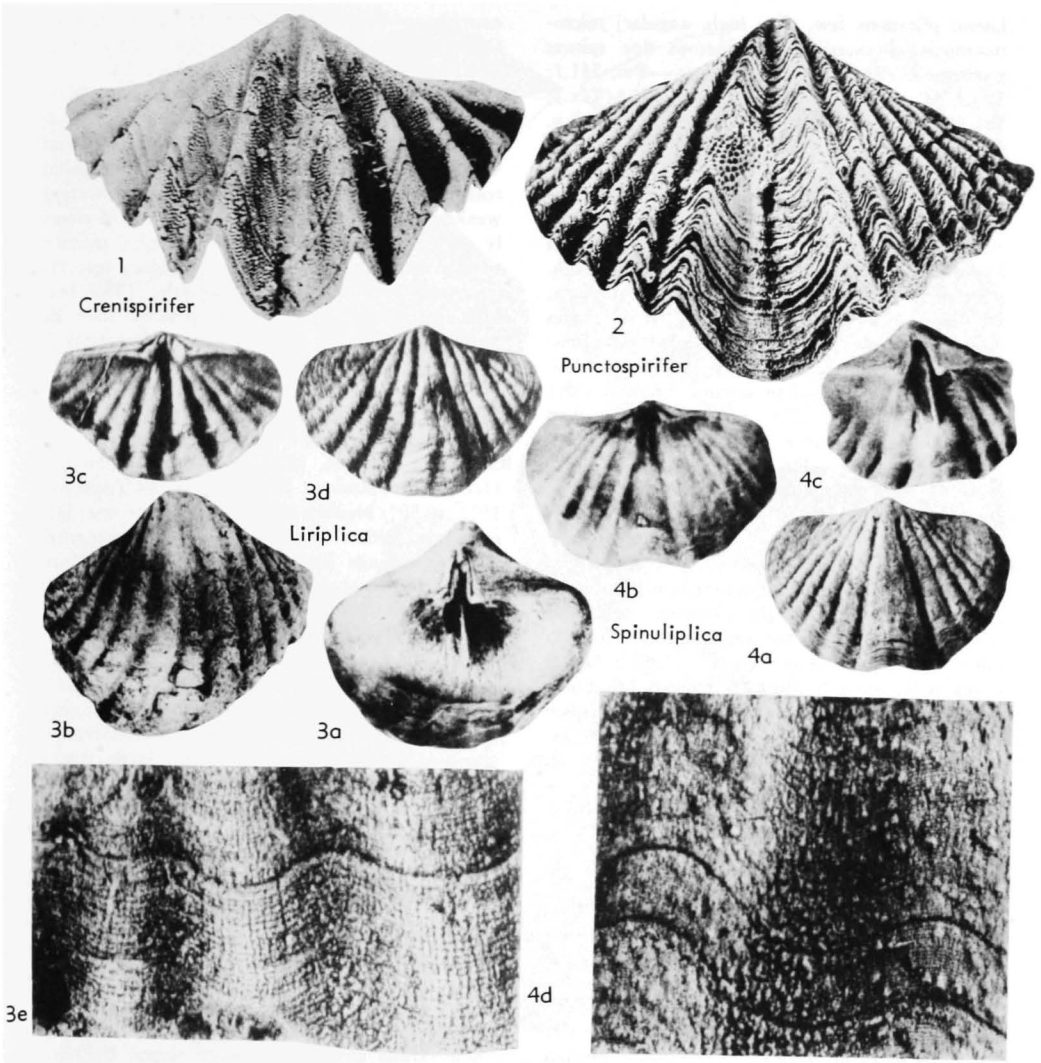


FIG. 581. Spiriferinidae (p. H713-H714).

transverse, with rounded cardinal extremities; micro-ornament consisting of fine, radially arranged spines; pedicle valve interior with dental plates, lacking median septum; neither presence nor absence of punctation firmly established. *Miss.*, N.Am.——FIG. 580,*6*. **A. aciculifera* (ROWLEY), L.Miss.; *6a,b,* brach.v., ped.v., ×12 (683).

Altiplecus STEHLI, 1954, p. 349 [**A. cooperi*; OD]. Small, highly transverse, triangular in outline; fold and sulcus deep, rather narrow, smooth; lateral plications few, low, rounded; micro-ornament of strong spines, generally in 1 or 2 concentric rows on irregular growth lamellae; punctate. *L. Perm.*, N.Am.——FIG. 580,*2*. **A. cooperi*, USA (Tex.); *2a,* ant., ×1.5; *2b,* ped.v., ×3 (773).

Callispirina COOPER & MUIR-WOOD, 1951, p. 195 [*pro Maia* FREDERIKS, 1919 (1924), p. 298 (*non* LAMARCK, 1801; *nec* REICHENBACH, 1850); *pro Maya* RAKUSZ, 1932, p. 77 (*non* BLATTNY, 1925); *pro Mansuyella* REED, 1944, p. 249 (*non* ENDO, 1937)] [**Spiriferina ornata* WAAGEN, 1883, p. 505; OD] [=*?Paraspiriferina* REED, 1944, p. 252 (type, *Spiriferina (Paraspiriferina) ghundiensis*)]. Small, essentially equidimensional; cardinal extremities rounded; fold and sulcus distinct, smooth; lateral slopes with 3 or 4 very strong, angular plications; micro-ornament of numerous growth lines only; punctate. *M.Perm.*, India.——FIG. 580,*1*. **C. ornata* (WAAGEN); *1a-d,* brach.v., ped.v., lat., ant., ×1.5; *1e,* surface, ×? (845).

Crenispirifer STEHLI, 1954, p. 347 [**Spiriferina angulata* KING, 1930, p. 122; OD]. Small, transverse, subequally biconvex; cardinal extremities slightly rounded; fold and sulcus narrow, smooth;

lateral plications few, very high, angular; micro-ornament of exceedingly numerous fine spines; punctate. *U.Penn.-U.Perm.*, N.Am.——Fig. 581,*1*; 580,*3*. **C. angulata* (King), L.Perm., USA(Tex.); 581,*1*, ped.v., ×2; 580,*3a-e*, brach.v., brach.v. int., ant., ped.v. int., lat., ×1.5 (773).

?**Dimegelasma** Cooper, 1942, p. 232 [**Spirifer neglectus* Hall, 1858, p. 643; OD]. Strongly biconvex; approximately equidimensional; cardinal extremities rounded, producing hinge somewhat less than maximum width; interarea rather high, with delthyrium closed by flat pseudodeltidium; fold and sulcus pronounced, bald; lateral slopes with several, well-developed, rounded plications; pedicle valve interior with long, rather thin dental plates, lacking median septum; brachial valve interior with hinge plate supported by median septum; shell substance punctate. *Miss(L.Carb.)*, N.Am.-Australia.——Fig. 580,*4*. **D. neglectum* (Hall), Miss. (Keokuk Ls.); *4a-d*, ped.v., lat., brach.v., ant., ×1 (858); *4e,f*, ped.v. int., brach. v. int., ×0.7 (178).

Liriplica Campbell, 1961, p. 440 [**L. alta*; OD]. Small to medium-sized, equidimensional to moderately transverse, strongly biconvex; fold and sulcus smooth except for small median fold in sulcus and small median groove in fold; lateral slopes with about 6 distinct, rounded plications; micro-ornament of prominent growth lamellae and discontinuous capillae; pedicle valve interior with thick umbonal callus; punctate. *U. Carb.(?Westphal.)*, Australia (New S.Wales).—— Fig. 581,*3*, **L. alta*; *3a-d*, ped.v. int. mold, ped.v. mold, brach.v. int. mold, brach.v. mold, ×1; *3e*, surface, ×10 (143).

?**Mentzeliopsis** Trechmann, 1918, p. 229 [**M. spinosa*; OD]. Equidimensional to weakly transverse; cardinal extremities slightly rounded; fold and sulcus distinct, low, wide, bald; lateral slopes with several rather weak plications; micro-ornament consisting of prominent imbricating growth lamellae and large tubular spines; pedicle valve interior with dental plates and prominent median septum; shell substance seemingly impunctate. *Trias.*, N.Z.——Fig. 582,*2*. **M. spinosa*; *2a-c*, brach.v., ped.v., int. mold, ×1 (816).

Odontospirifer Dunbar, 1955, p. 154 [**O. mirabilis*; OD]. Small, transverse, strongly biconvex; fold narrow, smooth; sulcus with single median plication; lateral plications strong; micro-ornament of strong growth lamellae and faint capillae; hinge line denticulate; dental plates weak; impunctate. *U.Perm.*, Greenl.——Fig. 582,*4*. **O. mirabilis*; *4a-d*, brach.v., ped.v., lat., ant., ×3; *4e-f*, ped.v., ped.v. int., ×7.5 (269).

Punctospirifer North, 1920, p. 212 [**P. scabricosta*; OD]. Small to medium-sized, transverse; fold and sulcus distinct, wide, smooth; lateral plications strong and rather numerous; micro-ornament of strong, imbricate growth lamellae and distinct capillae; punctate. *L. Carb. - Perm.*, cosmop.——Fig. 581,*2*; 582,*3*. **P. scabricosta*, L. Carb.(Visean), Br.I.; 581,*2*, ped.v., ×3.3; 582, *3a-d*, brach.v., post., ant., lat., ×2 (142).

?**Punctothyris** Hyde, 1953, p. 288 [**P. argus*; OD]. Small; slightly transverse; cardinal angles rounded, resulting in hinge line less than maximum width; lateral slopes with about 10 gently rounded costae; fold and sulcus rather obscure, bearing weaker costae; micro-ornament consisting of closely spaced growth lamellae; pedicle valve interior with short dental plates, lacking median septum; shell substance presumably punctate. [The features interpreted by Hyde as punctae may be merely spine bases, in which case *Punctothyris* should be reassigned to the *Spiriferidae*.] *Miss.*, N.Am.——Fig. 582,*1*. **P. argus*, USA(Ohio); *1a-e*, lat., brach.v., ped.v., ant., post., ×2; *1f*, micro-ornament, ×15 (441).

