GONIATITOIDEA

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Superfamily GONIATITOIDEA de Haan, 1825

[*nom. correct.* MILLER & FURNISH, 1954, p. 687, *pro* Goniatitidea PLUMMER & SCOTT, 1937, p. 103, *nom. transl. ex* Goniatitea DE HAAN, 1825, p. 156]

Conch form discoidal to globular, rarely oxycone; moderately involute, usually with narrow umbilicus. Spiral ornamentation, if present, conspicuous and in some forms stronger than growth lines or striae. Course of growth lines and constrictions variable, with ventral sinus. Basic sutural formula (family Goniatitidae): ($E_1E_mE_1$) ALUI [German], (V_1V_1)LU:ID [Russian]; increase of sutural elements by trifurcation of branches of ventral lobe as well as of adventitious lobe (Delepinoceratidae), but no trifurcation of the adventitious lobe alone (Agathiceratoidea). *Mississippian (upper Tournaisian)–Pennsylvanian (Bashkirian, ?Moscovian).*

Family GONIATITIDAE de Haan, 1825

[*nom. transl.* SCHINDEWOLF, 1934, p. 160, *ex* Goniatitea DE HAAN, 1825, p. 156] [=Glyphioceratidae HYATT, 1884 in 1883–1884, p. 322, obj.]

Ventral lobe relatively narrow, with median saddle usually less than half as high as entire lobe, rarely higher; branches diverging strongly, apicad mostly pointed. Ventrolateral saddle acute or subacute. Adventitious lobe in lateral position, broad, pointed. No increase of additional suture elements. *Mississippian (upper Tournaisian–lower Serpukhovian [Chesterian]).*

Goniatites DE HAAN, 1825, p. 39 [**Conchiliolithus Nautilites sphaericus* MARTIN, 1809, p. 15 (*nomen nudum* because of nonbinominal derivation), =*Ammonites sphaericus* SOWERBY, 1814, p. 116, *nom. subst.,* SD Opinion 420, ICZN, 1956, p. 135] [=*Glyphioceras* HYATT, 1884 in 1883–1884, p. 328, obj.; SD HOLZAPFEL, 1889, p. 26, for discussion, see BISAT, 1924, p. 82; =*Sphenoceras* FOORD, 1903, p. 218, obj., SD LIBROVICH, 1938, p. 51, for discussion, see BISAT, 1924, p. 82; SCHMIDT, 1925, p. 563; =?*Progoniatites* KORN & others, 2003, p. 89 (type, *P. maghribensis,* OD); closely related or even synonymous; close similarity of *Goniatites* and *Progoniatites* in suture and conch form suggests synonymy despite considerable age difference; for discussion, see CONRAD & PAREYN, 1968, p. 572, and see genus entry for *Progoniatites*, p. 55 herein.] Conch form subglobose to globose; umbilicus open but narrow. Commonly numerous longitudinal lirae, crossing transverse striae, thereby producing reticulate or crenistriate pattern. Ventral lobe with more or less straight sides; height of median saddle about or a little less than half height of entire ventral lobe. Adventitious lobe with almost straight sides. Many species. *Mississippian (upper Tournaisian, upper Visean [Goniatites Zone, Chesterian]):* Great Britain, Ireland, Belgium, Germany, Czech Republic, Bosnia, Poland, Russia and Kazakhstan (South Urals), Russia (Verkhoian), Portugal, Spain, Algeria, Morocco, ?Turkey, China (Xinjiang), Australia (Queensland), Canada (Yukon Territories), USA (Arkansas, Alaska, Indiana, Oklahoma, Utah).——FIG. 31,*3a–c.* **G. sphaericus* (MARTIN); *a–b,* Bolland, England, Gilbertson Collection, BMNH C290a, ×1 (Nikolaeva, 2008); *c,* holotype, suture, BMNH C43871, Derbyshire, diameter at 25 mm, whorl width 22 mm, whorl height 11.7 mm, ×2.3 (Korn, 1988b).——FIG. 31,*3d–f.* *G. crenistria* (PHILLIPS); *d–e,* lectotype, Bolland, Gilbertson Collection, BMNH C282a, ×2; *f,* enlargement of flank, showing growth striae (Nikolaeva, 2008).

Arnsbergites KORN, 1988b, p. 95 [**Goniatites falcatus* ROEMER, 1850, p. 50; OD]. Conch form globular; evolute on inner whorls, later conch with moderately wide umbilicus. Ornamentation consisting of numerous delicate longitudinal lirae that cross transverse striae with strong ventrolateral and dorsolateral salients. Constrictions on internal molds common. Ventral lobe relatively wide, median saddle half as high as entire lobe. Ventrolateral saddle subacute. Adventitious lobe deep with somewhat sinuously curved sides. Seven species. *Mississippian (upper Visean [middle Goniatites Zone]):* Great Britain, Ireland, Germany, Czech Republic, Poland, Morocco.——FIG. 33,*2a–d.* **A. falcatus* (ROEMER); *a–b,* Dough Mountain, Leitrim County, Ireland, GSM ZI 3881, ×1 (Hodson & Moore, 1959); *c,* suture, diameter at 33.2 mm, whorl height 16.2 mm, whorl width 23.8 mm, Oelinghausen, Rhenish Massif, SMN Stuttgart 25057, ×2; *d,* cross section, Oelinghausen, ×2.4 (Korn, new).

Goniatitella KORN, 1988b, p. 134 [**G. agricola* KORN, 1988b, p. 135; OD]. Conch small, globular, with very narrow umbilicus. Growth lines delicate, almost linear. Ventral lobe relatively wide, with almost parallel flanks, median saddle moderately low, ventrolateral saddle subacute; adventitious lobe with sinuous flanks. One species. [This genus may

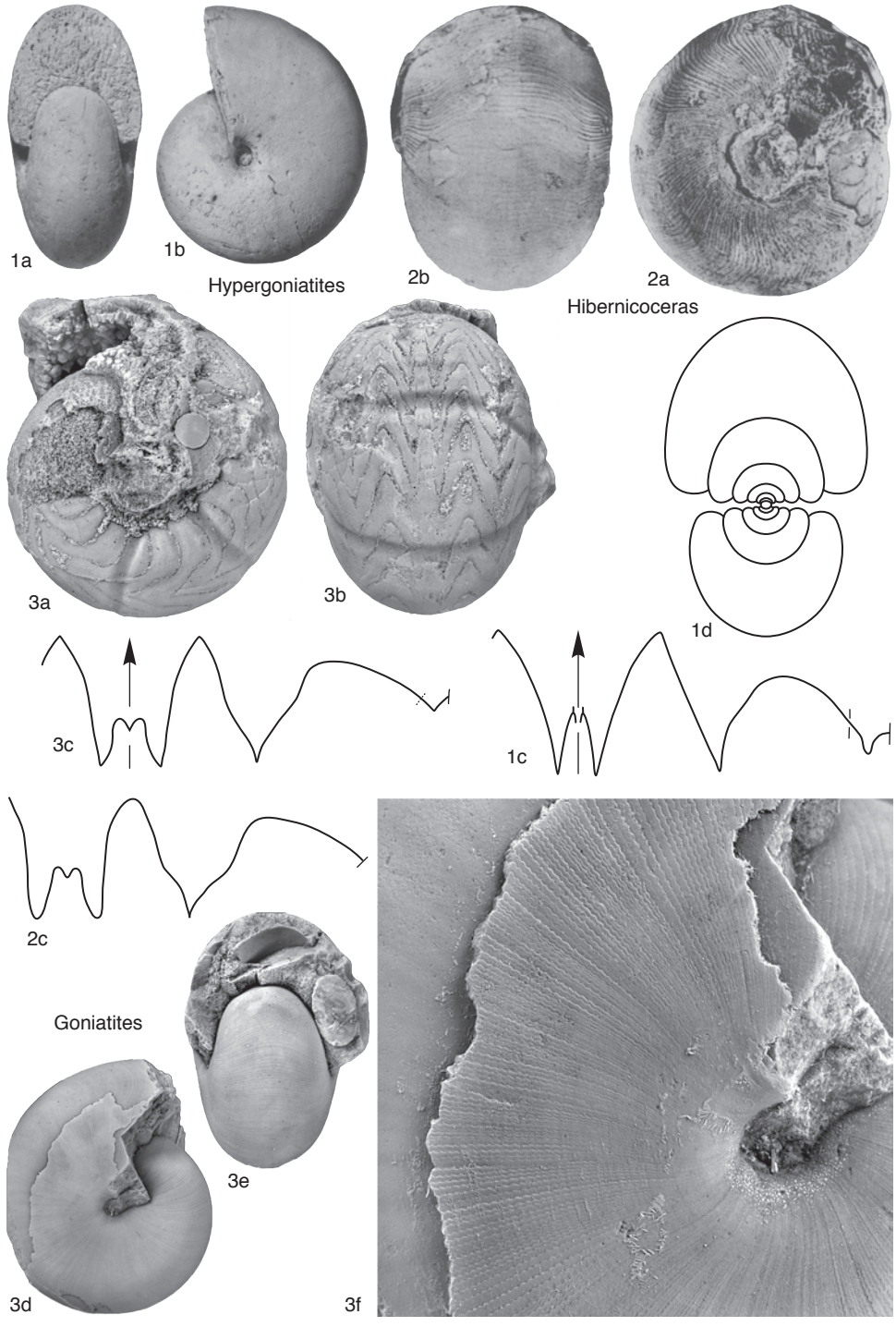

FIG. 31. Goniatitidae (p. 52–55).

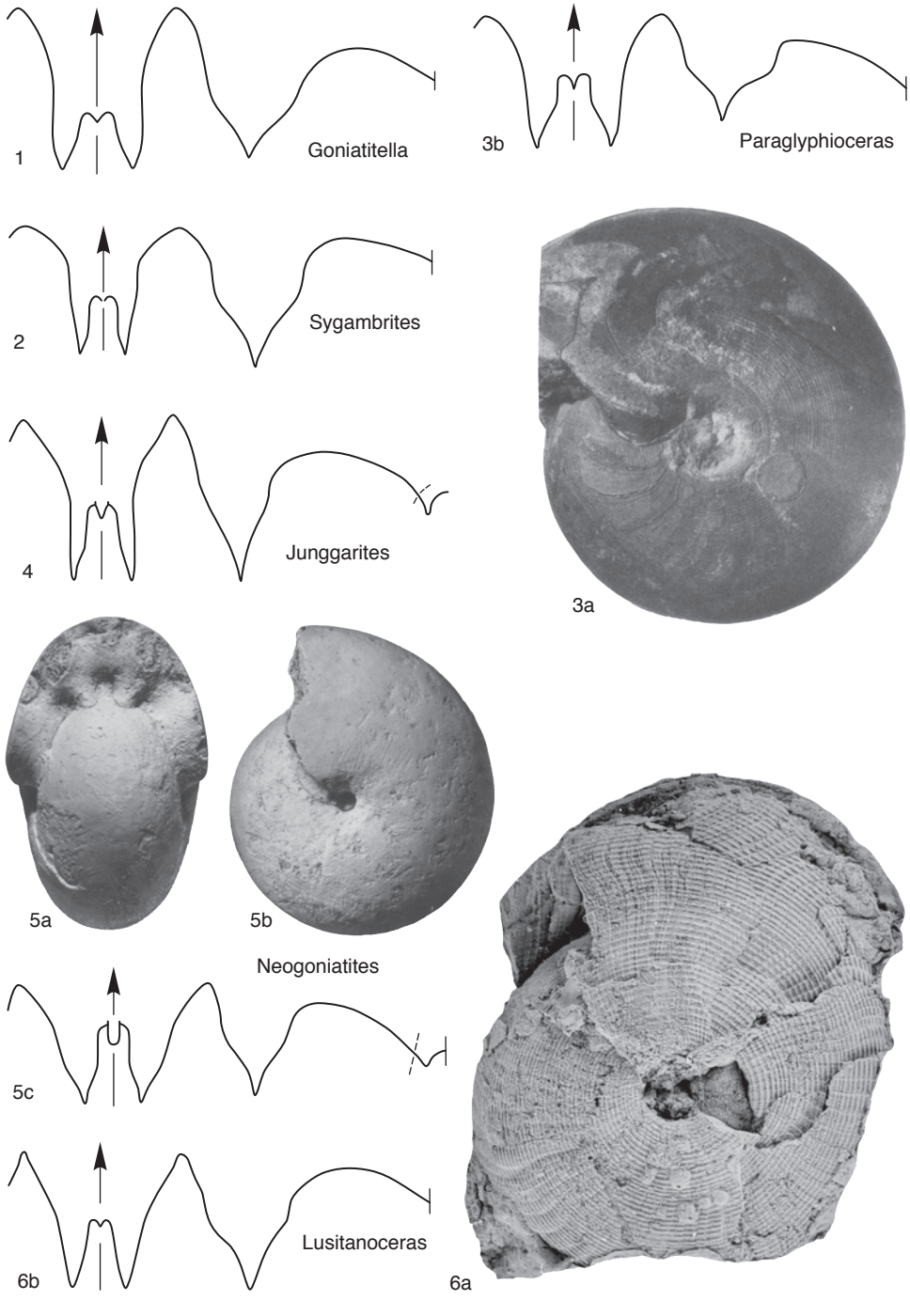

FIG. 32. Goniatitidae (p. 52–57).

be a junior synonym of *Goniatites* or related genera; juvenile specimens have a maximum diameter of 12.5 mm.] *Mississippian (upper Visean [middle Goniatites Zone]):* Germany.——Fig. 32,*1. *G. agricola,* holotype, suture, diameter at 11.6 mm, whorl height 6.8 mm, whorl width 10 mm, Landhausen, Rhenish Massif, WMN 10187, ×5 (Korn, 1988b).

Hibernicoceras Moore & Hodson, 1958, p. 87 [**H. hibernicum;* OD]. Conch form in young stages globular with wide umbilicus, later thickly discoidal with narrow umbilicus. Transverse striae rursiradiate to almost linear on flanks; slight salient on ventrolateral shoulder, forming shallow ventral sinus. Longitudinal lirae very faint, mainly around umbilicus. Ventral lobe moderately wide, with almost parallel sides in apical half, slightly diverging orad. First lateral saddle asymmetrical, subacute in adult forms. Adventitious lobe fairly wide, with sides more or less sigmoidal. Many species. *Mississippian (upper Visean):* Poland, Czech Republic, Germany, Ireland, Portugal, China (Xinjiang).——Fig. 31,*2a–c. *H. hibernicum,* holotype, Kiltyclogher, County Leitrim, Ireland, middle *Goniatites* Zone, GSM Zl 3025; *a–b,* ×2; *c,* suture, diameter at 15 mm, ×4.5 (Moore & Hodson, 1958).

Hypergoniatites Ruzhentsev & Bogoslovskaia, 1970, p. 58 [**H. exiguus;* OD]. Conch form as in *Goniatites,* usually with very narrow umbilicus. Growth lines faint, crenistriate, more or less linear, rarely with constrictions. Ventral lobe narrow at its base, orad very wide, with slightly continuously curved sides; median saddle reaching less than half entire height, prongs of ventral lobe narrow. Adventitious lobe with curved apical process. Many species. *Mississippian (upper Visean–lower Serpukhovian):* Russia (Novaia Zemlia), Spain, Morocco, China (Xinjiang), Kazakhstan (South Urals), Tajikistan, Uzbekistan.——Fig. 31,*1a–d. *H. exiguus; a–b,* holotype, Dombar Hills, South Urals, Kazakhstan, uppermost Visean, PIN 455/7494, ×1; *c,* holotype, suture, whorl height at 12.2 mm, whorl width 13.0 mm, ×3; *d,* cross section, PIN 455/7498, ×2 (Ruzhentsev & Bogoslovskaia, 1970).

Junggarites Liang & Wang, 1991, p. 105 [**J. pinguis* Liang & Wang, 1991, p. 106; OD]. Conch form as in *Goniatites,* with extremely narrow umbilicus. Growth lines crenistriate, spiral ornamentation faint. Ventral lobe with relatively narrow prongs, almost parallel sided; upper part of flanks widely divergent. Ventrolateral saddle subacute, adventitious lobe asymmetrical, deep, and bell shaped. One species. *Mississippian (upper Visean):* China (Xinjiang).——Fig. 32,*4. *J. pinguis,* suture, Kalajila, Altai, NIGP 91469, whorl height at 28 mm, whorl width 36 mm, ×2 (Liang & Wang, 1991).

Lusitanoceras Pereira de Sousa, 1923, p. 304 [**L. algarviense;* M]. Conch form of early whorls almost globular, with wide umbilicus; later stages subdiscoidal, with narrow umbilicus. Ornamentation consisting of faint biconvex growth striae, on young stages crenistriate, later with predominant spirals. Constrictions common. Ventral lobe moderately wide, with median saddle half as high as entire ventral lobe, prongs being almost parallel; flanks of ventral lobe in their orad half widely diverging. Ventrolateral saddle acute or subacute. Adventitious lobe deep, slightly bell shaped. More than ten species. [This genus is transitional to *Dombarites.*] *Mississippian (upper Visean [upper Goniatites Zone]):* cosmopolitan.——Fig. 32,*6a. *L. algarviense,* side view, Vaqueiros, Mértola Formation, Portugal, IGML 235, ×1 (Korn, 1997).——Fig. 32,*6b. L. poststriatum* (Brüning), suture, partly restored ventral part, Murraçao, Faro, Portugal, Mértola Formation, IGML 376, whorl height at 22.8 mm, ×1.7 (Korn, 1997).

Neogoniatites Ruzhentsev & Bogoslovskaia, 1970, p. 56 [**N. milleri;* OD] [=*?Xainzalites* Sheng, 1983, p. 58 (type, *X. xainzaensis,* OD)]. Conch form and ornamentation as in *Goniatites.* Ventral lobe wide, sides curved outside in upper half; median saddle higher than half height of entire lobe. Adventitious lobe with slightly pouched flanks. More than ten species. [This genus is closely related to *Paraglyphioceras. Xainzalites* is based on poorly preserved specimens apparently showing characteristics of *Neogoniatites.*] *Mississippian (upper Visean–lower Serpukhovian [upper Goniatites Zone, Pendleian]):* Spain, Morocco, Iran, China (Xinjiang, Xizang), Kazakhstan (South Urals), Tajikistan, USA (Kentucky, Nevada, Oklahoma, Texas).——Fig. 32,*5a–b. *N. milleri milleri,* holotype, Dombar Hills, South Urals, Kazakhstan, uppermost Visean, PIN 455/7093, ×1 (Ruzhentsev & Bogoslovskaia, 1971).——Fig. 32,*5c. N. milleri latus* Ruzhentsev & Bogoslovskaia, holotype, suture, Dombar Hills, South Urals, Kazakhstan, uppermost Visean, PIN 455/7107, whorl height at 22.7 mm, whorl width 29.5 mm, ×2.2 (Ruzhentsev & Bogoslovskaia, 1971).

Paraglyphioceras Brüning, 1923b, p. 22 [**P. rotundum* Brüning, 1923b, p. 27; SD Korn, 1988b, p. 117]. Conch thickly discoidal, on early whorls with wide umbilicus, adult stages with very narrow umbilicus. Growth lines crenistriate, on all stages biconvex and prorsiradiate; spiral ornamentation closely spaced. Ventral lobe V-shaped, moderately wide, median saddle about half as high as entire lobe. Ventrolateral lobe narrowly rounded to subacute, adventitious lobe symmetrical and bell shaped. Many species. [A suitable figure of the holotype is not available; the figured species is closely related.] *Mississippian (upper Visean [lower Goniatites Zone–middle Goniatites Zone]):* Great Britain, Ireland, Belgium, Germany, Czech Republic, Poland.——Fig. 32,*3a–b. P. striatum* (Sowerby), holotype, Derbyshire, England, upper Visean, BMNH 43870; *a,* side view, ×1.5 (Bisat, 1934); *b,* suture, diameter at 34.6 mm, whorl height 19.2 mm, whorl width 23.0 mm, ×2 (Korn, 1988b).

?Progoniatites Korn & others, 2003, p. 89 [**P. maghribensis;* OD] [=*Pericycloides* Follot, 1953, p. 14, *nom. nud.,* no type designated, subj.]. Similar to *Goniatites,* with V-shaped ventral lobe and moderately high median saddle, but ventrolateral saddle

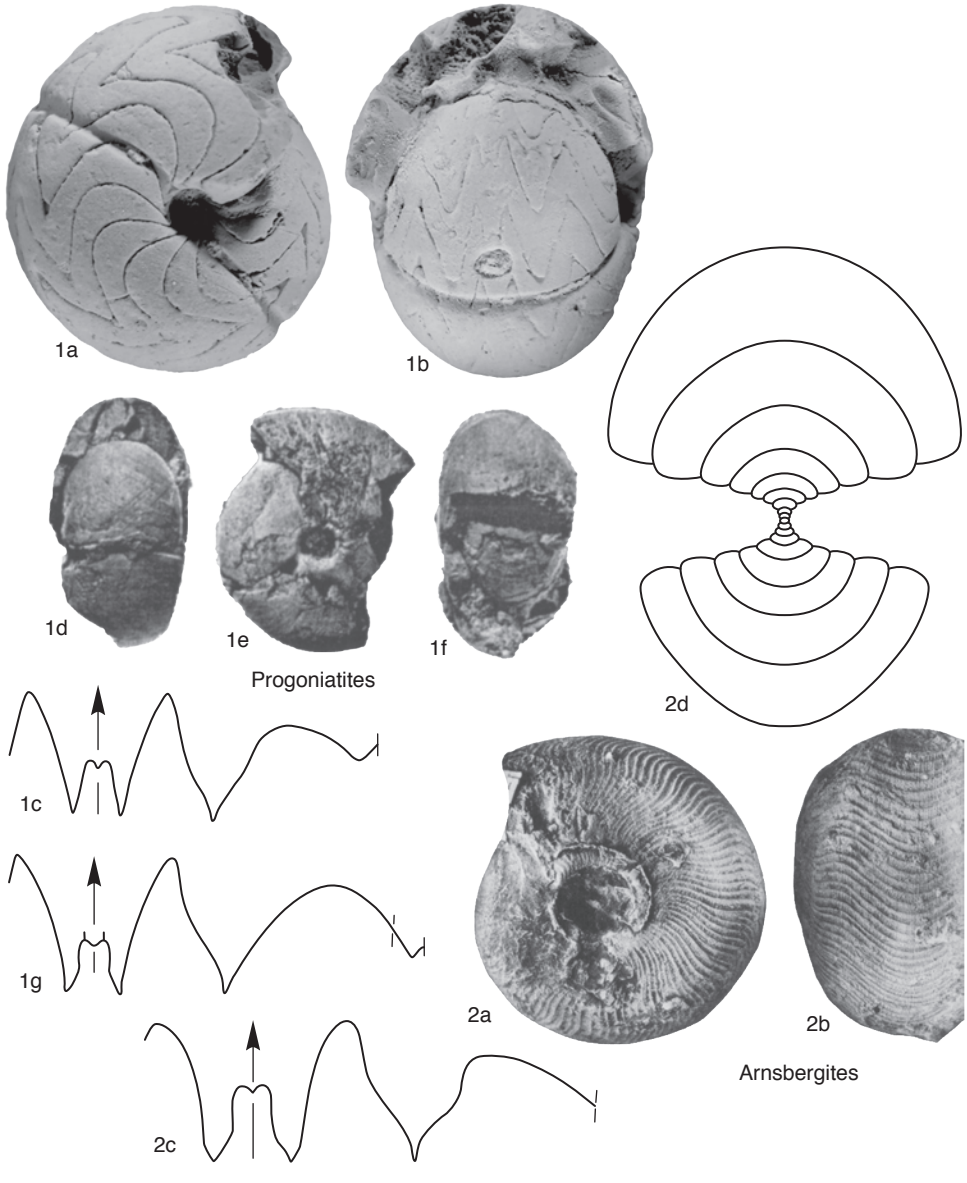

FIG. 33. Goniatitidae (p. 52–56).

slightly subacute. Three species. [The similarity of *Goniatites* and *Progoniatites* (=*Pericycloides* FOLLOT, 1953) in suture and conch form suggests synonymy despite considerable age difference; for discussion, see CONRAD & PAREYN, 1968, p. 572, and see genus entry for *Goniatites*, p. 52 herein.] *Mississippian (lower upper Tournaisian):* Morocco.——FIG. 33,*1a–c.* **P. maghribensis,* holotype, Taouz, Jebel Ouaoufilal, east of Ksar Bouhamed, Tafilalt, Oued Znaïgui Formation, MB C.3978; *a–b,* ×3; *c,* suture, diameter at 14.7 mm, whorl height 6.7 mm, whorl width 12.4 mm, ×3.4 (Korn & others, 2003).——FIG. 33,*1d–g. P. karensis* (KUZINA), Peiakha River, Pai-Khoi, Komi, Tournaisian-Visean boundary beds, PIN 2775/508; *d–f,* apertural, lateral, and ventral views, ×1.5; *g,* suture of holotype, whorl height at 10 mm, whorl width 14 mm, ×6.7 (Kuzina, 2000).

Sygambrites KORN, 1988b, p. 138 [**S. wollbriggensis;* OD] [?=*Kalajilagites* LIANG & WANG, 1991, p. 96 (type, *K. stenolobus,* OD)]. Conch form subglobular, relatively wide, with very narrow umbilicus.

Ventral lobe narrow, median saddle half as high as entire lobe, ventrolateral saddle relatively broad. Only holotype known. [*Kalajilagites* displays a more subacute ventrolateral saddle. This character is regarded herein as being of specific significance.] *Mississippian (upper Visean):* Germany.——Fig. 32,*2. *S. wollbriggensis,* holotype, suture, Wicheln, Möhnesee, Rhenish Massif, Kulmplattenkalk, WMN 10191, diameter at 18.7 mm, whorl height 8.1 mm, whorl width 18.9 mm, ×4.2 (Korn, 1988b).

Family DELEPINOCERATIDAE Ruzhentsev, 1957

[Delepinoceratidae Ruzhentsev, 1957, p. 58]

Conch form and ornamentation as in Goniatitidae; suture with tendency toward trifurcation of external lobes. Triangular whorls on immature stages in some genera common. Sutural formula of advanced forms: $(E_{1d}E_{1m}E_{1v}E_mE_{1v}E_{1m}E_{1d})(A_vA_mA_d)$LUI [German], $(V_2V_1V_2)(V_2V_1V_2)(L_2L_1L_2)$U:ID [Russian]. [Some authors (e.g., Ruzhentsev & Bogoslovskaia, 1971) restrict this family to genera with trifid prongs of the ventral lobe and trifid adventitious lobe; they assign genera with undivided ventral lobe to the family Agathiceratidae. This view disregards the peculiar characteristics of the Pennsylvanian and Permian genus *Agathiceras* and dissects the close relationship of delepinoceratid genera. This group is probably derived from *Lusitanoceras.*] *Mississippian (upper Visean)–Pennsylvanian (Bashkirian, ?Moscovian).*

Subfamily DELEPINOCERATINAE Ruzhentsev, 1957

[*nom. transl.* Kullmann, herein, *ex* Delepinoceratidae Ruzhentsev, 1957, p. 58]

Tendency of trifurcation of branches of ventral lobe as well as of adventitious lobe. *Mississippian (upper Visean–Serpukhovian).*

Delepinoceras Miller & Furnish, 1954, p. 690 [**Dimorphoceras thalassoides* Delépine & Menchikoff, 1937, p. 83; OD]. Branches of ventral lobe and adventitious lobe tridentate; median saddle very high. Five species. [The type species is poorly known and poorly preserved, and no suitable figure is available. The chosen species is closely related.] *Mississippian (Serpukhovian):* France, Spain, Algeria, Russia (Novaia Zemlia), Russia and Kazakhstan (South Urals), China (Guangxi), Uzbekistan, Tajikistan (Darvaz, Hissar Mountains), USA (Arkansas, Oklahoma, Utah, Nevada, California).——Fig. 34,*1a–c. D. bressoni* Ruzhentsev; *a–b,* Ada, Pontotoc County, Oklahoma, Springer Formation, upper Chesterian, SUI Iowa City 10986, ×2 (Furnish, Quinn, & McCaleb, 1964); *c,* holotype, suture, Kzyl-Shin, South Urals, Kazakhstan, upper Serpukhovian, PIN 455/330, whorl height at 32.0 mm, whorl width 27.5 mm, ×1 (Ruzhentsev & Bogoslovskaia, 1971).

Platygoniatites Ruzhentsev, 1956a, p. 158 [**P. molaris;* OD] [=*Altayceras* Wang, 1983, p. 527 (type, *A. chinensis* Wang, 1983, p. 528, OD)]. Sides of ventral and adventitious lobes with tendency toward processes, but not yet tridentate. Some forms with triangular coiling on immature stages. Ventral lobe wide, median saddle higher than half the height of entire ventral lobe. Prongs of ventral lobe and adventitious lobe pouched and bell shaped. [The synonym *Altayceras* is based on a single compressed and poorly preserved specimen that may belong in *Platygoniatites.*] Many species. *Mississippian (uppermost Visean–Serpukhovian):* Spain, Portugal, Russia (Novaia Zemlia), Russia and Kazakhstan (South Urals), China (Guangxi, Ningxia, Xinjiang), Tajikistan (Darvaz), USA (Nevada).——Fig. 34,*2a–f. *P. molaris,* Dombar Hills, South Urals, Kazakhstan, lower Serpukhovian; *a–b,* PIN 455/210, ×1; *c–d,* PIN 455/212, ×1; *e,* holotype, suture, PIN 455/209, whorl height at 31.5, whorl width 25 mm, ×1 (Ruzhentsev & Bogoslovskaia, 1971); *f,* cross section, Dombar Hills, PIN 455/214, ×2 (Ruzhentsev, 1956a).

Subfamily DOMBARITINAE Kullmann, 2007

[Dombaritinae Kullmann in Kullmann, Wagner, & Winkler Prins, 2007, p. 138] [type genus, *Dombarites* Librovich, 1957, p. 257]

Delepinoceratidae with tendency toward trifurcation of adventitious lobe only. *Mississippian (upper Visean)–Pennsylvanian (Bashkirian, ?Moscovian).*

Dombarites Librovich, 1957, p. 257 [**D. tectus* Librovich, 1957, p. 258; OD] [=*Revilloceras* Wagner-Gentis, 1980, p. 13 (type, *Mesoglyphioceras granosum barruelense* Wagner-Gentis, 1963, p. 11, OD)]. Conch form in general similar to *Lusitanoceras,* but adventitious lobe with short processes on both sides with tendency to become tridentate. Several species with triangular whorls on immature stages; some species with oxycone venter on adult stages. Ornamentation usually with closely spaced lirae, some species lacking spiral ornamentation. Ventral lobe relatively wide, median saddle about half as high or higher, in some species reaching two-thirds height of entire ventral lobe. Sides of ventral lobe diverging, less in apicad part, strongly in orad part; inflexion point coinciding usually with height of median saddle. First lateral saddle acute or subacute; adventitious

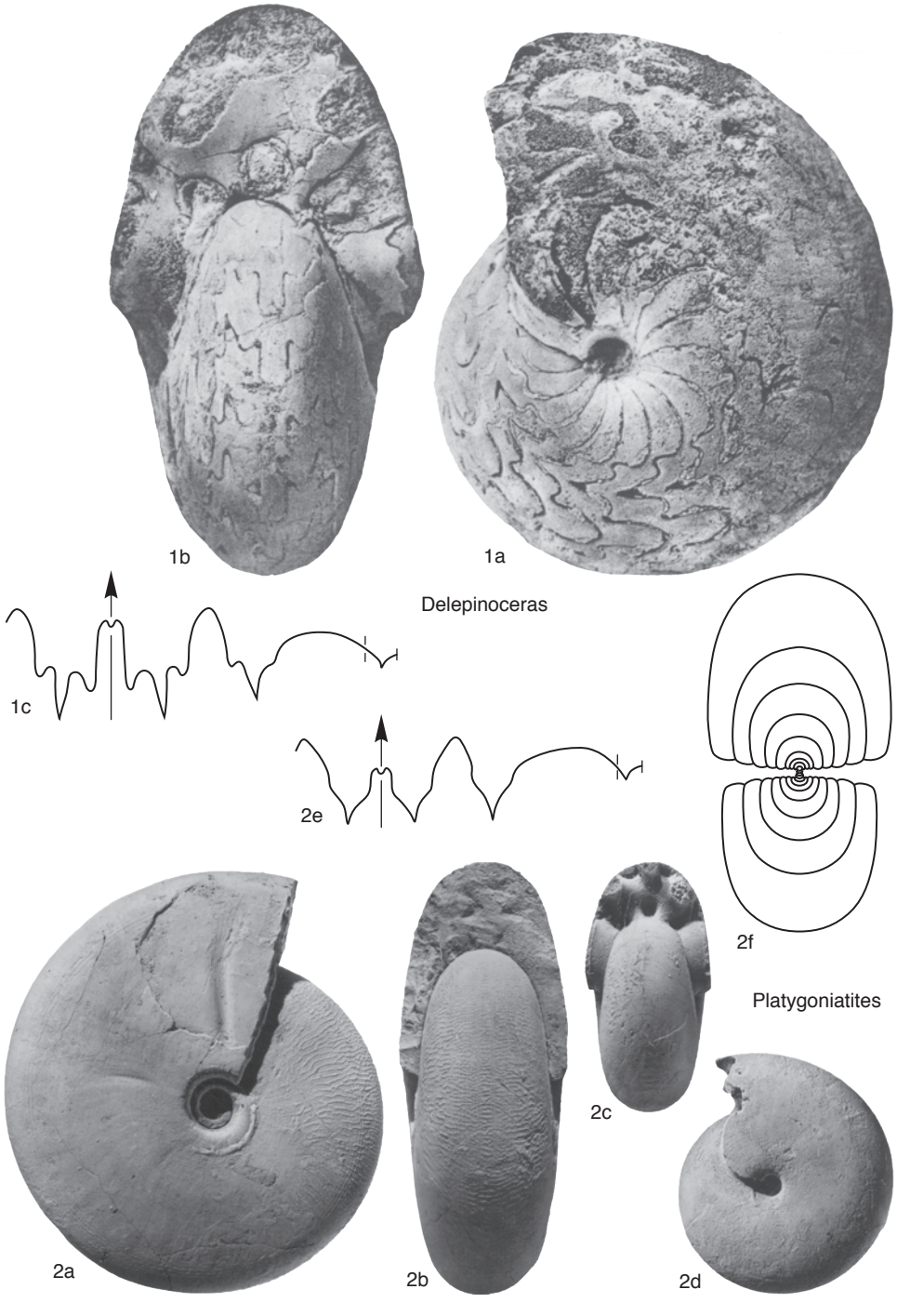

FIG. 34. Delepinoceratidae (p. 57).

