

inner whorls with fairly strong primary ribs around the umbilicus and fine secondaries on shoulders and periphery; outer whorls smooth. Suture with wide, rather short elements. *Lower Cretaceous* (?Hauterivian): Madagascar.—FIG. 48, *a, b*. **M. besairiei* (COLLIGNON); *a*, $\times 1$; *b*, $\times 2$ (Busnardo, 1970a).

Superfamily
DESMOCERATACEAE
Zittel, 1895

[*nom. transl.* WRIGHT & WRIGHT, 1951, p. 18, ex Desmoceratidae ZITTEL, 1895, p. 426]

Generally round- or oval-whorled, but some lanceolate or keeled; commonly smooth or with weak ribs, but some genera and families strongly ribbed and tuberculate; constrictions commonly present. Suture simple or complex, with or without retracted suspensive lobe; L symmetrically or asymmetrically trifold in nearly all. Probably strongly dimorphic throughout; macroconchs with simple apertures; microconchs with lappets and rostrum in most families, but lappets appear to be lacking in Pachydiscidae. *Lower Cretaceous* (Upper Valanginian)—*Upper Cretaceous* (Upper Maastrichtian).

In recent years it has variously been suggested that the superfamily Desmocerataceae had a monophyletic origin in Phylloceratidae, diphyletic in Phylloceratidae and Lytoceratidae, or monophyletic in Haplocerataceae. Some of the latter have sutures generally similar to those of early Desmocerataceae, but constrictions are not found in Haplocerataceae. Adult sutures of many Desmocerataceae repeatedly develop resemblances to those of some Lytocerataceae but only in particular features, and the basic pattern is quite different. It is probably equally significant that almost all characters of the ornament of Desmocerataceae and their derivatives Hoplitaceae and Acanthocerataceae repeat those of various Perisphinctaceae. The previously presumed most primitive desmoceratacean, *Eodesmoceras*, thought to be Valanginian, turns out to be based on probably Albian fragments of *Puzosia* and *Desmoceras*. Lower to Upper Hauterivian *Spitidiscus* include species with inner whorls closely resembling *Barremites* and *Valdedor-*

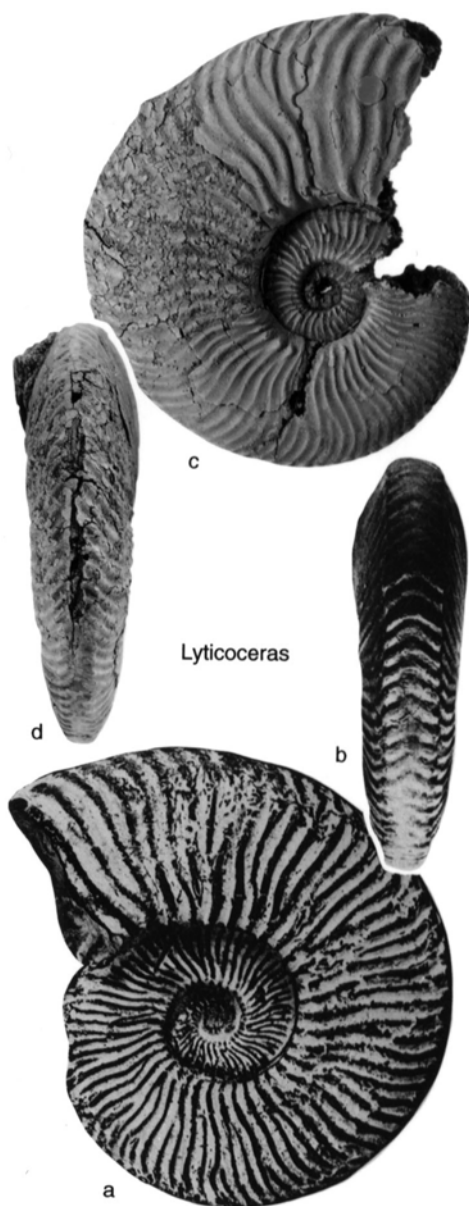


FIG. 47. Neocomitidae (p. 61–62)

sella; earliest species of *Spitidiscus* (Upper Valanginian) closely resemble *Olcostephanus*, and there is no significant sutural difference. Though a secure conclusion on the origin of the group cannot yet be reached, origin in Perisphinctaceae seems very natural.

The superfamily is here retained as distinct from its derivative Hoplitaceae,

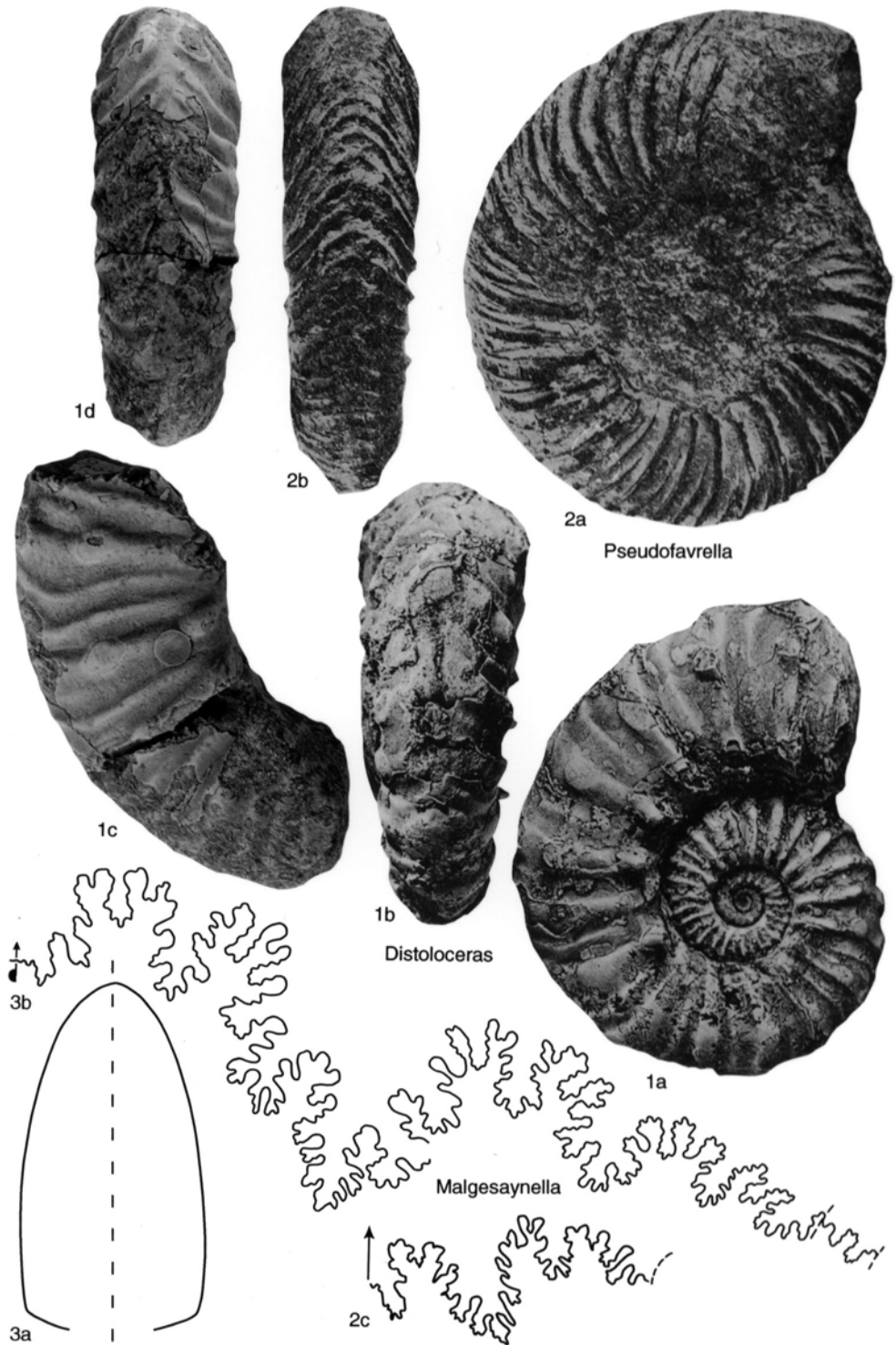


FIG. 48. Neocomitidae (p. 64–67)

although sutural ontogeny is closely similar, because the latter developed distinctive characters of ornament.

Family DESMOCERATIDAE Zittel, 1895

[Desmoceratidae ZITTEL, 1895, p. 426]

Characters of superfamily, excluding most of the more strongly ornamented forms. *Lower Cretaceous (Upper Valanginian)–Upper Cretaceous (Upper Maastrichtian)*.

There is little agreement on boundaries of subfamilies, and the present scheme can only be regarded as provisional. Recent splintering, however, seems unnecessary and unhelpful, since the group is very uniform in morphology and changes in characters are mostly gradual.

Subfamily BARREMITINAE Breskovski, 1977

[Barremitinae BRESKOVSKI, 1977, p. 893] [=Torcapellinae BRESKOVSKI, 1977, p. 891, *nom. correct.* WRIGHT, herein, *pro* Torcapellinae BRESKOVSKI; tribe Cassidoiceratini BRESKOVSKI, 1977, p. 893]

Whorl section ranging from more or less circular through rectangular to oxyconic; ribbing, if present, generally weak. Suture relatively simple, without markedly retracted suspensive lobe. The more or less oxyconic, Hauterivian genera separated as Torcapellinae are probably not closely related to each other. *Lower Cretaceous (Upper Valanginian–Upper Barremian)*.

The subfamily includes most of the genera previously placed in Eodesmoceratinae (WRIGHT, 1955, p. 567), but *Eodesmoceras celestini* (PICTET & CAMPICHE, 1860, p. 276), type species of *Eodesmoceras* (SPATH, 1923d, p. 33), was based on what now seem to be fragments of Albian *Puzosia* and *Desmoceras* (BUSNARDO & THIEULOY, 1989, p. 121); the holotype of Valanginian *E. haughtoni* (SPATH, 1930d) is too small to be identifiable.

Spitidiscus KILIAN, 1910c, p. 264 [**Ammonites rotula* J. de C. SOWERBY, 1827b, p. 136; SD ROMAN, 1938, p. 389]. Rather involute to rather evolute; whorl section more or less circular to flat-sided; frequent constrictions straight or slightly sinuous, moderately deep but wide, truncating low, single or rarely branching ribs. Earliest species have slight umbilical tubercles. *Lower Cretaceous (Upper Valanginian–*

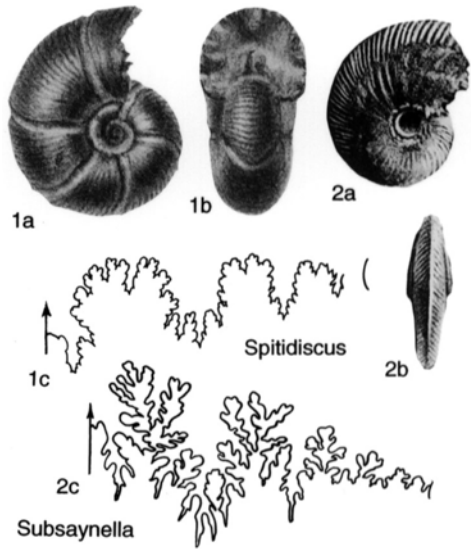


FIG. 49. Desmoceratidae (p. 69–71)

Upper Hauterivian, ?Lower Barremian): England, France, Spain, Austria.—FIG. 49, 1a–c. **S. rotula* (J. de C. SOWERBY), Hauterivian, England; a, b, $\times 1$; c, enlarged (Pavlov, 1892).

Barremites KILIAN, 1913, p. 333 [**Ammonites difficilis* ORBIGNY, 1841, p. 135; M] [= *Miodesmocer* WRIGHT, 1955, p. 568 (type, *Haploceras lechicum* UHLIG, 1883, p. 227(100); OD); *Raspailiceras* WRIGHT, 1956a, p. 74, *nom. nov. pro* *Raspailites* WRIGHT, 1955, p. 568, *non* JEANNET, 1951, p. 192 (type, *A. cassida* RASPAIL, 1831, p. 115; OD); *Nabdalsiceras* BRESKOVSKI, 1977, p. 892 (type, *A. nabdalsa* COQUAND, 1880, p. 367; OD); *Fallotliceras* BRESKOVSKI, 1977, p. 892, *non* PARONA & BONARELLI, 1897, p. 89 (type, *Desmoceras falloti* KILIAN, 1910c, p. 258; OD); *Cassidoiceras* DIMITROVA, 1967, p. 131 (*non* *Cassidoides*, p. 132, *pro errore*) (type, *Haploceras cassidooides* UHLIG, 1883, p. 230(103); OD)]. Moderately to very involute; fairly inflated, with rounded umbilical margin, to very compressed, with sharp umbilical margin; constrictions straight, sinuous, or slightly falcate on internal molds, forming collars on shell; with intermediate, feeble lirae to moderately distinct ribs. The variable Barremian populations have been much split by authors, but there seems to be no significant morphological gap between supposed genera. *Lower Cretaceous (Upper Hauterivian–Upper Barremian)*: Europe, northern Africa, Japan, Mexico, Colombia.—FIG. 50, 1a, b. **B. difficilis* (ORBIGNY), Barremian, France; $\times 0.75$ (Orbigny, 1840–1842).—FIG. 50, 1c, d. *B. raspaili* KILIAN, Barremian, France; $\times 0.75$ (Orbigny, 1840–1842).—FIG. 50, 1e, f. *B. chaputi* DIMITROVA, Barremian, France; $\times 1$ (Chaput, 1921).

Plesiospitidiscus BREISTROFFER, 1947b, p. 80(64) [**Ammonites ligatus* ORBIGNY, 1841, p. 126; OD]

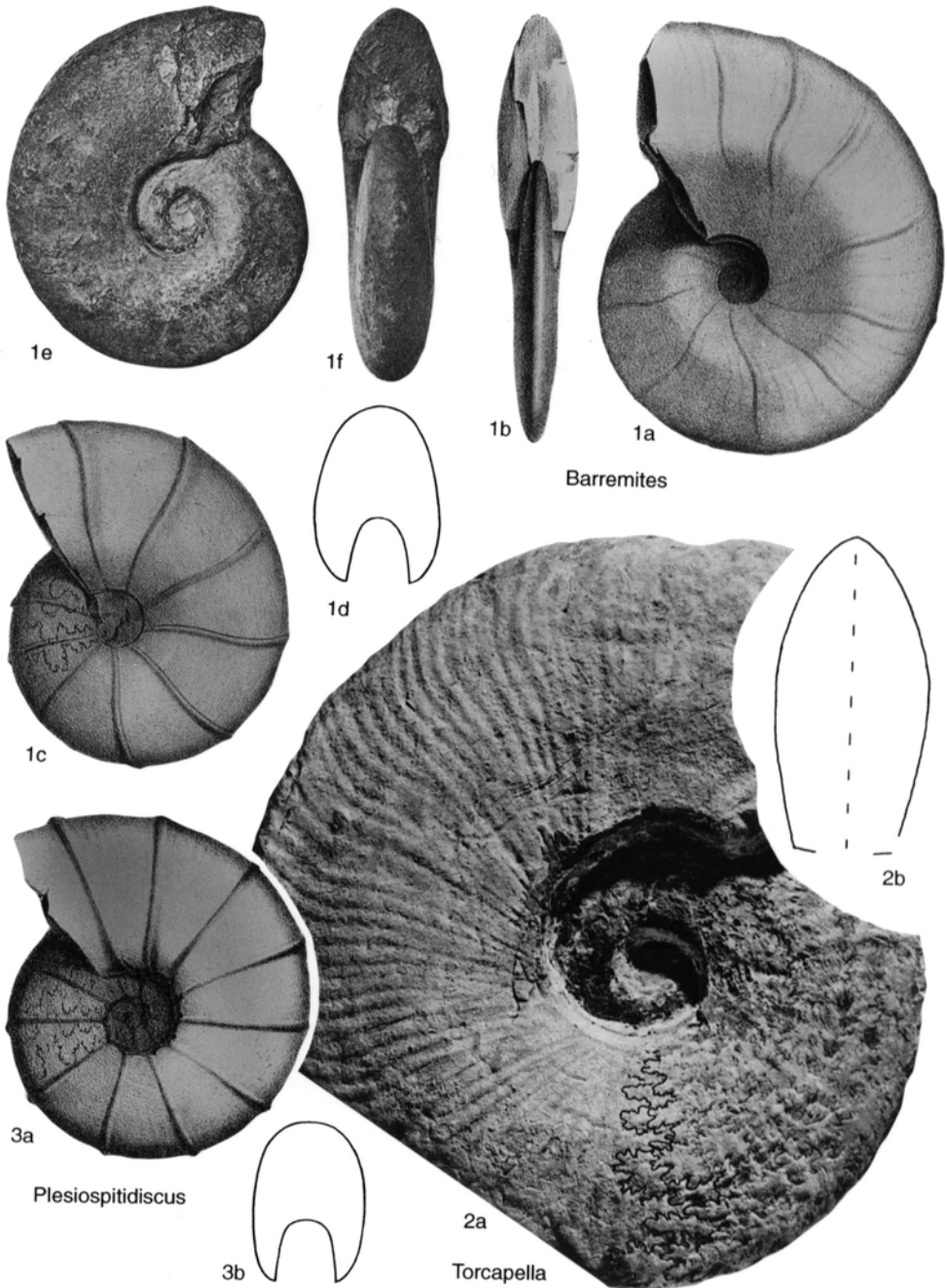


FIG. 50. Desmoceratidae (p. 69-71)

[=*Reboulites* DIMITROVA, 1967, p. 134 (type, *Puzosia issarpayensis* KILIAN & REBOUL, 1915, p. 248; OD)]. Compressed, with flat sides; ribs straight and radial; constrictions on internal molds do not truncate fine secondary ribs on outer part of sides. Doubtfully distinct from *Barremites*. Lower Cretaceous (Upper

Hauterivian): France, Bulgaria, Mexico.—FIG. 50, 3a, b. **P. ligatus* (ORBIGNY), France; $\times 1$ (Orbigny, 1840-1842).

Subsaynella SPATH, 1923d, p. 31 [*Ammonites sayni* PAQUIER, 1900, p. v; OD]. Rather involute, compressed, with slightly convex sides, whorl sec-

tion tending to become lanceolate; venter broadly or narrowly rounded in early forms but may be acute in later species; dense, fine ribs weak on midsides but becoming stronger and branching and curving forward on outer part; constrictions shallow. *Lower Cretaceous (Upper Hauterivian–Barremian)*: England, France, central Europe, northern Africa, Madagascar.—FIG. 49,2a–c. **S. sayni* (PAQUIER), Upper Hauterivian, France; a,b, $\times 1$; c, enlarged (Kilian, 1907–1913).

Torcapella BUSNARDO, 1970a, p. 95 [**Ammonites fabrei* TORCAPEL, 1884, p. 109(1); OD]. Involute, high-whorled, with more or less convex sides and narrowly rounded to sharp venter, rarely a true oxycone; umbilical shoulder sharp and wall steep; after early, less compressed, smooth stage, falcooid, single or branching, dense to rather distant ribs covering sides. Suture variable. *Lower Cretaceous (Lower Barremian)*: Spain, France, Romania, Bulgaria, Algeria.—FIG. 50,2a,b. **T. fabrei* (TORCAPEL), France; $\times 0.5$ (Busnardo, 1970b).

Subfamily PSEUDOSAYNELLINAE

Casey, 1961

[Pseudosaynellinae CASEY, 1961d, p. 169]

Young forms strongly ribbed, constricted, without tubercles, tending to oxyconic whorl section. *Lower Cretaceous (Lower Aptian–Upper Aptian)*.

Pseudosaynella SPATH, 1923d, p. 66 [**Ammonites bicurvatus* MICHELIN, 1838, p. 101; OD]. Small oxycones with flexuous to falcooid ribs and constrictions; later whorls smooth. Suture with numerous, descending auxiliaries. *Lower Cretaceous (Lower Aptian–Upper Aptian)*: western Europe, ?Japan.—FIG. 51,1a,b. *P. raresulcata* (ORBIGNY), Lower Aptian, France; $\times 1$ (Casey, 1961d).—FIG. 51,1c. **P. bicurvata* (MICHELIN), Lower Aptian, France; enlarged (Casey, 1961d).

Aioloceras WHITEHOUSE, 1926, p. 206 [**Cleonicerus argentinum* BONARELLI in BONARELLI & NÁGERA, 1921, p. 24; OD]. Venter narrowly arched; inner whorls with sharp, falcooid ribs; later whorls smooth. Doubtfully distinct from *Pseudosaynella*. *Lower Cretaceous (Upper Aptian)*: Australia (Queensland), Argentina (Patagonia).—FIG. 51,2a,b. **A. argentinum* (BONARELLI), Patagonia; $\times 1$ (Bonarelli & Nágera, 1921).

Subfamily PUZOSIINAE Spath, 1922

[Puzosiinae SPATH, 1922b, p. 126] [=Melchioritinae, *nom. correct.* WRIGHT & KENNEDY, 1984, p. 54, *pro* Melchioritinae BRESKOVSKI, 1977, p. 892; Abrytusitinae, *nom. correct.* WRIGHT & KENNEDY, 1984, p. 54, *pro* Abrytusitinae BRESKOVSKI, 1977, p. 893]

Includes the largest ammonite known. Generally more or less evolute, round- or oval-whorled; sides flat or convex, normally with strong constrictions at least on outer part of sides but some smooth. In typical

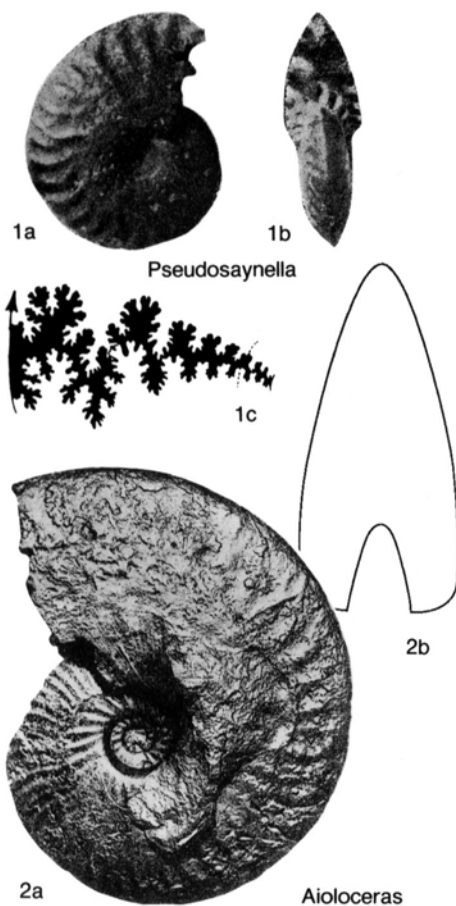


FIG. 51. Desmoceratidae (p. 71)

later genera suture finely divided, having strongly retracted suspensive lobe. Morphology of earlier genera very uniform and transitions gradational; sutures simpler, with less obviously retracted suspensive lobe. Boundary with Barremitinae is uncertain. *Lower Cretaceous (Middle Hauterivian)–Upper Cretaceous (Lower Maastrichtian)*.

Valdedorsella BREISTROFFER, 1947b, p. 76(60) [**Desmoceras akuschaense* ANTHULA, 1899, p. 104(50); OD] [=Puezalpella DIMITROVA, 1967, p. 140 (type, *Desmoceras ubligi* HAUG, 1889, p. 201; OD); *Weavericeras* H. A. LEANZA & WIEDMANN, 1980, p. 960 (type, *Latidorsella vaccaensis* WEAVER, 1931, p. 439; OD)]. Inflated with broad, rounded venter; whorl section oval to depressed; radial constrictions more or less straight, with prominent, rounded rib behind; normally rather weak ribs between constrictions, at least on early whorls. The genus is here taken to cover a variety of species that

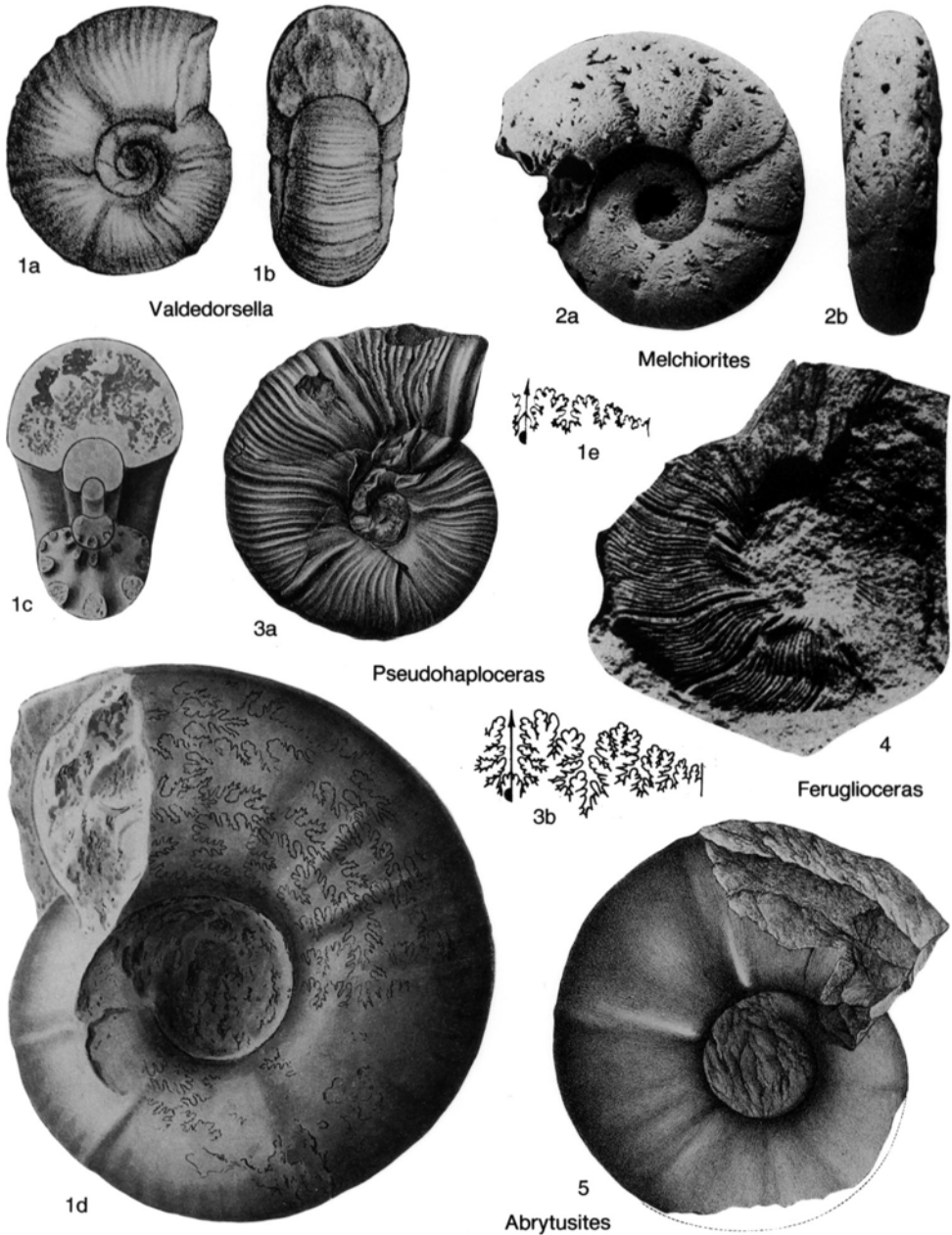


FIG. 52. Desmoceratidae (p. 71-75)

differ little and then only in degree of evolution and whorl section. *Lower Cretaceous (Middle Hauterivian–Upper Aptian)*: southeastern Europe, Caucasus, northern Africa, Madagascar, Japan, Alaska, Colombia, Argentina.—FIG. 52, 1a–c. **V. akuschaensis* (ANTHULA), Upper Aptian, Caucasus; X1 (Anthula, 1899).—FIG. 52, 1d, e. *V. vacaensis* (WEAVER), Middle Hauterivian, Argentina; d, holotype, X0.5; e, paratype, X0.5 (Weaver, 1931).

Abrytusites NIKOLOV & BRESKOVSKI, 1969, p. 92 [*Pachydiscus neumayri* HAUG, 1889, p. 204; OD]. Inflated, with constrictions; rather thick ribs springing irregularly, singly or in pairs, from indistinct umbilical bullae. Inner whorls closely resemble type species of *Valdedorsella*, from which it is probably indistinguishable. *Lower Cretaceous (Barremian)*: central Europe.—FIG. 52, 5. **A. neumayri* (HAUG), Austria; X0.4 (Haug, 1889).

Pseudohaploceras HYATT, 1900, p. 570 [**Ammonites liptoviensis* ZEUSCHNER, 1856, p. 181; OD] [= *Pleurohaploceras* RIEDEL, 1938, p. 14, *lapsus*; *Caseyella* C. M. CANTU-CHAPA, 1976, p. 15 (type, *Uhligella reesidei* HUMPHREY, 1949, p. 152; OD)]. Moderately involute, slightly to moderately compressed, with convex sides; constrictions regular, straight or sinuous, collared in some; fairly fine, distinct, sharp or rounded, branching ribs between constrictions, extending from umbilical edge and crossing venter. Offshoot of early *Valdedorsella*. *Lower Cretaceous (Barremian–Aptian)*: Europe, Egypt (Sinai), Japan, Mexico, Colombia.—FIG. 52, 3a, b. **P. liptoviense* (ZEUSCHNER), Barremian, Austria; a, $\times 0.5$; b, enlarged (Uhlig, 1883).

Feruglioceras A. F. LEANZA, 1967a, p. 156 [**F. piatnitzkyi*; OD]. Compressed, with subtabulate venter; frequent constrictions flexuous, separated by 15 or more, extremely fine, irregularly branching ribs. *Lower Cretaceous (Lower Albian)*: Argentina (Patagonia).—FIG. 52, 4. **F. piatnitzkyi*; $\times 1$ (A. F. Leanza, 1967a).

Umsinenoceras KENNEDY, WRIGHT, & KLINGER, 1979, p. 30 [**U. linguatuberculatum*; OD]. Small, compressed, rather evolute, with dense, fine, flexuous ribs; ribs prorsiradiate, single or branching on umbilical shoulder, and strongly projected ventrolaterally, where they may split, then weakening to lirae and forming a tongue-like projection on venter; ventrolateral clavi small, irregularly situated; flexuous constrictions narrow on the test, wider on molds running parallel to the ribs; body chamber with rounded venter and concave ribs. Suture with retracted suspensive lobe. *Lower Cretaceous (Middle Albian)*: South Africa (Zululand).—FIG. 53, 1a–d. **U. linguatuberculatum*; a–c, $\times 1$; d, $\times 2$ (Kennedy, Wright, & Klinger, 1979).

Kennicottia IMLAY, 1959, p. 183 [**K. bifurcata*; OD]. Rather involute; similar to *Pseudohaploceras* but with more regular and more regularly bifurcating ribs and weaker constrictions and associated flared ribs. *Lower Cretaceous (Lower Albian)*: Alaska.—FIG. 53, 2a–c. **K. bifurcata*; a, b, $\times 1$; c, $\times 2$ (Imlay, 1959).

Callizoniceras SPATH, 1923d, p. 35 [**Desmoceras hoyeri* KOENEN, 1902, p. 60; OD]. Small, rather evolute forms with more or less rounded whorl section, which may heighten on outer whorls; typically having strong, rounded, branching ribs and deep, steep-sided, collared constrictions. Suture rather simple. *Lower Cretaceous (Upper Barremian–Lower Albian)*: England, Germany, Alaska, Greenland.

C. (**Callizoniceras**). Ribs regular; ribs and constrictions slightly sinuous. *Lower Cretaceous (Upper Barremian–Aptian)*: England, Germany, Greenland.—FIG. 54, 1a, b. **C. (C.) hoyeri* (KOENEN), Upper Barremian, northern Germany; $\times 1$ (Koenen, 1902).

C. (**Wollemaniceras**) BREISTROFFER, 1947b, p. 37(21), 86(70) [**Desmoceras keilbacki* WOLLEMAN, 1907, p. 36; OD]. Falcooid constrictions projecting on venter; main ribs thick on inner part of sides, then splitting into riblets and fading on venter. *Lower Cretaceous (Lower Albian)*:

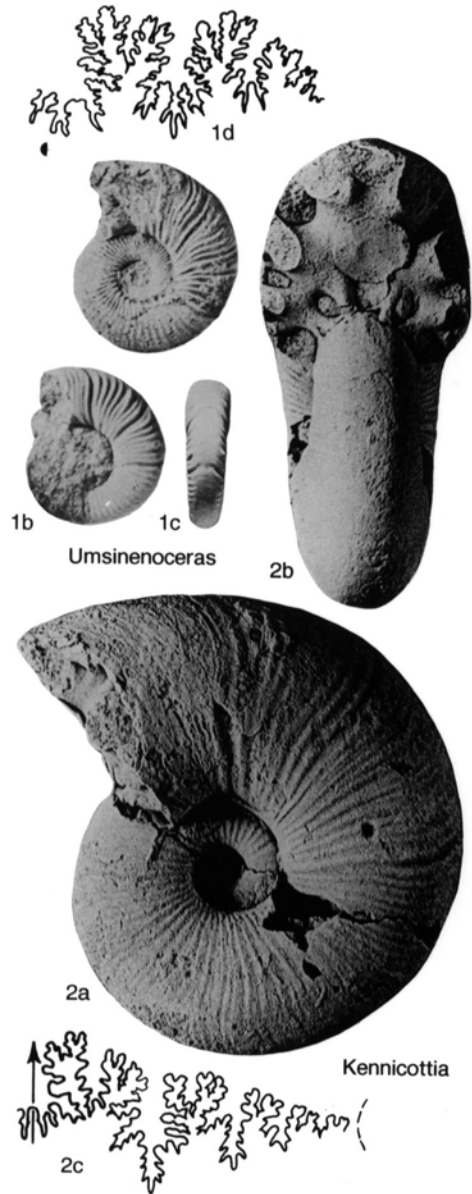


FIG. 53. Desmoceratidae (p. 73)

Germany, Alaska.—FIG. 54, 4a, b. **C. (W.) keilbacki* (WOLLEMAN), Germany; a, $\times 1$; b, $\times 3$ (Wolleman, 1907).

Melchiorites SPATH, 1923d, p. 33 [**Ammonites melchioris* TIETZE, 1872, p. 135; M]. Whorl section round, subquadrate, or compressed, with convex or flat sides; early whorls with sinuous, radial or oblique constrictions, projected on venter, but without ribs; later whorls with rather feeble ribs on outer part of sides and venter. Suture with auxiliaries not or only slightly retracted. *Lower Cretaceous*

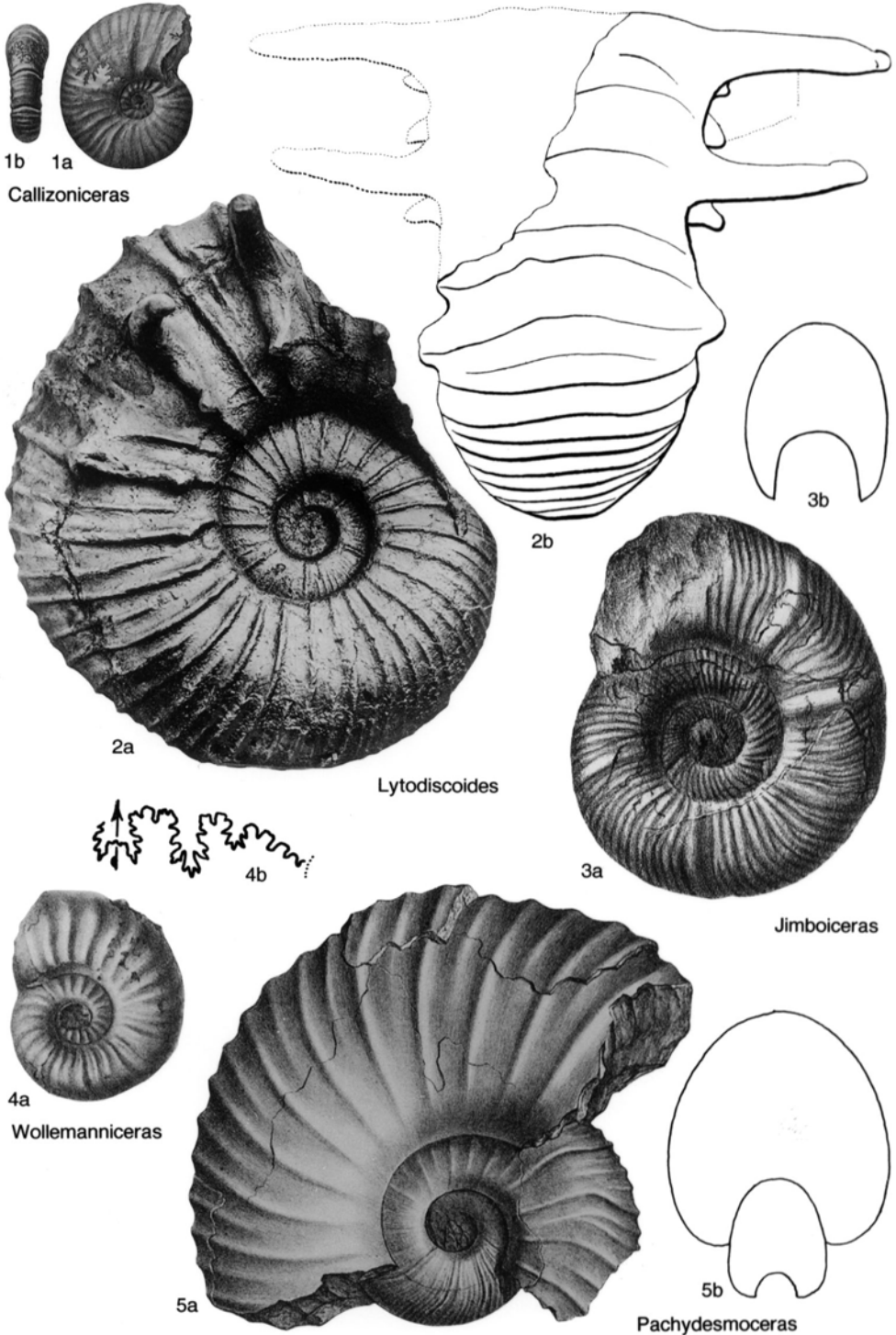


FIG. 54. Desmoceratidae (p. 73–78)