Rastelligera Hector, 1879, p. 538 [**R. elongata* Hector in Thomson, 1913, p. 50; SD Thomson, 1913, p. 50]. Medium-sized, highly transverse; lateral slopes with 4 or 5 distinct but gently rounded plications; hinge line denticulate; shell structure not known, probably punctate. *U.Trias.(Rhaet.)*, N.Z.——Fig. 583,*2*. **R. elongata*; *2a-c*, brach.v., ped.v. int., ant., ×1 (806).

Reticulariina Frederiks, 1916, p. 16 [**Spirifer spinosus* Norwood & Pratten, 1855, p. 71; OD]. Rather small, transverse; fold and sulcus rather narrow, smooth; lateral slopes with 5 or 6 distinct plications; micro-ornament of few large spines which leave elliptical scars; punctate. *Miss.*, N.Am. ——Fig. 583,*6*. **R. spinosa* (Norwood & Pratten), Chester., USA(Ill.); *6a*, brach.v., ×5; *6b-e*, ped.v., ant., post., lat., ×2 (142).

Sinucosta Dagis, 1963, p. 104 [**Spirifer emmrichi* Suess, 1854; OD] [?=*Guseriplia* Dagis, 1963, p. 107 (type, *G. multicostata*)]. Medium-sized, unequally biconvex, slightly transverse, with narrowly to broadly rounded cardinal extremities; lateral slopes with few to many distinct costae; fold and sulcus generally rather obscure, bearing costae similar to those on lateral slopes. *U.Trias.*, Eu.-Asia.——Fig. 583A,*1*. **S. emmrichi* (Suess); Rhaet., Alps; *1a-d*, brach.v., ped.v., post., lat., ×1 (212a).

Spinuliplica Campbell, 1961, p. 442 [**S. spinulosa*; OD]. Medium-sized, moderately transverse, with rounded cardinal extremities; fold distinct, smooth; sulcus with single median costa; lateral slopes with 6 or 7 rounded plications; micro-ornament of closely spaced, distinct growth lamellae and very numerous, fine, anteriorly directed spines; punctate. *U.Carb.(?Westphal.)*, Australia (New S. Wales).——Fig. 581,*4*. **S. spinulosa*; *4a-c*, brach.v., brach.v. int., ped.v. int., ×1; *4d*, surface, ×10 (143).

Spiriferellina Frederiks, 1919 (1924), p. 299 [**Terebratulites cristatus* von Schlotheim, 1816, p. 28; OD] [=*Tylotoma* Grabau, 1934, p. 100 (obj.)]. Small, moderately transverse, with

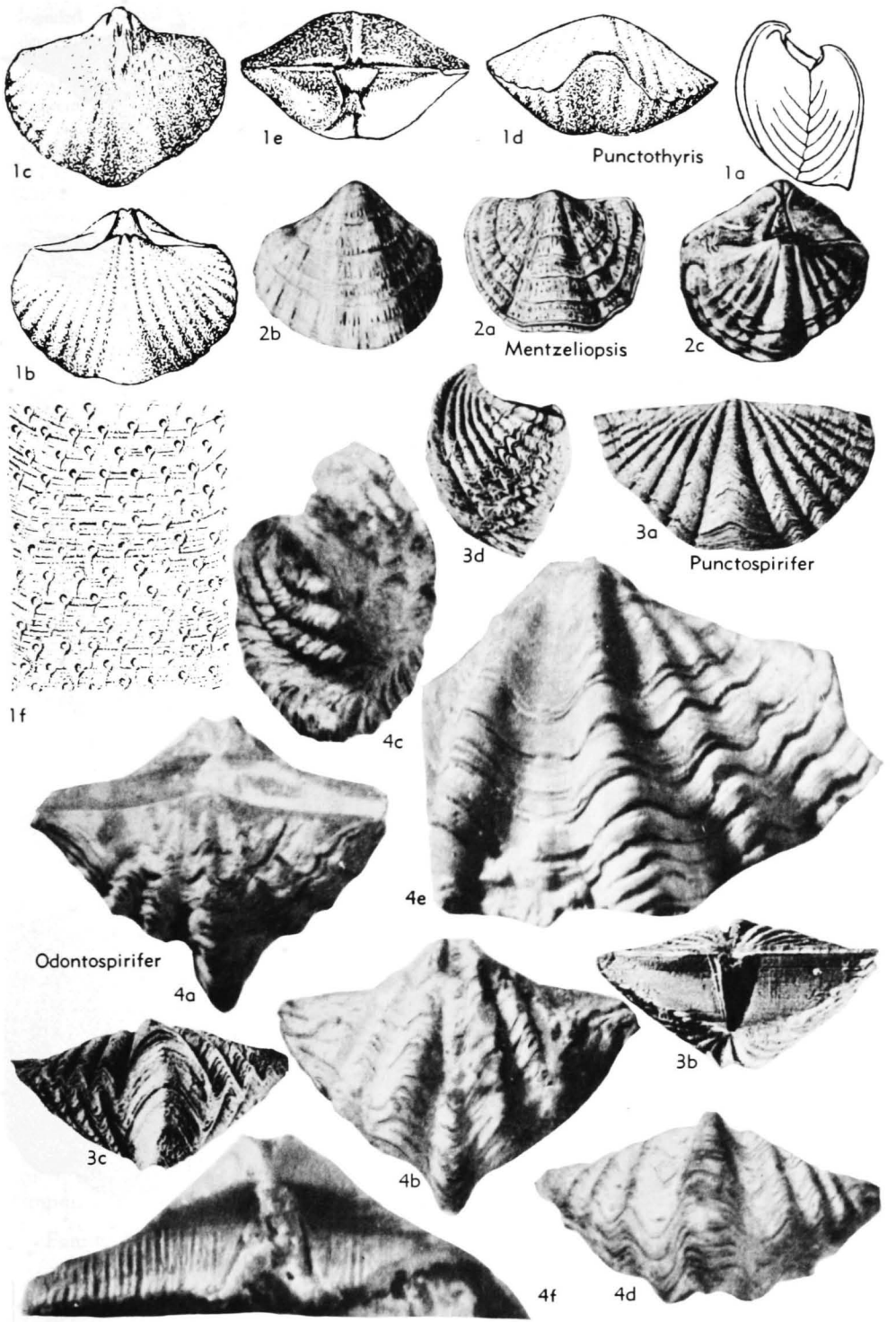


FIG. 582. Spiriferinidae (p. *H*714).

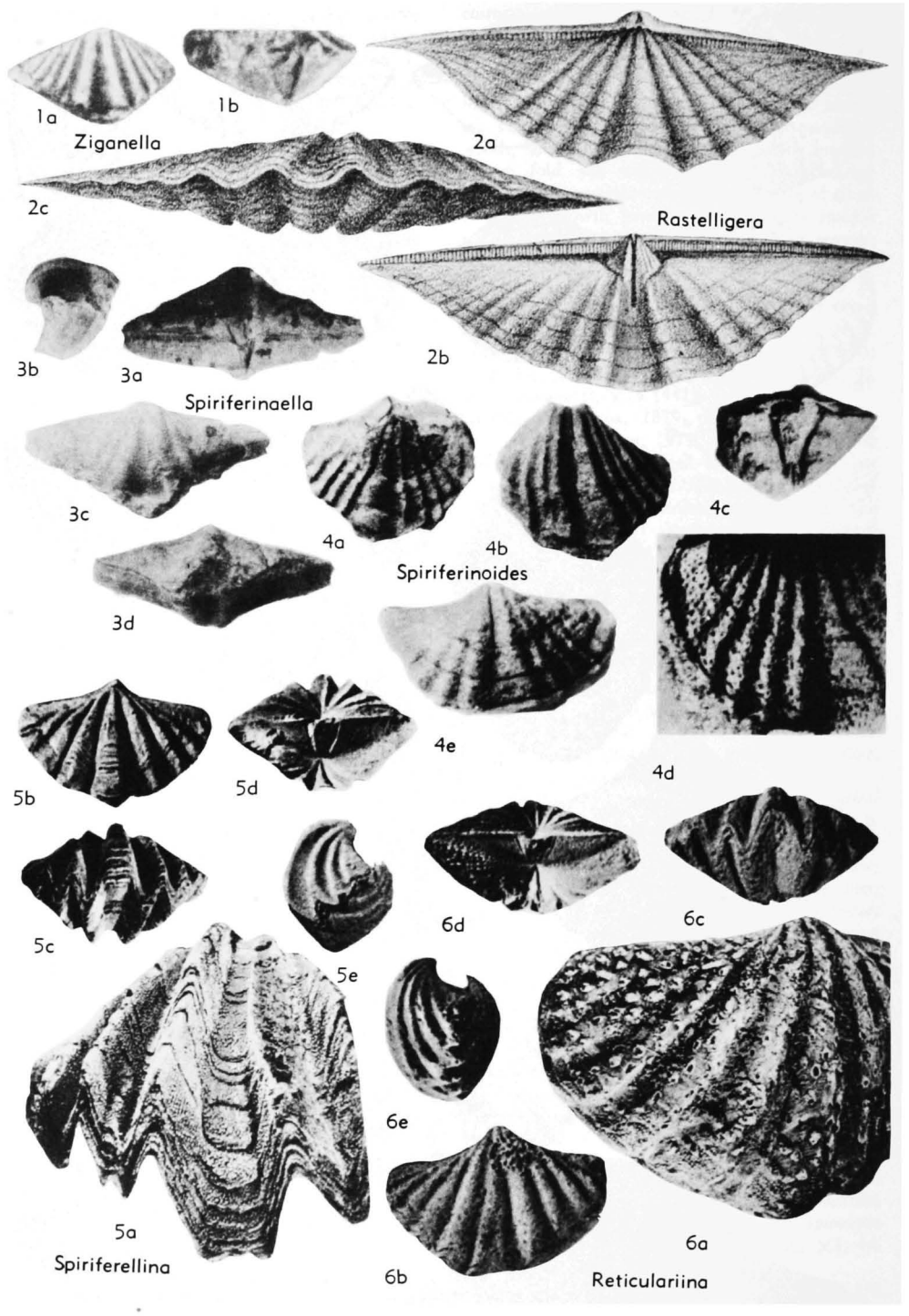


Fig. 583. Spiriferinidae (p. *H*714, *H*717).

rounded cardinal extremities; fold and sulcus deep, narrow, smooth; lateral slopes with 3 to 6 angular plications; micro-ornament of imbricate growth lamellae and very numerous fine granules; punctate. *Perm.,* Eu.-Asia-N.Am.——FIG. 583,*5*. **S. cristata* (VON SCHLOTHEIM), U.Perm., Ger.; *5a,* ped.v., ×5; *5b-e,* brach.v., ant., post., lat., ×2 (142).