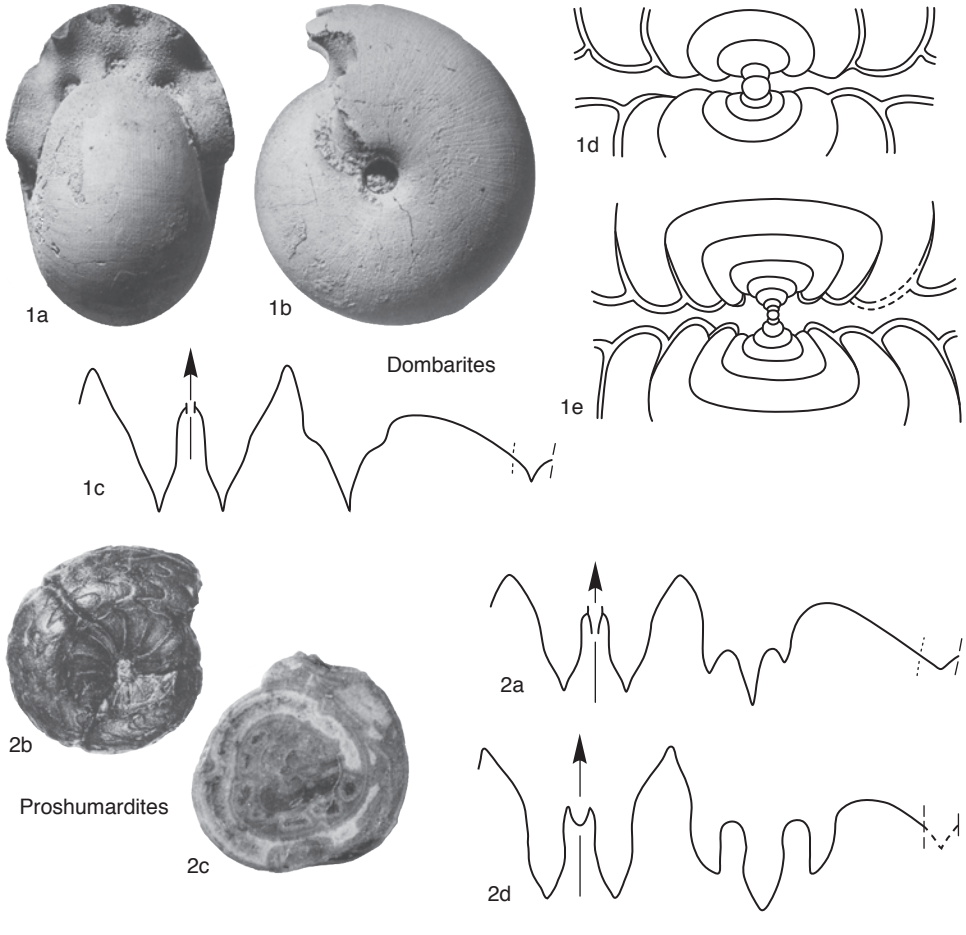

FIG. 35. Delepinoceratidae (p. 57–60).

lobe wide. Many species. [*Revilloceras* was established for forms with blunted tips of ventrolateral saddle, a general character in small forms.] *Mississippian (upper Visean–lower Serpukhovian):* France, Portugal, Spain, Algeria, Russia (Novaia Zemlia), Russia and Kazakhstan (South Urals), China (Guangxi, Ningxia, Xinjiang, Xizang), Tajikistan (Darvaz), Uzbekistan, USA (Arkansas, Oklahoma, Texas, Utah).——FIG. 35,*1a–c. *D. tectus; a–b,* Dombar Hills, South Urals, Kazakhstan, lower Serpukhovian, PIN 455/19456, ×1; *c,* suture, whorl height at 31 mm, whorl width 41.5 mm, PIN 455/19455, ×1.1 (Ruzhentsev & Bogoslovskaia, 1970).——FIG. 35,*1d–e. D. choctawensis* (SHUMARD), Johnston County, Oklahoma, Caney Shale, upper Chesterian; *d,* cross section showing subspherical early whorls, USNM 119502, ×5; *e,* cross section showing subquadrate early whorls, USNM 119504, ×5 (Gordon, 1965).

Proshumardites RAUZER-CHERNOUSOVA, 1928, p. 165 [**P. karpinskii;* OD] [=*Trigonoshumardites* KULLMANN, 1962, p. 333 (type, *P. (T.) wocklumerioides,* OD)]. Conch form thickly discoidal, umbilicus very narrow. Several species with triangular whorls on immature stages. Ornamentation consisting of fine growth lines and usually of prominent, closely spaced lirae; spiral ornamentation lacking in some species. Ventral lobe relatively wide; median saddle higher than half height of entire ventral lobe. Ventrolateral saddle rather broad, subacute, or narrowly rounded. Adventitious lobe wide and tridentate. More than ten species. [*Trigonoshumardites* had been erected for species with triangular inner whorls, a character regarded herein

as being of specific significance. Several authors have assigned some species of Serpukhovian age to *Pericleites;* its type, *Pericleites atticus* RENZ, had been secured from lower Permian (?Asselian) strata (see RENZ, 1955, p. 413, 416), however; for discussion, see family Agathiceratidae herein (below).] *Mississippian (Serpukhovian)–Pennsylvanian (Bashkirian, ?Moscovian):* France, Spain, Serbia, Slovakia, Ukraine (Donets), Algeria, Iran, China (Gansu, Guangxi, Guizhou, Xinjiang), Japan, Russia (Novaia Zemlia, South Urals), Kazakhstan (South Urals, Tian Shan), Kyrgyzstan, Tajikistan (Darvaz, Hissar Mountains, Pamirs), Uzbekistan, Canada (Northwest Territories), USA (Arkansas, Oklahoma, Texas, Utah, Nevada.——FIG. 35,*2a.* **P. karpinskii,* Chumaza River, South Urals, Bashkortostan, lower Bashkirian, Russia, whorl height at 8 mm, whorl width 10.5 mm, PIN 455/28786, ×4.3 (Ruzhentsev & Bogoslovskaia, 1978). ——FIG. 35,*2b–d. P. delepinei* (SCHINDEWOLF); *b,* Ben-Zireg, Algeria, Tagnana Formation, upper Serpukhovian, ×2 (Pareyn, 1961); *c,* median cut showing triangularity of inner whorls, Druzetic-Milivojevici, upper Serpukhovian, Serbia, Collection Stevanovics Beograd, S 23, ×3; *d,* suture, Cantabrian Mountains, Perlora, Asturias, Spain, upper Serpukhovian, diameter at about 18 mm, GPIT 1206/258, ×2.4 (Kullmann, 1962).

AGATHICERATOIDEA

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Superfamily AGATHICERATOIDEA Arthaber, 1911

[*nom. correct.* MILLER & FURNISH, 1954, p. 687, *pro* Agathiceratida BÖHMERS, 1936, p. 65, *nom. transl. ex* Agathiceratidae ARTHABER, 1911, p. 178] [=suborder Agathiceratina LEONOVA, 2002, p. 36]

Conch form thickly discoidal to globular; whorl section involute, umbilicus very small to closed. Siphuncle retrochoanitic, with long septal necks. Siphuncle of inner whorls in central position, and migrating ventrad becoming marginal on later volutions. *Pennsylvanian (Kasimovian)–Guadalupian (Wordian).*

Family AGATHICERATIDAE Arthaber, 1911

[Agathiceratidae ARTHABER, 1911, p. 178] [=Aristoceratinae LEONOVA, 2002, p. 41]

Suture line with trifurcation of adventitious lobe resulting in three discrete, subequal lateral lobes. Sutural formula: $(E_1E_mE_1)A_vA_mA_dLUI$ [German], $(V_1V_1)L_2L_1L_2U{:}ID$ [Russian]. [The presumed root group Dombaritinae (e.g., *Proshumardites*) is questionable.] *Pennsylvanian (Kasimovian)–Guadalupian (Wordian).*

Agathiceras GEMMELLARO, 1887, p. 75 [**A. suessi* GEMMELLARO, 1887, p. 79; OD] [=*Paragathiceras* RUZHENTSEV, 1950, p. 92 (type, *Agathiceras ? tornatum* GEMMELLARO, 1887, p. 82, OD)]. Conch form subdiscoidal, involute. Sculpture with prominent longitudinal lirae. Apertural constrictions common. Ventral lobe broad, with pouched, apicad pointed branches; median saddle in some forms reaching almost total height of ventral lobe. In adult, adventitious lobe of early whorls developing three discrete and subequal spatulate lobes. Many species. [*Paragathiceras* was erected for a form with a parabolic outline; for discussion, see GLENISTER & FURNISH, 1961, p. 695.] *Pennsylvanian (Kasimovian)–Guadalupian (Wordian):* Italy (Carnic Alps, Sicily), Slovenia, Tunisia, Ukraine (Crimea), Russia (South Urals, Siberia), Kazakhstan (South Urals), Afghanistan, China (Guizhou, Guangxi, Jilin, Nei Monggol, Xinjiang, Xizang), Iraq, Oman, Indonesia (Timor), Japan (Akiyoshi, Kitakami), Tajikistan (Darvaz, Pamirs), Thailand, Canada (British Columbia, Northwest Territories), Mexico

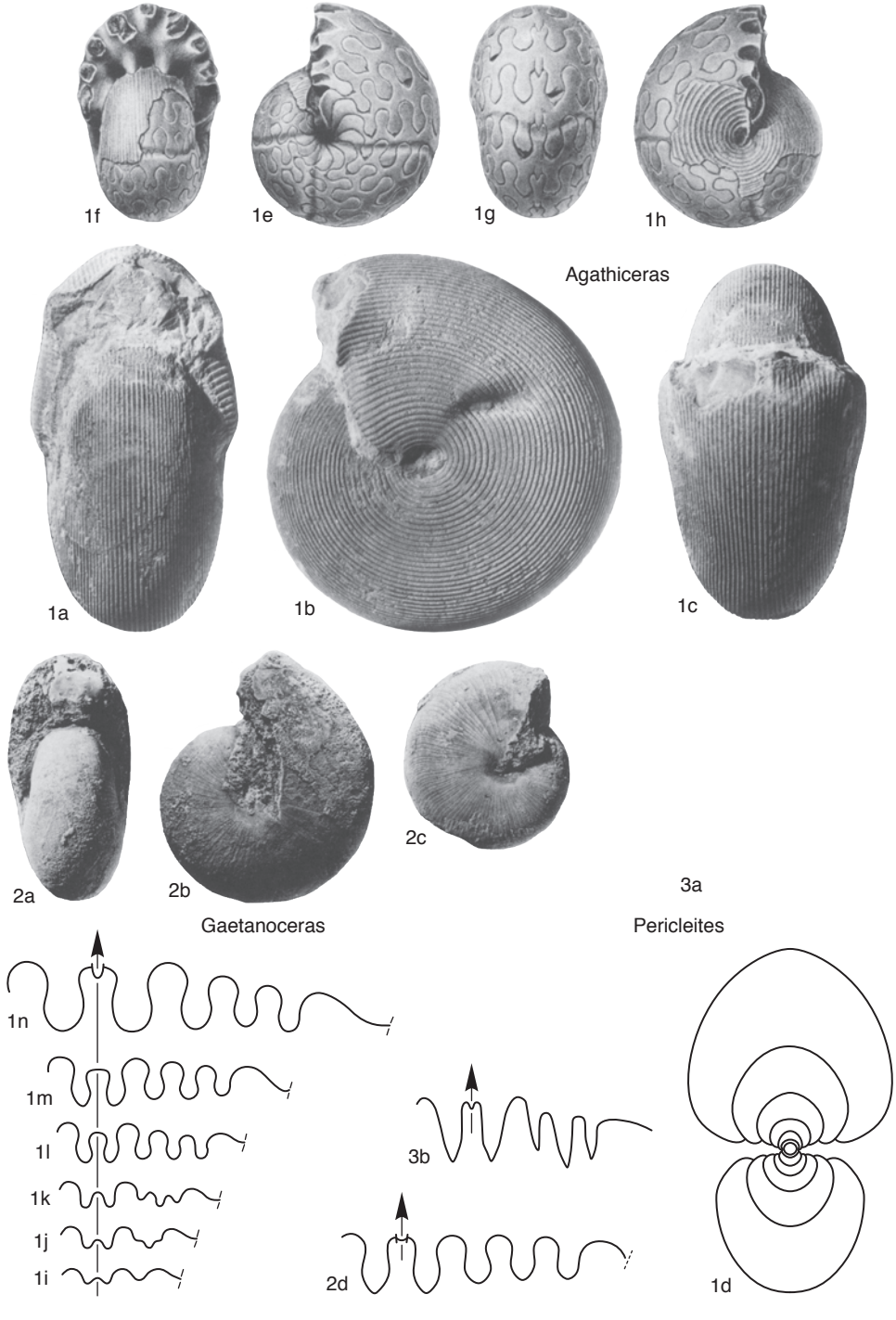

FIG. 36. Agathiceratidae (p. 60–62).

(Coahuila), USA (Texas, California), Australia (Western Australia).——FIG. 36,*1a–d. *A. suessi; a–c,* lectotype, Palazzo Adriano, Sicily, Italy, Sosio Limestone, Wordian, MGUP 86, approximately ×1.5 (Davis, Furnish, & Glenister, 1969); *d,* cross section, SUI 13613A, ×3 (Dixon, 1960).——FIG. 36,*1e–h. A. frechi* BÖSE, Wolf Camp, Glass Mountains, Brewster County, Texas, USA, Gaptank Formation, Virgilian, YPM 16762, ×2 (Miller & Furnish, 1940a).——FIG. 36,*1i–n. A. uralicum* (KARPINSKII), ontogenetic development of suture line; *i,* whorl width at 0.8 mm, PIN 317/2437, ×25; *j,* whorl width at 1 mm, ×25; *k,* whorl width at 1.3 mm, ×25; *l,* whorl width at 3.3 mm, ×10; *m,* whorl height at 3.5 mm, whorl width 4.3 mm, ×10; *n,* left bank of Aktasty River, eastern limestones, Aktastinskii subformation, Artinskian, PIN 317/2435, whorl height at 12 mm, whorl width 11 mm, ×5 (Ruzhentsev, 1956b).

Gaetanoceras RUZHENTSEV, 1938, p. 262 [**Agathiceras martini* HANIEL, 1915, p. 72; OD]. Similar to *Agathiceras,* but ornamentation consisting of delicate growth lines only. Five species. *Cisuralian (Kungurian)–Guadalupian (Wordian):* Tajikistan (Pamirs), Indonesia (Timor), China (Hunan).——FIG. 36,*2a–d. *G. martini* (HANIEL); *a–b,* lectotype (GLENISTER, FURNISH, & ZHOU, herein), Bitauni beds, Artinskian, Timor, GIUA no.THD 12735 (same as HANIEL, 1915, pl. 49,*18*), ×1; *c,* side view, GIUA, no. THD 874, ×1; *d,* holotype, suture, ×5.5 (Glenister, Furnish, & Zhou, new).

?Pericleites RENZ, 1910, p. 464 [**Paralegoceras (Pericleites) atticum;* M]. Conch form as in *Agathiceras,* thickly discoidal, with extremely narrow or even closed umbilicus. Ornamentation consisting of coarse, widely spaced growth lines forming a shallow sinus on flanks and on venter. No ribs and no spiral ornamentation. Ventral lobe relatively wide, Y-shaped, and adorad widely diverging, with lanceolate prongs, median saddle much higher than half height of entire lobe. Ventrolateral saddle subacute. On flanks, three spatulate lobes separated by rounded saddles, middle lobe being longer than ventrad and dorsad ones. One species. [The holotype (the only specimen) is poorly preserved, and the inner part of the suture and its ontogeny is unknown. Some authors regard the genus as closely related to *Proshumardites* (e.g., SCHMIDT, 1925, p. 599; RUZHENTSEV & BOGOSLOVSKAIA, 1971, p. 236), others as incompletely and insufficiently known (MILLER & CLINE, 1934a, p. 183; SCHINDEWOLF, 1939a, p. 431). For the revised stratigraphic assignment of the lower Permian, see RENZ, 1955, p. 413, 416.] *Cisuralian (?Asselian):* Greece.——FIG. 36,*3a–b. *P. atticus,* Hagia Triada, Attica, black Permian limestones, collection Renz; *a,* side view, approximately ×0.5; *b,* suture line, ×0.7 (Miller & Cline, 1934a, adapted from Renz, 1910).

NEOGLYPHIOCERATOIDEA

JÜRGEN KULLMANN

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Superfamily NEOGLYPHIOCERATOIDEA Plummer & Scott, 1937

[*nom. transl.* RUZHENTSEV & BOGOSLOVSKAIA, 1971, p. 242, *ex* Neoglyphioceratidae PLUMMER & SCOTT, 1937, p. 185]

Conch form very variable, from vermicular and evolute to globular and involute. Growth lines usually biconvex, with ventral sinus or salient. Spiral ornamentation common, consisting frequently of more or less widely spaced strong lirae. Ventrolateral grooves present in some genera. Strong constrictions widespread and often typical. Ventral lobe relatively narrow, with subparallel or divergent sides; median saddle low to about half as high as entire ventral lobe. First lateral saddle broadly rounded, adventitious lobe usually relatively narrow and pointed, lateral lobe on or close to umbilical wall. Sutural formula: $(E_1E_mE_1)$ ALUI [German], (V_1V_1)LU:ID [Russian]. *Mississippian (upper Visean)–Pennsylvanian (lower Bashkirian).*

Family NEOGLYPHIOCERATIDAE Plummer & Scott, 1937

[Neoglyphioceratidae PLUMMER & SCOTT, 1937, p. 185]

Conch subdiscoidal or pachycone, whorl section moderately involute or involute, mostly with narrow umbilicus. Spiral ornamentation frequent, but faint, or missing in some forms; no ventrolateral grooves. Ventral lobe with subparallel or divergent sides. *Mississippian (upper Visean–Serpukhovian).*

Subfamily NEOGLYPHIOCERATINAE Plummer & Scott, 1937

[*nom. transl.* KULLMANN, herein, *ex* Neoglyphioceratidae PLUMMER & SCOTT, 1937, p. 185]

Conch rather small, usually lenticular in adult whorls, sometimes with flattened flanks. Spiral ornamentation usually densely spaced, faint, and frequently crenulate. *Mississippian (upper Visean–Serpukhovian).*

Neoglyphioceras BRÜNING, 1923b, p. 30 [**Goniatites spiralis* PHILLIPS, 1841, p. 121; SD PLUMMER & SCOTT, 1937, p. 185] [=*Paragoniatites* LIBROVICH, 1938, p. 81, 103 (type, *Gastrioceras caneyanum* GIRTY, 1909, p. 57, OD)]. Conch form discoidal to subglobose, moderately involute. Sculpture consisting of fine transverse striae crossed by prominent longitudinal lirae; strong constrictions form lateral sinus, shallow salient on ventrolateral shoulder and shallow ventral sinus. Some species exhibit riblets. Ventral lobe relatively narrow, with roundly diverging sides; first lateral saddle broadly rounded. Adventitious lobe wide, bell shaped, pointed. Many species. *Mississippian (upper Visean–Serpukhovian):* Belgium, Great Britain, Ireland, Germany, Czech Republic, Poland, Portugal, Spain, Algeria, Morocco, Russia (Novaia Zemlia, South Urals, Siberia), China (Ningxia), Kazakhstan (South Urals, Karaganda), USA (Arkansas, Illinois, Oklahoma, Utah).——FIG. 37,*4a–b.* **N. spirale* (PHILLIPS); *a,* side view, Dough Mountains, County Leitrim, Ireland, upper Visean, ×2 (Moore & Hodson, 1958); *b,* suture, Sauerland, Germany, upper Visean, magnification not indicated (Brüning, 1923b).

Lusitanites RUZHENTSEV & BOGOSLOVSKAIA, 1971, p. 321 [**Goniatites subcircularis* MILLER, 1889, p. 440; OD]. Similar to *Neoglyphioceras,* but constrictions with ventral salient and spiral ornamentation consisting of 28 to 42 lirae; growth lines linear on ventral side, no riblets. Ventral lobe rather narrow, median saddle low, reaching one-third of entire lobe. Six species. *Mississippian (upper Visean):* Belgium, Great Britain, Ireland, Germany, Czech Republic, Poland, France, Portugal, Spain, Algeria, Russia (Novaia Zemlia, South Urals), Kazakhstan (South Urals, Mugodzhary), Tajikistan, Uzbekistan, USA (Arkansas, Kentucky, Utah, Texas).——FIG. 37,*1a–c.* **L. subcircularis* (MILLER), Crab Orchard, Rockcastle County, Kentucky, USA, Meramec series, PUC; *a–b,* ×2; *c,* suture, diameter at 12 mm, ×5.6 (Miller & Furnish, 1940b).

Lytheoceras RUZHENTSEV & BOGOSLOVSKAIA, 1971, p. 320 [**L. nitidum*; OD]. Similar to *Neoglyphioceras*, but no spiral ornamentation. Deep constrictions, one or two per whorl, almost linear. Two species. *Mississippian (lower Serpukhovian):* Russia and Kazakhstan (South Urals).——FIG. 37,*2a–c.* **L. nitidum; a–b,* holotype, River Zhaksy-Kargali, left bank, Aktiubinsk oblast', Aqtöbe, PIN 455/35639, ×2; *c,* suture, PIN 455/35641, whorl height at 4.4 mm, whorl width 5.3 mm, ×6.2 (Ruzhentsev & Bogoslovskaia, 1971).

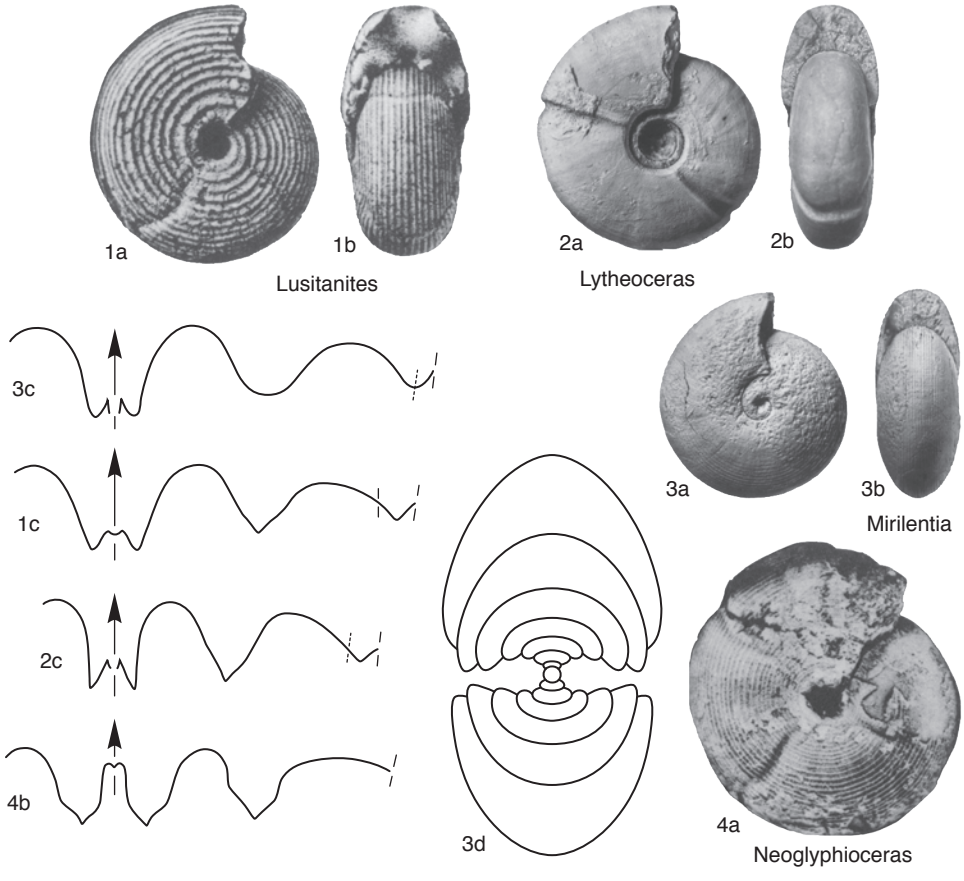

FIG. 37. Neoglyphioceratidae (p. 63–64).

Mirilentia RUZHENTSEV & BOGOSLOVSKAIA, 1971, p. 328 [**M. uberta*; OD]. Conch form small, thickly discoidal, with narrowly rounded, almost oxycone ventral side; umbilicus narrow, last half whorl with wide umbilicus. Faint longitudinal lirae may disappear on later stages; 3 to 4 constrictions, only on young stages, with lateral sinus and ventral salient. Ventral lobe narrow, rounded, with very low median saddle. Adventitious and lateral lobes broadly rounded. Three species. *Mississippian (Serpukhovian):* Russia and Kazakhstan (South Urals), Algeria.——FIG. 37,*3a–d. *M. uberta; a–b,* holotype, side view, apertural view, Dombar Hills, South Urals, Kazakhstan, lower Serpukhovian, PIN 455/35655, ×2; *c,* suture, PIN 455/35659, whorl height at 4.2 mm, whorl width 5.2 mm, ×8; *d,* cross section, PIN 455/35658, ×5 (Ruzhentsev & Bogoslovskaia, 1971).

Subfamily LYROGONIATITINAE Ruzhentsev & Bogoslovskaia, 1971

[Lyrogoniatitinae RUZHENTSEV & BOGOSLOVSKAIA, 1971, p. 272]

Shell form rather large, subdiscoidal or pachycone, moderately evolute to moderately involute. Umbilicus moderately wide. Some forms with umbilical seam covered by test material. Sculpture variable, some forms with umbilical notches. Lirae usually stronger than growth lines, sometimes 20 to 50 on outer surface; constrictions usually wide and deep, especially on steinkern. [Lyrogoniatitinae was established (RUZHENTSEV & BOGOSLOVSKAIA, 1971) as a

subfamily of Cravenoceratidae, sorting out *Lyrogoniatites* and other neoglyphioceratids from Neoglyphioceratidae. The arguments in regard to assumed different phylogenetic lineages in Neoglyphioceratidae, Cravenoceratinae, and Lyrogoniatitinae are not followed herein. The assignment of the closely related genera *Neoglyphioceras, Lyrogoniatites,* and *Pachylyroceras* to different families is regarded herein as questionable.] *Mississippian (upper Visean–lower Serpukhovian).*

Lyrogoniatites Miller & Furnish, 1940b, p. 368 [**L. newsomi georgiensis;* OD]. Similar to *Neoglyphioceras*, but with broader conch and lower number (30–60) of longitudinal lirae. Constrictions usually deep and narrow, with ventrolateral salient and ventral sinus on all growth stages. Ventral lobe rather narrow. Seven species and three questionable species. *Mississippian (upper Visean–lower Serpukhovian):* Great Britain, Germany, Portugal, Algeria, Czech Republic, Russia (Novaia Zemlia, South Urals), Kazakhstan (South Urals), Tajikistan (Darvaz), Uzbekistan, China (Ningxia), USA (Alaska, Georgia).——Fig. 38,*1a–d. *L. georgiensis*, holotype, Land's well, Lot 286, about 9 km north of Rome, Floyd County, Georgia, Chesterian, USNM 60600; *a–c,* ×1.5; *d,* suture, diameter at 15 mm, ×4.3 (Miller & Furnish, 1940b).

Alaoceras Ruzhentsev & Bogoslovskaia, 1971, p. 250 [**A. bajtalense* Ruzhentsev & Bogoslovskaia, 1971, p. 251; OD]. Conch subdiscoidal to pachycone, umbilicus wide or moderately wide. Umbilical seam as in *Pachylyroceras,* closed by test material with a thin groove alongside. Sculpture displays umbilical notches; spiral ornamentation weak, sometimes disappearing. One or two constrictions per whorl. Ventral lobe narrow at base; sides of ventral lobe considerably diverging. Two species. *Mississippian (upper Visean–lower Serpukhovian):* Kazakhstan (South Urals).——Fig. 38,*4a–c. *A. bajtalense,* holotype, Dombar Hills, South Urals, lower Serpukhovian, PIN 455/29782; *a–b,* apertural view, ×1; *c,* suture, whorl height at 7 mm, whorl width 18 mm, ×4 (Ruzhentsev & Bogoslovskaia, 1971).

Caenolyroceras Ruzhentsev & Bogoslovskaia, 1971, p. 277 [**C. subgloboide* Ruzhentsev & Bogoslovskaia, 1971, p. 278; OD]. Similar to *Lyrogoniatites,* but on early whorls with wide umbilicus, later moderately wide umbilicus. Ornamentation consisting of 35–55 strong spiral lirae and faint, weakly biconvex growth lines. Constrictions may be present. Two or three species. [The figures for *C. chalicum* are better than those for *C. subgloboide*.] *Mississippian (upper Visean–lower Serpukhovian):* ?Great Britain, Germany, Poland, Kazakhstan (South Urals), ?China (?Ningxia).——Fig. 38,*3a–c. C. chalicum* Korn, holotype, Estinghausen, Sauerland, Rhenish Massif, Germany, upper Visean, WMN 10210; *a–b,* ×2.5; *c,* paratype, suture, WMN 10216, whorl height at 4.1 mm, whorl width 9.6 mm, ×7.5 (Korn, 1988b).

Dombarigloria Ruzhentsev & Bogoslovskaia, 1971, p. 248 [**D. miranda* Ruzhentsev & Bogoslovskaia, 1971, p. 249; OD]. Conch form as in *Pachylyroceras.* Sculpture consisting of only 14–18 longitudinal lirae; no or inconspicuous constrictions. Ventral lobe narrow, with parallel sides. Two species. [This genus is closely related to *Pachylyroceras* and may be its junior synonym.] *Mississippian (upper Visean):* Kazakhstan (South Urals).——Fig. 38,*2. *D. miranda,* holotype, suture, Dombar Hills, PIN 455/29450, whorl height at 7.3 mm, whorl width 22.0 mm, ×2.6 (Ruzhentsev & Bogoslovskaia, 1971).

Pachylyroceras Ruzhentsev & Bogoslovskaia, 1971, p. 243 [**Lyrogoniatites cloudi* Miller & Youngquist, 1948, p. 660; OD] [=*Entogonoceras* Plummer & Scott, 1937, text-fig. 88, *nom. nud.,* no type designated; for discussion, see Gordon, 1965, p. 197]. Conch form large, thickly discoidal to subglobular, moderately evolute to moderately involute. Umbilicus rather wide, seam covered by test material. Sculpture consisting of about 20–30 coarse, widely spaced longitudinal lirae; constrictions in most forms variable, wide, and deep. Ventral lobe narrow, with slightly divergent sides. Seven species. *Mississippian (upper Visean [Meramecian–Chesterian]):* Spain, Portugal, Kazakhstan (South Urals), Tajikistan (Darvaz), USA (Arkansas, Oklahoma, Texas).——Fig. 38,*5a–d. *P. cloudi* (Miller & Youngquist); *a–c,* holotype, San Saba County, 4 km SE of San Saba, Texas, Chesterian, USNM, ×1.5 (Miller & Youngquist, 1948); *d,* suture, Dombar Hills, South Urals, Kazakhstan, PIN 455/29171, whorl height at 5.4 mm, whorl width 12.0 mm, ×5 (Ruzhentsev & Bogoslovskaia, 1971).

Family CRAVENOCERATIDAE Ruzhentsev, 1957

[Cravenoceratidae Ruzhentsev, 1957, p. 58]

Conch form broad or thickly discoidal, moderately evolute to involute; in general evolute on inner whorls. Surface in general smooth, weak spirals may be present in some species; coarse, widely spaced longitudinal lirae rare. Ventral lobe relatively narrow, median saddle comparatively low. *Mississippian (Serpukhovian)–Pennsylvanian (lower Bashkirian).*

Subfamily CRAVENOCERATINAE Ruzhentsev, 1957

[*nom. transl.* Ruzhentsev, 1960d, p. 212, *ex* Cravenoceratidae Ruzhentsev, 1957, p. 58]

Umbilicus moderately narrow. Growth striae dominant, frequently lamellar,

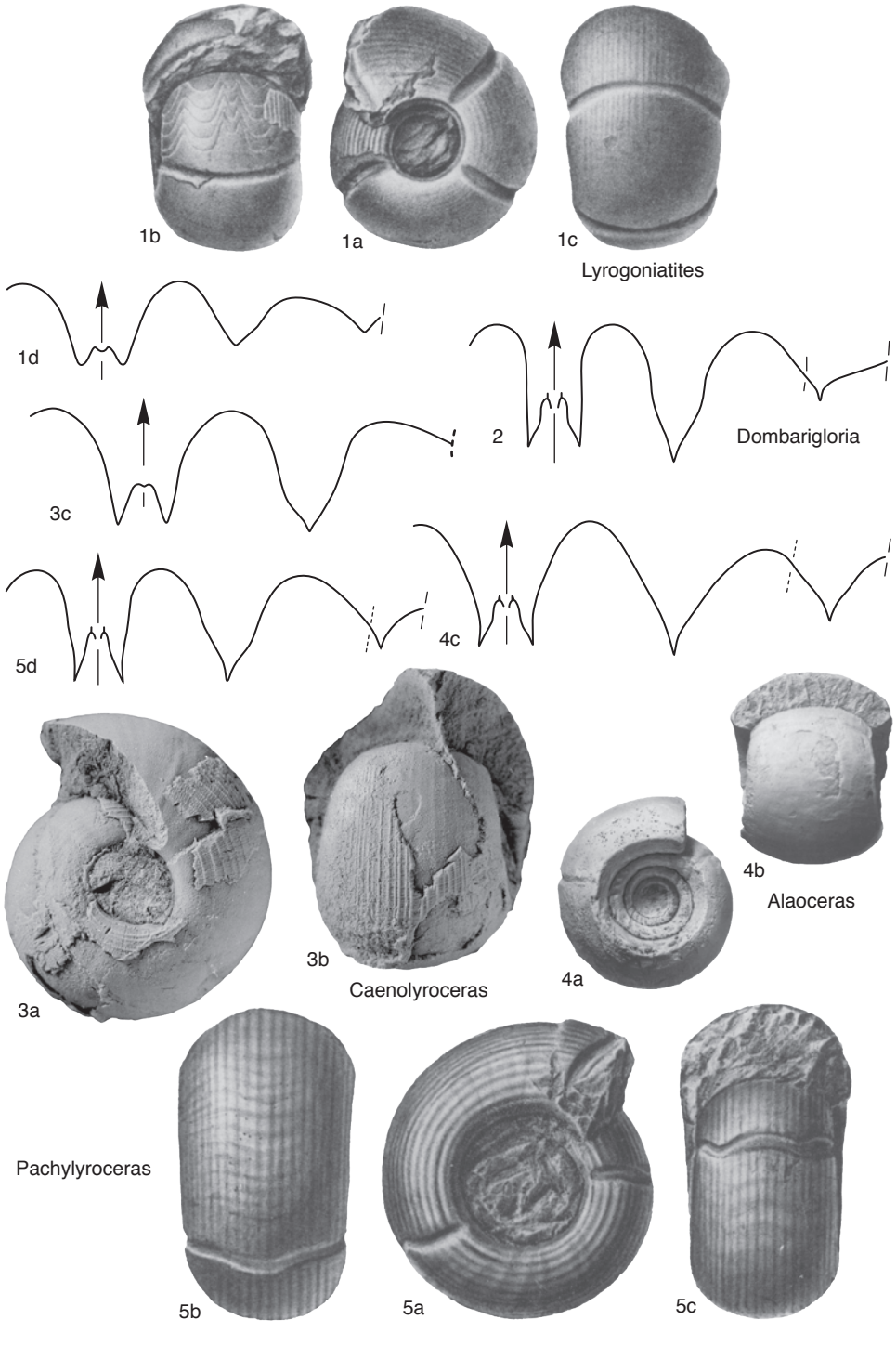

FIG. 38. Neoglyphioceratidae (p. 65).

sometimes dichotomizing. Spiral ornamentation may be present, but no reticulate ornament. *Mississippian (Serpukhovian [Chesterian])–Pennsylvanian (lower Bashkirian).*

Cravenoceras Bisat, 1928, p. 132 [**Homoceras malhamense* Bisat, 1924, p. 106; OD] [?=*Emstites* Korn, 1988b, p. 140 (type, *Paraglyphioceras schaelkense* Brüning, 1923b, p. 29, OD)]. Conch form thickly discoidal to globose, widely to moderately umbilicate, in young stages extremely evolute. Sculpture consisting of transverse lamellae, which are more or less straight on flanks, but forming a shallow ventral sinus. Spiral ornament may be present. Constrictions weak or absent. Ventral lobe narrow, with relatively low median saddle. Many species. [*Cravenoceras* is probably a senior synonym of *Emstites*; for discussion, see below. It is closely related and seems to be transitional to glaphyritid genera, e.g., *Syngastrioceras*; for discussion, see Saunders & Work, 1999.] *Mississippian (Serpukhovian [Chesterian]):* Great Britain, Ireland, Belgium, ?Germany, Spain, Portugal, Algeria, Czech Republic, Poland, Serbia, Russia (Moscow basin, Novaia Zemlia, South Urals), Ukraine, Kazakhstan (Karaganda, South Urals), Uzbekistan, Tajikistan (Darvaz), China (Xizang, Ningxia, Gansu), Australia (New South Wales), USA (California, Nevada, Oklahoma).——Fig. 39,*1a–d.* **C. malhamense* (Bisat), holotype, Bordley Shales, Moore Close Gill, Malham, Yorkshire, England, lower Serpukhovian; *a,* side view, ×3; *b,* side view of young specimen, ×5; *c,* suture, diameter at 13 mm, ×5.6; *d,* outline of holotype, ×5.6 (Bisat, 1924).

