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; ×1 (Hyatt, 1903).——FIG. 101,*1b,c. M. dumbli* (CRAGIN), Cenomanian, Texas; ×1 (Hyatt, 1903).

Neolobites FISCHER, 1882 in 1880–1887, p. 389 [**Ammonites vibrayeanus* 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. vibrayeanus* (ORBIGNY), France; *a,b,* ×0.75; *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. DOUVILLÉ 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* (Desmoceratidae, 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 Acanthoceratacea.

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, trifid 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 desmoceratid *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 Acanthoceratacea. CASEY, 1978.

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

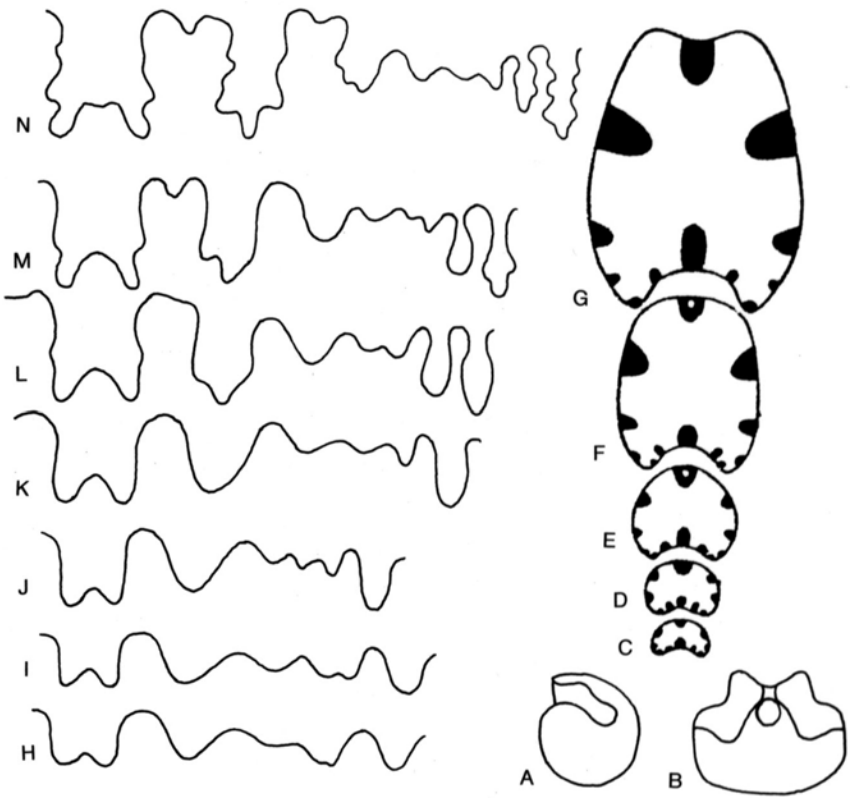

FIG. 102. Ontogenetic development of *Leymeriella tardefurcata* (ORBIGNY), Lower Albian, Mangyshlak; highly magnified (after Mikhailova, 1973).

ing over narrowly rounded venter, forming chevrons; constrictions present throughout. Grades into *Leymeriella;* distinction is analogous to that between *Pseudosonneratia* and *Hoplites*. *Lower Cretaceous (Lower Albian):* Germany, Spitsbergen.——FIG. 103,*3a,b. *P. schrammeni* (JACOB), Germany; ×1 (Jacob, 1908).

Leymeriella JACOB, 1907, p. 311 [**Ammonites tardefurcatus* ORBIGNY, 1841, p. 248; SD SPATH, 1925a, p. 75]. Venter flat or sulcate; ribs single but grooved on outer part. *Lower Cretaceous (Lower Albian–Middle Albian):* Europe, Transcaspia, Iran.

L. (Leymeriella). No umbilical or lateral tubercles; no constrictions; no ribs on umbilical wall. Occurrence and distribution as for genus.——FIG. 103,*1a,b. *L. (L.) tardefurcata* (ORBIGNY), France; ×1 (Jacob, 1908).

L. (Neoleymeriella) SAVELIEV, 1973, p. 184 [**L. (Leymeriella) consueta* CASEY, 1957, p. 53; OD]. With umbilical or lateral tubercles at least on early whorls; shallow constrictions on outer whorls; ribs commonly present on umbilical wall. Occurrence and distribution as for genus.——FIG. 103,*4a–c. *L. (N.) consueta,* England; ×1 (Casey, 1978).

Epileymeriella BREISTROFFER, 1947b, p. 87(71) [**Parahoplites hitzeli* JACOB, 1907, p. 256; OD] [=*Revilites* CASEY, 1978, p. 621 (type, *Hoplites (Leymeriella) revili* JACOB, 1908, p. 53 (1907, p. 303, *nom. nud.*); OD)]. Differs from *Leymeriella* in that venter is narrowly rounded and ribs branch near the umbilical edge, then branch again, crossing venter in chevrons; constrictions like those of *Proleymeriella* may appear on outer whorl. [Separation of the more evolute, finely and densely ribbed species as a subgenus of *Revilites* seems unnecessary.] *Lower Cretaceous (Lower Albian):* England, France, Bornholm, Japan.——FIG. 103,*2a,b. *E. hitzeli* (JACOB), France; ×1 (Jacob, 1908).——FIG. 103,*2c,d. E. revili* (JACOB), France; ×1 (Jacob, 1908).

Family BRANCOCERATIDAE Spath, 1934 (1900)

[Brancoceratidae SPATH, 1934, p. 465 (-inae, p. 443), *nom. nov. pro* Hystatoceratidae HYATT, 1900, p. 590. Brancoceratidae was introduced as a replacement name because *Hystatoceras* HYATT, 1900, p. 590 was regarded as a junior synonym of *Brancoceras* STEINMANN, 1881, p. 133. Since Brancoceratidae has been widely accepted, it is retained and takes the date of Hystatoceratidae under provisions of Article 40(b) of the Code.]

Typically rather evolute, with round, oval, or quadrate whorl section, ventral keel, strong ribs, and at least umbilical tubercles. Many genera with spiral striations or notches on ribs. *Lower Cretaceous (Lower Albian)–*

Upper Cretaceous (Lower Cenomanian).

The primitive subfamily, Brancoceratinae, normally has no keel in the adult, but it may appear cenogenetically. Mojsisovicziinae have a prominent keel and strong, flat to flared ribs, with or without tubercles. Mortoniceratinae include both involute, compressed forms without tubercles and evolute, square-whorled forms with strong tubercles. Except in some Brancoceratinae with almost pseudoceratitic sutures, there is little sutural variation that does not depend on whorl shape. Since a very large number of species is included in the family, there is a tendency to split it unduly, but the range of morphological difference is comparatively small and the species are mostly short-lived.

Subfamily BRANCOCERATINAE Spath, 1934 (1900)

[see under Brancoceratidae] [=Erioliceratidae Hoepen, 1955c, p. 377]

Generally small, evolute, with round, oval, square, or rectangular whorl section; venter may be sharp or distinctly keeled on inner whorls but only exceptionally so on outer; ribs usually strong, rounded or sharp, continuous over venter; in later genera tubercles appearing, first at umbilicus, then at shoulders. Suture simple, pseudoceratitic in some. *Lower Cretaceous (Lower Albian–Upper Albian).*

Brancoceras Steinmann, 1881, p. 133 [**Ammonites senequieri* Orbigny, 1841, p. 292; SD Hyatt, 1900, p. 590] [=*Hystatoceras* Hyatt, 1900, p. 590, obj.]. Small; early whorls smooth, with round or acute venter; later whorl section compressed-oval, with strong, single, straight or slightly flexuous, rounded or sharp ribs crossing venter transversely or in chevrons; on outer whorls venter rounded, fastigiate, or even carinate. Suture simple. *Lower Cretaceous (Lower Albian–Middle Albian):* England, France, Poland, India, ?Colombia, Peru, Venezuela.

B. (Brancoceras) [=*Paroxytropidoceras* Breistroffer, 1951b, p. 267, *nom. nud.* (type, *Brancoceras carinatum* Collignon, 1949b, p. 96; OD)]. Smooth stage may persist; venter of inner whorls acute; venter of outer may be fastigiate or even carinate (*Paroxytropidoceras*); ribs acutely chevroned on venter in some species. Occurrence as for genus: England, France, India.—— Fig. 104,*4a–c.* **B. (B.) senequieri* (Orbigny), France; *a,b,* ×0.75; *c,* enlarged (Orbigny, 1840–1842).

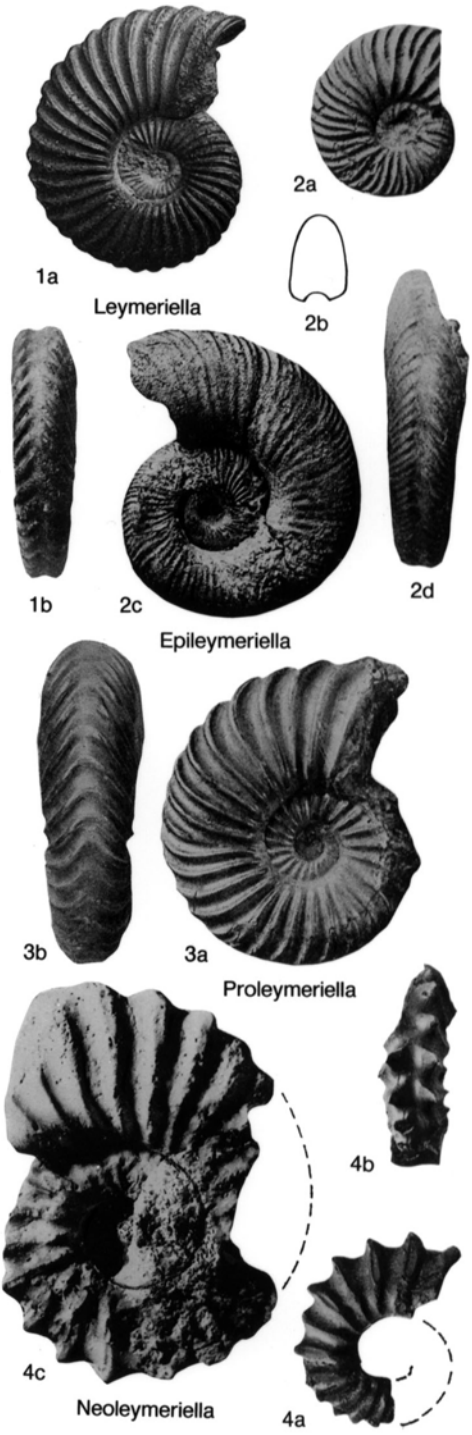

Fig. 103. Leymeriellidae (p 133–134).

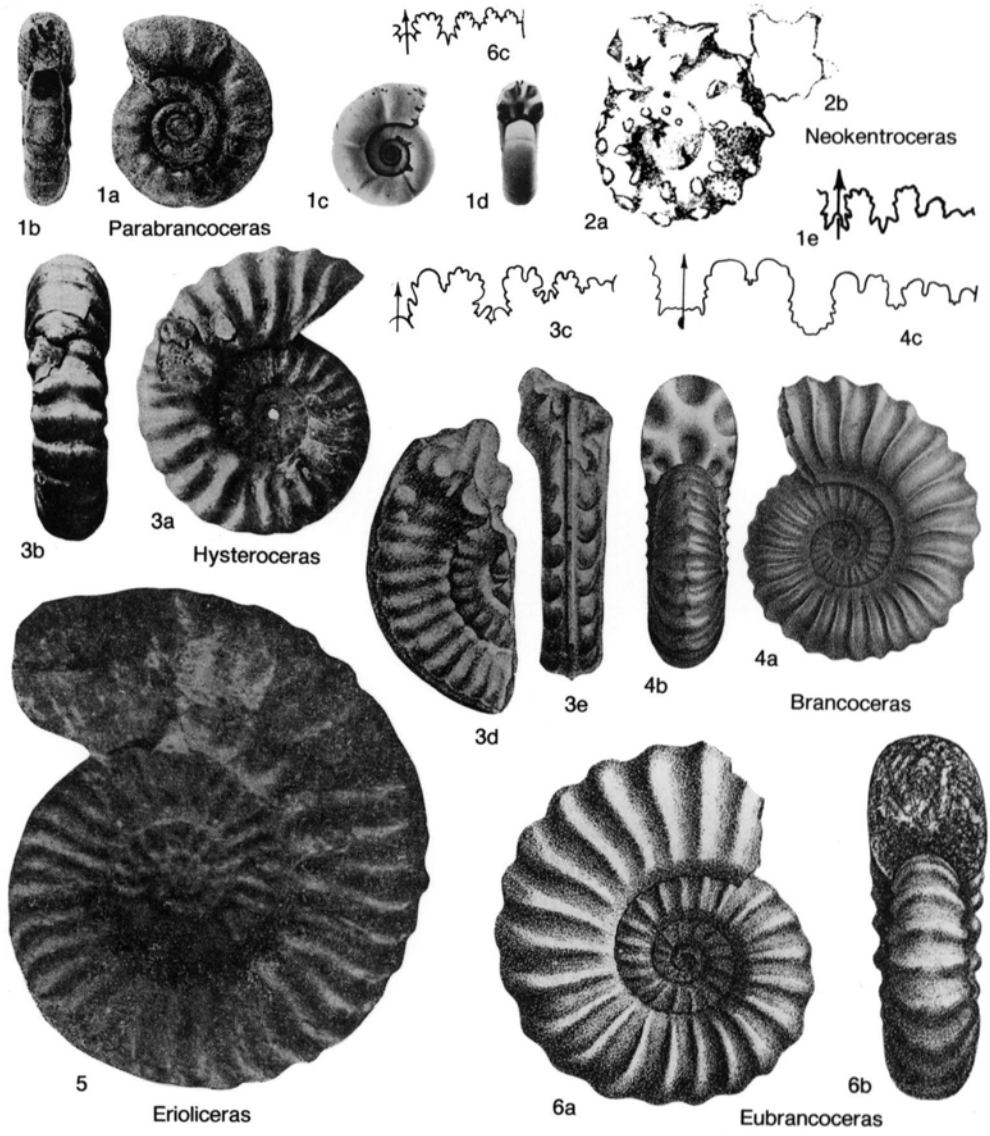

FIG. 104. Brancoceratidae (p. 135–137)

(Eubrancoceras) BREISTROFFER, 1951b, p. 267 [**Brancoceras aegoceratoides* STEINMANN, 1881, p. 133; OD] [=?*Rinconiceras* ETAYO SERNA, 1979, p. 78 (type, *R. rinconi;* OD)]. Venter of early whorls not acute; ribs more or less sharp to blunt; constrictions may occur. Occurrence as for genus: Poland, ?Colombia, Peru, Venezuela.——FIG. 104,*6a–c.* **B. (E.) aegoceratoides,* Lower Albian, Peru; ×1 (Steinmann, 1881).

Parabrancoceras BREISTROFFER, 1951b, p. 267 [**Brancoceras besairiei* COLLIGNON, 1949b, p. 89; OD]. Very evolute, with distant, broad ribs, at least until body chamber, and wide, shallow constrictions. *Lower Cretaceous (Lower Albian):* Spain, Madagascar.——FIG. 104,*1a–e.* **P. besairiei* (COLLIGNON); *a,b,* Madagascar, ×1 (Collignon, 1949b); *c–e,* Spain, *c,d,* ×2; *e,* ×5.6 (Wiedmann, 1966b).

Hysteroceras HYATT, 1900, p. 590 [**Ammonites varicosus* J. de C. SOWERBY, 1824, p. 74; OD] [=*Spathiceras* WHITEHOUSE, 1927, p. 110 (type, *Hystrichoceras antipodeum* R. ETHERIDGE, Jr., 1902, p. 47; OD); *Terascoceras* HOEPEN, 1944, p. 173 (type, *T. cariniferum;* OD); *Komeceras* HOEPEN, 1944, p. 180 (type, *K. acuticostatum;* OD); *Askoloboceras* HOEPEN, 1944, p. 185 (type, *A. fastigatum;* OD); *Petinoceras* HOEPEN, 1944, p. 186

(type, *P. recuperator;* OD)]. Keel commonly persisting to the ribbed stage; ribs branching or long and short, with umbilical and in some forms blunt ventrolateral tubercles; ribbing varies from sharp and high to broad and flat, but subdivision on this basis is not justified. [Reputed age of *Spathiceras* as Upper Albian to Lower Cenomanian is unfounded.] *Lower Cretaceous (Middle Albian–Upper Albian):* Europe, Australia (Northern Territory), Africa, Madagascar, Iran, Pakistan, Mexico, Venezuela, Curaçao, Greenland.——Fig. 104,*3a–c. *H. varicosum* (J. de C. Sowerby), Upper Albian, England; *a,b,* ×1; *c,* ×2.5 (Spath, 1923–1943).——Fig. 104,*3d,e. H. antipodeum* (Etheridge), Upper Albian, Australia (Northern Territory); ×1.5 (R. Etheridge, Jr., 1902).

Erioliceras Hoepen, 1955c, p. 378 [**E. tenuis;* OD] [=?*Omocyrtoceras* Hoepen, 1955c, p. 380 (type, *O. errabundum;* OD); ?*Tetragonoceras* Hoepen, 1955c, p. 382 (type, *T. robustum;* OD)]. Small, evolute, with square or rectangular whorl section; keel strong at first, weakening, and disappearing before end of last whorl; ribs single or branching, typically sinuous, thickened on shoulders, and tending to overhang backward. *Lower Cretaceous (Upper Albian):* South Africa (Zululand).——Fig. 104,*5. *E. tenuis;* ×1 (Hoepen, 1955c).

Neokentroceras Spath, 1921a, p. 306, ICZN Opinion 1254, 1983, Generic Name No. 2196 [**N. curvicornu* Spath, 1922a, p. 139 (1921a, p. 306, *nom. nud.*); ICZN Specific Name No. 2863]. Small; outer whorls as in *Hysteroceras;* inner whorls with very strong umbilical tubercles; weak or no lateral tubercles; large, clavate, normally irregular, ventrolateral tubercles; and ribs weak or absent. *Lower Cretaceous (Upper Albian):* western Africa, ?Brazil.——Fig. 104,*2a,b. *N. curvicornu,* Angola; inner whorls, ×1 (Spath, 1922a).

Subfamily MOJSISOVICZIINAE Hyatt, 1903

[*nom. transl.* Wright, 1952, p. 221, *ex* Mojsisovicziidae Hyatt, 1903, p. 24] [=Dipoloceratidae Spath, 1921a, p. 277; Cechenoceratidae Hoepen, 1941, p. 61; Drepanoceratidae Hoepen, 1941, p. 89]

Derivatives of Brancoceratinae, in which the keel tends to become stabilized as an adult feature and the ribs begin to differentiate. In some forms the keel appears early in ontogeny and is then lost; in others it only appears late. Apparently, there are two main stocks (both derived from *Mojsisoviczia* or one from the other): one compressed and high-whorled, which left no descendants, and the other more evolute, with round or square whorl section, which by acquisition of tubercles led to Mortoniceratinae. The boundary between subfamilies is arbitrarily taken at the point when large umbilical and ventrolateral tubercles are stabilized in the adult. *Lower Cretaceous (Lower Albian–Upper Albian).*

Mojsisoviczia Steinmann, 1881, p. 142 [**M. duerfeldi;* OD; =*Ammonites ventanillensis* Gabb, 1869, p. 273] [=*Dipoloceroides* Breistroffer, 1947b, p. 90(74) (type, *Ammonites delaruei* Orbigny, 1841, p. 296; OD)]. Macroconchs up to 100 mm in diameter; evolute and smooth in young, with round whorl section; later with prominent, sharp keel and strong, straight or slightly curved, single ribs, which may expand in breadth on shoulders or form large midlateral and ventrolateral tubercles. Microconchs 25 to 35 mm in diameter; smooth at first, then with feeble ribs and slight to moderate keel; finally smooth and without keel but generally with a few constrictions. The lectotype (Gebhard, 1983) of *M. duerfeldi* is a microconch here held to be of the associated *M. ventanillensis* (Gabb). Kennedy & Cooper, 1977; Gebhard, 1983. *Lower Cretaceous (Middle Albian):* Europe, South Africa (Zululand), Pakistan, Texas, Mexico, Colombia, Peru, Venezuela, Greenland.——Fig. 105,*1,a–e. *M. ventanillensis* (Gabb), Peru; *a,b,* lectotype of *M. duerfeldi,* ×1 (Gebhard, 1983); *c–e,* ×1 (Douglas, 1921).——Fig. 105,*1f,g. M. delaruei* (Orbigny), France; ×1 (Cooper, 1982).

Falloticeras Parona & Bonarelli, 1897, p. 89 [**Ammonites proteus* Orbigny, 1842a, p. 624; OD]. Closely resembles the smooth microconchs of *Mojsisoviczia,* but early whorls have weak ribs and keel declines at maturity. More probably a progenetic dwarf offshoot of *Mojsisoviczia* (Kennedy & Cooper, 1977), rather than a microconch of any species of *Mojsisoviczia* (Gebhard, 1983). *Lower Cretaceous (lower Middle Albian):* England, France, South Africa (Zululand), Peru.——Fig. 105,*2a–c. *F. proteus* (Orbigny), France; *a,b,* ×1; *c,* ×6 (Kennedy & Cooper, 1977).

Oxytropidoceras Stieler, 1920, p. 346 [**Ammonites roissyanus* Orbigny, 1841, p. 302; OD] [=*Pseudophacoceras* Spath, 1921a, p. 281, obj.]. Moderately to very compressed and high-whorled, with high keel; ribs single to branching, narrow and high, rounded or flat, with or without tubercles; keel may appear well before ribs; ribs may be effaced later. Suture generally with oblique outer slope on first lateral saddle. *Lower Cretaceous (Lower Albian–Upper Albian):* Europe, Morocco, Angola, South Africa (Zululand), Madagascar, Pakistan, California, Texas, Peru, Colombia, Venezuela, Brazil, Mexico.