Spiriferinaella FREDERIKS, 1926, p. 407 [**Spirifer artiensis* STUCKENBERG, 1898, p. 266; OD]. Like *Odontospirifer* except lateral plications somewhat weaker and more numerous, and dental plates stronger. *L.Perm.,* USSR.——FIG. 583,*3*. **S. artiensis* (STUCKENBERG); *3a-d,* post., lat., ped.v., ant., ×1 (158).

Spiriferinoides TOKUYAMA, 1957, p. 101 [**S. sakawanus* KOBAYASHI & TOKUYAMA in TOKUYAMA, 1957; OD]. Small, rather transverse, with rounded cardinal extremities; pedicle valve semiconical; brachial valve nearly flat; fold and sulcus well developed, smooth; lateral slopes with about 6 distinct plications; micro-ornament of imbricate growth lamellae and numerous, fine, tubular spines; dental plates weak, commonly reduced to teeth ridges; impunctate. *M.Trias.-U.Trias.,* Eu.-Asia.——FIG. 583,*4a-d*. **S. sakawanus,* U.Trias. (Carn.), Japan; *4a-c,* brach.v. int. mold, ped.v. int. mold, post. int. mold, ×2; *4d,* surface mold, ×5 (812).——FIG. 583,*4e*. *S. yeharai* KOBAYASHI & TOKUYAMA, U.Trias.(Carn.), Japan; ped.v. int. mold, ×2 (812).

?Ziganella NALIVKIN in IVANOVA, 1960, p. 280 [**Z. ziganensis*; OD]. Like *Punctospirifer* but lacking median septum in pedicle valve. *L.Carb. (Tournais.),* USSR.——FIG. 583,*1*. **Z. ziganensis*; *1a,b,* ped.v., post., ×1.5 (448).

Superfamily RETICULARIACEA Waagen, 1883

[*nom. transl.* PITRAT, herein (*ex* Reticulariinae WAAGEN, 1883, p. 538)]

Generally biconvex; equidimensional to slightly transverse; cardinal extremities rounded, resulting in rather short hinge line; fold and sulcus generally present, tending to be rather weak; macro-ornament generally lacking or consisting of low, weak plications; micro-ornament highly variable; pedicle valve interior with or without dental plates and median septum; brachial valve interior with striate cardinal process, with or without crural plates; shell substance impunctate. *?U.Sil., L.Dev.-Perm., ?Trias.*

Family RETICULARIIDAE Waagen, 1883

[*nom. transl.* IVANOVA, 1959, p. 56 (*ex* Reticulariinae WAAGEN, 1883, p. 538)]

Biconvex; equidimensional to slightly transverse, with rounded cardinal extremities and hinge line much less than maximum width; lateral slopes generally bald, more rarely weakly plicate; never costate; fold and sulcus generally present, commonly weak, bald; micro-ornament consisting of concentric growth lamellae, generally in combination with uniramous spines, papillae or granules; pedicle valve interior with or without dental plates and median septum; brachial valve interior generally lacking crural plates; cardinal process longitudinally striate; shell substance impunctate. *?U.Sil., L.Dev.-L.Carb., ?U.Carb.-?Trias.*

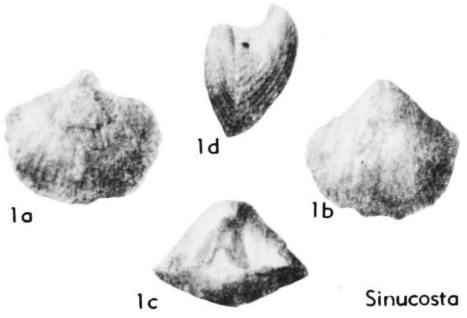


FIG. 583A. Spiriferinidae (p. *H*714).

Reticularia M'COY, 1844, p. 142 [**Terebratula? imbricata* SOWERBY, 1822, p. 40; SD DAVIDSON, 1882, p. 80] [=*?Sinothyris* MINATO, 1953, p. 68 (type, *Spirifer maureri* HOLZAPFEL, 1896)]. Unequally biconvex; slightly transverse, with rounded cardinal extremities; fold and sulcus very weak to absent; lateral slopes bald; micro-ornament consisting of conspicuous concentric growth lamellae and uniramous spines; pedicle valve interior with well-developed dental plates and median septum; brachial valve interior lacking crural plates. *?Dev., L.Carb.,* Eu.-Asia.——FIG. 584,*8a-d*. **R. imbricata* (SOWERBY), L.Carb., Br. I.; *8a-d,* brach.v., ped.v., ant., lat., ×1 (335).——FIG. 584,*8e-j*. *R. maureri* (HOLZAPFEL), Dev., China; *8e-i,* brach.v., ped.v., lat., post., ant., ×1; *8j,* ornament, ×5 (358).

[MINATO diagnosed *Sinothyris* as being "without dental plates, but with a median septum in the ventral valve." The diagnosis was based on Chinese forms referred to *Spirifer maureri* HOLZAPFEL, 1896, by GRABAU (1931, p. 394-96). Evidently MINATO based the diagnosis on GRABAU's statement that "no indications of dental plates have been seen in these specimens, but a median septum is indicated in one of them. . . ." The specimens to which GRABAU referred were not the whole suite of specimens which he had before him, but rather three exceptionally well-preserved specimens which evidently were not sectioned. In a later paragraph GRABAU (p. 396) mentioned a different specimen, the beak of which was broken, and wrote that "close-set dental lamellae are seen, much thickened by stereoplasm. . . ." In the light of this last statement it would appear that the specimens do possess dental plates, in which case no grounds are seen for separation of the genus based upon them from *Reticularia*.]

?**Ambikella** Sahni & Srivastava, 1956, p. 207 [**A. fructiformis*; OD]. Pedicle valve with prominent fold, brachial valve with distinct sulcus; anterior commissure sulcate; micro-ornament of concentric growth lamellae; pedicle valve interior with thin dental plates and median septum; brachial valve

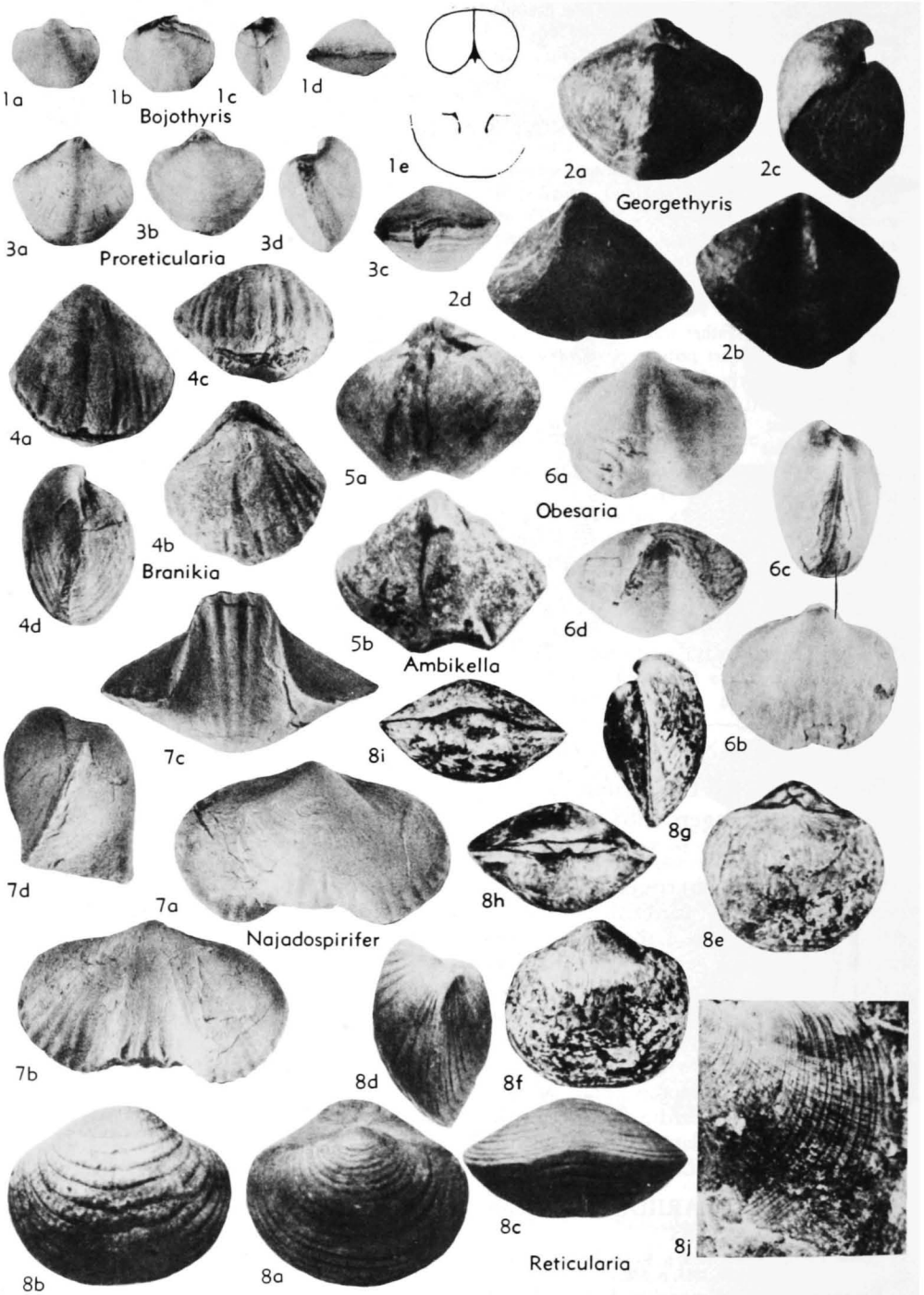


Fig. 584. Reticulariidae (p. *H*717-*H*719).

interior with long crural plates and median septum. *?U.Carb.*, India.——Fig. 584,*5*. **A. fructiformis*; *5a,b*, brach.v., ped.v., ×1 (701).