- (Upper Barremian–Lower Albian): Europe, northern Africa, Madagascar, California.——FIG. 52,2a,b. **M. melchioris* (TJETZE), lectotype, Upper Barremian or Lower Aptian, Czech Republic; ×1 (Vašíček, 1972).
- Puzosia** BAYLE, 1878, pl. 45, 46 (explanations) [**Ammonites planulatus* J. de C. SOWERBY, 1827b, p. 136; SD H. DOUVILLÉ, 1879, p. 91] [= *Pleuropachydiscus* HYATT, 1900, p. 571 (type, *Ammonites hoffmanni* GABB, 1869, p. 211; OD); ?*Puzosiella* EGOIAN, 1969, p. 174 (type, *P. minuta*; OD)]. Macroconchs large but only microconchs and nuclei known of most species. Whorl section round to compressed; fine ribs and constrictions, parallel to the ribs, generally present. In general more evolute than *Melchiorites*, with more linguiform projection of constrictions on venter and more complex suture with more strongly retracted suspensive lobe. Lower Cretaceous (?Upper Aptian, Lower Albian)—Upper Cretaceous (Upper Campanian): worldwide.
- P. (Puzosia)** [= *Matsumotoceras* HOEPEN, 1968a, p. 158 (type, *M. donlisteri*; OD); ?*Hyperpuzosia* MATSUMOTO, 1988, p. 26 (type, *H. tamon*; OD)]. Ribs distinct only on outer part of side. Microconchs may have coarser, stronger ribs on body chamber and some indication of former lap-pets (e.g., by lip on forward edge of constriction); on last whorl of macroconchs ribs and constrictions may weaken with age or be replaced by very coarse, distant ribbing or tubercles. [*Hyperpuzosia* with very large, variable ventrolateral nodes comprises macroconchs probably of a feebly ornamented species of *P. (Puzosia)*.] Lower Cretaceous (?Upper Aptian, Lower Albian)—Upper Cretaceous (Upper Campanian): worldwide.——FIG. 55,1a–c. *P. (P.) planulata* (J. de C. SOWERBY), Cenomanian, Germany; *a, b*, nucleus of macroconch, ×0.75; *c*, ×0.5 (Schlüter, 1871–1876).——FIG. 55,1d. ?*P. (P.) tamon* (MATSUMOTO, KAWASHITA, & TAKAHASHI in MATSUMOTO), macroconch, Lower Albian, Japan; ×0.2 (Matsumoto, 1988).
- P. (Anapuzosia)** MATSUMOTO, 1954, p. 71 (1938b, p. 193, *nom. nud.*) [**Puzosia buenaventura* ANDERSON, 1938, p. 185; OD]. Whorl section round to oval; close to moderately distant ribs arising at or near umbilical margin; secondaries branching or intercalated at midflank; ribs and constrictions sinuous. Body chamber (of ?macroconchs) with strong, distant radial ribs only. Lower Cretaceous (Lower Albian)—Upper Cretaceous (Upper Cenomanian): western Europe, Ukraine (Crimea), Angola, Madagascar, California, Venezuela, Ecuador, Brazil, Japan.——FIG. 55,2a,b. **P. (A.) buenaventura*, Lower Albian, California; macroconch, ×0.5 (Anderson, 1938).
- P. (Bhimaites)** MATSUMOTO, 1954, p. 113 [**Ammonites bhima* STOLICZKA, 1865, p. 137; OD]. More or less compressed, with convex or flat sides and prorsiradiate, curved constrictions strongly projected on shoulders; ribs, if present, only on venter. Sutures may have asymmetrically bifid L. Lower Cretaceous (Upper Albian)—Upper Cretaceous (Upper Turonian): England, France, Spain, ?northern Africa, Angola, South Africa (Zululand), Madagascar, southern India, Japan, Venezuela.——FIG. 56,2a–c. **P. (B.) bhima* (STOLICZKA), Upper Albian, southern India; ×1 (Stoliczka, 1865).
- P. (Mesopuzosia)** MATSUMOTO, 1954, p. 79 (1938b, p. 193, *nom. nud.*) [**M. pacifica*; OD] [= *Pteropuzosia* MATSUMOTO, 1988, p. 27 (type, *P. kawashitai*; OD)]. Similar in form to *P. (Puzosia)* but with stronger, more or less regular, dense ribs, starting at umbilical margin; last whorl smooth. [*Pteropuzosia* comprises macroconchs with very variable, large, coarse ribs to extreme winglike bulges on body chamber.] Upper Cretaceous (Lower Turonian–Upper Campanian): Austria, Angola, Madagascar, southern India, Alaska, California, Venezuela, Japan.——FIG. 56,1a–c. **P. (M.) pacifica* (MATSUMOTO), Turonian, Japan; *a, b*, ×0.75; *c*, microconch, ×0.5 (Matsumoto, 1988).——FIG. 56,1d. *P. (M.) yubarensis* (JIMBO), Coniacian, Japan; macroconch, ×0.1 (Matsumoto, 1988).
- Pachydesmoceras** SPATH, 1922b, p. 127 [**Ammonites denisonianus* STOLICZKA, 1865, p. 121; OD]. Commonly very large; inner whorls with oval section and frequent, sigmoid constrictions sharply bent forward at midflank with raised rib in front and fine riblets between; outer whorls with more inflated section and coarse, long and short, well-spaced ribs, more or less projected on outer one-third of side. At least one species with aperture of macroconchs preceded by large bulge. Suture as in *Puzosia*. Lower Cretaceous (Upper Albian)—Upper Cretaceous (Upper Turonian): France, Spain, Germany, Switzerland, Romania, Yugoslavia, western Africa, South Africa (Zululand), Madagascar, Iran, southern India, Japan, New Zealand.——FIG. 54,5a,b. *P. kossmati* (MATSUMOTO), Lower Turonian, southern India; ×0.5 (Kossmat, 1895–1898).
- Lytodiscoides** SPATH, 1922b, p. 126 [**Pachydiscus conduciensis* CHOFFAT, 1903, p. 18; OD]. Very large; whorl section round; main ribs strong, slightly curved, with intercalated long and short ribs; on distal part of body chamber every other main rib bearing a vast ventrolateral and a large umbilical spine. Probably macroconch of some species of *Pachydesmoceras*. Lower Cretaceous (Upper Albian): France, Mozambique, South Africa (Zululand).——FIG. 54,2a,b. **L. conduciensis* (CHOFFAT), Upper Albian, Mozambique; ×0.125 (Choffat, 1903).
- Epipuzosia** MATSUMOTO, 1988, p. 26 [**E. maya*; OD]. Macroconchs only recognized; similar to *Pachydesmoceras*, but ribs much weaker and with blunt, low ventrolateral tubercles on end of phragmocone and body chamber. Upper Cretaceous (?Upper Cenomanian): England, Switzerland. Upper Cretaceous (Lower Turonian): Japan.
- Jimboiceras** MATSUMOTO, 1954, p. 95 (SHIMIZU, 1935a, p. 180, *nom. nud.*) [**Desmoceras planulati-forme* JIMBO, 1894, p. 27(173); OD]. Round-whorled; early whorls with distinct, fine, prorsiradiate, and curved ribs (some bifurcating) and strongly

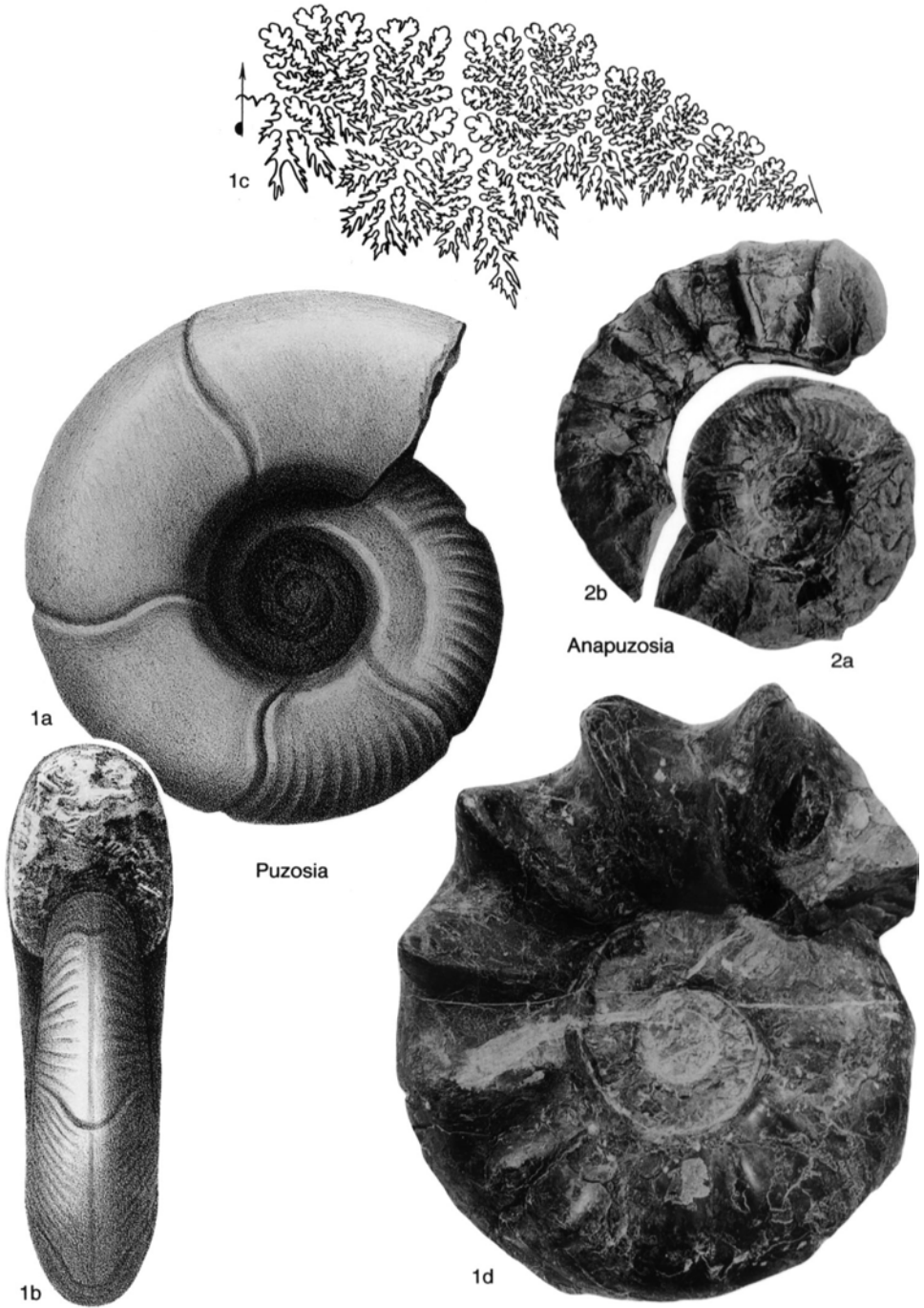


FIG. 55. Desmoceratidae (p. 75)

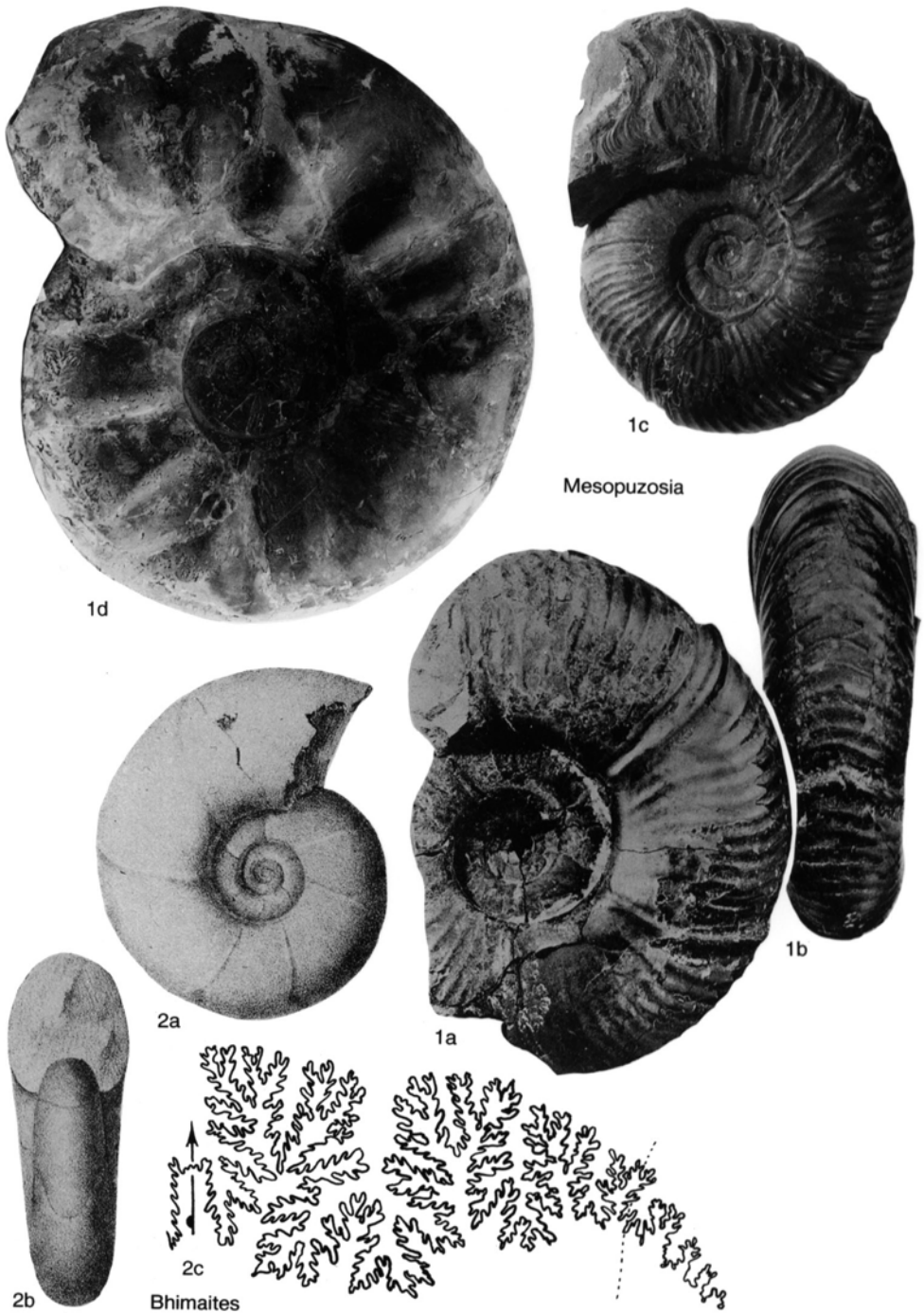


FIG. 56. Desmoceratidae (p. 75)

collared constrictions; later whorls with strong, rectiradiate, periodic ribs. *Upper Cretaceous (Turonian–Lower Santonian)*: Antarctica (Seymour Island), Germany, Madagascar, Japan.—FIG. 54,3a,b. **J. planulatiforme* (JIMBO), Turonian, Japan; $\times 0.5$ (Jimbo, 1894).

Achilleoceras HOEPEN, 1951c, p. 345 [**A. erasmusi*; OD]. Only single giant macroconch known. Inner whorls much as in *Austiniceras*; body chamber with dense minor ribs, irregular rodlike spines as in *Lyotdiscoides*, and strong, serrated siphonal crest. Possibly macroconch of an early *Austiniceras*. *Lower Cretaceous (Upper Albian)*: South Africa (Zulu-land).—FIG. 57,1a,b. **A. erasmusi*; $\times 0.1$, (Hoepen, 1951c).

Parapuzosia NOWAK, 1913, p. 363 [**Sonneratia daubreei* GROSSOUVRE, 1894, p. 154; SD SPATH, 1922b, p. 126]. Very large; moderately involute; high-whorled; compressed with flat sides to rather inflated with convex sides; early whorls constricted, but sooner or later constrictions replaced by strong major ribs with short secondaries or intercalatories on outer one-third of side. *Upper Cretaceous (Upper Cenomanian–Campanian)*: Europe, northern Africa, South Africa, Japan, Sakhalin, USA, Mexico, Curaçao, Argentina.

P. (Austiniceras) SPATH, 1922b, p. 127 [**Ammonites austeni* SHARPE, 1855, p. 28; OD]. Major ribs very distant until body chamber, where they approximate. *Upper Cretaceous (Upper Cenomanian, ?Upper Turonian)*: Europe.—FIG. 58a,b. **P. (A.) austeni* (SHARPE), Upper Cenomanian, England; holotype, $\times 0.67$ (Kennedy, 1971).

P. (Parapuzosia). Major ribs more or less close from early stage; body chamber of macroconchs becoming smooth. Macroconchs of late representatives include largest ammonites known, reaching diameter of 2.5 m. *Upper Cretaceous (?Coniacian, Lower Santonian–Campanian)*: distribution as for genus.—FIG. 59,2. **P. (P.) daubreei* (GROSSOUVRE), Lower Santonian, France; $\times 0.5$ (Grossouvre, 1894).

P. (Grandidiericeras) COLLIGNON, 1961, p. 17 [**G. grandidierorum*; OD]. Compressed, with narrow venter; thick, close ribs arising on umbilical wall or intercalated; constrictions weak or absent. Body chamber of macroconchs smooth and inflated. *Upper Cretaceous (Coniacian)*: Japan. *Upper Cretaceous (Middle Campanian)*: Madagascar.—FIG. 59,1a,b. **P. (G.) grandidierorum* (COLLIGNON), Middle Campanian, Madagascar; $\times 0.5$ (Collignon, 1961).

Kitchinites SPATH, 1922b, p. 127 [**Holcodiscus pondyberryanus* KOSSMAT, 1897, p. 40(147); OD] [= *Neopuzosia* MATSUMOTO, 1954 (Oct.), p. 89 (March, 1954, *nom. nud.*) (type, *K. japonicus* SPATH, 1922b, p. 127; OD)]. Rather small, more or less compressed and high-whorled, with slightly convex or flat sides and distant, deep constrictions slightly truncating ribs in some and bending sharply forward on venter; at first smooth between constrictions, then with fine, close ribs, and later with

strong, rounded ribs; ribs straight or flexuous, rectiradiate or prorsiradiate and, in some, strongly projected on venter. Later species tend to be more compressed with weaker ornament. *Upper Cretaceous (Santonian–Lower Maastrichtian)*: Austria, Angola, Madagascar, southern India, Pacific Russia, Sakhalin, Japan, Western Australia, New Zealand, California, Chile, Argentina, Antarctica.—FIG. 57,2a–c. **K. pondyberryanus* (KOSSMAT), Campanian, southern India; $\times 1$ (Kossmat, 1897).—FIG. 57,2d,e. *K. japonica* SPATH, Santonian, southern Sakhalin; *d*, $\times 0.75$; *e*, enlarged (Matsumoto, 1954).

Subfamily SILESITOIDINAE Breistroffer, 1953

[Silesitoidinae BREISTROFFER, 1953b, p. 74]

Small, rather evolute forms, superficially like Silesitidae but without the characteristic ribbing of that family. *Lower Cretaceous (Upper Aptian–Middle Albian)*.

Pseudosilesites EGOIAN, 1969, p. 179 [**P. seranoniformis*; OD]. Middle stage with flexuous ribs branching near umbilical edge; later with branching point moving outwards to ventrolateral shoulders; constrictions present. *Lower Cretaceous (Upper Aptian)*: western Caucasus.—FIG. 60,3a–c. **P. seranoniformis*; *a, b*, $\times 1$; *c*, $\times 5$ (Mikhailova, 1972).

Silesitoides SPATH, 1925e, p. 103 [**Silesites escragnollensis* JACOB, 1908, p. 43; OD] [= *Jacobella* PASSENDORFER, 1930b, p. 637 (*non* JEANNET, 1908, p. 205), obj.]. Whorl section round or oval; smooth at first, later with distant, rigid ribs that may branch on outer third. *Lower Cretaceous (Lower Albian–Middle Albian)*: France, Balearic Islands, Poland, northern Africa.—FIG. 60,2. **S. escragnollensis* (JACOB), Lower Albian, France; $\times 1$ (Jacob, 1908).

Parasilesites IMLAY, 1959, p. 184 [**P. bullatus*; OD] [= *Pseudosilesitoides* BREISTROFFER, 1951, p. 267, *nom. nud.*]. Like *Silesitoides* but ribbing on outer whorl sinuous and branching from umbilical bullae. *Lower Cretaceous (Lower Albian–Middle Albian)*: France, Balearic Islands, Sardinia, Poland, Alaska, Venezuela.—FIG. 60,1a,b. **P. bullatus*, Lower Albian, Alaska; *a*, $\times 1$; *b*, $\times 2$ (Imlay, 1959).

Subfamily BEUDANTICERATINAE Breistroffer, 1953

[Beudanticeratinae BREISTROFFER, 1953b, p. 74]

Mainly compressed, high-whorled, and rather involute; smooth or with distinct ribs that may be raised into umbilical swellings; with or without constrictions. *Lower Cretaceous (Upper Barremian–Upper Albian)*.

Although similar to earlier Barremitinae, most readily separable; the smooth forms

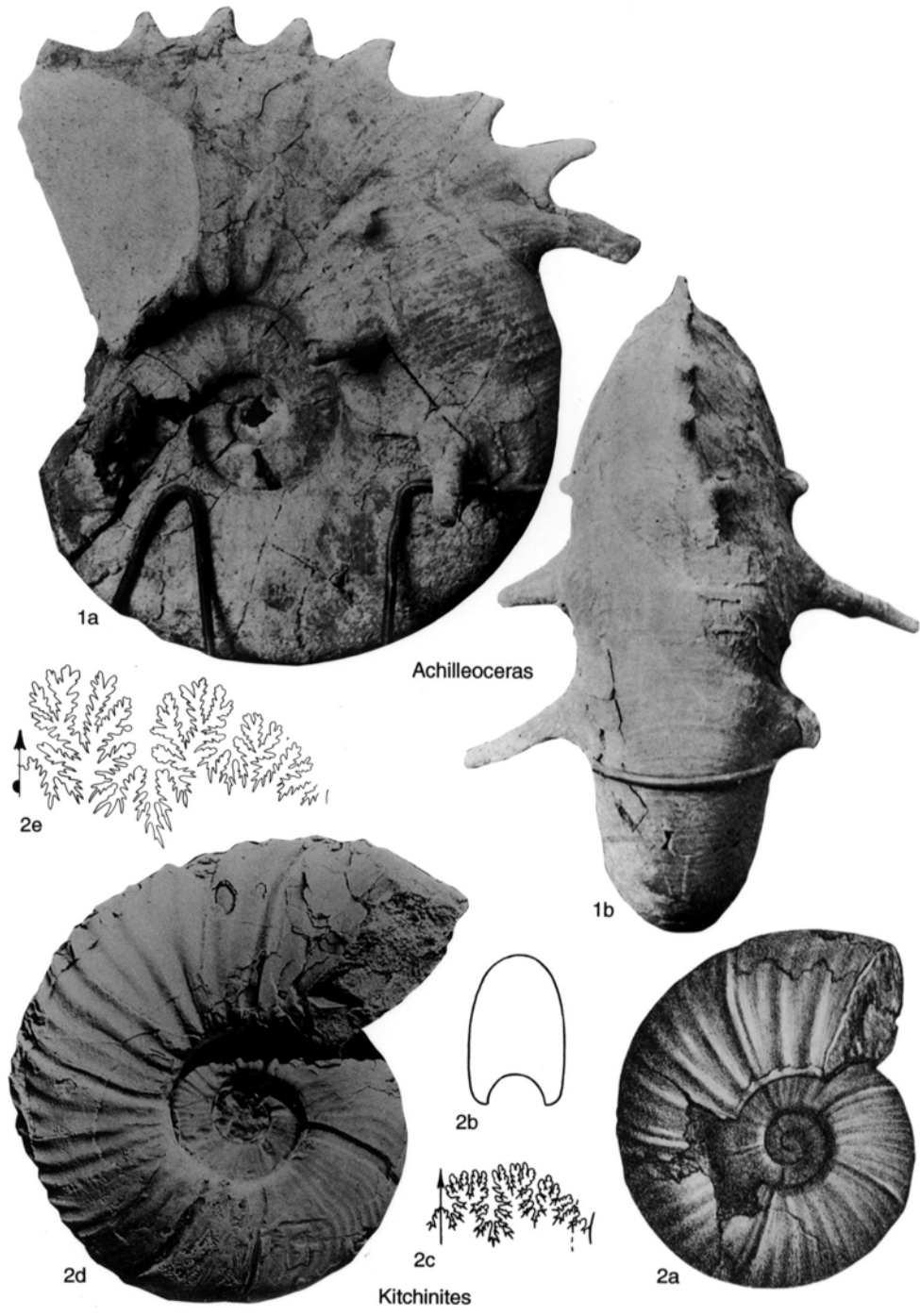


FIG. 57. Desmoceratidae (p. 78)



FIG. 58. Desmoceratidae (p. 78)

may include derivatives not only of *Uhligella* but also of various Cleoniceratidae. BREISTROFFER, 1947b; CASEY, 1954a; WRIGHT, 1955.

Zuercherella CASEY, 1954a, p. 112 [*Desmoceras zuercheri* JACOB & TOBLER, 1906, p. 9; OD] [= *Corteziceras* ETAYO SERNA, 1979, p. 27 (type, *C. cortezi*; OD)]. Similar in shape to its descendant *Uhligella* but with fine, sinuous ribs arising some distance above umbilical edge. Lower Cretaceous (Upper Barremian–Upper Aptian): Europe, northern Africa, eastern Africa, Mexico, Colombia.—FIG. 61,2a,b. **Z. zuercheri* (JACOB), Upper Aptian, Switzerland; ×1 (Jacob & Tobler, 1906).

Uhligella JACOB, 1907, p. 293 [*Desmoceras clansayense* JACOB, 1905, p. 403; SD KILIAN, 1907, p. 63]. High-whorled, with venter broadly or narrowly rounded, sides slightly convex to flat, and section typically broadest near umbilical edge; constrictions irregular and shallow; early whorls with strong or weak, sinuous, rounded main ribs distinctly raised into umbilical bullae, with several intercalated ribs; outer whorls smooth. Lower Cretaceous (Upper Aptian–Middle Albian): Europe, northern Africa, Venezuela.—FIG. 61,3a–c. **U. clansayensis* (JACOB), Lower Albian, France; a, paratype, ×1 (Jacob, 1905); b,c, holotype, ×1 (Casey, 1961d).

Beudanticeras HITZEL, 1902, p. 875 [*Ammonites beudanti* BRONGNIART in CUVIER & BRONGNIART, 1822, p. 95, 99, 394; OD]. Rather to very involute

and compressed; sides convex to flat; venter more or less narrowly arched but not acute; with or without shallow but distinct, prorsiradiate and sinuous, falcate or biconcave constrictions; smooth or with weak ribs; no tubercles. Suture finely divided. Probably includes offshoots of various more ornamented genera. *Lower Cretaceous (Lower Albian–Upper Albian)*: Europe, Egypt (Sinai), Australia (Queensland), Japan, Alaska, British Columbia, Texas, Argentina (Patagonia), Greenland.

B. (*Beudanticeras*) [=?*Rapidoplacenticeras* ALABUSHEV, 1988, p. 110 (type, *Proplacenticeras sutherlandbrowni* McLEARN, 1972, p. 56; OD)]. Moderately involute; umbilicus stepped, not funnel-shaped; whorl section generally slender. [*Rapidoplacenticeras* has slightly more complex saddle L/E but probably belongs here.] Occurrence and distribution as for genus.—FIG. 62,1a–c. **B. (B.) beudanti* (BRONGNIART), Upper Albian, England; a, b, $\times 0.75$; c, $\times 2$ (Casey, 1961a).

B. (*Grantziceras*) IMLAY, 1961, p. 56 (1960b, p. 105, *nom. nud.*) [**B. (G.) multiconstrictum*; OD] [=?*Pseudorbulites* CASEY, 1961d, p. 145 (BREISTROFFER, 1953b, p. 74, *nom. nud.*) (type, *Uhliggella convergens* JACOB, 1908, p. 29; OD)]. Involute, with stout, elliptical whorl section and deep, funnel-shaped umbilicus; test striated; frequent constrictions falcoid to biconcave. *Lower Cretaceous (Lower Albian)*: ?France, Spitsbergen, Alaska.—FIG. 62,2a–c. **B. (G.) multiconstrictum*, Alaska; a, b, $\times 0.75$; c, $\times 1$ (Imlay, 1961). —FIG. 62,2d, e. *B. (G.)? convergens* (JACOB), France; $\times 1$ (Casey, 1961d).

Boliteceras WHITEHOUSE, 1928a, p. 203 [**Ammonites daintreei* R. ETHERIDGE, 1872, p. 346; OD]. Rather involute and inflated, with broad, shallow, sinuous constrictions and fine, very feeble ribs; venter more broadly rounded than in *Beudanticeras*. A doubtful genus. *Lower Cretaceous (Upper Albian)*: Australia (Queensland).—FIG. 61,4. *B. perlatum* WHITEHOUSE; $\times 0.5$ (Whitehouse, 1928a).

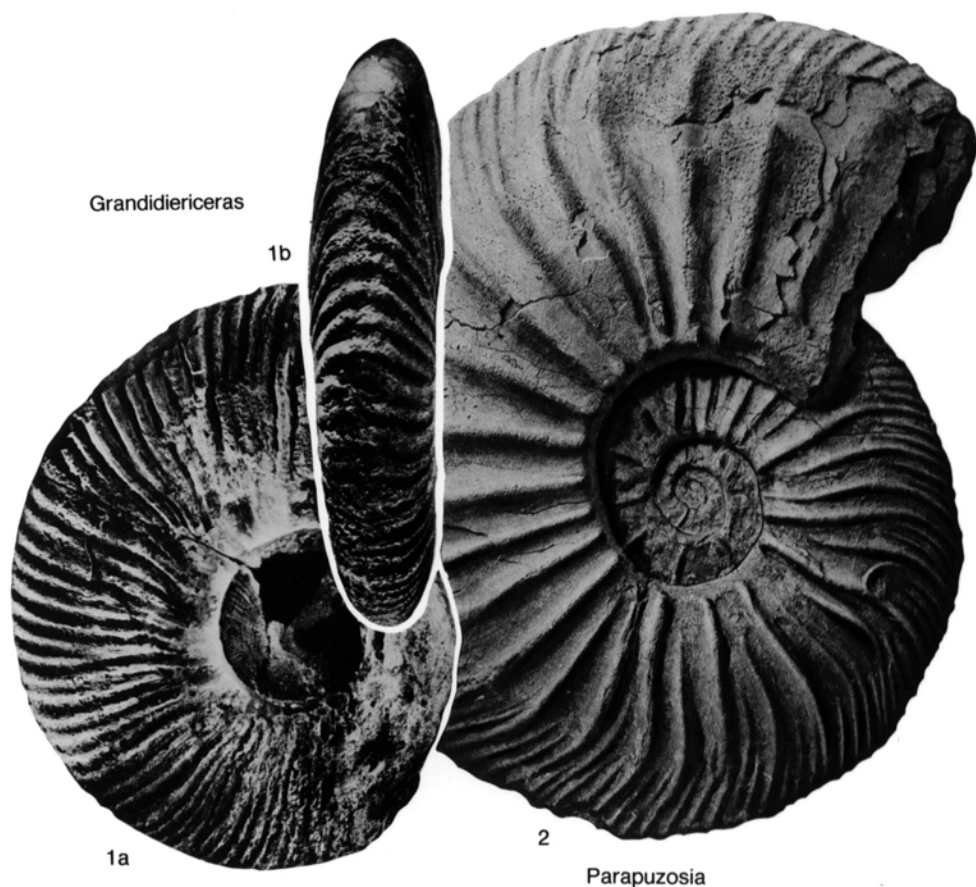


FIG. 59. Desmoceratidae (p. 78)

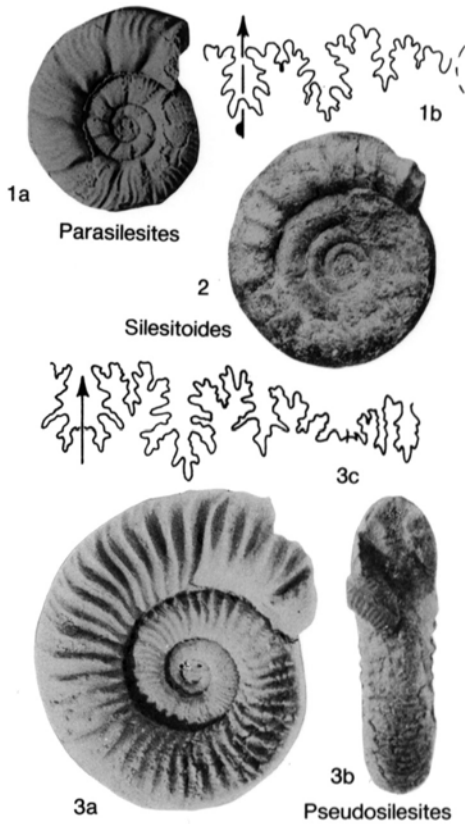


FIG. 60. Desmoceratidae (p. 78)

Cophinoceras WHITEHOUSE, 1928a, p. 204, *non* HYATT, 1900, p. 522, erroneous subsequent spelling of *Kophinoceras* HYATT, 1884, p. 285 [**C. ogilviei*; OD] [= *Beudantiella* BREISTROFFER, 1947b, p. 99(83)]. Similar to oval-whorled species of *Beudanticeras* but with sparse, nearly straight, prosiradiate main ribs and short intercalatories. *Lower Cretaceous (Upper Albian)*: Australia (Queensland).—FIG. 61, 1a, b. **C. ogilviei*; $\times 0.3$ (Whitehouse, 1928a).

Subfamily DESMOCERATINAE Zittel, 1895

[*nom. transl.* MATSUMOTO, 1938b, p. 190, ex Desmoceratidae ZITTEL, 1895, p. 426]

Involute, with little or no ornament except for collared constrictions and in some forms weak intermediate ribs on outer part of whorl; in one group venter tending to narrow, finally forming a keel. Suture with finely frilled elements and auxiliaries in regularly descending series, not retracted as in

Puzosiinae. Microconchs with lappets. MATSUMOTO, 1954; WRIGHT, 1955. *Lower Cretaceous (Upper Aptian)–Upper Cretaceous (Upper Maastrichtian)*.

Desmoceras ZITTEL, 1885, p. 465 [**Ammonites latidorsatus* MICHELIN, 1838, p. 101; SD BÖHM, 1895, p. 364] [= *Latidorsella* JACOB, 1907, p. 295, obj.; *Phyllodesmoceras* SPATH, 1925e, p. 100 (type, *Ammonites valdedorsatus* REYNÈS, 1876, p. 93; OD); *Lunatodorsella* BREISTROFFER, 1947b, p. 76(60) (type, *Puzosia chirichensis* PERVINQUIÈRE, 1907, p. 152; OD)]. Moderately to very involute, with cadicone, depressed-rounded, subquadrate, or oval section; with or without straight to sigmoid constrictions forming strong, rounded ribs on shell; with dense striae or feeble ribs between constrictions on outer part of side and venter. *Lower Cretaceous (Upper Aptian)–Upper Cretaceous (Lower Turonian)*: Europe, Africa, Madagascar, southern India, Japan, Australia (Queensland), New Zealand, Alaska, British Columbia, California, Texas, Venezuela.

D. (Desmoceras). Whorl section cadicone to subquadrate; constrictions present or not. *Lower Cretaceous (Upper Aptian)–Upper Cretaceous (Cenomanian)*: distribution as for genus.—FIG. 63, 5a–c. **D. (D.) latidorsatum* (MICHELIN), Middle Albian, France; a, b, $\times 0.75$; c, enlarged (Orbigny, 1840–1842).

D. (Pseudouhligella) MATSUMOTO, 1938a, p. 22 [**Desmoceras dawsoni* var. *japonica* YABE, 1904, p. 35; OD]. Less involute than *D. (Desmoceras)*; whorl section oval; constrictions and lirae biconcave. *Lower Cretaceous (Upper Albian)–Upper Cretaceous (Lower Turonian)*: France, Nigeria, Japan, New Zealand, Alaska, British Columbia, California.—FIG. 63, 3a–c. **D. (P.) japonica* (YABE), ?Cenomanian, Japan; $\times 0.5$ (Yabe, 1904).

Microdesmoceras MATSUMOTO & MURAMOTO in MATSUMOTO, MURAMOTO, & INOMA, 1972, p. 378 [**M. tetragonum*; OD]. Dwarf; nearly smooth; with simple suture; whorl section depressed at first but squarish on outer whorl. Coiling slightly scaphitoid. Internal mold with weak, sigmoid lirae and 4 feeble constrictions. *Upper Cretaceous (Cenomanian)*: Japan.—FIG. 64, 1a–d. **M. tetragonum*; a–c, $\times 1.3$; d, $\times 4$ (Matsumoto, Muramoto, & Inoma, 1972).

Moremanoceras COBBAN, 1971, p. 5 [**Tragodesmoceras scotti* MOREMAN, 1942, p. 208; OD]. Differs from *Desmoceras* in tendency to develop siphonal keel and in shorter and wider sutural elements with few auxiliaries. *Upper Cretaceous (Upper Cenomanian)*: Wyoming, Texas, New Mexico, Colorado, Arizona.—FIG. 63, 1a, b. **M. scotti* (MOREMAN), Texas; a, $\times 1$; b, $\times 2$ (Cobban, 1971).

Bassites COBBAN, 1987a, p. 1 [**B. reesidei*; OD]. Rather large derivative of *Moremanoceras* with weak, dense, flat ribs, no constrictions, and simple sutures. *Upper Cretaceous (Lower Turonian)*: Kansas.

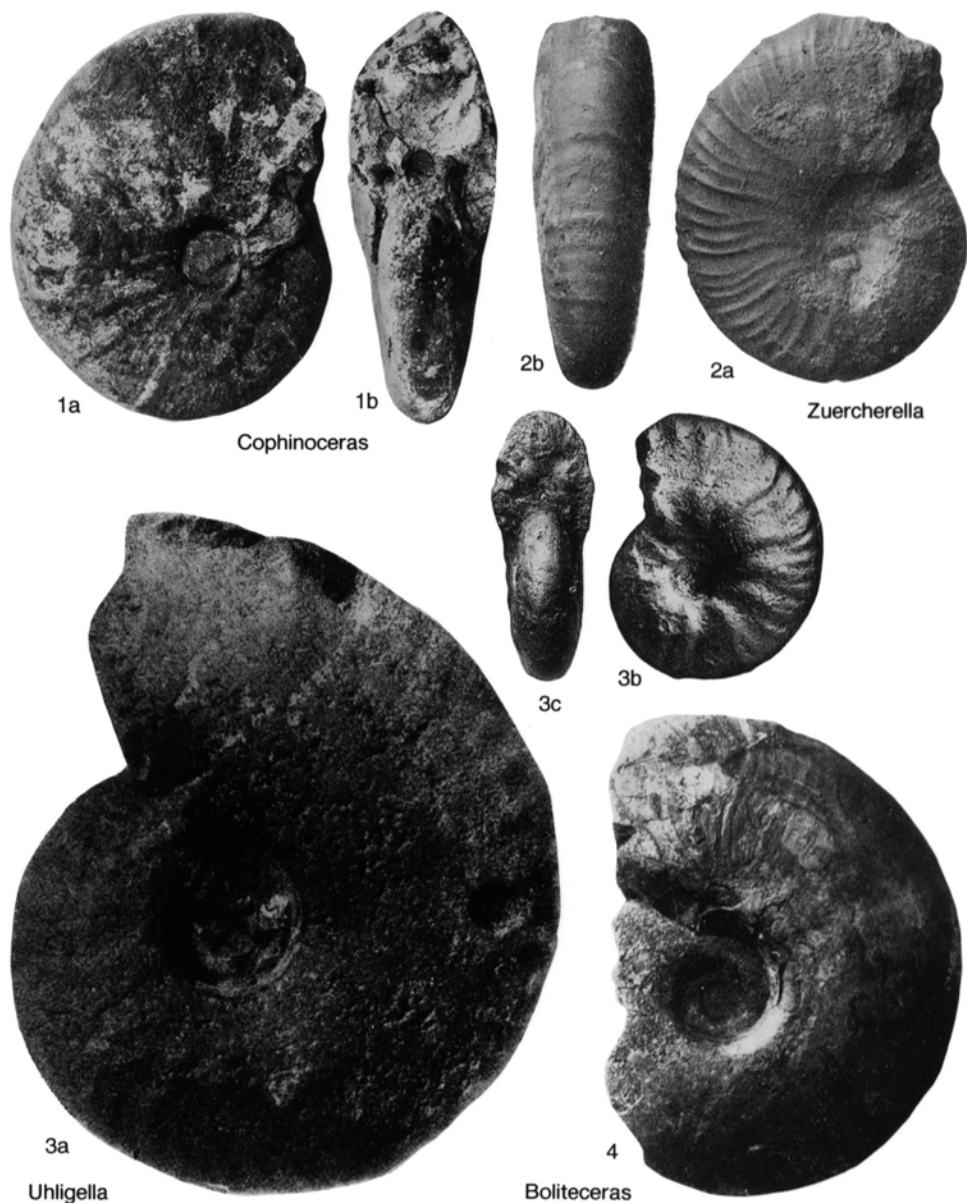


FIG. 61. Desmoceratidae (p. 80-82)

—FIG. 63,2a-c. **B. reesei*; $\times 0.5$ (Cobban, 1987a).

Tragodesmocerooides MATSUMOTO, 1942a, p. 24 [**T. subcostatus*; OD]. Very involute, moderately inflated; falcoid constrictions and sharp, dense, falcoid ribs or lirae on outer part of side strongly projected on venter; midline of venter tending to be raised. *Upper Cretaceous (Turonian-Lower Santonian)*: Madagascar, USA, Japan.—FIG. 63,4a,b.