?Aenigmatoceras Ruzhentsev & Bogoslovskaia, 1978, p. 144 [**A. rhipaeum;* OD]. Conch subdiscoidal, involute, umbilicus moderately narrow. Two or three deep constrictions per whorl, deepest with sinus on flanks, shallow and almost linear on venter. Ventral lobe wide, with divergent sides. Median saddle exceeding slightly half height of entire ventral lobe, prongs not pouched. First lateral saddle rather wide, rounded. Two species. [Deep constrictions in this genus suggest a resemblance to *Tympanoceras,* but the phylogenetic relationship is uncertain and assignment to Cravenoceratidae is tentative.] *Pennsylvanian (lower Bashkirian [Kinderscoutian]):* Russia (South Urals, Bashkortostan), Uzbekistan (Kyzylkumy).——Fig. 39,*2a–d.* **A. rhipaeum; a–b,* holotype, Akberda River, Bashkortostan, upper *Reticuloceras* Zone, PIN 455/36120, ×1.5; *c,* suture of holotype, whorl height at 7.5 mm, whorl width 11.0 mm, ×4.1; *d,* cross section, Malaia Suren' river, PIN 455/38943, ×3.3 (Ruzhentsev & Bogoslovskaia, 1978).

Cravenoceratoides Hudson, 1941, p. 282 [**Goniatites nitidus* Phillips, 1836, p. 235; OD]. Conch form subglobular to subdiscoidal, moderately evolute to moderately involute. Sculpture consisting of almost radial transverse striae dichotomizing somewhat irregularly at or close to umbilical shoulder. Ventral lobe relatively wide, with diverging sides. Nine species. *Mississippian (Serpukhovian [Chesterian]):* Belgium, Great Britain, Ireland, Germany, Czech Republic, Poland, Portugal, Algeria, Morocco, Kazakhstan (South Urals), Uzbekistan (Fergana, Kyzylkumy), USA (California).——Fig. 40,*5a–b.* **C. nitidus* (Phillips), lectotype, Dinckley, River Ribble, England, Arnsbergian, BMNH C279, ×5 (Hudson, 1946).

?Emstites Korn, 1988b, p. 140 [**Paraglyphioceras schaelkense* Brüning, 1923b, p. 29; OD]. Conch form thickly discoidal to globular. Umbilicus of early whorls very wide, later narrow or moderately wide. Umbilical edge well developed. Ornamentation consisting of fine biconvex or convex growth lines; some species with faint spiral lirae. Ventral lobe rather narrow and V-shaped, median saddle moderately low, first lateral saddle broadly rounded. Ventrolateral saddle asymmetrical and very narrow in juvenile specimens. Ten species, several questionable. [This genus is closely related to *Cravenoceras* and is probably its junior synonym; some authors regard minor differences in the ontogenetic development of the ventral lobe and ventrolateral saddle as being sufficient to warrant generic separation (for discussion, see Korn & Tilsley, 2002, p. 116).] *Mississippian (Serpukhovian [basal Pendleian, Chesterian]):* Germany, ?Great Britain, ?Ireland, Russia (Novaia Zemlia, South Urals), Kazakhstan (South Urals), USA (Arkansas).——Fig. 39,*3a–c.* **E. schaelkensis* (Brüning), Schälk near Letmathe, Rhenish Massif, Germany, basal Serpukhovian, WMN 10195 (collection Korn); *a–b,* ×2; *c,* suture, WMN 10199, whorl height at 10.1 mm, whorl width 14.3 mm, ×4.1 (Korn, 1988b).

Gorboviceras Kuzina & Yatskov, 1999, p. 96 [**G. biconvexum;* OD]. Conch form small, thickly discoidal, widely umbilicate on early whorls, later moderately wide. Ornamentation of juvenile forms consisting of biconvex lamellae, later linear lamellae with ventral sinus. Ventral lobe with subparallel sides, slightly constricted close to first lateral saddle. Adventitious lobe deep, with sinuous sides. Two species. *Mississippian (lower Serpukhovian):* Russia (Novaia Zemlia).——Fig. 39,*4a–c.* **G. biconvexum,* holotype, Berkha island, southern shore, PIN 4279/2500; *a–b,* ×1.5; *c,* suture, whorl height at 5.2 mm, whorl width 12.0 mm, ×4 (Kuzina in Kuzina & Yatskov, 1999).

Lechroceras Ruan & Zhou, 1987, p. 117 [**L. latilobatum* Ruan & Zhou, 1987, p. 118; OD]. Conch form pachycone, with moderately wide umbilicus. Growth lines lamellar, spiral ornamentation and constrictions present. Ventral lobe very wide, with widely divergent sides and rather low median saddle. Adventitious lobe subacute, comparatively short. One species. *Mississippian (lower Serpukhovian):* China (Ningxia).——Fig. 40,*4a–c.* **L. latilobatum; a–b,* holotype, lower member of Tsingyuan Formation, Shangxiaoyuchuan section, Zhongwei County, NGPI 95800, ×2 (new, courtesy of Zhou Zuren); *c*, suture, NIGP 95799, whorl height at 7.4 mm, ×4 (Ruan & Zhou, 1987).

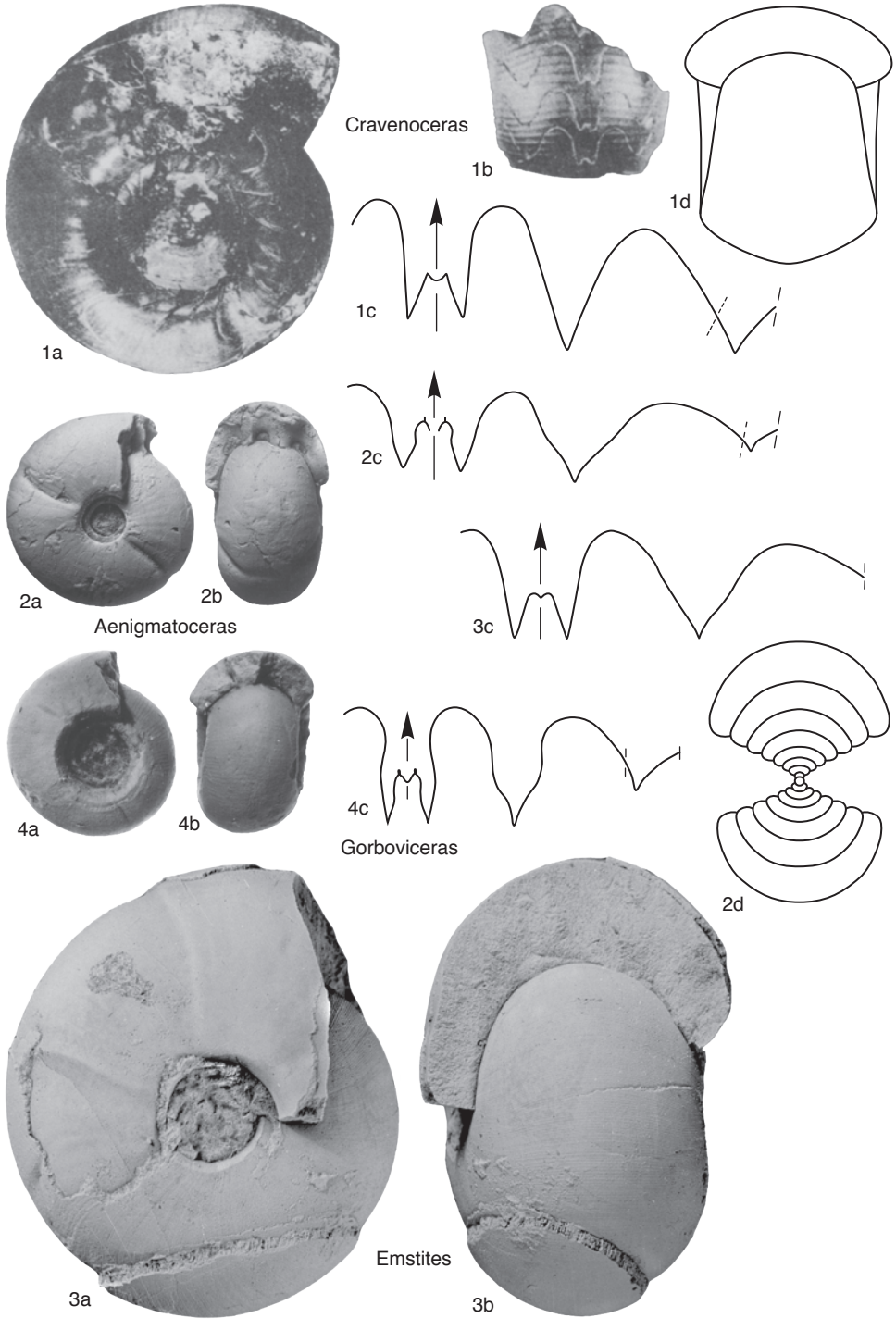

FIG. 39. Cravenoceratidae (p. 67).

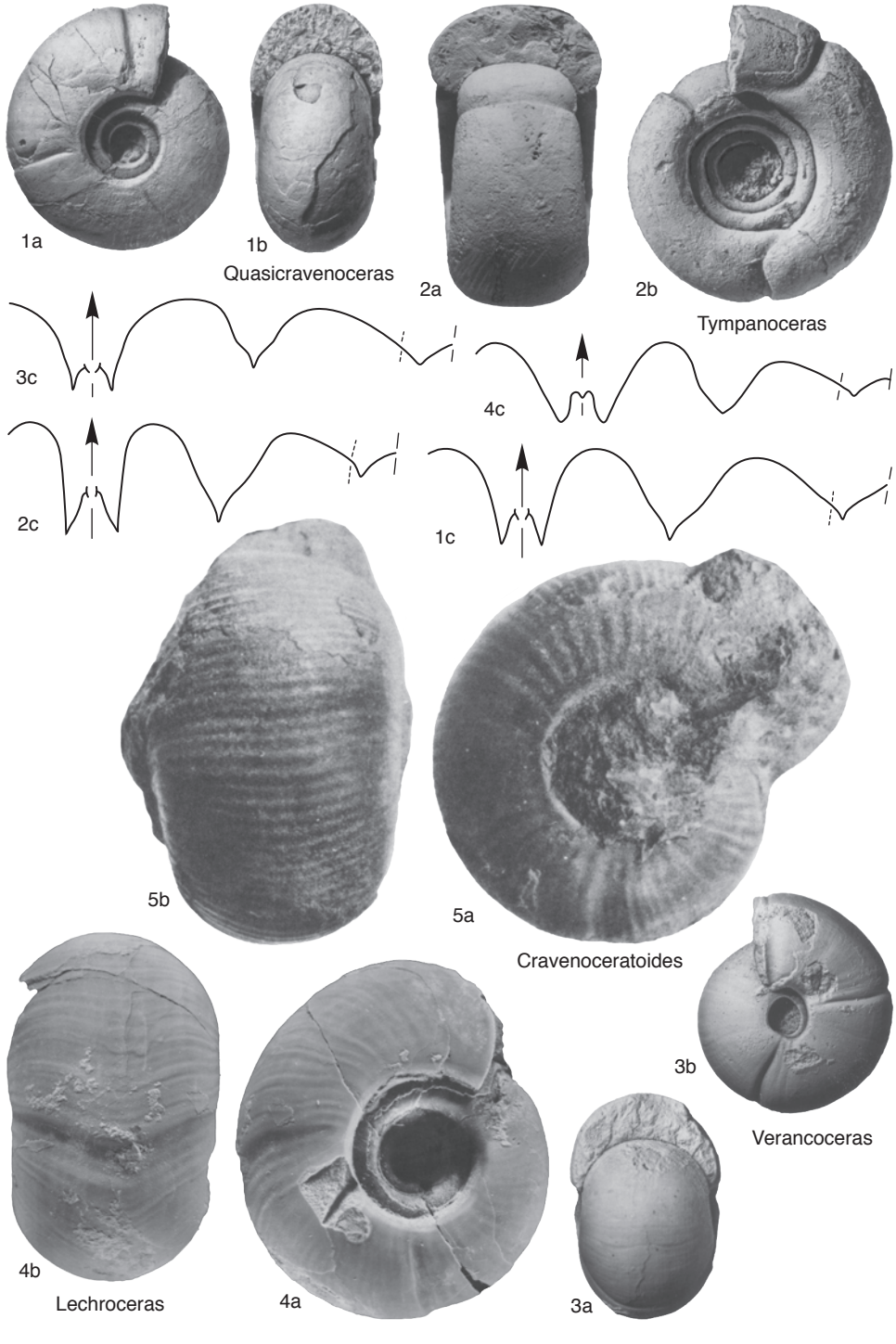

FIG. 40. Cravenoceratidae (p. 67–70).

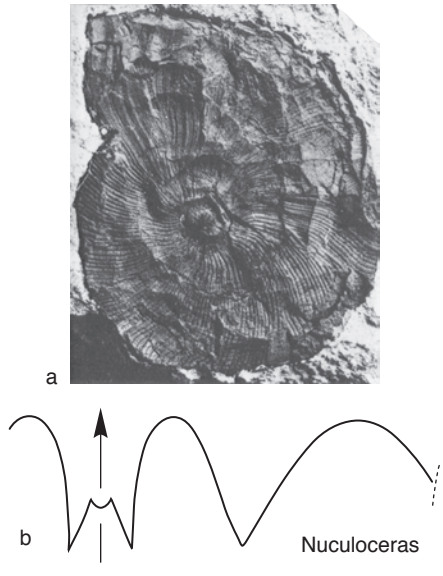

FIG. 41. Cravenoceratidae (p. 70).

Quasicravenoceras RUZHENTSEV & BOGOSLOVSKAIA, 1971, p. 279 [**Q. consuetum;* OD]. Conch form subdiscoidal, relatively involute, umbilicus moderately narrow or narrow. Sculpture consisting of distinct lamellae, sometimes thickened to little riblets; some longitudinal lirae may be present at umbilical ridge. Constrictions weak on shell surface, but strong and deep on steinkern. Ventral lobe with widely divergent sides, first lateral saddle very broad, rounded. Four species. *Mississippian (lower Serpukhovian):* Russia (Novaia Zemlia, South Urals), Kazakhstan (South Urals).——FIG. 40,*1a–c. *Q. consuetum*; *a–b,* holotype, Dombar Hills, South Urals, Kazakhstan, PIN 455/32707, ×1; *c,* suture, PIN 455/32710, whorl height at 7.7 mm, whorl width 13.0 mm, ×4 (Ruzhentsev & Bogoslovskaia, 1971).

Tympanoceras RUZHENTSEV, 1958, p. 295 [**T. trisulcum;* OD; =*T. trisulcatum* RUZHENTSEV & BOGOSLOVSKAIA, 1971, p. 270, *nom. van.*] [=*Collectoceras* RUZHENTSEV & BOGOSLOVSKAIA, 1971, p. 266 (type, *C. dombarense,* OD); =*Aravanites* ZAKHAROV, 1971, p. 93 (type, *A. kirgizstanicus,* OD)]. Conch form discoidal to subglobular, moderately involute, with wide umbilicus; height of aperture small. One to four constrictions per whorl, orad concave on flanks, crossing venter straight. Ventral lobe rather narrow, with relatively low median saddle; first lateral saddle broadly rounded. Adventitious lobe relatively narrow, pointed, with straight sides. Five species and two or three questionable species. [*Collectoceras* is distinguished by the presence of only one single deep constriction, regarded herein as being a specific rather than generic character. *Aravanites* is based on two poorly preserved specimens with somewhat more involute conch shape and slightly flattened flanks.] *Mississippian (lower Serpukhovian–upper Serpukhovian):* Russia (Novaia Zemlia, South Urals), Spain, Kazakhstan (South Urals), Kyrgyzstan, Uzbekistan; Spain, *upper Serpukhovian.*——FIG. 40,*2a–c. *T. trisulcum; a–b,* holotype, Dombar Hills, South Urals, Kazakhstan, lower Serpukhovian, PIN 455/458, ×2; *c,* suture, PIN 455/30363, whorl height at 6.0 mm, whorl width 12.0 mm, ×4 (Ruzhentsev & Bogoslovskaia, 1971).

?Verancoceras RUZHENTSEV & BOGOSLOVSKAIA, 1971, p. 282 [**V. admirabile* RUZHENTSEV & BOGOSLOVSKAIA, 1971, p. 283; OD]. Conch form as in *Quasicravenoceras*, but broader and with irregular umbilicus. Growth lines displayed as weak lamellae, no spiral ornamentation. Ventral lobe very narrow, with low median saddle. Three species. [This genus is closely related to *Quasicravenoceras*; its generic independence is uncertain.] *Mississippian (upper Serpukhovian):* Russia and Kazakhstan (South Urals), China (Xizang).——FIG. 40,*3a–c. *V. admirabile; a–b,* holotype, side view, Zhaksy-Kargali River, left bank, Aqtöbe (=Aktiubinsk oblast'), South Urals, Kazakhstan, Arnsbergian, PIN 455/33390, ×1.5; *c,* suture, PIN 455/33393, whorl height at 6.0 mm, whorl width 8.8 mm, ×6 (Ruzhentsev & Bogoslovskaia, 1971).

Subfamily NUCULOCERATINAE Ruzhentsev, 1957

[*nom. transl.* RUZHENTSEV, 1960d, p. 213, *ex* Nuculoceratidae RUZHENTSEV, 1957, p. 58]

Conch form pachycone. Umbilicus very narrow or closed. Faint dichotomizing riblets and weak lirae present. [The root group and phylogenetic relationship of this subfamily are uncertain.] *Mississippian (Serpukhovian).*

Nuculoceras BISAT, 1924, p. 100 [**N. nuculum;* OD]. Conch form subglobose to globose, narrowly umbilicate. Sculpture consisting of strong transverse striae crossed by closely spaced longitudinal lirae, sometimes producing crenistriate pattern. Transverse striae with ventrolateral salient and shallow ventral sinus. Ventral lobe narrow, with relatively low median saddle; first lateral saddle narrowly rounded. Adventitious lobe relatively narrow, pointed, with straight sides. Five species and four questionable species. [The type material for this genus is poorly known; for discussion, see RUZHENTSEV & BOGOSLOVSKAIA, 1971, p. 310.] *Mississippian (Serpukhovian):* Great Britain, Ireland, Belgium, Germany, Netherlands, Serbia, Ukraine, Morocco, China (Xizang), Kazakhstan (South Urals).——FIG. 41*a. *N. nuculum,* Couthuyin, Liège, Belgium, upper Serpukhovian, ×1.4 (Demanet, 1941).——FIG. 41*b. N. crenistriatoides* KULLMANN, holotype, suture, Družetić-Milivojević, Serbia, upper Serpukhovian, SLM 4063/22, whorl height at 5 mm, whorl width 6.5 mm, ×3.5 (Kullmann, 1962).

Family FERGANOCERATIDAE Ruzhentsev, 1960

[*nom. transl.* Ruzhentsev & Bogoslovskaia, 1971, p. 330, *ex* Ferganoceratinae Ruzhentsev, 1960d, p. 203]

Conch form discoidal or subdiscoidal, with rather narrow umbilicus. Ventrolateral furrows present. Sculpture consisting of strong longitudinal lirae crossed by growth lines forming ventral and lateral sinus. Ventral lobe rather wide, with divergent sides; median saddle moderately high or higher than half the height of entire ventral lobe. First lateral saddle broadly rounded, adventitious lobe in some forms asymmetric. *Mississippian (upper Visean).*

Ferganoceras Librovich, 1957, p. 253 [**F. elegans* Librovich, 1957, p. 254; OD] [=*Ruddelites* Malinky & Mapes, 1982, p. 309 (type, *R. drahovzali* Malinky & Mapes, 1982, p. 312, OD)]. Conch form discoidal, moderately involute; umbilicus rather narrow. Sculpture consisting of faint growth lines with ventral and lateral sinus, crossing longitudinal lirae and ventrolateral grooves. Suture as in *Neoglyphioceras.* Four species. [*Ruddelites* is based on small specimens showing minor differences at the ventral lobe, and the measurements and characters are regarded herein as being of specific significance.] *Mississippian (upper Visean):* France, Algeria, China (Guangxi), Kazakhstan (South Urals), Uzbekistan (Fergana, Kyzylkumi, Tian Shan), USA (Arkansas).——Fig. 42,*1a–c. *F. elegans,* Dombar Hills, South Urals, Kazakhstan; *a–b,* side view, PIN 455/6231, ×1.5; *c,* suture, PIN 455/6158, whorl height at 8.2 mm, whorl width 8.4 mm, ×3 (Ruzhentsev & Bogoslovskaia, 1971).

Nummoceras Ruzhentsev & Bogoslovskaia, 1971, p. 333 [**N. limbatum;* OD]. Similar to *Ferganoceras,* but conch form thin-discoidal, involute on last whorls, with almost flattened ventral side. Ventral lobe very wide, with median saddle half as high as entire lobe. Adventitious lobe about as deep as ventral lobe. One species. *Mississippian (upper Visean):* Kazakhstan (South Urals).——Fig. 42,*2a–d. *N. limbatum; a–b,* holotype, Dombar Hills, PIN 455/5802, ×1.5; *c,* suture, PIN 455/5807, ×5; *d,* cross section, PIN 455/5804, ×5 (Ruzhentsev & Bogoslovskaia, 1971).

Family RHYMMOCERATIDAE Ruzhentsev & Bogoslovskaia, 1971

[Rhymmoceratidae Ruzhentsev & Bogoslovskaia, 1971, p. 334] [=Rhymmoceratinae Ruzhentsev & Bogoslovskaia, 1971, p. 335]

Conch form discoidal, vermicular, evolute, with wide umbilicus. Conspicuous ornamentation varies considerably. Ventral lobe rather narrow, with low median saddle; advanced forms reach gastrioceran type of suture, but median lobe does not exceed half length of entire ventral lobe. [The root group and phylogenetic relationship of this family are uncertain.] *Mississippian (upper Visean)–Pennsylvanian (lower Bashkirian).*

Rhymmoceras Ruzhentsev, 1958, p. 293 [**R. vermiculatum;* OD]. Conch form small, discoidal, or vermicular, with wide umbilicus; ventral side well rounded. Sculpture consisting of prominent transversal striae, with ventrolateral salient and shallow ventral sinus, crossing longitudinal lirae and thereby producing a reticulate ornamentation. Faint riblets may be present. Several constrictions common on each whorl. Ventral lobe relatively narrow, with roundly divergent sides; first lateral saddle well rounded. Adventitious lobe larger than ventral lobe, pointed. Five species. *Mississippian (lower Serpukhovian):* Serbia, Spain, China (Ningxia), Kazakhstan (South Urals), Uzbekistan.——Fig. 42,*3a–c. *R. vermiculatum; a–b,* holotype, Dombar Hills, South Urals, Kazakhstan, PIN 455/425, ×3; *c,* suture, PIN 455/429, whorl height at 2.5 mm, whorl width 6.0 mm, ×5 (Ruzhentsev & Bogoslovskaia, 1971).

?Chumazites Ruzhentsev & Bogoslovskaia, 1978, p. 146 [**C. primus* Ruzhentsev & Bogoslovskaia, 1978, p. 147; OD]. Conch form small, subdiscoidal; inner whorls evolute, later whorls involute, with moderately narrow umbilicus. Ornamentation consisting of lamellae exhibiting shallow ventral sinus; no spiral sculpture. Inner mold with distinct riblets; no constrictions. First lateral saddle narrowly rounded. Two species. [The phylogenetic relationship of this genus is uncertain, and assignment to the Rhymmoceratidae is tentative.] *Pennsylvanian (lower Bashkirian):* Russia (South Urals).——Fig. 42,*5a–c. *C. primus; a–b,* holotype, Chumaza river, Bashkortostan, PIN 455/36444, ×3; *c,* suture, whorl height at 2.5 mm, whorl width 4 mm, ×10 (Ruzhentsev & Bogoslovskaia, 1978).

Ophilyroceras Ruzhentsev & Bogoslovskaia, 1971, p. 335 [**O. tersum* Ruzhentsev & Bogoslovskaia, 1971, p. 336; OD]. Sculpture consisting of 15 to 18 prominent longitudinal lirae. Strong constrictions with ventral salient always present. Suture primitive; ventral lobe narrow, median saddle low. Adventitious lobe smaller than ventral lobe, pointed. One species. [This genus is closely related and transitional to *Rhymmoceras.*] *Mississippian (upper Visean):* Kazakhstan (South Urals).——Fig. 42,*4a–c. *O. tersum; a–b,* holotype, Dombar Hills, PIN 455/33404, ×1.5; *c,* suture, PIN 455/33405, whorl height at 2.4 mm, whorl width 4.5 mm, ×6 (Ruzhentsev & Bogoslovskaia, 1971).

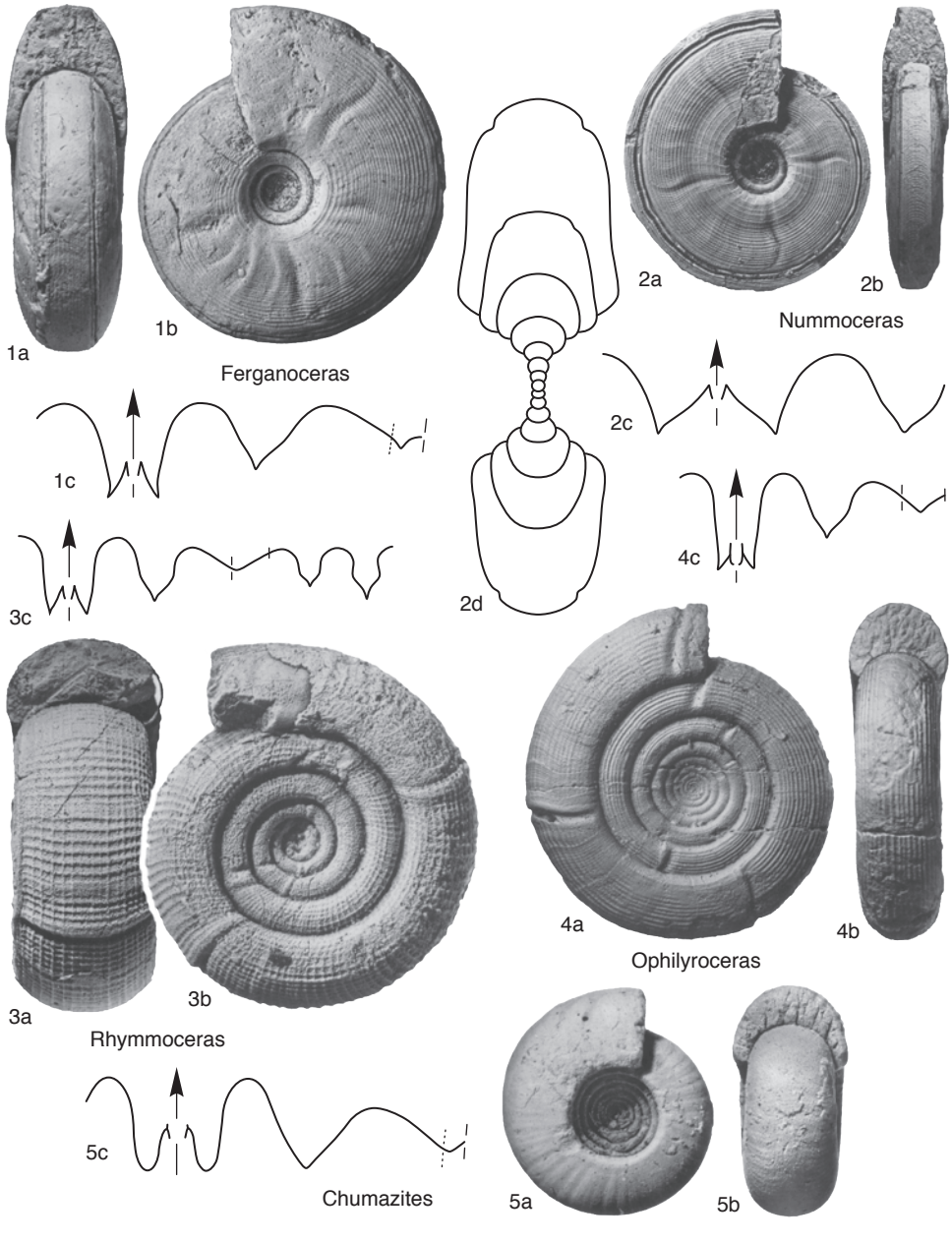

FIG. 42. Ferganoceratidae and Rhymmoceratidae (p. 71).

NEODIMORPHOCERATOIDEA

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Superfamily NEODIMORPHOCERATOIDEA Furnish & Knapp, 1966

[*nom. transl.* RUZHENTSEV & BOGOSLOVSKAIA, 1969a, p. 61, *ex* Neodimorphoceratinae FURNISH & KNAPP, 1966, p. 304]

Conch form thickly discoidal to discoidal, with tendency to oxyconic ventral side. Sculpture consisting of dichotomizing costellae. In the course of phylogeny ventral lobe widening and becoming bipartite. Sutural formula: $(E_1E_mE_1)$ALUI --> $(E_1E_2E_mE_2E_1)$ALUI [Germany], (V_1V_1) LU:ID --> $(V_{1.1}V_{1.2}V_{1.2}V_{1.1})$LU:ID [Russian]. *Pennsylvanian (Bashkirian)–Cisuralian (Asselian).*

Family RAMOSITIDAE Ruzhentsev & Bogoslovskaia, 1969

[Ramositidae RUZHENTSEV & BOGOSLOVSKAIA, 1969a, p. 62]

Conch form thickly discoidal to subdiscoidal, very involute. Umbilicus varying from moderately to extremely narrow. Ventral lobe wide, its branches being simple; first lateral saddle rounded. [The root group and phylogenetic relationship of this family are uncertain.] *Pennsylvanian (Bashkirian).*

Ramosites RUZHENTSEV & BOGOSLOVSKAIA, 1969a, p. 62 [**R. ramosus* RUZHENTSEV & BOGOSLOVSKAIA, 1969a, p. 64; OD]. Conch form discoidal to subglobular, involute. Umbilicus moderately narrow to extremely narrow. Sculpture radial; flat costellae regularly dichotomizing on flanks, on later stages with ventral sinus. No umbilical tubercles. Ventral lobe wide, median saddle reaching two-thirds height of entire ventral lobe. Adventitious lobe broad, ampullaceous. Many species. *Pennsylvanian (Bashkirian):* Belgium, Great Britain, Ireland, Netherlands, Germany, France, Spain, Portugal, Poland, Russia (South Urals), China (Guangxi, Ningxia, Xinjiang), Kazakhstan (South Urals), Kyrgyzstan, Uzbekistan (Fergana, Kyzylkumy).——FIG. 43,*1a–d. *R. ramosus; a–b,* Sholak-Say Canyon, South Urals, Kazakhstan, PIN 455/38151, ×1; *c,* side view, PIN 455/38152, ×1.5; *d,* suture of holotype, PIN 455/85150, whorl height at 13.3 mm, whorl width 16.0 mm, ×2.3 (Ruzhentsev & Bogoslovskaia, 1978).

Hodsonites RAMSBOTTOM, 1977, p. 288 [**Homoceras magistrorum* HODSON, 1957, p. 21; OD]. Conch as in *Homoceras*. Ornamentation with forwardly projecting small plications at umbilical edge from which fine striae arise by bi- or trifurcation, and intercalation crossing flanks and venter. Constrictions numerous. Ventral lobe wide, with low median saddle. One species. *Pennsylvanian (lower Bashkirian):* Great Britain, Ireland, Belgium, Germany, Poland.——FIG. 43,*2. *H. magistrorum* (HODSON), holotype, River Aille, near Lisdoonvarna, County Clare, Ireland, lower *Homoceras* Zone, GSM 86909, ×4 (Hodson, 1957).