?Bojothyris Havlíček, 1959, p. 147 [**B. nikiforovae*; OD]. Micro-ornament consisting of concentric growth lamellae only; pedicle valve interior with spondylium simplex; otherwise similar to *Reticularia*. *L.Dev.(Siegen.)*, Boh.——Fig. 584, *1*. **B. nikiforovae*; *1a-d*, ped.v., brach.v., lat., ant., ×1; *1e*, transv. sec., ×3 (411).

?Branikia Havlíček, 1957, p. 437 [**Spirifer ascanius* Barrande, 1879, p. 99; OD]. Approximately equidimensional, equally biconvex; fold and sulcus absent; macro-ornament consisting of rather low plications on entire valve surface, micro-ornament of growth lines only; pedicle valve interior with short, thick dental plates, lacking median septum; brachial valve interior lacking crural plates. *L.Dev.(Ems.)*, Boh.——Fig. 584,*4*. **B. ascania* (Barrande); *4a-d*, ped.v., brach.v., ant., lat., ×1.5 (411).

?Elythina Rzhonsnitskaya, 1952, p. 61 [**E. salairica*; OD]. Weakly transverse with slightly rounded cardinal extremities; macro-ornament consisting of rather well-developed plications on lateral slopes; micro-ornament consisting of concentric growth lamellae and fine, long spines; pedicle valve interior with thick dental plates, lacking median septum. *M.Dev.(Couvin.-Givet.)*, USSR. ——Fig. 586,*2*. **E. salairica*; *2a-d*, lat., brach.v., ped.v., ant., ×1 (465).

Georgethyris Minato, 1953, p. 68 [**Reticularia alexandri* George, 1932, p. 553; OD]. Pedicle valve interior lacking median septum; fold and sulcus very strong, producing markedly uniplicate anterior commissure; otherwise similar to *Reticularia*. *L.Carb.(Visean)*, Br.I.——Fig. 584,*2*. **G. alexandri* (George); *2a-d*, brach.v., ped.v., lat., ant., ×1 (335).

Najadospirifer Havlíček, 1957, p. 246 [**Spirifer najadum* Barrande, 1848, p. 171; OD] [=*Naiadospirifer* Havlíček, 1957, p. 246 *(nom. null.)*]. External appearance typically reticulariid in early growth stages but later developing strong angular fold and sulcus and plications over entire shell; plications very strong on fold and sulcus; pedicle valve interior with dental plates, lacking median septum; brachial valve interior with short crural plates, lacking median septum. *L.Dev.(Ems.)*, Eu. ——Fig. 584,*7*. **N. najadum* (Barrande); *7a-d*, ped.v., brach.v., ant., lat., ×1 (411).

Obesaria Havlíček, 1957, p. 438 [**Spirifer indifferens* var. *obesa* Barrande, 1848, p. 159; OD]. Anterior commissure strongly uniplicate; micro-ornament consisting of concentric rows of granules; pedicle valve interior lacking dental plates and median septum; otherwise similar to *Reticularia*. *M.Dev.(Couvin.)*, Boh.——Fig. 586,*1*; 584, *6*. **O. obesa* (Barrande); 586,*1*, micro-ornament, ×12; 584,*6a-d*, ped.v., brach.v., lat., ant., ×1.5 (411).

?Proreticularia Havlíček, 1957, p. 247 [**Spirifer carens* Barrande, 1879, p. 218; OD]. Anterior commissure rectimarginate to weakly uniplicate; macro-ornament lacking; micro-ornament consisting of densely crowded growth lamellae bearing papillae on their anterior terminations; pedicle valve interior lacking dental plates and median septum; brachial valve interior without crural plates. *U.Sil.(Ludlov.)*, Bohemia.——Fig. 584,*3*. **P. carens* (Barrande); *3a-d*, ped.v., brach.v., ant., lat., ×1 (411).

?Quadrithyrina Havlíček, 1959, p. 136 [**Q. ivanovae*; OD]. Rather transverse, with distinct fold and sulcus, uniplicate anterior commissure; micro-ornament consisting of concentric growth lamellae with or without capillae; pedicle valve interior with strong, high median septum, lacking dental plates; otherwise similar to *Reticularia*. *M. Dev.(Couvin.)*, Boh.——Fig. 585,*1*. **Q. ivanovae*; *1a-e*, ped.v., brach.v., ant., lat., transv. sec., ×1 (411).

?Quadrithyris Havlíček, 1957, p. 437 [**Spirifer robustus* Barrande, 1848; OD]. Markedly transverse, with strong fold and sulcus and uniplicate anterior commissure; lateral slopes generally bald, rarely with weak plications; otherwise similar to *Reticularia*. *L.Dev.(Ems.)-M.Dev.(Couvin.)*, Eu.-N.Afr.——Fig. 585,*4*. **Q. robustus* (Barrande), Ems., Boh.; *4a-d*, ped.v., brach.v., lat., ant., ×1.5 (411).

Reticulariopsis Frederiks, 1916, p. 17 [**Spirifer (Reticularia) dereimsi* Oehlert, 1901, p. 236; SD Frederiks, 1918, p. 87] [=*Eoreticularia* Nalivkin in Frederiks, 1919 (1924), p. 314 (type, *Spirifer indifferens* Barrande, 1847); *Tingella* Grabau, 1931, p. 407 (type, *T. reticularioides*)]. Lateral slopes bald or rarely with very weak plications; fold and sulcus distinct; pedicle valve interior with well-developed dental plates, lacking median septum; brachial valve interior with crural plates, lacking median septum; otherwise similar to *Reticularia*. *L.Dev.-M.Dev.*, *?U. Dev.*, Eu.-Asia-Afr.-?Australia.——Fig. 585,*2a-f*. **R. dereimsi* (Oehlert), L.Dev.(Ems.), Spain; *2a-f*, transv. sec., transv. sec., brach.v., ant., ped.v., lat., ×1 (613).——Fig. 585,*2g-l*. *R. reticularioides* (Grabau), M.Dev., China; *2g-j*, brach.v., ped.v., ant., lat., ×3; *2k*, ornament, ×6; *2l*, int. mold post., ×4.5 (358).

[Frederiks (1916, p. 17) diagnosed *Reticulariopsis* as "*Reticularia*-like, but without a septum." He based the genus on three species, *Spirifer elliptica* Phillips, 1836, *Delthyris fimbriata* Conrad, 1842, and *Spirifer (Reticularia) dereimsi* Oehlert, 1901, all of which were said to be "type specimens." In 1918 Frederiks (p. 87) designated *R. dereimsi* (Oehlert) as type, but apparently changed his mind and in 1926 (p. 404) designated *R. elliptica* (Phillips) as type. Subsequent authors have overlooked the earlier designation and have taken *R. elliptica* as type-species. George (1932, p. 525) reinvestigated *R. elliptica* and found it possesses a median septum; on that basis he synonymized *Reticulariopsis* with *Reticularia*. Later workers have tended to follow George's lead. However, *R. dereimsi*, which must be regarded as the type-species of *Reticulariopsis*, does not possess a median septum, and therefore *Reticulariopsis* cannot properly be placed in the synonymy of *Reticularia*.]

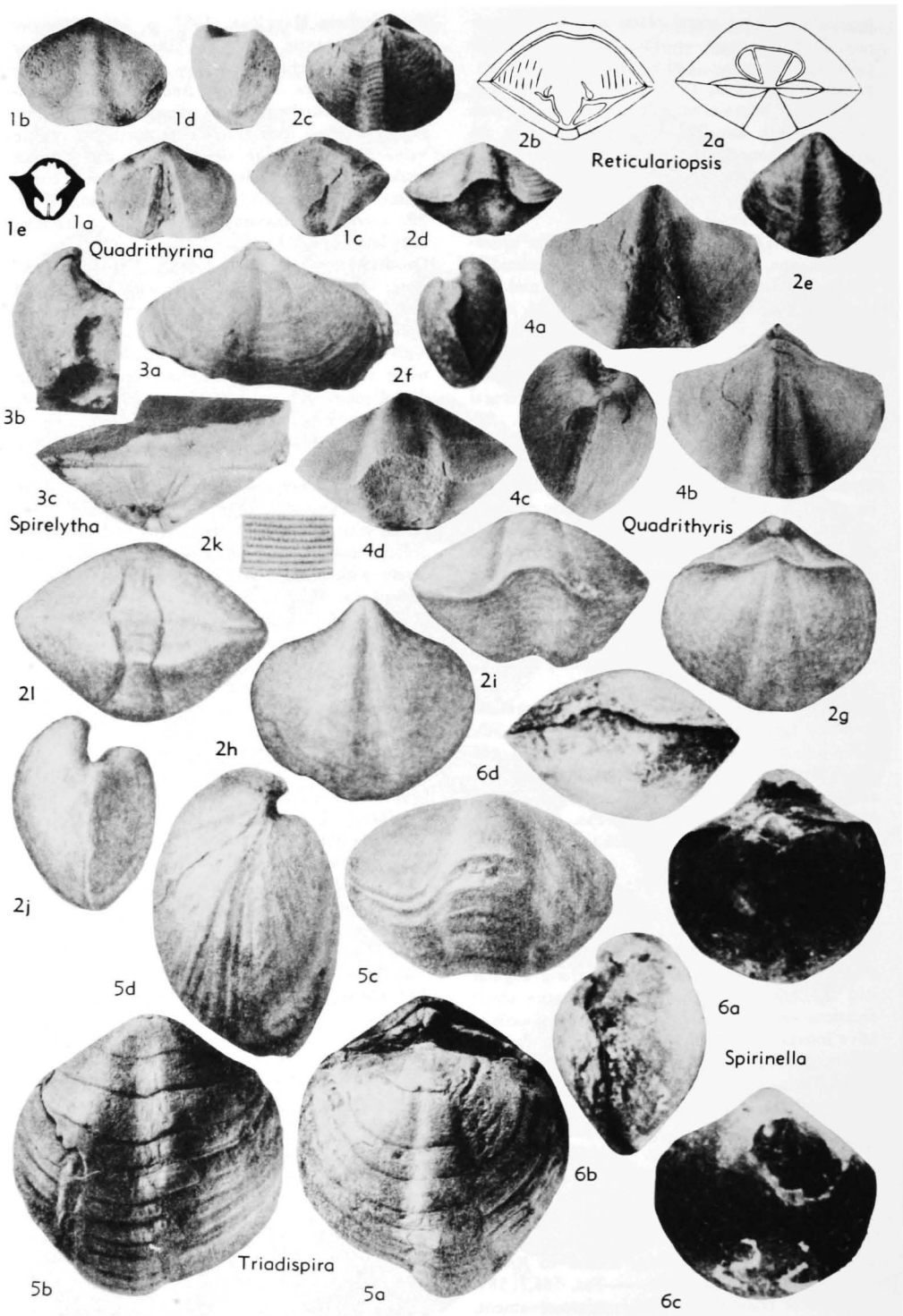


FIG. 585. Reticulariidae (p. *H719*, *H721*).