O. (**Oxytropidoceras**) [=*Manuaniceras* Spath, 1925c, p. 182 (type, *Pseudophacoceras manuanense* Spath, 1921a, p. 281; OD)]. Moderately to very high-whorled and compressed; rather involute; ribs coarse to fine, high and narrow to flat, mostly branching at various levels, and without tubercles. *Lower Cretaceous (Lower Albian–Middle Albian):* Europe, Angola, South Africa (Zululand), Madagascar, Pakistan, Texas, Peru, Colombia, Brazil.——Fig. 106,*2a–c. *O.*

(O.) roissyanum (Orbigny), France; *a,b,* ×0.75; *c,* enlarged (Orbigny, 1840–1842).——Fig. 106,*2d,e. O. (O.) manuanense* (Spath), Zululand; ×1 (Spath, 1921a).

O. (Mirapelia) Cooper, 1982, p. 291 [**Ammonites mirapelianum* Orbigny, 1850a, p. 124; OD]. Whorl section varying from only a little higher than wide to moderately compressed; ribs single, coarse to rather fine, and markedly flattened and broadened on shoulders. *Lower Cretaceous (Middle Albian):* England, France, Angola, Madagascar, California, Texas, Colombia, Peru, Brazil.——Fig. 106,*1a,b. *O. (M.) mirapelianum* (Orbigny), France; ×0.5 (Cooper, 1982).

O. (Venezoliceras) Spath, 1925c, p. 182 [**O. venezolanum* Stieler, 1920, p. 394; OD] [=*Lophoceras* Hoepen, 1931, p. 40, *non* Hyatt, 1893, p. 466 (type, *L. umsinense;* OD); *Tarfayites* Collignon, 1967, p. 19 (1963, p. 142, *nom. nud.*) (type, *O. (Tarfayites) bituberculatum;* OD)]. Ribs straight or slightly sinuous, typically coarse, high, steep in front, shallow behind, but may be flat at some growth stage; high umbilical to midlateral bullae on some ribs and bullate to slightly clavate ventrolateral tubercles on all. *Lower Cretaceous (Middle Albian–Upper Albian):* Morocco, South Africa (Zululand), Madagascar, Texas, Mexico, Venezuela, Peru.——Fig. 107,*2a,b. *O. (V.) venezolanum,* Venezuela, neotype; ×1 (Renz, 1982).

O. (Laraiceras) Renz, 1968, p. 650 [**O. (L.) laraense;* OD]. With alternate, long and short, coarse ribs; long ribs with umbilical, midlateral, and ventrolateral tubercles. *Lower Cretaceous (Upper Albian):* Venezuela.——Fig. 107,*3a,b. **O. (L.) laraense;* ×0.5 (Renz, 1982).

O. (Benavidesites) Cooper, 1982, p. 295 [**Venezoliceras harrisoni* Benavides-Cáceres, 1956, p. 460; OD]. Ribs fine and bifurcating at first, then coarsening, with midlateral tubercles on outer whorls. *Lower Cretaceous (Middle Albian):* Texas, Venezuela, Peru.——Fig. 106,*3a. *O. (B.) harrisoni* (Benavides-Cáceres), Peru; ×0.5 (Benavides-Cáceres, 1956).——Fig. 106,*3b. O. (B.) acutocarinatum* (Shumard), Texas; ×0.5 (K. Young, 1966).

O. (Adkinsites) Spath, 1931a, p. 350 [**Ammonites belknapi* Marcou, 1858, p. 34; OD] [=*Androiavites* Collignon, 1936, p. 186 (type, *O. (A.) besairiei;* OD)]. Ribs coarse, variable, straight or curved; inner whorls at least with strong umbilical and weak ventrolateral tubercles. *Lower Cretaceous (Middle Albian–Upper Albian):* Europe, Madagascar, Texas.——Fig.

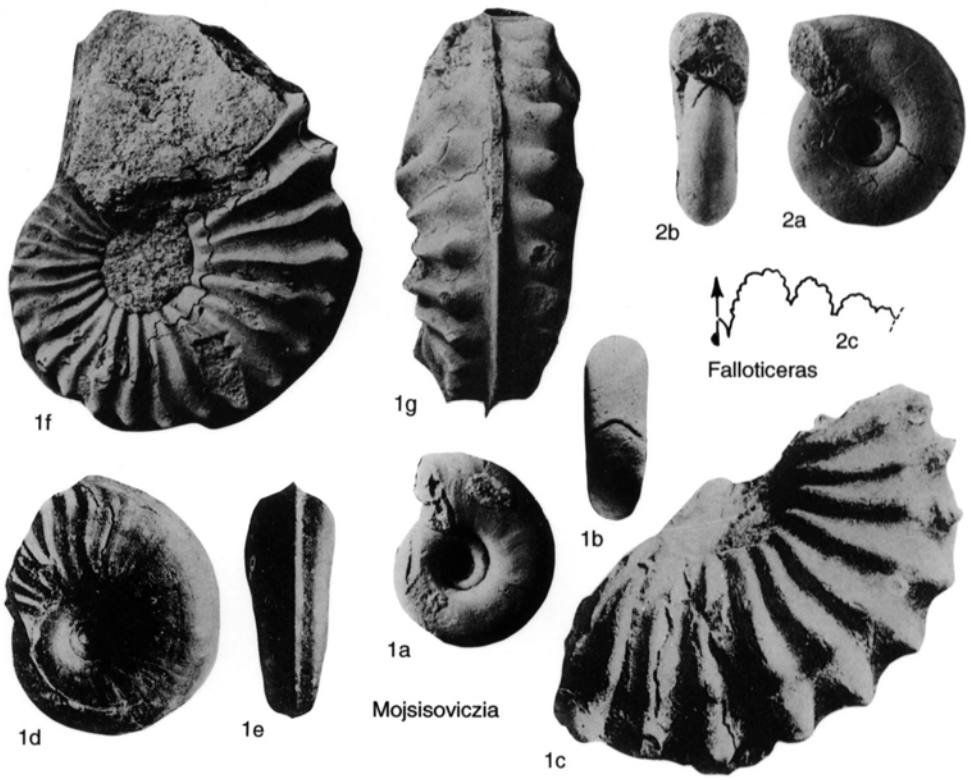

Fig. 105. Brancoceratidae (p. 137)

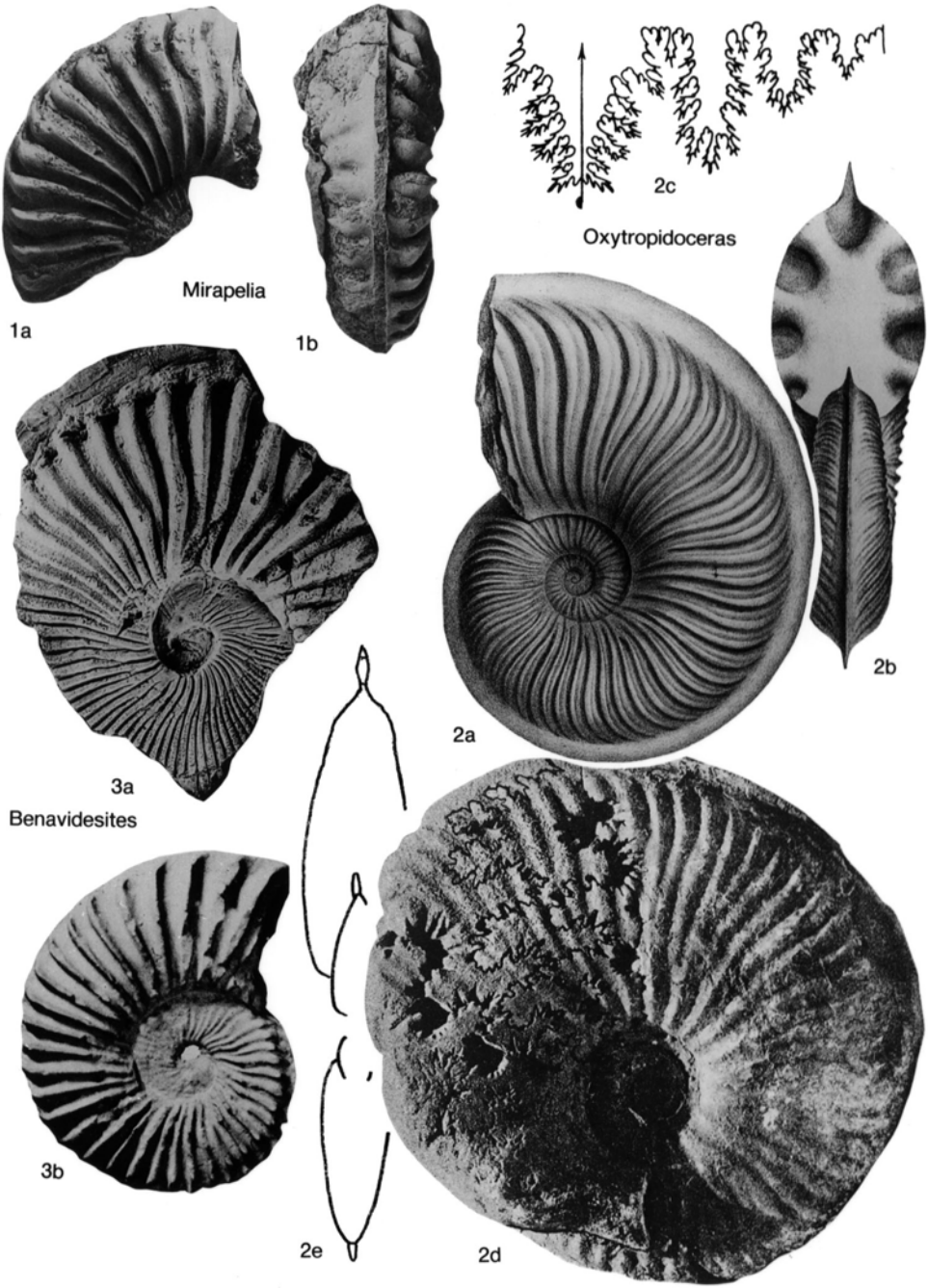

FIG. 106. Brancoceratidae (p. 137–138)

107,*1. O. (A.) bravoense* (BÖSE), Texas; ×1 (K. Young, 1966).

Dipoloceras HYATT, 1900, p. 589 [**Ammonites cristatus* BRONGNIART in CUVIER & BRONGNIART, 1822, pl. O, fig. 9; OD]. Rather evolute; typically inflated or depressed; keel prominent, commonly below level of ventrolateral ends of ribs; ribs dense to distant, rounded to sharp, typically a mixture of single and branched, the latter flared at point of branching; umbilical and ventrolateral tubercles present in

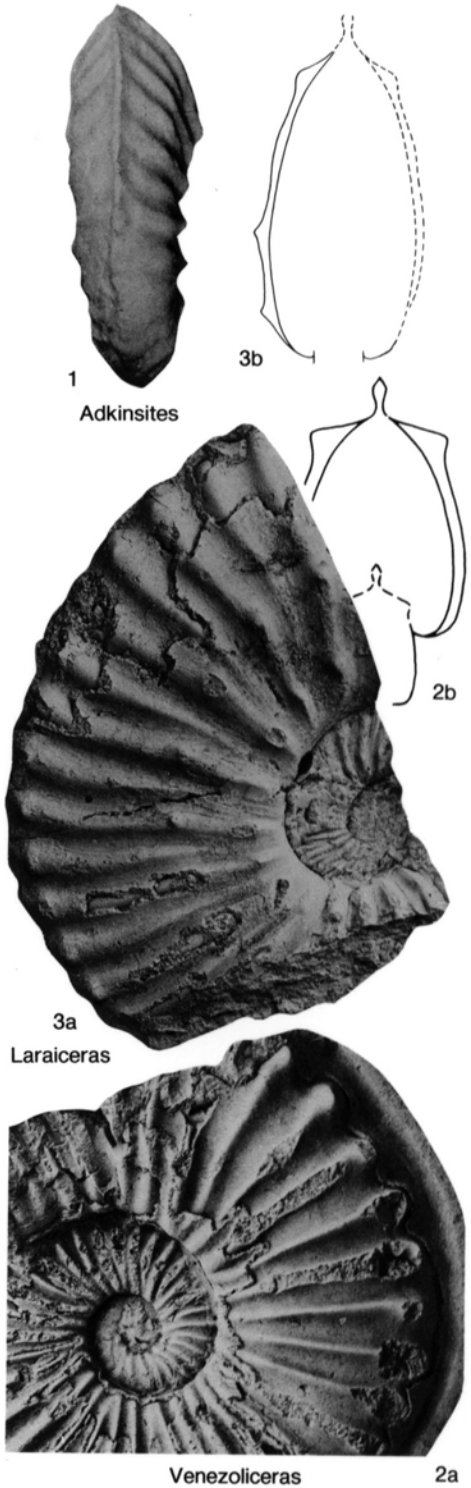

FIG. 107. Brancoceratidae (p. 138–139)

some. Sutures with plump, broad, finely indented saddles. *Lower Cretaceous (Middle Albian–Upper Albian):* Europe, South Africa (Zululand), Madagascar, Japan, Texas, ?Curaçao.

D. (Dipoloceras) [=*Cechenoceras* HOEPEN, 1941, p. 61 (type, *C. reversum;* OD)]. Whorl section round or depressed; umbilical and ventrolateral tubercles absent or insignificant. Occurrence and distribution as for genus.——FIG. 108,*1a–c.* **D. (D.) cristatum* (BRONGNIART in CUVIER & BRONGNIART), Middle Albian, France; *a,b,* ×1; *c,* ×2 (Orbigny, 1840–1842).

D. (Rhytidoceras) HOEPEN, 1931, p. 42 [**R. elegans;* OD] [=*Ricnoceras* HOEPEN, 1941, p. 59 (type, *R. pandai;* OD); *Diplasioceras* HOEPEN, 1946a, p. 203 (type, *D. fallax;* OD); *Euspectroceras* HOEPEN, 1946a, p. 202 (type, *E. strigile;* OD); ?*Mortoniceratoides* COOPER, 1982, p. 296 (type, *Mortoniceras rigidum* SPATH, 1933b, p. 413; OD)]. Inner whorls tending to be flat-sided, with distinct umbilical and weak ventrolateral tubercles and with ribs a mixture of branched and flexuous and single and straight; strong, spiral notching may occur (*Euspectroceras*). Occurrence and distribution as for genus.——FIG. 108,*2a,b.* **D. (R.) elegans* (HOEPEN), Upper Albian, Zululand; ×0.5 (Hoepen, 1941).

?Menuthengonoceras COLLIGNON, 1963, p. 130 [**M. komihevitraense;* OD]. Based on single fragment of discoidal, high-whorled form with shouldered venter and high keel. COLLIGNON (1963) compared the suture of *Menuthengonoceras* with *Hypengonoceras,* but the fragment seems as likely to belong to Mojsisovicziinae as to Engonoceratidae. *Lower Cretaceous (Middle Albian):* Madagascar.

Subfamily MORTONICERATINAE H. Douvillé, 1912

[*nom. transl.* SPATH, 1934, p. 465, *ex* Mortoniceratidae SPATH, 1925c, p. 182, *nom. correct. pro* Mortoniceratinés H. DOUVILLÉ, 1912, p. 295] [=Inflaticeratidae SPATH, 1925c, p. 181; Pervinquieriidae SPATH, 1926a, p. 79; Arestoceratidae HOEPEN, 1942, p. 117; Cainoceratidae HOEPEN, 1942, p. 127]

Moderately involute to very evolute; whorl section more or less rounded, square, or compressed, with low to high keel; ribs branching or long and short, at least in early whorls, but may be single and equal on body chamber or earlier; ribs low and rounded, or flat, or high and rounded, but not high and sharp; at least umbilical tubercles occurring, normally also inner ventrolateral, and frequently lateral and outer ventrolateral; some species with up to 5 tubercles on a rib; spiral striation or notching of ribs common; aperture simple (in probable macroconchs) or with rostrum directed forward, upward, or backward (in probable microconchs).

Suture generally with squarish, symmetrical, deeply and sharply indented saddles. HOEPEN, 1941–1951; SPATH, 1923–1943. *Lower Cretaceous (Middle Albian)–Upper Cretaceous (Lower Cenomanian).*

As the synonymies of subfamily and genera show, both the nomenclature and scale of classification of the group have been in doubt. A large number of species with many of the same basic characters vary in detail and in combination of whorl section, number and shape of tubercles at different growth stages, and in strength and direction of ribs. An attempt is made here to classify them in accord with the scale accepted in allied groups. The subfamily is derived from Mojsisovicziinae along one or several closely allied lines and remains very uniform.

Mortoniceras MEEK, 1876, p. 448 [**Ammonites vespertinus* MORTON, 1834, p. 40; OD (despite many authors, a valid species)] [for synonyms see subgenera]. More or less evolute, with square, rectangular, or trapezoidal costal whorl section; ribs normally strong but may weaken or strengthen on body chamber; with prominent umbilical and normally with inner ventrolateral tubercles at least and, at some growth stage, 1 or 2 lateral and an outer ventrolateral tubercle also may occur; keel high or low. *Lower Cretaceous (Middle Albian–Upper Albian):* Europe, Africa, India, North America, South America, Madagascar.

M. (Mortoniceras) [=*Pervinquieria* BÖHM, 1910, p. 152 (type, *Ammonites inflatus* J. SOWERBY, 1817c, p. 170; M); *Inflaticeras* STIELER, 1920, p. 346 (type, *Ammonites inflatus* J. SOWERBY, 1817c, p. 170; OD); *Subschloenbachia* SPATH, 1921a, p. 284 (type, *Ammonites rostratus* J. SOWERBY, 1817b, p. 163; OD); *Leonites* SPATH, 1932, p. 388 (type, *Ammonites leonensis* CONRAD, 1857, p. 160; OD); *Ophryoceras* HOEPEN, 1942, p. 91 (type, *O. jugosum;* OD); ?*Ameleceras* HOEPEN, 1942, p. 115 (type, *A. abjectum;* OD); *Rusoceras* HOEPEN, 1946a, p. 238 (type, *R. nothum;* OD); *Collignonia* HOEPEN, 1951b, p. 295 (type, *Pervinquieria (C.) undulatocostata* HOEPEN, 1951b, p. 295; OD); *Styphloceras* HOEPEN, 1951b, p. 300 (type, *Pervinquieria (S.) nodosocostata* HOEPEN, 1951b, p. 300; OD); *Omocrateceras* HOEPEN, 1951b, p. 313 (type, *Pervinquieria (O.) planiventer* HOEPEN, 1951b, p. 313; OD); *Subpervinquieria* MIRZOEV, 1969, p. 46 (type, *Pervinquieria (S.) luppovi* MIRZOEV, 1969, p. 46; OD)]. Ribs moderately fine to very coarse, normally branching at umbilical tubercles on early whorls, later single; with umbilical and inner ventrolateral tubercles; mediolateral tubercles typically weak, present or not; outer ventrolateral tubercle commonly percep-

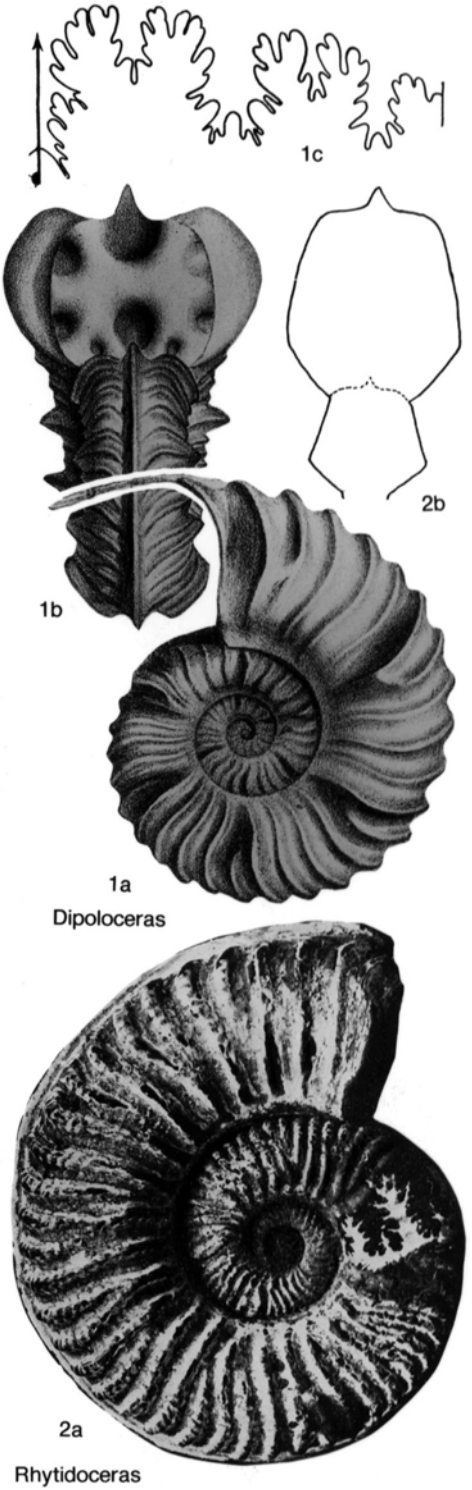

FIG. 108. Brancoceratidae (p. 140)

tible at some stage and in some species, e.g., *M. (M.) rostratum* (J. SOWERBY), and may be strong for a short stage, foreshadowing *M. (Durnovarites);* in a few species all tubercles weak and ribs dominant; rostrum (questionably of microconchs) raised and straight to recoiled. Occurrence and distribution as for genus except that it does not reach the extreme top of the Albian. ——FIG. 109*a–d.* **M. (M.) vespertinum* (MORTON), Upper Albian, Texas; *a,b,* holotype, ×0.25; *c,d,* ×0.5 (new).——FIG. 109*e–g. M. (M.) inflatum* (J. SOWERBY); *e,* Upper Albian, England, ×0.7; *f,* Upper Albian, England, ×1 (Spath, 1923–1943); *g,* Upper Albian, France, ×1 (Orbigny, 1840–1842).——FIG. 109*h. M. (M.) rostratum* (J. SOWERBY), Upper Albian, France; ×0.5 (Scholz, 1979).

M. (Boesites) K. YOUNG, 1968, p. 71 [**Pervinquieria romeri* HAAS, 1942, p. 73; OD]. Very evolute, with umbilical and ventrolateral bullae but no lateral tubercles; ribs strong and distant, equal or long and short, but not bifurcating. Barely distinct from some bituberculate *M. (Mortoniceras). Lower Cretaceous (Upper Albian):* Angola, Texas, Mexico.