**T. subcostatus*, Turonian, Japan; $\times 1$ (Matsumoto, 1942a).

Damesites MATSUMOTO, 1942a, p. 24 (1938b, p. 193, *nom. nud.*), ICZN Opinion 555, 1959, Generic Name No. 1349 [**Desmoceras damesi* JIMBO, 1894, p. 26(172); OD; ICZN Specific Name No. 1630 [= *Kotoceras* YABE, 1927, p. 36, ICZN Rejected Name No. 1264, *non* KOBAYASHI, 1934, p. 391, obj.; *Neokotoceras* ANDERSON, 1958, p. 218 (type,

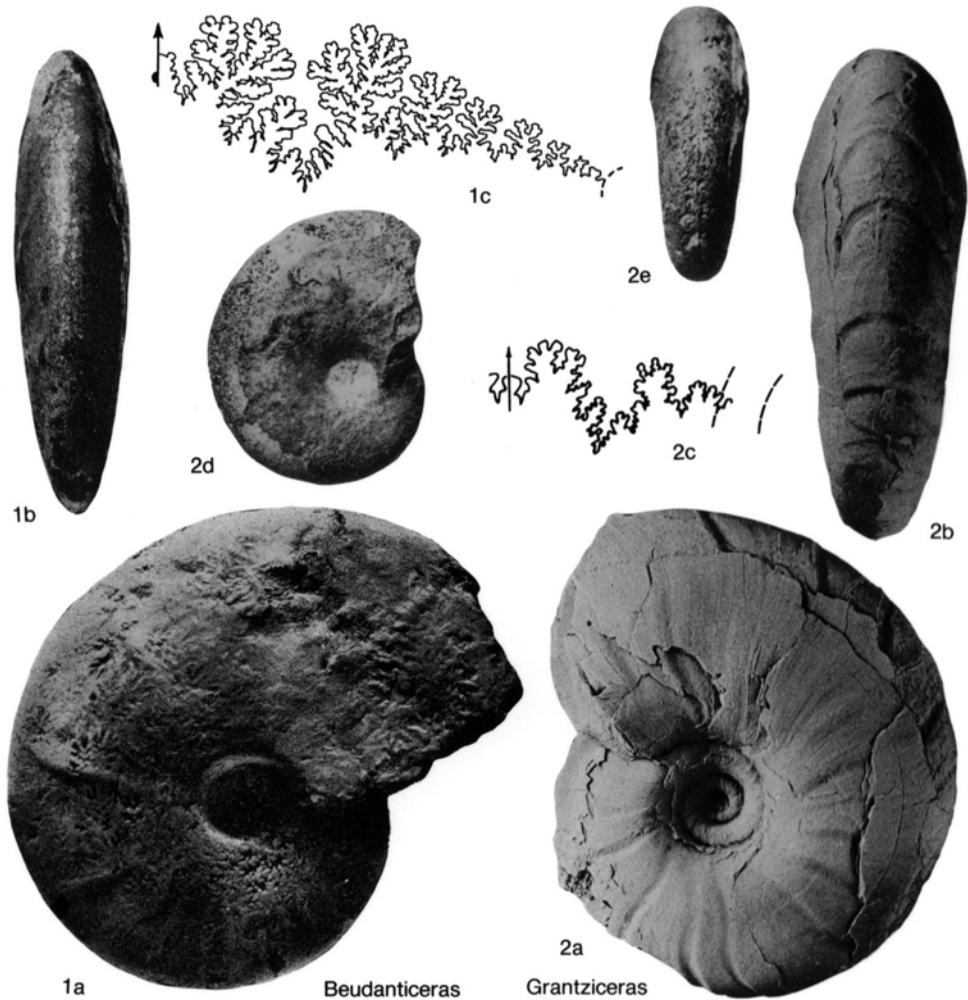


FIG. 62. Desmoceratidae (p. 81)

N. fresnoense; OD)]. Very involute, more or less compressed; sides flat and keel distinct; with falcoïd, sinuous or concave constrictions and, in some species, fine ribs. *Upper Cretaceous (Cenomanian–Campanian)*: Austria, Angola, Madagascar, southern India, Western Australia, Japan, British Columbia, USA.—FIG. 64, 2a, b. *D. sugata* (FORBES), ?Santonian, southern India; X1 (Kossmat, 1895–1898).—FIG. 64, 2c–e. *D. semicostatus* MATSUMOTO, Santonian, Japan; X1 (Obata & others, 1978).

Onitshoceras REYMENT, 1954b, p. 248 [**O. matsumotoi*; OD]. Moderately involute and inflated; whorl section subquadrate; numerous, thin, irregular ribs rising near umbilicus and strengthening on venter. Suture with very narrow lobes and one or more saddles projecting beyond line of suture. *Upper Cretaceous (Coniacian)*: ?France, Nigeria.—

FIG. 65, 1. **O. matsumotoi*, Coniacian, Nigeria; X2 (Reyment, 1954b).

Desmophyllites SPATH, 1929, p. 270, *nom. nov. pro Schlueteria* GROSSOUVRE, 1894, p. 216, non FRITSCH in FRITSCH & KAFKA, 1887, p. 33 [**Desmoceras larteti* SEUNES, 1891, p. 19; SD SPATH, 1921b, p. 46, *pro Schlueteria*] [= *Schluetericeras* COLLIGNON, 1938, p. 92, non HYATT, 1903, p. 110, obj.]. Very involute, inflated to compressed, with rounded venter; with sinuous to falcoïd or biconcave constrictions strongly projected and slightly collared on venter; shell smooth or finely striate. *Upper Cretaceous (Santonian–Upper Maastrichtian)*: Ireland, France, Spain, Austria, northern Africa, southeastern Africa, Madagascar, southern India, Japan, Alaska, British Columbia, California.—FIG. 65, 2a, b. **D. larteti* (SEUNES), Upper Maastrichtian, France; X1 (Seunes, 1891).

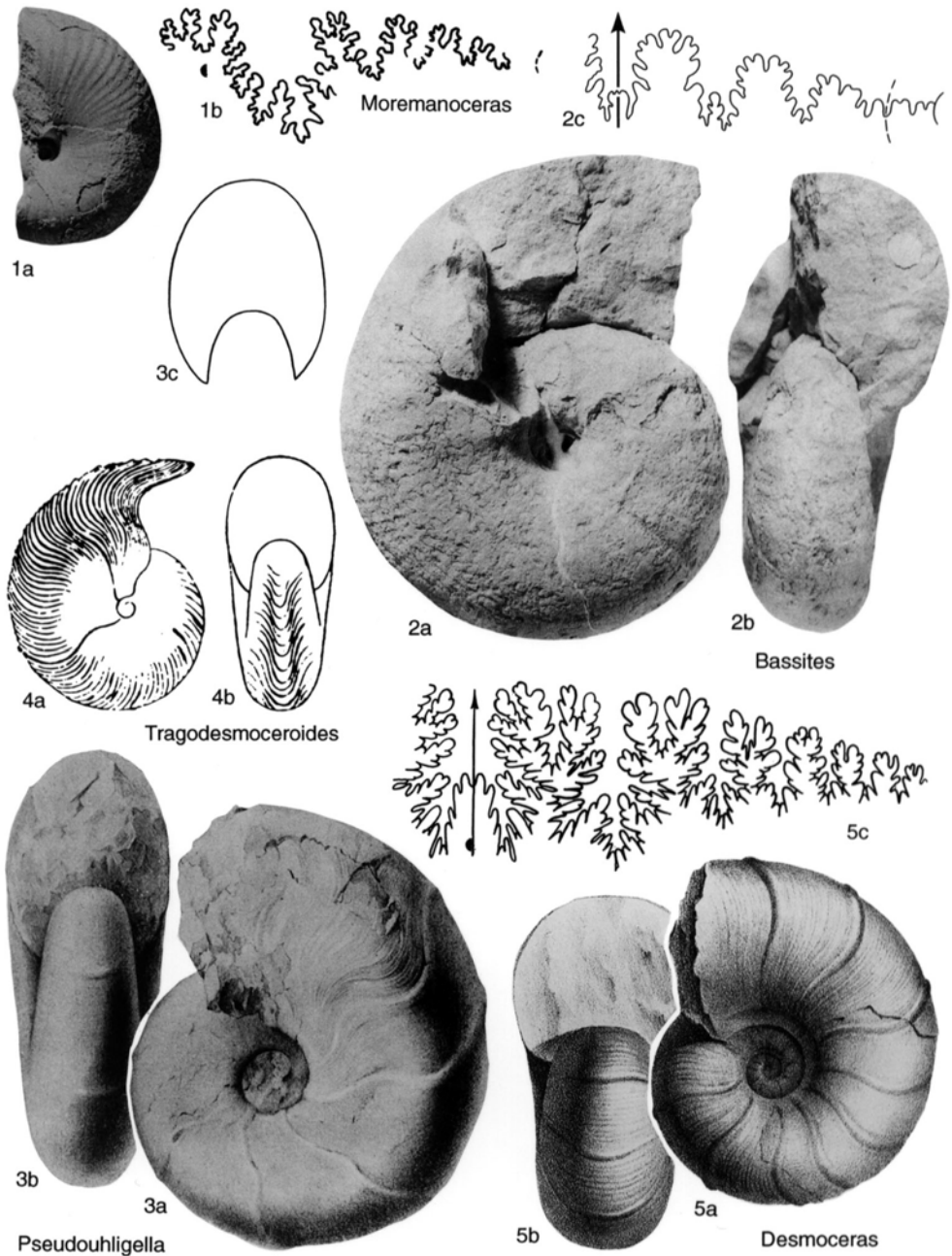


FIG. 63. Desmoceratidae (p. 82–83)

Subfamily HAUERICERATINAE
Matsumoto, 1938

[Hauericeratinae MATSUMOTO, 1938b, p. 193]

Rather evolute to rather involute; whorl section high, with flat sides; venter rounded

(at least initially), then typically fastigate, and later with sharp, high, septicarinat keel. Smooth or with weak tubercles on shoulders. Microconchs with lappets. Suture with suspensive lobe retracted or not. *Upper Cretaceous (Coniacian–Maastrichtian)*.

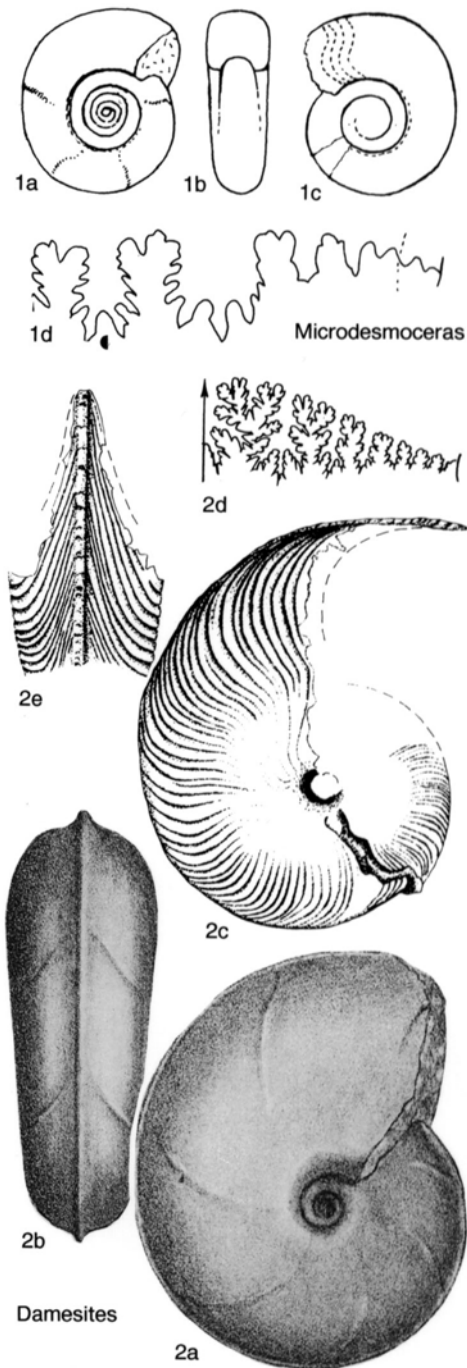


FIG. 64. Desmocerataidae (p. 82–84)

Origin is doubtful, either in Desmoceratinae close to point of origin of Muniericerataidae or in *Parapuzosia* of Puzosiinae.

Hauericeras GROSSOUVRE, 1894, p. 219 [**Ammonites pseudogardeni* SCHLÜTER, 1872, p. 54; OD] [= *Schlueteria* ROLLIER, 1922, p. 359, obj., non FRITSCH in FRITSCH & KAFKA, 1887, p. 33; *Pseudogardenia* TOMLIN, 1930, p. 23, obj.; *Gardeniceras* MATSUMOTO & OBATA, 1955, p. 134 (type, *Ammonites gardeni* BAILY, 1855, p. 450; OD)]. Characters as for subfamily. [Separation of *Gardeniceras* as subgenus for the less involute forms seems unnecessary.] *Upper Cretaceous* (Coniacian–Maastrichtian): Europe, South Africa, Madagascar, southern India, Japan, Western Australia, Victoria.—FIG. 66a–d. **H. pseudogardeni* (SCHLÜTER), Lower Campanian, Germany; macroconch, $\times 0.25$ (Schlüter, 1871–1876).—FIG. 66e. *H. angustum* YABE, Santonian, Japan; microconch, $\times 0.5$ (Obata & others, 1978).

?**Oiophyllites** SPATH, 1953, p. 21 [**O. decipiens*; OD]. Rather involute, very compressed, with narrowly rounded venter and almost flat sides; umbilical edge rounded; surface smooth except for sinuous striae. Suture simple and tending to have phylloid folioles. May be related to *Hauericeras*. *Upper Cretaceous* (Campanian): Antarctica (Graham Land), ?Angola.

Family SILESITIDAE Hyatt, 1900

[Silesitidae HYATT, 1900, p. 570]

Evolute, with oval or compressed whorl section; whorl height increasing slowly; inner whorls smooth, with constrictions; middle and later whorls with distant, broad or dense, fine ribs. Suture distinctly concave, with auxiliaries tending to curve forward in advance of first lateral saddle. FALLOT, 1921; UHLIG, 1883. *Lower Cretaceous* (Barremian–Lower Albian).

Probably derived from early *Barremites*.

Silesites UHLIG, 1883, p. 233, *nom. nov. pro Beneckeia* UHLIG, 1882a, p. 88, *non* MOJSISOVICS, 1882, p. 183 [**Ammonites seranonis* ORBIGNY, 1841, p. 361; OD]. Whorl section oval; constrictions regular and moderately deep; ribs radial and straight on inner part of sides but strongly projected on outer, forming chevrons on venter; a small tubercle may occur where rib bends below shoulder. *Lower Cretaceous* (Barremian): southern and central Europe, northern Africa, California, Argentina (Patagonia), Antarctica (Alexander Island).—FIG. 67, 4a, b. **S. seranonis* (ORBIGNY), France; $\times 1$ (Kilian, 1889a).

Neosilesites BREISTROFFER, 1951, p. 267 [**Silesites seranonis* var. *balearensis* FALLOT, 1920, p. 55; OD] [= *Neposiella* MAHMOUD, 1953, p. 286 (BREISTROFFER, 1952b, p. 2635, *nom. nud.*) (type, *Silesites nepos* H. DOUVILLE, 1917, p. 109)]. Sides flat or convex; venter broadly rounded; with sparse or dense, sharp primary ribs splitting on outer part of sides into fine secondaries that pass over venter. *Lower Cretaceous* (Upper Aptian–Lower Albian): Balearic Islands, Austria, Tunisia, Egypt (Sinai), Madagascar.—

FIG. 67, 1a–c. **N. balearensis* (FALLOT), Upper Aptian, Balearic Islands; a, b, $\times 1$ (Fallot, 1920); c, $\times 10$ (Wiedmann, 1966b).—FIG. 67, 1d. *N. nepos* (H. DOUVILLÉ), Lower Albian, Sinai; $\times 1$ (H. Douvillé, 1917).

Neostieria EGOIAN, 1969, p. 149 [**N. reliqua*; OD]. More inflated than *Neosilesites*, with distinct, oblique tubercles at point where distant primary ribs branch into fine secondaries, thus giving almost coronate whorl section. *Lower Cretaceous (Upper Aptian)*: Caucasus.—FIG. 67, 3a, b. **N. reliqua*; $\times 2$ (Egoian, 1969).

Miyakoceras OBATA, 1967, p. 130 [**M. tanohatense*; OD]. Small; ribs fine, dense, sinuous, single or branching, occasionally with ventrolateral tubercle; frequent, strong constrictions with enlarged rib behind. Suture with rather shallow, irregular elements. *Lower Cretaceous (Upper Aptian)*: Japan.—FIG. 67, 2a–c. **M. tanohatense*; a, b, $\times 2$; c, $\times 5$ (Obata, 1967).

Family KOSSMATICERATIDAE Spath, 1922

[*nom. transl.* SPATH, 1923d, p. 35, ex *Kossmaticeratinae* SPATH, 1922b, p. 134]

Compressed to inflated, rather involute to evolute, with fine to coarse, radial or prorsiradiate ribs interrupted on venter or not; ribs typically truncated by still more oblique constrictions; tubercles present or not. Microconchs lappeted. *Lower Cretaceous (Upper Aptian, Lower Albian)–Upper Cretaceous (Upper Maastrichtian)*.

A late Aptian to Turonian group of genera, Marshallitinae, is derived from Puzosiinae, probably *Pseudohaploceras*; a later Turonian to Maastrichtian group is conventionally separated as the subfamily Kossmaticeratinae. MATSUMOTO (1991) points out that the inner whorls of earliest Kossmaticeratinae resemble contemporary Puzosiinae more than they do latest Marshallitinae, but there is no clear morphological distinction between Marshallitinae and Kossmaticeratinae, and they are here regarded as successive subfamilies of Kossmaticeratidae.

Subfamily MARSHALLITINAE Matsumoto, 1955

[Marshallitinae MATSUMOTO, 1955b, p. 119]

An early group of variable kossmaticeraticids, more or less homeomorphous with the later Kossmaticeratinae. *Lower Cretaceous (?Upper Aptian, ?Lower Albian, Upper Albian)–Upper Cretaceous (Turonian)*.

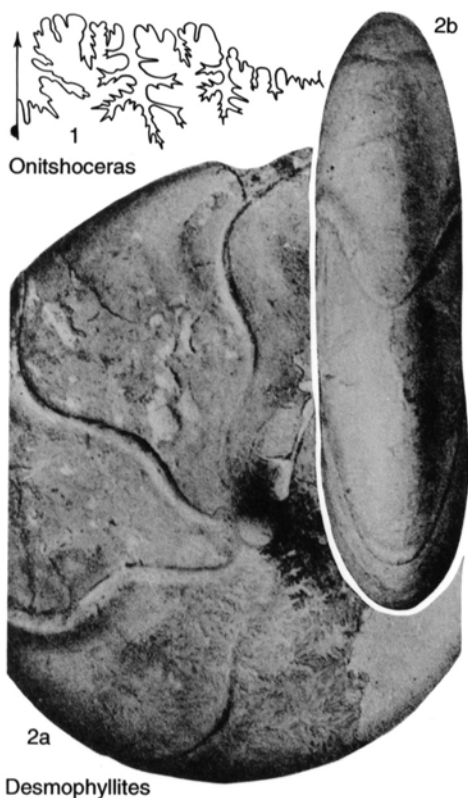


FIG. 65. Desmoceratidae (p. 84)

Hulenites MATSUMOTO, 1955b, p. 122 [**Puzosia reesei* ANDERSON, 1938, p. 187; OD]. Like compressed *Puzosia* but more involute, with flexuous ribs and prorsiradiate constrictions more distinct; internal mold may show spiral depression; venter tending to flatten and ribs to weaken on it. *Lower Cretaceous (?Upper Aptian, Albian)*: Alaska, California.—FIG. 68, 4. **H. reesei* (ANDERSON), Albian, California; $\times 1$ (Anderson, 1938).

Marshallites MATSUMOTO, 1955b, p. 119 (1954, p. 15, *nom. nud.*) [**M. compressus*; OD]. Varying from compressed, high-whorled, and involute to inflated and more evolute; ribs fine and flexuous, springing in bundles from weak umbilical bullae and truncated by frequent, prorsiradiate constrictions. Very much like *Maorites* (Campanian), but umbilical tubercles weaker. *Lower Cretaceous (Upper Aptian)–Upper Cretaceous (Upper Cenomanian)*: South Africa (Zululand), southern India, Japan, ?New Zealand, Alaska, British Columbia.—FIG. 68, 2a–c. **M. compressus*, Cenomanian, Japan; a, b, $\times 1$; c, $\times 2$ (Matsumoto, 1955b).

Eomarshallites MEDINA & RINALDI, 1986, p. 17 [**E. espinosum*; OD]. Like *Marshallites*, but juvenile whorls with small ventrolateral tubercles, thus resembling Turonian *Holcodiscoides*. *Lower Cretaceous (Upper Albian)*: Argentina (Patagonia).—FIG.

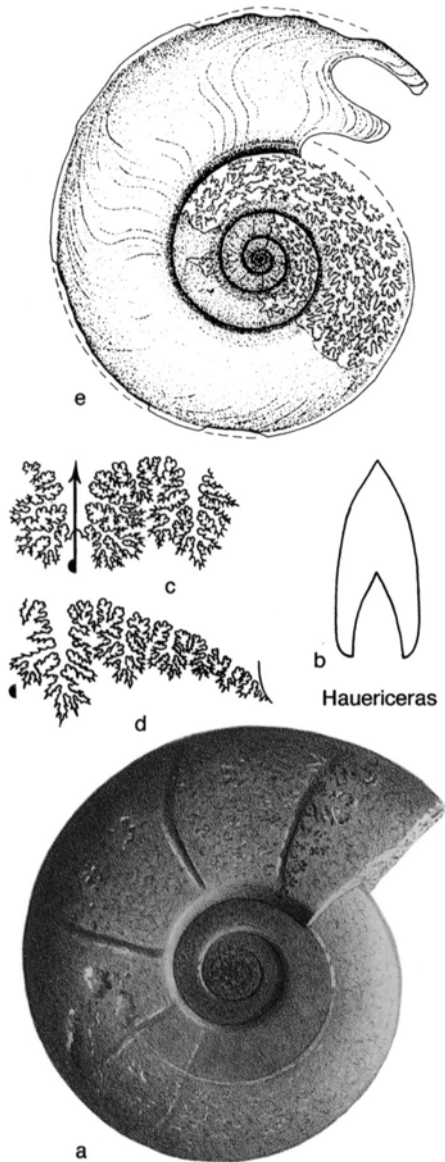


FIG. 66. Desmoceratidae (p. 86)

68,3a,b. **E. espinosum*, holotype; $\times 1$ (Medina & Rinaldi, 1986).

Yeharites MATSUMOTO, 1991, p. 8 [**Y. kobayashii* MATSUMOTO & TAKAHASHI in MATSUMOTO, 1991, p. 46; OD]. Moderately compressed, with sharply rounded shoulders and more or less flat venter; ribs on outer whorl strong, of variable length, mostly single, crossing venter transversely. *Lower Cretaceous (Upper Albian)*–*Upper Cretaceous (Lower Cenoma-*

nian): Japan, British Columbia.—FIG. 69,7a,b. **Y. kobayashii*, Japan; $\times 0.7$ (Matsumoto, 1991).

Yakushiceras MATSUMOTO, 1991, p. 10 [**Y. takahashii*; OD]. Rather evolute; whorl section compressed, suboval; venter flattened; ribs predominantly single, dense on inner whorls, distant on outer, with feeble or no umbilical bullae, but all with subdued ventrolateral tubercles. *Upper Cretaceous (Lower Cenomanian)*: Japan.—FIG. 68,6a,b. **Y. takahashii*; holotype; $\times 1$ (Matsumoto, 1991).

Maccarthrites MATSUMOTO, 1959, p. 67 [**M. gracilis*; OD]. Compressed, moderately involute; venter on later whorls tending to be fastigiate; most of phragmocone with few or no ribs but with strong, collared constrictions; last whorl with mainly single ribs of varying length, distinctly raised siphonally. *Upper Cretaceous (Cenomanian)*: Japan, Alaska.—FIG. 69,6a,b. **M. gracilis*, Alaska; $\times 2$ (Matsumoto, 1959).

Protokossmaticeras COLLIGNON, 1964, p. 19 [**P. madagascariense*; OD]. Similar to some *Marshallites*, but inner whorls inflated and with more distinct umbilical tubercles. Perhaps synonymous. *Lower Cretaceous (?Upper Albian)*: southern India. *Upper Cretaceous (Lower Cenomanian)*: Madagascar, Japan.—FIG. 69,4a,b. **P. madagascariense* COLLIGNON, Lower Cenomanian, Madagascar; $\times 1$ (Collignon, 1964).

Holcodiscoides SPATH, 1922b, p. 124 [**Ammonites cliveanus* STOLICZKA, 1866, p. 157; OD]. Less involute and densely ribbed than *Marshallites* and with subquadrate whorl section; sides flat; venter of outer whorl bordered by rather sparse ventrolateral tubercles. *Upper Cretaceous (Turonian)*: southern India.—FIG. 68,5a–c. **H. cliveanus* (STOLICZKA); $\times 1$ (Stoliczka, 1863–1865).

Moffittites IMLAY, 1959, p. 181 [**M. robustus*; OD]. Very inflated, with depressed whorl section; primary ribs close, regular, and slightly flexuous, branching at midflank into fine secondaries that tend to become lirae on venter; no umbilical tubercles. Suture with auxiliaries not retracted. *Lower Cretaceous (Lower Albian)*: Alaska.—FIG. 69,3a–c. **M. robustus*; a,b, $\times 1$; c, $\times 2$ (Imlay, 1959).

Eogunnarites WRIGHT & MATSUMOTO, 1954, p. 125 (MATSUMOTO, 1942b, p. 149, *nom. nud.*) [**Olcostephanus unicus* YABE, 1904, p. 28; OD] [=?*Sounnaites* MATSUMOTO & INOMA in MATSUMOTO, 1991, p. 110 (type, *Eogunnarites alaskensis* MATSUMOTO, 1959, p. 66; OD)]. Rather involute to rather evolute; depressed; umbilicus deep, with angular edge; fine, slightly curved ribs springing singly or bundled in threes and fours from weak to prominent umbilical tubercles; additional ribs intercalated; constrictions regular, each truncating 3 or 4 ribs. Microconchs with coarse ribs on outer whorl, which may develop ventrolateral tubercles or be strongly flared towards the aperture. [*Sounnaites*, for large forms with weak or no umbilical tubercles on inner whorls, probably comprises macroconchs of *Eogunnarites*.] *Lower Cretaceous (Upper Albian)*–*Upper Cretaceous (Cenomanian)*: southern India,

eastern Russia, Japan, Alaska.—FIG. 69,2a,b. **E. unicus* (YABE), Cenomanian, Japan; $\times 1$ (Wright & Matsumoto, 1954).—FIG. 69,2c,d. *E. alaskensis* (MATSUMOTO), Cenomanian, Alaska; $\times 0.4$ (Matsumoto, 1959).

Mikasaites MATSUMOTO, 1956, p. 174 [**M. orbicularis*; OD]. Similar to some *Eogunnarites* but with slightly angular venter and strong, close siphonal tubercles, at which the fine ribs mostly reunite. *Upper Cretaceous (Lower Cenomanian)*: eastern Russia, Japan.—FIG. 69,5a,b. **M. orbicularis* MATSUMOTO; $\times 1.5$ (Matsumoto, 1956).

Eomadrasites MATSUMOTO, 1955b, p. 132 (1954, p. 15, *nom. nud.*) [**E. nipponicus*; OD]. Less depressed and inflated than *Eogunnarites* and with sparse, irregular, large inner lateral, ventrolateral, and siphonal tubercles and irregular ribs, some looped. *Upper Cretaceous (Cenomanian)*: Japan.—FIG. 69,1a,b. **E. nipponicus*; $\times 1$ (Matsumoto, 1955b).

Wellmanites WRIGHT, 1957a, p. 808 [**W. zelandicus*; OD]. Small to medium-sized; rather evolute with depressed-rounded whorl section or with somewhat flattened sides; 4 or 5 deep constrictions to a whorl, with high collars, rectiradiate on sides, then projected; 1 to 3 long, sharp lateral spines and feeble ribs between each pair of constrictions; adult body chamber with large ventrolateral and siphonal spines. *Lower Cretaceous (Cenomanian)*: Japan, New Zealand, Alaska.—FIG. 68,1a–c. **W. zelandicus*, New Zealand; a, b, holotype; c, paratype, all $\times 1$ (Henderson, 1973).—FIG. 68,1d. *W. japonicus* MATSUMOTO, TAKAHASHI, & SANADA, Upper Cenomanian, Japan; holotype, $\times 1$ (Matsumoto, 1991).

[*Jacobitoides* MATSUMOTO, 1954, p. 15 (*nom. nud.*)].

Subfamily KOSSMATICERATINAE Spath, 1922

[Kossmaticeratinae SPATH, 1922b, p. 134] [=Brahmaitinae COLLIGNON, 1977, p. 20]

A very variable group, probably but not certainly derived from Marshallitinae; many genera in the two subfamilies are homeomorphous. *Upper Cretaceous (Upper Turonian–Maastrichtian)*.

Kossmaticeras GROSSOUVRE, 1901, p. 719 [**Ammonites theobaldianus* STOLICZKA, 1866, p. 161; SD DIENER, 1925, p. 96] [=*Pseudoholcodiscus* KILIAN & REBOUL, 1909, p. 19, *nom. nud.*; *Madrasites* KILIAN & REBOUL, 1909, p. 28 (type, *Ammonites theobaldianus* STOLICZKA, 1866, p. 161; SD WRIGHT, herein)]. Moderately evolute; whorl section oval to compressed; ribs more or less dense, fairly strong, simple, branched or intercalated; ribs arising from weak to strong umbilical tubercles, commonly strengthening on body chamber. Suture moderately indented. *Upper Cretaceous (Upper Turonian–Campanian)*: Austria, South Africa, Western Australia,

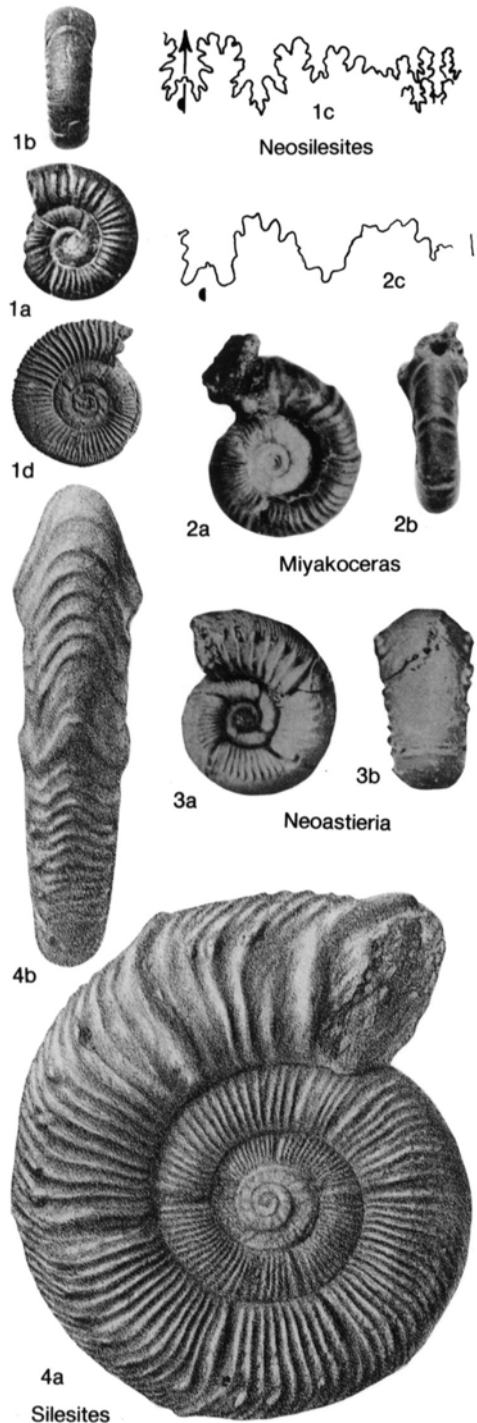


FIG. 67. Silesitidae (p. 86–87)

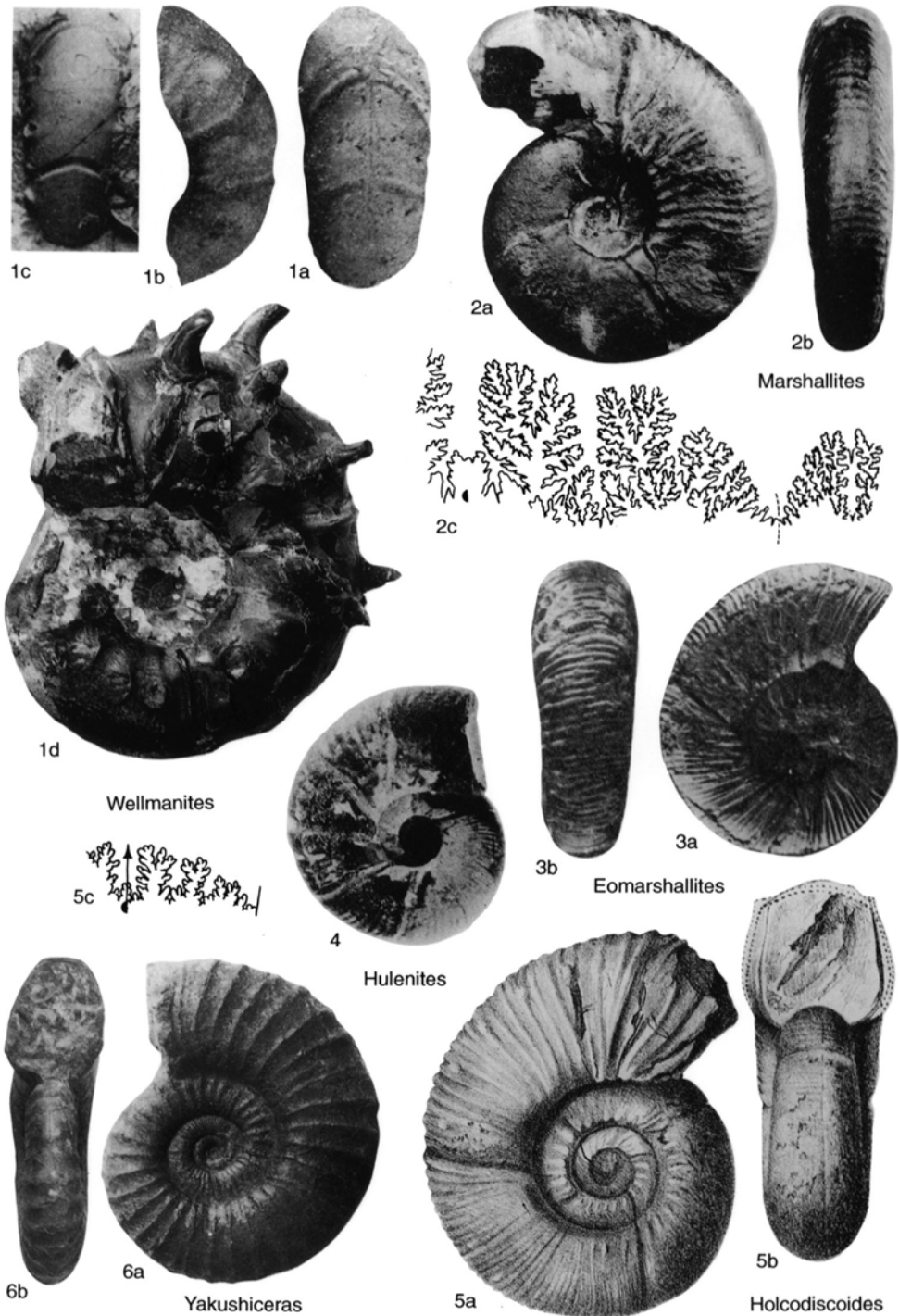


FIG. 68. Kossmaticeratidae (p. 87–89)

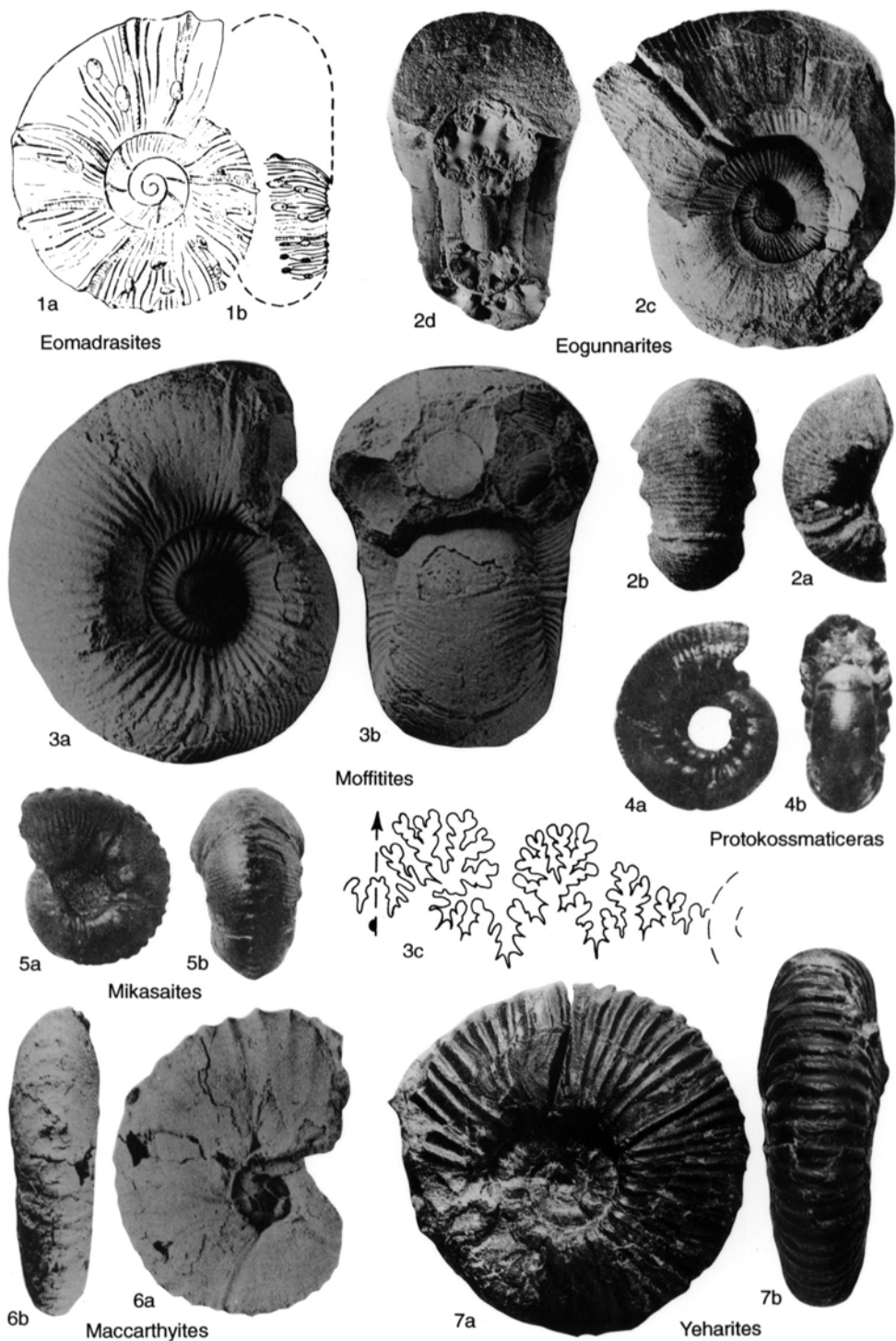


FIG. 69. Kossmaticeratidae (p. 88–89)

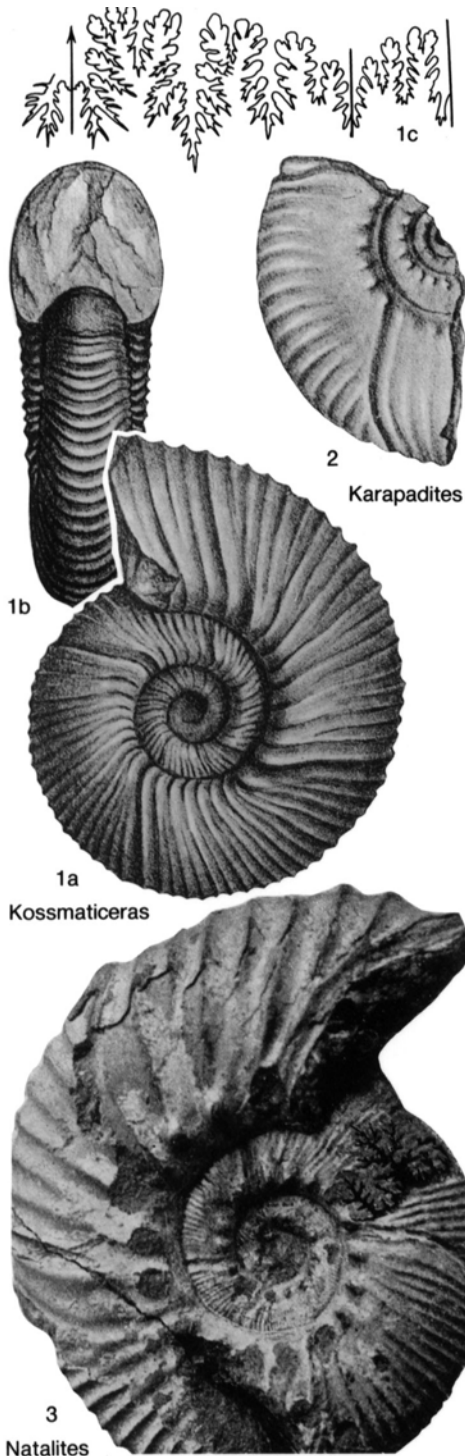


FIG. 70. Kossmaticeratinae (p. 89–92)

Madagascar, southern India, Japan, New Zealand, Argentina (Patagonia), Antarctica (Graham Land).

K. (Kossmaticeras) Umbilical tubercles very weak; whorl section generally oval. *Upper Cretaceous (Upper Turonian–Santonian)*: Austria, South Africa, Madagascar, southern India, Japan, New Zealand. —FIG. 70, 1a–c. **K. (K.) theobaldianum* (STOLICZKA), Santonian, southern India; $\times 1$ (Kossmat, 1895–1898).