Homoceratoides BISAT, 1924, p. 112 [**H. prereticulatus;* OD]. Conch form as in *Homoceras.* Sculpture of early whorls consisting of forwardly projecting small plications at umbilical edge, from which fine striae arise by bi- or trifurcation; growth striae may be intercalated. Later growth stages without plications; with increasing growth dichotomizing point receding from umbilical shoulder up to lateral area. Transverse striations noncrenulate. Constrictions usually present. Suture line with very broad ventral lobe and broadly rounded first lateral saddle. Many species. [The phylogenetic relationship of this genus is uncertain; it may be related to Bisatoceratidae (RUZHENTSEV & BOGOSLOVSKAIA, 1978, p. 303).] *Pennsylvanian (Bashkirian [Kinderscoutian–Yeadonian]):* Great Britain, Ireland, Belgium, Netherlands, Germany, Poland, Russia (South Urals), Ukraine (Donets), Portugal, Morocco, China (Guizhou, Xinjiang), Uzbekistan (Fergana).——FIG. 43,*3a. *H. prereticulatus,* Holden Gill, Silsden, Airedale, Yorkshire, England, Kinderscoutian, ×4 (Bisat, 1924).——FIG. 43,*3b–e. H. varicatus* (SCHMIDT), juvenile forms, Neheim, Emde brickworks, Rhenish Massif, Germany, Kinderscoutian; *b–c,* GPIT 1492/1833, ×8; *d–e,* GPIT 1492/1834, ×5 (Kullmann, new).——FIG. 43,*3f. H. librovitchi* RUZHENTSEV & BOGOSLOVSKAIA, holotype, suture, Schartym River, South Urals, Russia, Kinderscoutian, lower Bashkirian, PIN 455/40472, whorl height at 12.8 mm, whorl width 12.6 mm, ×2.5 (Ruzhentsev & Bogoslovskaia, 1978).

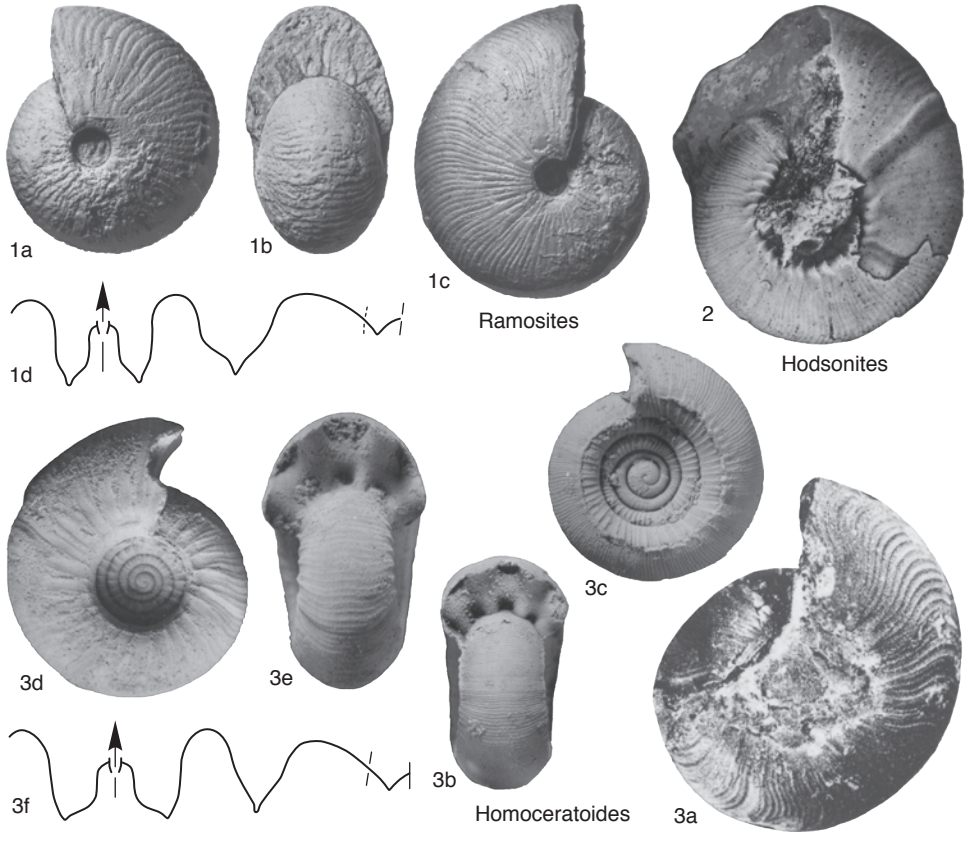

FIG. 43. Ramositidae (p. 73).

Family NEODIMORPHOCERATIDAE Furnish & Knapp, 1966

[*nom. transl.* RUZHENTSEV & BOGOSLOVSKAIA, 1969a, p. 65, *ex* Neodimorphoceratinae FURNISH & KNAPP, 1966, p. 304]

Conch form subdiscoidal to lenticular, involute. Umbilicus very narrow. Sculpture consisting of dichotomizing costellae, at least on early whorls. Spiral ornamentation common. Ventral lobe very wide, quadripartite, with simple lanceolate branches. First lateral saddle rounded to subacute. Sutural formula: $(E_1E_2E_mE_2E_1)$ALUI [German], $(V_{1.1}V_{1.2}V_{1.2}V_{1.1})$LU:ID [Russian]. *Pennsylvanian (upper Bashkirian)–Cisuralian (Asselian).*

Neodimorphoceras SCHMIDT, 1925, p. 512, 600 [**Dimorphoceras texanum* SMITH, 1903, p. 126; M] [=*Texites* SMITH, 1927b, p. 73, obj.]. Conch form lenticular or discoidal; umbilicus almost closed. Venter rounded, rarely concave. Ribs confined to early whorls; shell surface at maturity usually rather smooth, biconvex growth lines being very faint. Prongs of ventral lobe prominently bifid; first lateral saddle subangular. *Pennsylvanian (Moscovian)–Cisuralian (Asselian).*

N. (**Neodimorphoceras**). Ventral side with pronounced groove appearing at a diameter of about 20 mm. Five species. *Pennsylvanian (Moscovian–Gzhelian [Virgilian]):* USA (Illinois, Oklahoma, Texas), Canada (Northwest Territories).——FIG. 44,*2a–i. *N. (N.) texanum* (SMITH); *a–b,* Jacksboro, 5.6 km east of town, Texas, Finis shale, Graham Formation, Virgilian, SUI 13829, ×1; *c–e,* Jacksboro, 8 km north of town, Texas, Wayland shale, Graham Formation, Virgilian, SUI 13828, ×5; *f–h,* ontogenetic development of suture, SUI 13828, ×11.6; *i,* adult suture, James P. Conlin collection, Ft. Worth 3549, ×3.7 (Miller & Downs, 1950a).

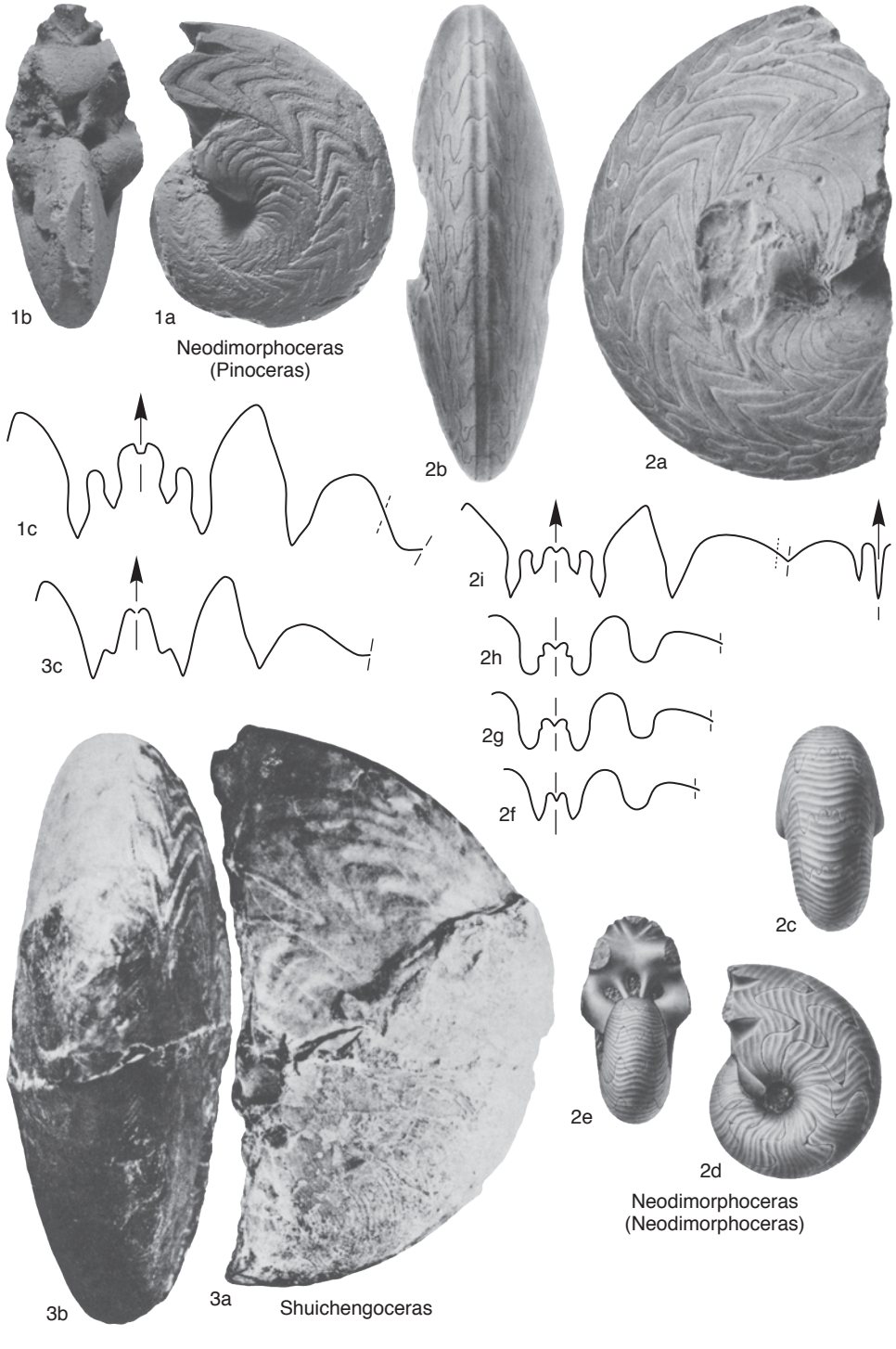

FIG. 44. Neodimorphoceratidae (p. 74–76).

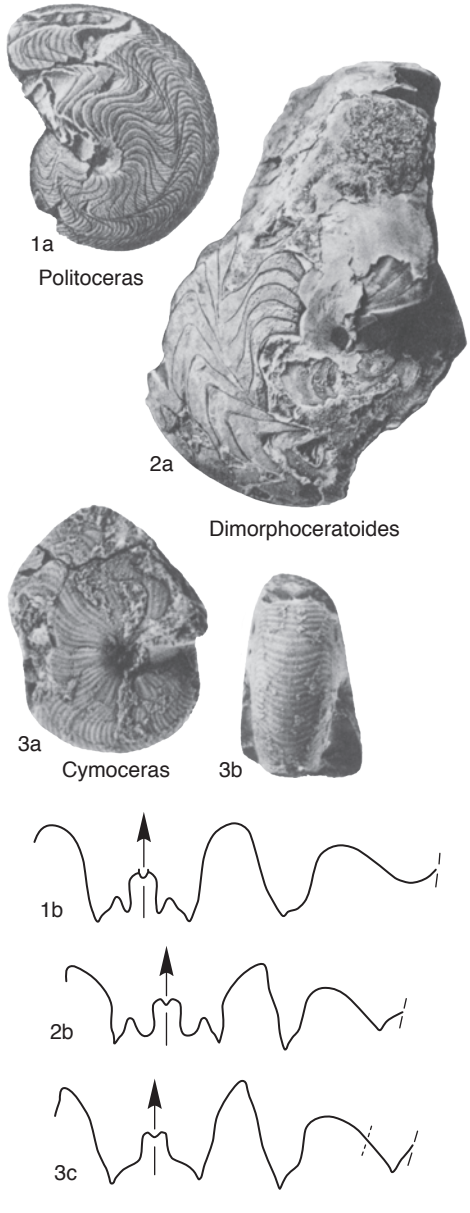

FIG. 45. Neodimorphoceratidae (p. 76).

N. (Pinoceras) RUZHENTSEV, 1947a, p. 523 [**N. (P.) daixense;* OD]. Ventral side broadly or narrowly rounded, without groove, even at large whorls. [This genus contains one species.] *Pennsylvanian (Gzhelian)–Cisuralian (Asselian):* Russia and Kazakhstan (South Urals).——FIG. 44,*1a–c. *N. (P.) daixense,* holotype, Ilinska, Chkalovskaia Oblast', South Urals, Russia, Gzhelian, PIN 320/1600; *a–b,* ×1.5; *c,* suture, whorl height at 18.0 mm, ×2 (Ruzhentsev, 1950).

Cymoceras MCCALEB, 1964, p. 236 [**C. miseri;* OD]. Conch form subdiscoidal. Biconvex transverse striae, with ventral sinus. Ventral lobe very wide, with asymmetrical branches; flanks of median saddle curved. Two species. *Pennsylvanian (upper Bashkirian):* ?Kyrgyzstan, Japan, USA (Arkansas, Texas).——FIG. 45,*3a–c. *C. miseri,* holotype, Woolsey, 2.5 km northeast, Washington County, Brentwood Member, Bloyd Formation, Arkansas, SUI 11633; *a–b,* ×1.7; *c,* suture, diameter at 17 mm, ×3.8 (adapted from McCaleb, 1968).

Dimorphoceratoides FURNISH & KNAPP, 1966, p. 305 [**D. campbellae;* OD]. Similar to *Cymoceras,* but with separate parts in branches of ventral lobe, its ventral part being rounded, the dorsal one acuminate. One species. *Pennsylvanian (upper Bashkirian–Moscovian):* USA (?Arkansas, Kentucky, Ohio).——FIG. 45,*2a–b. *D. campbellae,* holotype, Kendrick homestead, about 5.5 km east, Kendrick Shale, Floyd County, Kentucky, USA, upper Morrowan, SUI 11854; *a,* ×1.25; *b,* suture, diameter at 34 mm, ×1.2 (Furnish & Knapp, 1966).

Politoceras LIBROVICH, 1946, p. 80 [**Goniatites politus* SHUMARD in SHUMARD & SWALLOW, 1858, p. 199; OD]. Similar to *Cymoceras* and *Dimorphoceratoides,* but both ventral and dorsal parts of bipartite prongs of the ventral lobe acuminate (E_1, E_2 [German], $V_{1.1}$, $V_{1.2}$ [Russian]). Two or three species. *Pennsylvanian (Moscovian):* Great Britain, Belgium, Germany, Spain, ?Algeria, Ukraine (Donets), USA (?Illinois, Missouri, Oklahoma).——FIG. 45,*1a–b. *P. politum* (SHUMARD), neoholotype, George Howell strip pit, Henry County, Missouri, Cherokee Formation above Mulky Coal Member, Desmoinesian, SUI, Owen collection 672; *a,* ×2; *b,* suture, diameter at 18 mm, ×2.6 (Miller & Owen, 1939).

Shuichengoceras YIN, 1935, p. 31 [**Goniloboceras (S.) yohi* YIN, 1935, p. 31; OD]. Conch form discoidal, involute. Ventral side narrowly rounded. Branches of ventral lobe subdivided into two pointed parts; height of median saddle reaching about two-thirds entire ventral lobe. One species. *Pennsylvanian (upper Bashkirian):* China (Guizhou).——FIG. 44,*3a–c. *S. yohi,* northwestern Wangchapa, Wangjiapa Limestone; *a–b,* ×1 (Yin, 1935); *c,* suture, ×0.5 (Yin, 1935, adapted by Ruzhentsev & Bogoslovskaia, 1969a, fig. 4a).

GASTRIOCERATOIDEA

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Superfamily GASTRIOCERATOIDEA Hyatt, 1884

[*nom. correct.* RUZHENTSEV, 1957, p. 58, *pro* Gastrioceratidea PLUMMER & SCOTT, 1937, p. 169, *nom. transl. ex* Gastrioceratidae WEDEKIND, 1914, p. 12, *nom. correct. pro* Gastriocerae HYATT, 1884 in 1883–1884, p. 325] [*non* Gastrioceratidae MA & LI, 1998, p. 81, ?Guadalupian (Maokoa) of Jiangxi, China, subj.; insufficiently known, probably immature conchs belonging to Paragastrioceratidae]

Conch form variable, in general with broad whorl section and umbilicus. Early whorls commonly evolute. Shell smooth or sculptured. Prongs of ventral lobe relatively wide and pouched, its sides being curved or straight, but usually not divergent; median saddle usually half as high or higher than entire ventral lobe. First lateral saddle rounded, rarely subacute. Sutural formulae: $(E_1E_mE_1)$ALUI [German], (V_1V_1)LU:ID [Russian]. *Mississippian (?upper Visean [Chesterian], Serpukhovian)–Cisuralian (Asselian).*

Family GLAPHYRITIDAE Ruzhentsev & Bogoslovskaia, 1971

[*nom. transl.* RUZHENTSEV & BOGOSLOVSKAIA, 1978, p. 149, *ex* Glaphyritinae RUZHENTSEV & BOGOSLOVSKAIA, 1971, p. 285] [=Clistoceratidae RUZHENTSEV, 1975, p. 41; =Somoholitoidea RUZHENTSEV & BOGOSLOVSKAIA, 1978, p. 148, *partim*]

Conch form discoidal to globular, moderately involute to moderately evolute. Shell surface in general smooth, or with faint transverse or longitudinal ornamentation. [Clistoceratidae have been erected for subglobular forms with involute whorls and a narrow umbilicus. Some authors (e.g., RUZHENTSEV & BOGOSLOVSKAIA, 1978, p. 148) assign Glaphyritidae to superfamily Somoholitoidea RUZHENTSEV, 1938 (not recognized herein), on the basis that glaphyritids may represent the root group of the late Pennsylvanian and early Permian somoholitids because of the presence of pouched lateral lobes among glaphyritids; that character is regarded herein as being of minor general significance and inapplicable for systematic discrimination of superfamilies.] *Mississippian (?upper Visean [Chesterian], Serpukhovian)–Cisuralian (Asselian).*

Subfamily FAYETTEVILLEINAE Ruzhentsev & Bogoslovskaia, 1971

[Fayettevilleinae RUZHENTSEV & BOGOSLOVSKAIA, 1971, p. 340]

First four whorls planorbis-like serpenticone, third and fourth whorls as high or higher than wide, ventral side rounded; conchs smaller than 10 mm with very low median saddle and very short prongs. Adult conchs discoidal to subglobular with narrow or moderately wide umbilicus. Ventral lobe parallel sided or slightly divergent, with broadly rounded ventrolateral saddle and deep and acute or subacute adventitious lobe, frequently with slightly sinuous sides. [Fayettevilleinae was established as a subfamily of Rhymmoceratidae; for discussion, see MEEKS & MANGER, 1999.] *Mississippian (?upper Visean, Serpukhovian [Chesterian]).*

Fayettevillea GORDON, 1960, p. 146 [**F. planorbis* GORDON, 1960, p. 147; OD] [=?*Fayettevillea (Parafayettevillea)* YANG, 1986, p. 267 (type, *F. (P.) serpentina* YANG, 1986, p. 268, OD)]. Conchs of less than 20 mm diameter discoidal with moderately wide umbilicus. Growth lines with slight ventral salient, noncrenulate and widely spaced; a single crenulate ridge located on umbilical shoulder. On later stages wide umbilicus and weak constrictions. Ventral lobe almost parallel sided, adventitious lobe attenuate, medially expanded. Many species, some questionable. [For discussion, see MEEKS & MANGER, 1999, p. 146. *Parafayettevillea* is based on immature material, suggesting a relationship to *Fayettevillea*.] *Mississippian (?upper Visean, Serpukhovian):* Great Britain, ?Spain, Russia (Novaia Zemlia, South Urals), Kazakhstan (South Urals), Tajikistan (Hissar Mountains), USA (Arkansas, Oklahoma, California, Nevada, Utah).——FIG. 46,*1a–h.* **F. planorbis; a–c,* holotype, Fayetteville, 3.2 km east, Arkansas, USA, lower part of Fayetteville Shale, Chesterian, USNM 119552, ×2; *d,* suture, diameter at 6.7 mm, whorl height 1.7 mm, whorl width 2.8 mm, ×9 (Gordon, 1965); *e–h,* West Fork, Arkansas, upper part of Fayetteville Shale, Chesterian; *e–f,* SUI 93163, ×1.8; *g,* suture, diameter at 35 mm, reversed, SUI 93167, ×2.3; *h,* cross section, ammonitella crushed, SUI 93968,

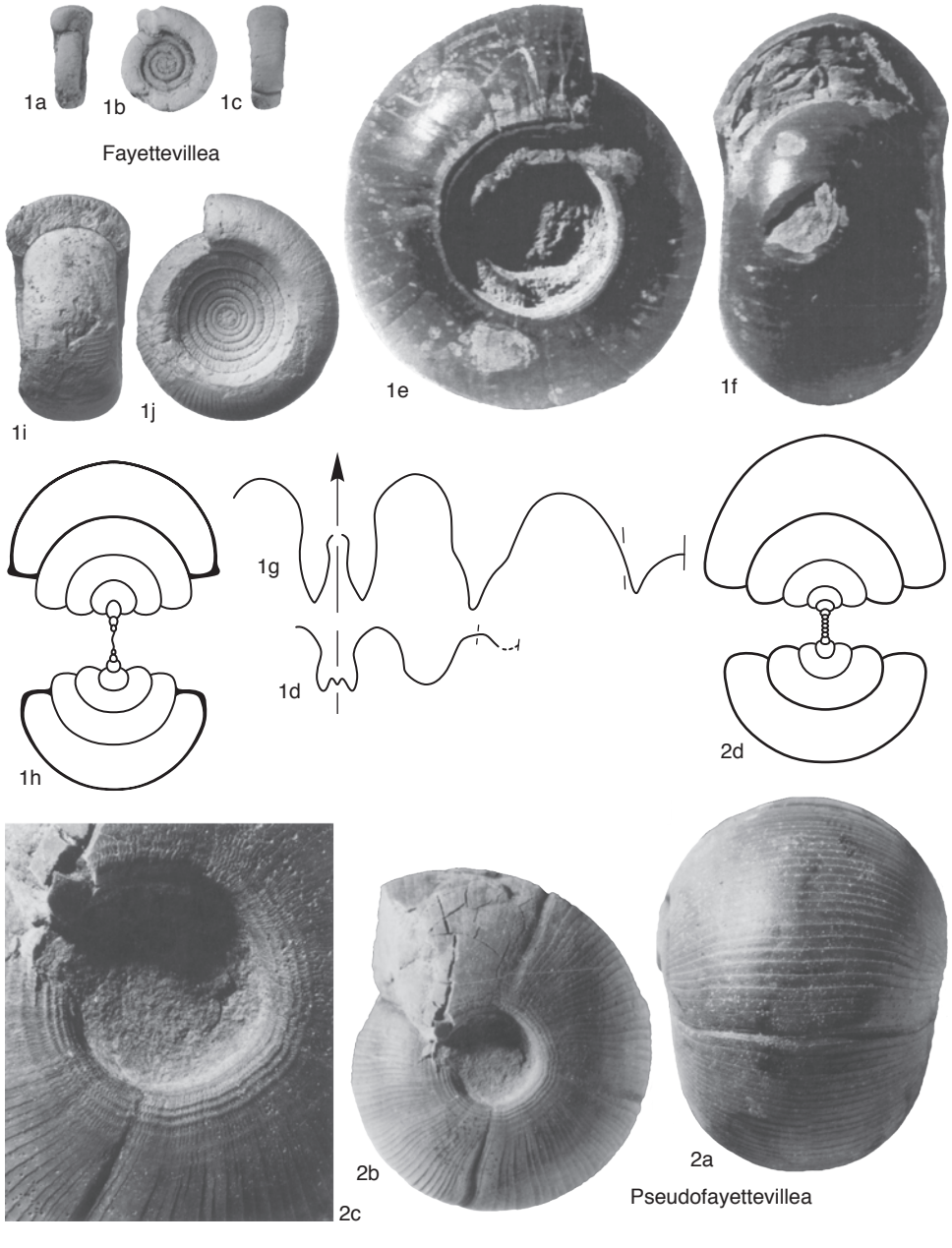

FIG. 46. Glaphyritidae (p. 77–79).

diameter at 23.2 mm, ×2.4 (Meeks & Manger, 1999).——FIG. 46,*1i–j. F. orientalis* RUZHENTSEV & BOGOSLOVSKAIA, Verkhniaia Kardailovka, Orenburg oblast', South Urals, upper Serpukhovian, PIN 455/33842, ×2 (Ruzhentsev & Bogoslovskaia, 1971).

Pseudofayettevillea MEEKS & MANGER, 1999, p. 140 [**P. gordoni* MEEKS & MANGER, 1999, p. 147; OD]. Conch form as *Fayettevillea*, but earlier pachycone with narrow umbilicus on all growth stages. Umbilical shoulder and adjacent conch flank ornamented by revolving ridges formed by liral crenulations, constrictions common. Ventral lobe with sinuous sides, ventrolateral saddle broadly rounded, adventitious lobe slightly constricted at its base. One species. *Mississippian (lower Serpuk-*

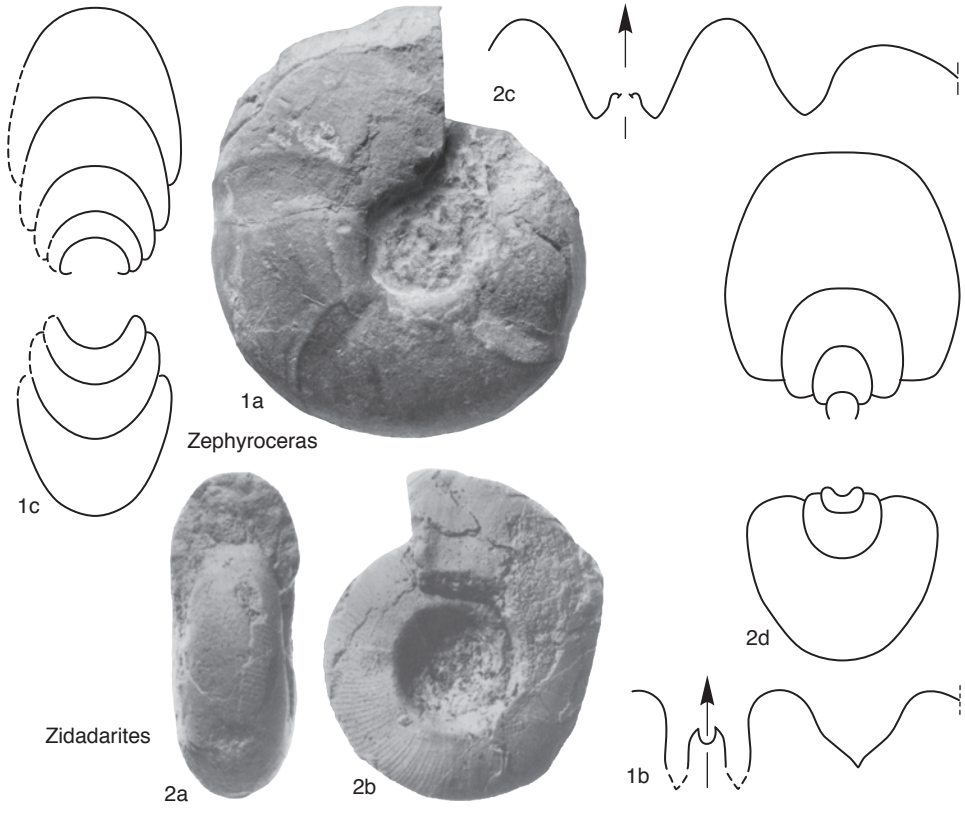

FIG. 47. Glaphyritidae (p. 79).

hovian [Chesterian]): USA (Arkansas).——FIG. 46,*2a–d. *P. gordoni,* holotype, West Fork, upper part of Fayetteville Shale, SUI 93064; *a–b,* ×1.9; *c,* side view of umbilical area, ×4.4; *d,* cross section at 23.5 mm, SUI 93986, ×2.4 (Meeks & Manger, 1999).

Zephyroceras KULLMANN, 1962, p. 314 [**Eoasianites (Zephyroceras) asturicus* KULLMANN, 1962, p. 316; OD]. Conch form subdiscoidal, involute, with moderately wide or narrow umbilicus. Several constrictions on internal mold well developed, with pronounced ventral sinus. Ventral lobe moderately wide, with lanceolate prongs; median saddle reaching about two-thirds height of entire lobe. Adventitious lobe wide and rather low, acute with slightly restricted tip. Five or six species. *Mississippian (upper Serpukhovian):* Spain, Russia and Kazakhstan (South Urals), Uzbekistan, Kyrgyzstan (Tian Shan), USA (Nevada).——FIG. 47,*1a–c. *Z. asturicum,* Perlora, Asturias, Cantabrian Mountains, Spain; *a,* paratype, GPIM L 4024, side view, ×1; *b,* suture, GPIM L 4022, diameter at 16 mm, ×3.7 (Kullmann, 1962); *c,* cross section, enlarged (Kullmann, new).

Zidadarites NIKOLAEVA, 1997, p. 232 [**Z. leveni;* OD]. Conch thickly discoidal, with moderately wide or narrow umbilicus and subangular umbilical shoulder. Ornamentation consisting of coarse lamellae, no spirals. Ventral lobe moderately wide, with low median saddle. One or two species. *Mississippian (upper Serpukhovian):* Tajikistan (Darvaz), USA (Arkansas, Oklahoma).——FIG. 47,*2a–d. *Z. leveni; a–b,* holotype, Khyrsdara River, left bank, southwestern Darvaz, Pamirs, PIN 4407/177, ×2.5; *c,* suture, PIN 4407/185, whorl height at 2.1 mm, whorl width 4.5 mm, ×9.7; *d,* cross section, PIN 4407/186, ×6.2 (Nikolaeva, 1997).

Subfamily GLAPHYRITINAE Ruzhentsev & Bogoslovskaia, 1971

[Glaphyritinae RUZHENTSEV & BOGOSLOVSKAIA, 1971, p. 285]

Conch form subdiscoidal to globular, moderately or completely involute; first whorls commonly evolute. Umbilicus moderately wide to moderately narrow. Ventral lobe commonly half height of entire lobe, ventrolateral saddle broad and rounded or narrow and acute. *Mississippian (Serpukhovian)–Cisuralian (Asselian).*

Glaphyrites Ruzhentsev, 1936a, p. 484 [**Gastrioceras modestum* Böse, 1919, p. 83; OD] [=*Ambiguites* Smith, 1938, p. 29 (type, *A. gargantuus,* OD)]. Conch form globular to thickly discoidal, more or less involute, ventral side broadly rounded. Moderately evolute on inner whorls, later with moderately wide or narrow umbilicus. Growth lines on young stages usually with ventral salient, at maturity with broad sinus. Umbilical shoulder of immature whorls commonly slightly nodose. Ventral lobe fairly wide, height of median saddle exceeding half height of entire ventral lobe. First lateral saddle broadly rounded, adventitious lobe deep, relatively wide, and bell shaped. Many species. [*Ambiguites* was based on one rather large specimen with narrowly rounded, almost acute venter, which does not show form and sculpture of inner whorls; the type species is probably conspecific with *G. subdiscus* (Unklesbay, 1962). The suture is only partly known.] *Mississippian (lower Serpukhovian)–Cisuralian (Asselian):* Belgium, Czech Republic, Serbia, Russia (Polar Urals, Novaia Zemlia, South Urals, Verkhoian), Kazakhstan (South Urals), Kyrgyzstan (Kyzylkumi, Fergana, Tian Shan), Tajikistan (Hissar Mountains, Pamirs), Uzbekistan, Iran, China (Gansu, Guizhou, Ningxia, Xinjiang, Xizang), Spain, Algeria, Morocco, Namibia, Mexico, Argentina, Peru, Uruguay, USA (Arkansas, Iowa, Illinois, Kansas, Kentucky, Missouri, New Mexico, Nevada, Utah, Oklahoma, Pennsylvania, Ohio, California, Texas), Canada (Northwest Territories).——Fig. 48,*3a–c. *G. modestus* (Böse); *a–b,* Jacksboro, about 5.6 km east of town, Finis Shale, Graham Formation, northcentral Texas, USA, Virgilian, JPC 3699, ×1.5 (Miller & Downs, 1950a); *c,* suture, Wolf Camp, 8 km northeast, Glass Mountains, Brewster County, Texas, upper part of Gaptank Formation, YPM 16789, diameter at 12 mm, ×4.7 (Miller & Furnish, 1940a).——Fig. 48,*3d. G. rhymnus* Ruzhentsev, cross section, left bank of River Sakmara, at km 165, South Urals, Gzhelian, PIN 320/3330, ×3 (Ruzhentsev, 1950).

Cryptotyloceras Titus, 2000, p. 31 [**C. gordoni* Titus, 2000, p. 32; OD]. Conch form, growth lines, and suture similar to *Glaphyrites.* Temporarily nodose stage with distinct umbilical nodes beginning with cadicone stage, disappearing at maturity. One species. *Mississippian (lower Serpukhovian [Arnsbergian]):* USA (Utah, Nevada).——Fig. 48,*2a–c. *C. gordoni,* holotype, eastern Foot Range, Bishop Spring Anticline, Millard County, Utah, USA, Chainman Shale, USNM 414930; *a–b,* ×2; *c,* suture, diameter at 12 mm, reversed, SUI 93615, ×7 (Titus, 2000).

Eosyngastrioceras Titus, 2000, p. 38 [**E. quadratum* Titus, 2000, p. 39; OD]. Conch form pachycone to globular or cadicone, with narrow umbilicus. Growth lines rectiradiate; single prominent spiral cord on umbilical shoulder. Ventral lobe with moderately high median saddle, almost parallel sides, asymmetric ventrolateral saddle; rather wide adventitious lobe, slightly constricted at base. Three species. [*Eosyngastrioceras* and *Syngastrioceras* are regarded by Titus, 2000, as root groups of neoiococeratids.] *Mississippian (Serpukhovian):* USA (California, Utah, Nevada, Arkansas, Texas).——Fig. 48,*4a–b. *E. quadratum,* Cave Valley Well, Lincoln County, Nevada, USA, lower part of Scotty Wash Formation, SUI 93554, ×2 (Titus, 2000).——Fig. 48,*4c–d. E. inexpectans* Titus, Lincoln County, Nevada, lower part of Scotty Wash Formation; *c,* suture, SUI 93579, diameter at 26 mm, ×2; *d,* cross section, SUI 93556, ×2 (Titus, 2000).