M. (Deiradoceras) HOEPEN, 1931, p. 52 [**Inflaticeras prerostratum* SPATH, 1921a, p. 284; OD] [=*Drepanoceras* HOEPEN, 1931, p. 46, *non* STEIN, 1878, p. 25 (type, *D. undatum;* OD); *Mimeloceras* HOEPEN, 1944, p. 196, *nom. nov. pro Mimoceras* HOEPEN, 1941, p. 85, *non* HYATT, 1884, p. 309 (type, *Mimoceras binodosum;* OD)]. Whorl section depressed to slightly compressed, subquadrate, with sharp keel; very strong umbilical and ventrolateral tubercles with costal whorl section concave between; midlateral tubercles may be visible at some stage; early whorls tending to have rounded venter as in *Dipoloceras;* rostrum projected in continuation of coiling of shell. *Lower Cretaceous (Upper Albian):* western Europe, Africa, Venezuela.——FIG. 110,*3.* **M. (D.) prerostratum* (SPATH), South Africa (Zululand); ×0.75 (Spath, 1921a).

M. (Durnovarites) SPATH, 1932, p. 380 [**Subschloenbachia perinflata* SPATH, 1922a, p. 113; M; SPATH (1932, p. 380) designated the type as follows: "*M. (D.) subquadratum,* nov. Plate xxxvii, figs. 6a,b (Diagnosis below)"; however, the diagnosis did not appear until 1933 (p. 429) and, after 1931, mere reference to a figure was insufficient to validate a species. Thus, *M. (D.) subquadratum* was in 1932 a *nom. nud.* SPATH (1933b, p. 429) quoted the type species of *Durnovarites* as *M. (D.) perinflatum* (SPATH) without comment.] [=*Reyreiceras* COLLIGNON, 1979, p. 34 (type, *R. reyrei;* OD)]. Whorl section square to depressed-trapezoidal; from early stage at least 4 nearly equally spaced tubercles on each rib, the outer one as prominent as the others and tending to be clavate. *Lower Cretaceous (Upper Albian):* Europe, Africa, Madagascar, Texas.——FIG. 110,*2a,b.* **M. (D.) perinflatum* (SPATH), France; ?microconch, ×0.5 (Scholz, 1979).——FIG. 110,*2c,d. M. (D.) subquadratum,* England; ×1 (Spath, 1923–1943).

M. (Angolaites) SPATH, 1932, p. 380 [**Pervinquieria gregoryi* SPATH, 1922a, p. 127; OD] [=?*Praeangolaites* COLLIGNON, 1979, p. 41 (type, *P. galvaoi;* OD)]. Rather compressed; with single ribs at all stages; at first with umbilical tubercles; later also with prominent inner and outer ventrolateral tubercles. *Lower Cretaceous (Upper Albian):* western Africa.——FIG. 110,*1a,b.* **M. (A.) gregoryi* (SPATH), Angola; ×0.5 (Spath, 1922a).

M. (Drakeoceras) K. YOUNG, 1957, p. 19 [**D. drakei;* OD]. Compressed to rather inflated; normally with branching ribs at some stage and with double ventrolateral tubercles as in *M. (Angolaites). Lower Cretaceous (Upper Albian):* Angola, Texas.——FIG. 110,*5a,b.* **M. (D.) drakei* (YOUNG), Texas; ×0.75 (K. Young, 1957).

M. (Pagoceras) HOEPEN, 1951b, p. 324 [**P. amplificatum;* OD] [=*Poikiloceras* HOEPEN, 1951b, p. 329 (type, *P. firmum;* OD)]. Moderate-sized, with markedly fastigiate venter becoming increasingly acute with age. *Lower Cretaceous (Upper Albian):* South Africa (Zululand).——FIG. 110,*4a,b.* **M. (P.) amplificatum* (HOEPEN); ×0.5 (Hoepen, 1951b).

Goodhallites SPATH, 1932, p. 381 [**Ammonites goodhalli* J. SOWERBY, 1820, p. 100; OD] [=*Letheceras* HOEPEN, 1942, p. 138 (type, *L. complanatum;* OD); *Cainoceras* HOEPEN, 1942, p. 149 (type, *C. liberum;* OD); *Lethargeceras* HOEPEN, 1942, p. 149 (type, *L. incommodum;* OD); *Aidoceras* HOEPEN, 1946b, p. 248 (type, *A. jubatum;* OD)]. More or less compressed and high-whorled, with high keel; inner whorls generally finely ribbed, with rather weak umbilical, ventrolateral, and rarely midlateral tubercles or none; outer whorls normally with strong ornament, tubercles becoming more prominent with age, but final part may be nearly smooth. *Lower Cretaceous (Upper Albian):* Europe, Africa, Madagascar, southern India, Australia (Queensland), Texas, Venezuela.——FIG. 111,*3a,b.* **G. goodhalli* (J. SOWERBY), England; *a,* ×0.67; *b,* ×0.5 (Spath, 1923–1943).——FIG. 111,*3c,d. G. liber* (HOEPEN), South Africa (Zululand); ×1 (Hoepen, 1942).

Arestoceras HOEPEN, 1942, p. 118 [**A. collinum;* OD] [=?*Tetagmenoceras* HOEPEN, 1942, p. 122 (type, *T. tumulosum* HOEPEN, 1942, p. 123; SD WRIGHT, herein)]. Early whorls as in some early, less tuberculate species of *M. (Mortoniceras),* but ornament tending to disappear, whorl height to increase, and venter to become fastigiate rather than keeled. Perhaps a subgenus of *Goodhallites. Lower Cretaceous (Upper Albian):* South Africa (Zululand).——FIG. 111,*2.* **A. collinum;* ×0.75 (Hoepen, 1942).

Neoharpoceras SPATH, 1921a, p. 282 [**Ammonites hugardianus* ORBIGNY, 1841, p. 291; OD]. Compressed; more involute than *Prohysteroceras* and with more rounded venter and lower keel; ribs dense and sinuous, without tubercles. Suture florid. *Lower Cretaceous (Upper Albian):* western Europe.——FIG.

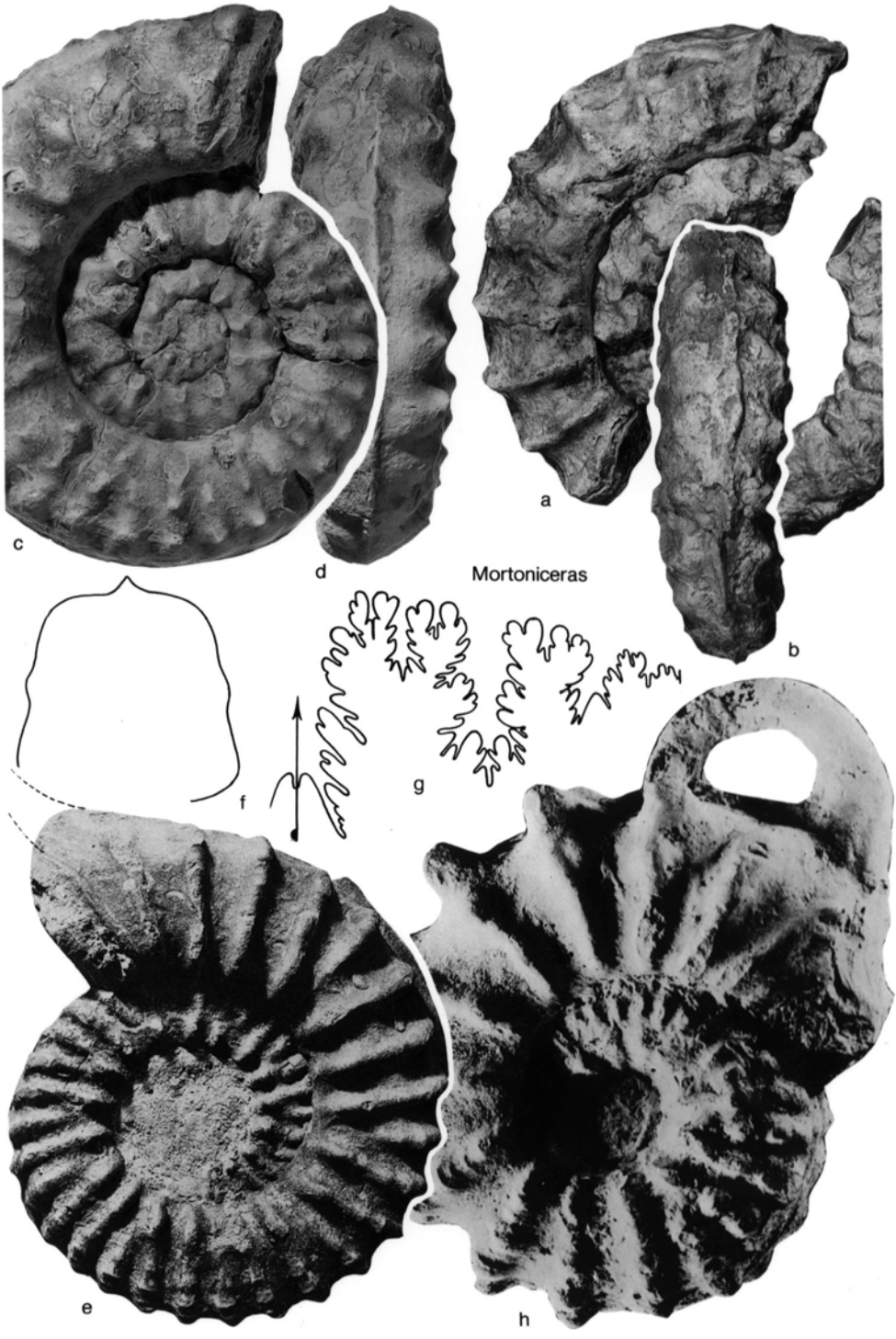

FIG. 109. Brancoceratidae (p. 141–142)

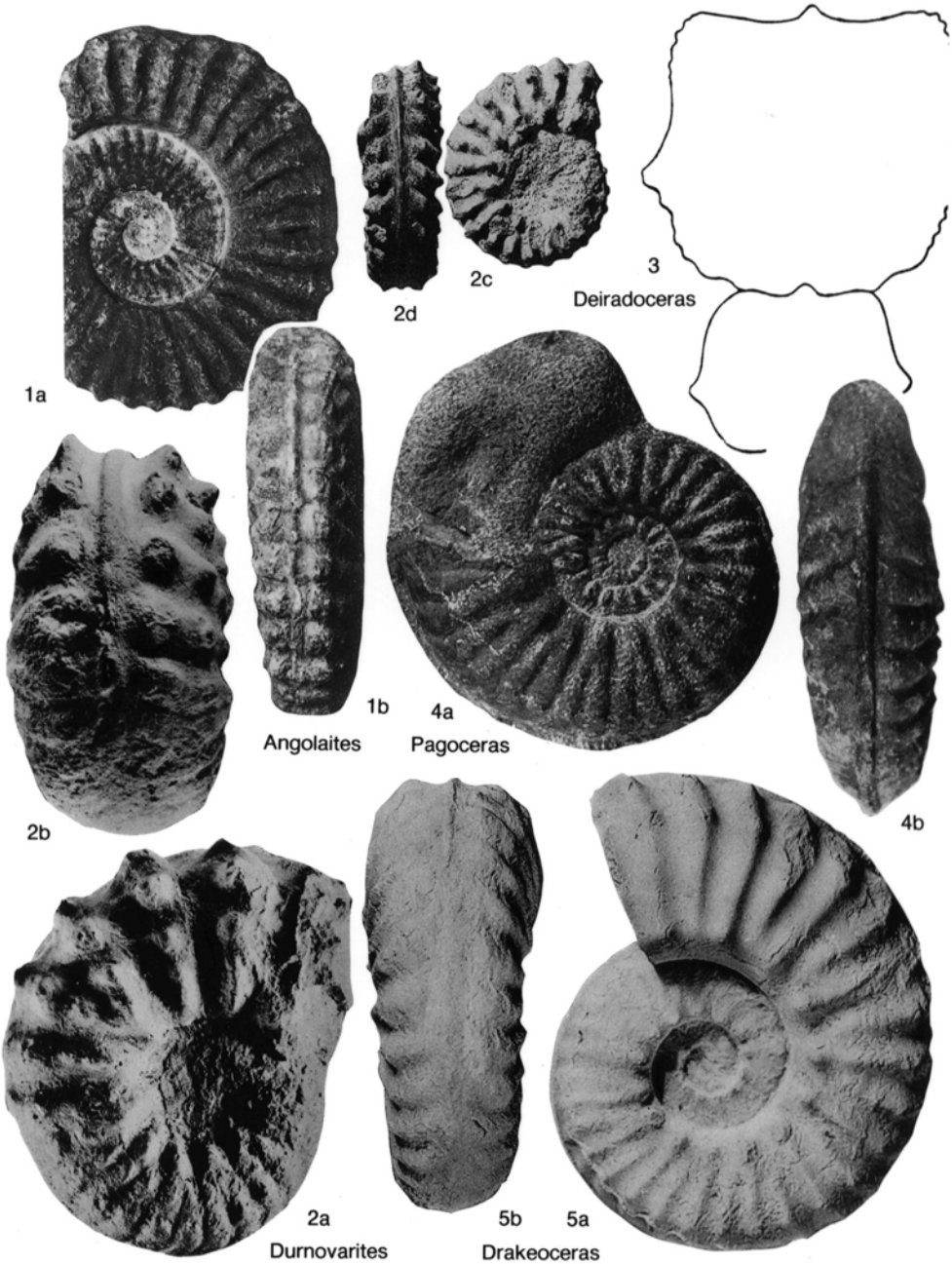

FIG. 110. Brancoceratidae (p. 142)

111,*1a,b.* **N. hugardianum* (ORBIGNY), France; ×0.75 (Orbigny, 1840–1842).

Prohysteroceras SPATH, 1921a, p. 286, ICZN Opinion 1254, 1983, Generic Name No. 2195 [**P. wordiei* SPATH, 1922a, p. 143 (1921a, p. 286, *nom. nud.*); ICZN Specific Name No. 2862]. Rather evolute and moderately compressed; ribs fine, close, sinuous, and branching; tubercles weak or absent; rostrum prominent, directed upward. *Lower Cretaceous (Upper Albian):* England, Angola.——FIG. 111,*4a–c.* **P. wordiei,* Angola; *a,* ×0.7; *b,* ×1; *c,* ×2.5 (Spath, 1922a).

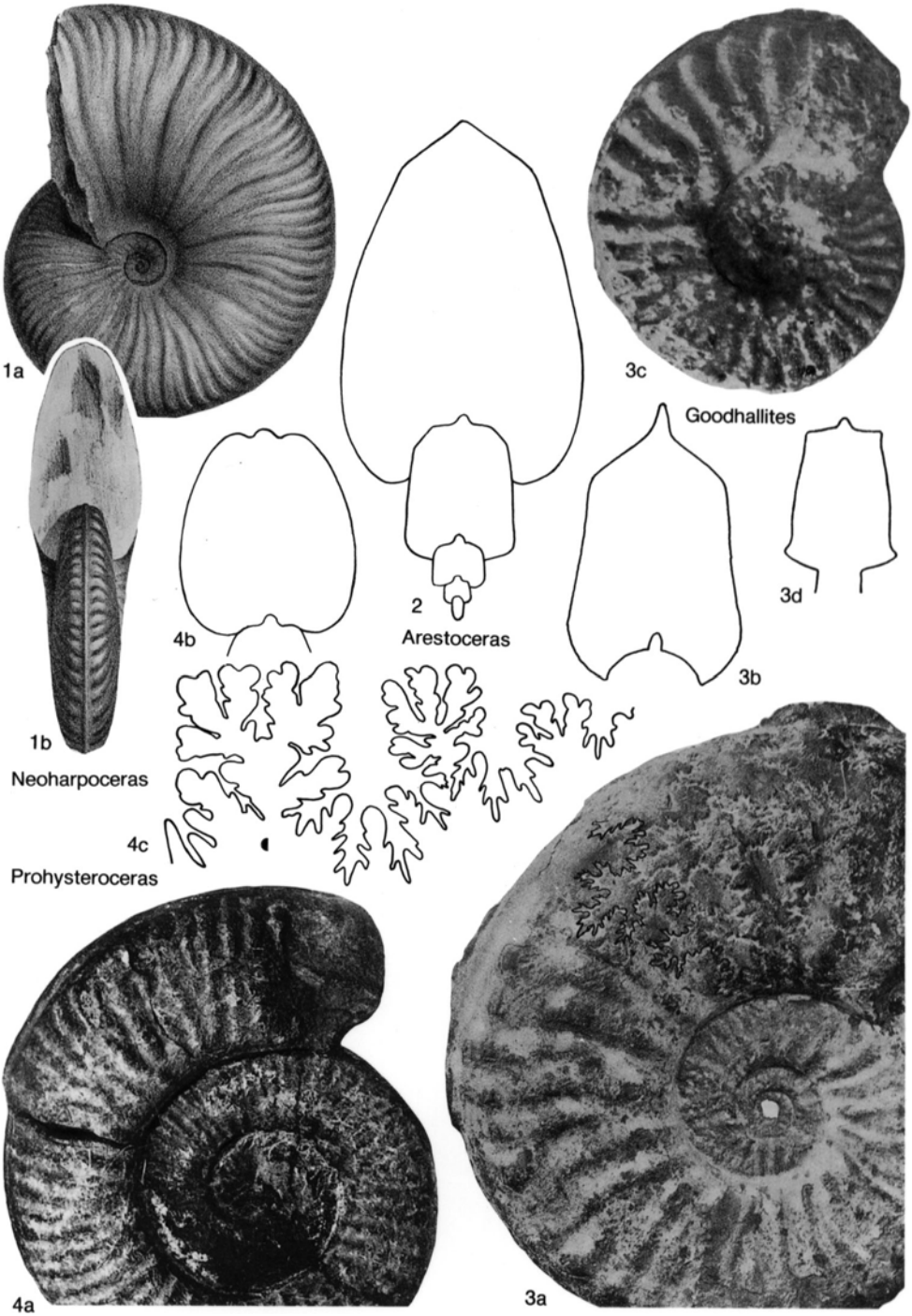

FIG. 111. Brancoceratidae (p. 142–144)

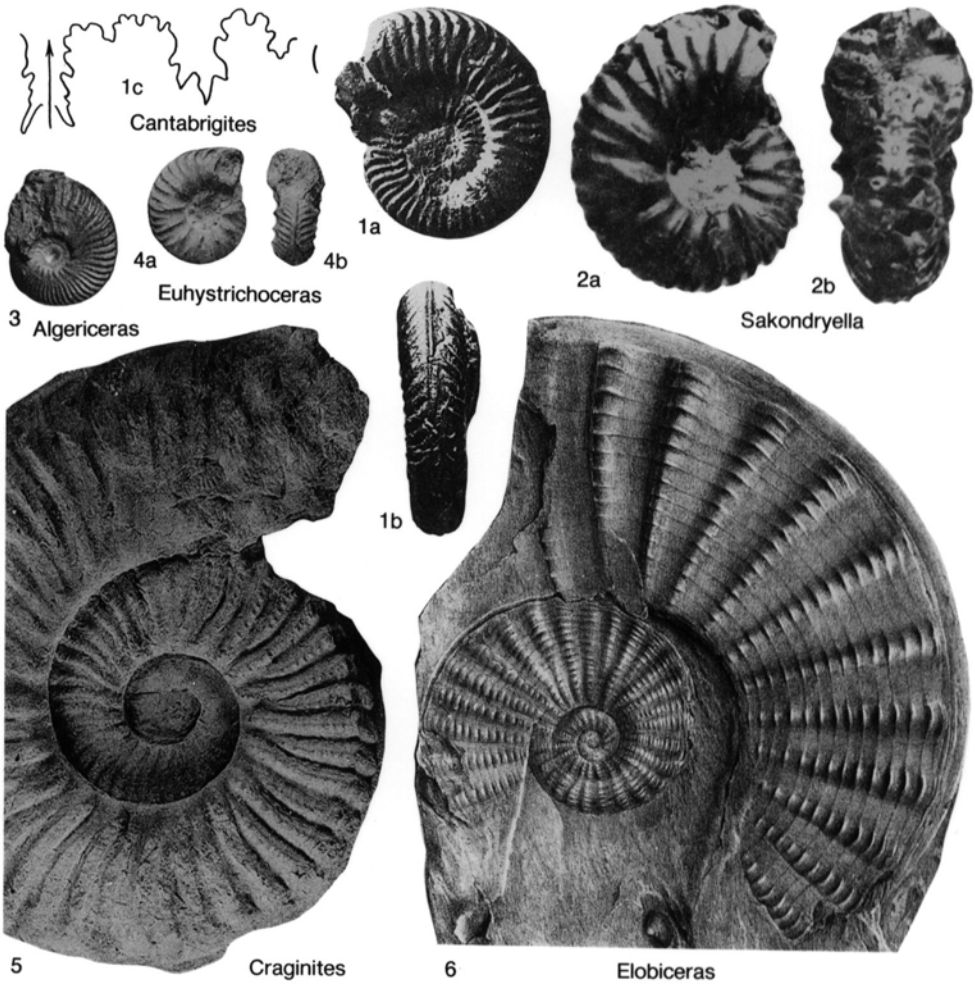

FIG. 112. Brancoceratidae (p. 146–147)

Elobiceras SPATH, 1921a, p. 306 [**Schloenbachia elobiensis* SZAJNOCHA, 1885, p. 235; OD]. Rather evolute and compressed, with numerous clavi or spiral notches on the ribs. *Lower Cretaceous (Upper Albian):* Angola, southern India, Nigeria, Texas.

E. (Craginites) K. YOUNG, 1957, p. 14 [**Schloenbachia leonensis* var. *serratescens* CRAGIN, 1893, p. 241; OD]. With alternate, long and short, flexuous ribs. Occurrence as for genus: Texas.——FIG. 112,*5. *E. (C.) serratescens* (CRAGIN); ×1 (K. Young, 1957).

E. (Elobiceras). Ribs single, rectiradiate. Occurrence as for genus: Angola, Nigeria, southern India.——FIG. 112,*6. *E. (E.) elobiense* (SZAJNOCHA), Angola; ×0.5 (Szajnocha, 1885).