K. (Natalites) COLLIGNON, 1954, p. 6 [**Madrasites natalensis* SPATH, 1922b, p. 134; OD; =*Holcodiscus africanus* HOEPEN, 1920, p. 146] [= *Kaiparaites* MATSUMOTO, 1955b, p. 142 (type, *Madrasites multicostatus* MARSHALL, 1926, p. 164; OD)]. Whorl section round to compressed; umbilical tubercles distinct to prominent. *Upper Cretaceous (Coniacian, Campanian)*: South Africa, southern India, Western Australia, Japan, New Zealand, Argentina (Patagonia), Antarctica (Graham Land). —FIG. 70, 3. **K. (N.) africanus* (HOEPEN), Campanian, South Africa (Pondoland); $\times 1$ (Spath, 1922b).

K. (Karapadites) COLLIGNON, 1954, p. 6 [**Holcodiscus karapadensis* KOSSMAT, 1897, p. 41(148); OD] [= *Karapadites* MATSUMOTO, 1955b, p. 143, obj.]. Sides flat; ribs absent or weak on midsides, at least in early and middle growth, but distinct umbilical tubercles invariably present. *Upper Cretaceous (Upper Campanian)*: Madagascar, southern India. —FIG. 70, 2. **K. (K.) karapadense* (KOSSMAT), southern India; $\times 1$ (Kossmat, 1895–1898).

Yokoyamaoceras WRIGHT & MATSUMOTO, 1954, p. 128 (SHIMIZU, 1935a, p. 198, *nom. nud.*) [**Holcodiscus kotoi* JIMBO, 1894, p. 33(179); OD]. Small, evolute, and compressed, with flat venter; in middle growth fine, flexuous ribs ending at small ventrolateral tubercles but crossing venter on body chamber. Like *Holcodiscoides*, but inner whorls without umbilical tubercles. Some or all described species are microconchs, presumably of contemporary *Kossmaticeras*, but dimorphic pairs have not been recognized. *Upper Cretaceous (?Turonian, Coniacian)*: ?southern India, Japan. —FIG. 71, 2a, b. **Y. kotoi* (JIMBO), Coniacian, Japan; $\times 1$ (Wright & Matsumoto, 1954). —FIG. 71, 2c. *Y. aff. minimum* MATSUMOTO, Coniacian, Japan; microconch, $\times 1$ (Obata & others, 1978).

Grossouvreites KILIAN & REBOUL, 1909, p. 26 [**Ammonites gemmatus* HUPÉ, 1854, p. 35; OD]. Ribs very fine and dense in young, springing in bundles from umbilical tubercles, later coarsen. Perhaps a subgenus of *Kossmaticeras*. *Upper Cretaceous (Campanian)*: Chile, Antarctica (Graham Land). —FIG. 71, 4a, b. **G. gemmatus* (HUPÉ), Chile; $\times 0.75$ (Steinmann, 1895).

Gunnarites KILIAN & REBOUL, 1909, p. 26 [**Olcostephanus antarcticus* WELLER, 1903, p. 417; SD DIENER, 1925, p. 101]. Like *Kossmaticeras (Natalites)* but with ribs stronger, more regular, invariably crenulate; compressed with fine ribs to round-whorled with coarse ribs. *Upper Cretaceous (Campanian)*: southern India, New Zealand, Ant-

- arctica (Graham Land).—FIG. 71,3a,b. **G. antarcticus* (WELLER), Graham Land; $\times 0.7$ (Spath, 1953).
- Maorites** MARSHALL, 1926, p. 173 [**Kossmaticeras tenuicostatum* MARSHALL, 1917, p. 445; OD]. Involute, compressed, high-whorled, with flat sides; with very dense, fine, flexuous ribs and distinct umbilical tubercles; ribs either fine throughout or becoming very coarse. Suture very finely divided. *Upper Cretaceous (Campanian)*: South Africa (Zululand), Madagascar, southern India, New Caledonia, New Zealand, Argentina, Antarctica (Graham Land).
- M. (Maorites)**. Ribs fine throughout. Occurrence and distribution as for genus.—FIG. 71,1a,b. **M. (M.) tenuicostatum* (MARSHALL), New Zealand; a, $\times 0.7$; b, $\times 1.5$ (Marshall, 1926).
- M. (Caledonites)** COLLIGNON, 1977, p. 14 [**C. neocaledonicus*; OD]. Inner whorls as in *M. (Maorites)*, but outer developing coarse ribs springing in bundles from large umbilical spines. Occurrence as for genus: New Caledonia.
- Pseudokossmaticeras** SPATH, 1922b, p. 126 [**Ammonites pacificus* STOLICZKA, 1866, p. 160; OD]. Round-whorled, with retriradiate, single ribs in adult; subduced umbilical tubercles persisting. *Upper Cretaceous (?Upper Campanian, Lower Maastrichtian–Upper Maastrichtian)*: Germany, Austria, Poland, Ukraine, Armenia, Turkey, Madagascar, southern India, USA, Argentina (Patagonia).—FIG. 72,1a–c. **P. pacificum* (STOLICZKA), Maastrichtian, southern India; $\times 1$ (Stoliczka, 1866).
- Neograhamites** SPATH, 1953, p. 27 [**N. kiliani*; OD]. Small; at first with fine (later with coarse) straight ribs branching from umbilical tubercles. *Upper Cretaceous (Campanian)*: South Africa (Pondoland), New Caledonia, New Zealand, Argentina (Patagonia), Antarctica (Graham Land).—FIG. 72,3. **N. kiliani*, Graham Land; $\times 1$ (Spath, 1953).
- Jacobites** KILIAN & REBOUL, 1909, p. 26 [**J. anderssoni*; OD]. Inner whorls as in *Kossmaticeras* but more inflated; in some forms coronate, with large lateral spines. Outer whorls with more or less flat, parallel sides and broad, fastigiate venter, with regular or irregular tuberculate or flared ribs. *Upper Cretaceous (Campanian)*: New Caledonia, New Zealand, Antarctica (Graham Land).
- J. (Jacobites)** [= *Neomadrasites* MARSHALL, 1926, p. 171 (type, *N. nodulosus*; OD); *Aucklandites* MARSHALL, 1927, p. 358 (type, *Acanthoceras ultimum* MARSHALL, 1926, p. 158; OD)]. Ribs fine, tending to be angulate or tuberculate on shoulder and some also on siphonal line; ribs may or may not coarsen on body chamber. Occurrence and distribution as for genus.—FIG. 72,2a. **J. (J.) anderssoni*, Graham Land; $\times 1$ (Kilian & Rebul, 1909).—FIG. 72,2b. *J. (J.) nodulosus* (MARSHALL), New Zealand; $\times 1$ (Henderson, 1970).
- J. (Tainuia)** MARSHALL, 1926, p. 185 [**T. aucklandica*; OD]. Outer whorls with coarse ribs, most with umbilical and all with 3 lateral, ventrolateral, and siphonal tubercles. Occurrence as for genus: New Zealand.—FIG. 72,5a,b. **J. (T.) aucklandica* (MARSHALL); $\times 0.5$ (Henderson, 1970).
- Brahmaites** KOSSMAT, 1897, p. 44(151) [**Ammonites brahma* FORBES, 1846, p. 100; SD YABE & SHIMIZU, 1924, p. 79] [= *Anabrahamites* YABE & SHIMIZU, 1924, p. 79 (type, *Ammonites vishnu* FORBES, 1846, p. 100; OD); *Subbrahmaites* YABE & SHIMIZU, 1924, p. 79 (type, *S. sachalinensis*; OD)]. Evolute; inner whorls depressed and coronate as in some *Jacobites*, with fine ribs with or without (*Anabrahamites*) umbilical tubercles; outer whorl section becoming round, with ribs weakening, reduced in some species to elongated umbilical tubercles, and rejuvenating on body chamber but interrupted ventrally; constrictions prorsiradiate, with strong collar behind, on outer whorl generally raised into siphonal tubercle. *Upper Cretaceous (Lower Maastrichtian–Upper Maastrichtian)*: France, Spain, Armenia, Madagascar, southern India, Sakhalin.—FIG. 72,4a–c. **B. brahma* (FORBES), southern India; a,b, $\times 0.75$; c, $\times 1$ (Kossmat, 1895–1898).

Family CLEONICERATIDAE Whitehouse, 1926

[Cleoniceratidae WHITEHOUSE, 1926, p. 206] [= *Vnigriceratinae* Saveliev, 1973, p. 132; *Lemuroceratinae* OWEN, 1988, p. 216]

Round-whorled to compressed and high-whorled; venter rounded, subtabulate, or acute; ribs Y-shaped to falcoid; primaries single or branching at umbilical edge, with or without umbilical bullae, branching again at midflank or beyond; some forms secondarily smooth; constrictions present throughout or absent, commonly several close together before aperture. Microconchs small, commonly with venter of body chamber broadening and coiling inward; macroconchs rather large, with ornament weakening on outer whorl. Suture with wide, more or less asymmetrical L and up to 6 auxiliary lobes in high-whorled forms. *Lower Cretaceous (Lower Albian, tardefurcata Zone–Middle Albian, dentatus Zone)*.

Freboldiceras, probably derived from *Calliconiceras* (Puzosiinae), gave rise to *Arctohoplites* and thence *Leconteites*; *Anadesmoceras* and *Cleoniceras* probably constituted one early side branch and *Cymahoplites* and *Lemuroceras* another.

The family has generally been placed in Hoplitaceae because of resemblances to Sonneratiinae, but since it apparently originated in Puzosiinae rather than in *Ubligella*

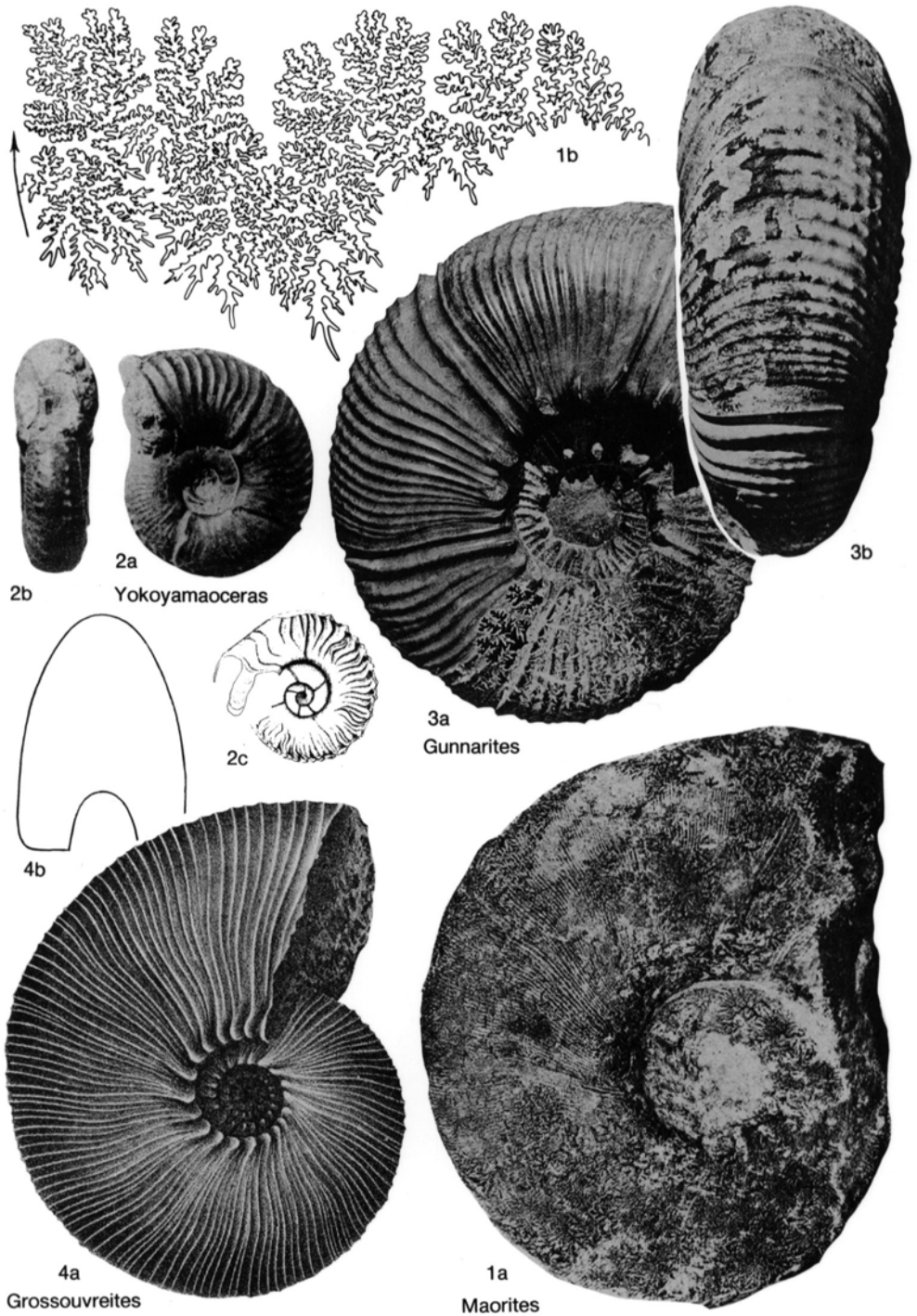


FIG. 71. Kossmaticeratidae (p. 92–93)

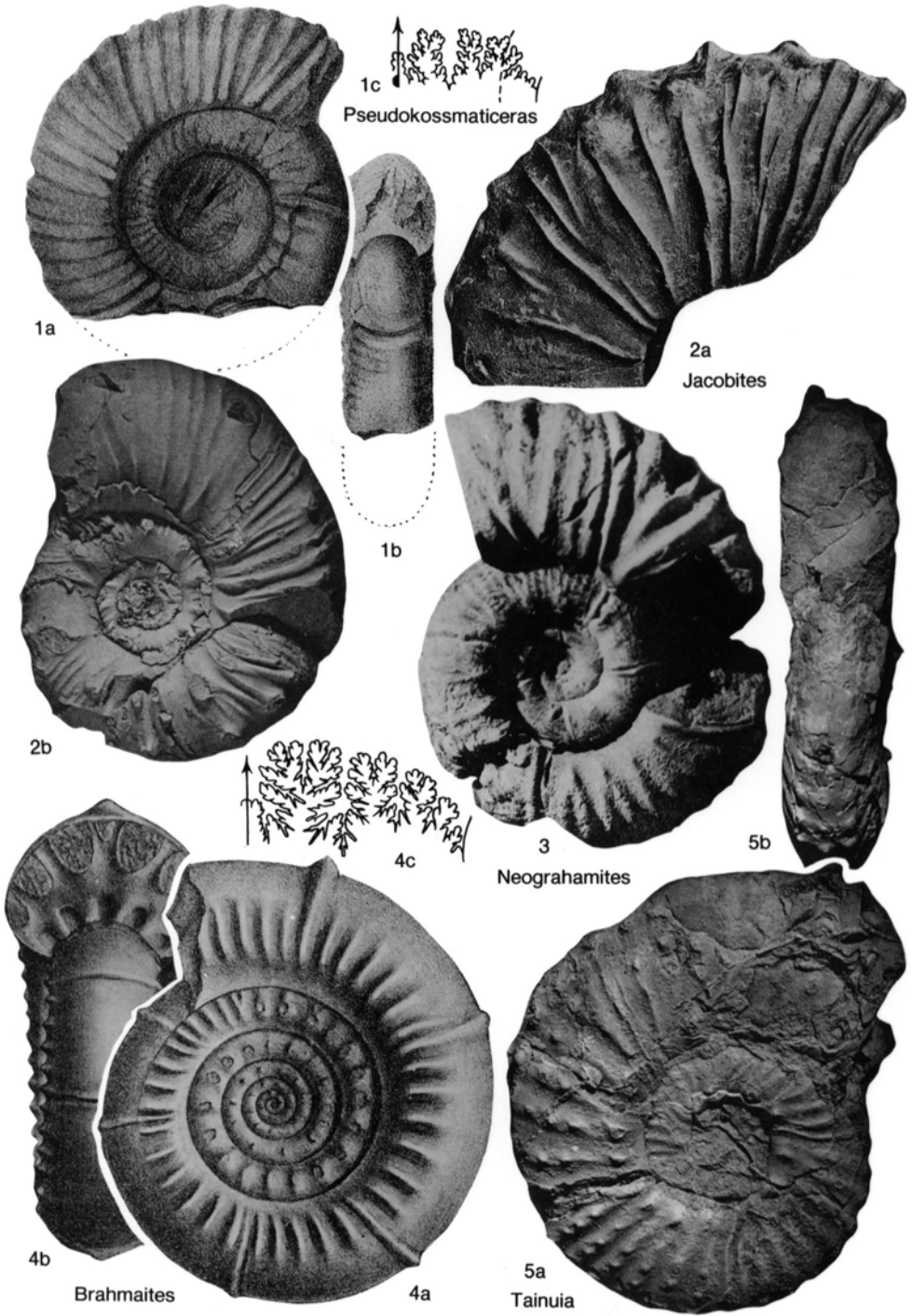


FIG. 72. Kosmaticeratidae (p. 93)

(Beudanticeratinae), the presumed source of Hoplitaceae, it is better placed in Desmocerataceae.

Freboldiceras IMLAY, 1959, p. 182 [**F. singulare*; OD].

More or less compressed, with convex sides converging to rounded venter; primary ribs distant, sinuous, prorsiradial, weakening rapidly on shoulders; secondaries feeble, intercalated or not; body chamber with a few, broad, shallow constrictions. Includes transitions to *Archthoplites*. *Lower Cretaceous (Lower Albian, tardefurcata Zone)*: Spitsbergen, Alaska, Arctic Canada, northern Greenland.—FIG. 73,1a–c. **F. singulare*, Alaska; *a, b*, $\times 1$; *c*, $\times 2$ (Imlay, 1959).

Archthoplites SPATH, 1925a, p. 76 [**Ammonites jachromensis* NIKITIN, 1888, p. 57; OD] [= *Subarchthoplites* CASEY, 1954a, p. 111 (type, *Meluroceras belli* MCLEARN, 1945, p. 10; OD); *Bellidiscus* SAVELIEV, 1973, p. 115 (type, *B. probus*; OD)]. Slightly compressed, with rounded to weakly flattened venter; primary ribs distant, high, remaining single or branching high up sides or with intercalated short secondaries; ribs slightly prorsiradial, straight to weakly biconcave. More compressed and higher-whorled species need not be separated as *Subarchthoplites* or *Bellidiscus*. *Lower Cretaceous (Lower Albian)*: central Russia, Transcaspiya, Iran, Spitsbergen, Arctic Canada, northern and eastern Greenland.—FIG. 73,2a–c. **A. jachromensis* (NIKITIN), central Russia; *a, b*, $\times 1$; *c*, enlarged (Nikitin, 1888).—FIG. 73,2d, e. *A. belli* (MCLEARN), Arctic Canada; $\times 1$ (Imlay, 1961).—FIG. 73,2f–h. *A. probus* (SAVELIEV), Transcaspiya; $\times 1$ (Saveliev, 1973).

Leconteites CASEY, 1954a, p. 110 (BREISTROFFER, 1951, p. 266, *nom. nud.*) [**Desmoceras lecontei* ANDERSON, 1902, p. 95; OD] [= *Puzosigella* CASEY, 1954a, p. 110 (type, *Pachydiscus sacramenticus* ANDERSON, 1902, p. 105; OD); *Vnigraceras* SAVELIEV, 1973, p. 143 (type, *V. emendatum*; OD); *V. (Astrodiscus)* SAVELIEV, 1973, p. 145 (type, *V. (A.) insegestum*; OD)]. Small to medium-sized, variable, and compressed to rather inflated; umbilicus from 17 to 30 percent of diameter; umbilical shoulder sharply rounded to angular; primary ribs sinuous, arising singly on umbilical wall or in twos or threes from umbilical bullae, projected towards venter, weakening or disappearing at venter; secondaries branching or intercalated at midflank; constrictions, if present, with or without collars. Suture finely or coarsely frilled. *Lower Cretaceous (Lower Albian, tardefurcata Zone)*: Alaska, British Columbia, Oregon, California.—FIG. 74,1a–c. **L. lecontei* (ANDERSON), California; *a, b*, $\times 1$; *c*, $\times 3.5$ (Jones, Murphy, & Packard, 1965).—FIG. 74,1d, e. *L. sacramenticus* (ANDERSON), California; $\times 0.5$ (Anderson, 1938).

Brewericeras CASEY, 1954a, p. 112 [**Ammonites breweri* GABB, 1864, p. 62; OD]. Compressed, with flat or moderately inflated sides; coiling eccentric. Derivative of *Leconteites* distinguished by absence of

umbilical tubercles and paired ribs, rarity of constrictions, and narrower stems to saddles of suture. Varying from smooth to strongly ribbed; ribs falcate and strongest on outer part. *Lower Cretaceous (Lower Albian, mammillatum Zone)*: ?Spitsbergen, Japan, Alaska, British Columbia, Oregon, California.—FIG. 74,2a. **B. breweri* (GABB), California; $\times 0.35$ (Jones, Murphy, & Packard, 1965).—FIG. 74,2b. *B. hulenense* (ANDERSON), California; $\times 3$ (Jones, Murphy, & Packard, 1965).

Anadesmoceras CASEY, 1954a, p. 107 [**A. strangulatum*; OD] [= *Carloscaceresiceras* ETAYO SERNA, 1979, p. 25 (type, *C. caceresi*; OD)]. More compressed than *Leconteites*; body chamber with periphery coiling inward and whorl section becoming subrectangular; shell with bundled striae; fine umbilical bullae and weak ribs on inner whorls, rarely throughout; aperture of microconchs may be preceded by wide, sinuous constrictions or folds. *Lower Cretaceous (Lower Albian, tardefurcata to lower mammillatum Zone)*: England, Denmark, Transcaspiya, northern Greenland, Colombia.—FIG. 74,3a. **A. strangulatum*, England; $\times 1$ (Casey, 1954a).—FIG. 74,3b–e. *A. emendatum* (SAVELIEV), Transcaspiya; $\times 1$ (Saveliev, 1973).

Cleoniceras PARONA & BONARELLI, 1897, p. 83 [**Ammonites cleon* ORBIGNY, 1850a, p. 124; OD] [= *Eocleoniceras* SAVELIEV, 1992, p. 84 (type, *C. (E.) remotum*; OD)]. Rather involute, compressed; venter arched to acute, rarely flat; typically with strong, sigmoid to falcoid ribs at some growth stage, single or springing in pairs from distinct umbilical bullae, commonly branching again or intercalated at midflank, tending to disappear on outer whorls of macroconchs, and commonly weak on venter. *Lower Cretaceous (Lower Albian, tardefurcata Zone–Middle Albian)*: western Europe, Transcaspiya, Madagascar, northwestern India, Alaska, British Columbia.

C. (Cleoniceras). Umbilical tubercles present at some stage; venter not tabulate. Occurrence and distribution as for genus.—FIG. 75,4a–c. **C. (C.) cleon* (ORBIGNY), Lower Albian, France; *a, b*, $\times 1$; *c*, $\times 2$ (Casey, 1966).

C. (Anacleoniceras) MIRZOEV, 1969, p. 38 [**Anacleoniceras caseyi*; OD] [= *Cleonella* DESTOMBES, 1970, p. 2063 (type, *Cleoniceras dimorphum* CASEY, 1966, p. 568; OD), *nom. nud.*]. Small; venter flattening on body chamber and ribs generally coarsening; umbilical tubercles prominent and ribs falcoid. Probably microconchs of *C. (Cleoniceras)*. Occurrence and distribution as for genus.—FIG. 75,3a, b. **C. (A.) caseyi* (MIRZOEV), Lower Albian, Turkmenistan; $\times 1$ (Mirzoev, 1969).

C. (Grycia) IMLAY, 1961, p. 64 [**C. (G.) sablei*; OD] [= ?*Paracleoniceras* COLLIGNON, 1963, p. 85 (type, *Cleoniceras besairiei* COLLIGNON, 1949b, p. 86; OD)]. Lacking umbilical tubercles at any stage. *Lower Cretaceous (Lower Albian, ?Middle Albian)*: Spitsbergen, ?Madagascar, Alaska.—FIG. 75,2a–c. **C. (G.) sablei*, Lower Albian,

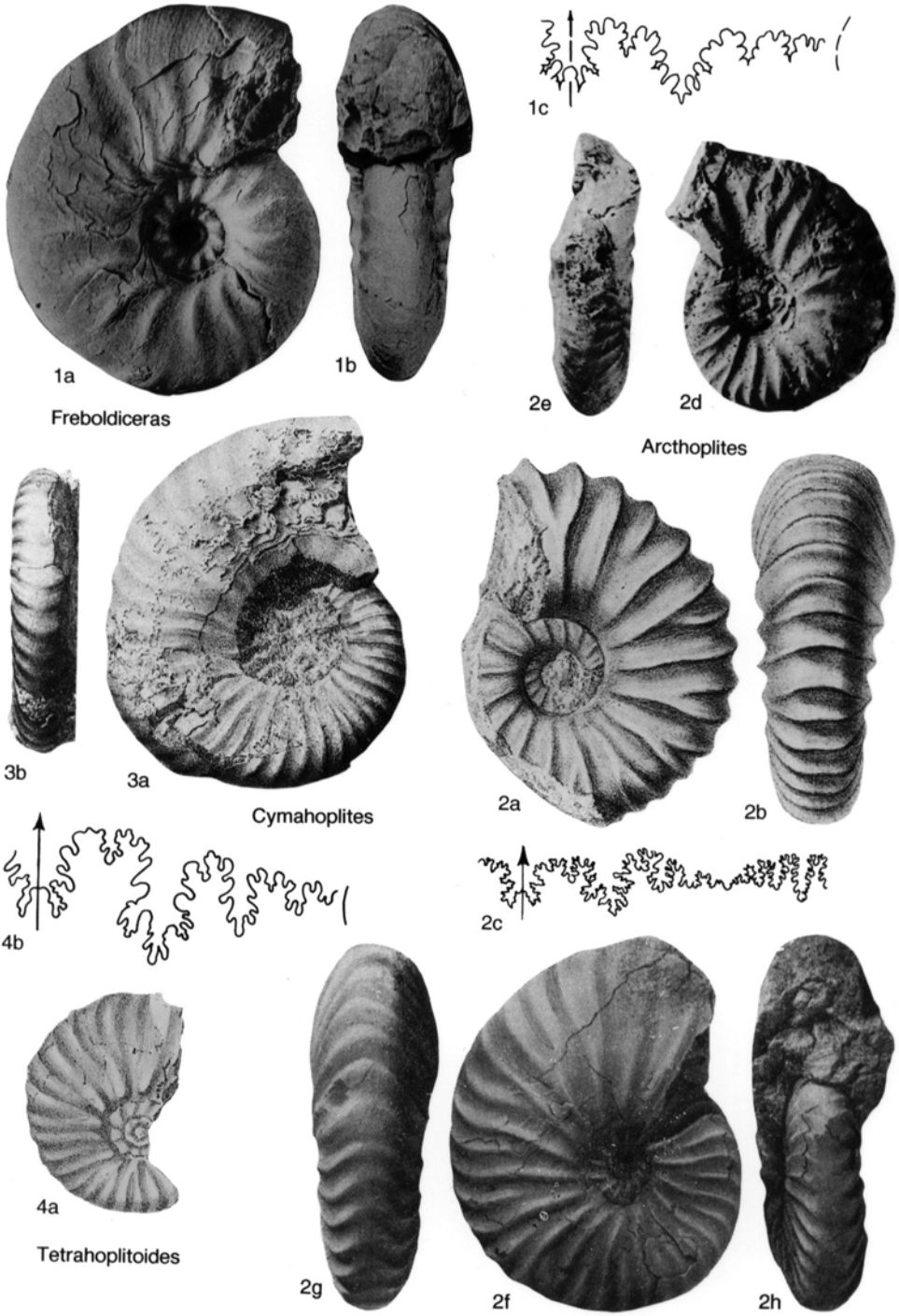


FIG. 73. Cleoniceratidae (p. 96–100)

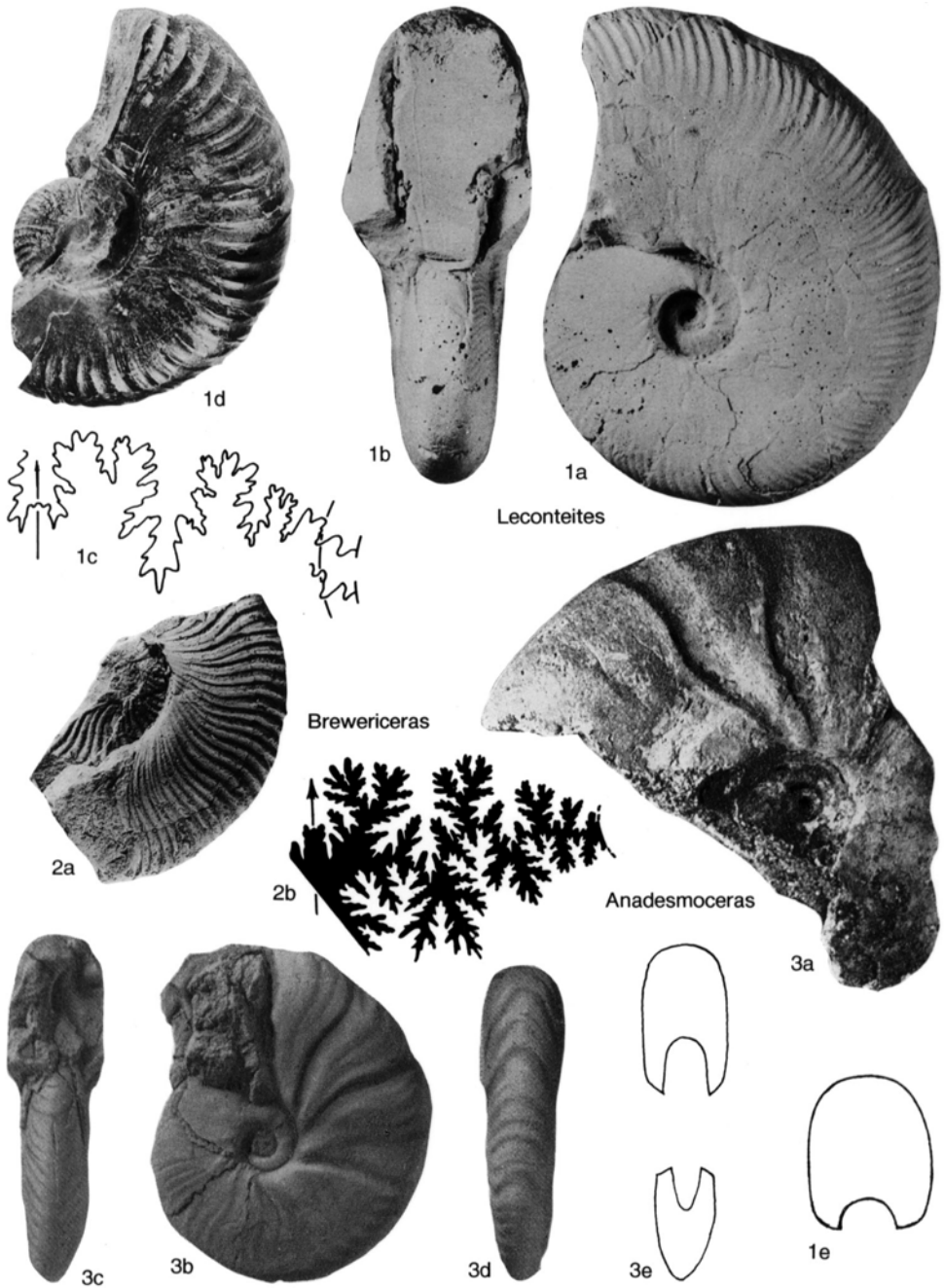


FIG. 74. Cleoniceratidae (p. 96)

Alaska; *a, b*, $\times 0.75$; *c*, $\times 1$ (Imlay, 1961).—
 FIG. 75, 2*d, e*. *C. (?G.) besairiei* (COLLIGNON),
 Middle Albian, Madagascar; $\times 1$ (Collignon,
 1949b).

C. (Neosaynella) CASEY, 1954a, p. 106 [**C. (N.) inornatum*; OD]. No ornament except obscure crescents on outer part of sides; umbilical rim sharp; venter narrowly tabulate in early stages,

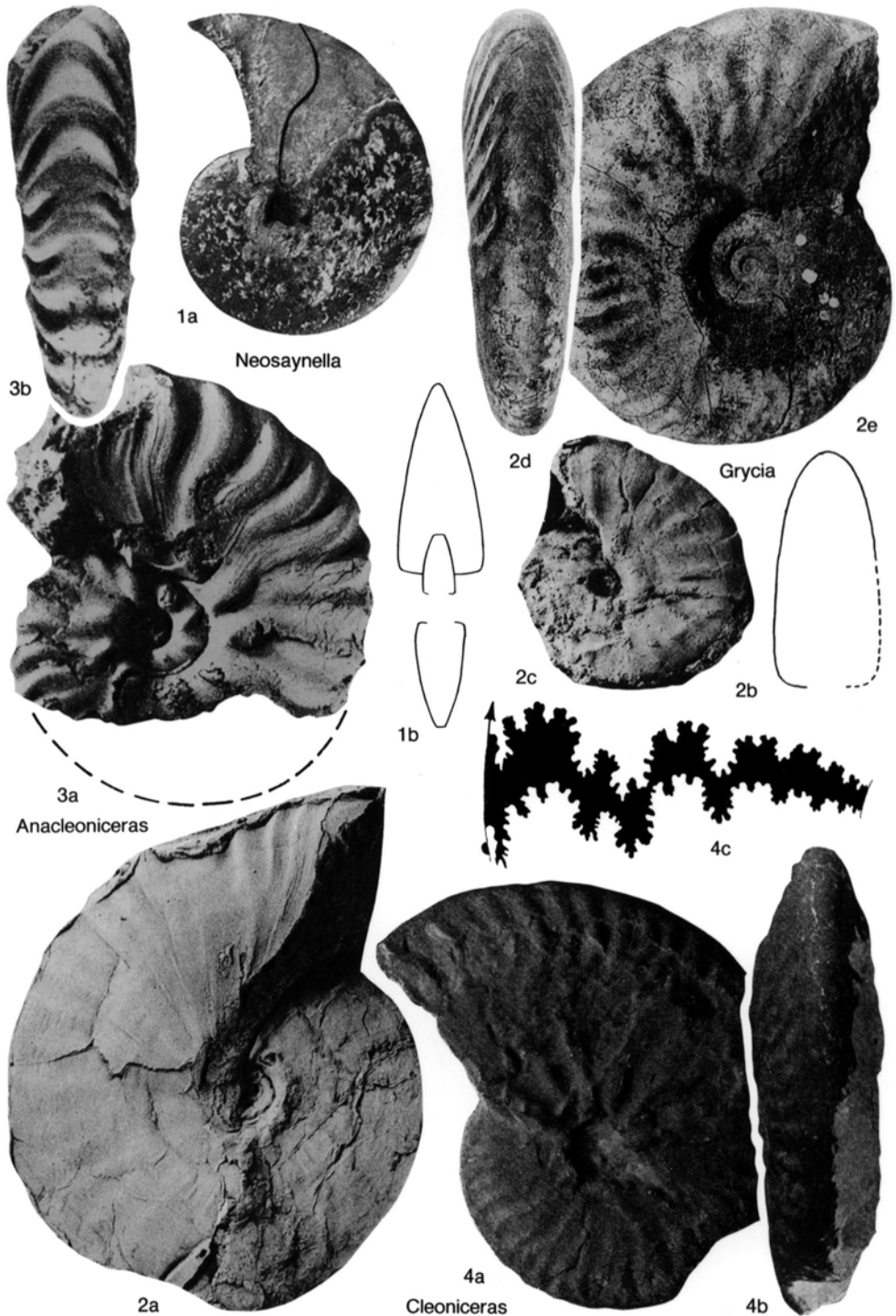


FIG. 75. Cleoniceratidae (p. 96–100)

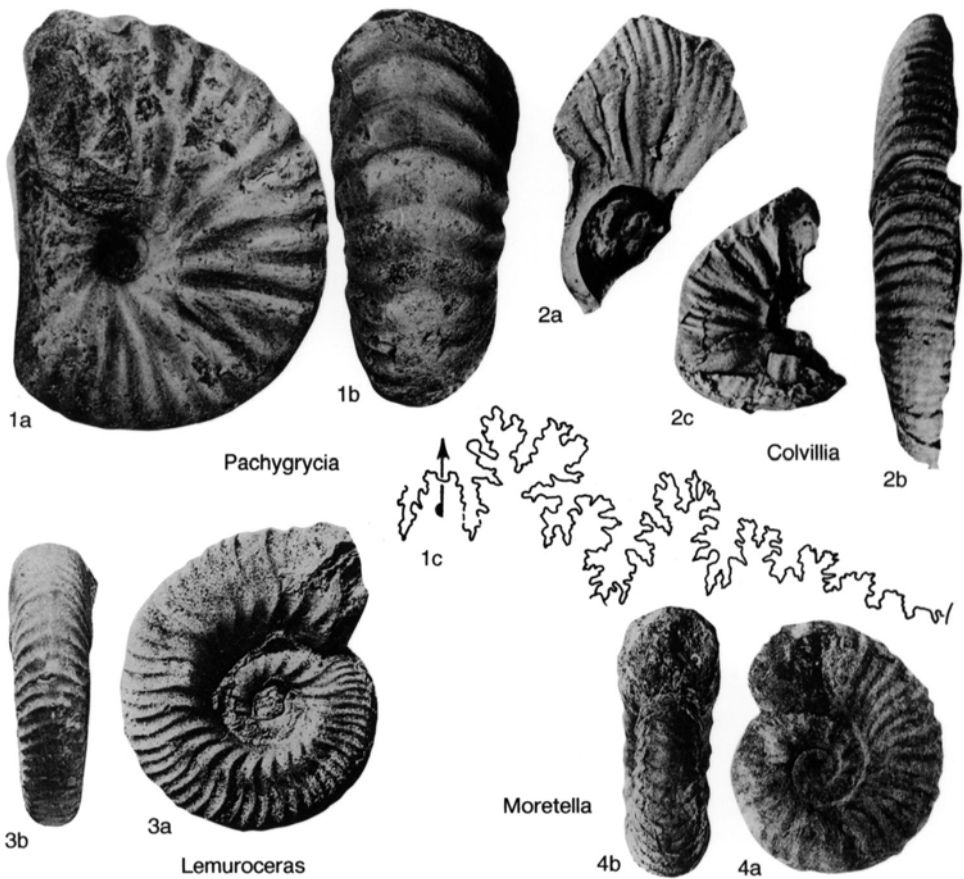


FIG. 76. Cleoniceratidae (p. 100–101)

then acute, and finally rounded. *Lower Cretaceous (Lower Albian, mammillatum Zone)*: England, France, Transcaspia, Alaska.—FIG. 75, 1a, b. **C. (N.) inornatum*, England; $\times 1$ (Casey, 1954a).

Tetrahoplitoides CASEY, 1954a, p. 115, *nom. nov. pro Coloboceras* CRICKMAY, 1927, p. 511, *non* TROUSSART, 1889, p. 233 [**Sonneratia stantoni* ANDERSON, 1902, p. 105; OD]. Like compressed *Tetrahoplites*, but venter more angular and ribs tending to weaken on midsides and venter. Probably derived from inflated *Leconteites* and only a homeomorph of compressed *Tetrahoplites*. *Lower Cretaceous (Lower Albian)*: California.—FIG. 73, 4a, b. **T. stantoni* (ANDERSON); a, $\times 1$; b, $\times 2$ (Anderson, 1902).

Cymahoplites SPATH, 1922a, p. 110 [**Ammonites kerenskianus* BOGOSLOVSKII, 1902, p. 32; M] [= *Vjasemskiceras* SAZONOVA, 1961, p. 22, *obj.*]. Compressed, with flat sides and well-rounded venter; early whorls with fine, fairly close, sinuous ribs starting at right angles to umbilical edge, some branching one-third up side, and crossing venter

with forward bend and slight flattening; points of branching raised into slight bullae; outer whorls more or less smooth. *Lower Cretaceous (Lower Albian, mammillatum Zone)*: England, Transcaspia.—FIG. 73, 3a, b. **C. kerenskianus* (BOGOSLOVSKII), Russia; $\times 1$ (Bogoslovskii, 1902).

Lemuroceras SPATH, 1942, p. 687 [**Pseudobaploceras aburense* SPATH, 1933a, p. 801; OD]. Compressed, evolute; ribs of varying strength; finer-ribbed species very similar to *Cymahoplites*, but ribs more oblique on umbilical edge; venter more quadrate and secondary ribs more numerous than in some otherwise similar, boreal *Archthoplites*. *Lower Cretaceous (Lower Albian, mammillatum Zone)*: Madagascar, Pakistan.—FIG. 76, 3a, b. **L. aburense* (SPATH), Pakistan; $\times 1$ (Spath, 1933a).