?**Spirelytha** FREDERIKS, 1919 (1924), p. 304 [**Spirifer schei* CHERNYSHEV, 1916, p. 69; OD]. Pedicle valve reticulariid in shape with well-developed sulcus; macro-ornament lacking; micro-ornament consisting of concentric growth lamellae and small, irregular tubercles; pedicle valve interior with dental plates, lacking median septum; brachial valve not known. *Perm.*, Arctic.——FIG. 585, *3*. **S. schei* (CHERNYSHEV); *3a-c*, ped.v., lat., post., ×1 (160).

?**Spirinella** JOHNSTON, 1941, p. 161 [**S. caecistriata*; OD]. Rather small; biconvex; essentially equidimensional; anterior commissure weakly uniplicate; macro-ornament lacking; micro-ornament consisting of concentric growth lamellae and obscure capillae; pedicle valve interior with dental plates, lacking median septum; brachial valve interior with neither median septum nor crural plates. *?U.Sil.(Ludlov.)*, Australia (New S. Wales).——FIG. 585,*6*. **S. caecistriata*; *6a-d*, brach.v., lat., ped.v., ant., ×2 (454a).

?**Triadispira** DAGIS, 1961, p. 457 [**T. caucasica*; OD]. Large; markedly biconvex; longer than wide; fold and sulcus distinct, forming markedly uniplicate anterior commissure; micro-ornament consisting of concentric growth lamellae and radially elongate papillae; otherwise similar to *Reticularia*. *Trias.*, USSR.——FIG. 585,*5*. **T. caucasica*, U.Trias.; *5a-d*, brach.v., ped.v., ant., lat., ×0.7 (212).

?**Undispirifer** HAVLÍČEK, 1957, p. 439 [**Spirifer undiferus* ROEMER, 1844, p. 73; OD]. Fold and sulcus distinct, bald; lateral slopes with low, rather obscure plications; pedicle valve interior with dental plates, lacking median septum; otherwise similar to *Reticularia*. *M.Dev.(Givet.)-U.Dev.(Frasn.)*, Eu.——FIG. 587,*3a*. **U. undiferus* (ROEMER), Ger.; brach.v., ×2.5 (411).——FIG. 587,*3b-e*. *U. transiens* (BARRANDE), Givet., Boh.; *3b-e*, ped.v., brach.v., ant., lat., ×1 (411).

Warrenella CRICKMAY, 1953, p. 596 [**W. eclectea*; OD] [=*Minatothyris* VANDERCAMMEN, 1957, p. 1 (type, *Spirifer euryglossus* SCHNUR, 1851)]. Fold and sulcus distinct, producing markedly uniplicate anterior commissure; pedicle valve interior with dental plates, lacking median septum; otherwise similar to *Reticularia*. *M.Dev.-U.Dev.*, cosmop. ——FIG. 587,*1a-f*. **W. eclectea*, U.Dev., Alta.; *1a-e*, brach.v., ped.v., post., ant., lat., ×1.5; *1f*, transv. sec., ×2 (205).——FIG. 587,*1g-j*. *W. euryglossus* (SCHNUR), U.Dev., Ger.; *1g-j*, brach.v., ped.v., lat., ant., ×1.5 (830).

Xenomartinia HAVLÍČEK, 1953, p. 6 [**X. monosepta*; OD]. Micro-ornament consisting of concentric growth lamellae and capillae, commonly with papillae at intersections; pedicle valve interior lacking dental plates; otherwise similar to *Reticularia*. *L. Dev. (Ems.)-M. Dev. (Couvin.)*, Eu.——FIG. 587,*2*. **X. monosepta*, Boh.; *2a-d*, ped.v., brach.v., ant., lat., ×2; *2e-f*, ped.v. int., brach.v. int., ×3 (411).

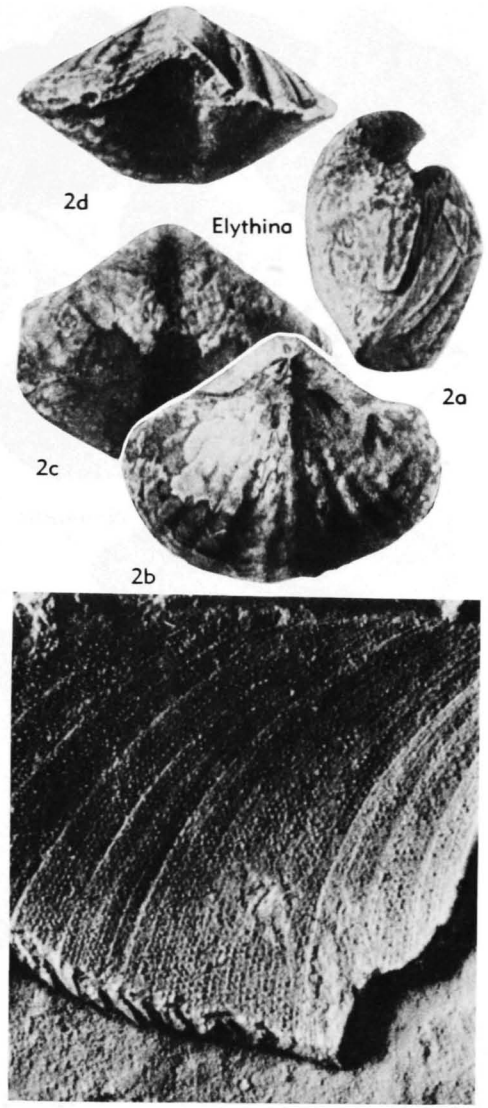


FIG. 586. Reticulariidae (p. H719).

Family ELYTHIDAE Frederiks, 1919 (1924)

[*nom. transl.* PITRAT, herein (*ex* Elythinae FREDERIKS, 1919 (1924), p. 304] [=Phricodothyrinae CASTER, 1939]

Markedly and almost evenly biconvex; equidimensional to moderately transverse, with broadly rounded cardinal extremities; fold and sulcus generally weak or absent, yielding rectimarginate to weakly uniplicate anterior commissure; macro-ornament lack-

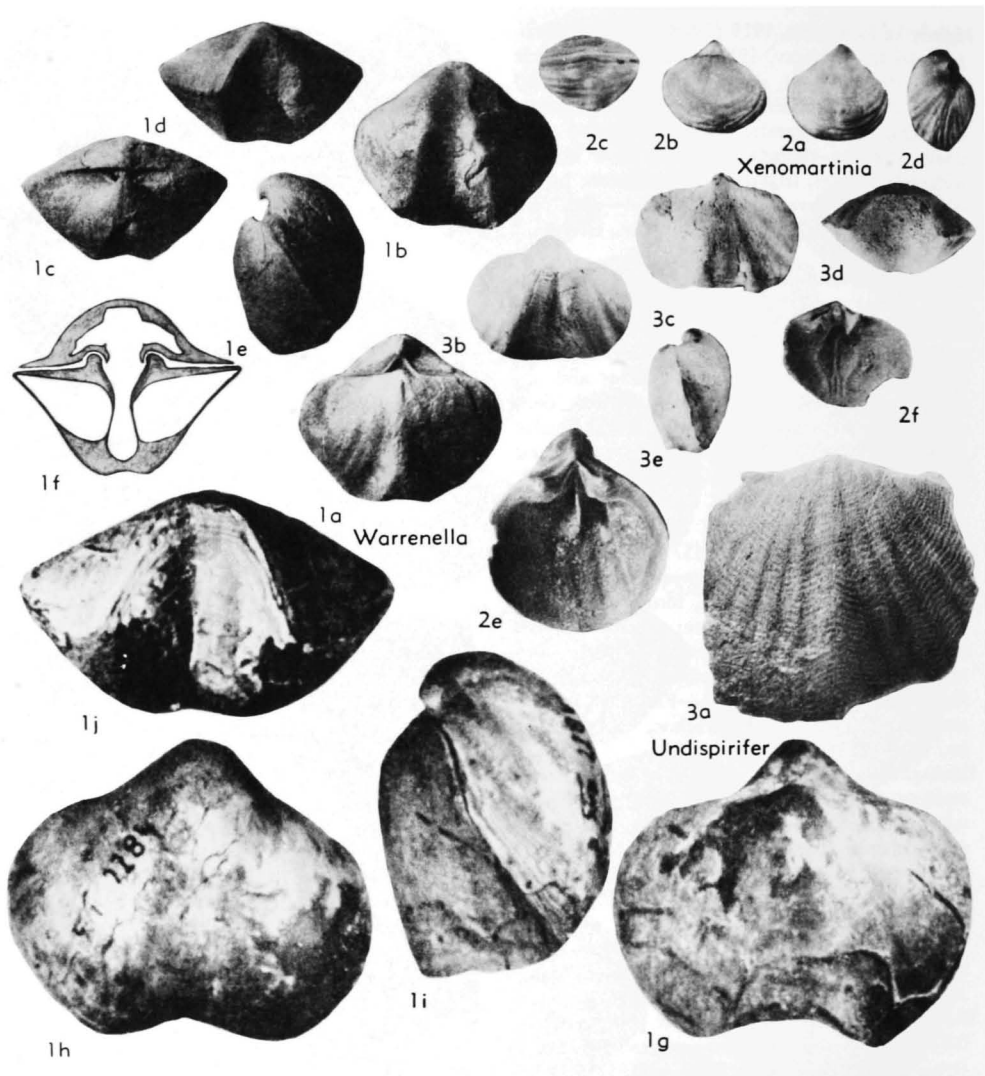


FIG. 587. Reticulariidae (p. *H721*).

ing, or less commonly consisting of rounded lateral plications; micro-ornament consisting of concentric growth lamellae, each terminating anteriorly in row of fine double-barreled spines; internal structures highly variable. *M.Dev.-Perm.*

Elita FREDERIKS, 1918, p. 87 [**Delthyris fimbriata* CONRAD, 1842, p. 263; OD] [=*Elytha* FREDERIKS, 1919 (1924), p. 304 *(nom. van.)*; *Elyta* IVANOVA, 1960, p. 277 *(nom. null.)*]. Lateral slopes with several low, rounded plications; pedicle valve interior with stout dental plates and median septum; brachial valve interior with short crural plates. *M.Dev.-U.Dev.*, cosmop.——FIG. 588,*4*. **E. fimbriata* (CONRAD), Hamilton, USA(N.Y.); *4a,b*, brach.v., lat., ×1 (178).