Cantabrigites SPATH, 1933b, p. 436 (1932, p. 380, *nom. nud.*) [**Mortoniceras (C.) cantabrigense* SPATH, 1932, p. 380; OD]. Small; generally with branching ribs at first, tending to become single, mostly nontuberculate. Suture much simplified. May be closer to *Hysteroceras* (Brancoceratinae). *Lower Cretaceous (Upper Albian):* England, France, Switzerland.——FIG. 112,*1a–c. *C. cantabrigense* SPATH, England; *a,b,* ×1; *c,* ×2 (Spath, 1923–1943).

Algericeras SPATH, 1925c, p. 182 [**Ammonites boghariensis* COQUAND, 1880, p. 35; OD] [=*Prionocycloides* SPATH, 1925c, p. 182 (type, *Ammonites proratus* COQUAND, 1880, p. 32; OD)]. Small; compressed to inflated, with rounded shoulders and keel; ribs fine or coarse, sharp and branching. Seems to be derived from *Cantabrigites.* KENNEDY & WRIGHT, 1981. *Upper Cretaceous (Lower Cenomanian):* northern Africa, Madagascar, Mexico.

A. (Algericeras). Keel nodate at first, then entire. Occurrence as for genus: northern Africa.——FIG. 112,*3. *A. (A.) boghariense* (COQUAND), Tunisia; ×2 (Pervinquière, 1907).

A. (Sakondryella) COLLIGNON, 1964, p. 21

[**Euhystrichoceras (S.) madagascariense* COLLIGNON, 1964, p. 21; OD; =*Euhystrichoceras remolinense* BÖSE, 1928, p. 247]. Keel with strong crenulations throughout. Occurrence as for genus: Madagascar, Mexico.——FIG. 112,*2a,b. *A. (S.) remolinense* (BÖSE), Madagascar; ×1 (Collignon, 1964).

Euhystrichoceras SPATH, 1923b, p. 143 [**Ammonites nicaisei* COQUAND, 1862, p. 323; OD]. Small; rather evolute; compressed to inflated, with flat or convex sides and strong, entire keel; irregular ribs springing in twos and threes from sharp umbilical tubercles and curving forward on venter; shorter ribs intercalated; ventrolateral tubercles may occur and if so lautiform ribbing may develop. KENNEDY & WRIGHT, 1981. *Upper Cretaceous (Lower Cenomanian):* England, northern Africa, Nigeria, Madagascar, Mexico.——FIG. 112*,4a,b. *E. nicaisei* (COQUAND), Tunisia; ×1 (Pervinquière, 1907).

Family LYELLICERATIDAE Spath, 1921

[Lyelliceratidae SPATH, 1921a, p. 286]

Small to moderate-sized; compressed to inflated; moderately to very evolute; ribs straight to sigmoid, uniform to long and short, rarely branched, crossing venter transversely or in chevrons, zigzagging or interrupted, and with or without tubercles. Suture rather simple; with bifid saddles; deep, parallel-sided ventral lobe; trifid lateral lobes; and no umbilical retraction. *Lower Cretaceous (Lower Albian)–Upper Cretaceous (Lower Cenomanian).*

Probably derived from *Leymeriellidae.*

Subfamily LYELLICERATINAE Spath, 1921

[Lyelliceratinae SPATH, 1921a, p. 286]

Evolute, with strong tuberculation. *Lower Cretaceous (Lower Albian–Middle Albian).*

Tegoceras HYATT, 1903, p. 84 [**Ammonites mosensis* ORBIGNY, 1841, p. 237; OD] [=*Rauliniceras* H. DOUVILLÉ, 1911, p. 85 (type, *Hoplites gladiator* BAYLE, 1878, pl. 45, fig. 1–2; OD); *Seunesiceras* BREISTROFFER, 1953b, p. 74, *nom. nud.*]. Moderately involute to evolute; whorl section compressed, subrectangular to subhexagonal; venter flat or slightly convex; ribs simple, thick, and rounded, with wide interspaces and emphasized or tuberculate one-third up side; ribs forming nodes on shoulder and alternating across venter with zigzagging ventral ribs or clavate on shoulder with smooth venter. Mature body chamber smooth, with rounded venter. Suture with short elements that may be broken into fingerlike denticulations. *Lower Cretaceous (Lower Albian–Middle Albian):* western Europe, Madagascar, Pakistan, Venezuela.——FIG. 113*,1a–d. *T. mosense* (ORBIGNY), Lower Albian; *a–c,* holotype, France, ×1; *d,* England, ×1 (Casey, 1978). ——FIG. 113,*1e,f. T. camatteanum* (ORBIGNY), Middle Albian, France; ×1 (Orbigny, 1840–1842).

Prolyelliceras SPATH, 1930b, p. 65 [**P. peruvianum;* OD] [=*Ralphimlayites* ETAYO SERNA, 1979, p. 81 (type, *R. apuloensis;* OD)]. Slightly compressed and high-whorled, with flexuous ribs continuous across venter or in some flattened on it; ventrolateral and siphonal clavi subordinate to ribs. Some species (*Ralphimlayites*) also have inner ventrolateral tubercles during middle growth and may not lose tubercles completely on body chamber. Grades into *Lyelliceras* and separation may not be necessary. *Lower Cretaceous (Lower Albian):* Tunisia, Colombia, Peru.——FIG. 113,*3a–c. P. prorsocurvatum* (GERHARDT), Colombia; *a,b,* ×0.75; *c,* ×2 (Gerhardt, 1897b).

Lyelliceras SPATH, 1922a, p. 107 [**Ammonites lyelli* ORBIGNY, 1841, p. 255; OD]. Moderately to very evolute; whorl section slightly compressed to circular; normally having straight radial ribs with 2 or 3 rows of lateral clavi and one row of siphonal clavi, but siphonal clavi effaced in some forms; tubercles normally dominant over ribs; ribs continuing straight over venter or zigzagging. *Lower Cretaceous (Lower Albian–Middle Albian):* western Europe, Madagascar, Pakistan, Mexico, Colombia, Peru, Venezuela.——FIG. 113,*2a–c. *L. lyelli* (ORBIGNY), Middle Albian, France; *a,b,* ×0.75; *c,* enlarged (Orbigny, 1840–1842).

Subfamily STOLICZKAIINAE Breistroffer, 1953

[Stoliczkaiinae BREISTROFFER, 1953b, p. 74]

More involute than Lyelliceratinae, with ribs tending to become dominant over tubercles. *Lower Cretaceous (Middle Albian)–Upper Cretaceous (Lower Cenomanian).*

Neophlycticeras SPATH, 1922a, p. 107 [**Ammonites brottianus* ORBIGNY, 1841, p. 290; OD] [=*Faraudiella* BREISTROFFER, 1947b, p. 88(72) (type, *Ammonites gardonicus* HÉBERT & MUNIER-CHALMAS, 1875, p. 113; OD; =*Ammonites blancheti* PICTET & CAMPICHE, 1859, p. 188); *Eotropitoides* CASEY, 1965, p. 462 (type, *N. jayeti* BREISTROFFER, 1936, p. 65, *nom. nud.;* OD)]. Moderately to very involute; more or less compressed, with sides flat or convex and ribs flat or broadly rounded; venter sharp and crenulate or rounded with row of siphonal tubercles. [*Eotropitoides* as a subgenus for compressed forms with ribbing effaced at midside and siphonal tubercles tending to form a keel seems unnecessary; the incipient forbesiceratoid adventive lobe on the outer side of the first lateral saddle also appears in typical *Neophlycticeras.*] *Lower Cretaceous (Middle Albian–Upper Albian):* western Europe, Morocco, Madagascar, ?Japan, Colombia, Peru,

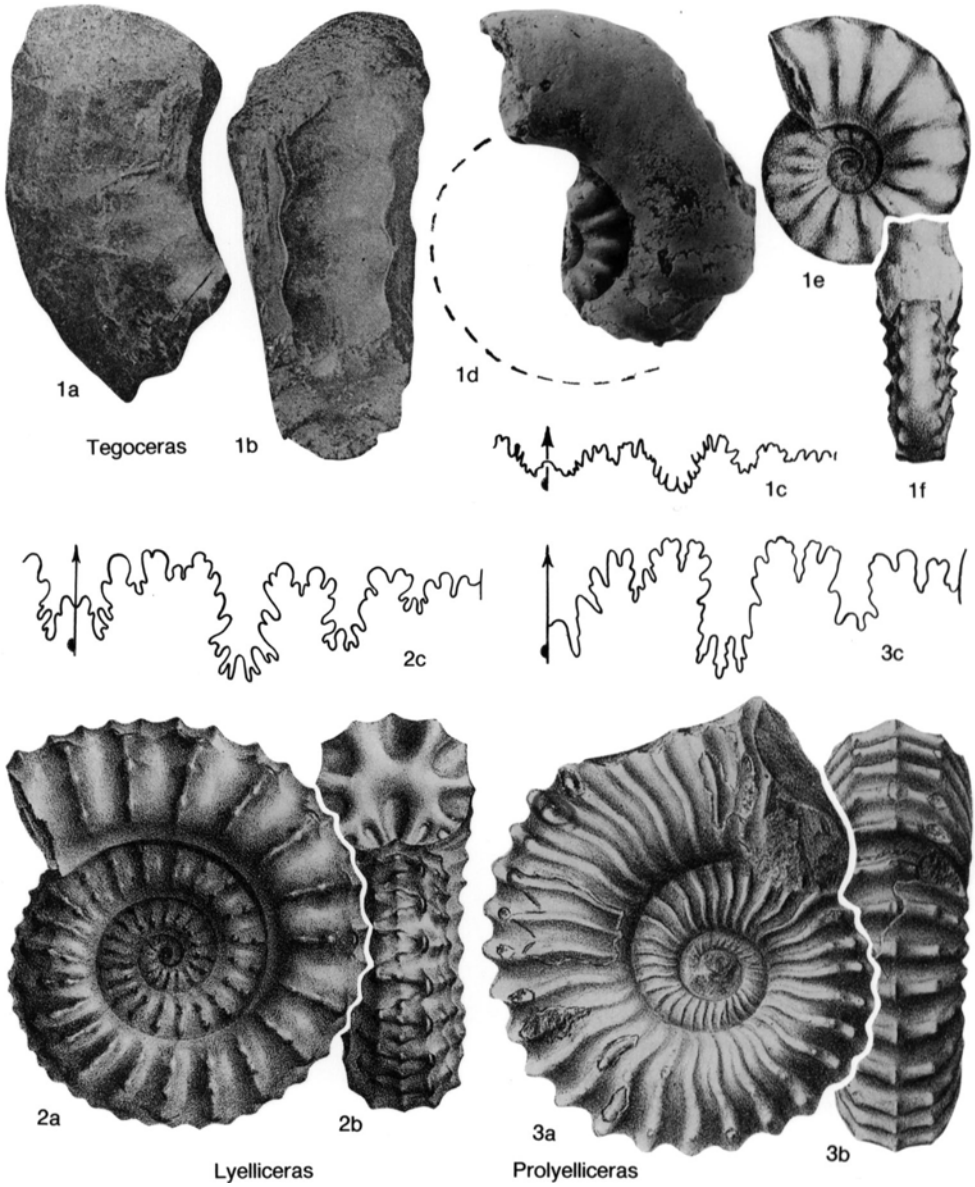

FIG. 113. Lyelliceratidae (p. 147)

Venezuela.——FIG. 114,*1a,b.* **N. brottianum* (ORBIGNY), Middle Albian, France; ×1; *c,* enlarged (Orbigny, 1840–1842).——FIG. 114,*1d–f. N. blancheti* (PICTET & CAMPICHE), Upper Albian, Switzerland; *d,e,* ×1; *f,* enlarged (Pictet & Campiche, 1858–1864).

Protissotia COLLIGNON, 1932, p. 12 [**Tissotia (Protissotia) madagascariensis;* OD; =*Ammonites itierianus* ORBIGNY, 1841, p. 367]. Dwarf offshoot of *Neophlycticeras;* sides flat, with or without marked umbilical and ventrolateral nodes; sutures tending to be slightly pseudoceratitic. *Lower Cretaceous (Upper Albian):* western and central Europe, Madagascar, Venezuela.——FIG. 115,*4a–d.* **P. itierianus* ORBIGNY, Venezuela; *a–c,* ×1; *d,* ×2 (Renz, 1970).

Cenisella DELAMETTE & LATIL, 1989, p. 57 [**Ammonites bonettianus* PICTET, 1847, p. 306; OD]. Early

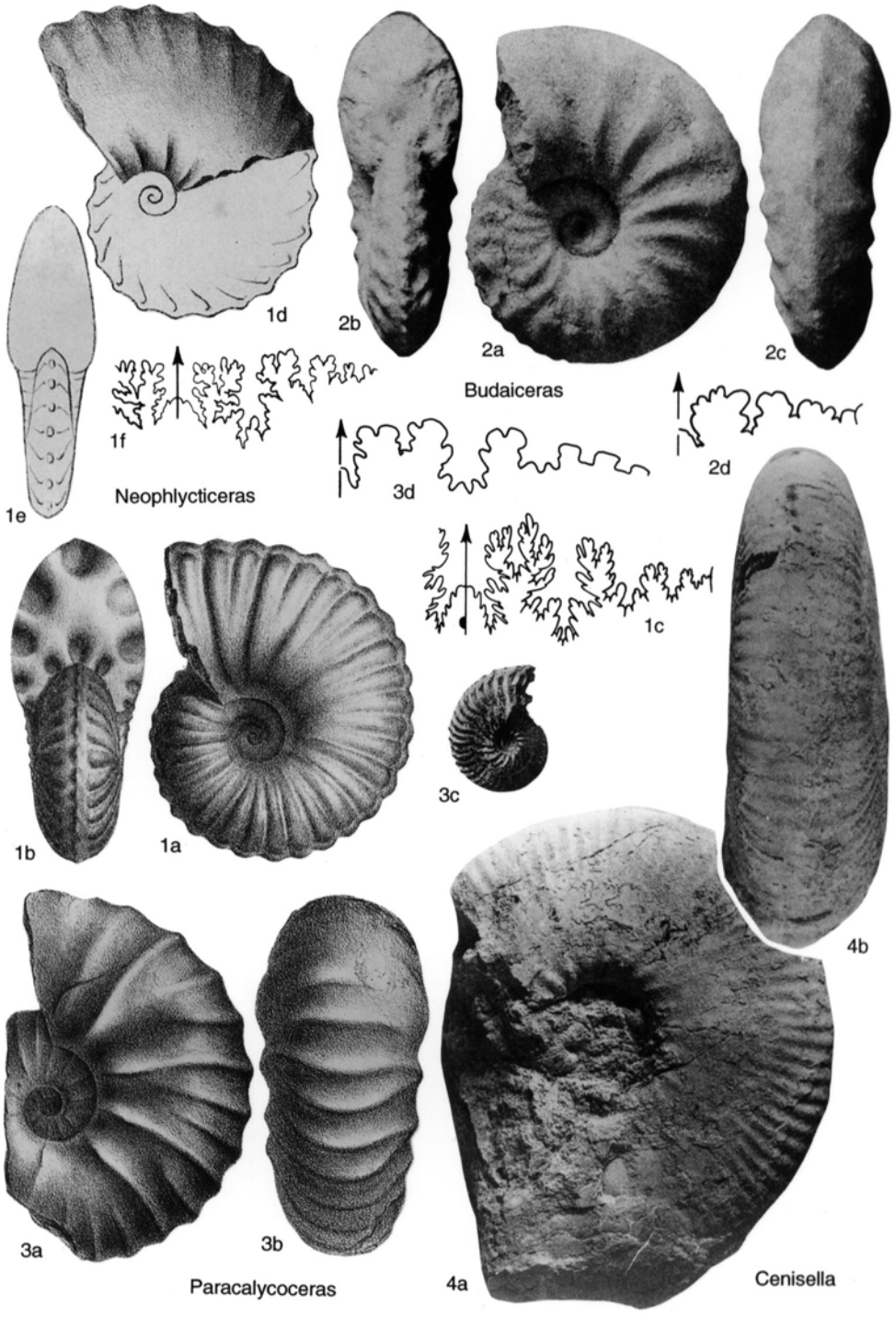

Fig. 114. Lyelliceratidae (p. 147–151)

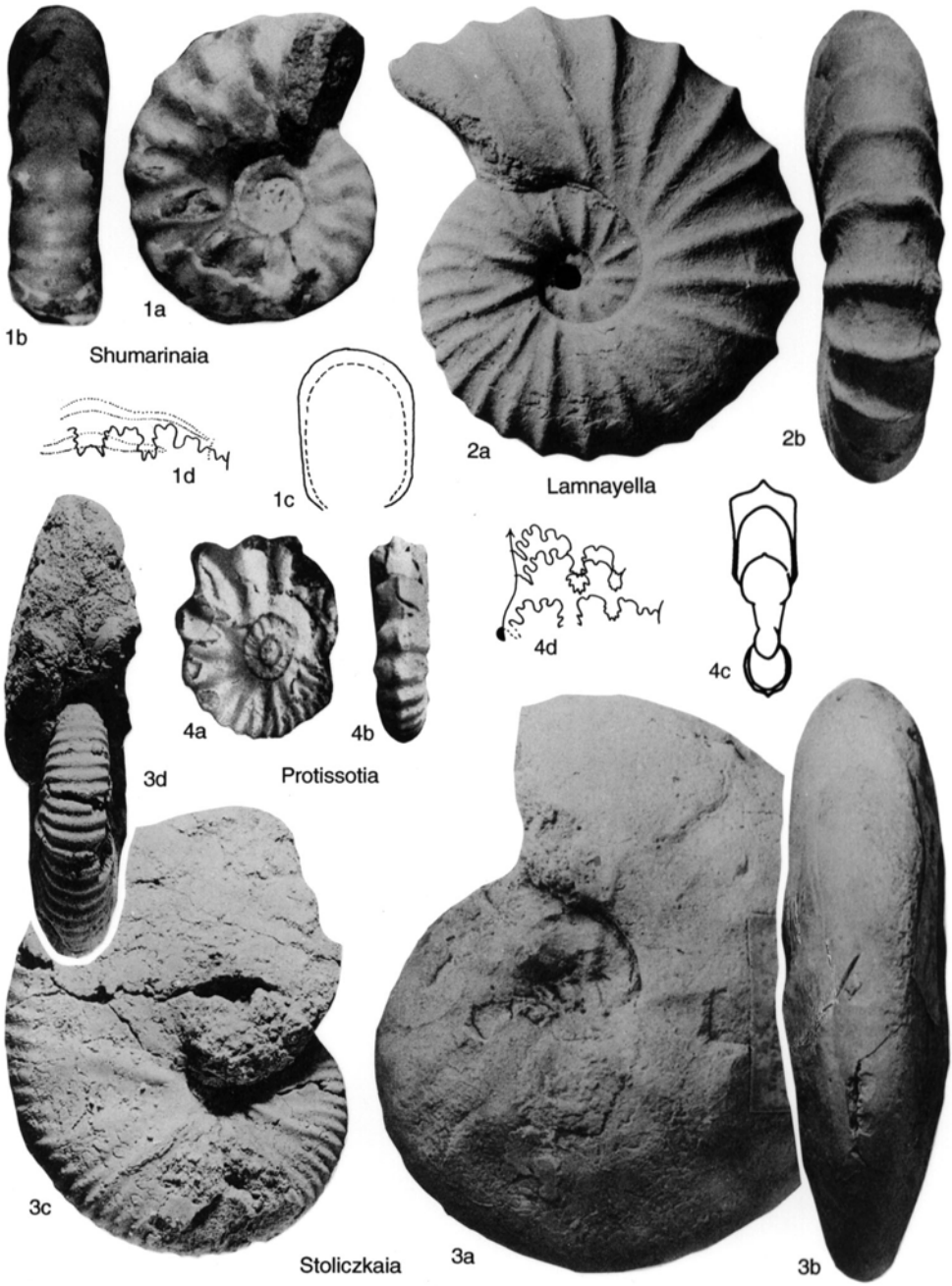

FIG. 115. Lyelliceratidae (p. 148–151)

whorls as in *Neophlycticeras,* but ventral tubercles soon disappearing and fine, dense ribs tending to arise in bundles from umbilical tubercles. *Lower Cretaceous (Upper Albian):* France.——FIG. 114,*4a,b.* **C. bonnetiana* (PICTET); ×0.8 (Delamette & Latil, 1989).

Budaiceras BÖSE, 1928, p. 255 [**B. mexicanum;* OD; =*Barroisiceras hyatti* SHATTUCK, 1903, p. 36]. Differs

from *Neophlycticeras* only in the more or less prominent ventrolateral clavi and in the siphonal clavi being up to twice as numerous as the ventrolateral. *Upper Cretaceous (Lower Cenomanian):* France, Texas, Mexico.——Fig. 114,*2a–d. *B. hyatti* (Shattuck), Texas; ×1 (K. Young, 1979).

Stoliczkaia Neumayr, 1875a, p. 931 [**Ammonites dispar* Orbigny, 1841, p. 142; SD Diener, 1925, p. 179]. Rather involute; umbilical seam egresses in adult; whorl section high and compressed to subquadrate; primary ribs straight or slightly curved, rounded, with numerous intercalatories or branched secondaries; ribs normally fine in young and coarsening, in some species suddenly, with age, then weakening or disappearing on body chamber (in questionable macroconchs) or persisting (in questionable microconchs); venter in young flat, fastigiate, or rounded, with 1, 2, or 3 tubercles; later ribs tending to cross and thicken on venter and tubercles to weaken or disappear. Suture with well-rounded folioles, tending to simplify. *Lower Cretaceous (Upper Albian)–Upper Cretaceous (Lower Cenomanian):* Europe, northern and western Africa, Madagascar, southern India, Japan, Texas, Arizona, Brazil, Mexico.

S. (Stoliczkaia) [=*Villoutreysia* Casey, 1965, p. 435 (type, *S. (V.) villoutreysi;* OD)]. Except in young, venter flat or rounded; juvenile ventrolateral and siphonal tubercles not normally persisting; ribs weakening or not on body chamber. *Lower Cretaceous (Upper Albian):* distribution as for genus.——Fig. 115,*3a–d. *S. (S.) dispar* (Orbigny); *a,b,* France, lectotype, ×0.5; *c,d,* England, ×0.75 (Wright & Kennedy, 1978).