Moretella COLLIGNON, 1963, p. 101 [**Pseudosonneratia madagascariensis* COLLIGNON, 1949b, p. 81; OD]. Small, with round or quadrate whorl section; ribs running obliquely from umbilical seam, generally branching a little above umbilical margin, and thickening markedly on venter. Probably dwarf, inflated offshoot of *Lemuroceras*. *Lower Cretaceous*

(Lower Albian): Madagascar.—FIG. 76,4a,b. **M. madagascariensis* (COLLIGNON); $\times 1$ (Collignon, 1949b).

?*Pachygyrcia* JELETZKY & STELCK, 1981, p. 3 [**P. canadensis*; OD]. Whorl section and ornament as in *Sommeratia*, but suture with wide L and 6 auxiliary lobes. Lower Cretaceous (Lower Albian): northern Canada.—FIG. 76,1a–c. **P. canadensis*; a,b, $\times 1$; c, $\times 2.5$ (Jeletzky & Stelck, 1981; courtesy of the Geological Survey of Canada).

Colvillia IMLAY, 1961, p. 57 [**C. kenti*; OD]. Moderately involute, compressed, with convex sides and narrowly arched venter; primary ribs long, thick, splitting about midflank into 2 or 3 secondaries that are projected on shoulders; constrictions present, strongest on venter. Suture with wide E/L and L, but other elements narrow. Lower Cretaceous (Lower Albian): Alaska.—FIG. 76,2a,b. **C. kenti*; $\times 1$ (Imlay, 1961).—FIG. 76,2c. *C. crassicostata* IMLAY; $\times 1$ (Imlay, 1961).

Family PACHYDISCIDAE Spath, 1922

[nom. transl. SPATH, 1923d, p. 39, ex Pachydiscinae SPATH, 1922b, p. 132]

Moderate-sized to large; rather involute to evolute; inflated and depressed to compressed and high-whorled. Distinguished from Desmoceratidae primarily by strong ribbing at some stage of growth; ribbing normally crossing venter without interruption and showing tendency to strong tuberculation at least on umbilical shoulder. Suture much as in Desmoceratinae, with smaller, less asymmetric L and narrower, generally less retracted umbilical lobes than Puzosiinae. Microconchs without lappets; from the Turonian onward there is a series of small forms with simple apertures and prominent umbilical, ventrolateral, and even siphonal tubercles; most, if not all, are microconchs of contemporary genera. GROS-SOUVRE, 1894; COLLIGNON, 1952; MATSUMOTO, 1954, 1955c; WRIGHT, 1955. Lower Cretaceous (Upper Albian)—Upper Cretaceous (Upper Maastrichtian).

The family arose in the Late Albian, probably from Desmoceratinae.

Eopachydiscus WRIGHT, 1955, p. 570 [**Pachydiscus laevicaniculatus* LASSWITZ, 1904, p. 236; OD; =*Ammonites marcianus* SHUMARD, 1854, p. 209]. Large, rather inflated to compressed, and moderately involute; venter more or less narrowly rounded; inner whorls having frequent, strong but shallow constrictions with collared ribs, with or without intermediate ribs; distinct umbilical bullae sometimes present; ribs and constrictions becoming

increasingly projected on shoulders with age; outer whorls smooth or with distant, barlike ribs on inner part of side. Suture with broad, open, minutely frilled elements and auxiliaries in regularly descending series. KENNEDY, WRIGHT, & CHANCELLOR, 1983. Lower Cretaceous (Upper Albian): southern India, New Mexico, Colorado, Texas.—FIG. 77,2. **E. marcianus* (SHUMARD), Texas; $\times 0.75$ (Lasswitz, 1904).

?*Chimbuites* CASEY & GLAESSNER in GLAESSNER, 1958, p. 213 [**C. sinuosocostatus*; OD]. Moderately compressed, with broadly rounded venter; strong, thick primary ribs forming umbilical bullae; three or more secondaries of varying strength branching from umbilical bullae and strongly projected on shoulders. Suture with rather wide, plump elements. Upper Cretaceous (Upper Cenomanian): New Guinea, Bathurst Island.—FIG. 78,1a,b. **C. sinuosocostatus*, New Guinea; a, $\times 0.75$; b, $\times 1$ (Glaessner, 1958).

Lewesiceras SPATH, 1939b, p. 296 [**Ammonites peramplus* MANTELL, 1822, p. 200; OD]. Early whorls with ribs and constrictions much as in early whorls of *Eopachydiscus* but with more or less strong umbilical tubercles and with ribs more sinuous and persisting to a later stage; later whorls tending to become smooth, more compressed, and higher-whorled. Sutures well spaced, with simple and massive elements, and rather less finely frilled than in *Eopachydiscus*. Upper Cretaceous (Lower Cenomanian—Upper Turonian, ?Coniacian): Europe, northern Africa, Madagascar, central Asia, southern India, Japan, Montana.—FIG. 78,2a,b. *L. mantelli* WRIGHT & WRIGHT, Upper Turonian, England; $\times 1$ (Sharpe, 1853–1857).

Tongoboryceras HOUŠA, 1967, p. 42 [**Lewesiceras tongoboryense* COLLIGNON, 1952, p. 23; OD]. Inflated, with broadly rounded venter; inner whorls smooth with strong constrictions forming angle on venter; outer whorls with nearly uniform, strong ribs; umbilical tubercles moderately strong to absent. Sutures interlocking, with long, slender, deeply incised elements. Upper Cretaceous (Upper Turonian—Coniacian): England, France, ?Spain, Austria, Madagascar, Japan.—FIG. 79,1a,b. **T. tongoboryense* (COLLIGNON), Lower Coniacian, Madagascar; $\times 1$ (Collignon, 1955).

Menabonites HOUŠA, 1967, p. 41 [**Pachydiscus anapadensis* KOSSMAT, 1895, p. 155(52); OD]. Differs from *Lewesiceras* in retaining depressed whorl section and umbilical tubercles to a later stage and from *Tongoboryceras* in having, at least on outer whorls, ventrolateral tubercles on primary and some secondary ribs. Upper Cretaceous (Turonian—Coniacian): France, Madagascar, India.—FIG. 79,2a,b. **M. anapadensis* (KOSSMAT), Turonian, India, $\times 0.75$ (Stoliczka, 1865).

Pseudojacobites SPATH, 1922b, p. 121 [**Pachydiscus farmeryi* CRICK, 1910, p. 345; OD] [= *Pseudopuzosia* SPATH, 1926a, p. 80 (type, *Desmoceras marlowense* NOBLE, 1911, p. 398; OD); *Rotalinites* SHIMIZU, 1935a, p. 181 (type, *Ammonites rosalinus* STOLICZKA, 1864, p. 65; OD)]. Depressed, evolute,

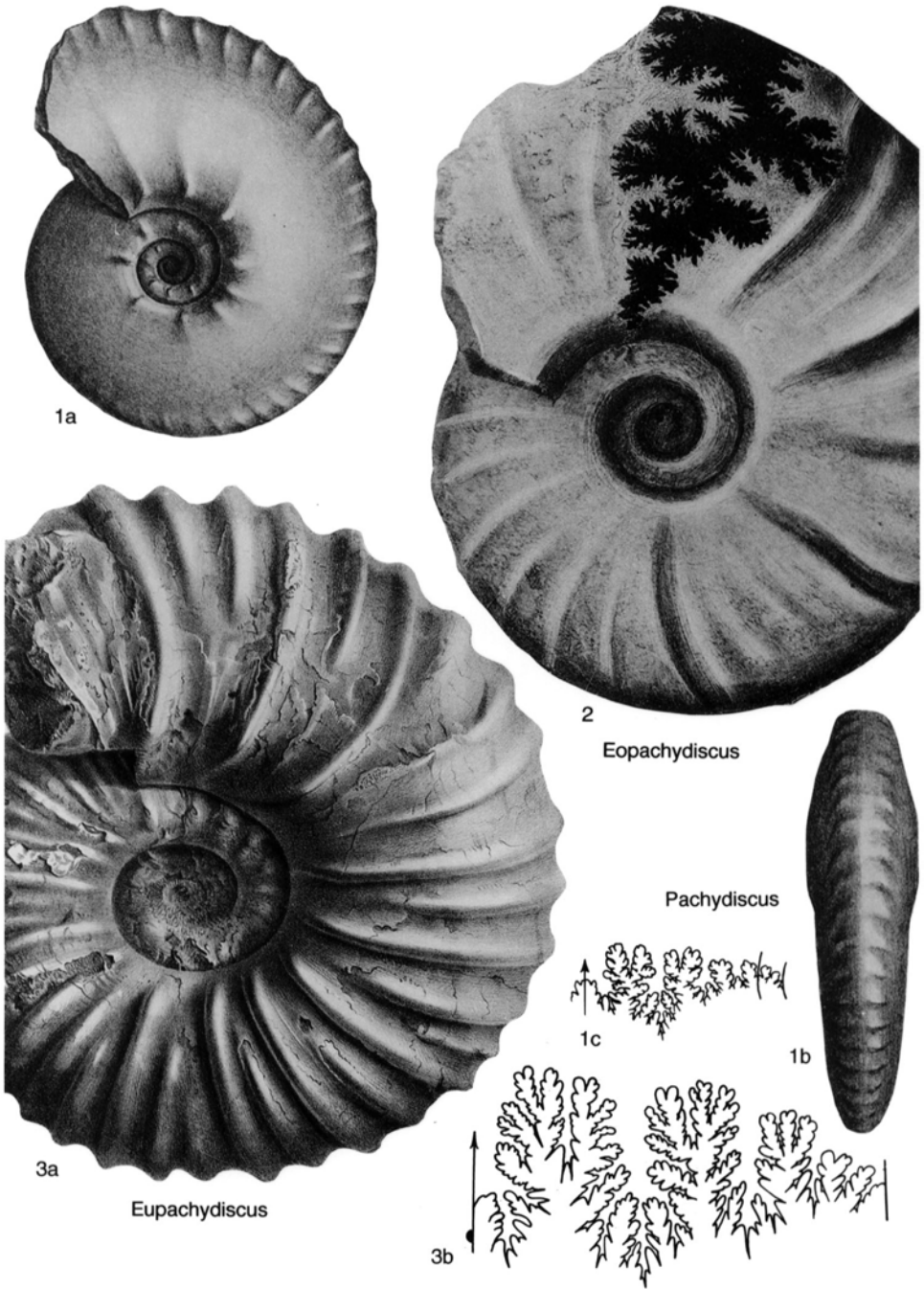


FIG. 77. Pachydiscidae (p. 101–107)

with strong constrictions crossing the wide venter almost transversely, each preceded by a strong, rounded rib springing from an umbilical bulla; weak or no intermediate ribs; outer whorls with

strong umbilical, ventrolateral, and siphonal septispinate tubercles. Sutures slightly interlocking; elements long and narrow, with sharp subdivisions. *Upper Cretaceous (Upper Turonian–Coniacian): En-*

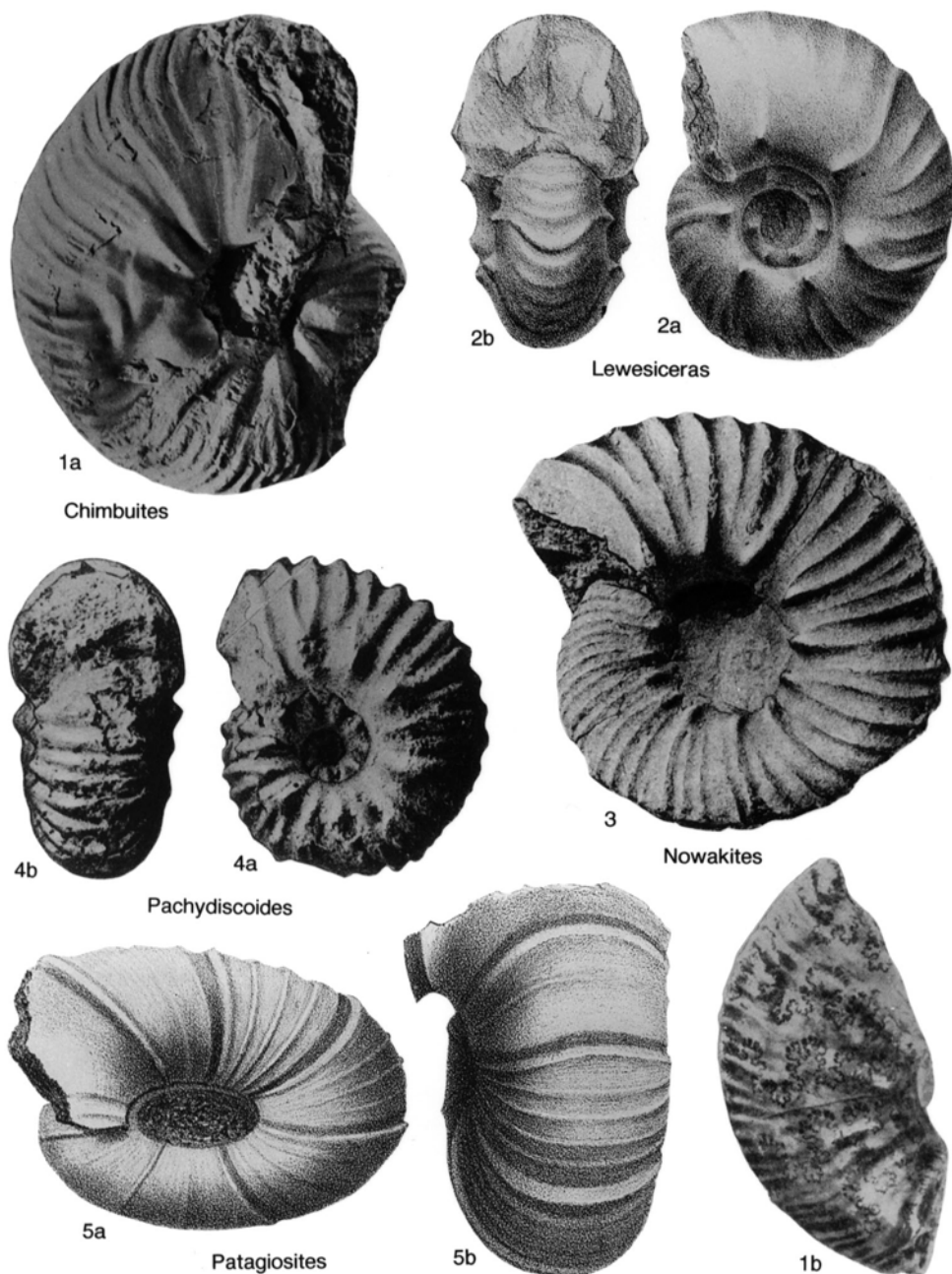


FIG. 78. Pachydiscidae (p. 101–105)

gland, Madagascar, southern India.—FIG. 79, 3a–e. **P. farmeryi* (CRICK), Upper Turonian, England; ×1 (Wright, 1979).

Pachydiscoides SPATH, 1922b, p. 124 [**Sonneratia janeti* GROSSOUVRE, 1894, p. 145; OD]. Moderately involute; whorl section nearly circular to high and

oval; prominent umbilical bullae giving rise to pairs of very strong, coarse, straight ribs; a few intercalated ribs present. *Upper Cretaceous* (Coniacian–Santonian): France, Spain, northern Africa, Madagascar.—FIG. 78, 4a, b. **P. janeti* (GROSSOUVRE), Coniacian, France; ×1 (Grossouvre, 1894).

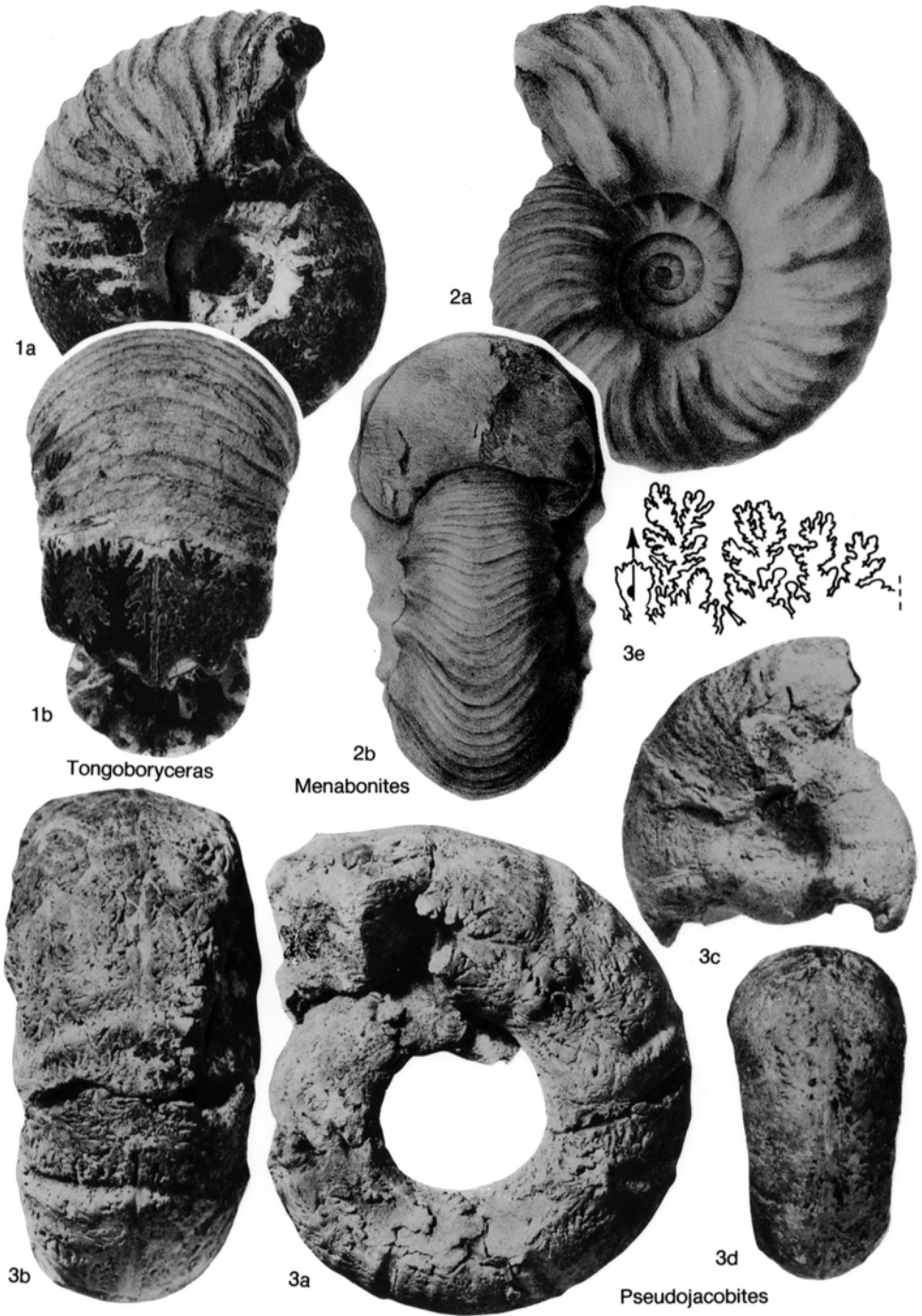


FIG. 79. Pachydiscidae (p. 101–103)

Tuberodiscoides COLLIGNON, 1966, p. 31 [**T. termierorum*; OD]. Extreme development of *Pachydiscoides* with flat sides and fastigiate venter; coarse ribs springing mainly in pairs from very large umbilical tubercles are produced into sharp ventrolateral angle and end in a distinct siphonal tubercle. *Upper Cretaceous (Lower Santonian)*: Madagascar. —FIG. 80, 2a, b. **T. termierorum*; X1 (Collignon, 1966).

Nowakites SPATH, 1922b, p. 124 [**Pachydiscus carezi* GROSSOUVRE, 1894, p. 190; OD]. Moderately involute; whorl section circular to oval; prominent, sharp, main ribs springing in pairs from weak umbilical bullae and curving forward to venter, with several intercalatories of unequal length between these pairs; broad, shallow constrictions on inner whorls only. Suture with massive lobes. *Upper Cretaceous (Coniacian–Santonian)*: France, Spain, Germany, Austria, Armenia, southern India, Japan. —FIG. 78, 3. **N. carezi* (GROSSOUVRE), Coniacian, France; X1 (Grossouvre, 1894).

Canadoceras SPATH, 1922b, p. 125 [**Ammonites newberryanus* MEEK, 1876, p. 47; OD] [= *Pseudopachydiscus* YABE & SHIMIZU, 1926, p. 172 (type, *Pachydiscus kossmati* YABE, 1909, p. 417, *nom. nud.*; OD)]. Rather evolute, more or less compressed probable derivative of *Nowakites*. Strong, equal, sharp, branching or intercalated ribs beginning a little above umbilical shoulder; distinct, rather oblique constrictions, accompanied by collared ribs with umbilical tubercles, persisting to a late stage; ornament weakening on umbilical part of outer whorl. *Upper Cretaceous (Upper Santonian–Campanian)*: South Africa (Pondoland), Madagascar, Japan, Alaska, British Columbia, California, Brazil. —FIG. 80, 1a–c. **C. newberryanum* (MEEK), Campanian, British Columbia; a, b, X0.5 (Spath, 1922b); c, X0.75 (Usher, 1952).

Teshioites MATSUMOTO, 1955c, p. 173 [**T. ryugasensis*; OD]. Microconch, probably of *Canadoceras*, with ventrolateral tubercles on body chamber. *Upper Cretaceous (Upper Campanian)*: ?France, Japan, Sakhalin. —FIG. 81, 1a, b. **T. ryugasensis*, Japan; X0.5 (Matsumoto, 1955c).

Patagiosites SPATH, 1953, p. 38 [**Ammonites patagiosus* SCHLÜTER, 1867, p. 22; OD]. Distinct constrictions persisting to fairly late stage; without definite umbilical tubercles; after early whorls at least, ribs weak and irregular or absent. *Upper Cretaceous (Lower Santonian–Maastrichtian)*: northwestern Europe, Austria, Alaska, Argentina (Patagonia), Antarctic Peninsula (Graham Land). —FIG. 78, 5a, b. **P. patagiosus* (SCHLÜTER), Campanian, Germany; distorted, X1 (Schlüter, 1871–1876).

Menuites SPATH, 1922b, p. 123 [**Ammonites menu* FORBES, 1846, p. 111; OD] [= *Anapachydiscus* YABE & SHIMIZU, 1926, p. 172 (type, *Pachydiscus (Parapachydiscus) fascicostatus* YABE in YABE & SHIMIZU, 1921, p. 57; OD); *Neopachydiscus* YABE & SHIMIZU, 1926, p. 173 (type, *Pachydiscus naumanni* YOKOYAMA, 1890, p. 187; OD); *Besaireites* COLLIGNON, 1931b, p. 19 (type, *Kossmaticeras pseudorotalinus*

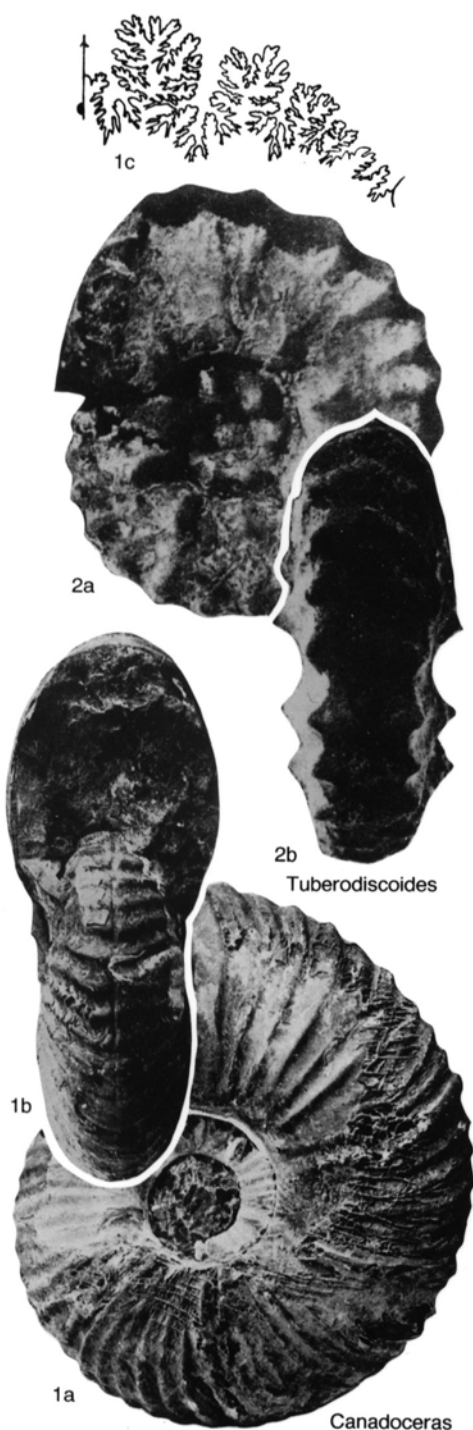


FIG. 80. Pachydiscidae (p. 105)

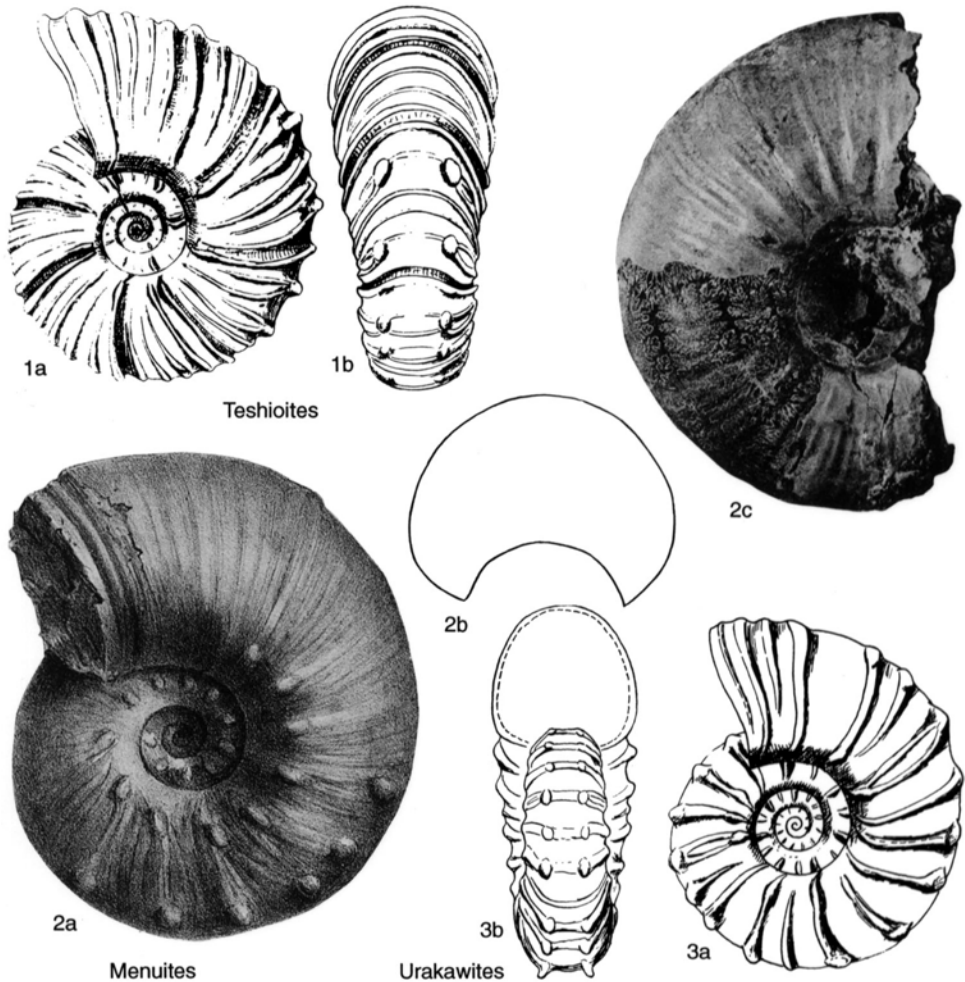


FIG. 81. Pachydiscidae (p. 105–107)

COLLIGNON, 1931b, p. 18; M); *Hoepenites* COLLIGNON, 1952, p. 9 (type, *Pachydiscus patagonicus* PAULCKE, 1907, p. 232; OD); *Cobbanoscaphites* COLLIGNON, 1969, p. 51 (type, *C. menabensis*; OD)]. Very inflated to rather compressed; moderately involute; smooth and constricted at first, then with umbilical bullae and fine, straight or slightly curved ribs. Macroconchs large; body chamber with ribs coarsening or disappearing. Microconchs small, with rounded umbilical and ventrolateral tubercles on outer whorl and with constricted, simple aperture. *Upper Cretaceous* (?Coniacian, Santonian–*Upper Maastrichtian*): virtually worldwide.—FIG. 81, 2a, b. **M. menu* (FORBES), Campanian, southern India; microconch, $\times 1$ (Stoliczka, 1863–1866).—FIG. 81, 2c. *M. fascicostatus* (YABE & SHIMIZU), Santonian, Japan; macroconch, $\times 0.75$ (Yabe & Shimizu, 1926).

Eupachydiscus SPATH, 1922b, p. 124 [**Ammonites isculensis* REDTENBACHER, 1873, p. 122; OD] [= *Mesopachydiscus* YABE & SHIMIZU, 1926, p. 172 (type, *Pachydiscus haradai* JIMBO, 1894, p. 29(168); OD)]. Whorl section inflated and depressed, almost round in later whorls; early whorls with rather fine, distant, narrow but prominent ribs springing in pairs from umbilical tubercles; in midgrowth coarse, distant ribs appear which, with their umbilical tubercles, may become even stronger on last whorl. *Upper Cretaceous* (Coniacian–Campanian): Europe, Madagascar, Japan, New Zealand, British Columbia.—FIG. 77, 3a, b. **E. isculensis* (REDTENBACHER), Coniacian, Austria; a, $\times 0.5$; b, $\times 0.75$ (Redtenbacher, 1873).

Urakawites MATSUMOTO, 1955c, p. 167 [**Pachydiscus rotalinoides* YABE, 1915, p. 21; OD]. Less depressed and more strongly ribbed than *Meninites*. Micro-

conch, probably of *Eupachydiscus*. *Upper Cretaceous* (Campanian): ?Germany, ?Angola, Japan, Sakhalin, British Columbia.—FIG. 81,3a,b. **U. rotalinooides* (YABE), Japan; $\times 0.5$ (Matsumoto, 1955c).

Pachydiscus ZITTEL, 1884, p. 466 [**Ammonites neubergicus* HAUER, 1858, p. 12; SD GROSSOUVRE, 1894, p. 177; ICZN Opinion 1519, 1989 (given precedence over *Ammonites christna* FORBES, 1846, p. 103)]. Compressed, high-whorled, with flat or convex sides; ribs tending to differentiate into short umbilicals and separate ventrolaterals, the latter tending to be interrupted on venter or to disappear. *Upper Cretaceous* (Campanian—Upper Maastrichtian): worldwide.

P. (**Pachydiscus**) [= *Parapachydiscus* HYATT, 1900, p. 570 (type, *Ammonites gollevillensis* ORBIGNY, 1850a, p. 212; OD); *Joaquinities* ANDERSON, 1958, p. 218 (type, *J. fasciostatus*; OD)]. Ribs persisting. Occurrence and distribution as for genus.—FIG. 77,1a–c. *P.* (*P.*) *compressus* SPATH, Campanian, southern India; $\times 0.75$ (Kossmat, 1895–1898).

P. (**Neodesmoceras**) MATSUMOTO, 1947, p. 39 (1938b, p. 193, *nom. nud.*) [**P. (N.) japonicus*; OD]. Ribs disappearing early, leaving shell almost smooth. *Upper Cretaceous* (Maastrichtian): Madagascar, southern India, Japan, Alaska, California.

Family MUNIERICERATIDAE

Wright, 1952

[Muniericeratidae WRIGHT, 1952, p. 222] [= *Pseudoschloenbachiiinae* HOEPEN, 1968b, p. 186]

Moderately involute, with more or less fastigiate whorl section; generally with sinuous ribs tending to be tuberculate at umbilical and ventrolateral shoulders; midlateral tubercles may also occur. Suture with rather shallow and coarsely denticulate elements, the number of auxiliary lobes decreasing with time. *Upper Cretaceous* (Lower Turonian—Lower Campanian).

Tragodesmoceras appears to be derived from some Desmoceratinae, either *Tragodesmocerooides* or *Pseudoubligella*, and leads to *Muniericeras* and thence to *Pseudoschloenbachia*, which evolved rapidly into an abundance of closely related forms, here grouped in 10 subgenera, probably too much subdivided. Separation of *Tragodesmoceras* and *Muniericeras* and the rest into two subfamilies seems unnecessary.

Tragodesmoceras SPATH, 1922b, p. 127 [**Desmoceras clypealoides* LEONHARD, 1897, p. 57; OD]. Involute, with convex or flat sides and narrowly rounded venter; strong, slightly sinuous ribs arising at umbilical

edge, carrying no tubercles, and crossing venter without interruption; periodic constrictions and enlarged ribs may be present. *Upper Cretaceous* (Lower Turonian—Upper Santonian): France, Sweden, Germany, Madagascar, Kansas, Colorado, California, Oregon.—FIG. 82,1a,b. **T. clypealoides* (LEONHARD), Upper Turonian, Germany; $\times 1$ (Leonhard, 1897).—FIG. 82,1c. *T. carlilense* COBBAN, Upper Turonian, Colorado; $\times 1$ (Cobban, 1971).

Muniericeras GROSSOUVRE, 1894, p. 156 [**M. lapparenti*; OD] [= *Praemuniericeras* COLLIGNON, 1966, p. 13 (type, *P. proprium*; OD); *Morrisites* HOEPEN, 1968b, p. 185 (type, *M. louwi*; OD)]. More evolute and fastigiate than *Tragodesmoceras*, without periodic, enlarged ribs, and with ribs sharper, more distant and more strongly projected on shoulders; ribs may branch at umbilical margin and again on shoulders; umbilical and in some species ventrolateral tubercles occur; venter sharp and crenulate. Separation of species with ribs weakening or absent between ventrolateral tubercles and keel seems unnecessary. *Upper Cretaceous* (Coniacian—Upper Santonian): France, Germany, Austria, South Africa (Zululand), Madagascar.—FIG. 82,2a,b. **M. lapparenti*, Coniacian, France; $\times 1$ (Grossouvre, 1894).

Texasia REESIDE, 1932, p. 14 [**Ammonites dentatocarinatus* F. A. ROEMER, 1852, p. 33 (C. F. ROEMER, 1849, p. 417, *nom. nud.*); SD WRIGHT, 1957b, p. 432] [= *Lehmaniceras* COLLIGNON, 1966, p. 50 (type, *L. sornayi*; OD)]. Moderately involute; whorl section high, nearly rectangular or oval; with large umbilical tubercles, from which straight ribs branch in twos and threes, each rib with large ventrolateral clavus and extending across fastigiate venter to end in siphonal clavus; ribs weakening on outer whorls, but tubercles remaining. *Upper Cretaceous* (Middle Santonian—Lower Campanian): Spain, Madagascar, Texas.—FIG. 82,3a–c. **T. dentatocarinata* (ROEMER), Santonian, Texas; a, b, $\times 1$; c, $\times 2$ (Reeside, 1932).—FIG. 82,3d,e. *T. sornayi* (COLLIGNON), Middle Santonian, Madagascar; $\times 1$ (Collignon, 1966).

Pseudoschloenbachia SPATH, 1921a, p. 236 [**Ammonites umbulazi* BAILY, 1855, p. 456; OD]. Small to moderately large; more or less evolute; typically with parallel sides and fastigiate venter, distinct umbilical tubercles, and sinuous branching ribs; in later radiation inflated and square-whorled, cordate, or lanceolate forms occur; ribs and tubercles may coarsen or disappear, or ribs may break up into fine riblets. *Upper Cretaceous* (Middle Santonian—Lower Campanian): Spain, Egypt, Syria, southeastern Africa, Madagascar, southern India, British Columbia, Texas, Mississippi.

P. (**Pseudoschloenbachia**). Compressed with keel high, finely or coarsely crenulate, and generally well separated from rib endings; keel may be smooth on some internal molds; umbilical tubercles, commonly obliquely clavate, giving rise to 2 or more, sinuous to falcate ribs ending in ventrolateral tubercles; constrictions may occur.

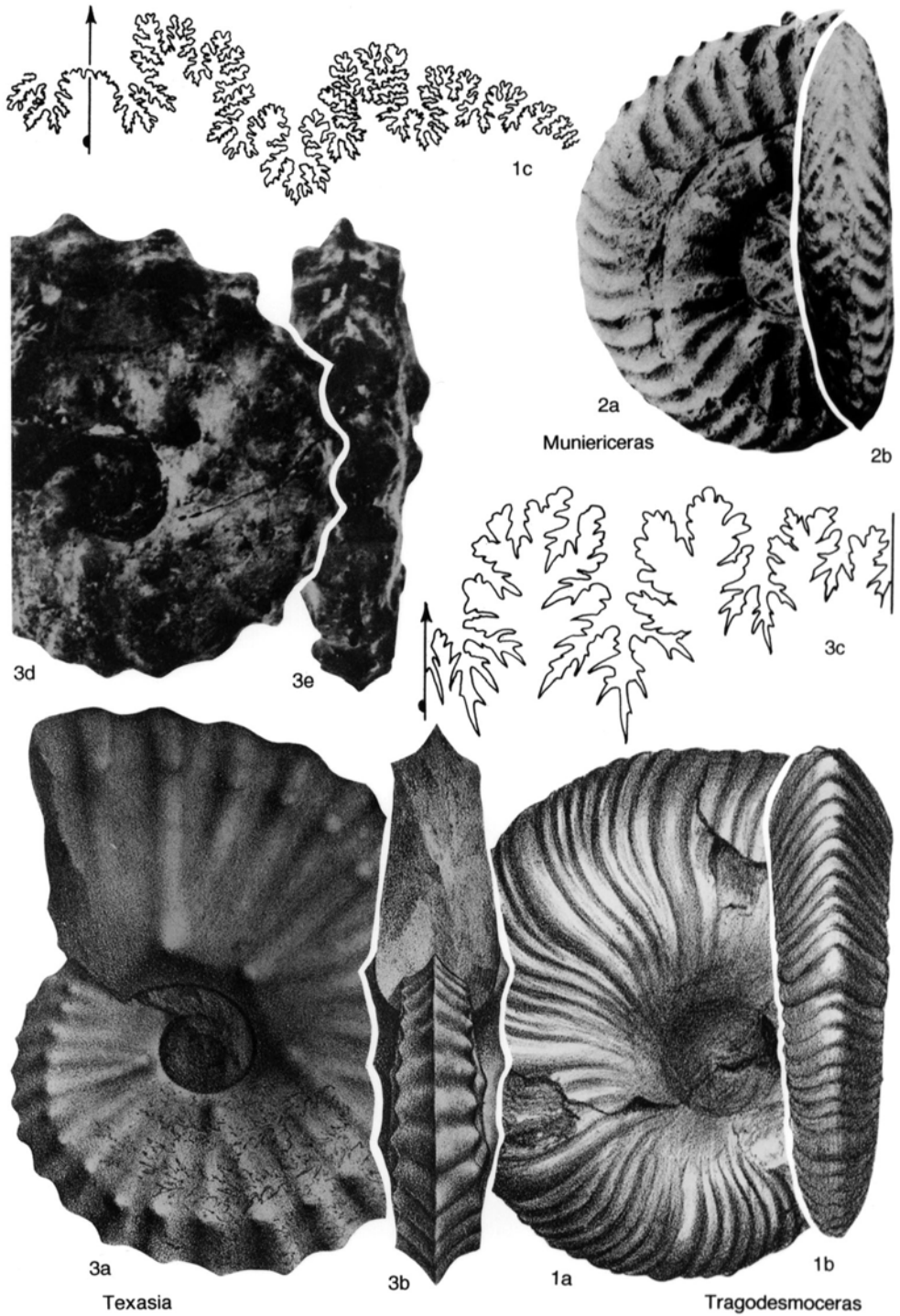


FIG. 82. Muniericeratidae (p. 107)

Some species almost smooth. Occurrence and distribution as for genus.—FIG. 83, 1*a, b*. **P. (P.) umbulazi* (BAILY), Upper Santonian, South Africa (Pondoland); X1 (Hoepen, 1921).—FIG. 83, 1*c*. *P. (P.) griesbachi* (HOEPEN), Upper Santonian, South Africa (Pondoland); X1 (Hoepen, 1921).