Kitakamithyris MINATO, 1951, p. 374 [**Torynifer (Kitakamithyris) tyoanjiensis* MINATO, 1951; OD]. Brachial valve lacking median septum; otherwise similar to *Torynifer*. *L.Carb.*, Japan-Australia.——FIG. 588,*6*. **K. tyoanjiensis*, Tournais., Japan; *6a*, post., ×1; *6b*, ornament, ×2 (561).

Martinothyris MINATO, 1953, p. 70 [**Terebratula? lineata* J. SOWERBY, 1822, p. 39 (=*Conchyliolites (Anomites) lineatus* MARTIN, 1809) (ICZN Opinion 420, p. 132, 1956); OD]. Pedicle valve interior with dental plates; brachial valve interior with crural plates; otherwise similar to *Phricodothyris*. *L.Carb.*, Br.I.——FIG. 588,*1*. **M. lineatus*

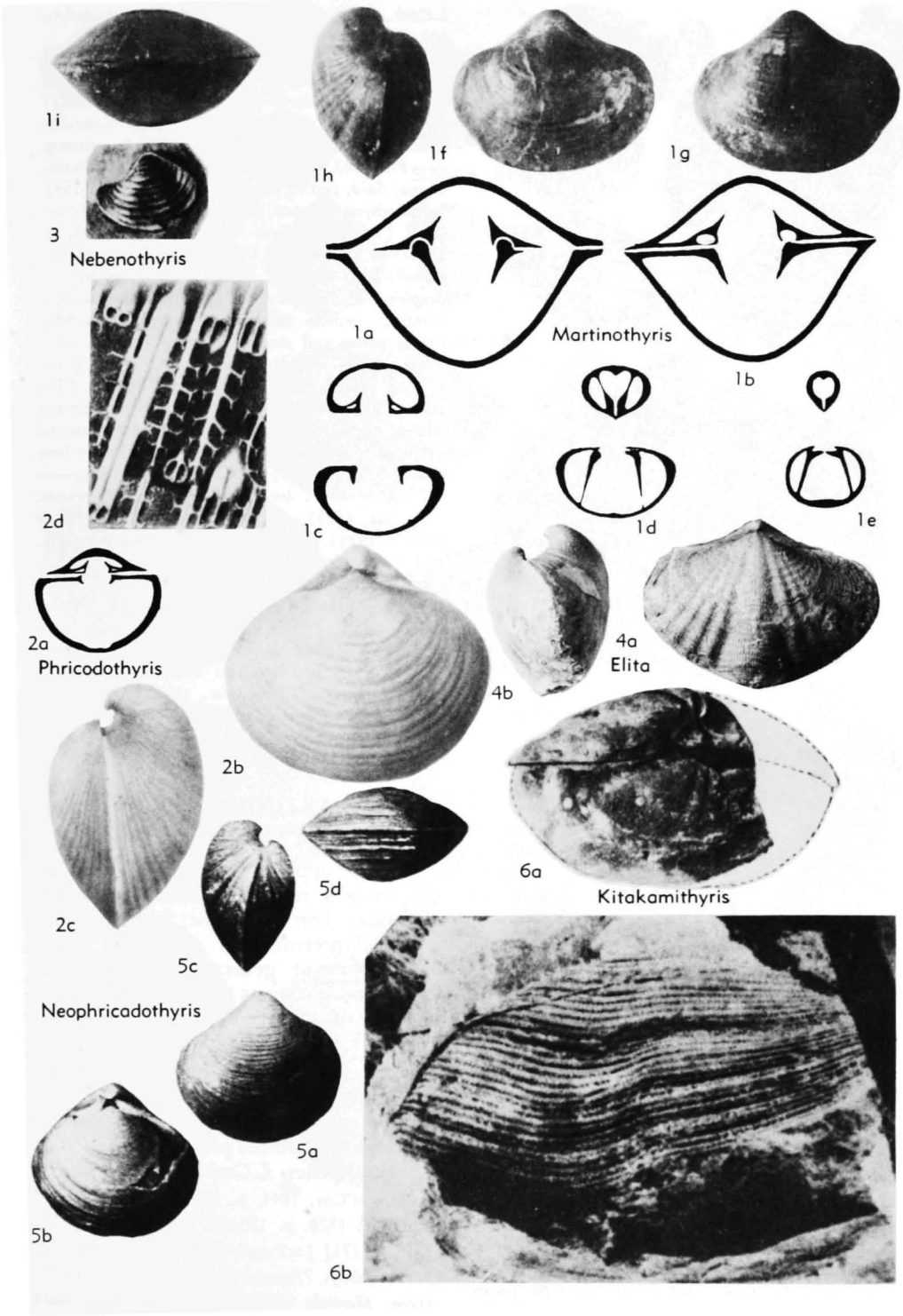


FIG. 588. Elythidae (p. *H722*, *H724*).

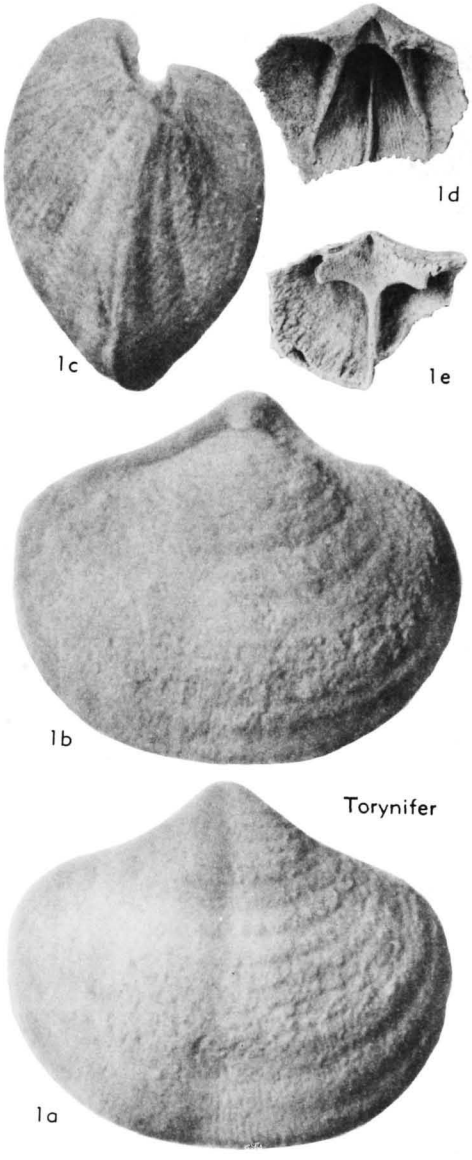


FIG. 589. Elythidae (p. *H*724).

(SOWERBY); *1a-e*, transv. sec., ×2; *1f-i*, brach.v., ped.v., lat., ant., ×1 (335).

Nebenothyris MINATO, 1953, p. 72 [**N. lineatus*; OD]. Pedicle valve interior with median septum; brachial valve interior with median septum; otherwise seemingly similar to *Phricodothyris*; poorly known. [MINATO deliberately used NEBE's (1911, p. 447) misidentification of *Terebratula? lineata* J. SOWERBY as type-species for *Nebenothyris*. According to the *Code* (Art. 70,b,i) the type-species is to be based on the NEBE material, but is to be known as *Nebenothyris lineatus* MINATO, 1953.] *L.Carb.*, Ger.——FIG. 588,*3*. **M. lineatus*; ped.v., ×1 (596).

Neophricadothyris LIKHAREV, 1934, p. 214 [**Squamularia asiatica* CHAO, 1929, p. 91; OD] [=*Neophricodothyris* IVANOVA, 1960, p. 277 *(nom. null.)*]. Spiralia directed posterolaterally; otherwise similar to *Phricodothyris*. *Perm.*, cosmop. ——FIG. 588,*5*. **N. asiatica* (CHAO), L.Perm., China; *5a-d*, ped.v., brach.v., lat., ant., ×1 (154).

Phricodothyris GEORGE, 1932, p. 524 [**P. lucerna*; OD] [?=*Squamularia* GEMMELLARO, 1899, p. 189 (*non* ROTHPLETZ, 1896) (type, *S. rotundata*); *Condrathyris* MINATO, 1953, p. 69 (type, *Spirifer perplexa* MCCHESNEY, 1860)]. Macro-ornament wanting; pedicle valve interior typically lacking dental plates and median septum; brachial valve interior with laterally directed spiralia, generally lacking crural plates and median septum. [The name *Squamularia* was first used by ROTHPLETZ (1896) for a fossil which could be either animal or plant. Its use by GEMMELLARO (1899) is here regarded as invalid.] *L.Carb.-Perm.*, cosmop.—— FIG. 588,*2a*. **P. lucerna*, L.Carb., Br.I.; transv. sec., ×2 (335).——FIG. 588,*2b-d*. *P. perplexa* (MCCHESNEY), Penn., USA; *2b,c*, brach.v., lat., ×1.5; *2d*, spines, ×8 (485).

Torynifer HALL & CLARKE, 1894, pl. 84 [**T. criticus* (=*Spirifer pseudolineatus* HALL, 1858, p. 645); OD]. Pedicle valve interior with dental plates and median septum; brachial valve interior with low median septum; otherwise similar to *Phricodothyris*. *U.Dev.-Miss.*, cosmop. —— FIG. 589,*1*. **T. pseudolineatus* (HALL), Meramec., USA; *1a-c*, ped.v., brach.v., lat., ×1.5 (858); *1d,e*, ped.v. int., brach.v. int., ×2 (178).