S. (Shumarinaia) Matsumoto & Inoma, 1975, p. 276 [**S. (S.) hashimotoi;* OD]. Small, moderately evolute, and compressed, with early onset of distant, wide ribs, in some species to the exclusion of any fine-ribbed stage; on early part of body chamber, ribs angulate or raised into blunt tubercles on shoulder. Suture simple. Superficially resembles some Brancoceratinae. *Lower Cretaceous (Upper Albian):* England, Tunisia, Nigeria, Madagascar, southern India, Japan, Brazil.——Fig. 115,*1a–d. *S. (S.) hashimotoi*, Japan; *a,b,* ×1; *c,d,* ×2 (Matsumoto & Inoma, 1975).

S. (Lamnayella) Wright & Kennedy, 1978, p. 394 [**S. (L.) juigneti;* OD]. Medium-sized; venter fastigiate, feebly trituberculate in young, and evenly rounded when mature; feeble umbilical bullae giving rise to single, rarely paired, strong, narrow, high, distant, slightly flexed, and prorsiradiate ribs; 1 to 3 shorter ribs intercalated during early to middle growth; most ribs on body chamber long, strong, and distant. *Upper Cretaceous (Lower Cenomanian):* England, France, Romania, southern India, Japan, Texas, Mexico.——Fig. 115,*2a,b. *S. (L.) juigneti,* France; ×1 (Wright & Kennedy, 1978).

Ojinagiceras Cobban & Kennedy, 1989, p. 138 [**O. ojinagaense;* OD] [=*Ojianagiceras* Cobban & Kennedy, 1989, p. 138, *pro errore,* as indicated by origin and name and consistent spelling throughout paper]. Progenetic dwarf offshoot, probably of *Stoliczkaia.* Very small, involute, and compressed; venter fastigiate on early whorls, rounding and flattening later; at first with strong, conical ventrolateral tubercles and flank ribs; later with primary ribs single or branching from umbilical bullae, with one or two intercalated secondaries; all ribs crossing rounded venter; ornament weakening at end of body chamber. *Upper Cretaceous (Lower Cenomanian):* Texas.

Paracalycoceras Spath, 1925c, p. 197 [**Ammonites wiestii* Sharpe, 1857, p. 47; OD] [=*Cottreauites* Collignon, 1929, p. 44 (type, *Acanthoceras (Prionotropis) subvicinale* Boule, Lemoine, & Thevenin, 1907, p. 11(31); OD)]. Inner whorls involute and compressed; ribs sinuous; primaries prorsiradiate and branching at midflank or with short intercalatories; with inner and outer ventrolateral tubercles, the inner very weak, and with feeble siphonal tubercles or slight ridge. Outer whorls more evolute and inflated, with broad, distant primary and short intercalated ribs crossing venter without interruption in concave curve; ribs rursiradiate on outer part of sides. Suture with 5 lateral lobes. *Upper Cretaceous (Lower Cenomanian):* England, ?Poland, Algeria, Madagascar, Texas.——Fig. 114,*3a,b. *P. wiestii* (Sharpe), England; ×0.75 (Sharpe, 1857).——Fig. 114,*3c,d. P. subvicinale* (Boule, Lemoine, & Thevenin), Madagascar; *c,* ×1; *d,* ×4 (Boule, Lemoine, & Thevenin, 1907).

Zuluscaphites Hoepen, 1955a, p. 360 [**Z. orycteropusi;* OD] [=*Huescarites* Latil, 1990, p. 31 (type, *H. companyi;* OD)]. Rather small; whorl section inflated, increasing rapidly, then decreasing before last suture; with long and short ribs; with siphonal tubercles on at least part of shell. *Lower Cretaceous (Upper Albian):* France, Spain, South Africa (Zululand).

Family FLICKIIDAE Adkins, 1928

[*nom. correct.* Wright, 1957b, p. 409, *pro* Flickidae Adkins, 1928, p. 217]

Dwarf derivatives of Lyelliceratidae, Stoliczkaiinae, retaining ornament in one subfamily and losing it and tending to very simple, even goniatitic sutures in another. Wright & Kennedy, 1979; Kennedy & Wright, 1984. *Lower Cretaceous (Upper Albian)–Upper Cretaceous (Upper Cenomanian).*

Subfamily SALAZICERATINAE Kennedy & Wright, 1984

[Salaziceratinae Kennedy & Wright, 1984, p. 166]

Strong ornament retained; elements of mature suture not entire. *Lower Cretaceous*

(Upper Albian)–Upper Cretaceous (Lower Cenomanian).

Salaziceras Breistroffer, 1936, p. 64 [**Ammonites salazacensis* Hébert & Munier-Chalmas, 1875, p. 114; OD] [=*Salazaciceras* Breistroffer, 1940, p. 127(57), *nom. van.; Noskytes* Scholz, 1979, p. 97 (1978, p. 604, *nom. nud.*) (type, *S. (N.) bakonyense* Scholz, 1979, p. 97; OD)]. Moderately involute, inflated, with deep umbilicus; weak to strong umbilical bullae giving rise to more or less straight, coarse, rounded ribs. Suture with simple but still slightly incised elements. Microconchs have ventrolateral tubercles on body chamber and aperture with rostrum and lateral lappets. Scholz, 1979. *Lower Cretaceous (Upper Albian):* England, France, Hungary, Morocco, Nigeria.——Fig. 116,*2a–c. *S. salazacense* (Hébert & Munier-Chalmas), France; *a,b,* ×2; *c,* enlarged (Wright & Kennedy, 1979).

Neosaynoceras Breistroffer, 1947b, p. 92(76) [**Saynoceras gazellae* Pervinquière, 1907, p. 115; OD]. Globular and involute, with sharp umbilical, ventrolateral, and siphonal tubercles connected in adult by sharp ribs; body chamber incompletely known, but early part with umbilical bulge as in some *Scaphites;* phragmocone an approximate homeomorph of *Saynoceras.* Derived from *Salaziceras* by extension of the tuberculation of some forms of that genus. Kennedy & Wright, 1984. *Upper Cretaceous (Lower Cenomanian):* Tunisia, Madagascar.——Fig. 116,*1a–d. *N. gazellae* (Pervinquière), Tunisia; *a–c,* ×2; *d,* ×4.25 (Kennedy & Wright, 1984).

Subfamily FLICKIINAE Adkins, 1928

[*nom. transl.* Kennedy & Wright, 1984, p. 166, *ex* Flickiidae Adkins, 1928, p. 217]

Ornament tending to disappear and suture to simplify, becoming goniatitic in some. *Lower Cretaceous (Upper Albian)–Upper Cretaceous (Lower Cenomanian, ?Upper Cenomanian).*

Ficheuria Pervinquière, 1910, p. 35 [**F. kiliani;* OD]. Very involute and globular, with umbilical shoulder tending to be angular. Suture with very feebly indented elements. *Lower Cretaceous (Upper Albian)–Upper Cretaceous (Lower Cenomanian):* Hungary, northern Africa, Japan.——Fig. 116,*3a–c. *F. kiliani,* Upper Albian, Algeria; *a,b,* ×1; *c,* ×4 (Pervinquière, 1910).——Fig. 116,*3d. F. pernoni* Dubourdieu, Upper Albian, Algeria; ×4 (Dubourdieu, 1953).

Flickia Pervinquière, 1907, p. 212 [**F. simplex;* OD]. Moderately evolute and rather compressed, with narrowly arched venter; surface smooth or with flexuous striae strengthening into ribs on body chamber. Suture with entire elements. *Lower Cretaceous (Upper Albian)–Upper Cretaceous (Lower Cenomanian):* northern Africa, Tanzania, South Africa (Zululand), Madagascar, Texas.——Fig. 116,*4a–c. **F. simplex,* Upper Albian, Tunisia; *a,b,* ×2; *c,* ×4 (Pervinquière, 1910).

Adkinsia Böse, 1928, p. 232 [**A. adkinsi;* OD; =*Flickia? bosquensis* Adkins, 1920, p. 87]. More involute and inflated than *Flickia* but less so than *Ficheuria;* with distinct umbilical tubercles and in some rather strong ribs on body chamber. Suture with entire elements. *Upper Cretaceous (Lower Cenomanian):* Texas.——Fig. 116,*5. **A. bosquensis* (Adkins); ×2 (Böse, 1928).

?Litophragmatoceras Kennedy & Cobban, 1988a, p. 537 [**L. incomptum;* OD]. Differs from *Flickia* in falcoid growth lines and body chamber with crowded, broad and narrow, flexuous, simple ribs separated by constriction-like interspaces. *Upper Cretaceous (Upper Cenomanian):* Arizona.——Fig. 116,*6a–c. **L. incomptum; a,b,* ×2; *c,* ×5 (Kennedy & Cobban, 1988a; reprinted with the permission of Cambridge University Press).

Family FORBESICERATIDAE Wright, 1952

[*nom. transl.* Wright, 1955, p. 573, *ex* Forbesiceratinae Wright, 1952, p. 220]

Very involute, compressed, and high-whorled, with flat or slightly convex sides; venter narrow and fastigiate or flat or sulcate, with 0, 1, 2, or 3 keels; smooth or with fine ribs; midlateral tubercles rarely present; ventrolateral tubercles commonly present. Suture with long, narrow elements; saddles tending to be phylloid, lobes to be bifid; with adventive lobe in first lateral saddle foreshadowed in ancestral *Neophlycticeras. Lower Cretaceous (Upper Albian)–Upper Cretaceous (Cenomanian).*

Paradolphia Casey, 1965, p. 461 [**P. prisca;* OD]. Very involute, compressed, and flat-sided, with fastigiate venter and faintly nodate keel. Shoulders showing faint, prorsiradiate ribs. Suture with long, subphylloid saddles, narrow lobes, bifid first lateral lobe, and oblique, incipient adventive lobe in external saddle. *Lower Cretaceous (Upper Albian):* England, France.——Fig. 116,*8a–c. **P. prisca; a,b,* ×1; *c,* ×3.5 (Casey, 1965).

Forbesiceras Kossmat, 1897, p. 18(125), *nom. nov. pro Discoceras* Kossmat, 1895, p. 179(83), *non* Barrande, 1867, p. 177 [**Ammonites largilliertianus* Orbigny, 1841, p. 320; SD Diener, 1925, p. 180] [=*Cenomanites* Haug, 1898, p. 78, obj.; *Neopulchellia* Collignon, 1929, p. 29 (type, *Pulchellia (Neopulchellia) gignouxi* Collignon, 1929, p. 30; SD Wright, herein)]. More discoidal than *Paradolphia;* ribs generally present and rectiradiate, sigmoid, or falcate, forming slight nodes on shoulders and normally crossing venter

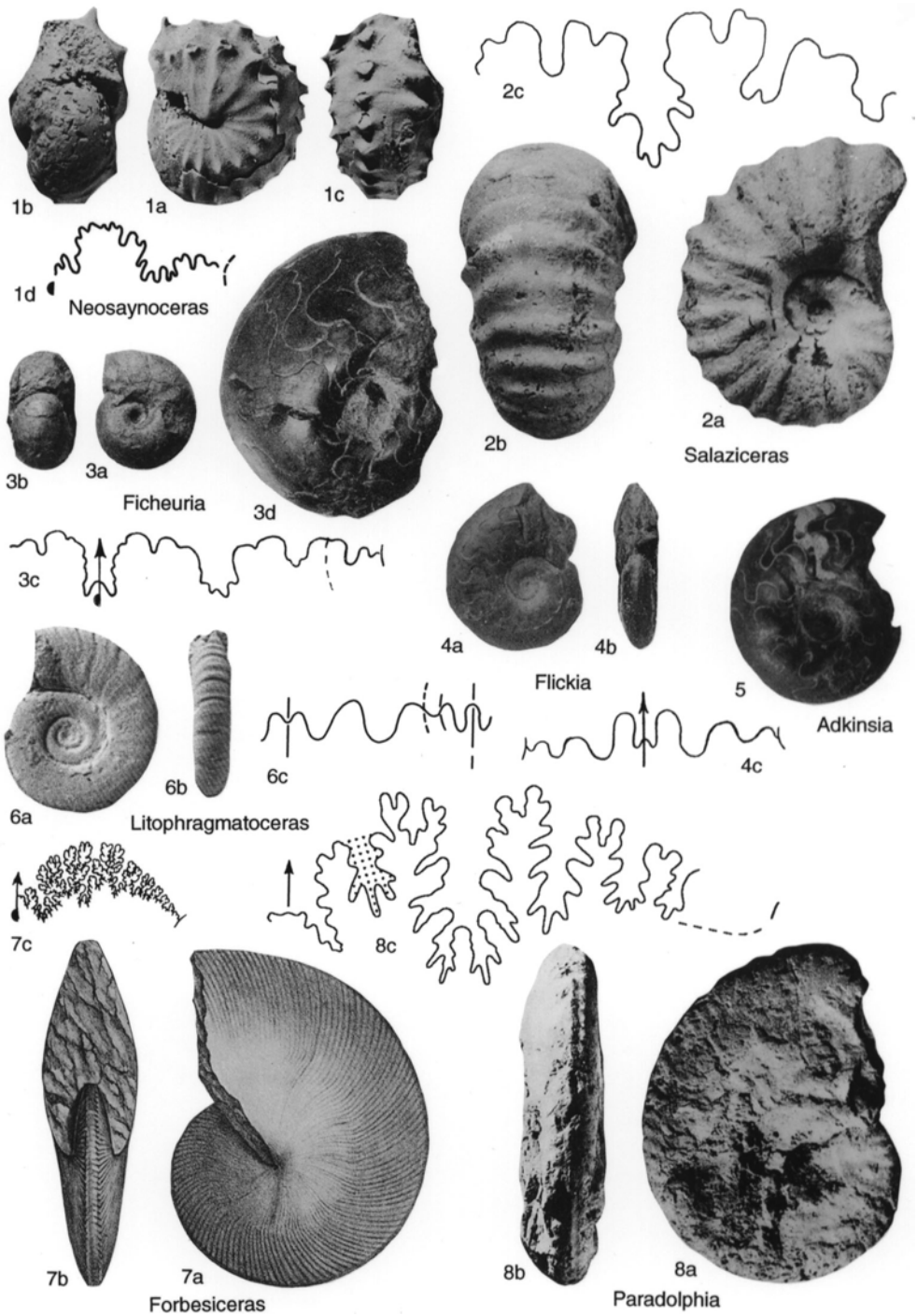

FIG. 116. Flickiidae (p. 152–154)

transversely; midlateral tubercles may be present. Suture markedly phylloid; adventive lobe as large as second lateral. *Upper Cretaceous (Lower Cenomanian–Upper Cenomanian):* Europe, Africa, Madagascar, southern India, Texas.——Fig. 116,*7a–c.* **F. largilliertianum* (Orbigny), southern India; ×0.5 (Kossmat, 1895–1898).

Family ACANTHOCERATIDAE Grossouvre, 1894

[*nom. correct.* Hyatt, 1900, p. 585, *pro* Acanthoceratidés Grossouvre, 1894, p. 22 (H. Douvillé is quoted by some as author, but the work in which the name appeared was not published)]

Strong tuberculation, at least umbilical and ventrolateral, in most genera; in some, however, ribs dominant, while in others, ornament may be weak or absent on outer whorls. Most genera evolute. Whorl section ranging from compressed to very depressed. Dimorphic in size only, with no apertural modification in microconchs. Suture with few special characteristics or variations, though in some later genera sutural detail tending to simplify as in successor families. *Upper Cretaceous (Lower Cenomanian–Coniacian).*

The family represents a burst of radiation during the Cenomanian from the rather limited Lyelliceratidae.

Subfamily MANTELLICERATINAE Hyatt, 1903

[*nom. transl.* Wright & Wright, 1951, p. 24, *ex* Mantelliceratidae Hyatt, 1903, p. 105; ICZN Opinion 557, 1959, Family-Group Name No. 267] [=Utauriceratinae Matsumoto in Matsumoto, Muramoto, & Takahashi, 1969, p. 291]

Involute to rather evolute; round-whorled or compressed, rarely depressed; generally having prominent ribs with at least outer ventrolateral tubercles. *Upper Cretaceous (Lower Cenomanian).*

Mantelliceras seems to have been derived paedomorphically from bituberculate-ventered species of *Stoliczkaia,* but exact order of appearance of genera and relationships are obscure because of worldwide lack of known ammonite deposits at the Albian-Cenomanian boundary.

Mantelliceras Hyatt, 1903, p. 113, ICZN Opinion 557, 1959, Generic Name No. 1353 [**Ammonites mantelli* J. Sowerby, 1814a, p. 119; OD; ICZN Specific Name No. 1634] [=*Couloniceras* Busnardo, 1966a, p. 223 (type, *Ammonites couloni* Orbigny, 1850a, p. 147; OD); *Promantelliceras* Thomel, 1972, p. 31 (type, *Mantelliceras picteti* Hyatt, 1903, p. 114; OD); *Neomantelliceras* Thomel, 1972, p. 42 (type, *Ammonites mantelli tuberculata* Mantell, 1822, p. 114; OD); *Bunburyiceras* Thomel, 1972, p. 46 (type, *Mantelliceras cantianum* Spath, 1926a, p. 82; OD)]. Involute to rather evolute; compressed to inflated; ribs irregularly branching or long and short, straight to slightly sinuous, high and narrow to subdued; ribs may broaden toward ventrolateral shoulder; normally having distinct umbilical and outer ventrolateral tubercles, commonly also a midlateral row at least on inner whorls, and also, in some specimens, inner ventrolateral tubercles; in multituberculate forms the umbilical tubercle generally less prominent than midlateral tubercle. Ribs tending to broaden and tubercles to weaken on body chamber, where umbilical seam egresses markedly. Strongly dimorphic, with macroconchs up to twice the diameter of microconchs. Suture rather deeply incised, with rectangular external saddle, long and variably trifid L, and up to 4 umbilical lobes in external suture, commonly retracted. Wright & Kennedy, 1984. *Upper Cretaceous (Lower Cenomanian):* Europe, northern and eastern Africa, Madagascar, southern India, Texas, Brazil.——Fig. 117,*4a–c.* **M. mantelli* (J. Sowerby), England; ×1 (Sharpe, 1853–1857).

Utauriceras Wright, 1956b, p. 392 [**Ammonites vicinale* Stoliczka, 1864, p. 84; OD]. Inner whorls differing from compressed *Mantelliceras* only in greater involution, more flexuous ribs, and 1 or more additional auxiliary lobes in the suture. Body chambers unknown; the genus may be closely related to *Graysonites*. Casey, 1960b; Kennedy & Hancock, 1971. *Upper Cretaceous (Lower Cenomanian):* Madagascar, southern India.——Fig. 117,*1a–c.* **U. vicinale* (Stoliczka), southern India; *a,b,* ×0.5; *c,* ×1 (Matsumoto & Sarkar, 1966).

Graysonites K. Young, 1958, p. 171 [**G. lozoi;* OD]. Inner whorls as in compressed *Mantelliceras;* outer with coarse, distant ribs, large umbilicolateral bullae, and strong to extreme ventrolateral horns. External saddle asymmetrical, with outer element narrow; several retracted auxiliaries. *Upper Cretaceous (Lower Cenomanian):* Spain, Japan, California, Texas, Brazil.——Fig. 118*a–f.* **G. lozoi,* Texas; *a,b,* ×0.3; *c,d,* ×1; *e,* ×0.5; *f,* ×0.75 (K. Young, 1958).

Sharpeiceras Hyatt, 1903, p. 111 [**Ammonites laticlavius* Sharpe, 1855, p. 31; OD] [=*Tlahualiloceras* Kellum & Mintz, 1962, p. 275 (type, *T. tlahualiloense;* OD)]. Evolute; whorl section compressed-oval to quadrate; ribs fine to coarse, typically but not invariably single, with umbilical, lateral, and inner and outer ventrolateral tubercles on every rib and rarely an additional outer lateral tubercle; venter slightly concave or flat, with feeble siphonal ridge in some specimens; adult body chamber quadrate, with large ventrolateral tubercles or (?secondarily deformed) smooth and fastigiate.

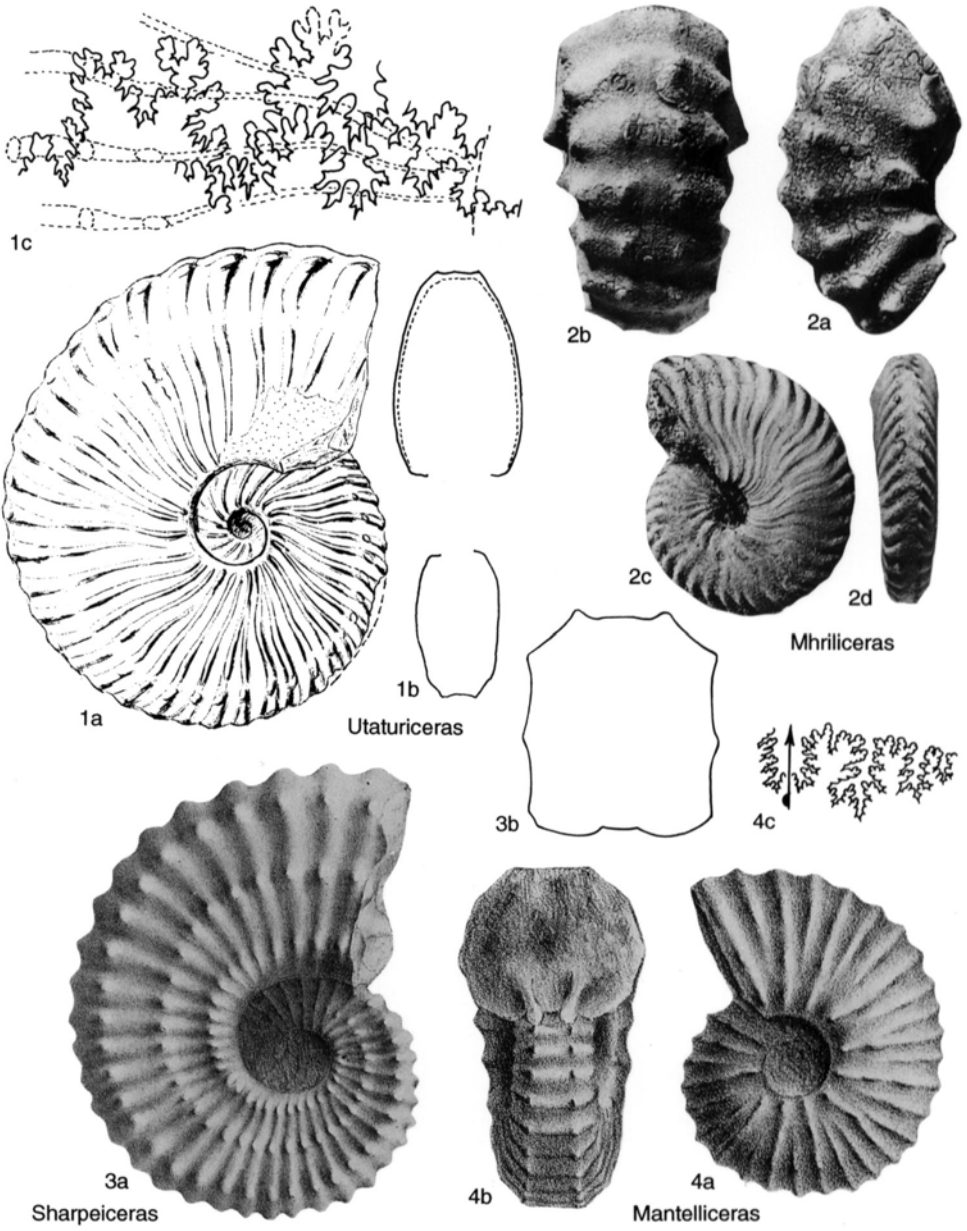

FIG. 117. Acanthoceratidae (p. 154–156)

Suture with long, narrow, more or less symmetrically bifid L. *Upper Cretaceous (Lower Cenomanian):* western Europe, Poland, northern and eastern Africa, Madagascar, Syria, Iran, southern India, Japan, Texas, Venezuela.——FIG. 117,*3a,b.* **S. laticlavium* (SHARPE), England; ×0.5 (Sharpe, 1855).