Oxiglaphyrites Kuzina & Yatskov, 1999, p. 109 [**O. insolitus;* OD]. Ventral lobe wide, diverging orad considerably at an inflexion point half the height of entire lobe, median saddle low. Ventrolateral saddle narrowly rounded or subacute, adventitious lobe wide and almost rectangular, about as deep as ventral lobe. One or two species. *Mississippian (lower Serpukhovian [Arnsbergian]):* Russia (Novaia Zemlia).——Fig. 49,*1a–d. *O. insolitus,* holotype, Rogacheva River, PIN 4279/2360; *a–b,* ×1.5; *c,* suture, whorl height at 8.0 mm, whorl width 14.5 mm, ×4; *d,* cross section, ×9 (Kuzina & Yatskov, 1999).

Paracravenoceras Gordon, 1960, p. 141 [**P. ozarkense* Gordon, 1960, p. 143; OD]. Conch form thickly discoidal to subglobose. Immature stages showing sinuous striae, with ventrolateral salients, ventral and lateral sinuses; straight growth striae at maturity. First lateral saddle rounded to slightly subacute at maturity. Two or three species. [This genus is transitional to *Syngastrioceras* and may be its junior synonym; for discussion, see Nassichuk, 1975, p. 85.] *Mississippian (Serpukhovian):* Kyrgyzstan (?Tian Shan), China (Guangxi), USA (Arkansas, Nevada, Texas).——Fig. 48,*1a–e. *P. ozarkense,* holotype, Fayetteville, east of Sequoyah Mountain, Arkansas, USA, Fayetteville Shale, Chesterian, USNM 119539; *a–b,* ×2; *c,* suture, USNM 119542, diameter at 16.0 mm, whorl height 6.9 mm, whorl width 13.8 mm, ×2.5; *d,* cross section, ×1; *e,* cross section, USNM 119544, ×4 (Gordon, 1965).

Richardsonites Elias, 1956, p. 128 [**Gastrioceras richardsonianum* Girty, 1909, p. 54; OD]. Conch large, subdiscoidal to pachycone, moderately evolute, umbilicus wide to moderately narrow; on early whorls subdiscoidal and planorbiform. Usually up to five broad convex constrictions; ventral groove may be present. Median saddle higher than half height of entire ventral lobe. Eight species (two questionable). [This type species lacks constrictions but possesses a ventral groove.] *Mississippian (Serpukhovian):* Great Britain, Spain, Ukraine (Donets), Russia (Novaia Zemlia), USA (Arkansas, Oklahoma, Texas, Utah, Nevada, California).——Fig. 49,*2a–e. *R. richardsonianus* (Girty), Frisco, Pontatoc County, Oklahoma, Caney Shale, Chesterian; *a–b,* ×1 (Youngquist, 1949); *c,* suture, PIN 2965/7, whorl height at 17.3 mm, whorl width 24 mm, ×1.6 (Ruzhentsev & Bogoslovskaia, 1971); *d,* cross section, USNM 119532, ×1; *e,* topotype, cross section, USNM 119533, ×3.6 (Gordon, 1965).

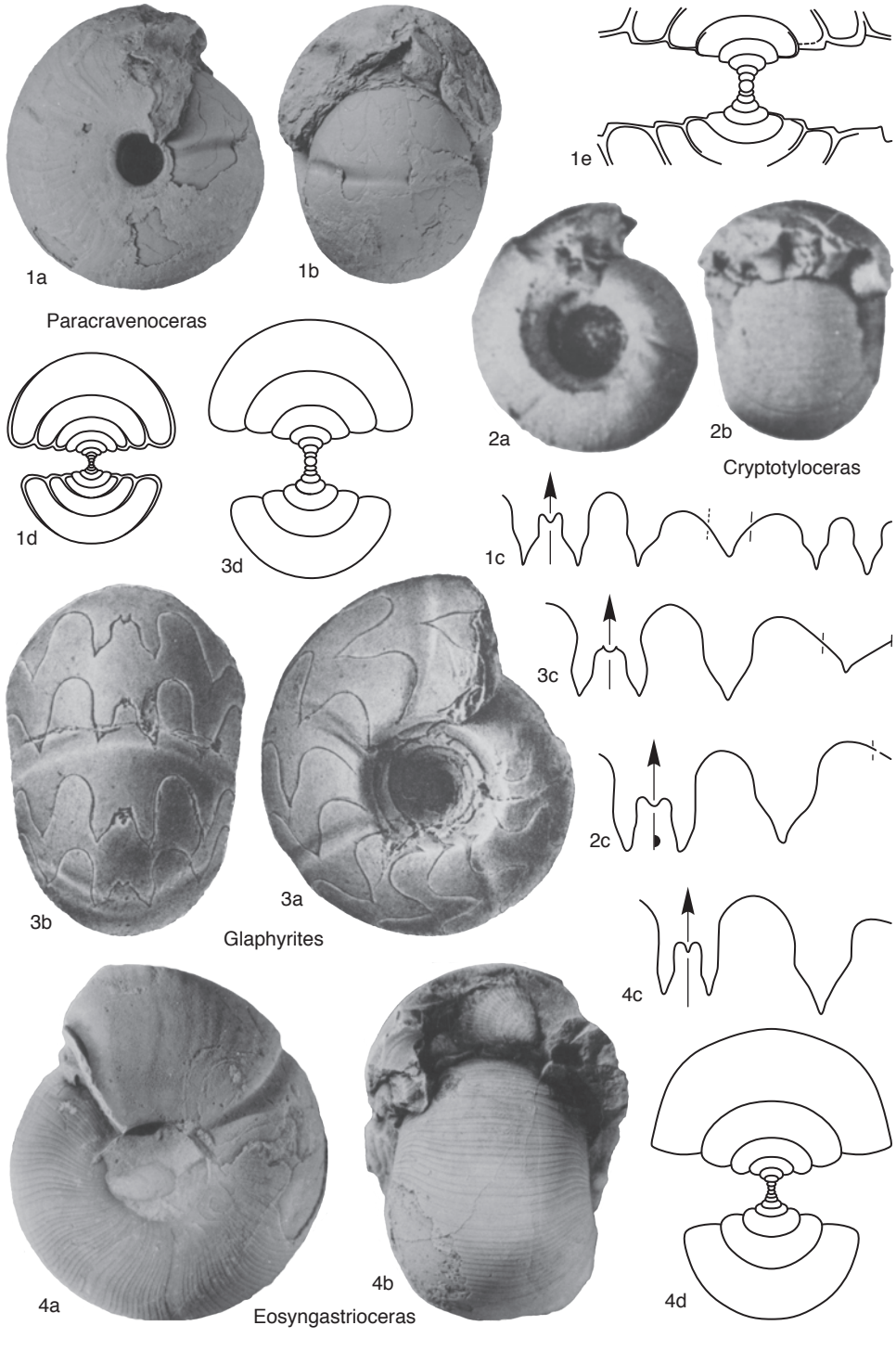

FIG. 48. Glaphyritidae (p. 80).

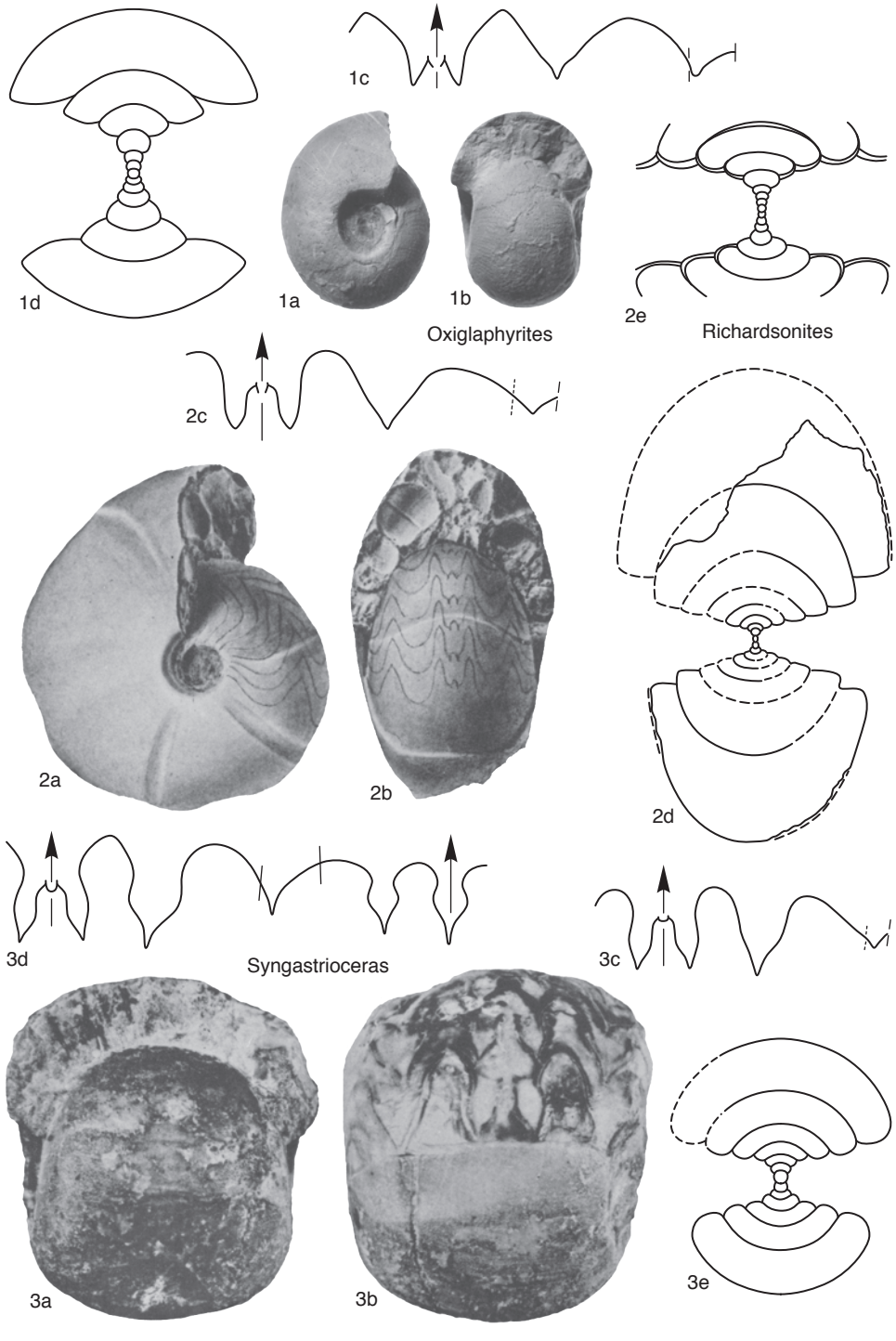

FIG. 49. Glaphyritidae (p. 80–83).

Syngastrioceras Librovich, 1938, p. 81 [**Gastrioceras orientale* Yin, 1935, p. 19; OD] [=*Pseudoglaphyrites* Ruzhentsev & Bogoslovskaia, 1971, p. 292 (type, *P. shokalensis* Ruzhentsev & Bogoslovskaia, 1971, p. 293, OD), for discussion, see Nassichuk, 1975, p. 95; =*Neogastrioceras* Nassichuk, 1975, p. 95 (type, *N. arcticum* Nassichuk, 1975, p. 96, OD)]. Conch form pachycone to globular, umbilicus moderately wide to narrow. Constrictions may be present on internal mold. Suture line similar to *Glaphyrites*, but first lateral saddle subacute to acute on adult stages. Many species. [This genus is transitional to *Glaphyrites.* At the adult stage, *Pseudoglaphyrites* exhibits a comparatively high median saddle and acute ventrolateral saddle, similar to *S. oblatum* (Fig. 49,*3e*). *Neogastrioceras* differs slightly in the proportions of the suture: their ventral prongs are wider and the first lateral saddle is narrower, characters regarded herein as being of specific significance.] *Mississippian (Serpukhovian)–Pennsylvanian (Moscovian):* Belgium, Great Britain, France, Spain, Algeria, Russia (Novaia Zemlia, South Urals), Ukraine (Donets), Kazakhstan (South Urals), Kyrgyzstan (Fergana), Tajikistan (Hissar Mountains, Pamirs), Uzbekistan (Kyzylkumi, Tian Shan), China (Guangxi, Guizhou, Xinjiang), Japan, Canada (Northwest Territories), USA (Arkansas, Illinois, Nevada, Utah, Oklahoma, Texas).——Fig. 49,*3a–c. *S. orientale* (Yin), holotype, northwest of Wangjiapa, Guizhou, China, Moscovian; *a–b,* ×1 (Yin, 1935); *c,* suture, enlarged, magnification not stated (Yin, 1935; adapted by Bogoslovskii, Librovich, & Ruzhentsev, 1962).——Fig. 49,*3d. S. globosum* (Easton), suture, Fayetteville, Washington County, Arkansas, Cane Hill Member, Hale Formation, basal Morrowan, SUI 34143, diameter at 25 mm, ×2.4 (Saunders, 1971).——Fig. 49,*3e. S.* sp., cross section, Confusion Range, Utah, Chainman Shale, Chesterian, GPIT 1418/1104, ×2.8 (Kullmann & Scheuch, 1972).

Subfamily STENOGLAPHYRITINAE Ruzhentsev & Bogoslovskaia, 1971

[Stenoglaphyritinae Ruzhentsev & Bogoslovskaia, 1971, p. 300]
[=Clistoceratidae Ruzhentsev, 1975, p. 33]

Conch form subdiscoidal to globular, moderately to completely involute; width of umbilicus ranging from moderately narrow to closed. Some genera with evolute early whorls. [This genus is transitional to Glaphyritinae.] *Mississippian (Serpukhovian)–Pennsylvanian (Moscovian).*

Stenoglaphyrites Ruzhentsev & Bogoslovskaia, 1971, p. 301 [**Cravenoceras involutum* Gordon, 1965, p. 210; OD]. Conch form similar to glaphyritids, first whorls usually evolute, but adult stages with narrow or closed umbilicus. Growth lines linear. Constrictions may be present on internal mold. Suture similar to *Glaphyrites,* ventral lobe wide, with almost parallel sides; adventitious lobe deep and acute, lanceolate or bell shaped, but never pouched. Many species. *Mississippian (Serpukhovian)–Pennsylvanian (lower Bashkirian [Yeadonian]):* Ireland, Portugal, Russia (South Urals), Kazakhstan (South Urals, Tian Shan), Uzbekistan (Kyzylkumy), China (Xinjiang), USA (Arkansas, California, Nevada, Texas).——Fig. 50,*5a–e. *S. involutus* (Gordon); *a–c,* holotype, Batesville, Stone County, Pitkin limestone, upper shale member, Chesterian, Arkansas, USA, USNM 119523, ×1; *d,* suture, USNM 119524, diameter at 6.0 mm, whorl height 3.1 mm, whorl width 4.4 mm, ×7.8; *e,* paratype, cross section, USNM 119524, ×3.8 (Gordon, 1965).

Aclistoceras Ruzhentsev, 1975, p. 41 [**A. felix* Ruzhentsev, 1975, p. 42; OD]. Conch form pachycone to subglobular, involute, with narrow but open umbilicus. Prongs of ventral lobe moderately pouched, median saddle exceeding slightly half height of entire ventral lobe. Ventrolateral saddle broadly rounded, first lateral lobe lanceolate or bell shaped. Six species. *Pennsylvanian (Bashkirian–Moscovian):* Russia (Siberia), China (Xinjiang, Guangxi), USA (Arkansas, Texas), Canada (Northwest Territories).——Fig. 50,*1a–b. *A. felix; a,* holotype, suture, Sette-Daban, Udachnyi rivulet, lower Ekachan Formation, North Verkhoian, East Siberia, PIN 3088/48, whorl height at 12.0 mm, whorl width 24.5 mm, ×2.3; *b,* cross section, PIN 3088/51, Zyrian River Basin, Druzhok rivulet, North Verkhoian, East Siberia, Agidzhin Formation, ×2.8 (Ruzhentsev, 1975).

Clistoceras Nassichuk, 1967, p. 240 [**C. globosum* Nassichuk, 1967, p. 241; OD]. Conch and suture similar to *Aclistoceras,* but umbilicus closed on late growth stages by thickening of primary shell at umbilical shoulder and helicolateral deposits. One or more constrictions per whorl. Faint growth lines, on young stages sinuous, at maturity slightly biconvex, with shallow ventral sinus. First lateral saddle subacute. Umbilical portion of lateral lobe exhibiting incipient flexure, caused by helicolateral deposits. One species. *Pennsylvanian (Moscovian [Duckmantian]):* China (Xinjiang), Canada (Northwest Territories).——Fig. 50,*4a–d. *C. globosum,* Hare Fiord, Ellesmere Island, Hare Fiord Formation, Atokan, Northwest Territories; *a,* apertural view, GSC 19968, ×4; *b,* side view, GSC 19966, ×4.3; *c,* suture, conch diameter at 11.5 mm, ×6.5; *d,* cross section, GSC 19965, ×2.5 (Nassichuk, 1967).

Euroceras Ruzhentsev & Bogoslovskaia, 1971, p. 306 [**E. ellipsoidale* Ruzhentsev & Bogoslovskaia, 1971, p. 307; OD]. Conch form subdiscoidal, with very narrow umbilicus. Constrictions on internal mold, with pronounced ventral sinus. Ventral lobe wide, with wide branches; median saddle reaching three-quarters height of entire ventral lobe, sides almost parallel. Five species. [Inner whorls are unknown for this genus. *Euroceras* may belong

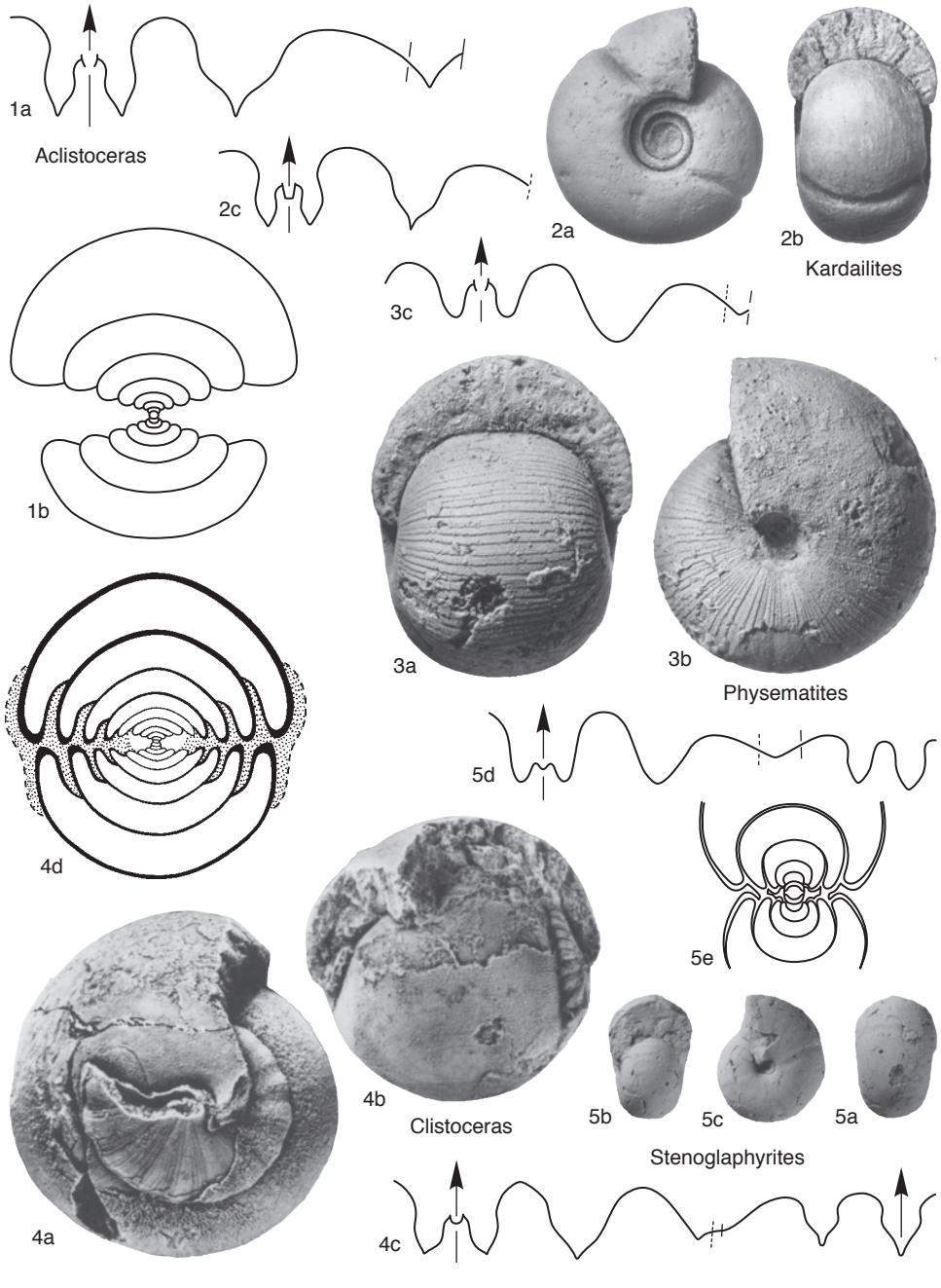

FIG. 50. Glaphyritidae (p. 83–85).

to Bisatoceratidae and may be a junior synonym of *Neoglaphyrites;* for discussion, see NASSICHUK, 1975, p. 106.] *Mississippian (Serpukhovian):* Spain, Ukraine (Donets), Kazakhstan (South Urals), China (Guangxi), USA (Nevada).——FIG. 51,*5a–c.*

**E. ellipsoidale,* holotype, Sholak-Sai Canyon, South Urals, Kazakhstan, Arnsbergian, PIN 455/38136; *a–b,* ×1; *c,* suture, whorl height at 13.4 mm, whorl width 15.8 mm, ×2.4 (Ruzhentsev & Bogoslovskaia, 1971).

Kardailites Ruzhentsev & Bogoslovskaia, 1971, p. 271 [**K. primus* Ruzhentsev & Bogoslovskaia, 1971, p. 272; OD]. Conch relatively small, pachycone, rather involute, with moderately narrow umbilicus. Two strong constrictions exhibiting slight ventral salient. Ventral lobe wide, with pouched prongs; median saddle higher than half height of entire ventral lobe, ventrolateral saddle very broad, adventitious lobe bell shaped. One species. [The holotype of the type species may be immature. The phylogenetic relationship is uncertain for this genus; deep constrictions suggest a relationship to cravenoceratids, and suture is of gastrioceran type.] *Mississippian (lower Serpukhovian [Arnsbergian]):* Russia (South Urals).——Fig. 50,*2a–c. *K. primus,* holotype, Verkhnaia Kardailovka, Ural river, Orenburgskaia oblast', PIN 455/36131; *a–b,* ×1.5; *c,* suture, whorl height at 6.2 mm, whorl width 10.9 mm, ×4.1 (Ruzhentsev & Bogoslovskaia, 1971).

Paraschartymites Ruzhentsev & Bogoslovskaia, 1978, p. 172 [**P. repens;* OD] [=?*Pseudoschartymites* Yang, 1987, p. 159, 171 (type, *P. ningxiaensis* Yang, 1987, p. 160, OD)]. Conch form small, discoidal or lenticular, completely involute; last whorls surround completely the previous ones. Early whorls evolute, widely umbilicate; adult stages with relatively narrow umbilicus. Growth lines consisting of weak rectilinear lamellae; weak constrictions may be present on internal mold. Ventral lobe with rather wide prongs and divergent sides. Height of median saddle reaching three-quarters height of all lobes. Four species. [This genus is similar to *Schartymites* in the interpretation of Ruzhentsev, 1975, p. 42, fig. 5v; if Ruzhentsev's view is correct, *Paraschartymites* is to be regarded as a junior synonym of *Schartymites. Pseudoschartymites* appears to be based on specimens with immature sutures; its relationship remains questionable.] *Pennsylvanian (lower Bashkirian [Reticuloceras Zone]):* Russia (Novaia Zemlia, South Urals), Kyrgyzstan (Fergana), Uzbekistan (Kyzylkumi), China (?Ningxia).——Fig. 51,*4a–d. *P. repens,* holotype, Malaia Suren river, left bank, Bashkortostan, Russia, PIN 455/38632; *a–b,* ×1.5; *c,* suture, whorl height at 8.2 mm, whorl width 9.5 mm, ×4.7; *d,* cross section, ×2.2 (Ruzhentsev & Bogoslovskaia, 1978).

Physematites Ruzhentsev & Bogoslovskaia, 1978, p. 162 [**P. charis;* OD]. Conch very small, subglobular, completely involute; umbilicus narrow. Growth lamellae almost rectilinear. Constrictions may be present on internal mold. Ventral lobe wide, with divergent sides. Median saddle exceeding half height of ventral lobe; basal portion of ventral prongs rounded. Adventitious lobe deeper than ventral lobe, also rounded. One species. [The type material for this genus may be immature.] *Pennsylvanian (lower Bashkirian [Homoceras Zone]):* Russia and Kazakhstan (South Urals), Tajikistan (Hissar Mountains), China (Xinjiang, Ningxia).——Fig. 50,*3a–c. *P. charis,* holotype, Sholak-Sai Canyon, Aktiubinskaia oblast', Aqtöbe, South Urals, Kazakhstan, PIN 455/36712; *a–b,* ×3; *c,* suture, whorl height at 5.5 mm, whorl width 10.0 mm, ×3.9 (Ruzhentsev & Bogoslovskaia, 1978).

Rhadinites Saunders, 1973, p. 40 [**Cravenoceras miseri* Gordon, 1965, p. 211; OD]. Early whorls lenticular with wide umbilicus, at maturity pachycone, with narrow umbilicus. Growth lines straight on young stages, later sinuous. Ventral lobe almost parallel sided, median saddle reaching two-thirds height of entire ventral lobe; ventrolateral saddle asymmetric and almost subacute in adult specimens. One or two species. [This genus is transitional to *Glaphyrites* or *Syngastrioceras.*] *Mississippian (?lower Serpukhovian, upper Serpukhovian):* Russia and Kazakhstan (South Urals), Russia (?Novaia Zemlia), USA (Arkansas, Oklahoma).——Fig. 51,*1a–d. *R. miseri* (Gordon); *a–b,* Boggy Creek, Pontotoc County, Oklahoma, Rhoda Creek Formation, Chesterian, SUI 34708e, ×1.3; *c,* suture, Peyton Creek, 8 km southeast of Leslie, Van Buren County, Arkansas, SUI 34743g, diameter at about 20 mm, whorl height 10 mm, ×2.4; *d,* cross section, SUI 34742b, ×3 (Saunders, 1973).

?Schartymites Librovich, 1939b, p. 16, 40 [**Goniatites barbotanus* de Verneuil, 1845, p. 369; OD]. Conch subdiscoidal to globular, involute; in adult stages umbilicus very narrow. Growth lamellae weak, with ventral sinus at maturity. Height of median saddle reaching three-quarters height of entire ventral lobe. Many species. [This genus was erected without clear diagnosis; type species is poorly known, its early whorls are unknown, and the holotype is uncertain. According to Ruzhentsev (1975, p. 42), *Schartymites* is evolute on inner whorls, but his figure is not based on the type material. *Schartymites* seems to be closely related to *Stenoglaphyrites.*] *Pennsylvanian (lower Bashkirian [Kinderscoutian–Yeadonian]):* Russia (Novaia Zemlia, South Urals), Kazakhstan (Tian Shan), Uzbekistan (Fergana, Kyzylkumy), Kyrgyzstan (South Fergana), Iran, China (?Guizhou).——Fig. 51,*2a–d. *S. barbotanus* (de Verneuil), Shartym river, Cheliabinskaia oblast', South Urals, PIN 455/38095; *a–b,* ×1; *c,* suture, whorl height at 14.5 mm, whorl width 23 mm, ×2 (Ruzhentsev & Bogoslovskaia, 1978); *d,* cross section, PIN 455/38098, ×2.2 (Ruzhentsev & Bogoslovskaia, 1978).

Subitoceras Ruzhentsev & Bogoslovskaia, 1978, p. 163 [**S. sholakense* Ruzhentsev & Bogoslovskaia, 1978, p. 164; OD]. Conch form large, discoidal, very involute; umbilicus narrow. Prominent growth lamellae forming a ventral salient in young stages, adult stages exhibit ventral sinus; no constrictions. Ventral lobe wide, with almost parallel sides; height of median saddle reaching about three-quarters of entire ventral lobe. Adventitious lobe wide, shorter than ventral lobe. One species from one locality. *Pennsylvanian (lower Bashkirian [Homoceras Zone]):* Kazakhstan (South Urals), Kyrgyzstan.——Fig. 51,*3a–c. *S. sholakense,* holotype, Sholak-Say Canyon, South Urals, Kazakhstan, PIN 455/38490;

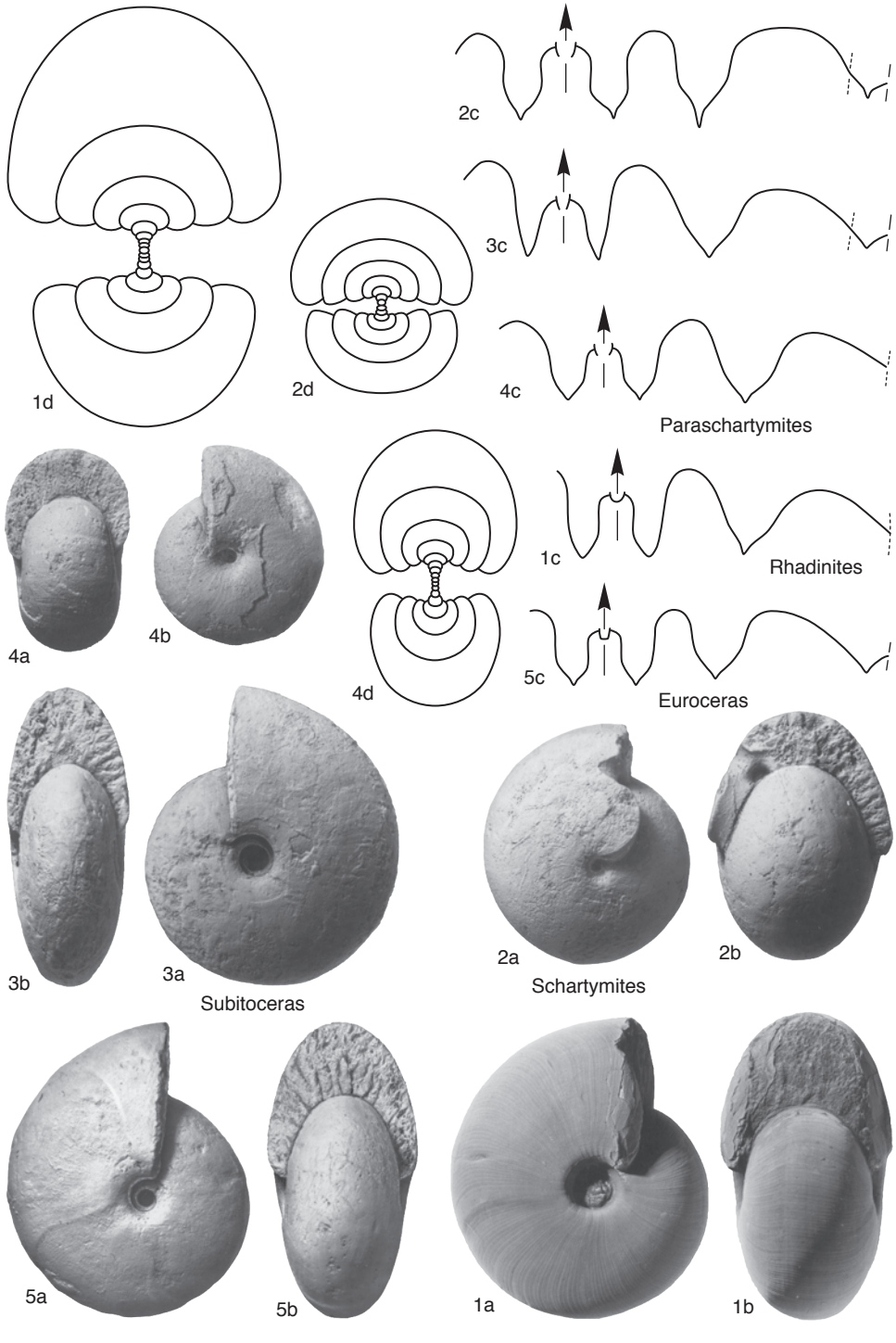

FIG. 51. Glaphyritidae (p. 83–87).

a–b, ×1; *c,* suture, whorl height at 12.4 mm, whorl width 13.0 mm, ×2.7 (Ruzhentsev & Bogoslovskaia, 1978).