Family MARTINIIDAE Waagen, 1883

[*nom. transl.* IVANOVA, 1959, p. 56 (*ex* Martiniinae WAAGEN, 1883, p. 524)]

Biconvex; approximately equidimensional, with broadly rounded cardinal extremities and rather short hinge line; fold and sulcus generally present, but commonly weak; macro-ornament generally lacking, rarely with lateral plications or costae; micro-ornament consisting of concentric growth lamellae and surficial pits, some shells with capillae; pedicle valve interior with or without dental plates and median septum; brachial valve interior with low, longitudinally striated cardinal process, with or without crural plates. *L.Carb.-Perm., ?Trias.*

Martinia M'COY, 1844, p. 128 [**Spirifer glaber* J. SOWERBY, 1820, p. 123; SD ICZN Opinion 421, 1956, p. 171] [=*Pseudomartinia* LEIDHOLD, 1928, p. 82 (obj.); *?Paramartinia* REED, 1949, p. 471 (type, *Martinia (Paramartinia) lingulata* REED, 1949)]. Fold and sulcus distinct, forming uni-

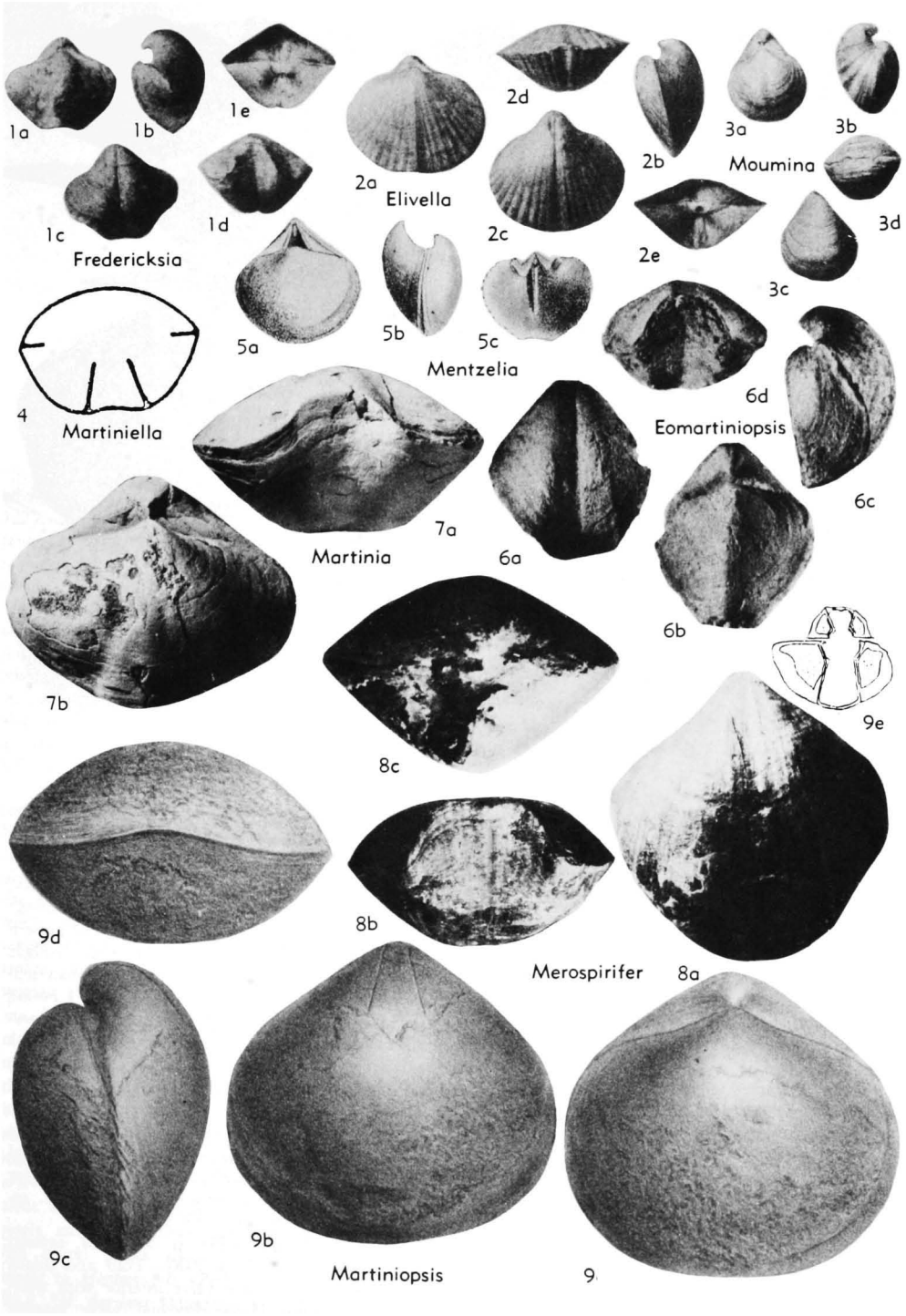


FIG. 590. Martiniidae (p. *H724*, *H726-H727*).

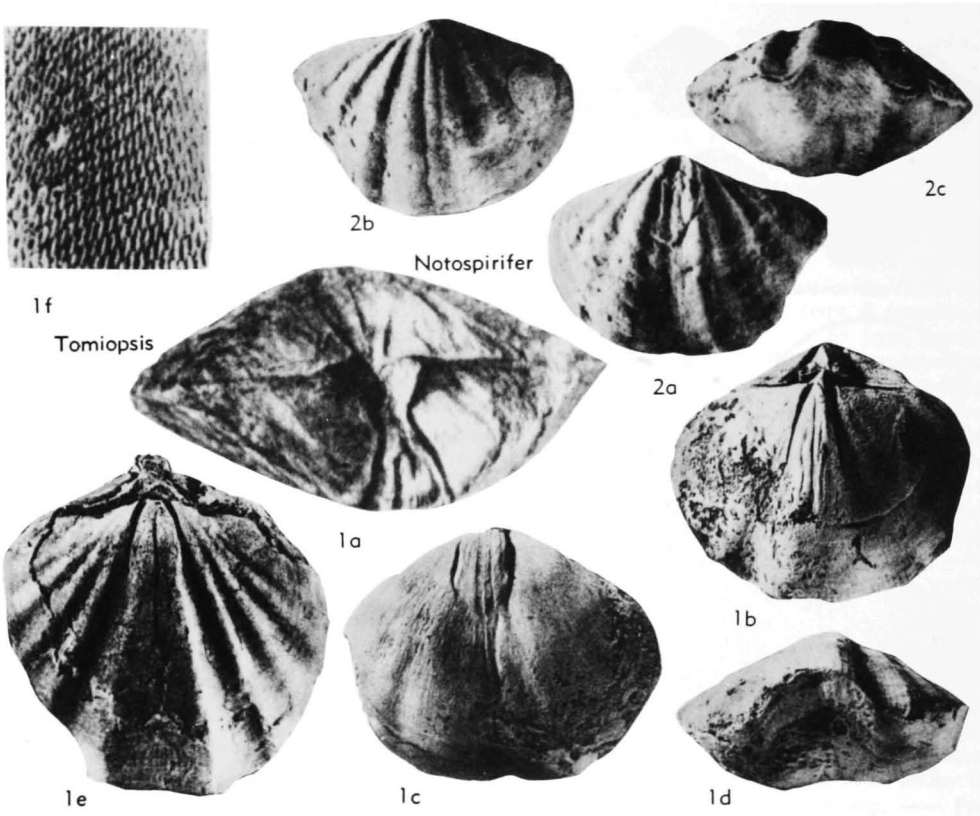


FIG. 591. Martiniidae (p. *H727*).

plicate anterior commissure; macro-ornament lacking; micro-ornament consisting of concentric growth lamellae and surficial pits; pedicle valve interior lacking dental plates and median septum; brachial valve interior lacking crural plates. *L.Carb., ?U.Carb.,* cosmop.——FIG. 590,*7*. **M. glabra* (SOWERBY), L.Carb., Br.I.; *7a,b,* ant., brach.v., ×0.5 (581).

Elivella FREDERIKS, 1919 (1924), p. 316 [**Martiniopsis baschkirica* CHERNYSHEV, 1902, p. 558; SD FREDERIKS, 1926, p. 403]. Lateral slopes with rather numerous, low, rounded plications; micro-ornament consisting of capillae and surficial pits; pedicle valve interior with dental plates, lacking median septum; otherwise similar to *Martinia. L.Perm.,* USSR.——FIG. 590,*2*. **E. baschkirica* (CHERNYSHEV); *2a-e,* brach.v., lat., ped.v., ant., post., ×1 (158).

Eomartiniopsis SOKOLSKAYA, 1941, p. 78 [**E. elongata*; OD]. Fold and sulcus distinct, producing strongly uniplicate anterior commissure; crural plates very short; otherwise similar to *Martiniopsis. L.Carb.,* USSR.——FIG. 590,*6*. **E. elongata*; *6a-d,* ped.v., brach.v., lat., ant., ×1 (752).

Fredericksia PAECKELMANN, 1931, p. 48 [*pro Munia* FREDERIKS, 1918, p. 88 (*non* HODGE, 1836)] [**Spiriferina (Mentzelia) simensis* CHERNYSHEV, 1902, p. 514; OD]. Fold and sulcus strong; micro-ornament consisting of concentric growth lamellae, capillae, and surficial pits; pedicle valve interior with dental plates and median septum; otherwise similar to *Martinia. L.Perm.,* USSR.——FIG. 590,*1*. **F. simensis* (CHERNYSHEV); *1a-e,* brach.v., lat., ped.v., ant., post., ×1 (158).

?Martiniella GRABAU & TIEN in GRABAU, 1931, p. 420 [**M. nasuta*; OD]. Micro-ornament consisting of capillae; presence of surficial pits not established; pedicle valve interior with dental plates, lacking median septum; otherwise similar to *Martinia. Carb.,* China.——FIG. 590,*4*. *M.* sp. GRABAU; transv. sec., ×1 (359).