Mhriliceras KENNEDY & WRIGHT, 1985, p. 514 [**Mammites lapparenti* PERVINQUIÈRE, 1907, p. 312; OD]. Compressed and involute to inflated and evolute; the former having dense, flexuous ribs with evanescent inner and persistent outer ventrolateral tubercles; the latter having strong umbilical bullae giving rise to pairs of coarse ribs with strong, conical inner and clavate outer ventrolateral tubercles. Approximate homeomorphs of Upper Cenomanian *Metoicoceras* and Lower Turonian *Mammites. Upper*

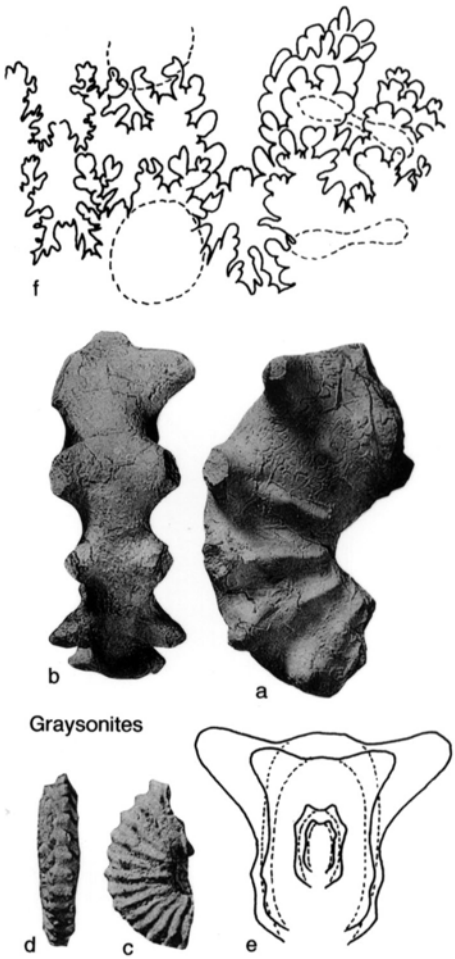

FIG. 118. Acanthoceratidae (p. 154)

Cretaceous (Lower Cenomanian): England, France, Israel, Tunisia, Nigeria, Madagascar.——FIG. 117,*2a–d. *M. lapparenti* (PERVINQUIÈRE); *a,b,* Tunisia, ×1; *c,d,* Madagascar, ×1 (Kennedy & Wright, 1985).

Subfamily ACANTHOCERATINAE Grossouvre, 1894

[*nom. transl.* WRIGHT & WRIGHT, 1951, p. 28, *ex* Acanthoceratidae, HYATT, 1900, p. 585, *nom. correct. pro* Acanthoceratidés GROSSOUVRE, 1894, p. 22]

Some with tubercles dominant, others with ribs dominant, but all with siphonal tubercles at some stage. *Upper Cretaceous (Lower Cenomanian–Middle Turonian).*

Acanthoceras appears to have been derived from *Acompsoceras* at the beginning of the Middle Cenomanian, but its exact relationship with *Calycoceras,* which appeared at the same time, is obscure.

Acompsoceras HYATT, 1903, p. 111 [**Ammonites bochumensis* SCHLÜTER, 1871, p. 1; OD; =*Ammonites renevieri* SHARPE, 1857, p. 44] [=*Pseudacompsoceras* SPATH, 1925c, p. 197 (type, *P. vectense;* OD)]. Moderately evolute to involute; more or less compressed; inner whorls with moderate to strong ribs typically branching or long and short, strong umbilical bullae, inner and outer ventrolateral and commonly feeble siphonal tubercles, or faintly nodate ridge; lateral tubercles appearing in middle growth in some individuals; umbilical and clavate outer ventrolateral tubercles persisting, with tabulate or slightly raised venter, but other tubercles weakening; body chamber smooth. Suture with deeply divided external saddle and well-rounded folioles that at maturity may be phylloid. *Upper Cretaceous (Lower Cenomanian):* western Europe, northern Africa, Madagascar, Syria, USA, Brazil.——FIG. 119,*4a–c. *A. renevieri* (SHARPE), Germany; *a,b,* ×0.375; *c,* ×0.5 (Schlüter, 1871–1876).——FIG. 119,*4d. A. sarthacense* (GUÉRANGER), England; ×1 (Sharpe, 1857).

Acanthoceras NEUMAYR, 1875b, p. 929 [**Ammonites rhotomagensis* BRONGNIART in CUVIER & BRONGNIART, 1822, p. 83; SD GROSSOUVRE, 1894, p. 27] [=*Metacanthoplites* HYATT, 1900, p. 589, obj.; *Alternacanthoceras* MARCINOWSKI, 1979, p. 61 (type, *Protacanthoceras jukesbrownei* SPATH, 1926a, p. 82; OD)]. Early whorls with round to square whorl section and with umbilical, inner and outer (generally clavate) ventrolateral, and siphonal tubercles; distinct ribs, if present, branching or long and short. Later whorls with ribs, single and uniform or long and short, sometimes weakening; umbilical tubercles may enlarge and move up side, ventrolaterals may fuse to form large horn, while siphonals may disappear, leaving broad, flat venter. [*Alternacanthoceras* for species with long and short ribs persisting to late stage seems unnecessary.] *Upper Cretaceous (Lower Cenomanian–Upper Cenomanian):* Europe, Africa, Iran, southern India, Japan, northern Australia, USA, Peru.——FIG. 119,*3a–c. *A. rhotomagense* (BRONGNIART in CUVIER & BRONGNIART), Lower Cenomanian, France; *a,b,* lectotype, ×1; *c,* topotype, ×1 (Kennedy & Hancock, 1970).

Cunningtoniceras COLLIGNON, 1937a, p. 40 [**Ammonites cunningtoni* SHARPE, 1855, p. 35; OD] [=?*Guerangericeras* THOMEL, 1972, p. 119 (type, *Ammonites confusus* GUÉRANGER, 1867, p. 5; OD)]. Derivatives of *Acanthoceras* with multituberculate venter caused by secondary ribs branching from inner ventrolateral tubercles or intercalated and bearing outer ventrolateral and siphonal tubercles; inner ventrolateral tubercles tending to move outward to level of venter and to form large, laterally directed horns. Although an approximate homeomorph of *Euomphaloceras, Cunningtoniceras* retains general build of *Acanthoceras,* as well as suture with square external saddle. *Upper Cretaceous*

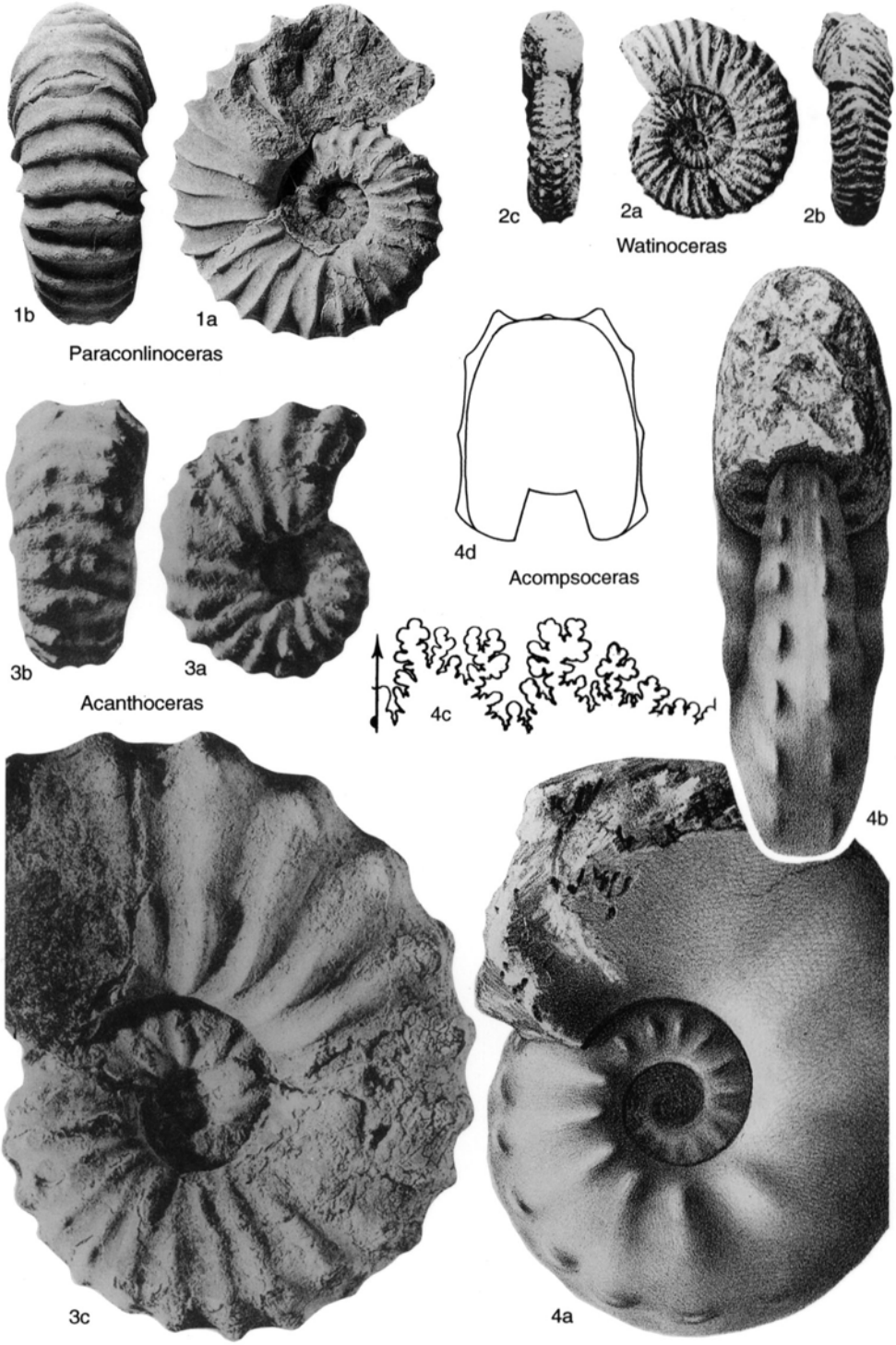

Fig. 119. Acanthoceratidae (p. 156–162)

(Middle Cenomanian, ?Upper Cenomanian): Europe, northern Africa, South Africa (Zululand), Madagascar, southern India, Bathurst Island, Japan.——Fig. 120,*5a,b. *C. cunningtoni* (Sharpe), Middle Cenomanian, England, holotype; ×0.5 (Kennedy, 1971).

Protacanthoceras Spath, 1923b, p. 144 [**Ammonites bunburianus* Sharpe, 1853, p. 25; OD]. Dwarf with macroconchs and microconchs differing primarily in size; rather involute to evolute; compressed to inflated; with more or less prominent umbilical and inner ventrolateral tubercles; outer ventrolateral and siphonal tubercles tending to form 3 close rows of clavi on broad or narrow venter, clavi generally uniting on outer part of body chamber to form chevronlike ribs. Suture with plump, round, only moderately indented elements. Wright & Kennedy, 1980. *Upper Cretaceous (Lower Cenomanian–Upper Cenomanian):* England, France, Madagascar, USA (Western Interior).——Fig. 121,*2a,b. *P. bunburianum* (Sharpe), Upper Cenomanian, England; ×1 (Jukes-Browne & Hill, 1896).

Conlinoceras Cobban & Scott, 1972, p. 60 [**Calycoceras (Conlinoceras) gilberti* Cobban & Scott, 1972, p. 60; OD]. Early whorls with weak ornament similar to that of *Acanthoceras;* mature whorls circular to compressed in section, with distant, high ribs crossing venter and almost no umbilical tubercles. *Upper Cretaceous (Middle Cenomanian):* USA (Gulf Coast, Western Interior).——Fig. 122,*3a,b. *C. gilberti* (Cobban & Scott), Colorado; ×0.75 (Cobban & Scott, 1972).

Paraconlinoceras Kennedy & Cobban, 1990a, p. 114 [**Eucalycoceras leonense* Adkins, 1928, p. 240; OD]. Dwarf derivative of *Conlinoceras* with inner whorls like *Acanthoceras,* but outer like *Calycoceras (Gentoniceras),* from which it differs in the clavate ventrolateral tubercles of inner whorls. *Upper Cretaceous (Middle Cenomanian):* USA (Gulf Coast, Western Interior).——Fig. 119,*1a,b. *P. leonense* (Adkins), Wyoming; ×1 (Kennedy & Cobban, 1990a).

Dunveganoceras Warren & Stelck, 1940, p. 149 [**Acanthoceras albertense* Warren, 1930a, p. 21; OD]. Medium-sized to large; early whorls with umbilical bullae, conical inner and clavate outer ventrolateral tubercles; siphonal tubercles present at first but disappearing early, leaving venter flat or concave; ventral tubercles steeper in front than behind; outer whorls with dominant, rounded ribs and rounded, flat, or fastigiate venter, with or without ventrolateral horns or bulges. *Upper Cretaceous (Middle Cenomanian–Upper Cenomanian):* Canada, USA (Gulf Coast, Western Interior), Brazil.

D. (Plesiacanthoceras) Haas, 1964, p. 610, *nom. nov. pro Paracanthoceras* Haas, 1963, p. 2, *non* Furon, 1935, p. 59 [**Metoicoceras wyomingense* Reagan, 1924, p. 181; OD]. Differs from *Acanthoceras* only in early loss of siphonal tubercles, asymmetry of tubercles in side view, and exaggerated ventrolateral horns on last whorl. *Upper Cretaceous (Middle Cenomanian):* USA (Gulf Coast, Western Interior).——Fig. 121,*3a,b. *D. (P.) wyomingense* (Reagan), Montana; ×0.5 (Cobban, 1987b).

D. (Dunveganoceras). Outer whorl without exaggerated ventrolateral horns. *Upper Cretaceous (Upper Cenomanian):* Canada, USA (Western Interior), Brazil.——Fig. 121,*6a–c. D. (D.) albertense montanense,* Montana; *a,b,* ×1; *c,* ×0.25 (Cobban, 1952b).

Plesiacanthoceratoides Kennedy & Cobban, 1990a, p. 136 [**Protacanthoceras vetula* Cobban, 1987b, p. 21; OD]. Progenetic dwarf derivative of *Plesiacanthoceras;* homeomorph of *Protacanthoceras.* Constrictions present or not. *Upper Cretaceous (Middle Cenomanian–Upper Cenomanian):* Wyoming, Montana, Texas.

Paracompsoceras Cobban, 1971, p. 10 [**P. landisi;* OD]. Inner whorls with strong tubercles as in *Acanthoceras;* outer whorls smooth and moderately compressed, with slightly flattened sides and venter. *Upper Cretaceous (Upper Cenomanian):* New Mexico.——Fig. 120,*1a–c. *P. landisi;* ×1 (Cobban, 1971).

Kennediella Cooper, 1979, p. 124 [**Pseudotissotia inopinata* Kennedy & Bayliss, 1977, p. 902; OD]. Evolute, with rounded-quadrate whorl section and broad, flat venter with 3 continuous, low, rounded keels; slight umbilical bulges but no ribs. Based on single fragment. Close homeomorph of *Pseudotissotia* but probably descended from smooth form of *Acanthoceras. Upper Cretaceous (Upper Cenomanian):* England.——Fig. 120,*4a,b. *K. inopinata* (Kennedy & Bayliss); ×1 (Kennedy & Bayliss, 1977).

Tarrantoceras Stephenson, 1955, p. 59 [**T. rotatile;* OD; =*Mantelliceras sellardsi* Adkins, 1928, p. 239]. Small, compressed, and evolute; with ribs close to distant, rectiradiate, straight or slightly sinuous, branching from umbilical tubercles or long and short, and transverse across arched or flat venter; early whorls with umbilical bullae, inner and close outer ventrolateral tubercles, and slight siphonal tubercles. Suture with short, broad, and rather simple saddles, the second lateral commonly projecting beyond the rest. *Upper Cretaceous (Upper Cenomanian):* England, France, Turkestan, southern India, Japan, Texas, Colorado, ?Colombia, ?Venezuela.

T. (Tarrantoceras). Tubercles persisting up to body chamber, on which inner ventrolateral and, later, outer ventrolateral tubercles may disappear. Occurrence as for genus: Texas, Colorado, ?Colombia, ?Venezuela.——Fig. 122,*1a–c. *T. (T.) sellardsi* (Adkins), Texas; ×1 (Stephenson, 1955).

T. (Sumitomoceras) Matsumoto in Matsumoto, Muramoto, & Takahashi, 1969, p. 280 [**S. faustum;* OD]. Siphonal tubercles disappearing early, then ventrolaterals; on body chamber ribs crossing arched venter without weakening; interspaces between some long ribs are deeper than the rest, forming shallow constrictions. Occurrence as for genus: England, France, Turkestan, southern India, Japan, Texas.——Fig. 122,*4a–c. *T. (S.) faustum* Matsumoto in Matsumoto, Muramoto, & Takahashi, Japan; ×1 (Matsumoto, Muramoto, & Takahashi, 1969).

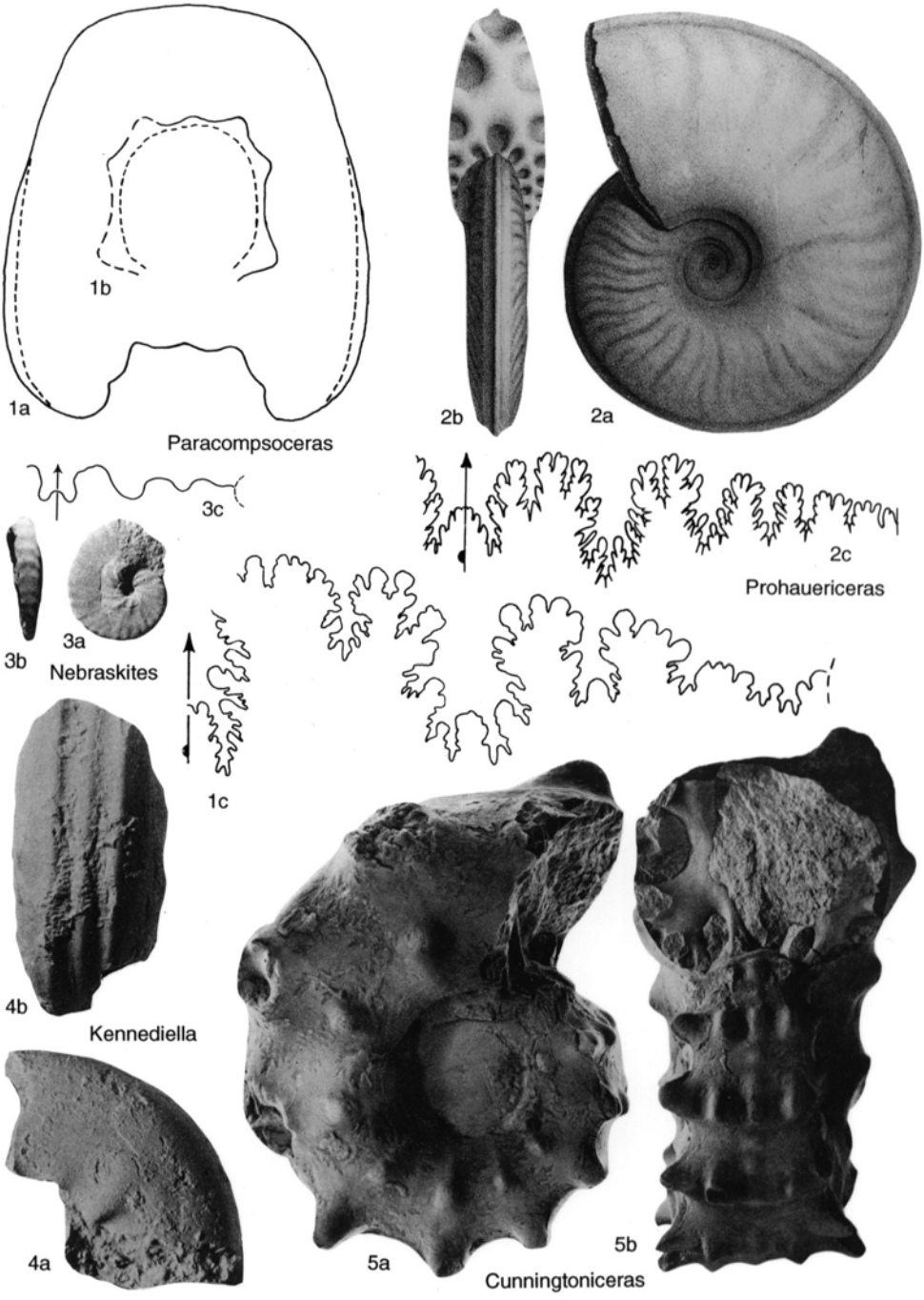

FIG. 120. Acanthoceratidae (p. 156–162)

Kastanoceras KENNEDY & COBBAN, 1990b, p. 394 [**K. spinigerum;* OD]. Minute, progenetic dwarf derivative of *Tarrantoceras.* Coronate, with feeble ribs, large inner ventrolateral spines, and feeble outer ventrolateral and siphonal clavi. *Upper Cretaceous (Middle Cenomanian):* Montana.——FIG. 121,*5a,b.* **K. spinigerum;* ×2 (Kennedy & Cobban, 1990b).