Family HOMOCERATIDAE Spath, 1934

[*nom. transl.* Ruzhentsev, 1960d, p. 211, *ex* Homoceratinae Spath, 1934, p. 15]

Early whorls evolute, adult conch form discoidal to globose and involute. Umbilicus moderately wide to narrow. More or less prominent transversal ornamentation frequently present; course of growth striae or lamellae variable, but always forming ventral sinus. Spiral ornamentation rare and if present, mostly restricted to umbilical shoulder. Umbilical tubercles in advanced forms. Ventral lobe relatively wide, with sigmoidal or roundly diverging sides; median saddle fairly high. First lateral saddle broadly rounded. Adventitious lobe pointed, mostly with straight sides, rarely bell shaped or rounded. *Pennsylvanian (lower Bashkirian [Chokierian–Yeadonian, Halian]).*

Subfamily HOMOCERATINAE Spath, 1934

[Homoceratinae Spath, 1934, p. 15]

Commonly early whorls evolute, frequently with wide and low aperture and sharp umbilical shoulder (calyx stage). Adult whorls often strongly oxyconic. Transversal ornamentation rarely coarse, usually lamellate, and sometimes dichotomizing. Umbilical tubercles in advanced forms. No reticulate ornamentation. *Pennsylvanian (lower Bashkirian [Chokierian–Yeadonian]).*

Homoceras Hyatt, 1884 in 1883–1884, p. 330 [**Goniatites smithii* Brown, 1841, p. 218; SD ICZN, 1976, opinion 1061; original type, *Goniatites calyx* Phillips, 1836, p. 236, by monotypy, was based on a very young and uncharacteristic shell; for discussion, see Ramsbottom, 1972, p. 161] [=*Pseudohomoceras* Librovich, 1947, p. 61, obj., *nom. nud.*]. Conch subdiscoidal, widely to moderately umbilicate; early whorls evolute, wide, and with low aperture, with sharp umbilical shoulder and wide umbilicus (calyx stage). Adult stages of some forms oxycone. Transverse ornamentation coarse, lamellate, on immature stages almost linear, later with weakly pronounced ventrolateral salient and shallow ventral sinus. Ventral lobe relatively wide, with sigmoidal sides; median lobe fairly low to half height of entire ventral lobe. First lateral saddle well rounded, adventitious lobe wide and pointed. Many species. [For discussion, see Moore, 1946, p. 395; Ruzhentsev & Bogoslovskaia, 1971, p. 19–22. *Pseudohomoceras* was erected without any description; its type species was chosen as new type of *Homoceras.*] *Pennsylvanian (lower Bashkirian [Homoceras Zone]):* Belgium, Great Britain, France, Germany, Ireland, Netherlands, Portugal, Algeria, Morocco, Poland, Russia and Kazakhstan (South Urals), Tajikistan (Hissar Mountains, Pamirs), Uzbekistan (Fergana, Kyzylkumy), China (Guangxi, Guizhou), USA (Nevada).——Fig. 52,*2a–b. *H. smithii* (Brown), Roadford, river Aille, Clare County, Ireland, *Homoceras* Zone, ×2.5 (Hodson & Leckwijck, 1958).——Fig. 52,*2c–d. H. coronatum* Haug, Sholak-Sai Canyon, Aqtöbe (=Aktiubinskaia oblast'), South Urals, Kazakhstan, *Homoceras* Zone; *c,* PIN 455/39217, suture at 24.5 mm, whorl height 25.0 mm, whorl width 25.0 mm, ×1.4; *d,* cross section, PIN 455/39222, ×2.9 (Ruzhentsev & Bogoslovskaia, 1978).

?Aljezurites Korn, 1997, p. 67 [**A. katharinae* Korn, 1997, p. 68; OD]. Conch small, pachyconic, with moderately wide umbilicus. Early growth stage up to 12 mm diameter with ventral groove. Ornamentation with concave-convex riblets dichotomizing near umbilicus. Ventral lobe wide with almost parallel sides and more than twice as wide as lanceolate adventitious lobe; median saddle reaching about three-quarters height. One species. [Early whorls and morphogeny for this genus are unknown, and the systematic assignment is uncertain.] *Pennsylvanian (lower Bashkirian [Kinderscoutian]):* Portugal.——Fig. 52,*4a–c. *A. katharinae,* holotype, Carrapateira, Praia das Quebradas, Portugal, *Reticuloceras* Zone, IGML 1; *a–b,* ×2; *c,* suture, IGML 36, whorl height at 7.4 mm, ×4 (Korn, 1997).

Bashkortoceras Ruzhentsev & Bogoslovskaia, 1971, p. 24 [**B. salavati;* OD]. Only few whorls evolute, calyx stage indistinct; later stages involute, umbilicus narrow, adult whorls mostly oxycone. Fine growth lamellae form ventral sinus. Double and triple intraventral ridges commonly developed on intermediate ontogenetic stages. Ventral lobe with cuneiform branches; adventitious lobe very short. Three species. *Pennsylvanian (lower Bashkirian [Kinderscoutian]):* Russia (South Urals), Uzbekistan (Kyzylkumy).——Fig. 53,*2a–d. *B. salavati,* holotype, Malaia Suren' river, left bank, Bashkortostan, South Urals, *Reticuloceras* Zone, PIN 455/40134; *a–b,* ×1.5; *c,* suture, whorl height at 8.3 mm, whorl width 13.4 mm, ×3; *d,* cross section, PIN 455/40135, ×3 (Ruzhentsev & Bogoslovskaia, 1971).

Bogdanoceras Ruzhentsev & Bogoslovskaia, 1971, p. 30 [**B. bifurcum;* OD]. Conch form subdiscoidal, calyx stage distinct. Later whorls involute, umbilicus moderately narrow. Sculpture consisting of coarse ribs dichotomizing on middle of flanks, forming ventral sinus. Two intraventral ridges developed in intermediate ontogenetic stages. Longitudinal elongate tubercles on umbilical shoulder.

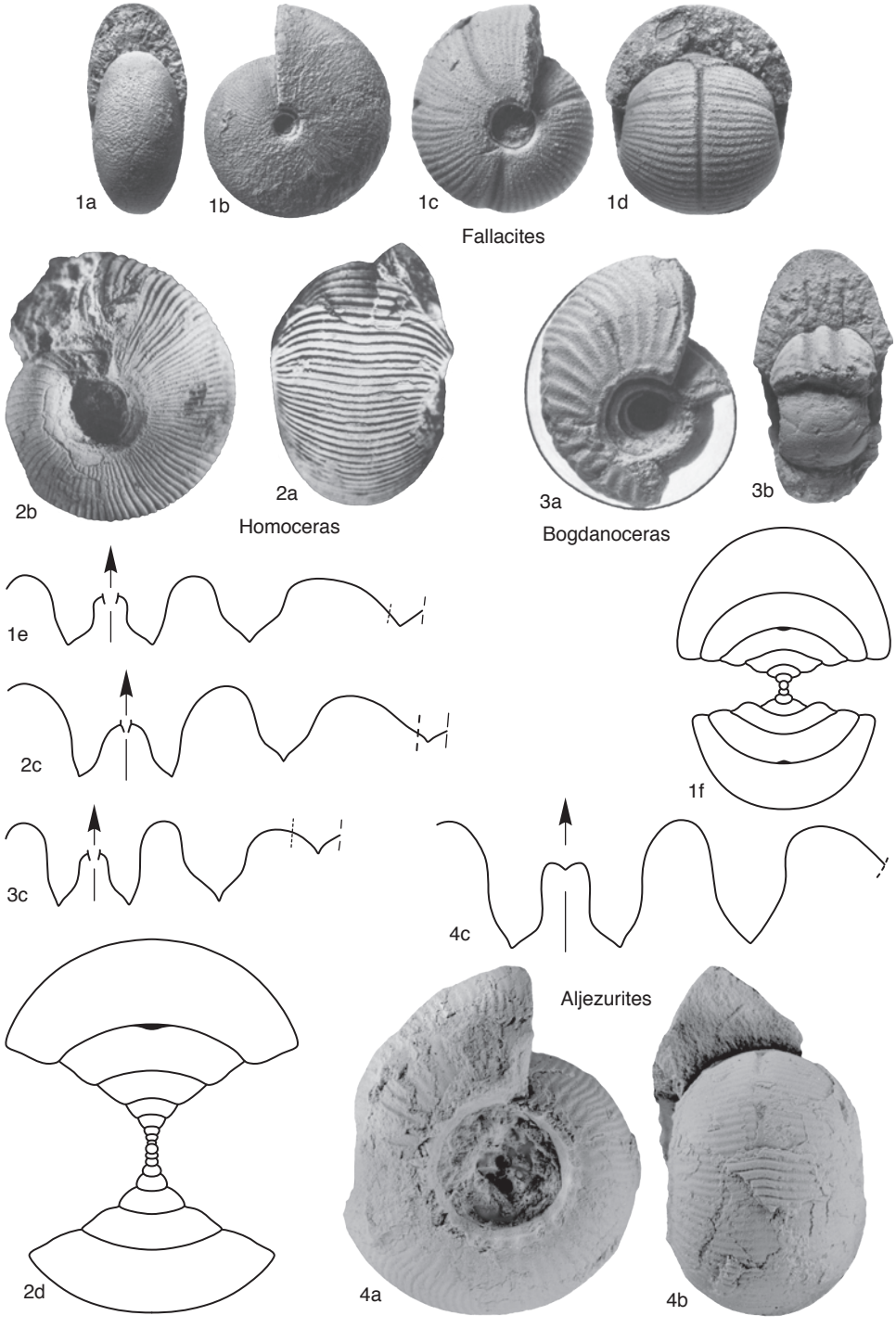

FIG. 52. Homoceratidae (p. 87–89).

One species. [The type material consists of two poorly preserved specimens.] *Pennsylvanian (lower Bashkirian [Reticuloceras Zone]):* Russia (South Urals).——Fig. 52,*3a–c. *B. bifurcum,* holotype, Bol'shaia Suren' river, left bank, Bashkortostan, PIN 455/40437; *a–b,* ×1; *c,* suture, whorl width at 10 mm, ×3.7 (Ruzhentsev & Bogoslovskaia, 1971).

Fallacites Ruzhentsev & Bogoslovskaia, 1971, p. 29 [**F. portentosus;* OD]. Conch form subdiscoidal; calyx stage of early whorls extremely broad; later stages completely involute, umbilicus moderately narrow. Ornamentation consisting of fine dichotomizing lamellae; on intermediate stages one intraventral ridge. Ventral lobe with rather wide median saddle reaching about two-thirds entire height of ventral lobe. Adventitious lobe very wide. One species. *Pennsylvanian (lower Bashkirian [lower Reticuloceras Zone]):* Russia (South Urals).——Fig. 52,*1a–f. *F. portentosus,* Chumaza river, Bashkortostan; *a–b,* holotype, PIN 455/40408, ×1; *c–d,* paratype, PIN 455/40413, ×3; *e,* suture, PIN 455/40410, whorl height at 7.4 mm, whorl width 11 mm, ×3.7; *f,* cross section, PIN 455/40412, ×3 (Ruzhentsev & Bogoslovskaia, 1971).

Isohomoceras Ruzhentsev & Bogoslovskaia, 1971, p. 19 [**Glyphioceras inostranzewi* Karpinskii, 1889, p. 60; OD]. Conch form and suture line similar to *Homoceras.* Early whorls evolute, but lacking sharp umbilical shoulder (no calyx stage). Seven species. *Pennsylvanian (lower Bashkirian [Homoceras Zone]):* Belgium, Great Britain, Ireland, Germany, Portugal, Algeria, Russia and Kazakhstan (South Urals), Kyrgyzstan (South Fergana), Uzbekistan (Fergana, Gissar Mountains), USA (Nevada).——Fig. 53,*4a–b. *I. inostranzewi* (Karpinskii), Shartym river, Cheliabinskaia oblast', South Urals, Russia, *Homoceras* Zone; *a,* suture, PIN 455/39720, whorl height at 24 mm, whorl width 21 mm, ×1.8; *b,* cross section, PIN 455/39723, ×3 (Ruzhentsev & Bogoslovskaia, 1971).

Parahomoceras Ruzhentsev & Bogoslovskaia, 1971, p. 31 [**P. asperum* Ruzhentsev & Bogoslovskaia, 1971, p. 32; OD]. Early whorls evolute, but without calyx stage, umbilical shoulder narrowly rounded, no keel. No furrows on internal mold. Later stages do not possess lamellar growth striae. Tubercles along umbilical shoulder as in *Umbetoceras,* but small and slightly prolongated. Two species. *Pennsylvanian (lower Bashkirian [Homoceras Zone]):* Russia and Kazakhstan (South Urals), Morocco.——Fig. 53,*1a–b. *P. asperum,* Sholak-Sai Canyon, Aqtöbe (=Aktiubinskaia oblast'), South Urals, Kazakhstan; *a,* suture, PIN 455/40439, whorl height at 5.4 mm, whorl width 14.5 mm, ×4.2; *b,* cross section, PIN 455/40440, ×3 (Ruzhentsev & Bogoslovskaia, 1971).

Umbetoceras Ruzhentsev & Bogoslovskaia, 1971, p. 28 [**U. uskalykense;* OD] [=?*Machangoceras* Yang, 1978, p. 168 (type, *M. subglobosum* Yang, 1978, p. 169, OD)]. Early whorls evolute, with distinct calyx stage; conch form of adult stage involute, pachycone, and with moderately wide umbilicus. Sculpture consisting of strong riblets on intermediate stages; tubercles present on umbilical shoulder. Deep ventral furrow on internal mold. Suture resembling gastrioceran type: ventral lobe wide, median saddle exceeding two-thirds height of entire ventral lobe, adventitious lobe wide. Five species. [?*Machangoceras* is based on one poorly preserved specimen with a subglobular conch form; its ontogeny is insufficiently known.] *Pennsylvanian (lower Bashkirian [Kinderscoutian–Yeadonian]):* Russia (South Urals), Uzbekistan (Fergana, Tian Shan).——Fig. 53,*3a–c. *U. uskalykense,* holotype, Uskalyk river, west of Umbetov, Bashkortostan, South Urals, Russia, Kinderscoutian, PIN 455/40390; *a–b,* ×2; *c,* suture, whorl height at 6.0 mm, whorl width 13.5 mm, ×3 (Ruzhentsev & Bogoslovskaia, 1971).

Vallites Ruzhentsev & Bogoslovskaia, 1971, p. 20 [**Homoceras henkei* Schmidt, 1934, p. 453; OD]. Adult whorls with conspicuous umbilical wall ornamented with spiral lirae. Early whorls evolute, with rounded umbilical shoulder, no calyx stage; adult whorls pachyconic, completely involute and with very narrow umbilicus. Transverse striae simple or dichotomizing. Ventral lobe rather wide, with cuneiform branches; median saddle fairly high. Adventitious lobe shorter than ventral lobe. Seven species. *Pennsylvanian (lower Bashkirian [Homoceras Zone–Reticuloceras Zone]):* Belgium, Great Britain, Ireland, Germany, Czech Republic, Poland, Portugal, Algeria, Morocco, Russia (South Urals), Uzbekistan (Fergana).——Fig. 53,*5a–d. *V. henkei* (Schmidt); *a,* side view, Roadford, River Aille, County Clare, Ireland, lower *Reticuloceras* Zone, GSM 86931, ×2; *b–c,* Emde-Neheim brickworks, Sauerland, Rhenish Massif, Germany, lower *Reticuloceras* Zone, collection Pitz, GÖT, ×2 (Kullmann, new); *d,* cross section, Ireland, lower *Reticuloceras* Zone, PIN 2966/16, ×3 (Ruzhentsev & Bogoslovskaia, 1971).——Fig. 53,*5e. V. schmidti* Ruzhentsev & Bogoslovskaia, holotype, suture, Bol'shaia Suren' river, east of Suleiman, South Urals, Bashkortostan, Russia, PIN 455/40113, whorl height at 9.3 mm, whorl width 10.5 mm, ×3 (Ruzhentsev & Bogoslovskaia, 1971).

Subfamily DECORITINAE Ruzhentsev & Bogoslovskaia, 1975

[*nom. transl.* Kullmann, herein, *ex* Decoritidae Ruzhentsev & Bogoslovskaia, 1975, p. 48]

Conch form small, in general similar to Homoceratinae, but no calyx stage, with sharp umbilical shoulder on early whorls. Sculpture consisting of dichotomous or polyschizotomous ribs forming shallow ventrolateral salient and ventral sinus. Reticulate ornamentation in advanced forms. Ventral lobe relatively narrow, median saddle usually lower than half height of entire ventral lobe.

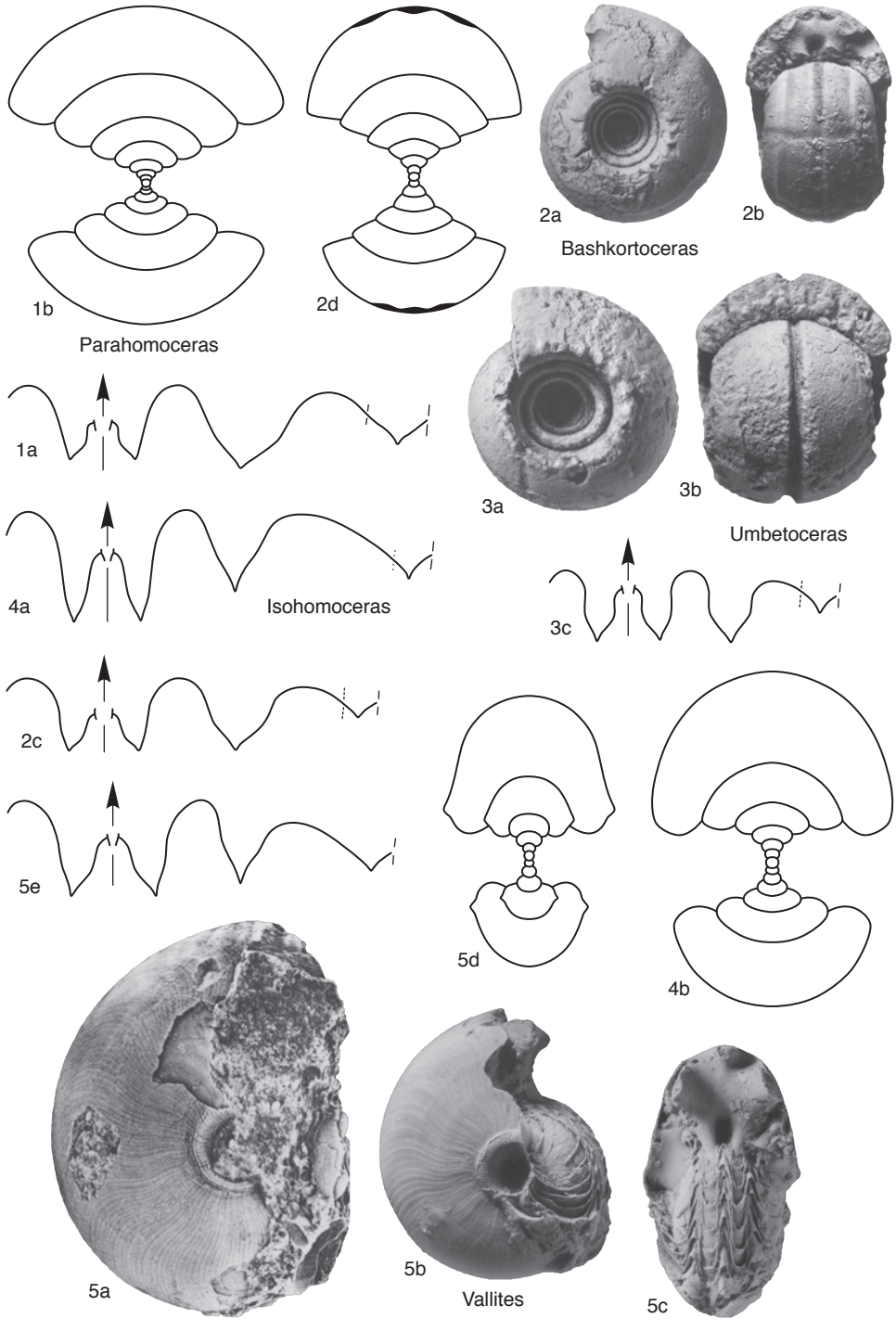

FIG. 53. Homoceratidae (p. 87–89).

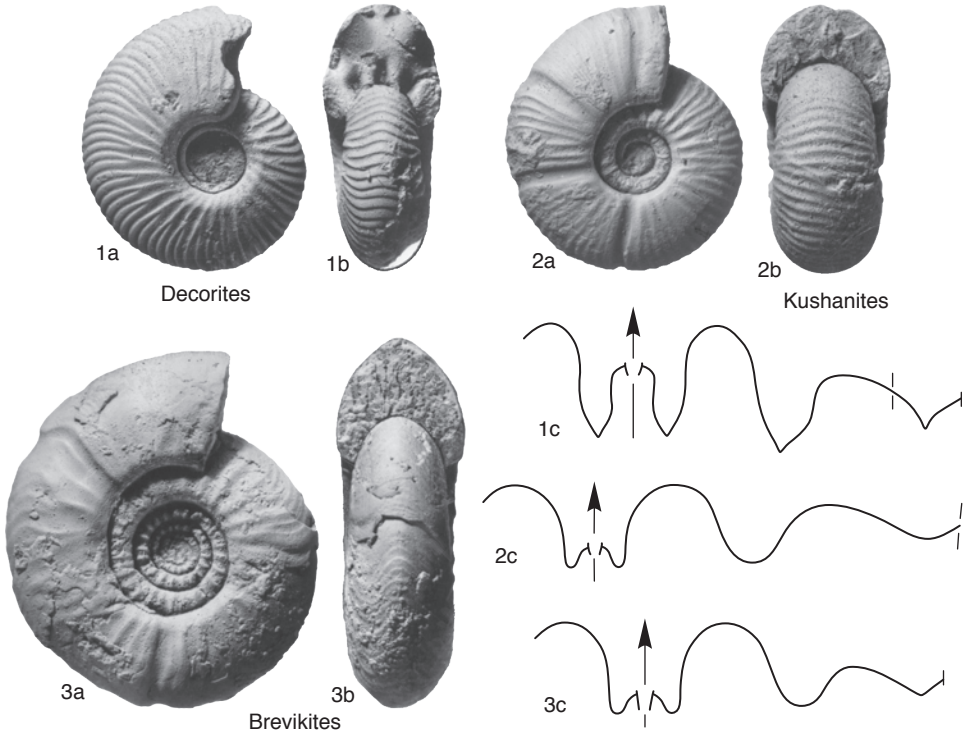

FIG. 54. Homoceratidae (p. 91–92).

Prongs of ventral lobe and adventitious lobe may be small and rounded. [Decoritidae was established as an independent family, but RUZHENTSEV and BOGOSLOVSKAIA (1978, p. 222) confirmed the close relationship to the Homoceratidae.] *Pennsylvanian (lower Bashkirian [Kinderscoutian–Yeadonian]).*

Decorites RUZHENTSEV & BOGOSLOVSKAIA, 1975, p. 48 [**D. crassicostatus;* OD]. Conch form lenticular, involute, with moderately wide to narrow umbilicus. Umbilical tubercles present on immature stages. Strong dichotomous ribs, starting at elongated tubercles crossing flanks and venter with shallow ventrolateral salient and ventral sinus. No longitudinal ornament. Median saddle about half as high as entire ventral lobe. Three or four species. *Pennsylvanian (lower Bashkirian [Reticuloceras Zone]):* Russia (South Urals), ?Algeria, Uzbekistan (Fergana, Kyzylkumy, Tian Shan).——FIG. 54,*1a–c. *D. crassicostatus,* holotype, Bol'shaia Suren' river, eastern Suleiman, South Urals, Bashkortostan, Russia, PIN 455/42252; *a–b,* ×2; *c,* suture, whorl height at 7.6 mm, whorl width 7.6 mm, ×4 (Ruzhentsev & Bogoslovskaia, 1975).

Brevikites RUZHENTSEV & BOGOSLOVSKAIA, 1975, p. 51 [**B. inops;* OD]. Conch form lenticular, with tendency to oxycone venter; umbilicus moderately wide. Early whorls with umbilical tubercles, later wrinkles, giving rise to dichotomous riblets; intercalated ribs present. Riblets form narrow ventral sinus. Weak longitudinal lirae present. Several constrictions per whorl. Ventral lobe relatively narrow, almost parallel sided, with very low median saddle. Adventitious lobe subacute or rounded. Two species. *Pennsylvanian (lower Bashkirian [Kinderscoutian, Reticuloceras Zone]):* Russia (South Urals).——FIG. 54,*3a–c. *B. inops; a–b,* holotype, Bol'shaia Karsakla, Malaia Suren', Bashkortostan, PIN 455/47877, ×2; *c,* suture, whorl height at 6 mm, whorl width 7.7 mm, ×4.8 (Ruzhentsev & Bogoslovskaia, 1975).

Kushanites RUZHENTSEV & BOGOSLOVSKAIA, 1975, p. 50 [**K. kirgizorum;* OD]. Conch form lenticular, rarely pachycone; umbilicus moderately wide. Sculpture with prominent dichotomous ribs, crossing venter with a very shallow sinus, ending in wrinkles near umbilical wall. No spiral ornamentation. Several narrow and deep constrictions per whorl. Suture line primitive, with rounded lobes and saddles, ventral lobe narrow, with very low median saddle. One species, from one locality. *Pennsylvanian (lower Bashkirian [Marsdenian–Yeadonian]):* Uzbekistan (Fergana), China (Ningxia).——FIG. 54,*2a–c. *K. kirgizorum,* holotype, Aravan river, southwest of Yangi-Kurgan, Fergana, Uzbekistan, Yeadonian,

PIN 2195/3014; *a–b,* ×2; *c,* suture, whorl height at 6 mm, whorl width 7.7 mm, ×7.2 (Ruzhentsev & Bogoslovskaia, 1975).

Family RETICULOCERATIDAE Librovich, 1957

[Reticuloceratidae Librovich, 1957, p. 252]

Conch form subdiscoidal, moderately to completely involute; umbilicus wide to narrow. Linear or biconvex growth lines, commonly crossed by longitudinal lirae, thus forming reticulate ornamentation. Nodelike riblets and lateral plications in some forms. Ventrolateral furrows may be present. Suture line relatively simple, in some forms with rounded elements. Prongs of ventral lobe well developed, but rarely pouched, frequently at its base narrowly rounded; median saddle usually about half as high as entire ventral lobe, or slightly higher. Advanced genera with higher median saddle, wider lateral lobe, and generally attenuate lobes. [The root group of Decoritinae and Surenitinae may be *Homoceras.*] *Pennsylvanian (Bashkirian [Alportian–Langsettian]).*

Subfamily SURENITINAE Ruzhentsev & Bogoslovskaia, 1975

[*nom. transl.* Kullmann, herein, *ex* Surenitidae Ruzhentsev & Bogoslovskaia, 1975, p. 52] [=Melvilloceratidae Nassichuk, 1975, p. 133]

Umbilical tubercles on early growth stages, frequently disappearing in adult forms. Reticulate ornamentation restricted to later growth stages. Growth striae with ventral and lateral sinus; early stages display irregularly ramified riblets. Ventral lobe wide, median saddle relatively high. [Surenitinae was established as an independent family; Ruzhentsev and Bogoslovskaia (1975, p. 47) confirmed the close relationship of both Decoritinae and Surenitinae to *Homoceras,* the joint ancester. The spiral ornamentation, the common character, is predominant in the family Reticuloceratidae. Melvilloceratidae comprise genera with advanced sutures displaying a comparatively high median saddle, regarded herein as being of generic or specific significance.] *Pennsylvanian (lower Bashkirian [Alportian–Langsettian]).*

Surenites Ruzhentsev & Bogoslovskaia, 1975, p. 52 [**S. krestovnikovi;* OD]. Conch form rather involute, umbilicus moderately wide. At immature stages only transverse striae and umbilical tubercles present, giving rise to riblets forming ventral sinus; adult shell surface bearing reticulate ornamentation. Some species with crenulate growth striae, but no lirae. Intraventral furrow and constrictions on internal mold may be present. Six species. *Pennsylvanian (lower Bashkirian [Alportian–Marsdenian]):* Russia (South Urals), Ukraine (Donets), China (Xinjiang), Uzbekistan (Fergana, Kyzylkumy).——Fig. 55,*4a–c.* **S. krestovnikovi,* Bol'shaia Suren', eastern tributary Suleiman, South Urals, Bashkortostan, Russia, Kinderscoutian; *a–b,* holotype, PIN 455/40748, ×1.5; *c,* suture, PIN 455/40747, whorl height at 9.6 mm, whorl width 11.3 mm, ×3.1 (Ruzhentsev & Bogoslovskaia, 1975).

Aphantites Ruzhentsev & Bogoslovskaia, 1978, p. 243 [**A. aenigmaticus;* OD]. Conch form small, lenticular, almost completely involute, umbilicus narrow. Faint umbilical tubercles restricted to early whorls; weak riblets on young shells are predominant over fine and frequent spirals. Suture primitive: ventral lobe with rounded prongs, diverging orad, with very broad first lateral saddle, adventitious lobe deep and broadly rounded. One species. *Pennsylvanian (lower Bashkirian [Yeadonian]):* Uzbekistan (Fergana).——Fig. 55,*5a–c.* **A. aenigmaticus,* Yangi-Kurgan, left bank of Aravan river, Fergana, Uzbekistan, Yeadonian, PIN 2195/1205; *a–b,* ×1.5; *c,* suture, whorl height at 6.0 mm, whorl width 9.8 mm, ×5.3 (Ruzhentsev & Bogoslovskaia, 1978).

Gaitherites Quinn, 1965, p. 234 [**Pygmaeoceras solidum* Gordon, 1965, p. 262; M]. Conch form pachycone, with narrow umbilicus. Ornamentation consisting of linear growth lines, no spiral elements. Umbilical ribs present on young stages. Median saddle reaching two-thirds height of entire ventral lobe; first lateral saddle narrowly rounded. Two or three species. [No suitable illustrations of the type species are available.] *Pennsylvanian (upper Bashkirian [Bloydian]):* China (Guangxi), USA (Arkansas, Oklahoma).——Fig. 55,*1a–c. G. morrowensis* (Miller & Moore), Gaither Mountain, 11.3 km southwest of Harrison, Boone County, Arkansas, USA, Bloydian; *a–b,* ×3 (Saunders, Manger, & Gordon, 1977); *c,* suture, same locality, upper Morrowan, ×1.2 (Miller & Moore, 1938).

?Marianoceras Librovich in Bogoslovskii, Librovich, & Ruzhentsev, 1962, p. 381 [**Goniatites marianus* de Verneuil, 1845, p. 369; OD]. Whorl width wide, conch form pachycone or subglobular; umbilicus moderately wide. Sculpture consisting of nodes, originating at umbilical ridge, prolonging to ribs; growth lines and spiral ornamentation weak. Two species. [Originally only small and perhaps immature specimens were known for this genus. Librovich in Bogoslovskii, Librovich, & Ruzhentsev, 1962, p. 381) regarded *Marianoceras* as a subgenus of *Branneroceras* because of its

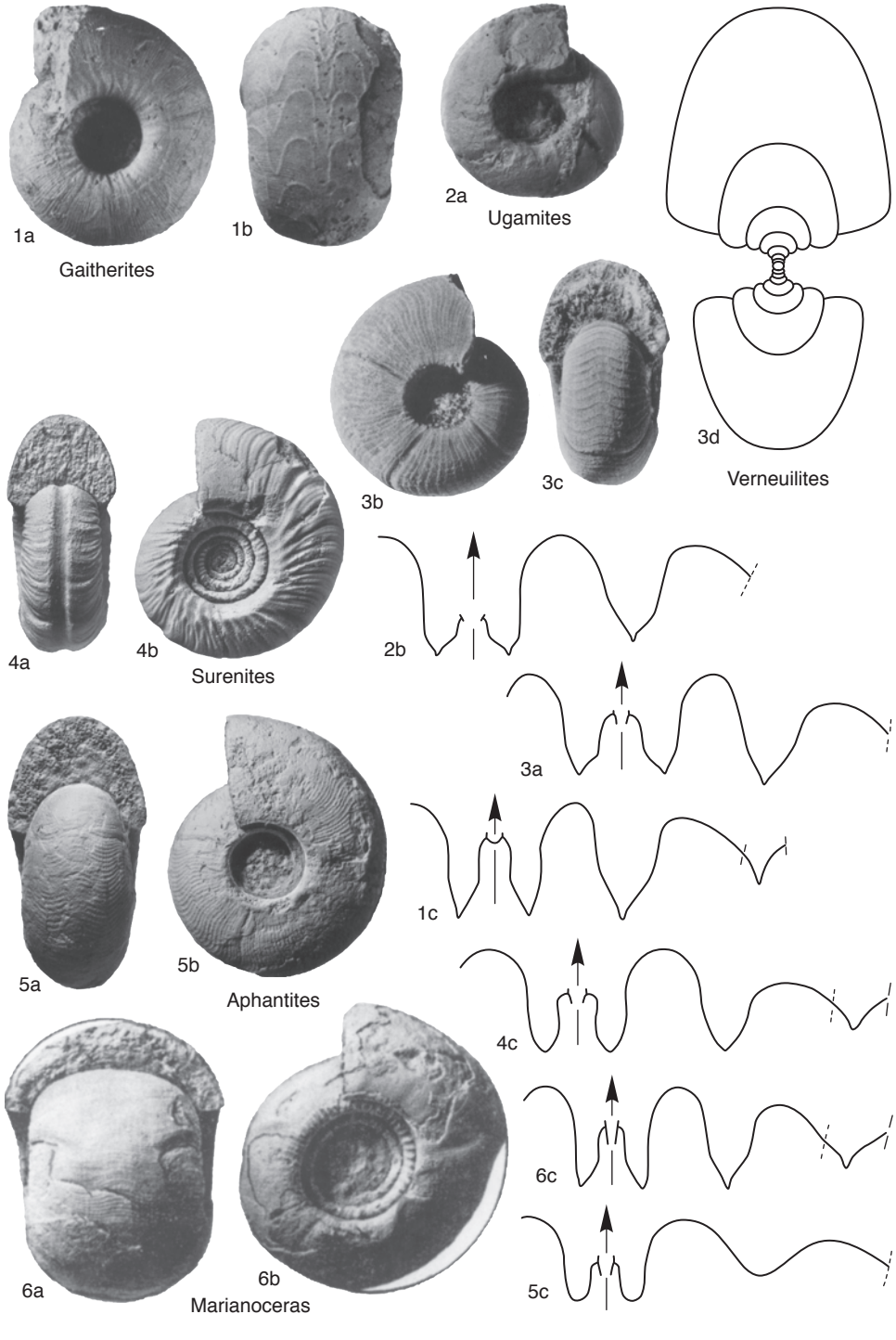

FIG. 55. Reticuloceratidae (p. 92–94).

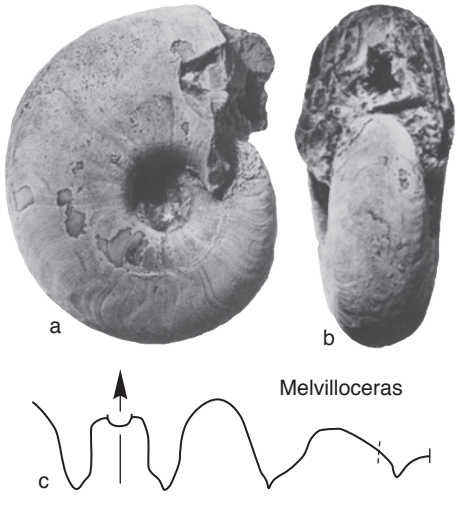

FIG. 56. Reticuloceratidae (p. 94).

relatively wide umbilicus; however, it seems to be closely related to *Verneuilites* and may be its junior synonym.] *Pennsylvanian (lower Bashkirian):* Portugal, Russia (South Urals), Ukraine (Donets), Kazakhstan, Kyrgyzstan (Tian Shan).——FIG. 55,*6a–c. *M. marianum* (DE VERNEUIL), Shartym River, South Urals, Russia, PIN 455/428855; *a–b,* ×2; *c,* suture, PIN 455/42884, whorl height at 8.5 mm, whorl width 18.0 mm, ×2.4 (Ruzhentsev & Bogoslovskaia, 1978).