- P. (*Fournierella*)** COLLIGNON, 1966, p. 118 [**Schloenbachia fournieri* GROSSOUVRE, 1894, p. 112; OD]. Differs from *P. (Pseudoschloenbachia)* in having on body chamber wide constrictions between flat plateaus comprising one or more bundles of ribs. Occurrence as for genus: France, Madagascar.—FIG. 83, 4*a, b*. **P. (F.) fournieri* (GROSSOUVRE), Santonian, France; X0.75 (Grossouvre, 1894).
- P. (*Vendegiesiella*)** COLLIGNON, 1969, p. 101 [**P. (V.) spinosa*; OD]. Differs from *P. (Fournierella)* only in tendency of major ribs forming plateaus to be replaced by bundles of riblets and for mid-lateral tubercles to appear irregularly. *Upper Cretaceous (Lower Campanian)*: Madagascar.—FIG. 83, 3*a, b*. **P. (V.) spinosa*; X0.5 (Collignon, 1969).
- P. (*Besairiella*)** COLLIGNON, 1969, p. 110 [**P. (B.) besairiei*; OD]. Compressed to rather inflated; large; umbilical tubercles giving rise to short, straight primary ribs that are raised into a lateral tubercle and branch at lateral tubercle into 2 or more secondary ribs, each bearing a ventrolateral clavus and sweeping forward on venter; irregular intercalatory ribs present; on body chamber most tubercles disappearing and ribs replaced by bundles of riblets. *Upper Cretaceous (Lower Campanian)*: Madagascar, southern India.—FIG. 84, 3. **P. (B.) besairiei*, Madagascar; X0.5 (Collignon, 1969).
- P. (*Hourciella*)** COLLIGNON, 1969, p. 123 [**P. (H.) bererensis*; OD]. With low, distant ribs tending to obsolescence and ending in round to clavate ventrolateral tubercles; keel consisting of high, more or less distant clavi not corresponding exactly with ribs. *Upper Cretaceous (Lower Campanian)*: Madagascar.—FIG. 84, 5. **P. (H.) bererensis*; X0.75 (Collignon, 1969).
- P. (*Condamyella*)** COLLIGNON, 1969, p. 134 [**P. (C.) condamyi*; OD]. Rather inflated; whorl section more or less subquadrate; ribbing tending to consist of bundles of fine riblets superimposed on folds. *Upper Cretaceous (Lower Campanian)*: Madagascar.—FIG. 84, 1*a, b*. **P. (C.) condamyi*; X0.5 (Collignon, 1969).
- P. (*Buehrierella*)** COLLIGNON, 1969, p. 145 [**P. (B.) buehrieri*; OD] [= *Termierella* COLLIGNON, 1969, p. 175 (type, *P. (T.) lenticularis*; OD)]. Compressed-oval to triangular in section, with strong to extreme umbilical tubercles giving rise to broad folds; entire test from early stage covered by fine, falciform riblets. *Upper Cretaceous (Lower Campanian)*: Madagascar.—FIG. 84, 6*a, b*. **P. (B.) buehrieri*; X0.5 (Collignon, 1969).

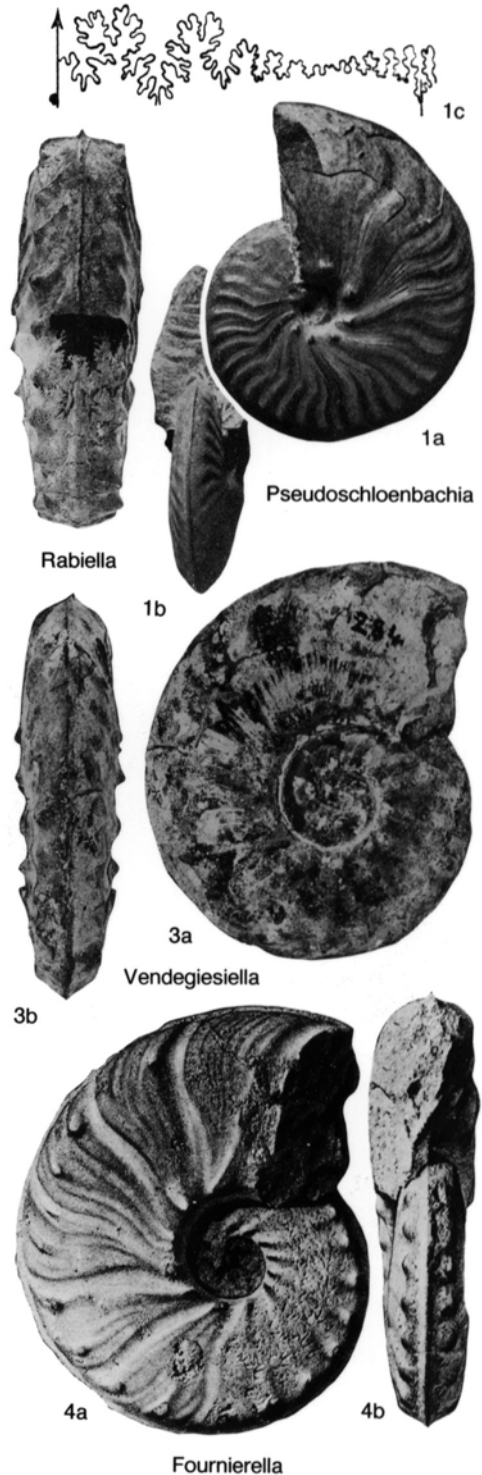


FIG. 83. Muniericeratidae (p. 107–111)

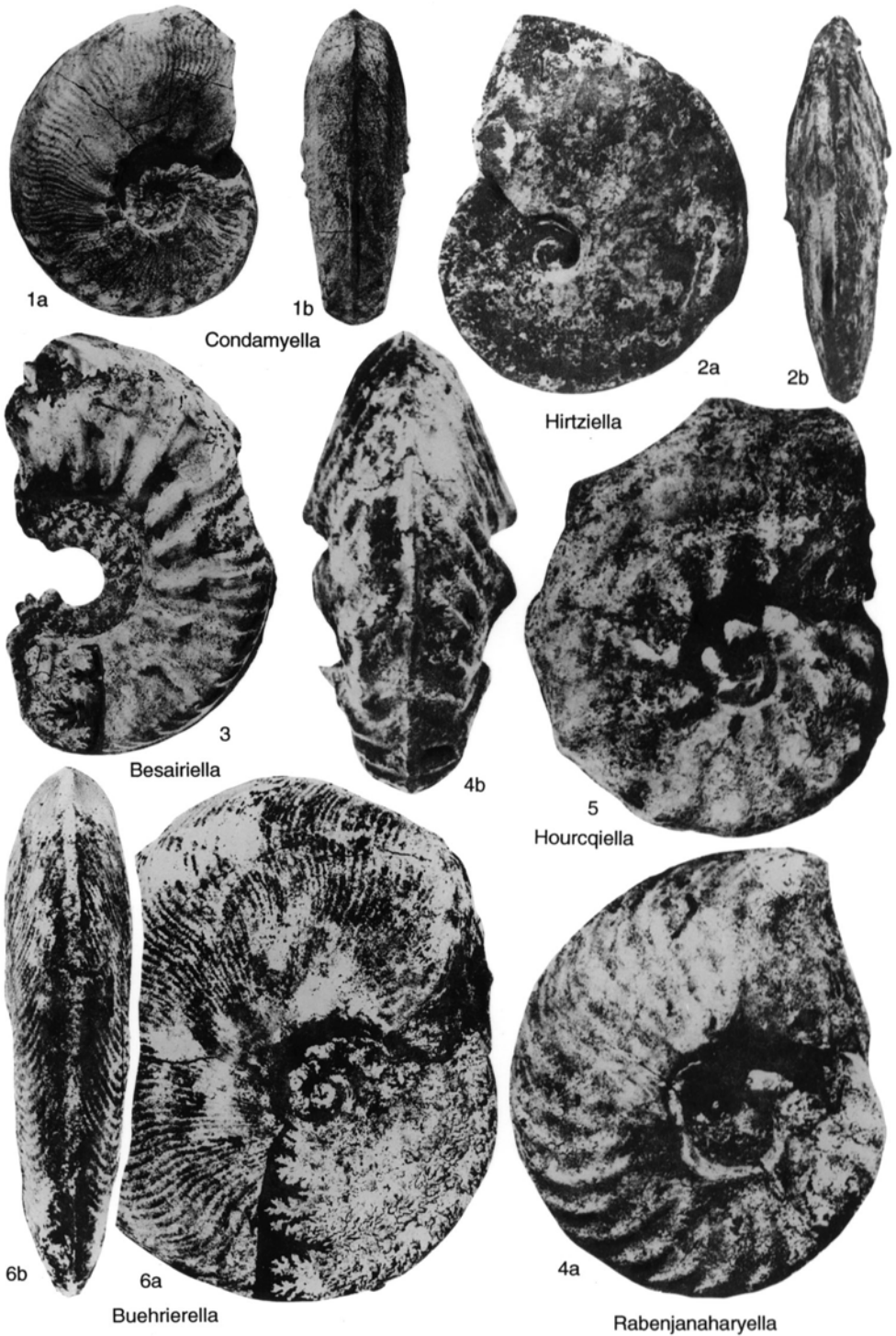


FIG. 84. Muniericeratidae (p. 109–111)

- P. (**Rabiella**) COLLIGNON, 1969, p. 157 [**P. (R.) orthogona*; OD]. Stout, with subquadrate whorl section and distant, strong, single or branching ribs bearing umbilical and ventrolateral tubercles, much as in *M. (Mortonicerus)*; body chamber with converging sides and fine, falciform riblets. *Upper Cretaceous (Lower Campanian)*: Madagascar.—FIG. 83,2. **P. (R.) orthogona*; $\times 0.5$ (Collignon, 1969).
- P. (**Rabenjanaharyella**) COLLIGNON, 1969, p. 166 [**P. (R.) rhomboidalis*; OD]. Stout, with more or less triangular whorl section and coarse, falcoid ribs springing singly or in pairs from large to very large umbilical tubercles; body chamber with fine riblets. *Upper Cretaceous (Lower Campanian)*: Madagascar.—FIG. 84,4a,b. **P. (R.) rhomboidalis*; $\times 0.75$ (Collignon, 1969).
- P. (**Hirtziella**) COLLIGNON, 1969, p. 183 [**P. (H.) inornata*; OD]. Compressed; entirely or virtually smooth, with traces only of umbilical and ventrolateral tubercles; keel very finely denticulate. *Upper Cretaceous (Lower Campanian)*: Madagascar.—FIG. 84,2a,b. **P. (H.) inornata*; $\times 0.75$ (Collignon, 1969).

Superfamily PULCHELLIACEAE

H. Douvillé, 1890

[*nom. transl.* DRUSCHITS in LUPPOV & DRUSCHITS, 1958, p. 106, ex Pulchelliidae HYATT, 1903, p. 136, *nom. correct. pro* Pulchelliidés H. DOUVILLÉ, 1890, p. 287]

A compact group of small to moderate-sized forms; very involute to moderately evolute; smooth or with ribs ranging from fine and thin to broad and flat; various tubercles developing; venter rounded, sulcate, or keeled. Suture with wide, shallow, feebly denticulate elements, in some ceratitic. Origin uncertain but probably in Desmoceratidae, Barremitinae. *Lower Cretaceous (Upper Hauterivian–Upper Aptian)*.

Family PULCHELLIIDAE

H. Douvillé, 1890

[*nom. correct.* HYATT, 1903, p. 136, *pro* Pulchelliidés H. DOUVILLÉ, 1890, p. 287] [=Heinziidae HYATT, 1903, p. 128]

Characters as for superfamily. *Lower Cretaceous (Upper Hauterivian–Upper Aptian)*.

- Pilotissotia** HYATT, 1900, p. 590 [**Pulchellia chalmasi* NICKLÈS, 1890, p. 16; OD]. Involute, compressed, with entire or tuberculate keel; smooth at first, then broad, shallow folds may develop. *Lower Cretaceous (Upper Hauterivian–Lower Aptian)*: Spain, France, Switzerland, Algeria, Colombia.—FIG. 85,1a–c. **P. chalmasi* (NICKLÈS), Barremian, Spain; a, $\times 2$; b, $\times 1.5$; c, $\times 5$ (Nicklès, 1890).
- Lophobites** HYATT, 1900, p. 590 [**Neolobites? cotteaui* NICKLÈS, 1894, p. 54; OD]. Similar to

Pilotissotia, but venter rounded, not keeled, and saddles and lobes almost entire. *Lower Cretaceous (Barremian)*: Spain.—FIG. 85,3. **L. cotteaui* (NICKLÈS); $\times 2$ (Nicklès, 1890–1894).

- Nicklesia** HYATT, 1903, p. 138 [**Ammonites dumasianus* ORBIGNY, 1842b, p. 69; OD] [=*Nicklesiella* BÜRGL, 1956, p. 55 (type, *Pulchellia (Nicklesiella) leivaensis* BÜRGL, 1956, p. 55; OD); *Semipulchellia* BÜRGL, 1956, p. 57 (type, *P. (Semipulchellia) communis*; OD)]. Very involute; smooth at first, later with broad, flat ribs and narrower interspaces crossing the rounded or slightly flattened venter without interruption. Forms transitional to *Pulchellia* have flat or shallowly sulcate venters on inner whorls (*Nicklesiella*, *Semipulchellia*). *Lower Cretaceous (Barremian)*: southern and central Europe, northern Africa, Colombia.—FIG. 85,2a,b. **N. dumasiana* (ORBIGNY), Colombia; $\times 0.5$ (Orbigny, 1842b).—FIG. 85,2c–e. *N. communis* (BÜRGL), Colombia; $\times 1$ (Bürgl, 1956).
- Buergliceras** ETAYO SERNA, 1968, p. 63 [**B. buerglii*; OD]. Similar to *Nicklesia*, except ribs ending in large ventrolateral clavi alternating with very large siphonal clavi. *Lower Cretaceous (Barremian)*: Colombia.—FIG. 85,5a–c. **B. buerglii*; a, side, $\times 1$; b, periphery, $\times 1$; c, section, $\times 1$ (Etayo Serna, 1968).
- Pulchellia** UHLIG, 1883, p. 246(122) [**Ammonites galeatus* BUCH, 1839, p. 5; SD GIGNOUX, 1921, p. 147]. Involute to evolute; compressed and flat-sided to rather inflated with convex sides; ribs ranging from coarse, broad, and flat to dense, fine, and sharp; ribs branching, or long and short, or more or less uniform and single, forming blunt to sharp ventrolateral clavi, always opposite, and continuing strongly or feebly across flat or sulcate venter; inner ventrolateral tubercles and umbilical bullae may be present. Variation within the genus seems to be continuous in all characters except degree of involution. *Lower Cretaceous (Upper Hauterivian–Upper Barremian)*: southern and central Europe, northern Africa, ?Japan, California, Venezuela, Colombia, Chile.
- P. (**Pulchellia**) [= *Caicedia* BÜRGL, 1956, p. 66 (type, *Ammonites caicedi* KARSTEN, 1858, p. 107; OD); *Hettneria* BÜRGL, 1956, p. 70 (type, *P. selecta* GERHARDT, 1897b, p. 142; OD)]. Involute; umbilicus about 10 percent of diameter. Occurrence and distribution as for genus.—FIG. 86,1a,b. **P. (P.) galeata* (BUCH), Barremian, Colombia; $\times 1$ (Riedel, 1938).—FIG. 86,1c,d. *P. (P.) caicedi* (KARSTEN), Barremian, Colombia; $\times 1$ (Karsten, 1858).—FIG. 86,1e–g. *P. (P.) orbignyi* BÜRGL, Barremian, Colombia; $\times 0.75$ (Orbigny, 1842b).
- P. (**Heinzia**) SAYN, 1891a, p. 153(19) [**Ammonites provincialis* ORBIGNY, 1850a, p. 99; SD ROMAN, 1938, p. 469] [= *Gerhardtia* HYATT, 1903, p. 135 (type, *Ammonites galeatoides* KARSTEN, 1858, p. 107; OD)]. Evolute; umbilicus about one-fourth diameter. Occurrence and distribution as for genus.—FIG. 86,2a,b. **P. (H.) provincialis* (ORBIGNY), Barremian, France; $\times 1$ (Cottreau,

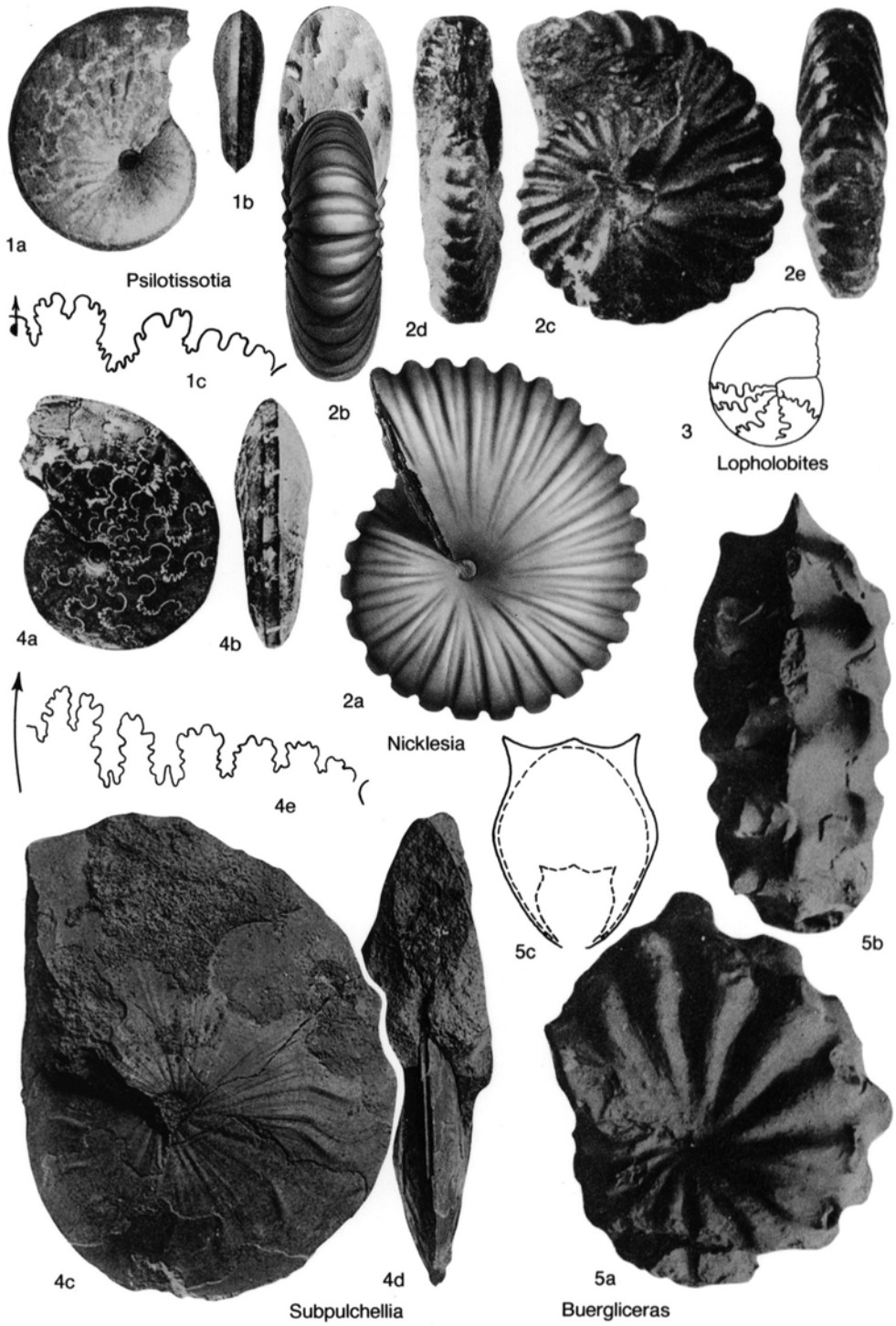


FIG. 85. Pulchelliidae (p. 111-114)

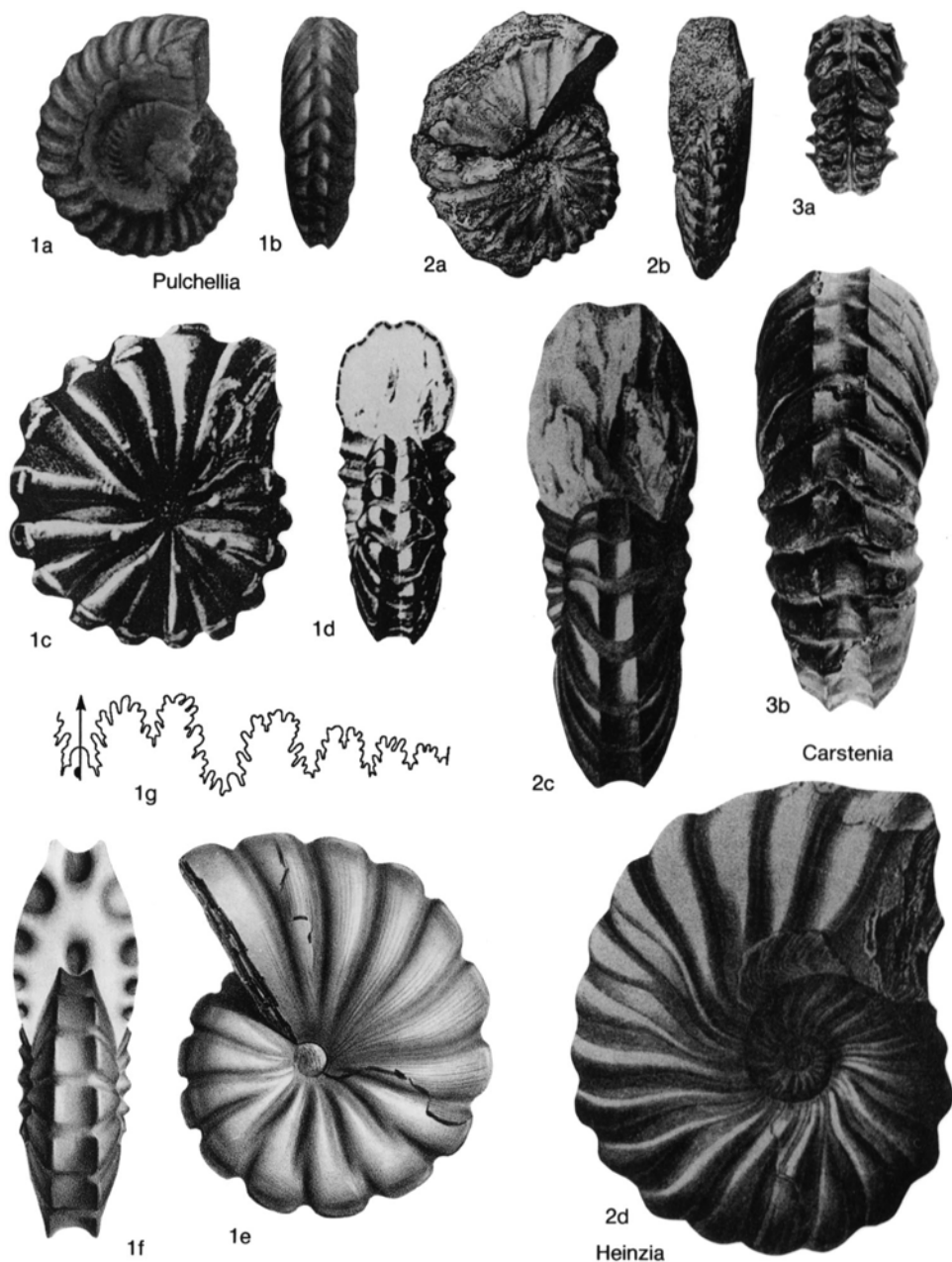


FIG. 86. Pulchelliidae (p. 111–113)

1937).—FIG. 86,2c,d. *P. (H.) galeatoides* (KARSTEN), Barremian, Colombia; $\times 0.75$ (Karsten, 1858).

P. (Carstenia) HYATT, 1903, p. 133 [*Ammonites lindigi* KARSTEN, 1858, p. 108; OD] [= *Karstenia* SAYN, 1904, p. 123, *nom. van.*]. Relatively evo-lute; whorl section inflated at all stages; from a small diameter, ribs strong with prominent inner

and outer ventrolateral clavi and large lateral tubercles; on last part of outer whorl, ribs broader and only outermost tubercle remaining. *Lower Cretaceous (Barremian)*: Colombia.—FIG. 86,3a,b. **P. (C.) lindigi* (KARSTEN); a, $\times 1$; b, $\times 0.75$ (Collet, 1924).

Coronites HYATT, 1903, p. 130 [*Heinzia coronatoides* SAYN, 1891a, p. 160(30); OD]. Only very small

nuclei known. Evolute; whorl section coronate; ribs dense, strong, and both single and branching, with or without large umbilical tubercles; venter with narrow groove. *Lower Cretaceous (Barremian):* Algeria.

Subpulchellia HYATT, 1903, p. 139 [**S. castellanensis*; OD] [= *Mogbaraeceras* BREISTROFFER, 1940, p. 135(65) (type, *Knemiceras priscum* H. DOUVILLÉ, 1917, p. 122; OD)]. Very involute, compressed, and flat-sided; venter narrow, concave, and bordered by continuous, sharp ridges; surface smooth except for irregular, weak folds and striae. *Lower Cretaceous (Barremian–Upper Aptian):* Spain, France, Egypt (Sinai).—FIG. 85,4a,b. *S. oehlerti* (NICKLES), Barremian, Spain; X2 (Nicklès, 1894).—FIG. 85,4c–e. *S. prisca* (H. DOUVILLÉ), Lower Aptian, Sinai; c,d, macroconch, X1; e, suture showing adventive lobe in saddle E/L, X2 (H. Douvillé, 1917).

[**Psilopulchellia** HYATT, 1903, p. 136 (*nom. nud.*) was mentioned by its author as the primitive member of the family, but no species were mentioned. The species selected by ROMAN, 1938, p. 468, as type is a *Pulchellia*.]

Superfamily HOPLITACEAE

H. Douvillé, 1890

[*nom. correct.* WRIGHT & WRIGHT, 1951, p. 21, *pro* Hoplitida SPATH, 1922a, p. 95, *nom. transl. ex* Hoplitidae H. DOUVILLÉ, 1890, p. 290] [= Placenticerataceae HYATT, 1900, *nom. correct.* CASEY, 1960a, p. 208, *pro* Placenticeratida HYATT, 1900, p. 584; ?Engonocerataceae HYATT, 1900, *nom. transl.* BASSE, 1952b, p. 658, *ex* Engonoceratidae HYATT, 1900, p. 585]

Derivatives, probably monophyletic, of *Uhligella* (Desmoceratidae, Beudanticeratinae) developing strong ornament typically comprising branched ribs springing from umbilical tubercles. Many with flat or grooved venter bordered by ventrolateral clavi. Nature of dimorphism not yet fully known, but microconchs probably having simple apertures. Sutures of desmoceratid type except in Placenticeratidae and Engonoceratidae, in which elements are multiplied and develop special features. SPATH, 1923–1943; WRIGHT, 1955; CASEY, 1965. *Lower Cretaceous (Upper Aptian)–Upper Cretaceous (Upper Maastrichtian).*

Family HOPLITIDAE

H. Douvillé, 1890

[*nom. correct.* BOHM, 1895, p. 365 (not HYATT, 1900, as incorrectly stated in Opinion 353), *pro* Hoplitidés H. DOUVILLÉ, 1890, p. 290; ICZN Opinion 353, 1955, Family-Group Name No. 10]

Compressed to inflated; typically with ribs springing from distinct umbilical tubercles,

interrupted or not on flat or rounded venter. Suture as in Desmoceratidae. *Lower Cretaceous (Upper Aptian, Lower Albian)–Upper Cretaceous (Lower Cenomanian).*

Particularly characteristic of central and northern European Middle Albian; few genera found south of the equator.

Subfamily SONNERATIINAE Destombes, Juignet, & Rioult, 1973

[Sonneratiinae DESTOMBES, JUIGNET, & RIOULT, 1973, p. 70]
[=Otohoplitiinae SAVELIEV, 1992, p. 24]

The trend is from strong, frequently single ribbing and arched venter to ribs branching from umbilical tubercles, with ventrolateral angulation or tubercles and flat venter. Later whorls of macroconchs may be more or less smooth, or have only obscure ribs, or strong ribbing may persist. Suture generally with relatively narrow L. *Lower Cretaceous (Upper Aptian, jacobi Zone, Lower Albian–Middle Albian).*

Sonneratiinae is the primitive subfamily of Hoplitidae, from which the rest were derived. *Sonneratia* is not known before the Lower Albian *mammillatum* Zone, but *Farnhamia* of the ?*acuticostata* Zone has inner whorls closely resembling *Sonneratia*. *Bucaillella* of the ?*jacobi* Zone has a hoplitoid suture and is best placed here (DESTOMBES, JUIGNET & RIOULT, 1973), though with some doubt.

?**Bucaillella** DESTOMBES, JUIGNET, & RIOULT, 1973, p. 71 [**B. cayeuxi*; OD]. Evolute; inflated but increasing only slowly in width; ribs strong, rather thin, high, single or branching high up on sides, and arising on umbilical wall but not forming umbilical tubercles; venter evenly rounded in young and may be slightly flattened in adults, but ribs not interrupted. Body chamber reduced in cross section. Suture typically hoplitoid. *Lower Cretaceous (Upper Aptian, jacobi Zone):* northeastern France.—FIG. 87,3a–c. **B. cayeuxi*; a,b, X0.75; c, X5 (Destombes, Juignet, & Rioult, 1973).

Farnhamia CASEY, 1954a, p. 107 [**F. farnhamensis*; OD]. Large; rather evolute; inner whorls first rounded in section, later subquadrate, with strong, blunt ribs rising in twos and threes from umbilical bullae and bent forward on venter; in middle growth, long and short nontuberculate ribs may occur; outer whorls smooth or with weak to moderate folds. Affiliation to *Archhoplites* (OWEN, 1988, p. 215) seems doubtful. *Lower Cretaceous (Lower*

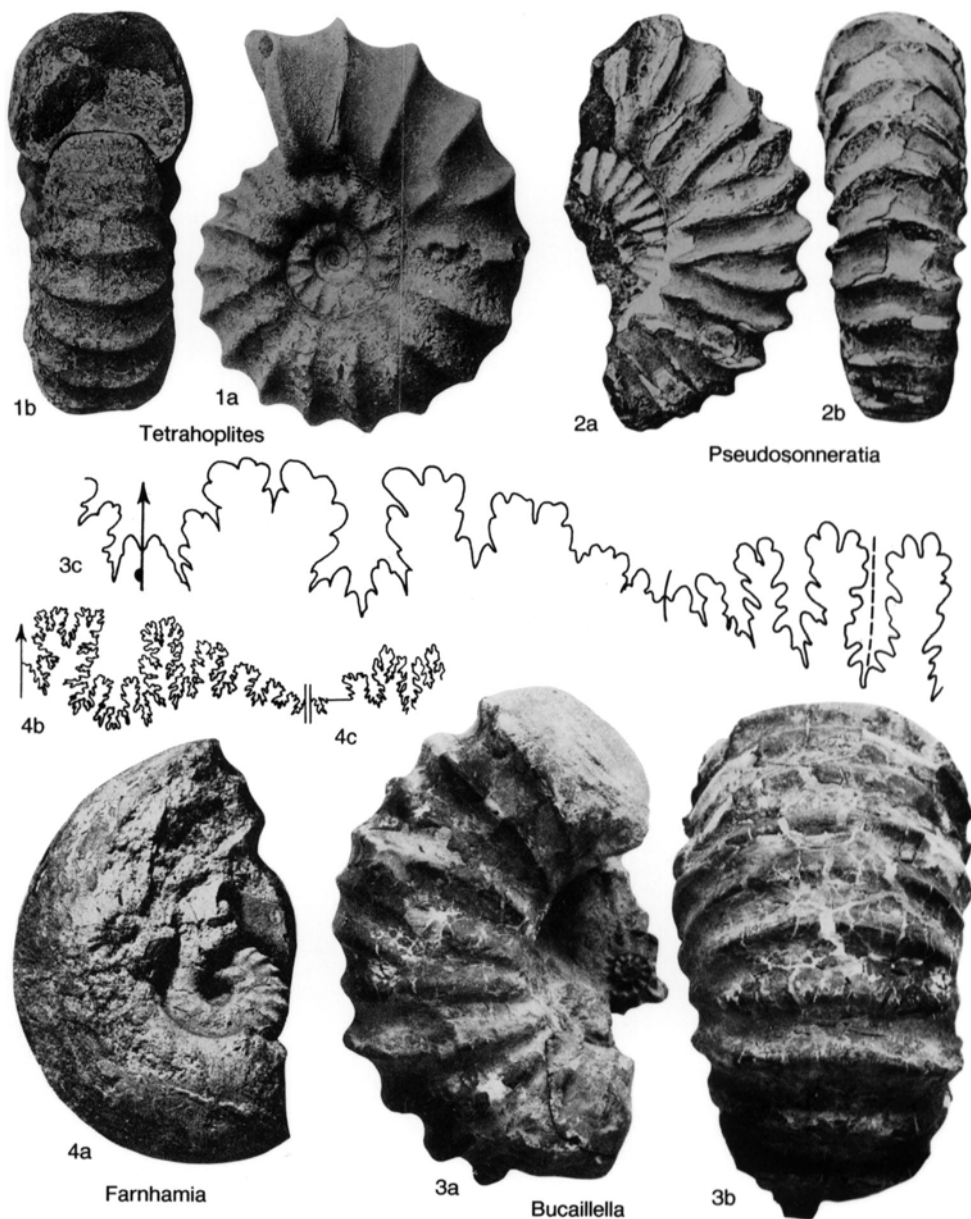


FIG. 87. Hoplitidae (p. 114–117)

Albian, tardefurcata Zone): England.—FIG. 87, 4a–c. **F. farnhamensis*; a, $\times 0.25$; b, c, $\times 0.5$ (Casey, 1954a).

Sonneratia BAYLE, 1878, explanation to pl. 60, fig. 5–6 [*Ammonites dutempleanus* ORBIGNY, 1850a, p. 123; M] [= *Eosonneratia* SAVELIEV, 1973, p. 80 (type, *S. (E.) vniгри*; OD); *Globosonneratia* SAVELIEV, 1973,

p. 83 (type, *S. (G.) globulosa* SAVELIEV, 1973, p. 83; OD; = *S. perinflata* BREISTROFFER, 1947b, p. 84(68)]. More or less involute and inflated, with arched venter; ribs strong and rounded, long and short or branching at umbilical swellings, and crossing venter without thickening on shoulders. Suture much as in *Farnhamia* but with longer L. *Lower*

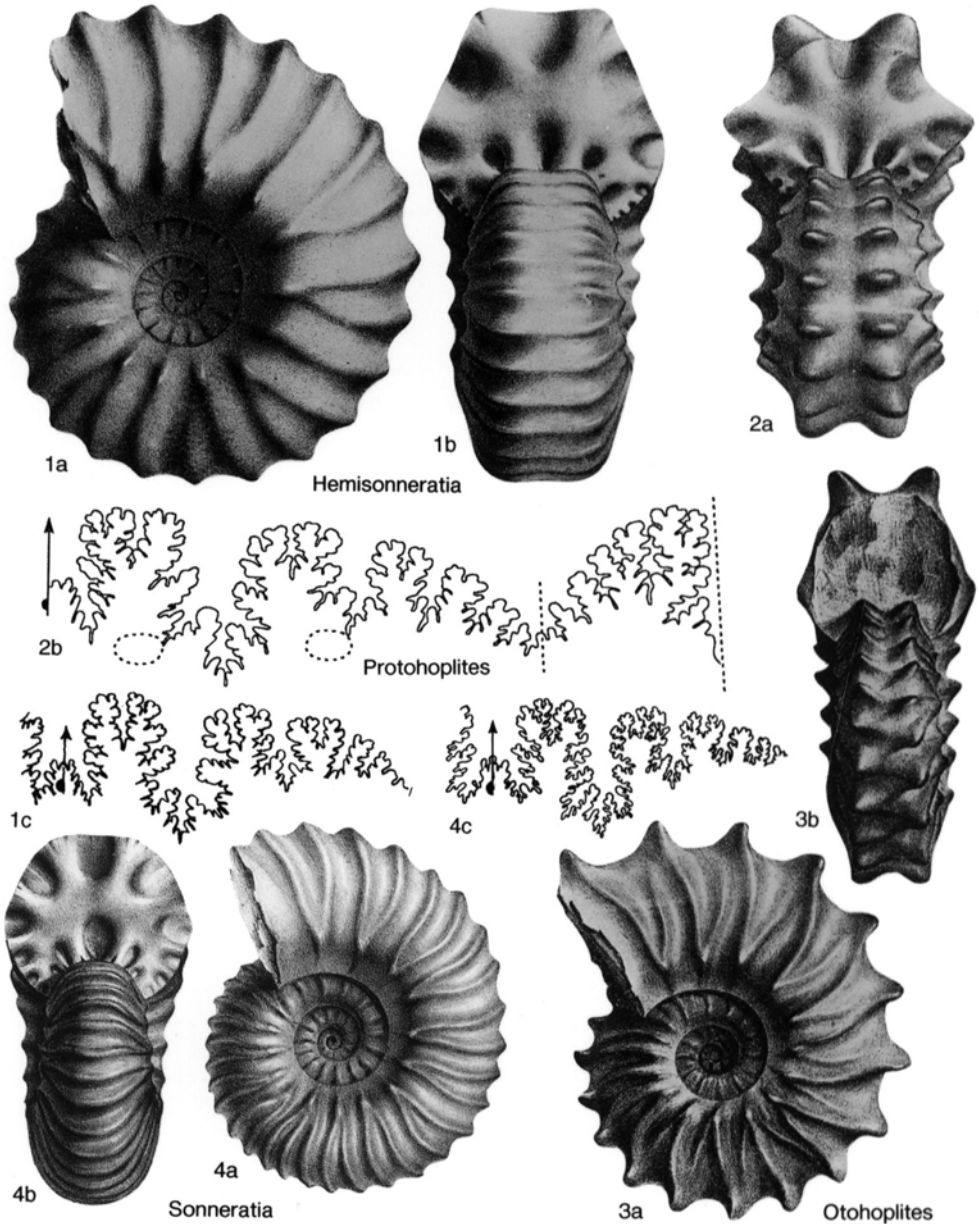


FIG. 88. Hoplitidae (p. 115–117)

Cretaceous (Lower Albian): Europe, Transcaspia. —FIG. 88, 4a–c. **S. dutempleana* (ORBIGNY), France; a, b, $\times 0.5$; c, $\times 0.75$ (Orbigny, 1840–1842). *Tetrahoplites* CASEY, 1952, p. 134 [**Sonneratia subquadrata* SINZOW, 1907, p. 476; OD]. Whorl section subquadrate, inflated to rather compressed; ribs sigmoid or concave throughout, rising mostly in pairs from blunt umbilical bullae, and bent forward but not thickened on venter. Suture as in

Farnhamia but with longer median element in L. Lower Cretaceous (Lower Albian): England, France, Transcaspia. —FIG. 87, 1a, b. **T. subquadratus* (SINZOW), Transcaspia; $\times 0.75$ (Sinzow, 1907). *Pseudosonneratia* SPATH, 1925a, p. 76 [**P. typica*; OD]. Slightly inflated to rather compressed and high-whorled, with slight flattening of sides and narrow venter. Sinuous ribs branching from umbilical bullae or alternately long and short, crossing

venter without interruption and with strong forward sweep. *Lower Cretaceous (Lower Albian, mammillatum Zone)*: England, France, Switzerland, Bornholm, Spitsbergen, Transcaspia.—FIG. 87, 2a, b. **P. typica*, France; $\times 0.75$ (Jacob, 1908).

Protohoplites SPATH, 1923d, p. 65 [**Ammonites archiacianus* ORBIGNY, 1841, p. 244; OD]. Moderately evolute; whorl section subhexagonal and depressed or compressed; venter depressed, bordered by long bullae opposite tubercles; umbilical tubercles prominent. Suture with rather narrow L and retracted toward umbilicus. Adult last whorl with rounded venter and coarse, single or branching, sigmoid ribs. *Lower Cretaceous (Lower Albian–Middle Albian)*: Europe.

P. (Hemisonneratia) CASEY, 1952, p. 135 (BREISTROFFER, 1952a, p. 153, *nom. nud.*) [**Ammonites puzosianus* ORBIGNY, 1841, p. 265; OD]. Ribs merely thickened on shoulders. Occurrence and distribution as for genus.—FIG. 88, 1a–c. **P. (H.) puzosianus* (ORBIGNY), Middle Albian, France; $\times 0.75$ (Orbigny, 1840–1842).

P. (Protohoplites). Ribs raised into strong ventrolateral tubercles. Occurrence and distribution as for genus.—FIG. 88, 2a, b. **P. (P.) archiacianus* (ORBIGNY), Middle Albian, France; a, $\times 0.75$; b, enlarged (Orbigny, 1840–1842).

Otohoplites STEINMANN, 1925, p. 361 [**Ammonites raulinianus* ORBIGNY, 1841, p. 238; SD CASEY, 1952, p. 135]. Rather inflated to compressed, with looped or zigzagging ribs ending in oblique ventrolateral clavi, generally with ribs zigzagging across venter; adult body chamber of macroconchs smooth, with rounded venter. *Lower Cretaceous (Lower Albian, mammillatum Zone)*: Europe, Transcaspia.—FIG. 88, 3a, b. **O. raulinianus* (ORBIGNY), France; $\times 0.75$ (Orbigny, 1840–1842).