Microsulcatoceras KENNEDY & COBBAN, 1990b, p. 400

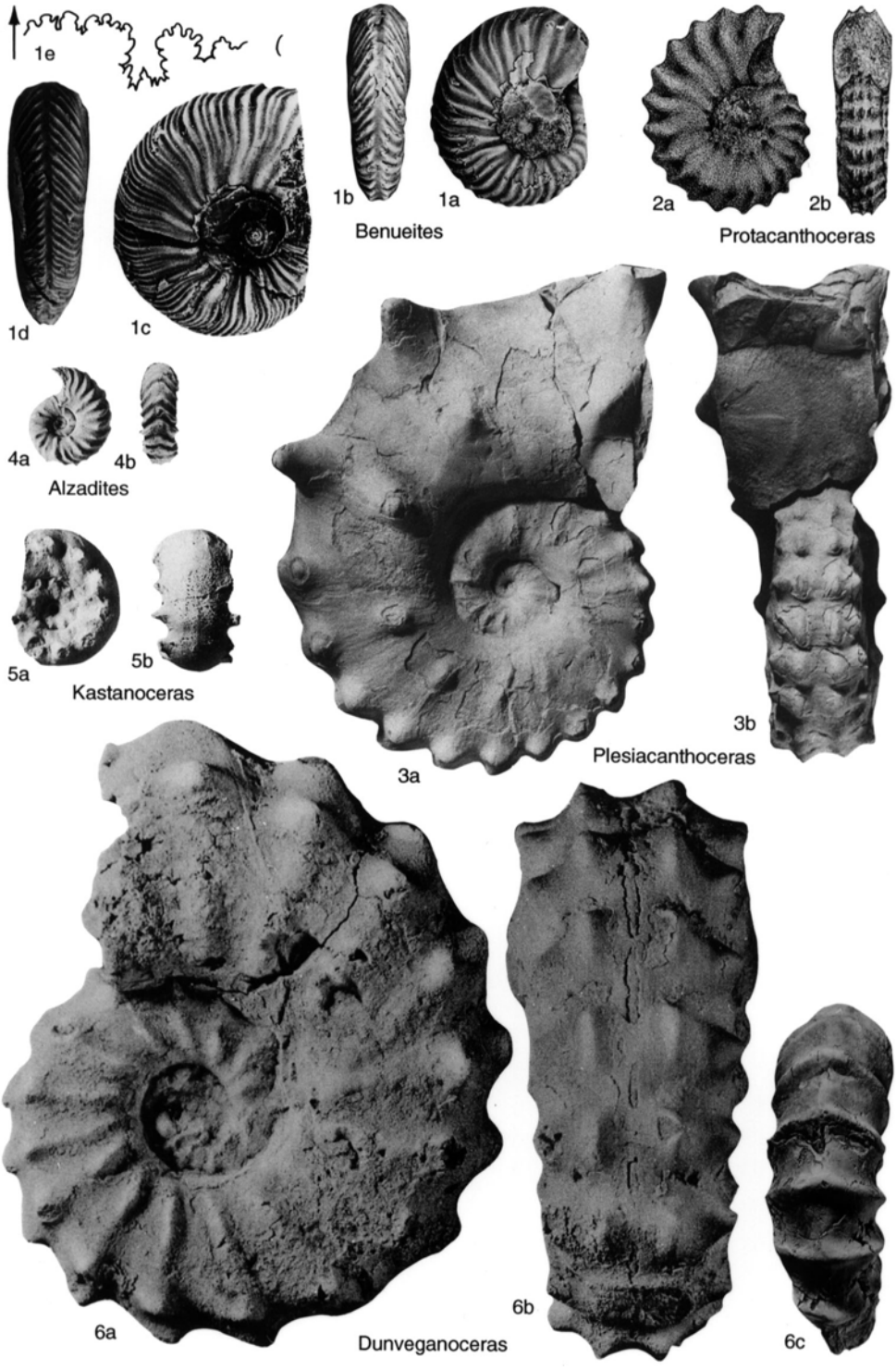

FIG. 121. Acanthoceratidae (p. 158–162)

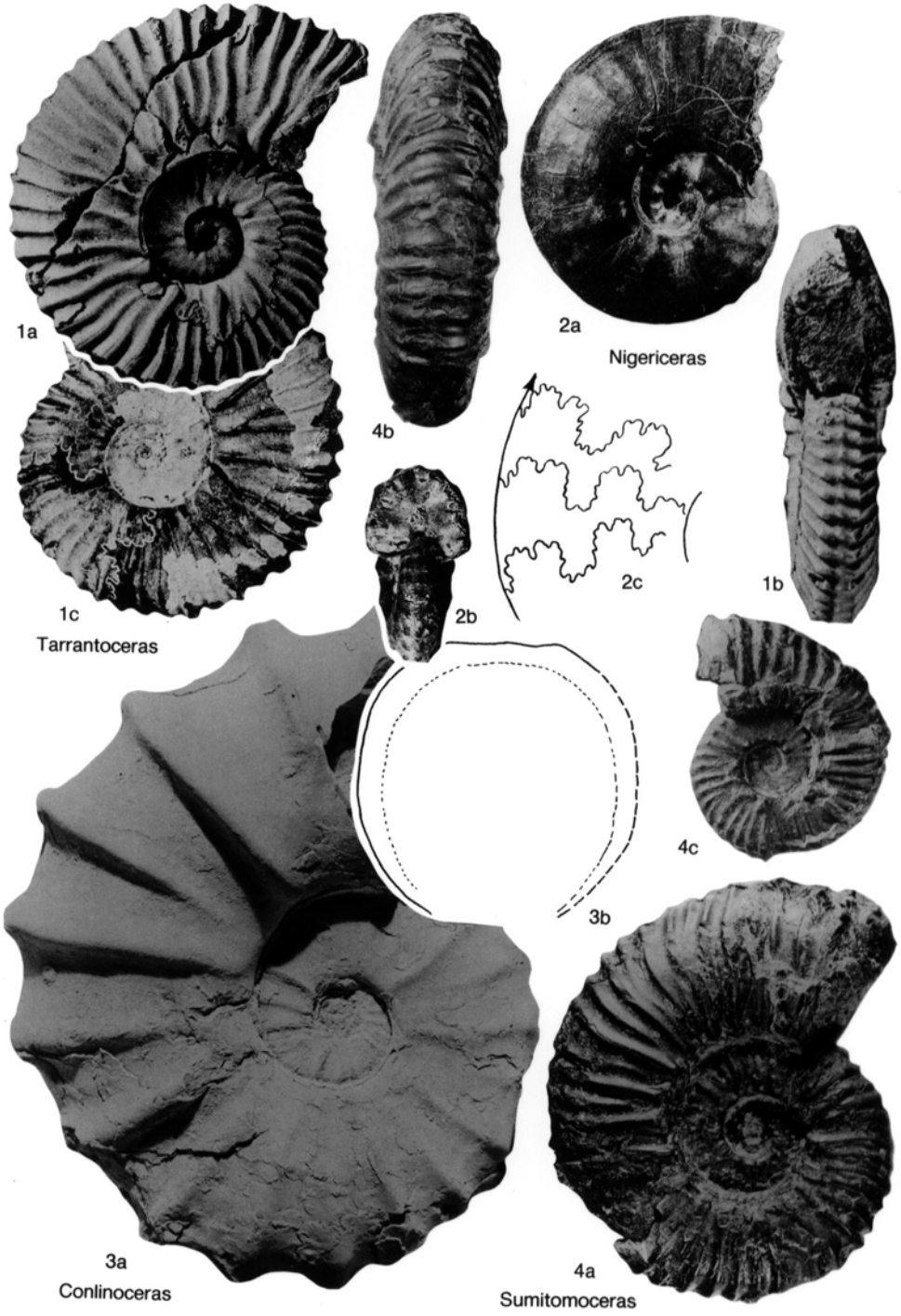

Fig. 122. Acanthoceratidae (p. 158–167)

[**M. puzosiiforme;* OD]. Progenetic dwarf derivative, probably of *Tarrantoceras (Sumitomoceras).* Involute, with flexuous constrictions, umbilical and inner ventrolateral tubercles, and ribs crossing venter uninterrupted. *Upper Cretaceous (Upper Cenomanian):* Montana, Texas, ?New Mexico.

Alzadites KENNEDY & COBBAN, 1990b, p. 396 [**A. alzadensis;* OD]. Small, with or without constrictions, and with minute umbilical bullae, prorsiradiate ribs, and inner and outer ventrolateral and siphonal tubercles. Progenetic dwarf derivative of some genus of Acanthoceratinae, resembling *Protacanthoceras. Upper Cretaceous (Middle Cenomanian–Upper Cenomanian):* Utah, Wyoming, Montana.——FIG. 121,*4a,b. A. westonensis* KENNEDY & COBBAN, Upper Cenomanian, Wyoming; ×1 (Kennedy & Cobban, 1990b).

Thomelites WRIGHT & KENNEDY in JUIGNET, KENNEDY, & WRIGHT, 1973, p. 231 [**Jeanrogericeras sornayi* THOMEL in PORTHAULT, THOMEL, & VILLOUTREYS, 1967, p. 431; OD]. Evolute, inflated to compressed, with sides parallel as far as inner ventrolateral tubercle, then converging to narrow venter. Ribs weak to strong, branching in twos or threes from umbilical tubercles or intercalated; inner ventrolateral tubercle on inner whorls at least, at which ribs may branch; all ribs with outer ventrolateral clavi; siphonal tubercle on inner whorls at least. Suture with external saddle deeply divided; folioles phylloid or simple and rounded. *Upper Cretaceous (Upper Cenomanian–Lower Turonian):* England, France, Israel, ?southern India, Texas, South Dakota, Brazil.——FIG. 123,*1a,b. *T. sornayi* (THOMEL), England; ×0.75 (Juignet, Kennedy, & Wright, 1973).

Neocardioceras SPATH, 1926a, p. 81 [**Ammonites juddii* BARROIS & GUERNE, 1878, p. 46; OD]. Small, evolute, and compressed to round in section; with fine, rather high, flexuous ribs, long and short or branching from small umbilical bullae; each rib may bear fine inner and outer ventrolateral tubercles; one row of close, round siphonal tubercles tending to form nodate keel; tubercles may disappear on outer whorls, leaving fine, sharp ribs. Probably derived from late *Thomelites. Upper Cretaceous (Upper Cenomanian–Lower Turonian):* England, France, Spain, Montana, ?Brazil.——FIG. 123,*3a–f. *N. juddii* (BARROIS & GUERNE), Upper Cenomanian, England; *a–d, N. j. juddii,* ×1 (Wright & Kennedy, 1981); *e,f, N. j. barroisi* (WRIGHT & KENNEDY), ×1 (Wright & Kennedy, 1981).

Watinoceras WARREN, 1930b, p. 66 [**W. reesidei;* OD; =*Acanthoceras amudariense* ARKHANGELSKY, 1916, p. 48] [=*Arkhangelskiceras* IL'IN, 1957, p. 425, obj.]. Small to medium-sized; early whorls compressed, with inner and outer ventrolateral tubercles on fine ribs and flat or weakly rounded venter; in later whorls venter may become concave between rows of ventrolateral clavi or rounded with ribs crossing in chevrons; ornament may coarsen with age. *Upper Cretaceous (Lower Turonian):* England, Morocco, Nigeria, Turkestan, Alberta, USA, Venezuela.——FIG. 119,*2a–c. *W. amudariense* (ARKHANGELSKY), Turkestan; *a,b,* one specimen, ×1; *c,* another, ×1 (Arkhangelsky, 1916).

Nebraskites KENNEDY & COBBAN, 1988b, p. 582 [**N. haresiceratiforme;* OD]. Progenetic dwarf offshoot, perhaps of *Watinoceras.* Very involute and flat-sided, with narrow, tabulate venter; feeble umbilical bullae giving rise to pairs of ribs with incipient inner and clavate outer ventrolateral tubercles joined across venter by a low rib; ribs single on body chamber, strengthening near aperture. *Upper Cretaceous (Middle Turonian):* Nebraska.——FIG. 120,*3a–c. *N. haresiceratiforme; a,b,* ×1; *c,* ×5 (Kennedy & Cobban, 1988b).

Benueites REYMENT, 1954a, p. 153 [**B. benueensis;* OD]. Small, rather evolute, and compressed; with flat sides, sloping shoulders, and narrow venter commonly with deep, narrow sulcus on early whorls and later with shallow sulcus, slightly concave or flat. Apparently dimorphic; one form with fine, sigmoid ribs, and only slight umbilical and outer ventrolateral tubercles; the other with coarse ribs and generally with umbilical and inner and outer ventrolateral tubercles. *Upper Cretaceous (Lower Turonian):* France, Morocco, Cameroon, Nigeria, Trinidad, Venezuela, Colombia, northeastern Brazil.——FIG. 121,*1a–c. *B. benueensis; a,b,* Trinidad; ×2 (Reyment, 1971); *c,* Nigeria; ×2 (Reyment, 1954a).——FIG. 121,*1d,e. B. spinosus* (REYMENT), Trinidad; ×2 (Reyment, 1971).

Quitmaniceras POWELL, 1963, p. 313 [**Q. reaseri;* OD]. Rather evolute, compressed; generally with keel entire or serrate in young and on later whorls narrowly rounded, fastigiate, or narrowly tabulate; ribbing irregular, generally falcoid, and single, indistinctly branched, or intercalated; main ribs may have an umbilical bulla, a blunt or sharp inner ventrolateral bulla, and a small outer ventrolateral clavus. Suture with rather shallow, oblique elements. Probably derived from compressed *Protacanthoceras. Upper Cretaceous (Lower Turonian):* Texas, Mexico.——FIG. 123,*4a–c. *Q. reaseri,* Mexico; ×1 (Powell, 1963).

?Prohauericeras NOWAK, 1913, p. 370 [**Ammonites goupilianus* ORBIGNY, 1841, p. 317; SD DIENER, 1925, p. 140]. Moderately involute, compressed; sides flat to slightly convex; venter rounded-fastigiate, developing a distinct, rounded keel; with rather feeble, flexuous, long and short ribs. Suture with 6 external lobes. Inner whorls perhaps belonging to this genus show traces of ventrolateral tubercles and may indicate an origin in *Quitmaniceras. Upper Cretaceous (Middle Turonian):* France.——FIG. 120,*2a–c. *P. goupilianum* (ORBIGNY); *a,b,* ×0.75; *c,* enlarged (Orbigny, 1841).

Calycoceras HYATT, 1900, p. 589, ICZN Opinion 557, 1959, Generic Name No. 1352 [**Ammonites navicularis* MANTELL, 1822, p. 198; ICZN Specific Name No. 1633] [=*Metacalycoceras* SPATH, 1926a, p. 83, ICZN Rejected Name No. 1265, obj.]. Rather evolute, with whorl section depressed and subcircular, oval, polygonal, or subquadrate; ribs strong, generally straight, continuous over rounded or flat but not concave venter; on early whorls at

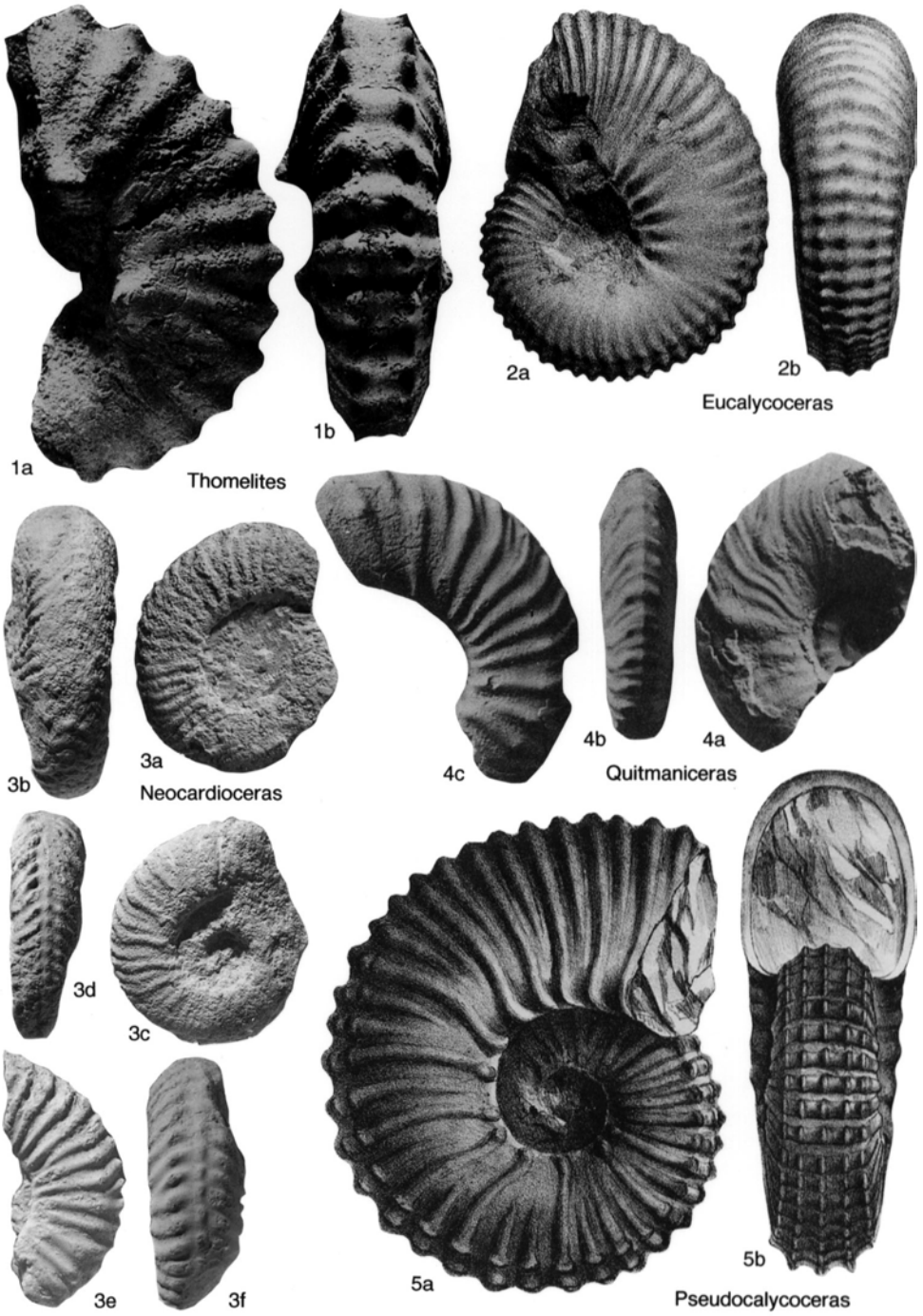

FIG. 123. Acanthoceratidae (p. 162–167)

least umbilical, ventrolateral, siphonal, and, in most specimens, midlateral tubercles; in multituberculate forms umbilical tubercle more prominent than midlateral; tubercles may disappear with age and may or may not be rejuvenated on last part of shell. Marked dimorphism in size apparently general. Contrary to the situation in *Mantelliceras,* a number of subgenera are here accepted because there are significant morphological and, to some extent, time gaps between species groups. *Upper Cretaceous (Cenomanian):* Europe, Africa, Madagascar, Syria, Iran, southern India, Papua New Guinea, Japan, USA, Argentina.

C. (Gentoniceras) THOMEL, 1972, p. 65 [**Ammonites gentoni* BRONGNIART in CUVIER & BRONGNIART, 1822, p. 183; OD] [=*Subeucalycoceras* THOMEL, 1972, p. 113 (1969, p. 650, *nom. van.*) (type, *Acanthoceras baylei* PERVINQUIÈRE, 1907, p. 81; OD; =*Acanthoceras sarthacense* BAYLE, 1878, pl. 72, fig. 1–2)]. Small, evolute, with strongly tuberculate inner whorls; siphonal tubercles normally disappearing early, then ventrolaterals; umbilical tubercles may persist; body chamber with strong, well-spaced ribs; ribs single, or branching at umbilical tubercles or edge, or long and short, and uninterrupted on evenly rounded venter. Strongly dimorphic; macroconchs commonly twice the size of microconchs. Occurrence as for genus: Europe, Africa, Madagascar, southern India, Japan, California, South Dakota.——FIG. 124,*1a–d. *C. (G.) gentoni* (BRONGNIART in CUVIER & BRONGNIART); *a,b,* lectotype, Middle Cenomanian, France, ×1; *c,d,* macroconch, Upper Cenomanian, England, ×1 (Kennedy, 1971).

C. (Calycoceras). Medium-sized to large; whorl section normally depressed and may be polygonal; ribs more or less distant and coarse; all tubercles except umbilical normally absent in middle growth, but weak outer ventrolaterals may persist and be rejuvenated on body chamber. Occurrence as for genus: distribution as for genus.——FIG. 125*a–f. *C. (C.) naviculare* (MANTELL); *a–d,* Upper Cenomanian, England; *a,b,* holotype, ×0.7; *c,d,* ×1 (Kennedy, 1971); *e,f,* Upper Cenomanian, Angola, ×0.75 (H. Douvillé, 1931).

C. (Newboldiceras) THOMEL, 1972, p. 105 [**Acanthoceras newboldi* KOSSMAT, 1897, p. 4(111); OD; =*Acanthoceras asiaticum* JIMBO, 1894, p. 31(177)] [=*Mourreiceras* THOMEL, 1972, p. 118 (type, *N. (M.) mourrei;* OD); *Pseudacanthoceras* THOMEL, 1972, p. 153 (type, *Acanthoceras tapara* WRIGHT, 1963, p. 605)]. Large; whorl section tending to be polygonal with marked ventrolateral facet or subquadrate throughout; outer ventrolateral and in many cases inner ventrolateral and siphonal tubercles persisting. [Although *Pseudacanthoceras* resembles *Acanthoceras* in developing clavate ventrolateral and siphonal tubercles and in its rectangular whorl section, it probably comprises extreme *Newboldiceras.*] Occurrence as for genus: Europe, Africa, Madagascar, India, Japan, California.——FIG. 124,*3a–c. *C. (N.) asiaticum* (JIMBO), Middle Cenomanian, southern India; *a,b,* ×0.5; *c,* ×1 (Kossmat, 1897).