Melvilloceras NASSICHUK, 1975, p. 134 [**M. sabinense* NASSICHUK, 1975, p. 135; OD] [=?*Lutuginoceras* POPOV, 1979, p. 86 (type, *L. rotaii,* OD)]. Conch form lenticular and moderately involute, with narrow umbilicus. Umbilical nodes present during early growth stages. Ornamentation delicately reticulate; sinuous growth striae more conspicuous than longitudinal lirae. Four to six constrictions per whorl. Broad ventral lobe, with median saddle exceeding three-quarters height of entire ventral lobe. One or two species. [*Lutuginoceras* is based on the holotype of the type species only, which is possibly an immature specimen, the suture of which is unknown; assignment to *Melvilloceras* or related genus is probable.] *Pennsylvanian (upper Bashkirian [Langsettian]):* Ukraine (Donets), Canada (Northwest Territories).——FIG. 56*a–c. *M. sabinense; a–b,* holotype, Barrow Dome, Melville Island, Northwest Territories, Otto Fiord Formation, Bloydian, GSC 33804, ×2; *c,* suture, diameter at 22 mm, GSC 33807, magnification not stated (Nassichuk, 1975).

Ugamites NIKOLAEVA, 1994, p. 104 [**U. rumjanzevae;* OD]. Conch form lenticular to subdiscoidal, with moderately wide umbilicus. Transverse ornamentation consisting of inconspicuous and feeble umbilical placations giving rise to bunches of fine and closely spaced crenulated striae; longitudinal ornamentation also very delicate. Ventral lobe with subparallel sides and comparatively low median saddle. One species. *Pennsylvanian (lower Bashkirian [Bilinguites-Cancelloceras Zone]):* Kazakhstan (Tian Shan).——FIG. 55,*2a–b. *U. rumjanzevae*, holotype, Koishaly-Sai, Ugam Mountains, PIN 4324/24; *a,* side view, ×2; *b,* suture, whorl height at 5.7 mm, whorl width 9.0 mm, ×6.2 (Nikolaeva, 1995).

Verneuilites LIBROVICH, 1939b, p. 16 [**Glyphioceras diadema verneuili* YANISHEVSKII, 1900, p. 322; OD] [=*Pygmaeoceras* GORDON, 1960, p. 147 (type, *Gastrioceras pygmaeum* MATHER, 1915, p. 243, OD); =?*Paraverneuilites* POPOV, 1979, p. 76 (type, *P. linter,* OD)]. Conch at early growth stage widely umbilicate, adult conch form lenticular to subdiscoidal, involute, with narrow, in some forms very narrow, umbilicus. Growth lines almost linear, without sharp ventrolateral salient. Early stages display finely crenulate lirae, which may became delicately reticulate later. Umbilical plications or nodelike riblets present. Some forms with constrictions. Ventral lobe considerably wide, median saddle reaching two-thirds height of entire ventral lobe. Seven or eight species. [*Pygmaeoceras* is based on immature specimens that seem to be congeneric with *Verneuilites;* for discussion, see MANGER & SAUNDERS, 1980, p. 46. *Paraverneuilites* is based on immature specimens that are similar in conch shape to *Verneuilites* but do not show umbilical nodes and reticulate ornamentation; suture unknown.] *Pennsylvanian (Bashkirian [Yeadonian, ?Langsettian]):* Great Britain, Russia (South Urals, Siberia), ?Ukraine (Donets), China (Ningxia, Xinjiang), USA (Arkansas, Oklahoma).——FIG. 55,*3a. *V. verneuili* (YANISHEVSKII), suture, Shartym river, Cheliabinskaia oblast', South Urals, Russia, lower Bashkirian, Yeadonian, PIN 455/42624, whorl height at 10 mm, whorl width 11 mm, ×3.2 (Ruzhentsev & Bogoslovskaia, 1978).——FIG. 55,*3b–d. V. pygmaeus* (MATHER), Kessler Mountain, east side, Washington County, Arkansas, Bloyd Formation, UA 77-205-6; *b–c,* ×2.7; *d,* cross section, UA 77-218-213, ×2.7 (Manger & Saunders, 1980).

Subfamily RETICULOCERATINAE Librovich, 1957

[*nom. transl.* KULLMANN, herein, *ex* Reticuloceratidae LIBROVICH, 1957, p. 252] [=Arkanitinae MCCALEB, QUINN, & FURNISH, 1964, p. 26]

Ornamentation reticulate. Umbilical tubercles, nodelike riblets, and lateral plications common, frequently restricted to early whorls. Conch form lentiform to pachycone, with tendency to develop oxycone ventral side. Width of umbilicus varies from wide

to narrow. Suture variable, in some genera relatively simple, displaying rounded lobes; median saddle comparatively low. [The root group may be *Surenites* (for discussion, see RUZHENTSEV & BOGOSLOVSKAIA, 1978, p. 59), which is possibly the predecessor of *Phillipsoceras*.] *Pennsylvanian (Bashkirian [Kinderscoutian–Langsettian]).*

Reticuloceras BISAT, 1924, p. 114 [**Goniatites reticulatus* PHILLIPS, 1836, p. 235; OD]. Conch form involute, with wide or narrow umbilicus. Ornamentation in general weakly developed; sculpture consisting of transverse growth striae, sometimes crenulate, with ventrolateral salient and ventral sinus, usually crossed by fine spiral lirae, thus producing reticulate ornamentation. Small riblets near umbilicus and faint umbilical nodes common at early whorls. Constrictions may be present, but no ventrolateral furrows. Median saddle reaching half height of entire ventral lobe; adventitious lobe as wide and deep as ventral lobe. Two subgenera: *Reticuloceras (Reticuloceras)* BISAT, 1924 and *Reticuloceras (Swintoceras)* SAUNDERS & RAMSBOTTOM, 1993 (for discussion, see SAUNDERS & RAMSBOTTOM, 1993, p. 995). [This genus is closely related and transitional to *Phillipsoceras:* the relation of width of umbilicus:diameter in *Reticuloceras* is 0.25–0.15 (average value = 0.18) and in *Phillipsoceras* is 0.5–0.3 (average value = 0.39); for discussion, see RUZHENTSEV and BOGOSLOVSKAIA, 1978, p. 275.] *Pennsylvanian (lower Bashkirian).*

R. (**Reticuloceras**). Conch form with narrow, in some forms very narrow, umbilicus. Sculpture in general weakly developed and mainly restricted to early stages, consisting of strongly reticulate ornamentation and small weak ribs near umbilicus as well as faint umbilical nodes. Ventral lobe always narrow and deep, with almost parallel sides. Many species. *Pennsylvanian (lower Bashkirian [Kinderscoutian–Marsdenian]):* Belgium, Great Britain, Ireland, France, Germany, Netherlands, Poland, Portugal, Algeria, Morocco, Russia (South Urals), Ukraine (Donets), Uzbekistan (Fergana, Kyzylkumy), China (Ningxia).——FIG. 57,*2a–b. *R. (R.) reticulatum* (PHILLIPS); *a,* Hagen, Westfalen, Rhenish Massif, Germany, upper *Reticuloceras* Zone, Kinderscoutian, ×2 (Schmidt, 1925); *b,* suture, Donets, Ukraine, collection Librovich, magnification not stated, approximately ×4 (Bogoslovskii, Librovich, & Ruzhentsev, 1962).

R. (**Swintoceras**) SAUNDERS & RAMSBOTTOM, 1993, p. 995 [**Homoceras spiraloides* BISAT & HUDSON, 1943, p. 407; OD]. Reticulate ornamentation weakly developed. Noncrenulate to crenulate transverse striae linked by faint spiral lirae. Umbilical nodes at early whorls and constrictions on later stages may be present. Ventral lobe with narrow prongs that tend to be swollen. Three species. *Pennsylvanian (lower Bashkirian [Reticuloceras Zone]):* Great Britain, USA (Arkansas).——FIG. 57,*5. *R. (S.) spiraloides* (BISAT & HUDSON), suture of paratype, Swint Clough, Alport Valley, Derbyshire, England, *Reticuloceras* Zone, Kinderscoutian, Keyworth GSM 63089, diameter at 15 mm, whorl height 8 mm, ×4.8 (Saunders & Ramsbottom, 1993).

Agastrioceras SCHMIDT, 1938, p. 120 [**Glyphioceras subcrenatum* var. *carinata* FRECH, 1899, pl. 46,*3;* OD]. Inner whorls evolute; whorl height strongly increasing on later stages, with tendency to develop narrowly rounded or oxycone venter. Conch form lenticular or subdiscoidal, no angular flanks. Umbilicus moderately wide to narrow. Sculpture of inner whorls only with small nodes at umbilical wall, some species with very fine spiral ornamentation. Nine or ten species. [For discussion, see PATTEISKY, 1965. The suture line of the type species is unknown for this genus.] *Pennsylvanian (Bashkirian [Marsdenian–Langsettian]):* Belgium, Great Britain, Germany, Netherlands, Poland, Kyrgyzstan and Uzbekistan (Tian Shan).——FIG. 57,*1a–c. *A. carinatum* (FRECH); *a,* side view, Albringhausen, Rhenish Massif, Germany, Yeadonian, GMB Foto 41, ×2 (Kullmann, new, same specimen as Patteisky, 1959, pl.10,*1*); *b,* Herbede, Rhenish Massif, Germany, GMB Foto 419, ×1 (Kullmann, new, same specimen as Patteisky, 1959, pl. 10,*9*); *c,* cross section, Silschede, Rhenish Massif, Yeadonian, GMB Foto 2114, ×2.7 (Kullmann, new, same specimen as Patteisky, 1965, pl. 3,*11c*).

Alurites RUZHENTSEV & BOGOSLOVSKAIA, 1975, p. 57 [**A. costatus;* OD]. Conch form small, ophiocone to lenticular, rather involute, umbilicus wide. Sculpture reticulate, spiral ornamentation weak. Umbilical tubercles or riblets sickle shaped, giving rise to fasciculate ribbing and forming ventral sinus. Prongs of ventral lobe narrow and rounded or subacute, median saddle comparatively low. Five or six species. *Pennsylvanian (lower Bashkirian [Kinderscoutian–Marsdenian]):* Russia (South Urals), Uzbekistan (Kyzylkumy), China (?Ningxia).——FIG. 58,*1a–c. *A. costatus,* holotype, Chumaza river, Bashkortostan, South Urals, lower Bashkirian, Kinderscoutian, PIN 455/47898; *a–b,* ×2.5; *c,* suture, PIN 455/47897, whorl height at 2.7 mm, whorl width 5.2 mm, ×10 (Ruzhentsev & Bogoslovskaia, 1975).

Arkanites MCCALEB, QUINN, & FURNISH, 1964, p. 26 [**Eumorphoceras relictum* QUINN, MCCALEB, & WEBB, 1962, p. 112; OD]. Conch form subglobose, rather evolute, with moderately wide umbilicus and broadly rounded ventral side. Sculpture consisting of well-developed umbilical ribbing, sometimes with nodelike bases. Ventrolateral grooves broad and deep. Suture line almost of gastrioceran type: ventral lobe large, median saddle exceeding half height of entire ventral lobe; first lateral saddle broadly rounded. Adventitious lobe large, with sigmoidal sides, and pointed. Three species. *Pennsylvanian (lower Bashkirian [Marsdenian–Yeadonian]):* China (Ningxia), USA (Arkansas, Oklahoma).

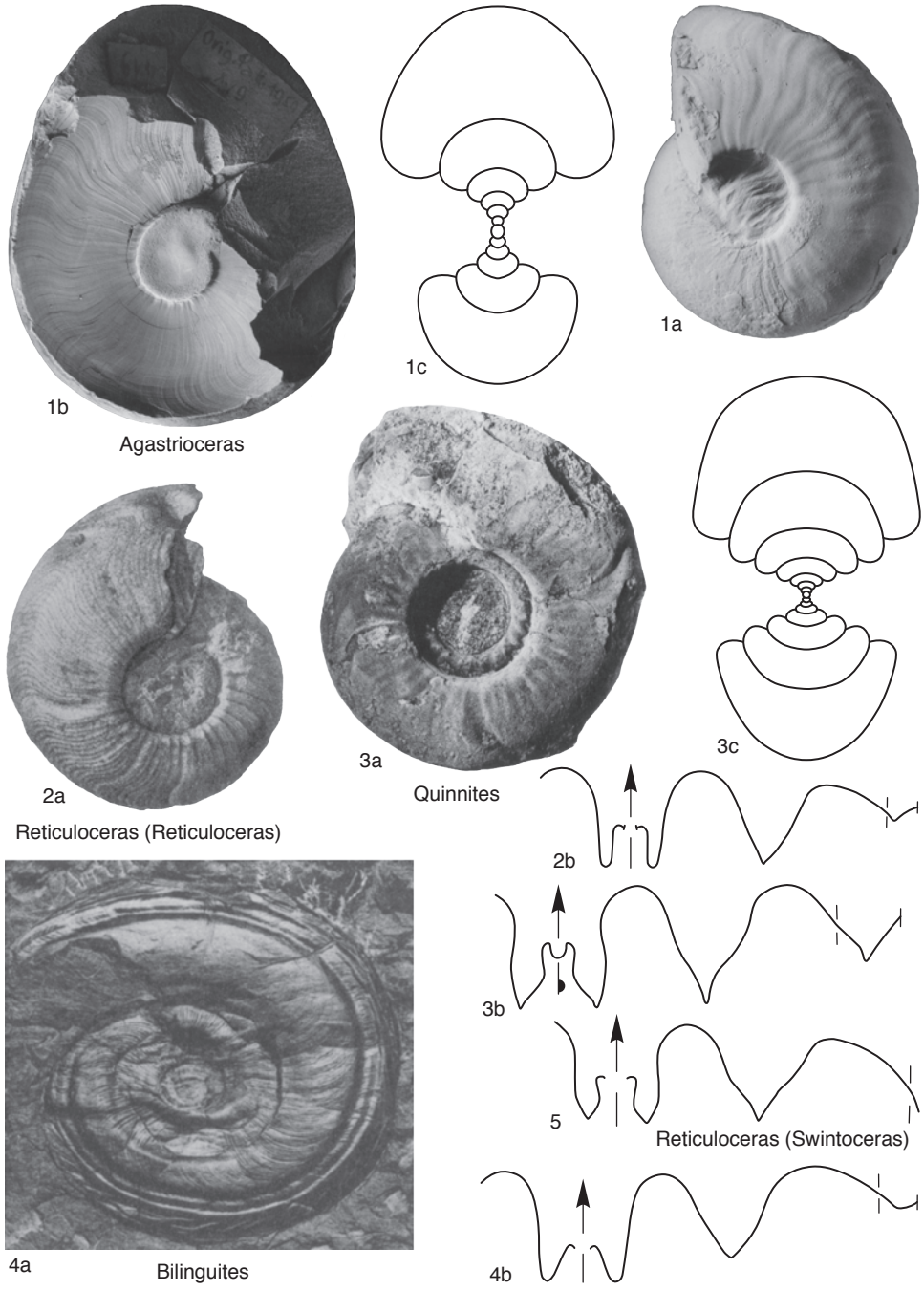

FIG. 57. Reticuloceratidae (p. 95–99).

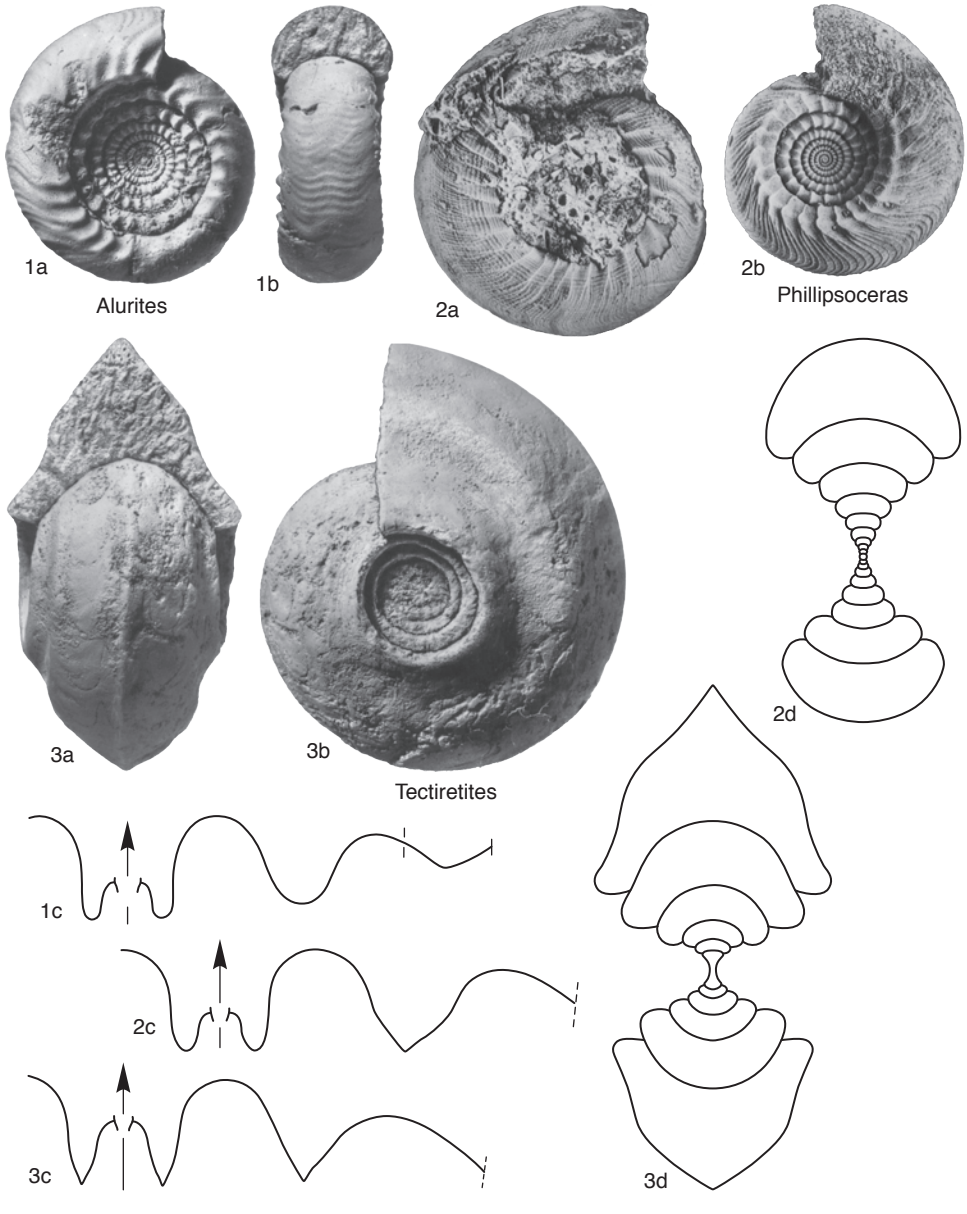

FIG. 58. Reticuloceratidae (p. 95–99).

——FIG. 59,*1a–d. *A. relictus* (QUINN, MCCALEB, & WEBB); *a–b,* Bradshaw Mountain, Carroll County, Arkansas, USA, Prairie Grove Member, Hale Formation, UA L-63-BM-13, ×1.75; *c,* UA L-63-BM-13, suture at 40 mm diameter, ×2; *d,* cross section, SUI 11535, ×2.4 (McCaleb, Quinn, & Furnish, 1964).

Bilinguites LIBROVICH, 1946, p. 79 [**Reticuloceras superbilingue* BISAT, 1924, p. 51; OD]. Conch form similar to *Reticuloceras*, with moderately wide to narrow umbilicus, but ornamentation with strong ventrolateral salient and two ventrolateral furrows on each side; longitudinal lirae weak, if present. Many species. *Pennsylvanian (lower Bashkirian [?Kinderscoutian, Marsdenian–Yeadonian]):* Belgium, Great Britain, Germany, Ireland, Netherlands, Poland, Portugal, Algeria, Morocco, Russia (South Urals), Ukraine (Donets), China (Gansu, Guizhou,

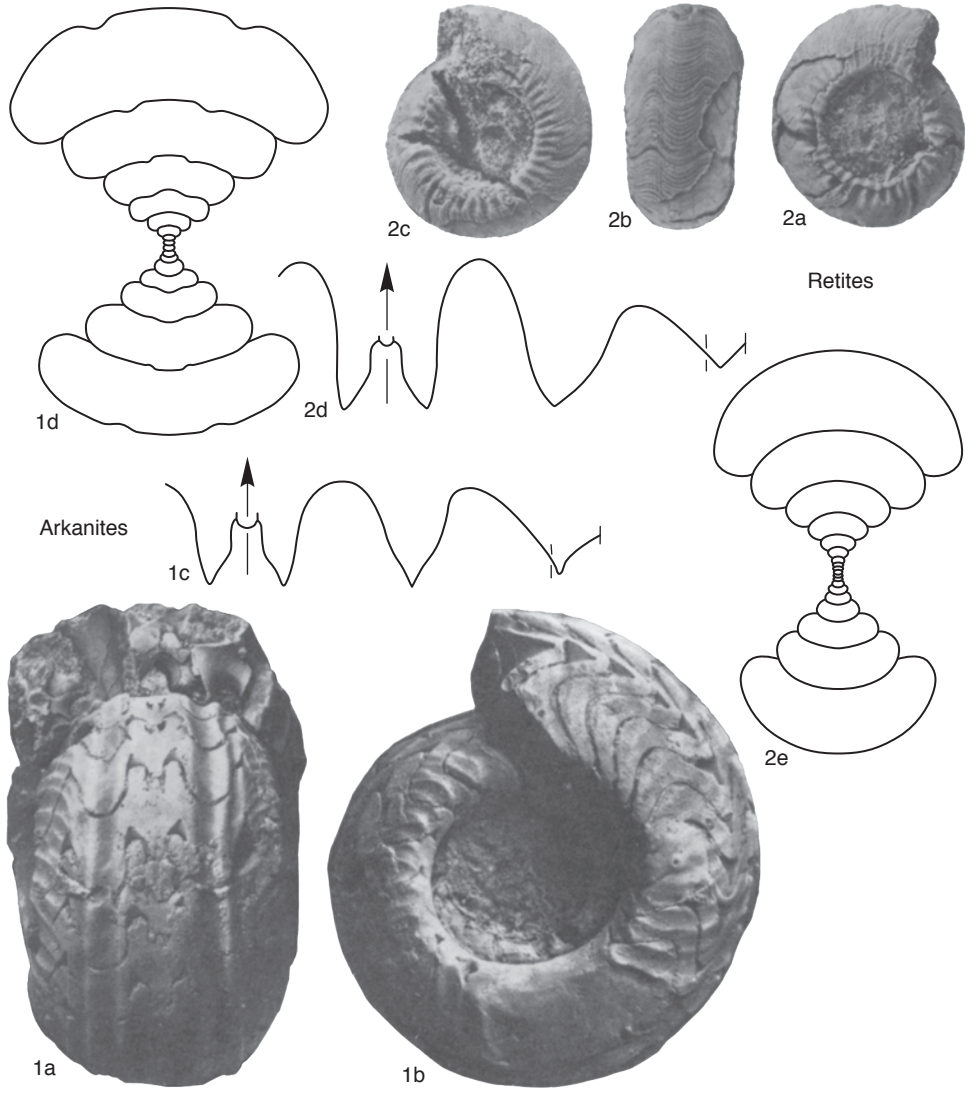

FIG. 59. Reticuloceratidae (p. 95–99).

Ningxia), Uzbekistan (Fergana, Tian Shan), Canada (Northwest Territories), USA (Oklahoma).—— FIG. 57,*4a–b. *B. superbilinguis* (BISAT); *a,* side view, Aiseau-Presles, Hainaut, Belgium, upper Marsdenian, depository not stated, ×3 (Demanet, 1941); *b,* suture, Donets, Ukraine, Marsdenian, magnification not stated (Bogoslovskii, Librovich, & Ruzhentsev, 1962).

Phillipsoceras RUZHENTSEV & BOGOSLOVSKAIA, 1975, p. 55 [**Goniatites (Beyrichoceras) circumplicatile* FOORD, 1903, p. 200; OD]. Conch form on early whorls with wide, later with moderately wide umbilicus, frequently narrowly umbilicate in adult forms. Some species with tendency to form oxycone venter. Sculpture consisting of transverse growth striae crossed by fine spiral lirae, thus producing strong reticulate ornamentation. At early whorls rather strong riblets or nodes near umbilicus. Adventitious lobe wider than ventral lobe. Many species. [This genus is closely related and transitional to *Reticuloceras* and may be its junior synonym: the relation of width of umbilicus:diameter in *Reticuloceras* is 0.25–0.15 (average value = 0.18) and in *Phillipsoceras* is 0.5–0.3 (average value = 0.39); for discussion, see RUZHENTSEV & BOGOSLOVSKAIA, 1978, p. 275.] *Pennsylvanian (lower Bashkirian [Kinderscoutian–Marsdenian]):* Belgium, England, Wales, Ireland, France, Germany, Spain, Portugal,

Morocco, Russia (South Urals), Kazakhstan (Tian Shan), Kyrgyzstan (Fergana), Uzbekistan (Fergana, Tian Shan, Kyzylkumi), China (Gansu).——Fig. 58,*2a–b. *P. circumplicatile* (Foord); *a,* lectotype, side view, Lisdoonvarna district, County Clare, Ireland, Kinderscoutian, GSEI 4803 K, ×2; *b,* side view, Neheim, Rhenish Massif, Germany, Kinderscoutian, GS London 86917, ×2.5 (Hodson, 1957).——Fig. 58,*2c–d. P. alpharhipaeum* Ruzhentsev & Bogoslovskaia; *c,* suture, left bank of Malaia Suren' river, Bashkortostan, South Urals, Kinderscoutian, PIN 455/43212, whorl height at 5.6 mm, whorl width 9.7 mm, ×6; *d,* cross section, Chumaza river, Bashkortostan, South Urals, Kinderscoutian, PIN 455/43151, ×2.7 (Ruzhentsev & Bogoslovskaia, 1978).

Quinnites Manger & Saunders, 1980, p. 31 [**Gastrioceras (Branneroceras) henbesti* Gordon, 1965, p. 255; OD]. Conch form lenticular to subdiscoidal, with moderately wide or wide umbilicus. Umbilical riblets common; weak spiral ornamentation, strong constrictions, and ventral groove may be present. Suture gastrioceratoid, with elongate, attenuate ventral prongs, adventitious lobe elongate. Three or four species. *Pennsylvanian (lower Bashkirian [Marsdenian–Yeadonian]):* Russia (?Novaia Zemlia), Kazakhstan (Tian Shan), USA (Arkansas).——Fig. 57,*3a–c. *Q. henbesti* (Gordon), House of Hess, 3.2 km south of West Fork, Washington County, Arkansas; *a,* holotype, side view, USNM 119660, ×1.4; *b,* suture, diameter at 23.9 mm, reversed, ×3.3; *c,* topotype, cross section, UA 77-218-224, ×1.9 (Manger & Saunders, 1980).

Retites McCaleb, 1964, p. 233 [**R. semiretia* McCaleb, 1964, p. 234; OD]. Similar to *Phillipsoceras,* conch lenticular, evolute, with wide or moderately wide umbilicus. Strong ribs present in all stages, more or less confined to umbilical shoulder diverging into weak ribbing on ventrolateral side and venter. Reticulate sculpture formed by coarse, noncrenulate transverse striae, longitudinal ornamentation weak. Type of suture line reticuloceratid; prongs of ventral lobe attenuate, not pouched, median saddle not reaching half height of entire ventral lobe. Eight species. [This genus is transitional to *Phillipsoceras* and may be its junior synonym.] *Pennsylvanian (lower Bashkirian [Kinderscoutian–Yeadonian]):* Portugal, Russia (South Urals), Kazakhstan (Tian Shan), Kyrgyzstan (Fergana), Uzbekistan (Kyzylkumi), China (Guangxi, Ningxia), USA (Arkansas).——Fig. 59,*2a–e. *R. semiretia; a–c,* holotype, Fayetteville, Washington County, Arkansas, Cane Hill Member, Hale Formation, lower Morrowan, SUI 11683, ×1.75; *d,* suture, diameter at 25 mm, magnification not indicated (McCaleb, 1964); *e,* cross section, Fayetteville Railroad cut, Cane Hill Member, Hale Formation, lower Morrowan, UA 77-218-107, ×2.7 (Manger & Saunders, 1980).

Tectiretites Ruzhentsev & Bogoslovskaia, 1975, p. 59 [**T. hodsoni;* OD] [=*Reticuloceras (Panxianoceras)* Yang, 1978, p. 171 (type, *R. (P.) microreticulatum,* OD)]. Inner whorls evolute, later stages involute, with moderately wide umbilicus. At maturity, conch form oxycone and tectiform, with angular flanks and ventral keel. Ornamentation consisting of small nodes at umbilical wall, in some species elongated to riblets that cross venter with small sinus. Most species with spiral ornamentation. Suture reticuloceratid. Many species. [For discussion, see Manger & Saunders, 1980, p. 13. *Panxianoceras* was erected for forms with a relatively wide umbilicus, regarded herein as being of specific significance.] *Pennsylvanian (lower Bashkirian [Kinderscoutian–Marsdenian]):* Great Britain, Ireland, Portugal, Russia (South Urals), Kazakhstan (Tian Shan), Uzbekistan (Tian Shan), Kyrgyzstan (Tian Shan, Fergana), China (Guizhou, Xinjiang).——Fig. 58,*3a–c. *T. hodsoni,* holotype, Abuliaisov, 3.5 km east, Bashkortostan, South Urals, Russia, PIN 455/46136; *a–b,* ×1; *c,* suture, whorl height at 18.5 mm, whorl width 28 mm, ×2.1 (Ruzhentsev & Bogoslovskaia, 1975).——Fig. 58,*3d. A. confinis* (Ruzhentsev & Bogoslovskaia), holotype, cross section, Chumaza river, Bashkortostan, South Urals, Kinderscoutian, PIN 455/46305, ×1.3 (Ruzhentsev & Bogoslovskaia, 1978).

Family GASTRIOCERATIDAE Hyatt, 1884

[*nom. correct.* Wedekind, 1914, p. 12, *pro* Gastriocerae Hyatt, 1884 in 1883–1884, p. 325]

Conch form subdiscoidal to globular. Early whorls usually evolute, adult stages with wide or moderately narrow umbilicus. Umbilical shoulder with nodes, generally elongate transversely, sometimes combined with rather strong ribs. Growth striae sinuous or rather straight, mostly with ventral sinus. Longitudinal lirae present in some forms. Suture similar to Glaphyritidae; ventral lobe wide, deeply subdivided, moderately pouched, with asymmetrical prongs; height of median saddle exceeding half height of entire ventral lobe. Origin of family possibly in unsculptured glaphyritids. [Some authors (e.g., Ruzhentsev & Bogoslovskaia, 1978, p. 60) regard *Surenites* or related forms as predecessors of *Cancelloceras* and *Gastrioceras.*] *Pennsylvanian (lower Bashkirian [Marsdenian]–Moscovian).*

Gastrioceras Hyatt, 1884 in 1883–1884, p. 327 [**Ammonites listeri* Sowerby, 1814, p. 97; SD Foord & Crick, 1897, p. 226; *non* Martin, 1809, pl. 35,*3;* see Opinion 231, ICZN, 1954, p. 239)] [=*Gastrioceras (Lissogastrioceras)* Gordon, 1965, p. 257 (type, *Gastrioceras fittsi* Miller & Owen, 1944, p. 424, OD)]. Conch form typically broad. Umbilical shoulder ornamented with nodes that are

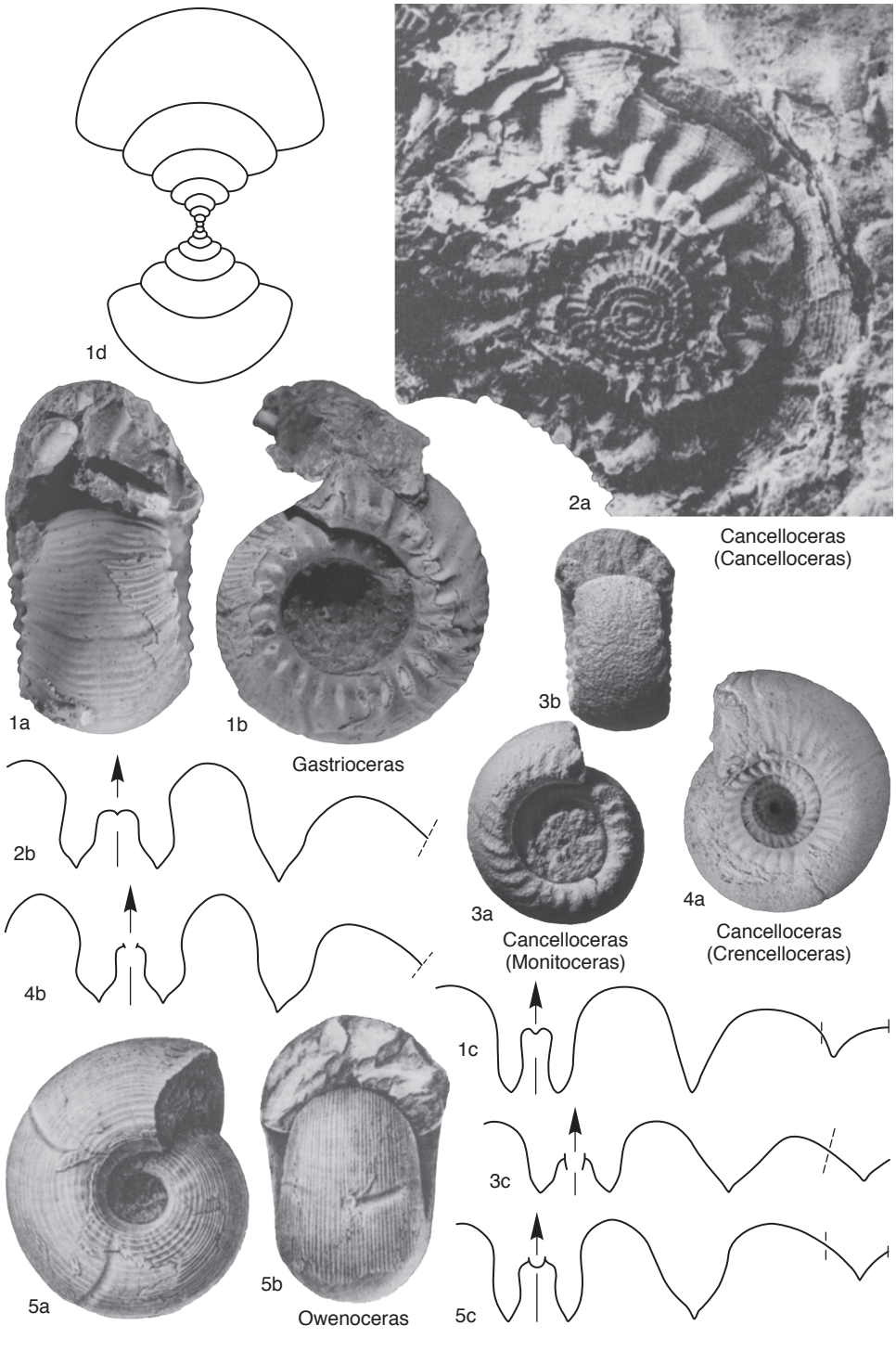

FIG. 60. Gastrioceratidae (p. 99–101).

elongated transversely; in some species rather strong ribs. Longitudinal lirae usually very faint or absent, sometimes confined to umbilical shoulders. Suture similar to *Glaphyrites,* ventral lobe wide, height of median saddle exceeding half height of entire ventral lobe, its prongs being slightly pouched or attenuate; first lateral saddle broadly rounded, adventitious lobe deep, relatively wide and bell shaped, in some forms attenuate. Many species. [*Lissogastrioceras* exhibits smooth unornamented ventral regions, regarded herein as being of specific significance.] *Pennsylvanian (upper Bashkirian [Langsettian]–Moscovian):* Belgium, Netherlands, Great Britain, Ireland, Germany, Portugal, Algeria, Morocco, Poland, Ukraine (Donets), Uzbekistan (Fergana), China (Gansu, Guizhou, Xinjiang, Ningxia), Japan, Canada (Northwest Territories), USA (Arkansas, Illinois, Ohio, Kentucky, Oklahoma, Texas, Alabama).——Fig. 60,*1a–c.* **G. listeri* (Sowerby), Shore, Lancashire, Bullion Mine, England, Langsettian, GSM 56454; *a–b,* ×2 (new, courtesy of W. Ramsbottom; same specimen as Ramsbottom & Calver, 1962, pl.15,*9*); *c,* suture, BMNH C. 4953, provenance not stated, diameter at 58.5 mm, magnification not stated (Foord & Crick, 1897).——Fig. 60,*1d. G. carbonarium carbonarium* (von Buch), cross section, Essen-Rellinghausen, Mine Langenbrahm II, Rhenish Massif, Germany, Langsettian, GMB P220, Foto 2130, ×2.6 (Kullmann, new, same specimen as Patteisky, 1965, pl. 7,*4b*).