Subfamily ANAHOPLITINAE Breistroffer, 1947

[*nom. transl.* WRIGHT, herein, ex Anahoplitidae BREISTROFFER, 1947b, p. 100(84)] [=Pleurohoplitinae Saveliev, 1992, p. 26]

Compressed; high-whorled, with flat venter. Suture much incised, tending to become asymmetrical in later forms as siphon moves to ventrolateral angle. *Lower Cretaceous (?Lower Albian, Middle Albian–Upper Albian)*.

Anahoplitoides, derived from compressed *Pseudosonneratia (Isophoplites)*, is placed here with a query since it may not be the direct ancestor of the Middle Albian, *dentatus* Zone species of *Anahoplites*.

?**Anahoplitoides** CASEY, 1961b, p. 599 [**Saynella splendens* (J. SOWERBY) var. *gigas* SINZOW, 1915, p. 20; OD] [= *Pochialayniceras* ALABUSHEV & ALABUSHEVA, 1988, p. 29 (type, *Hoplites yakounensis* WHITEAVES, 1900, p. 280; OD)]. Inner whorls like a costate *Anahoplites* but with ventrolateral tubercles

opposite; outer whorls, at least of macroconchs, with smooth venter. *Lower Cretaceous (Lower Albian)*: England, Transcaspia, eastern Siberia, British Columbia.—FIG. 89, 1a–c. **A. gigas* (SINZOW); a, b, $\times 0.25$; c, $\times 1$ (Casey, 1961b).

Anahoplites HYATT, 1900, p. 584 [**Ammonites splendens* J. SOWERBY, 1815, p. 1; OD] [= *Leptohoplites* SPATH, 1925d, p. 144 (type, *L. falcooides*; SD SPATH, 1928a, p. 231)]. Rather involute, compressed, with flat sides and flat, rarely sulcate venter; flexuous ribs and striae normally ending in fine, dense ventrolateral nodes; umbilical tubercles weak. Suture with short and wide L, much incised. Siphuncle and suture normally asymmetrical in later stages. *Lower Cretaceous (Middle Albian–Upper Albian)*: Europe, Transcaspia.—FIG. 89, 2a–c. *A. planus* (MANTELL), Middle Albian, England; a, b, $\times 1$; c, $\times 1.5$ (Spath, 1923–1943).—FIG. 89, 2d. *A. cantabrigensis* SPATH, Upper Albian, England; $\times 1$ (Spath, 1923–1943).

Pleurohoplites SPATH, 1921a, p. 237 [**Ammonites renauxianus* ORBIGNY, 1840, p. 113; OD]. Less involute than *Anahoplites*; whorl section compressed to very inflated; venter rounded to subcarinate; strong ribs branching from umbilical tubercles, not looped, and ending in ventrolateral nodes or swellings or continuous to siphonal line. *Lower Cretaceous (Upper Albian)*: Europe.

P. (Pleurohoplites). Compressed; venter subcarinate; sides more or less flat. Occurrence and distribution as for genus.—FIG. 89, 4a, b. **P. (P.) renauxianus* (ORBIGNY), France; $\times 0.5$ (Orbigny, 1840–1842).

P. (Arrhaphoceras) WHITEHOUSE, 1927, p. 109 [**Ammonites woodwardi* STEELEY, 1865, p. 236; OD] [= *Praeschoenbachia* SCHOLZ, 1973, p. 124 (type, *Schoenbachia (P.) briacensis* SCHOLZ, 1973, p. 124; OD)]. Inflated, with rounded venter; ribs crossing venter almost without interruption; umbilical tubercles prominent; ventrolateral bullae appearing on inner whorls and may persist. Specimens with persistent ventrolateral bullae may also have a low, rounded keel and are transitional to *Schoenbachia*, but separation as *Praeschoenbachia* seems unnecessary. Occurrence and distribution as for genus.—FIG. 89, 3a–c. *P. (A.) studeri* (PICTET & CAMPICHE), Switzerland; a, b, $\times 1$; c, enlarged (Pictet & Campiche, 1860).

Subfamily HOPLITINAE H. Douvillé, 1890

[*nom. transl.* WRIGHT, 1952, p. 220, ex Hoplitidae, *nom. correct.* BÖHM, 1895, p. 365 (not HYATT, 1900, as incorrectly stated in ICZN Opinion 353), *pro* Hoplitidae H. DOUVILLÉ, 1890, p. 290; ICZN Opinion 353, 1955, Family-Group Name No. 10] [= *Semenovitinae* MIRZOEV, 1967, p. 63; Euhoplitinae Saveliev, 1992, p. 26; Discophoplitinae Saveliev, 1992, p. 27]

Venter flat, grooved, or slightly rounded; ribs interrupted on venter, with peripheral endings alternate; ribs branching from umbilical tubercles and commonly ending in

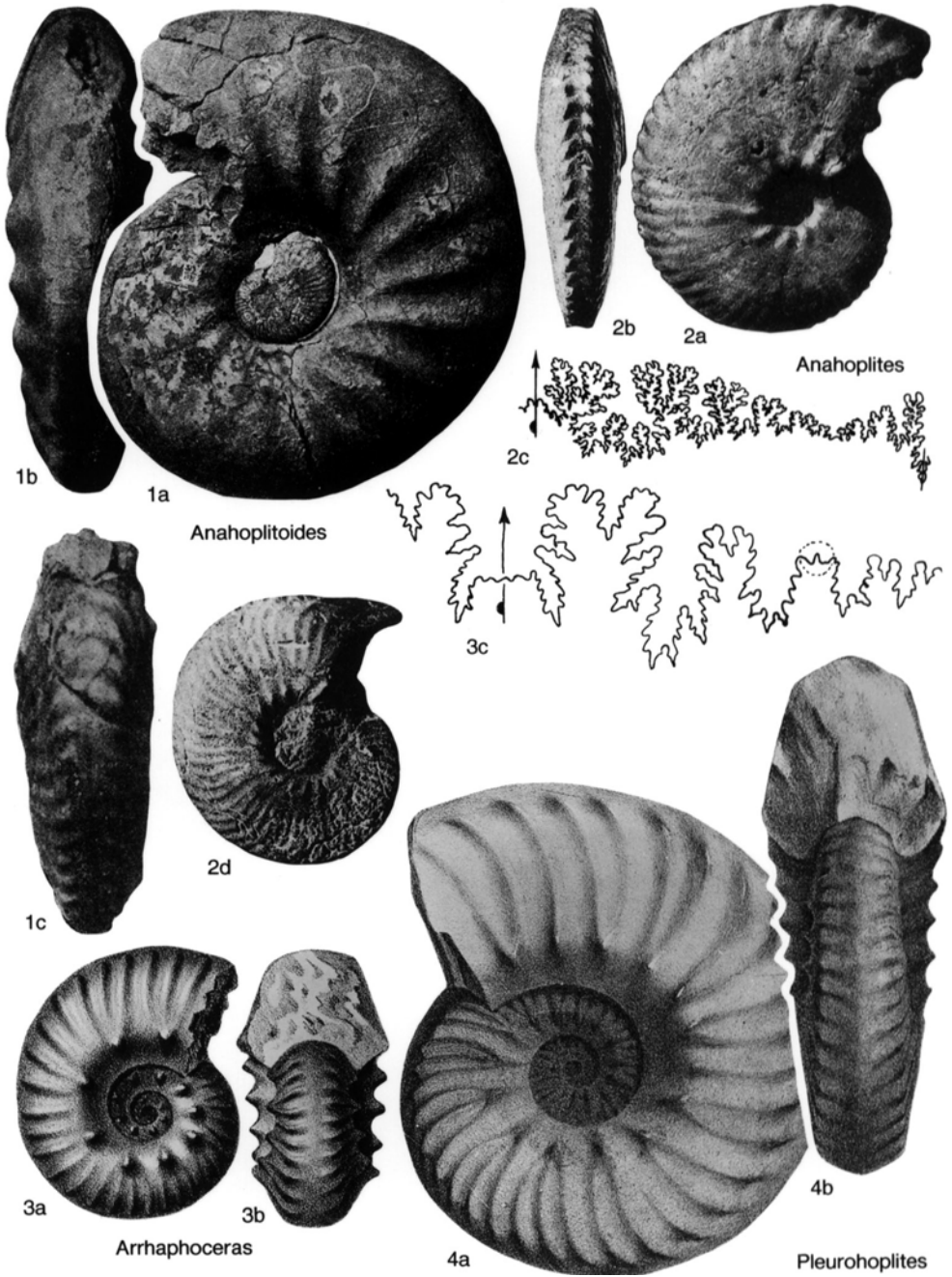


FIG. 89. Hoplitidae (p. 117)

prominent ventrolateral clavi; ribs repeatedly tending to unite in pairs at clavi. A stock appeared early in the Middle Albian with a steep-sided, narrow groove within the ventral

sulcus. At the end of the Albian, smooth, raised venters appeared, which foreshadowed the sharply keeled Schloenbachiidae of the Cenomanian. Large individuals with adult

body chamber nearly smooth and with rounded venter are presumed to be macroconchs. SPATH, 1923–1943; CASEY, 1965. *Lower Cretaceous (Middle Albian)*—*Upper Cretaceous (Lower Cenomanian)*.

Hoplites NEUMAYR, 1875a, p. 681 (1875b, p. 925), ICZN Opinion 353, 1955, Generic Name No. 876 [**Ammonites dentatus* J. SOWERBY, 1821, p. 3; ICZN Specific Name No. 489] [= *Odonthoplites* BREISTROFFER, 1947b, p. 100(84), ICZN Rejected Name No. 296 (type, *Hoplites canavarii* PARONA & BONARELLI, 1897, p. 93); *Daghestanites* GLAZUNOVA, 1953, p. 45, *nom. nud.*]. Whorl section compressed-rectangular to depressed-trapezoidal; prominent ribs branching from strong umbilical bullae and interrupted on venter, their ends prominent and opposite or alternate; some with zigzagging ribs; rib endings are normally thickened or raised into ventrolateral tubercles, which in most are oblique clavi. *Lower Cretaceous (Middle Albian)*: Europe, Transcaspa, Mexico.

H. (Isohoplites) CASEY, 1954a, p. 112 [**Parahoplites steinmanni* JACOB, 1907, p. 255; OD]. High-whorled and compressed, with ribs depressed on venter; ribs opposite, at least on inner whorls. Transitional from *Pseudosonneratia*. Occurrence as for genus: England, France, Switzerland, Poland, Spitsbergen.—FIG. 90,4a,b. **H. (I.) steinmanni* (JACOB), France; X1 (Casey, 1965).

H. (Hoplites). Ribs interrupted and alternate on venter. Occurrence and distribution as for genus.—FIG. 90,3a,b. **H. (H.) dentatus* (J. SOWERBY), England; X1 (Spath, 1923–1943).

Epiphoplites SPATH, 1925a, p. 81 [**Ammonites denarius* J. de C. SOWERBY, 1826, p. 78; OD]. Compressed to rather inflated; strong, rounded ribs branching in twos or threes from sharp umbilical tubercles; venter flat or slightly concave. *Lower Cretaceous (Middle Albian–Upper Albian)*: Europe, Transcaspa.

E. (Epiphoplites). Ribs ending rather inconspicuously on shoulders. Occurrence and distribution as for genus.—FIG. 91,5a,b. *E. (E.) trifidus* SPATH, Upper Albian, France; X1 (Orbigny, 1840–1842).

E. (Metaclavites) CASEY, 1965, p. 461 [**Hoplites denarius* var. *compressus* PARONA & BONARELLI, 1897, p. 94; OD] [= *Gazdaganites* MIRZOEV, 1969, p. 41 (type, *G. gazdaganensis*; OD)]. Differs from *E. (Epiphoplites)* in that the ribs end in ventrolateral clavi more or less parallel to siphuncle. *Lower Cretaceous (Upper Albian)*: England, France, Turkmenistan.—FIG. 91,6a,b. **E. (M.) compressus* (PARONA & BONARELLI), France; X1 (Orbigny, 1840–1842).

Semenoviceras WRIGHT, herein, *nom. nov. pro Semenovites* GLAZUNOVA, 1960, p. 93, *non* TARBINSKII, 1932, p. 194 [**Hoplites michalskii* SEMENOV, 1899, p. 120; OD]. Differs from *Epiphoplites (Metaclavites)* in having simpler suture, prolonged smooth stage, and more flexuous ribs. *Lower Cretaceous (Upper Albian)*: England, Russia,

Iran.—FIG. 90,2a–c. **S. michalskii* (SEMENOV), Mangyshlak; X1 (Semenov, 1899).

Dimorphoplites SPATH, 1925a, p. 81 [**Ammonites biplicatus* MANTELL, 1822, p. 91; OD]. Rather compressed, with venter flat to slightly sulcate; ribs strong, usually looped, persisting to end of body chamber; ventrolateral clavi more or less parallel to siphuncle. *Lower Cretaceous (Middle Albian–Upper Albian)*: Europe, Transcaspa, Greenland.—FIG. 90,1a,b. **D. biplicatus* (MANTELL), Middle Albian, England; X1 (Spath, 1923–1943).

Callihoplites SPATH, 1925a, p. 81 [**Ammonites catillus* J. de C. SOWERBY, 1827a, p. 123; OD]. Compressed or square whorl section; inner whorls with umbilical bullae and ventrolateral clavi with or without looped ribs between; body chamber typically smooth, with rounded venter, but some late forms probably ornamented to end (?microconchs). *Lower Cretaceous (Upper Albian)*: Europe.—FIG. 91,1a,b. *C. sp. aff. C. patella* SPATH, Upper Albian, England; X1—FIG. 91,1c. *C. patella* SPATH, Upper Albian, England; X1 (Spath, 1923–1943).

Euhoplites SPATH, 1925a, p. 82 [**E. truncatus*; OD]. More or less evolute; compressed to inflated; venter flat or concave, typically with deep groove above siphuncle; strong ribs zigzagging between umbilical tubercles and prominent, parallel ventrolateral clavi, but ribs or tubercles or both may be absent. *Lower Cretaceous (Middle Albian–Upper Albian)*: Europe, Greenland.—FIG. 91,2a,b. **E. truncatus* SPATH, Middle Albian, France; X1 (Spath, 1923–1943).

Discophoplites SPATH, 1925a, p. 83 [**Ammonites coelonotus* SEELEY, 1865, p. 237; OD]. Compressed to moderately inflated; involute to evolute; venter grooved but not flat; typically with falcoid ribs and umbilical but no ventrolateral tubercles. *Lower Cretaceous (Upper Albian)*: western Europe, Hungary, Transcaspa.—FIG. 91,4a–f. *D. subfalcatus* (SEMENOV); a,b, England, X1 (Spath, 1923–1943); c,d, Transcaspa, X1 (Pictet & Campiche, 1858–1860); e,f, Spain, microconch with aperture, X1 (Wiedmann & Kaufmann, 1978).

Hyphoplites SPATH, 1922a, p. 110 [**Ammonites falcatus* MANTELL, 1822, p. 117; OD] [= *Drepanites* BENETT, 1831, p. 3, *non* MOJSISOVICS, 1893, p. 495 (suppressed by ICZN Opinion 1609)]. Differs from *Discophoplites* in having flat and grooved venter, falcate ribs, and, in most species, 1 or 2 rows of ventrolateral tubercles. *Lower Cretaceous (Upper Albian)*—*Upper Cretaceous (Lower Cenomanian)*: Europe, Israel, Transcaspa.—FIG. 91,3a,b. **H. falcatus* (MANTELL), Lower Cenomanian, England; X1 (Sharpe, 1853–1857).

Subfamily GASTROPLITINAE Wright, 1952

[Gastropolitinae WRIGHT, 1952, p. 220]

Primitive arched venter broadening; whorl section may become square. Ribs mostly branching in pairs from thin, oblique umbilical bullae and may become flattened.

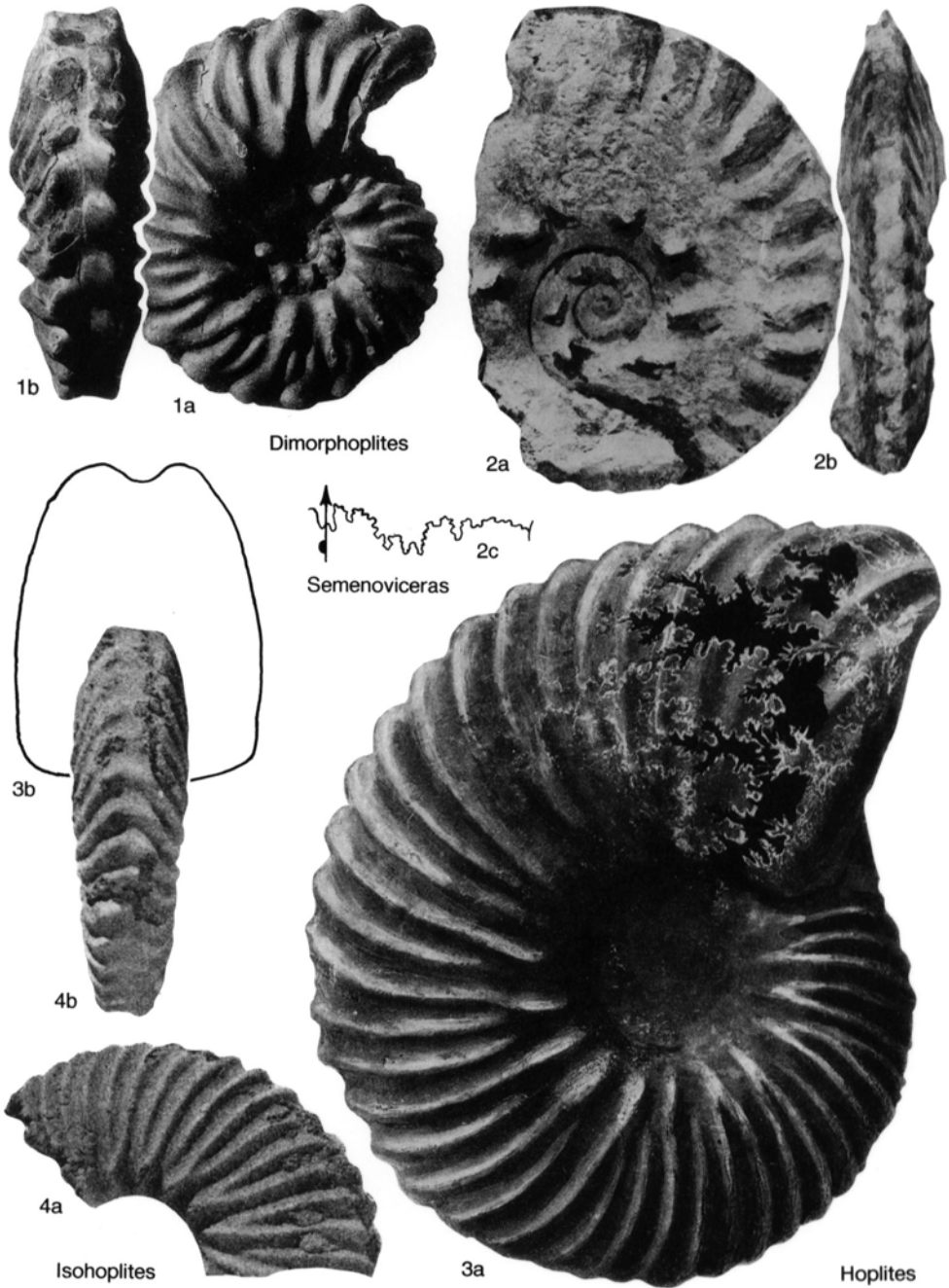


FIG. 90. Hoplitidae (p. 119)

Ventrolateral tubercles and later siphonal tubercles or keel tending to appear. Sutures very variable within species and individuals in proportion of elements and degree of in-

cision, but normally L wide and divided by one or two large folioles. *Lower Cretaceous (Lower Albian)–Upper Cretaceous (?Cenomanian)*.

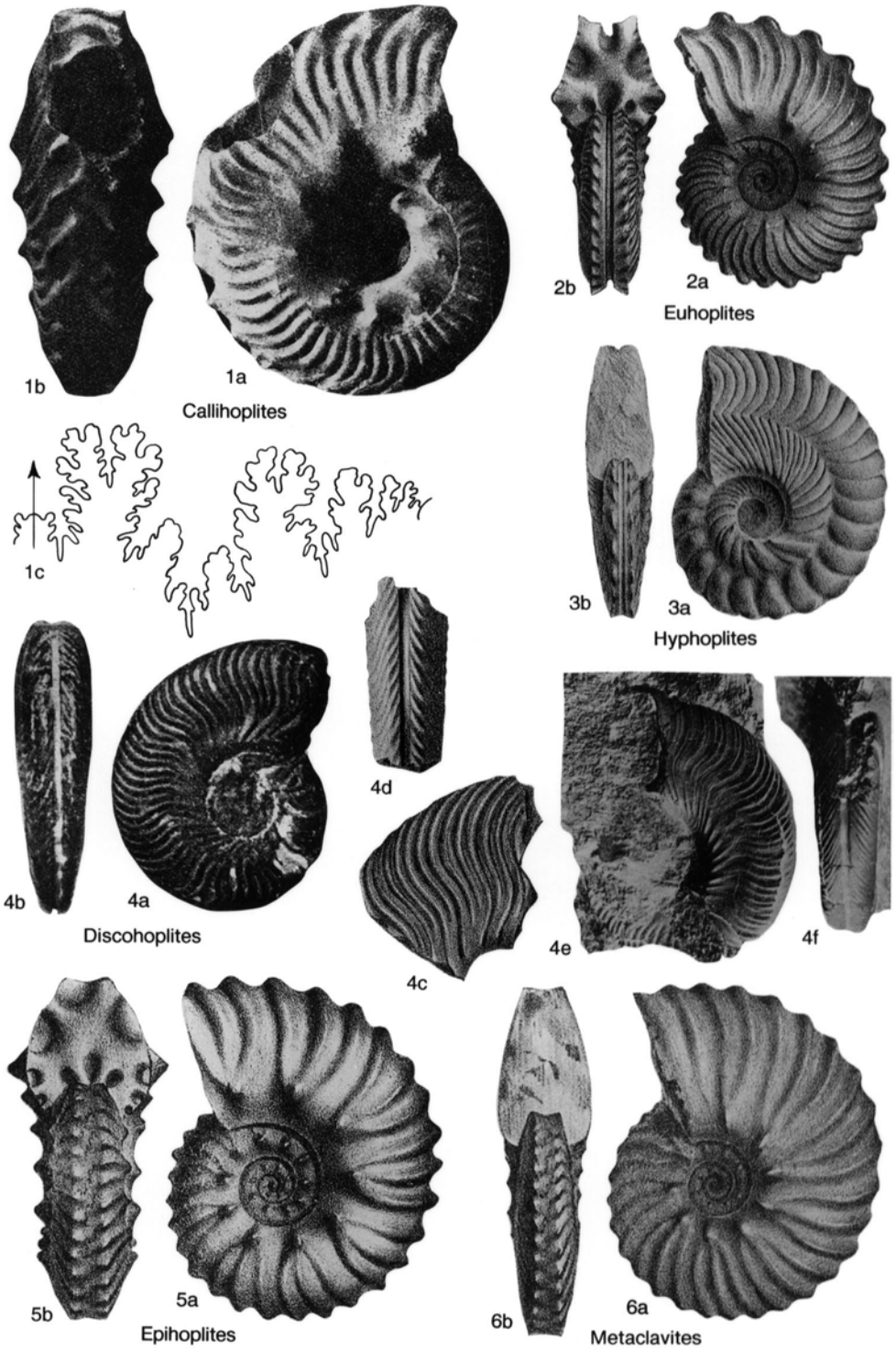


FIG. 91. Hoplitidae (p. 119)

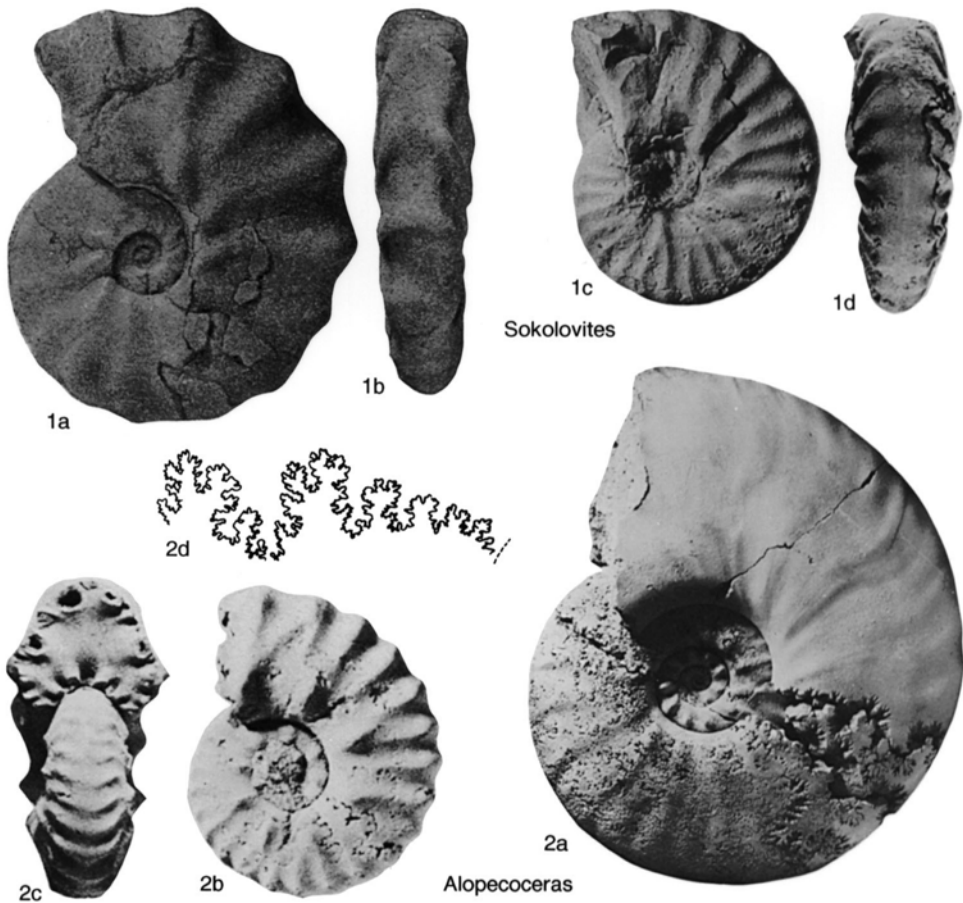


FIG. 92. Hoplitidae (p. 122–124)

Perhaps derived from compressed *Tetrahoplites* (Sonneratiinae), but resemblances to *Archthoplites* suggest possible alternative origin in Cleoniceratidae. The subfamily is found mostly in boreal America.

Sokolovites CASEY, 1966, p. 552 [*S. subdragunovi*; OD] [=? *Cleogastrolites* JELETZKY, 1980, p. 4 (type, *C. aberrans*; OD)]. Moderately involute, flat-sided, with sparse primary and secondary ribs forming ventrolateral bulges and on later whorls crossing venter more or less transversely. *Lower Cretaceous (Lower Albian)*: Transcaspaia, ?Spitsbergen, Arctic Canada. —FIG. 92, 1a, b. **S. subdragunovi*, Mangyshlak; $\times 1$ (Casey, 1966). —FIG. 92, 1c, d. ?*S. aberrans* (JELETZKY), Arctic Canada; $\times 1$ (Jeletzky, 1980; courtesy of the Geological Survey of Canada).

Pseudopulchellia IMLAY, 1961, p. 65 [**P. pattoni*; OD] [=? *Stelckiceras* JELETZKY, 1980, p. 12 (type, *Placenticeras (perezianum?* var.) *liardense* WHITEAVES,

1889, p. 189; OD)]. Involute, compressed, and high-whorled, with subparallel or converging sides; venter narrowly rounded until last whorl, then broadening; flexuous ribs, rounded or flat-topped, may widen and strengthen ventrolaterally. Similar at some stages to *Gastrolites (Paragastrolites)* but initially lacking umbilical bullae and with venter flat only on last whorl. *Lower Cretaceous (Middle Albian)*: Alaska, northern Canada. —FIG. 93, 2a. **P. pattoni*, Alaska; *a*, $\times 1$ (Imlay, 1961). —FIG. 93, 2b–d. *P. imlayi*, northern Canada; $\times 1$ (Jeletzky, 1980; courtesy of the Geological Survey of Canada). —FIG. 93, 2e. ?*P. liardense* (WHITEAVES); $\times 0.25$ (Jeletzky, 1980; courtesy of the Geological Survey of Canada).

Gastrolites MCLEARN, 1930, p. 7 [**Hoplites canadensis* WHITEAVES, 1893a, p. 118; OD]. More or less involute, compressed, with rounded venter in early stages; later becoming broader, with flat venter; ribs coarse, more or less prominent, variably high and narrow, rounded, or flattened, branching above umbilical edge, tending to form bullae, cross-

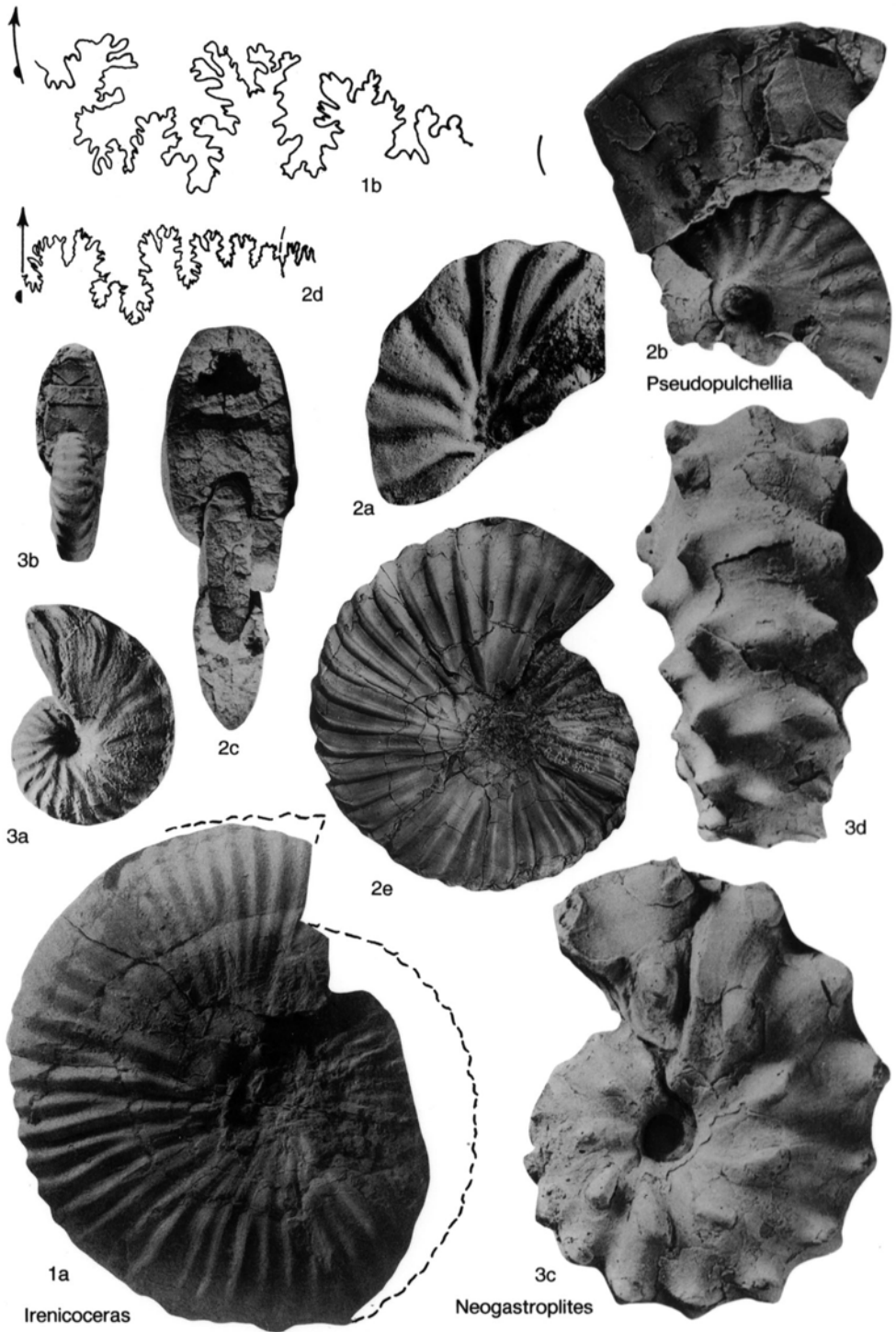


FIG. 93. Hoplitidae (p. 122–124)

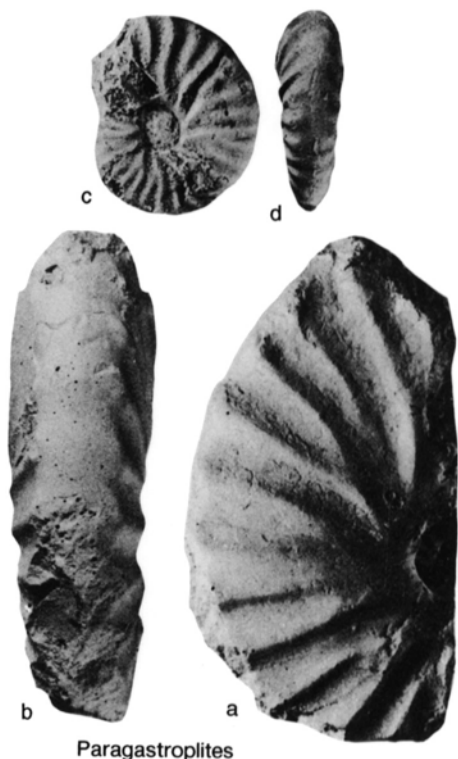


FIG. 94. Hoplitidae (p. 124)

ing venter with slight forward bend or straight or interrupted, with incipient ventrolateral tubercles. Macroconchs with diameter of 120 to 150 mm, smooth body chamber, and, in some species, smooth penultimate whorl; microconchs with diameter of 50 to 60 mm and with ribs persisting to end. Suture rather simple with shallow elements to finely incised with long elements. *Lower Cretaceous (Middle Albian)*: England, ?Spitsbergen, Alaska, British Columbia, Saskatchewan, Alberta, Arctic Canada.

G. (Paragastrolites) IMLAY, 1961, p. 62 [**G. spiekeri* McLEARN, 1931, p. 5; OD]. More involute than *G. (Gastrolites)*, with venter more or less arched; smooth or nearly so on early and middle whorls; sides convergent; ribs strong, flattened or not, in adult crossing venter in slight forward bend. Occurrence as for genus: Alaska, British Columbia, Alberta. —FIG. 94a–d. **G. (P.) spiekeri* McLEARN; a, b, British Columbia, X1; c, d, Alaska; X1 (Imlay, 1961).

G. (Gastrolites) [= *Pseudogastrolites* JELETZKY, 1980, p. 5 (type, *P. arcticus*; OD); *Anagastrolites* JELETZKY, 1980, p. 8 (type, *A. tozeri*; OD); *Stotticeras* JELETZKY, 1980, p. 10 (type, *S. crowense*; OD)]. Less involute than *G. (Paragastrolites)*; venter flat, with ribs crossing uninterrupted, transversely or slightly bowed. Suture

with short and wide to rather long elements. [*Stotticeras*, large with smooth body chamber, comprises macroconchs.] Occurrence as for genus: England, Spitsbergen, Alaska, northern Canada, British Columbia, Saskatchewan, Alberta. —FIG. 95a–e. **G. (G.) canadensis* (WHITEAVES), British Columbia; a, b, X1 (McLearn, 1930); c, d, holotype, X1 (Jeletzky, 1964; courtesy of the Geological Survey of Canada); e, X0.5 (Jeletzky, 1964; courtesy of the Geological Survey of Canada). —FIG. 95f, g. *G. (G.) arcticus* (JELETZKY), northern Canada; X1 (Jeletzky, 1980; courtesy of the Geological Survey of Canada). —FIG. 95h, i. *G. (G.) tozeri* (JELETZKY), northern Canada; X1 (Jeletzky, 1980; courtesy of the Geological Survey of Canada). —FIG. 95j, k. *G. (G.) crowensis* (JELETZKY), northern Canada; j, X1; k, enlarged (Jeletzky, 1980; courtesy of the Geological Survey of Canada).

Irenicoceras WARREN & STELCK, 1958, p. 38 [**I. bahani*; OD]. Large, flat-sided, and compressed, with strong, branching ribs persistent to end. Suture very irregular, generally with rather long elements. ?*Lower Cretaceous (said to be Lower Cenomanian but probably Upper Albian)*: Alberta. —FIG. 93, 1a, b. **I. bahani*; a, X0.25; b, X1 (Warren & Stelck, 1958).

Neogastrolites McLEARN, 1931, p. 7 [**Buchiceras* (?) *cornutum* WHITEAVES, 1885, p. 239; OD] [= *Beatonoceras* WARREN & STELCK, 1958, p. 41 (type, *B. beatonense*; OD)]. Inflated forms up to 175 mm in diameter; compressed forms up to 600 mm; each successive species varies from compressed and flat-sided forms with smooth outer whorls through equally compressed, strongly ribbed, and almost untuberculate forms to moderately to very inflated forms with strong ribs, distant, bullate or spinate midlateral tubercles where the ribs branch, spinate or clavate ventrolateral tubercles, and with or without siphonal swelling or distinct siphonal tubercles (REESIDE & COBBAN, 1960). Differs from the earlier *Gastrolites* primarily in having the venter more or less arched, commonly with distinct siphonal swelling or tubercles. Striaptychus. *Lower Cretaceous (Upper Albian)*; *Upper Cretaceous (?Cenomanian)*: British Columbia, Saskatchewan, Utah, Wyoming, Montana. —FIG. 93, 3a–d. **N. cornutus* (WHITEAVES), Upper Albian, Wyoming; a, b, compressed form, X1; c, d, inflated form, X1 (Reeside & Cobban, 1960).

?**Alopecoceras** KENNEDY & KLINGER, 1978, p. 58 [**A. ankeritterae*; OD]. Inner whorls with trapezoidal section and conical or bullate umbilical tubercles giving rise to pairs of ribs with intercalaries; all ribs bearing conical ventrolateral tubercles; ribs thickened and transverse across venter. Later whorls compressed, with narrowly rounded venter and feeble, falcon ribs and constrictions. *Lower Cretaceous (Middle Albian)*: South Africa (Zululand). —FIG. 92, 2a–d. **A. ankeritterae*; a, X0.5; b–d, X1 (Kennedy & Klinger, 1978).