Martiniopsis WAAGEN, 1883, p. 524 [**M. inflata*; SD ETHERIDGE, 1892, p. 238]. Fold and sulcus weak to absent; pedicle valve interior with well-developed dental plates; brachial valve interior with long, thin crural plates; otherwise similar to *Martinia. U.Carb.-Perm.,* Eu.-Asia.——FIG. 590,*9*. **M. inflata,* L.Perm., India; *9a-d,* brach.v.,

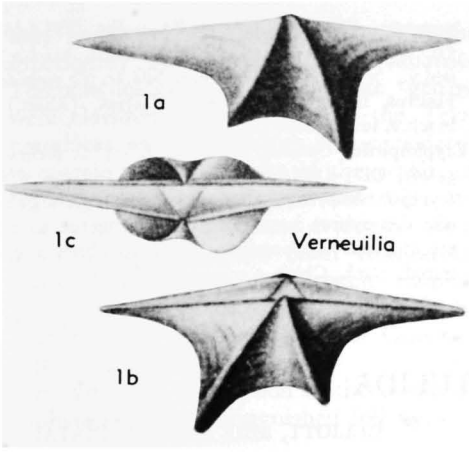


FIG. 592. Family Uncertain (p. *H727*).

ped.v., lat., ant., ×1 (845); *9e*, transv. sec., ×1 (122).

?Mentzelia QUENSTEDT, 1871, p. 522 [**Spirifer medianus* QUENSTEDT, 1852, p. 482 (=**Spirifer mentzeli* DUNKER, 1851, p. 287); OD]. Shape typically martiniid, but fold and sulcus wanting; anterior commissure rectimarginate; macro-ornament lacking; micro-ornament poorly known; pedicle valve interior with dental plates, strong median septum, and delthyrial plate; brachial valve interior lacking crural plates. *?Perm., Trias.*, Eu.-Asia.——FIG. 590,*5*. **M. mentzeli* (DUNKER), M.Trias., Ger.; *5a-c*, brach.v., lat., ped.v. int., ×? (651).

?Merospirifer REED, 1948 (1949), p. 467 [**Martinia (Merospirifer) insolita*; OD]. Macro-ornament consisting of very numerous, very weak costae; micro-ornament including concentric growth lamellae and granules, evidently lacking surficial pits; pedicle valve interior with dental plates and median septum. *L.Carb.*, Br.I.——FIG. 590,*8*. **M. insolita*; *8a-c*, ped.v., ant., post., ×1 (665).

Moumina FREDERIKS, 1919 (1924), p. 321 [**Martinia incerta* CHERNYSHEV, 1902, p. 569; OD]. Small; micro-ornament consisting of concentric growth lamellae, capillae and surficial pits; otherwise similar to *Martinia*. *L.Perm.*, USSR.——FIG. 590,*3*. **M. incerta* (CHERNYSHEV); *3a-d*, brach.v., lat., ped.v., ant., ×1 (158).

Notospirifer HARRINGTON, 1955, p. 115 [**Spirifer darwini* MORRIS, 1845, p. 279; OD]. Fold and sulcus distinct; lateral slopes with 3 to 6 moderately strong plications; brachial valve interior with crural plates short or lacking; otherwise similar to *Martiniopsis*. *Perm.*, Australia.——FIG. 591,*2*. **N. darwini* (MORRIS); *2a-c*, ped.v., brach. v., ant., ×1 (141).

Tomiopsis BENEDIKTOVA, 1956, p. 169 [**Brachythyris kumpani* YANISHEVSKIY, 1935, p. 68; OD] [=*Ingelarella* CAMPBELL, 1959, p. 340 (type, *I. angulata*)]. Fold and sulcus distinct; lateral slopes with several very weak plications; otherwise similar to *Martiniopsis*. *?L.Carb., U.Carb.-Perm.*, Asia-Australia.——FIG. 591,*1a*. **T. kumpani* (YANISHEVSKIY), *Carb.(?Visean-?Namur.)*, USSR; post. int. mold, ×1.5 (448).——FIG. 591,*1b-e*. *T. angulata* (CAMPBELL), Perm., Australia; *1b-e*, brach.v. int. mold, ped.v. int. mold, ant. int. mold, ×0.7, brach.v. int. mold, ×1 (141).——FIG. 591,*1f*. *T.* sp. CAMPBELL, Perm., Australia; micro-ornament, ×5 (141).

Superfamily and Family UNCERTAIN

Verneuilia HALL & CLARKE, 1894, p. 58 [**Spirifer cheiroptyx* D'ARCHIAC & DE VERNEUIL, 1842, p. 370; SD HALL & CLARKE, 1895, p. 762]. Medium-sized; very transverse with sharply pointed cardinal extremities; both brachial and pedicle valves with strong median sulci bounded by very pronounced, flaring ridges; lateral slopes markedly concave; macro-ornament lacking; micro-ornament consisting of concentric growth lines only; interior unknown. *Dev., ?L.Carb.*, Eu.-?Asia.——FIG. 592,*1*. **V. cheiroptyx* (D'ARCHIAC & DE VERNEUIL), M.Dev., Ger.; *1a-c*, ped.v., brach.v., post., ×1.5 (396).

Suborder, Superfamily, and Family UNCERTAIN

Clavigera HECTOR, 1879, p. 538 [**C. bisulcata* HECTOR in THOMSON, 1913, p. 50; SD MARWICK, 1953, p. 45] [=*Hectoria* TRECHMANN, 1918, p. 233 (obj.) (*non* TEPPER, 1889, *nec* CASTELNAU, 1873); *Hectorina* FINLAY, 1927, p. 533 (obj.); *Clavigerina*

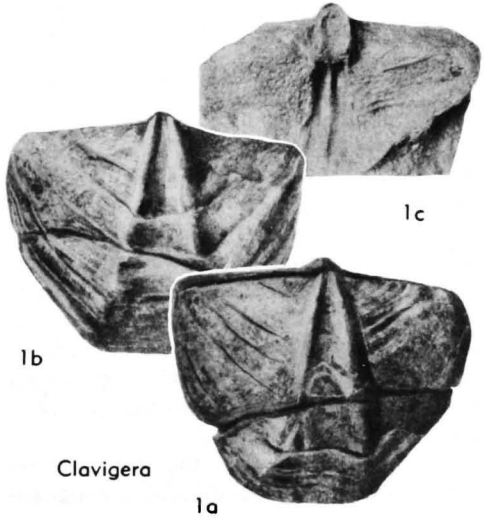


FIG. 593. Family Uncertain (p. *H727-H728*).

MARWICK, 1953, p. 45 *(nom. null.)*]. Large, gently biconvex; length and width subequal; each valve with shallow median sulcus bordered by a distinct ridge on either side; anterior commissure rectimarginate; macro-ornament lacking; micro-ornament consisting of growth lamellae only; pedicle valve interior with distinct dental plates and low median ridge; brachial valve interior with laterally directed spiralia and very large, spoon-shaped, non-striate cardinal process projecting far into pedicle valve; shell substance impunctate. *U.Trias.-L.Jur.*, N.Z.——FIG. 593,*1a,b*. **C. bisulcata*, U.Trias. (Rhaet.); *1a,b*, brach.v., ped.v., ×0.67 (816).——FIG. 593,*1c*. *C. tumida* HECTOR in THOMSON, 1913, U.Trias. (Rhaet.); brach.v. int., ×0.67 (816).

Cryptospirifer GRABAU, 1931, p. 405 [**C. lochengensis*; OD] [=*Lochengia* GRABAU, 1931, p. 478 (type, *L. holoensis*) *(nom. nud.)*]. Original generic description is so all-encompassing as to be meaningless. Type-species has never been illustrated. *Carb.*, China.

TEREBRATULIDA

By H. M. MUIR-WOOD, F. G. STEHLI, G. F. ELLIOTT, and KOTORA HATAI

[British Museum (Natural History); Western Reserve University; Iraq Petroleum Company, Ltd.; Tohoku University]

Brachiopods classed as terebratulids are a long-ranging, distinctive group of the phylum, differentiated by persistent characters of external form, by the punctate nature of their shell, and by internal features, chief of which is the relatively simple calcareous loop extending from the beak region of the brachial valve for support of the lophophore. In outline, the shells most commonly are teardrop-shaped, pointed at the posterior extremity, near which the valves are hinged and where a generally rounded foramen provides for egress of the pedicle, and rounded anteriorly where the valves open widest. The shell surface commonly is smooth, but it may be finely to somewhat coarsely plicate and marked by more or less prominent radially disposed rounded depressions (sulci) and elevations (folds) extending from the beak to the anterior shell margin.

This assemblage of brachiopods ranging in age from Early Devonian to Recent is assigned to the Order Terebratulida which contains three suborders—the Centronellidina, ranging from Lower Devonian to Permian, most primitive and earliest to appear; the Terebratulidina, well represented in the Paleozoic but primarily post-Paleozoic; and the Terebratellidina, sparsely represented in the Paleozoic but important in post-Paleozoic time.

The description of the terebratuloid brachiopods has been divided among authors in such a way that neither taxonomically bounded nor stratigraphically limited segments are separable readily according to authorship without undesirable overlap and offlap. Hence, an editorial organization which assigns precedence to the subordinal groups is adopted, with treatment of stratigraphically differentiated groups held secondary. The contributions of some authors are thus broken into parts, and cross references between chapters are needed in order to avoid repetition. These features should cause little inconvenience, however, to students of the Terebratulida who consult the *Treatise*.

TEREBRATULIDA—MAIN GROUPS

By H. M. MUIR-WOOD & F. G. STEHLI

A brief history of the classification of Brachiopoda given by MUIR-WOOD (1955) indicates subordinal and family-group classification (p. 85-93) extant at the time of her writing. Whereas genera distinguished as terebratulids were divided among four families (Centronellidae, Stringocephalidae, Terebratulidae, Terebratellidae) by SCHUCHERT in 1913, all placed in the single superfamily Terebratulacea, MUIR-WOOD recorded 15 families. Of these, eight (Centronellidae, Rhipidothyridae, Stringocephalidae, Meganteridae, Dielasmatidae, Terebratulidae, Cancellothyridae, Orthotomidae) were included in the superfamily Terebratulacea (also suborder Terebratuloidea) and seven (Zeilleriidae, Megathyridae, Platidiidae, Kraussinidae, Dallinidae, Laqueini-