Cancelloceras Ruzhentsev & Bogoslovskaia, 1969b, p. 1333 [**Gastrioceras cancellatum* Bisat, 1923, p. 47; OD] [=*Leiogastrioceras* Yang, 1978, p. 184 (type, *L. discoideum,* OD)]. Conch moderately involute. Well-developed tubercles on umbilical shoulder similar to *Gastrioceras,* but with reticulate ornamentation at maturity. Suture resembles *Gastrioceras.* Many species. Three subgenera: *Cancelloceras (Cancelloceras)* Ruzhentsev & Bogoslovskaia, 1969b; *Cancelloceras (Monitoceras)* Ruzhentsev & Bogoslovskaia, 1978; and *Cancelloceras (Crencelloceras)* Nikolaeva & Kullmann, 1995. [*Leiogastrioceras* was established for species with relatively high median saddle and narrow adventitious lobe. For discussion, see Nikolaeva & Kullmann, 1995.] *Pennsylvanian (lower Bashkirian [Marsdenian–Yeadonian]):* Belgium, England, Wales, France, Germany, Netherlands, Poland, Portugal, Russia (South Urals), Ukraine (Donets), Algeria, Morocco, Kazakhstan (Tian Shan), Kyrgyzstan (Tian Shan), Uzbekistan (Fergana, Tian Shan), China (Ningxia, Guizhou), USA (Arkansas, Oklahoma, Nevada).

C. (Cancelloceras). Spirals more pronounced than transverse ornamentation; relatively low number of plications. Seven species. *Pennsylvanian (lower Bashkirian [Marsdenian–Yeadonian]):* Great Britain, Belgium, Netherlands, ?France, Germany, Portugal, Algeria, ?Poland, Ukraine (Donets), Uzbekistan (Fergana), China (Ningxia).——Fig. 60,*2a–b.* **C. (C.) cancellatum* (Bisat); *a,* lectotype, side view, Meanwood, Leeds, Yorkshire, Rough Rock, Yeadonian, BMNH C.25767, ×3.5 (new, courtesy of W. Ramsbottom, same specimen as Ramsbottom & Calver, 1962, pl. 14,*5*); *b,* suture, Eira Velha, Portugal, upper part of Quebradas Formation, Yeadonian, IGML 379, whorl height at 11.8 mm, whorl width 11.8 mm, ×3.2 (Korn, 1997).

C. (Crencelloceras) Nikolaeva & Kullmann, 1995, p. 369 [**Cancelloceras elegans* Ruzhentsev & Bogoslovskaia, 1978, p. 296; OD]. Transverse ornamentation more pronounced than spirals, in general higher number of plications. Conch form and suture similar to *Cancelloceras.* Many species. [No suitable illustration displaying characteristics of the ornament of the type species is available.] *Pennsylvanian (lower Bashkirian [Marsdenian–Yeadonian]):* England, Wales, Germany, Belgium, Netherlands, Portugal, Algeria, Russia (South Urals), Ukraine (Donets), Kazakhstan (Tian Shan), Uzbekistan (Fergana, Tian Shan), China (Ningxia), USA (Arkansas, Oklahoma).——Fig. 60,*4a–b. C. (C.) crencellatum* Bisat, =*C. (Cr.) soliari* Nikolaeva & Kullmann, paratype, Choça, near São Marcos da Serra, southwestern Portugal, Quebradas Formation, Yeadonian, IGML 24/1; *a,* side view, ×2; *b,* suture, ×3.1 (Nikolaeva & Kullmann, 1995).

C. (Monitoceras) Ruzhentsev & Bogoslovskaia, 1978, p. 288 [**Gastrioceras marianum karpinskii* Yanishevskii, 1900, p. 319; OD]. Strong transverse ornamentation, weak spirals; umbilical riblets disappearing on early stages. Ventral lobe with wide prongs and divergent sides. One species. *Pennsylvanian (lower Bashkirian [Marsdenian]):* Russia (South Urals).——Fig. 60,*3a–c.* **C. (M.) karpinskii* (Yanishevskii), Shartym river, Cheliabinsk oblast', Marsdenian; *a–b,* PIN 455/48002, ×2; *c,* suture, PIN 455/48000, whorl height at 6.3 mm, whorl width 12.3 mm, ×4.2 (Ruzhentsev & Bogoslovskaia, 1978).

?Owenoceras Miller & Furnish, 1940b, p. 359 [**Neoglyphioceras bellilineatum* Miller & Owen, 1939, p. 154; OD]. Conch form involute, with moderately wide or rather narrow umbilicus. Shell surface with prominent longitudinal lirae; growth lines weak. Umbilical nodes may be present. Suture similar to *Gastrioceras.* Three or four species. [The root group and phylogenetic reationship of the genus is uncertain.] *Pennsylvanian (upper Moscovian):* China (Xinjiang, ?Guizhou), Russia (Siberia), USA (Missouri, Oklahoma).——Fig. 60,*5a–c.* **O. bellilineatum* (Miller & Owen), Ewing strip pit, Henry County, Missouri, Cherokee Formation above Mulky coal, Desmoinesian, Owen collection no. 627; *a–b,* ×2; *c,* suture, diameter at 17 mm, whorl height 5 mm, whorl width 12 mm, ×4.5 (Miller & Owen, 1939).

THALASSOCERATOIDEA

JÜRGEN KULLMANN

[University of Tübingen, Germany]

Superfamily THALASSOCERATOIDEA Hyatt, 1900

[*nom. transl.* KULLMANN, 1962, p. 67, *ex* Thalassoceratidae HYATT, 1900, p. 553]

Conch form thick-discoidal to globular, involute. Umbilicus narrow or closed. Growth striae biconvex, with ventral sinus. Ventral lobe wide; height of median saddle usually extending considerably to half height of entire ventral lobe. Lobes simple (Bisatoceratidae) or serrate and digitate (Thalassoceratidae). [The close relationship of families in this superfamily is uncertain.] *Pennsylvanian (upper Bashkirian)–Guadalupian (Wordian).*

Family BISATOCERATIDAE Miller & Furnish, 1957

[*nom. transl.* RUZHENTSEV, 1975, p. 33, *ex* Bisatoceratinae MILLER & FURNISH in MILLER, FURNISH, & SCHINDEWOLF, 1957, p. 60]

Conch subdiscoidal, with narrow or closed umbilicus. Lobes comparatively simple; median saddle high, sometimes reaching almost height of ventral lobe. Spiral ornamentation in some forms. [The relationship to the superfamily is uncertain.] *Pennsylvanian (upper Bashkirian)–Cisuralian (Asselian, ?Artinskian).*

Bisatoceras MILLER & OWEN, 1937, p. 417 [**B. primum;* OD]. Conch subdiscoidal, umbilicus very narrow or closed; immature growth stages globular. Growth lines usually biconvex, forming ventral and lateral sinuses; constrictions may be present. Median saddle of ventral lobe exceeding two-thirds height of entire ventral lobe. Adventitious lobe simple, with convex sides. Many species. *Pennsylvanian (upper Bashkirian–Moscovian [Missourian]):* China (Guangxi), Japan, Russia (Novaia Zemlia, Siberia), Canada (Northwest Territories), USA (Arkansas, California, Kansas, Missouri, Nevada, Oklahoma).——FIG. 61,*1a–b. *B. primum,* syntype, 1 km south of Collinsville, Oklahoma, USA, Coffeyville Formation, concretions just above Dawson coal, Missourian, Owen collection; *a,* side view, ×2; *b,* suture, ×2.3 (Miller & Owen, 1937).

Neoglaphyrites RUZHENTSEV, 1938, p. 272 [**Glaphyrites (Neoglaphyrites) bashkiricus* RUZHENTSEV, 1938, p. 272; OD]. Conch involute, with open but very narrow umbilicus. Umbilical wall steep. Suture line similar to *Bisatoceras*, but with V-shaped lobe on umbilical wall. Five species. [For discussion, see NASSICHUK, 1975, p. 105. No suitable illustrations of the type species are available.] *Pennsylvanian (?upper Bashkirian, Gzhelian)–Cisuralian (Asselian, ?Artinskian):* Russia (Bashkortostan, South Urals), China (Gansu), Japan, Canada (Northwest Territories), USA (Oklahoma).——FIG. 61,*3a–b. N. bisulcatus* NASSICHUK, Ellesmere Island, Northwest Territories, Canada; *a,* GSC 33749, ×1; *b*, holotype, GSC 33748, ×2 (Nassichuk, 1975).——FIG. 61,*3c. N. satrus* (MAKSIMOVA), holotype, suture, north of Akhunovo, Yuresan River, Bashkortostan, Russia, Asselian, PIN 323/441, whorl height at 13.2 mm, whorl width 14.8 mm, ×1.8 (Ruzhentsev, 1951).

Pseudobisatoceras MAKSIMOVA, 1940a, p. 859 [**Bisatoceras secundum* MILLER & MOORE, 1938, p. 353; OD]. Similar to *Bisatoceras* but with spiral ornamentation. Two species. [This genus may be a junior synonym of *Bisatoceras*.] *Pennsylvanian (upper Bashkirian–Moscovian):* Russia (Novaia Zemlia), USA (Arkansas, Oklahoma).——FIG. 61,*2. *B. secundum* (MILLER & MOORE), syntype, suture, east side of Gaither Mountain, 11 km southwest of Harrison, Arkansas, Brentwood Limestone, Bloydian, ×2.1 (Miller & Moore, 1938).

Family THALASSOCERATIDAE Hyatt, 1900

[Thalassoceratidae HYATT, 1900, p. 553]

Lobes partly asymmetrical, serrate to digitate, with progressive increase in degree of digitation; saddles rounded. Some forms with ventrolateral grooves; no longitudinal ornamentation. Umbilical callus may be present. Ventral lobe with moderately high median saddle and diverging sides (Gleboceratinae new subfamily) or with high median saddle and digitate prongs of ventral lobe (Thalassoceratinae). Strong sculpture rare. *Pennsylvanian (Kasimovian)–Guadalupian (Wordian).*

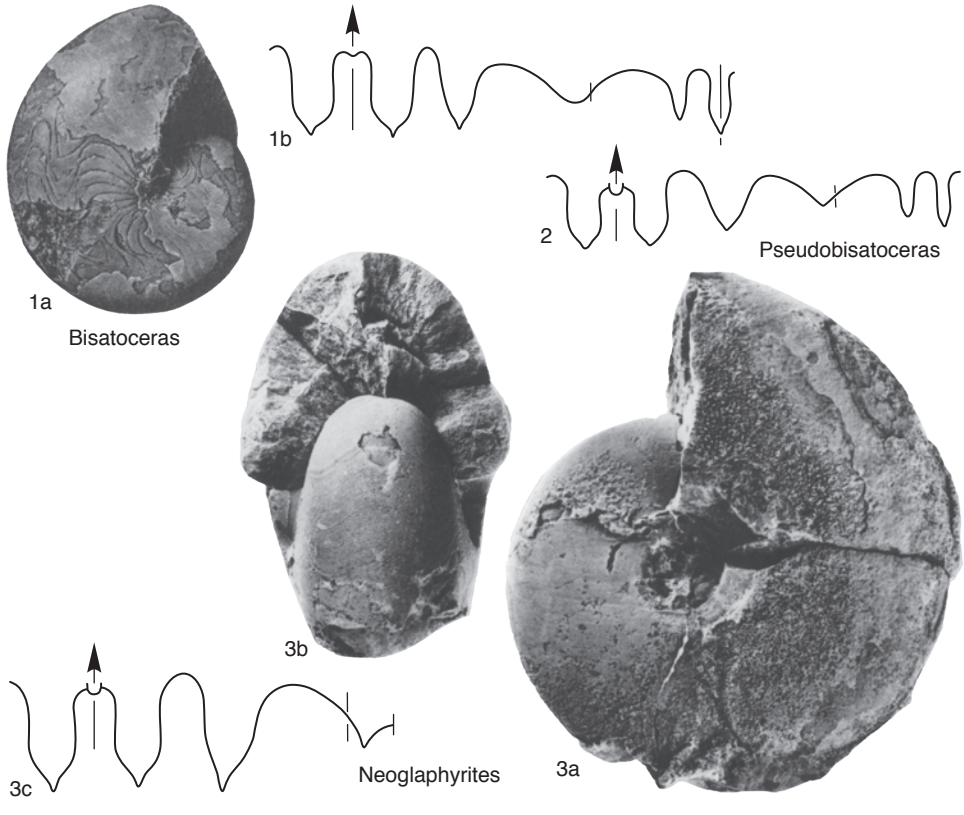

FIG. 61. Bisatoceratidae (p. 102).

Subfamily GLEBOCERATINAE new subfamily

[Gleboceratinae KULLMANN, herein] [=Yinoceratinae RUZHENTSEV, 1960d, p. 207, *partim*] [type genus, *Gleboceras* RUZHENTSEV, 1950, p. 108]

Small-sized thalassoceratoideans with globular conch and very narrow umbilicus. Shell surface may be smooth or with strong ribbing and tubercles. Ventral lobe simply subdivided, with slightly diverging sides and broadly rounded ventrolateral saddle. Adventitious and lateral lobes digitate or serrate. [The systematic affinities of this subfamily are unknown, and assignment to Thalassoceratidae is tentative.] *Pennsylvanian (Kasimovian [Virgilian]).*

Gleboceras RUZHENTSEV, 1950, p. 108 [**G. mirandum;* OD]. Conch globular, umbilicus very narrow. Ventral lobe moderately wide, with gently bended sides and simple, lanceolate prongs. First lateral lobe serrate, umbilical lobe with irregular incisions. One or two species. *Pennsylvanian (Kasimovian [Virgilian]):* Russia (South Urals), USA (Oklahoma).——FIG. 62,*1a–c.***G. mirandum,* holotype, Sakmara River at km 167, Chkalovskaia Oblast', South Urals, Russia, lower Zhigulian, PIN 320/1876; *a–b,* ×3 (Bogoslovskii, Librovich, & Ruzhentsev, 1962); *c,* suture, whorl width at 7 mm, ×6.4 (Ruzhentsev, 1950).

Mapesites WORK & BOARDMAN, 2003, p. 1195 [**M. chautauquaensis;* OD]. Conch subglobose, with depressed whorls and narrow umbilicus. Sculpture exhibiting tuberculate ventrolateral ridge and strong ribs that intersect with ventral sulci producing three longitudinal rows of barlike tubercles. Ventral lobe with median saddle half as high as entire lobe, and diverging sides. First lateral lobe irregularly digitate. One species. *Pennsylvanian (Kasimovian [basal Virgilian]):* USA (Kansas).——FIG. 62,*2a–d.* **M. chautauquaensis,* holotype, 1.4 km west of Peru, Chautauqua County, SUI 62428; *a–c,* ×5.5; *d,* suture, diameter at 7 mm, enlarged, magnification not stated (Work & Boardman, 2003).

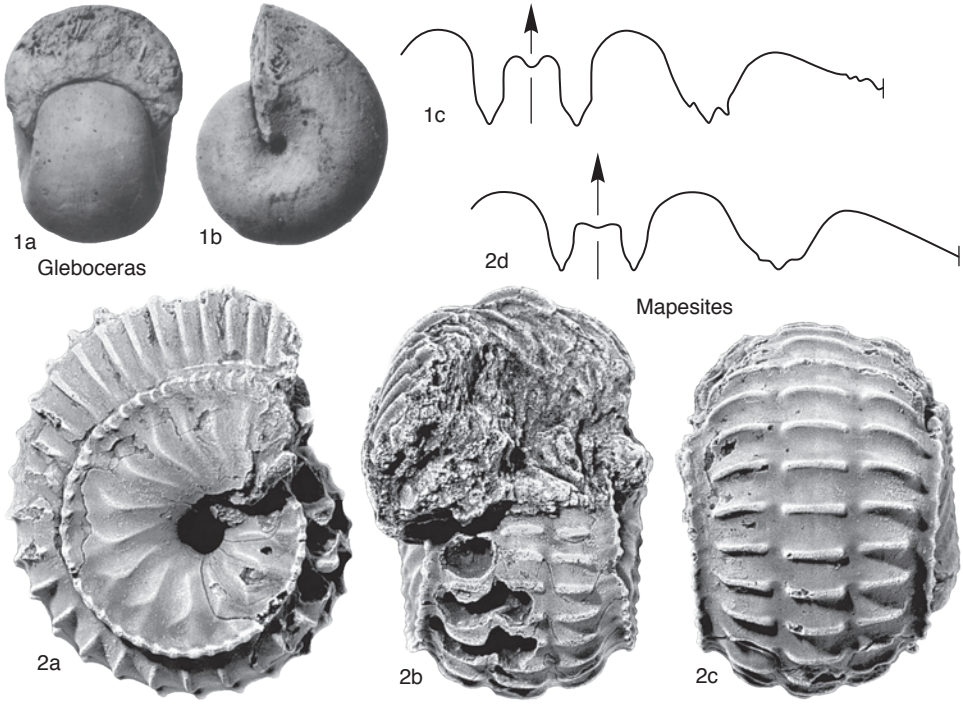

FIG. 62. Thalassoceratidae (p. 103).

Subfamily THALASSOCERATINAE Hyatt, 1900

[*nom. transl.* KULLMANN, herein, *ex* Thalassoceratidae HYATT, 1900, p. 553] [=Aristoceratinae LEONOVA, 2002, p. 41]

Lobes including ventral lobe partly asymmetrical serrate to digitate, with tendency toward increased degree of digitation; saddles rounded. Some forms with ventrolateral grooves; no spiral ornamentation. Conch surface smooth. Umbilical callus may be present. *Pennsylvanian (Kasimovian [Missourian])–Guadalupian (Wordian).*

Thalassoceras GEMMELLARO, 1887, p. 69 [**T. phillipsi* GEMMELLARO, 1887, p. 71; SD PLUMMER & SCOTT, 1937, p. 357]. Conch form subdiscoidal, with very narrow or closed umbilicus. Digitation of suture line reaching saddles. External lateral lobe wider than prongs of ventral lobe; saddles narrowly rounded. Seven species. *Cisuralian (Sakmarian)–Guadalupian (Wordian):* Italy (Sicily), Slovenia (?Karawanken Mountains), Russia (North and South Urals), Ukraine (Crimea), Kazakhstan (South Urals), Tajikistan (Pamirs), China (Guizhou), Indonesia (Timor), Australia (Western Australia), USA (?Texas).——FIG. 63,*3a–d. *T. phillipsi*, lectotype, (Beinert, Furnish, & Glenister, herein), Rocca de San Benedetto, Sicily, MGUP 109, Wordian; *a–c,* same as GEMMELLARO, 1887, pl. 10,*13–14,* ×2.5 (Furnish & Glenister, new); *d,* suture, diameter at 16 mm, ×2.3 (Miller, Furnish, & Schindewolf, 1957).——FIG. 63,*3e. T. gemmellaroi* (KARPINSKII), cross section, left shore of Aktasta River, South Urals, Aktastinian subformation, PIN 317/2634, ×5.1 (Ruzhentsev, 1956b).

Aristoceras RUZHENTSEV, 1940b, p. 524 [**A. chkalovi* RUZHENTSEV, 1940b, p. 526; OD] [=*Uralites* VOINOVA, 1934, p. 3 (type, *U. orenburgensis,* M, *nom. nud., non* CHERNOV, 1907, p. 292, *nom. nud., teste* RUZHENTSEV, 1950, p. 98)]. Conch form discoidal, with narrow or closed umbilicus, venter flat, with ventrolateral grooves. Coarse sinuous growth lamellae forming deep ventral sinus and narrow ventrolateral salient. Constrictions may be present. Suture similar to *Eothalassoceras.* Five species, two species questionable. [For discussion, see RUZHENTSEV, 1950, p. 98.] *Pennsylvanian (Kasimovian)–Cisuralian (Asselian):* Russia and Kazakhstan (South Urals), ?Spain, USA (Oklahoma, Texas).——FIG. 63,*1a–d. *A. chkalovi; a–b,* South Urals, Russia, Gzhelian, ×1.25 (Bogoslovskii, Librovich, & Ruzhentsev, 1962); *c–d,* west of Nikols'kii, South Urals, lower part of Orenburg stage; *c,* holotype, suture, PIN 320/786, whorl height at 10.4 mm, whorl width 8.2 mm,

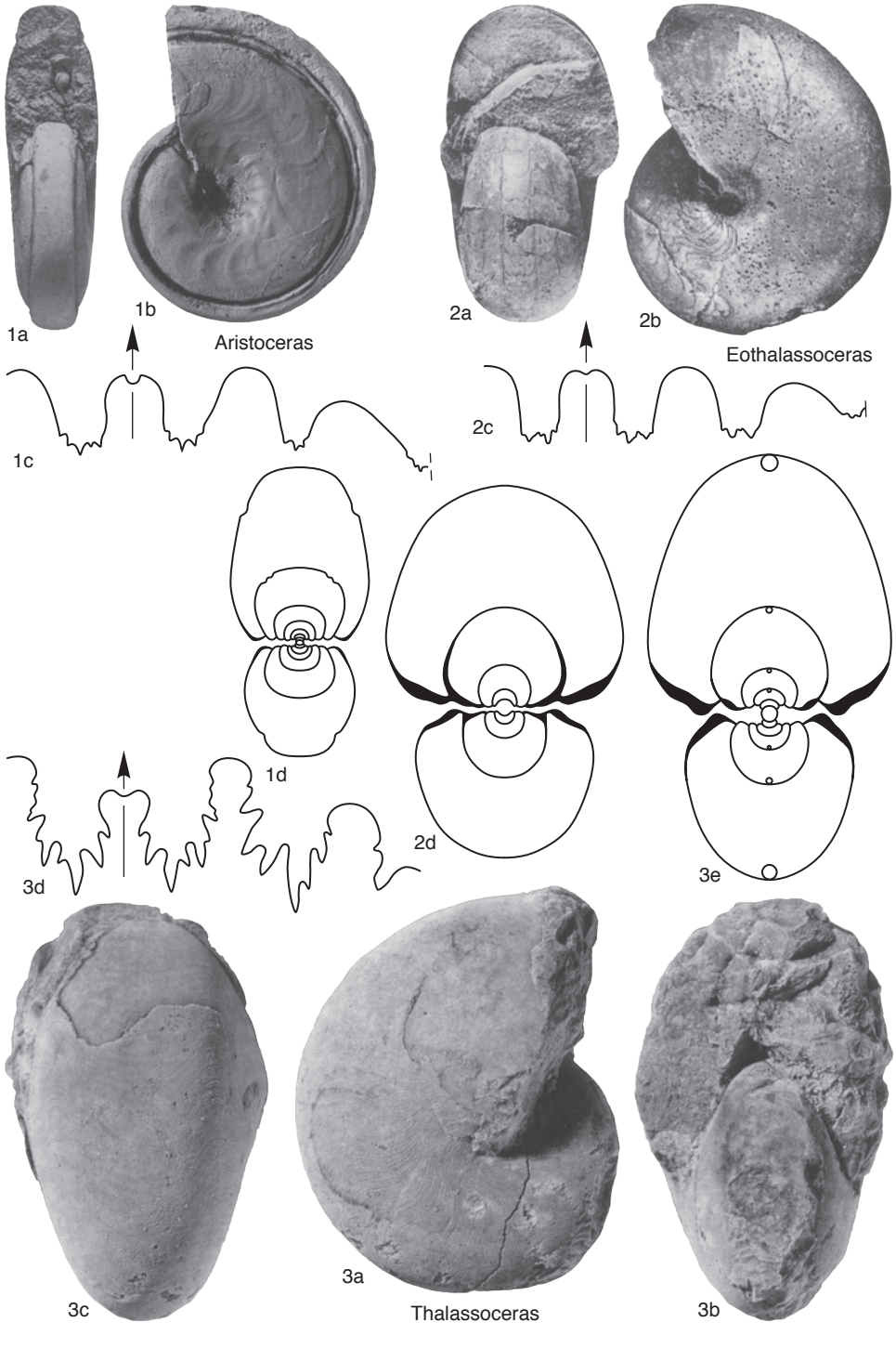

Fig. 63. Thalassoceratidae (p. 104–107).

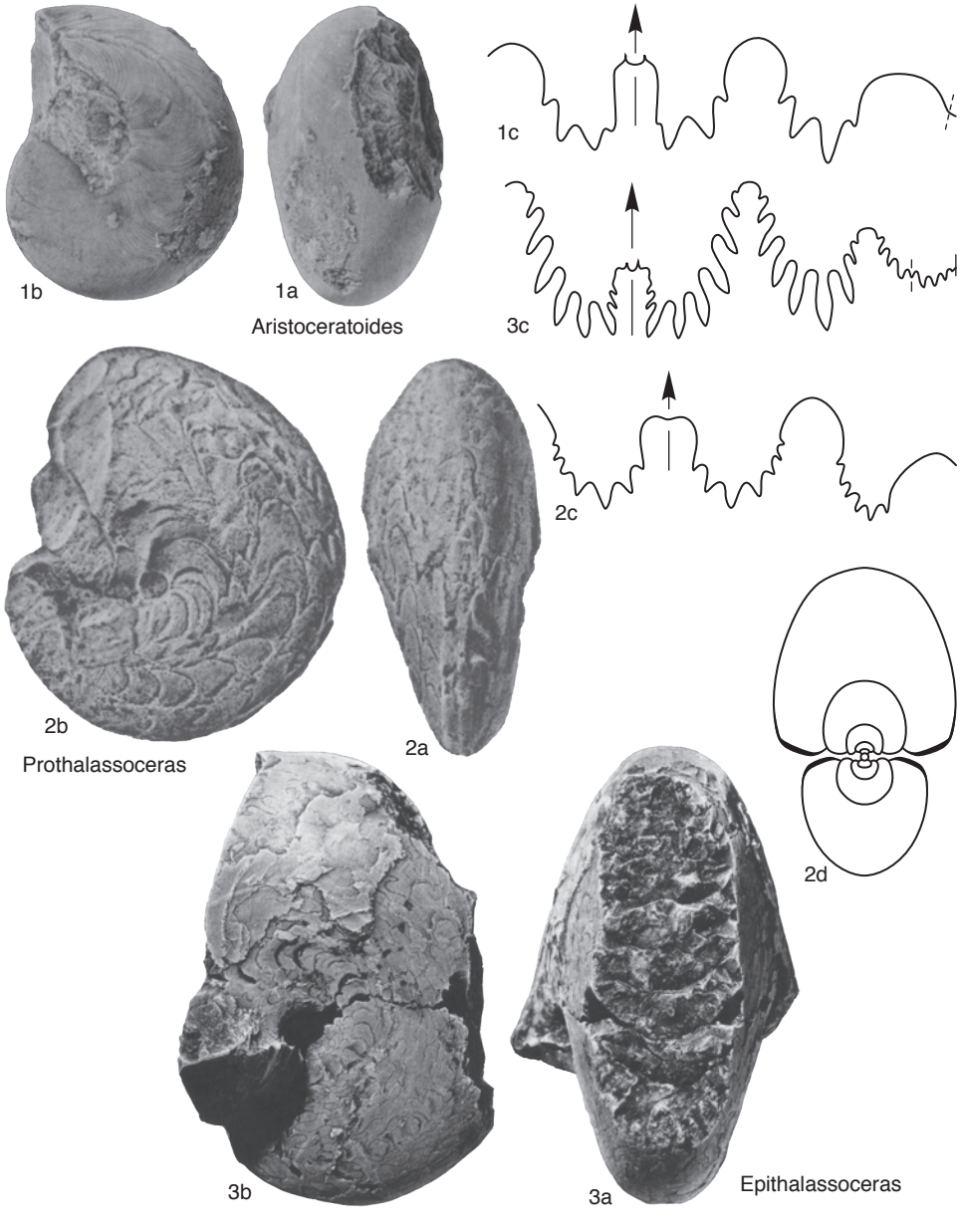

FIG. 64. Thalassoceratidae (p. 107).

×3.4 (Ruzhentsev, 1950); *d,* cross section, PIN 320/787, ×2.7 (Ruzhentsev, 1950).

Aristoceratoides Ruzhentsev, 1960d, p. 206 [**Thalassoceras varicosum* Gemmellaro, 1887, p. 74; OD]. Conch wide, with rounded venter and ventrolateral grooves. Growth lamellae with strong ventrolateral salient. Suture with almost regular digits restricted to lower halves of lobes. Two species and one questionable species. [For discussion, see Beinert, 1971.] *Guadalupian (?Roadian, Wordian):* Italy (Sicily), Mexico (?Coahuila).——Fig. 64,*1a–c.* **A. varicosus* (Gemmellaro), lectotype, Railroad station at Roccapalumba, near Torto River, about 27 km southeast of Palermo, Sicily, compact erratic limestone block, Wordian, IGUP 110, Beinert, Furnish & Glenister, herein, same as Gemmellaro, 1887, pl. 5,*20,22; a–b,* ×3 (new); *c,* suture, diameter at 8 mm, ×8.4 (Beinert, 1971).

Eothalassoceras Miller & Furnish, 1940a, p. 105 [**Prothalassoceras inexpectans* Miller & Owen, 1937, p. 418; OD]. Sutural serration irregular, asymmetrical, shallow, and restricted to bases of prongs of ventral lobe and adjacent lobes. Ventral lobe very wide, almost parallel sided, median saddle as high as first lateral saddle. Two species. *Pennsylvanian (Kasimovian–Gzhelian):* USA (Alaska, Oklahoma, Texas, New Mexico).——Fig. 63,*2a–d.* **E. inexpectans* (Miller & Owen), 1.2 km south of Collinsville, Tulsa County, Oklahoma, Coffeyville Formation, just above Dawson coal, Missourian; *a–c,* lectotype (Beinert, 1971), SUI 1996; *a–b,* ×1.5; *c,* suture, Coffeyville Formation, about 1 mile south of Collinsville, Oklahoma, diameter at 21 mm, ×2.3 (Miller & Owen, 1937); *d,* cross section, topotype, SUI 34668, ×2.5 (Beinert, 1971).

Epithalassoceras Miller & Furnish, 1940a, p. 105 [**E. ruzencevi;* OD]. Conch thickly discoidal, with small umbilicus. Suture similar to *Thalassoceras,* but external lobes even more strongly denticulate: external suture dissected nearly to tops of saddles by deep digits. Median saddle about half height of entire ventral lobe. First lateral lobe as wide as each prong of ventral lobe. Internal lateral lobe bifid. Two species. *Guadalupian (Roadian–Wordian):* USA (Texas), Mexico (Coahuila).——Fig. 64,*3a–c.* **E. ruzencevi*, holotype, West of Noria de Malascachas, Valle de Las Delicias, Coahuila, Mexico, Malascachas section, Wordian, YPM 16303; *a–b,* ×2 (Beinert, Furnish, & Glenister, new); *c,* suture, diameter at approximately 9 mm, ×3 (Miller & Furnish, 1940a).

Prothalassoceras Böse, 1919, p. 102 [**P. welleri* Böse, 1919, p. 104; SD Plummer & Scott, 1937, p. 353] [=*Allothalassoceras* Leonova, 2002, p. 41 (type, *Prothalassoceras bogoslovskayae* Leonova in Leonova & Dmitriev, 1989, p. 115, OD)]. Conch subdiscoidal to subglobular, with very narrow or closed umbilicus. Suture line almost completely digitate, but denticulation of lobes not reaching saddles. Adventitious lobe narrower than prongs of ventral lobe. Many species. [*Allothalassoceras* has a slightly wider umbilicus and wider conch close to the umbilicus, which is regarded herein as being of specific significance.] *Pennsylvanian (Kasimovian)–Cisuralian (Kungurian):* Russia and Kazakhstan (South Urals), Tajikistan (Darvaz, Pamirs), Canada (Yukon), USA (New Mexico, Texas).——Fig. 64,*2a–c.* **P. welleri; a–b,* McGregor Ranch, Otero County, New Mexico, Hueco Formation, Artinskian, USNM, ×1.5 (Miller & Parizek, 1948); *c,* suture, upper part of Wolfcamp Formation, Texas, ×2.6 (Miller & Furnish, 1940a).——Fig. 64,*2d. P. jaikense* Ruzhentsev, cross section, Chkalovskaia oblast', South Urals, Russia, Gzhelian, ×2.8 (Bogoslovskii, Librovich, & Ruzhentsev, 1962).