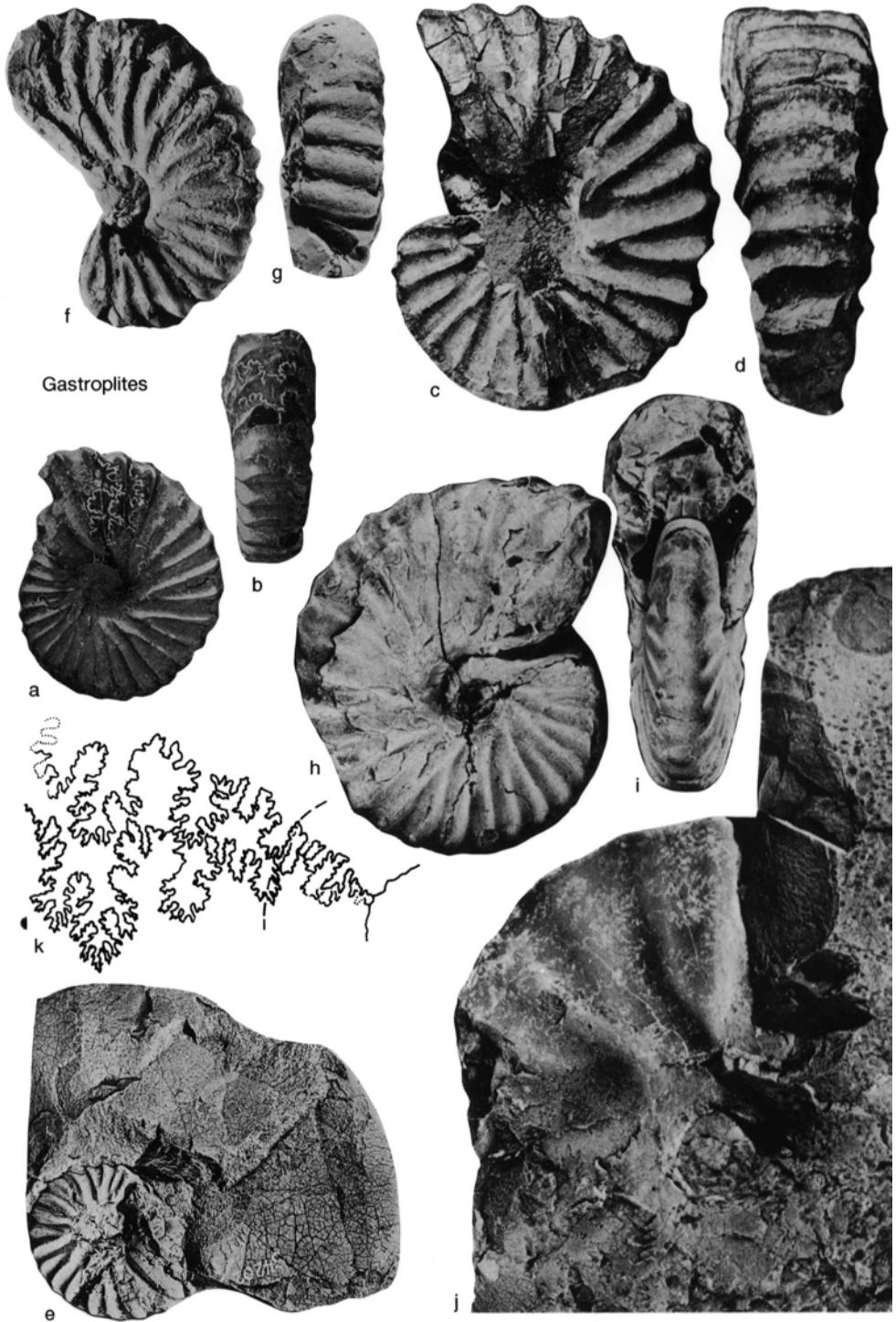


FIG. 95. Hoplitidae (p. 124)

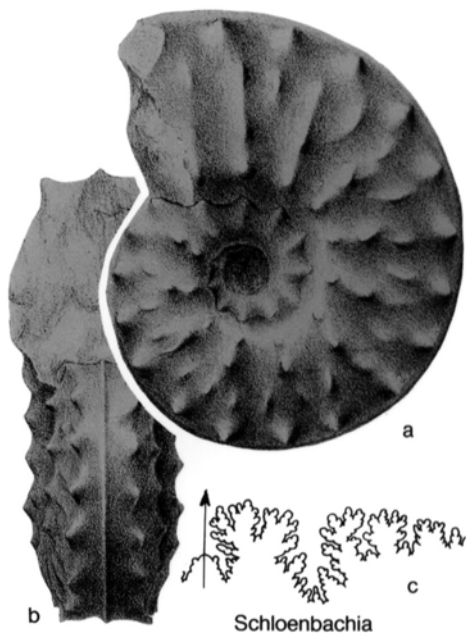


FIG. 96. Schloenbachiidae (p. 126)

Family SCHLOENBACHIIDAE

Parona & Bonarelli, 1897

[*nom. correct.* WRIGHT & WRIGHT, 1951, p. 22, *pro* Schloenbachiidae PARONA & BONARELLI, 1897, p. 89]

Evolute to rather involute, compressed to inflated; normally with distinct keel, irregular ribs, and at least umbilical and ventrolateral tubercles; suture as in Hoplitidae. *Upper Cretaceous* (Lower Cenomanian–Upper Cenomanian).

The family was derived from Hoplitidae, from which it is distinguished only by its generally sharp keel and tendency to multituberculation.

Schloenbachia NEUMAYR, 1875b, p. 887 [**Ammonites varians* J. SOWERBY, 1817b, p. 169; SD H. DOUVILLÉ, 1890, p. 290] [=*Hystrichoceras* HYATT, 1900, p. 589 (type, *Ammonites coupei* BRONGNIART in CUVIER & BRONGNIART, 1822, p. 391; OD; =? *Ammonites varians* J. SOWERBY); *Saltericeras* ATABEKIAN, 1960, p. 187 (type, *Ammonites salteri* SHARPE, 1856, p. 50; OD; holotype is a malformed *Schloenbachia*). Involute and compressed to evolute and inflated; keel strong to very weak; some compressed forms nearly smooth, but ribs generally distinct, well-spaced, and irregular, with umbilical, ventrolateral, and, in many forms, lateral tubercles. *Upper Cretaceous* (Lower Cenomanian–Upper Cenomanian): Europe, Transcaспia, Greenland.—FIG.

96a–c. **S. varians* (J. SOWERBY), Lower Cenomanian, England; ×1 (Sharpe, 1857).

Family PLACENTICERATIDAE

Hyatt, 1900

[Placenticeratidae HYATT, 1900, p. 585] [=Hypengonoceratinae CHIPLONKAR & GHARE, 1976, p. 2; Baghiceratinae CHIPLONKAR & GHARE, 1976, p. 3]

Moderate-sized to large; inner whorls at least generally involute, compressed, with narrow, flat or grooved venter and little or no ornament; outer whorls similar or evolute and more or less inflated, with strong ornament. Suture with adventive and auxiliary elements; the external saddle and first lateral lobe becoming very wide and developing a number of more or less equal, new elements; saddles and lobes may be short and more or less rounded or long, narrow-necked, and much frilled. Of the Albian genera, *Hypengonoceras*, despite some resemblances to Engonoceratidae, seems to belong here, while *Hengestites* and *Karamaites* are clearly derived from Hoplitidae. HYATT, 1903; IL'IN, 1959; MIRZOEV, 1967; WOLLEBEN, 1967; MIKHAILOVA, 1974b; MARCINOWSKI, 1980; KENNEDY & WRIGHT, 1983. *Lower Cretaceous* (Upper Albian)—*Upper Cretaceous* (Upper Maastrichtian).

Hengestites CASEY, 1960a, p. 201 [**H. applanatus*; OD]. Large, high-whorled, and involute, with angular umbilical rim and narrow venter; early whorls with faint, flexuous riblets ending in alternating ventrolateral clavi; later shell smooth and venter sulcate with carinate edges, then tabulate. Suture with shallow ventral lobe, broad, bifid or asymmetrically trifid first lateral lobe, and bifid and subphylloid saddles; a deep adventive lobe dividing external saddle unequally, ventral part being much smaller. *Lower Cretaceous* (Upper Albian): England.—FIG. 97, 2a, b. **H. applanatus*; a, ×0.5; b, ×1 (Casey, 1960a).

Placenticeras MEEK, 1876, p. 462 [**Ammonites placenta* DEKAY, 1828, p. 278; OD] [= *Placentoceras* MEEK, 1871a, p. 429, *nom. oblit.*; *Diplacmoceras* HYATT, 1900, p. 585 (*Diplacmoceras* HYATT, 1903, p. 242, *nom. van.*) (type, *Ammonites bidorsatus* F. A. ROEMER, 1841, p. 88; OD); *Stantonoceras* JOHNSON, 1903, p. 208 (type, *S. pseudocostatum*; OD; = *Ammonites guadaloupeae* C. F. ROEMER, 1849, p. 416); *Proplacenticeras* SPATH, 1926, p. 79 (type, *Placenticeras fritschi* GROSSOUVRE, 1894, p. 124; OD); *Pseudoplacenticeras* SPATH, 1926a, p. 79 (type, *Ammonites milleri* HAUER, 1866, p. 304; OD); *Gissarites* IL'IN, 1958, p. 727 (type, *G. kysylchense*; OD); *Parastantonoceras* COLLIGNON, 1965a, p. 17

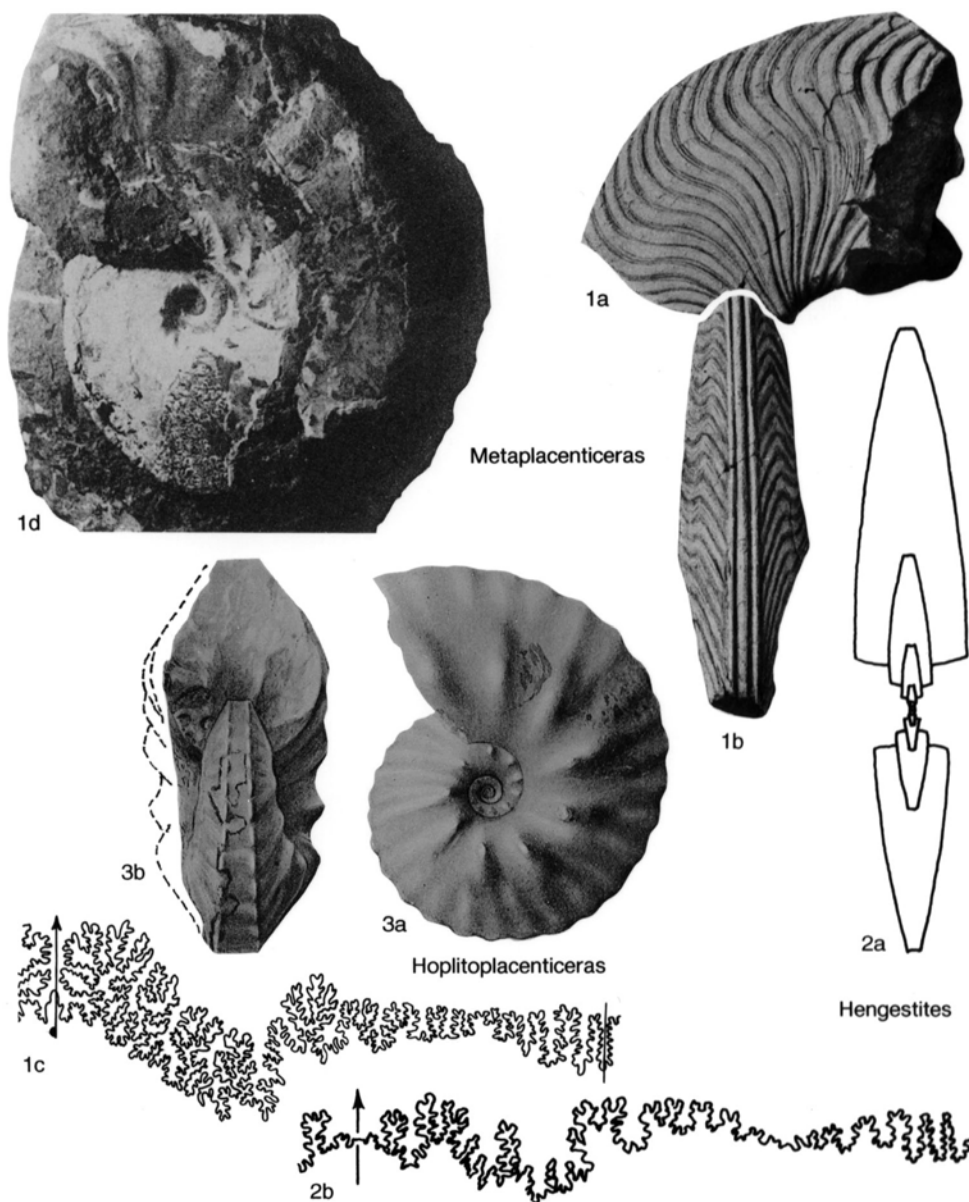


FIG. 97. Placenticeratidae (p. 126–130)

(type, *P. murphyi*; OD); *Karamaites* M. I. SOKOLOV in CASEY, 1965, p. 461 (M. I. SOKOLOV, 1961, p. 152, *nom. nud.*) (type, *Placenticerus? grossourei* SEMENOV, 1899, p. 97; OD); *Karamaiceras* M. I. SOKOLOV, 1967, p. 138 (type, *K. kolbajense*; OD); *Turkmenites* IL'IN, 1975, p. 154 (type, *Placenticerus gouerdakensis* LUPPOV, 1963, p. 144; OD); *Kopetdagites* IL'IN, 1975, p. 159 (type, *K. kopetdagensis*; OD); *Mediasiceras* IL'IN, 1975, p. 159 (type, *M. beliakovae*; OD); *Beschtubeites* IL'IN, 1975,

p. 162 (type, *B. beschubensis*; OD); *Asiatostantonoceras* IL'IN, 1975, p. 172 (type, *Stantonoceras tagamense*; OD); *Baghiceras* CHIPLONKAR & GHARE, 1976, p. 3 (type, *B. ambai*; OD); *Malwiceras* CHIPLONKAR & GHARE, 1976, p. 4 (type, *M. variabilis*; OD); *Placentoscaphites* CHIPLONKAR & GHARE, 1977, p. 68 (type, *P. dangerfeldi*; OD); *Sancarlosia* CHIPLONKAR & GHARE, 1978, p. 79 (type, *Placenticerus sancarlosense* HYATT, 1903, p. 200; OD)]. Populations show great variability,

ranging from compressed, involute forms with convergent, slightly convex sides, narrow, tabulate venter, no to weak, falcoid ribs, long umbilical bullae, and inner and more numerous outer ventrolateral tubercles to forms with similar inner whorls, but outer becoming more evolute, rectangular to square in section, with more prominent umbilical and ventrolateral tubercles, the inner of which, originally midlateral, may move outwards to form the ventrolateral margin while the outer may disappear. In any population macroconchs comprise the larger, more compressed, and more feebly ornamented forms. The relative size of sutural elements varies slightly with time; early species tend to have the 4th lateral lobe smaller than the 5th. *Placenticeras* was formerly distinguished from *Karamaites* by progressive increase in number of sutural elements, by development of strong dimorphism with strongly ornamented microconchs, and by progressive outward migration of umbilical tubercles to midlateral and of midlateral to inner ventrolateral position. However, strongly ornamented microconchs are now known from Cenomanian and there seem to be no valid grounds for dividing the slowly evolving series. Lower Cretaceous (Upper Albian)—Upper Creta-

ceous (Lower Campanian): France, Spain, Germany, Poland, eastern Africa, Madagascar, Israel, central Asia, southern India, British Columbia, USA, Mexico, Colombia.—FIG. 98*a, b*. *P. grossouvrei* SEMENOV, Cenomanian, Mangyshlak; $\times 0.75$ (Semenov, 1899).—FIG. 98*c*. *P. mediasiaticum* (LUPPOV), Cenomanian, central Asia; $\times 2$ (Marcinowski, 1980).—FIG. 99*a, b*. **P. placenta* (DEKAY), Campanian, New Jersey; $\times 1$ (Hyatt, 1903).—FIG. 99*c–e*. *P. fritschi* GROSSOUVRE, Coniacian, France; $\times 1$ (Grossouvre, 1894).—FIG. 99*f–h*. *P. guadalupae* (ROEMER), Campanian, Texas; $\times 0.5$ (F. A. Roemer, 1852).—FIG. 99*i, j*. *P. bidorsatum* (ROEMER), Lower Campanian, Germany; $\times 0.75$ (Müller & Wollemand, 1906).

Metaplacenticeras SPATH, 1926a, p. 79 [**Placenticeras pacificum* SMITH, 1900, p. 187; OD] [= *Paraplacenticeras* MATSUMOTO, 1953, p. 149 (type, *Placenticeras subtilistriatum* JIMBO, 1894, p. 25(171); OD)]. Compressed, flat-sided, with weak to strong, falcoid to falcate ribs; venter tricarinate, at least in middle growth. Suture line follows that of ribs. SMITH, 1900; MATSUMOTO, 1953. Upper Cretaceous (?Santonian, Campanian): Japan, California.—FIG. 97, 1*a–c*. **M. pacificum* (J. P. SMITH), California;

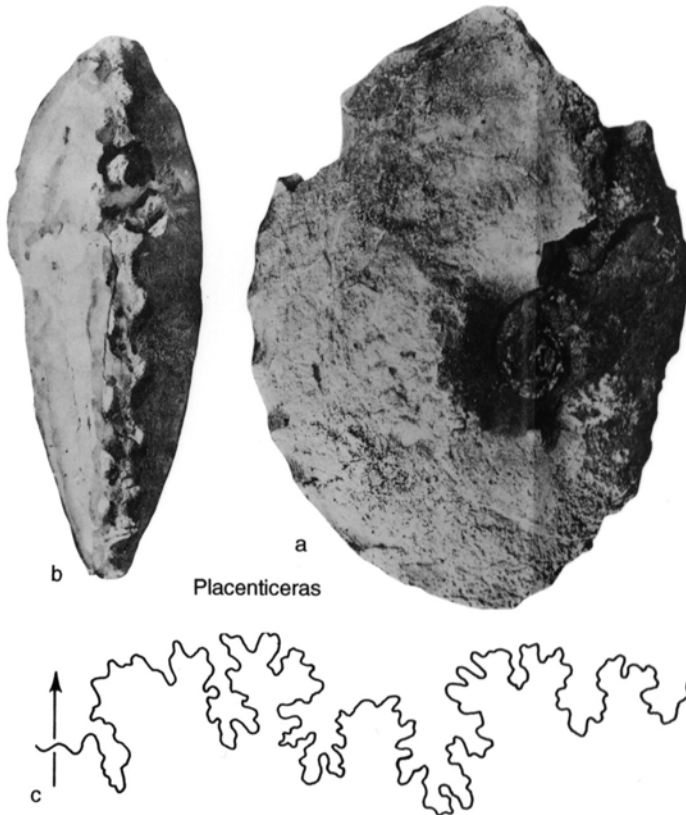


FIG. 98. Placenticeratidae (p. 126–128)

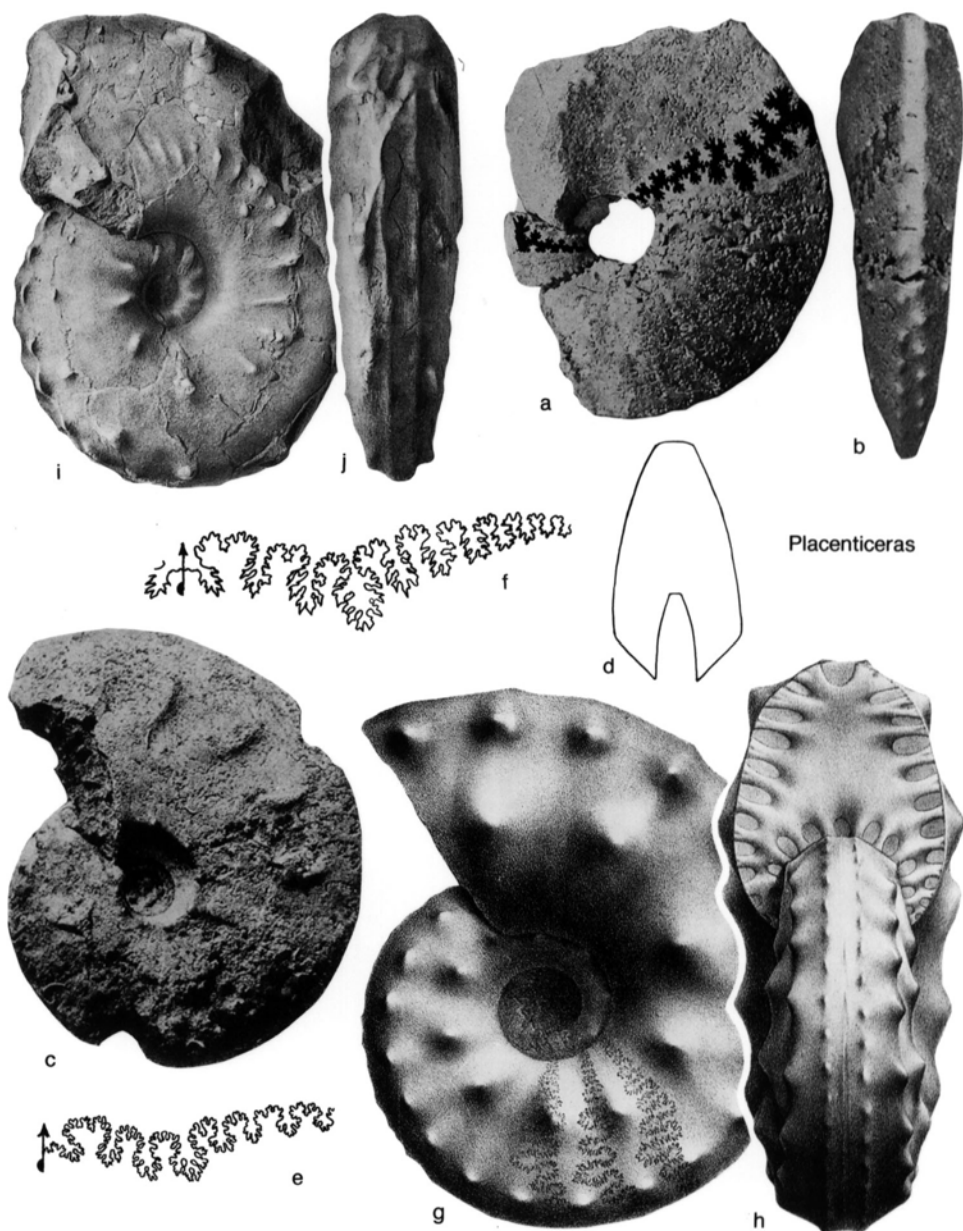


FIG. 99. Placenticeratidae (p. 126–128)

a, b, $\times 0.75$; *c*, $\times 1$ (Reeside, 1926).—FIG. 97, *Id. M. subtilistriatum* (JIMBO), Japan; ?microconch, $\times 1$ (Matsumoto, 1953).

Hoplitoplacenticeras PAULCKE, 1907, p. 183, ICZN Opinion 554, 1959, Generic Name No. 1348 [**Hoplites plasticus* PAULCKE, 1907, p. 186; ICZN Specific Name No. 1629] [= *Dechenoceras* KAYSER, 1924, p. 175, *nom. nud.*]. Rather evolute; whorl

section compressed and parallel-sided to trapezoidal; venter flat; with prominent ribs varying from coarse and rounded to dense and fine; ribs nearly straight, with inner and outer ventrolateral tubercles, of which outer may be large and clavate; ribs crossing venter transversely and may have trace of siphonal tubercle. *Upper Cretaceous (Upper Campanian–Upper Maastrichtian)*: France, The

Netherlands, Germany, western Africa, Egypt, South Africa (Natal), Madagascar, central Asia, British Columbia, Wyoming, Texas, Argentina (Patagonia).—FIG. 97,3a,b. **H. plasticus* PAULCKE, Campanian, Patagonia; $\times 0.75$ (Paulcke, 1907).

?Family ENGONOCERATIDAE

Hyatt, 1900

[Engonoceratidae HYATT, 1900, p. 585] [=Knemiceratidae HYATT, 1903, p. 144; Neolobitinae LUPPOV & MIKHAILOV in LUPPOV & DRUSHCHITS, 1958, p. 125]

Typically compressed, more or less flat-sided, and involute, with venter flat at least in some stage; single or branching, irregular ribs may occur with umbilical, lateral, or ventrolateral tubercles. Suture with numerous auxiliary and adventive elements; saddles tending to simplify, being characteristically entire. More strongly ornamented forms giving rise to a succession of very compressed, smooth forms with narrow, bicarinate venters. Smooth offshoots are difficult to distinguish morphologically. Some genera closely resemble Pulchelliidae but are probably not closely related, and their origin remains uncertain. HYATT, 1903; SPATH, 1923–1943; CASEY, 1960–1980. *Lower Cretaceous* (?Upper Aptian, Lower Albian)—Upper Cretaceous (Upper Cenomanian).

Knemiceras BÖHM, 1898, p. 200 [**Ammonites syriacus* BUCH, 1850, p. 20; OD] [=*Glottoceras* HYATT, 1875, p. 372 (type, *Buchiceras attenuatum* HYATT, 1875, p. 372; M; genus was abandoned by HYATT, 1900, 1903, presumably on the incorrect basis that it was homonym of *Glossoceras* BARRANDE, 1867, p. 94, but was revived by BREISTROFFER, 1952b, p. 2633 and should be treated as *nom. oblit.*); *Cnemidoceras* HAUG, 1900, p. 24, *nom. van.*; *Cnemioceras* HAUG, 1900, p. 85, *nom. van.*; *Knemiceras* KRAUSE, 1902, p. 7, *nom. van.*; *Glossoceras* R. DOUVILLÉ, 1907, p. 150, *non* BARRANDE, 1867, p. 94, *pro Glottoceras* HYATT; *Iranoknemiceras* COLLIGNON, 1981, p. 258 (type, *K. ubligi* (CHOFFAT) var. *douvillei* BASSE, 1940, p. 431; OD)]. Compressed to moderately inflated; sides flat and parallel or converging; venter flat or slightly concave; ribs moderately to very strong, sparse, rounded or flat, arising singly or in pairs from stout umbilical tubercles; ribs may branch again at midlateral tubercles, ending in ventrolateral clavi or crossing venter. Suture with frilled lobes and slightly frilled, rarely entire saddles; commonly irregular. *Lower Cretaceous* (?Upper Aptian, Lower Albian—Upper Albian): southwestern Europe, northern Africa, Syria, Saudi Arabia, Iran, Ecuador, Colombia, Peru, Venezuela.—FIG. 100,3a,b. **K.*

syriacum (BUCH), Upper Albian, Syria; $\times 1$ (Basse, 1940).

Parengonoceras SPATH, 1924b, p. 508 [**Ammonites ebrayi* LORIOU, 1882, p. 7; OD]. Early whorls with flat sides converging to narrow, flat venter and with indistinct ribs ending in ventrolateral clavi; later whorls with subrectangular section and with 1, then 2 rows of lateral bullae appearing; finally ventrolateral clavi disappearing and venter becoming rounded. CASEY, 1978. *Lower Cretaceous* (*Lower Albian—Middle Albian*): England, France, Algeria, Venezuela, Colombia, Peru.—FIG. 100,1a–c. **P. ebrayi* (LORIOU), Middle Albian, France; a, b, $\times 0.25$; c, $\times 1$ (Loriot, 1882).

Hypengonoceras SPATH, 1922a, p. 112 [**Placentoceras warthi* KOSSMAT, 1895, p. 188(92); OD]. Large, with converging, flat sides and narrow, flat or concave venter; sparse, low, falcoid ribs ending in alternating ventrolateral clavi. Suture with large, pincerlike bifid folioles or normally incised. More probably a derivative of *Parengonoceras* than an early placenticeratid. KLINGER & KENNEDY, 1989. *Lower Cretaceous* (*Upper Albian*): France, Spain, Mozambique, South Africa (Zululand), Madagascar, Israel, southern India, Sakhalin.—FIG. 101,3. **H. warthi* (KOSSMAT), southern India; $\times 0.75$ (Kossmat, 1895–1898).

Platknemiceras BATALLER, 1954, p. 174 [**Knemiceras* (*Platknemiceras*) *bassei*; OD] [=*Platyknemiceras* BATALLER, 1959, p. 1–77, *nom. null.*]. Suture as in *Knemiceras* but very compressed and involute, with no ornament except fine, flexuous striae; venter narrow, grooved, and later tabulate. *Lower Cretaceous* (*Lower Albian—Middle Albian*): France, Spain, Algeria, Iran, Lebanon, Egypt (Sinai), Japan, Texas, Peru, Colombia.—FIG. 100,5a,b. **P. bassei*, Lower Albian, Spain; a, $\times 1$; b, $\times 1$ (Casey, 1961c).—FIG. 100,5c. *P.* sp., Lower Albian, Peru; c, $\times 1$ (Casey, 1961c).

Engonoceras NEUMAYR & UHLIG, 1881, p. 140(12) [**Ammonites pierdenalis* BUCH, 1850, p. 31; SD PERVINQUIERE, 1907, p. 200] [=?Engonohoplitoidea BASSE, 1940, p. 441 (type, *E. khenchelaensis*; OD)]. Involute; inner whorls very compressed, with narrow, flat or sulcate venter; later flexuous striae normally replaced by weak, flat, flexuous or straight ribs ending in small ventrolateral clavi placed alternately and, in some shells, joined across venter by zigzagging ribs; umbilical and lateral tubercles may be present, and venter of last whorl may be rounded. Suture with more elements than *Knemiceras* and with saddles normally all entire except that outermost are bifid; external lobe normally with strongly divergent branches. *Lower Cretaceous* (*Middle Albian*)—Upper Cretaceous (*Cenomanian*): England, France, northern Africa, Syria, USA, Mexico, Colombia.—FIG. 100,4a–c. *E. serpentinum* (CRAGIN), Upper Albian, Texas; $\times 1$ (Hyatt, 1903).

Protengonoceras HYATT, 1903, p. 153 [**Engonoceras gabbi* BÖHM, 1898, p. 197; OD]. Like *Engonoceras* but lacking tubercles at any stage and having ribs

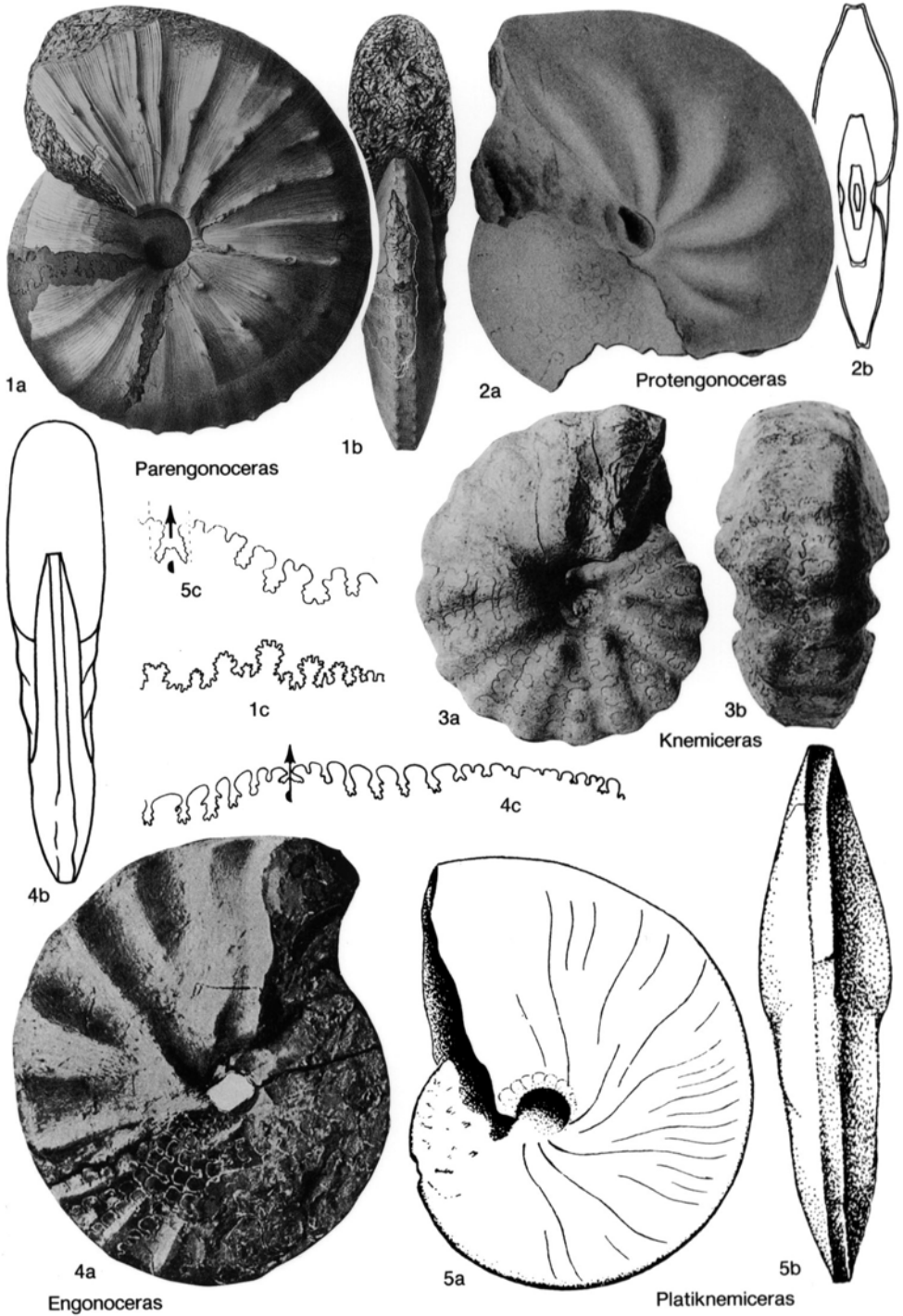


FIG. 100. Engonoceratidae (p. 130–132)

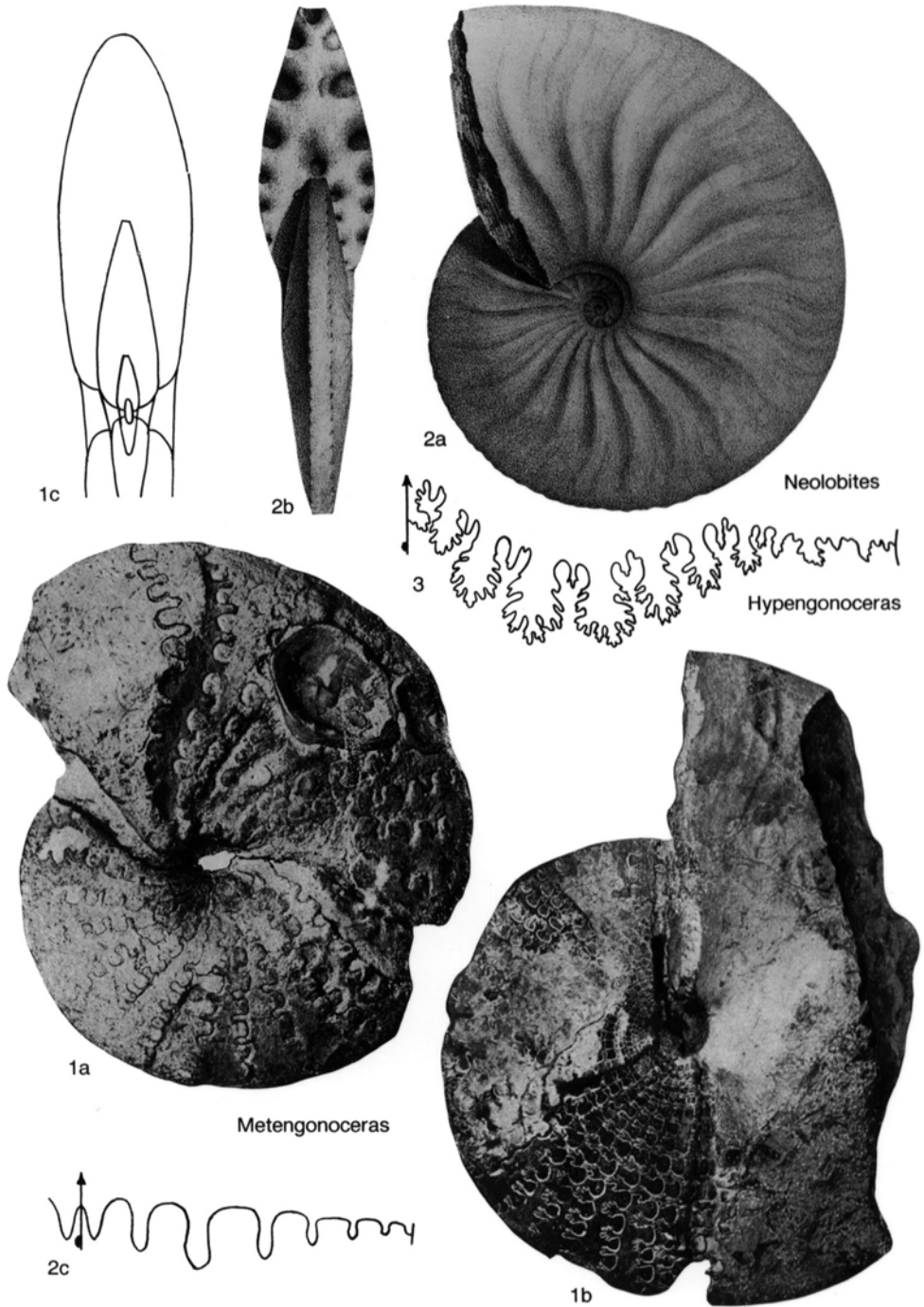


FIG. 101. Engonoceratidae (p. 130–133)

only on body chamber. *Lower Cretaceous (Middle Albian)*: Texas.—FIG. 100,2a,b **P. gabbi* (BÖHM); X0.75 (Hyatt, 1903).

Metengonoceras HYATT, 1903, p. 179 [**M. inscriptum*; SD ROMAN, 1938, p. 491] [= *Epengonoceras* SPATH, 1924b, p. 508 (type, *Sphenodiscus dumbli* CRAGIN,

1893, p. 243; OD)]. Compressed, with flat to slightly concave sides; venter fairly broad on inner whorls but soon narrowing until acute on internal mold, though still with very narrow, flat or concave area on shell, and finally becoming rounded; with very weak ribs or smooth; ventrolateral tubercles rarely present. *Lower Cretaceous* (?Middle Albian, Upper Albian)—*Upper Cretaceous* (*Upper Cenomanian*): France, western Africa, ?Madagascar, Texas. —FIG. 101, 1a. **M. inscriptum* HYATT, Upper Albian, Texas; X1 (Hyatt, 1903). —FIG. 101, 1b, c. *M. dumbli* (CRAGIN), Cenomanian, Texas; X1 (Hyatt, 1903).

Neolobites FISCHER, 1882 in 1880–1887, p. 389 [**Ammonites vibrayanus* ORBIGNY, 1841, p. 322; M]. Similar to *Engonoceras* in shape, but may be less involute; some species developing strong lateral and ventrolateral tubercles as in *Parengonoceras*. Distinguished by suture with fewer elements, all entire. *Upper Cretaceous* (*Cenomanian*): France, northern Africa, Syria, Saudi Arabia, Peru, Bolivia. —FIG. 101, 2a–c. **N. vibrayanus* (ORBIGNY), France; a, b, X0.75; c, enlarged (Orbigny, 1840–1842).

Superfamily ACANTHOCERATACEAE Grossouvre, 1894

[*nom. correct.* WRIGHT & WRIGHT, 1951, p. 24, *pro* Acanthoceratida HYATT, 1900, p. 585, *nom. transl. et correct.* *ex* Acanthoceratidés GROSSOUVRE, 1894, p. 22] [H. DOUVILLE is quoted by some as author, but the work in which the name appeared was not published.]

Typically strongly ribbed forms with tendency to develop prominent tubercles, but including a wide variety of other types. *Lower Cretaceous* (*Lower Albian*)—*Upper Cretaceous* (*Maastrichtian*).

Not enough is yet known of the initial appearance and phylogeny in the Lower Albian of the families here included to be sure of their relations. Leymeriellidae, confined to the *tardefurcata* Zone, was certainly derived from *Callizoniceras* (BRINKMANN, 1937). Lyelliceratidae, of which the earliest genus is *Tegoceras*, is first known early in the *mammillatum* Zone; it has significant resemblances to Leymeriellidae and was probably derived from it, despite an apparent time gap. It was the source of the dominant Cenomanian Acanthoceratidae, whose various subfamilies gave rise to most of the strongly ornamented ammonites of the rest of the Cretaceous as well as to a wide range of secondarily smooth forms.

Brancoceratinae and Mojsisovicziinae have less certain origins. Both are first known

in the Lower Albian *mammillatum* Zone. *Parabrancoceras* resembles *Silesitoides* and *Callizoniceras* (Desmocerotidae, Puzosiinae) but has stronger ribs. The earliest known mojsisovicziid is already a high-keeled *Oxytropidoceras*. Inner whorls of various brancoceratids have acute venters, and there are many later members of the two subfamilies that closely resemble each other. There is a notorious lack of continuous deposits at crucial horizons in the Tethyan Lower Albian, and it seems probable that Mojsisovicziinae evolved from unknown Brancoceratinae before the *mammillatum* Zone. Whether the origin of these subfamilies is distinct from that of the Leymeriellidae-Lyelliceratidae line is still quite uncertain. They are therefore here still grouped in Acanthocerataceae.

Family LEYMERIELLIDAE Breistroffer, 1951

[*nom. transl.* WRIGHT, 1955, p. 571, *ex* Leymeriellinae BREISTROFFER, 1951b, p. 266]

Small, compressed, evolute, and uncoiling with growth; most with single ribs, flattened or grooved, but some with branching ribs; ribs interrupted or not on venter; umbilical or lateral and clavate ventrolateral tubercles present or not. Suture rather simple, with bifid saddles, deep, parallel-sided ventral lobes, trifold lateral lobes, and no umbilical retraction. *Lower Cretaceous* (*Lower Albian*—*Middle Albian*).

The subdivisions of the suture on either side of the umbilical seam derive ontogenetically from the splitting of the internal umbilical lobe, U1, as in the Hoplitidae, rather than from the splitting of the saddle between U1 and U2, as in the Lyelliceratidae (Fig. 102) (MIKHAILOVA, 1973). Even so, the probability is that the Leymeriellidae, derived from the desmocerotid *Callizoniceras* (BRINKMANN, 1937), is more closely related to the Lyelliceratidae, here treated as its descendants, than to the Hoplitidae and is to be placed in Acanthocerataceae. CASEY, 1978.

Proleymeriella BREISTROFFER, 1947b, p. 37(21), 86(70) [**Parahoplites schrammeni* JACOB, 1907, p. 302; OD]. Whorl section oval; simple, strong ribs pass-