C. (Proeucalycoceras) THOMEL, 1972, p. 81 [**C. (Eucalycoceras) besairiei* COLLIGNON, 1937a, p. 37(13); OD] [=?*Haugiceras* THOMEL, 1972, p. 96 (type, *Acanthoceras haugi* PERVINQUIÈRE, 1907, p. 270; OD)]. Inner whorls relatively compressed; sides and venter commonly flat; ribs dense, fine, and flexuous, with weak to strong umbilical bullae and weak outer ventrolateral clavi; inner ventrolateral and siphonal tubercles present initially but disappearing early; whorl section tending to become square, with blunt, well-rounded ribs. Occurrence as for genus: western Europe, northern Africa, Madagascar, Oman, southern India, Texas.——FIG. 124,*2a,b. *C. (P.) besairiei,* Middle Cenomanian, Madagascar; ×1 (Collignon, 1937a).——FIG. 124,*2c,d. C. (P.) choffati* (KOSSMAT), Middle Cenomanian, southern India; ×0.75 (Kossmat, 1897).

C. (Hourcqiceras) COLLIGNON, 1939, p. 19 [**C. (H.) hourcqi;* OD]. More or less similar in form and ornament to *C. (Gentoniceras)* but with persistent constrictions and exceptionally thick shell. [*Tunesites,* if Cenomanian, may be a senior synonym, but it is probably Turonian.] *Upper Cretaceous (Upper Cenomanian):* Madagascar.

?Tunesites PERVINQUIÈRE, 1907, p. 255 [**T. salammbo* PERVINQUIÈRE, 1907, p. 255; SD ROMAN, 1938, p. 441]. The syntypes are minute nuclei, almost smooth but for marked constrictions with feebly tuberculate, raised rib behind. If, as stated by PERVINQUIÈRE, they are Cenomanian, *Tunesites* may be a senior synonym of *Calycoceras (Hourcqiceras).* If, as seems more likely, they are Turonian, *Tunesites* may be a senior synonym of *Romaniceras.* At present a *nomen dubium.* KENNEDY, WRIGHT, & HANCOCK, 1980a. *Upper Cretaceous (Cenomanian or Turonian).*

Eucalycoceras SPATH, 1923b, p. 144, ICZN Opinion 557, 1959, Generic Name No. 1354 [**Ammonites pentagonus* JUKES-BROWNE in JUKES-BROWNE & HILL, 1896, p. 156; OD; ICZN Specific Name No. 1635] [=*Pseudomantelliceras* THOMEL, 1972, p. 35 (type, *Acanthoceras (Mantelliceras) pervinquierei* COLLIGNON, 1931b, p. 42; OD)]. High-whorled and rather compressed; at first venter flat and may be bituberculate, but later arched and trituberculate; ribs dense and narrow to flat and distant, with sharp umbilical, inner and outer ventrolateral, and, at least on outer whorls, pointed or bullate siphonal tubercles; tubercles may disappear on body chamber and ribs become flat and steep behind. *Upper Cretaceous (Upper Cenomanian):* England, France, Spain, Madagascar, Israel, southern India, Japan, Texas.——FIG. 123,*2a,b. *E. pentagonum* (JUKES-BROWNE in JUKES-BROWNE & HILL), England; ×0.5 (Jukes-Browne & Hill, 1896).

Pseudocalycoceras THOMEL, 1969, p. 650 [**Ammonites harpax* STOLICZKA, 1864, p. 72; OD] [=*Neocalyco-*

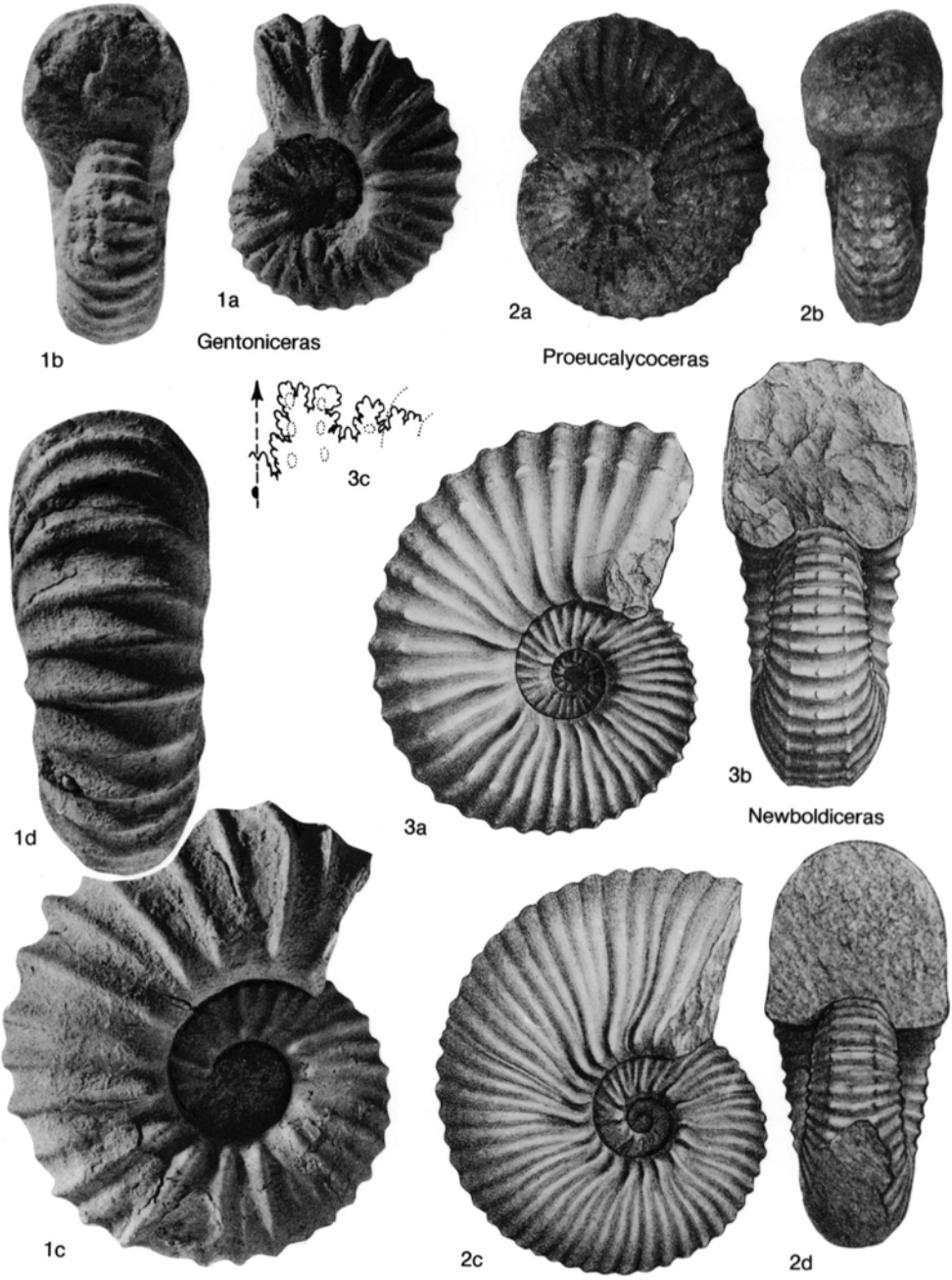

FIG. 124. Acanthoceratidae (p. 164)

ceras THOMEL, 1969, p. 651, *nom. nud.*]. Slightly compressed to slightly depressed; ribs flexuous to convex and prorsiradiate, more or less regularly branching or long and short; primaries arising from umbilical bullae, characteristically twisted; all ribs with inner ventrolateral nodes or clavi and outer ventrolateral and siphonal clavi; on latter part of body chamber ribs narrow, approximate, and generally recurved; tubercles disappearing. MATSUMOTO & KAWANO, 1975. *Upper Cretaceous (Upper*

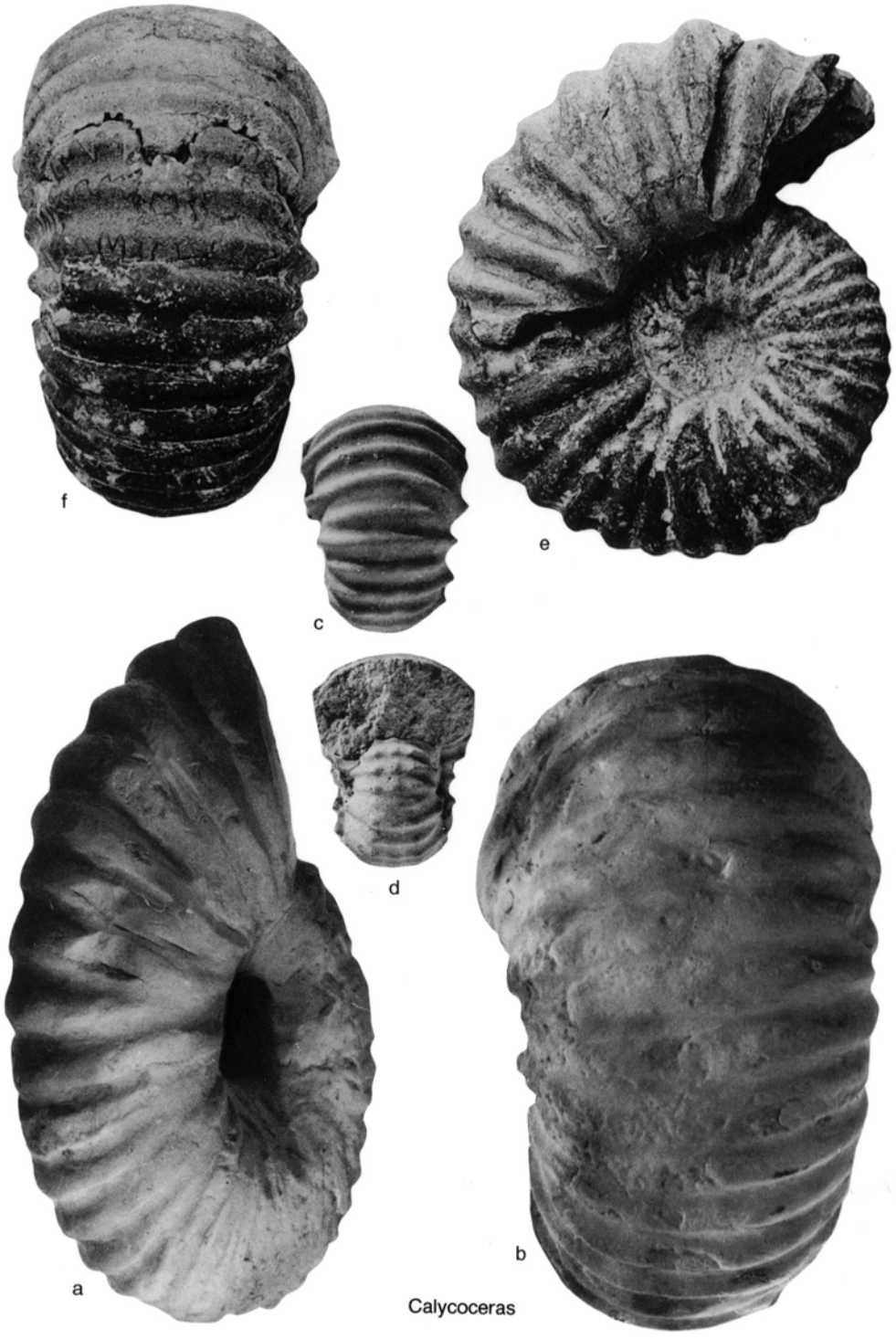

FIG. 125. Acanthoceratidae (p. 164)

Cenomanian): western Europe, Romania, northern Africa, Angola, Madagascar, Syria, Israel, southern India, Texas, Colorado, Brazil.——Fig. 123,*5a,b.* **P. harpax* (Stoliczka), southern India; ×0.75 (Stoliczka, 1864).

Nigericeras Schneegans, 1943, p. 118 [**N. gignouxi;* OD; =*Acanthoceras(?) gaddeni* Chudeau, 1909, p. 71]. Acanthoceratine ornament of ribs and umbilical, inner and outer ventrolateral, and siphonal tubercles persisting to varying diameters up to 40 mm; thereafter, shell smooth except for strong to weak folds, which may be rursiradiate; weak siphonal ridge may be present; whorl section oval, round, or quadrate. Suture simplifying. *Upper Cretaceous (Upper Cenomanian):* England, western Africa, Israel, Turkestan, Colorado, Texas.——Fig. 122,*2a–c.* **N. gignouxi,* Niger; *a,* ×0.75; *b,* ×0.5; *c,* ×1 (Schneegans, 1943).

Subfamily EUOMPHALOCERATINAE Cooper, 1978

[Euomphaloceratinae Cooper, 1978, p. 102]

Derivatives of *Calycoceras,* mostly with constrictions in early stages or throughout. *Upper Cretaceous (Upper Cenomanian–Lower Coniacian).*

Lotzeites Wiedmann, 1960, p. 731 [**Acanthoceras aberrans* Kossmat, 1895, p. 202(106); OD]. Extreme development of *C. (Calycoceras),* with inner whorls generally similar but distinguished by broader, flatter venter with strong ventral constrictions; main ribs with prominent umbilical and inner ventrolateral tubercles, at which ribs branch and cross venter transversely; untuberculate secondaries are intercalated on body chamber. Distinguished from *Euomphaloceras* by more rapidly increasing whorl breadth and absence of outer ventrolateral tubercles. *Upper Cretaceous (Upper Cenomanian):* England, southern India.——Fig. 126,*3a,b.* **L. aberrans* (Kossmat), southern India; ×1 (Kossmat, 1895).

Euomphaloceras Spath, 1923b, p. 143 [**Ammonites euomphalus* Sharpe, 1855, p. 31; OD] [=*Kanabiceras* Reeside & Weymouth, 1931, p. 11 (type, *Acanthoceras? kanabense* Stanton, 1894, p. 181; OD; =*Scaphites? septemseriatus* Cragin, 1893, p. 240); *Burroceras* Cobban, Hook, & Kennedy, 1989, p. 37 (type, *B. clydense;* OD)]. Very evolute; whorl section square to depressed-octagonal; prominent umbilical and ventrolateral tubercles on some or all main ribs; ribs branching at ventrolateral tubercles and carrying 3 rows of small, bullate to clavate tubercles on broad venter; shallow ventral constrictions on early whorls, variously persistent; ribs may be transverse or in chevrons on venter. Suture having narrow external saddle with oblique dorsal slope and wide, splayed first lateral lobe. [*Burroceras* with slightly prolonged, early, smooth stage and flatter-sided adult whorls is transitional to *Pseudaspidoceras* but does not need separation.] *Upper Cretaceous (Upper Cenomanian):* western Europe, northern Africa, Angola, Madagascar, Syria, southern India, Japan, USA (Western Interior, California), Brazil.——Fig. 126,*1a–c.* **E. euomphalum* (Sharpe), England; ×1 (Crick, 1899).——Fig. 126,*1d,e. E. septemseriatum* (Cragin), Texas; ×0.5 (Moreman, 1942).

Paraburroceras Cobban, Hook, & Kennedy, 1989, p. 40 [**P. minutum;* OD]. Progenetic dwarf offshoot of *Euomphaloceras ("Burroceras").* Almost smooth until last part of phragmocone. *Upper Cretaceous (Upper Cenomanian):* New Mexico.

Morrowites Cobban & Hook, 1983, p. 9 [**Mammites wingi* Morrow, 1935, p. 467; OD]. Larger, in some species at least with early whorls smooth except for feebly tuberculate ribs bordering constrictions. Suture with external saddle normally much narrower than widely splayed first lateral lobe. Adult whorls similar to *Mammites,* but early constrictions and suture indicate close relationship to *Euomphaloceras. Upper Cretaceous (Lower Turonian):* Europe, western Africa, Madagascar, USA (Western Interior).——Fig. 127,*2a–d. M. subdepressus* Cobban & Hook, New Mexico; *a–c,* ×1; *d,* ×0.5 (Cobban & Hook, 1983).

Kamerunoceras Reyment, 1954b, p. 250 [**Acanthoceras eschii* Solger, 1904, p. 124; OD] [=*Schindewolfites* Wiedmann, 1960, p. 736 (type, *S. inaequicostatus;* OD); ?*Polyaspidoceras* Matsumoto, 1978, p. 18 (type, *P. shimizui;* OD)]. Very evolute; whorl section circular to subquadrate, becoming higher with age; ribs single, straight to sinuous, irregular, and very distant until body chamber where there may be strengthening intercalatories. Early whorls with weak umbilical bullae, with or without weak lateral tubercles, and with inner and stronger outer ventrolateral and irregular, weak to strong, clavate siphonal tubercles. Tubercles persisting or weakening, with ribs becoming dominant. Probably derived from *Euomphaloceras* by increase in whorl height, flattening of sides, and reduction of secondary ribs with their tubercles. *Upper Cretaceous (Lower Turonian):* England, France, Spain, northern and western Africa, Madagascar, Israel, Japan, Texas, Colorado, ?Colombia, Venezuela, Brazil. ——Fig. 126,*2a,b.* **K. eschii* (Solger), Cameroon; nucleus, ×1 (Kennedy & Wright, 1979).——Fig. 126,*2c–e. K. turoniense* (Orbigny), France; *c,d,* ×0.25; *e,* ×1.5 (Pervinquière, 1903a).——Fig. 126,*2f–h. K. inaequicostatus* (Wiedmann), Spain; ×1 (Wiedmann, 1964).

Pseudaspidoceras Hyatt, 1903, p. 106 [**Ammonites footeanus* Stoliczka, 1864, p. 101; OD] [=*Ampakabites* Collignon, 1965a, p. 29 (type, *Kamerunoceras (Ampakabites) auriculatum* Collignon, 1965a, p. 29; OD)]. Early whorls slightly inflated to slightly compressed; more or less flat-sided; distant primary ribs with umbilical bullae, strong inner and weaker outer ventrolateral tubercles; irregular, weak, branching or intercalated secondary ribs bearing outer ventrolateral tubercles only; flat venter with or without slight, transverse constrictions. Later whorl height increasing, with

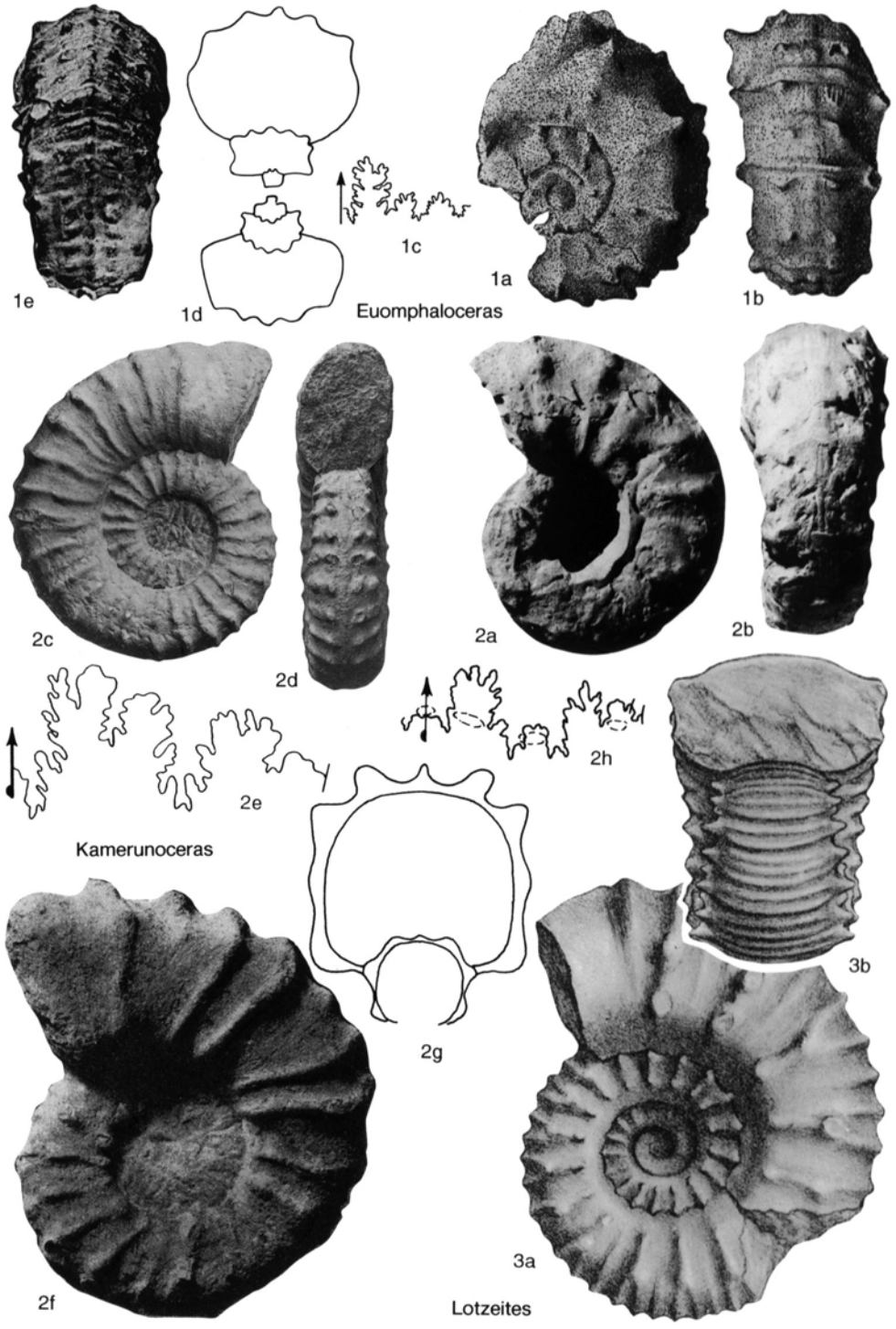

FIG. 126. Acanthoceratidae (p. 167)

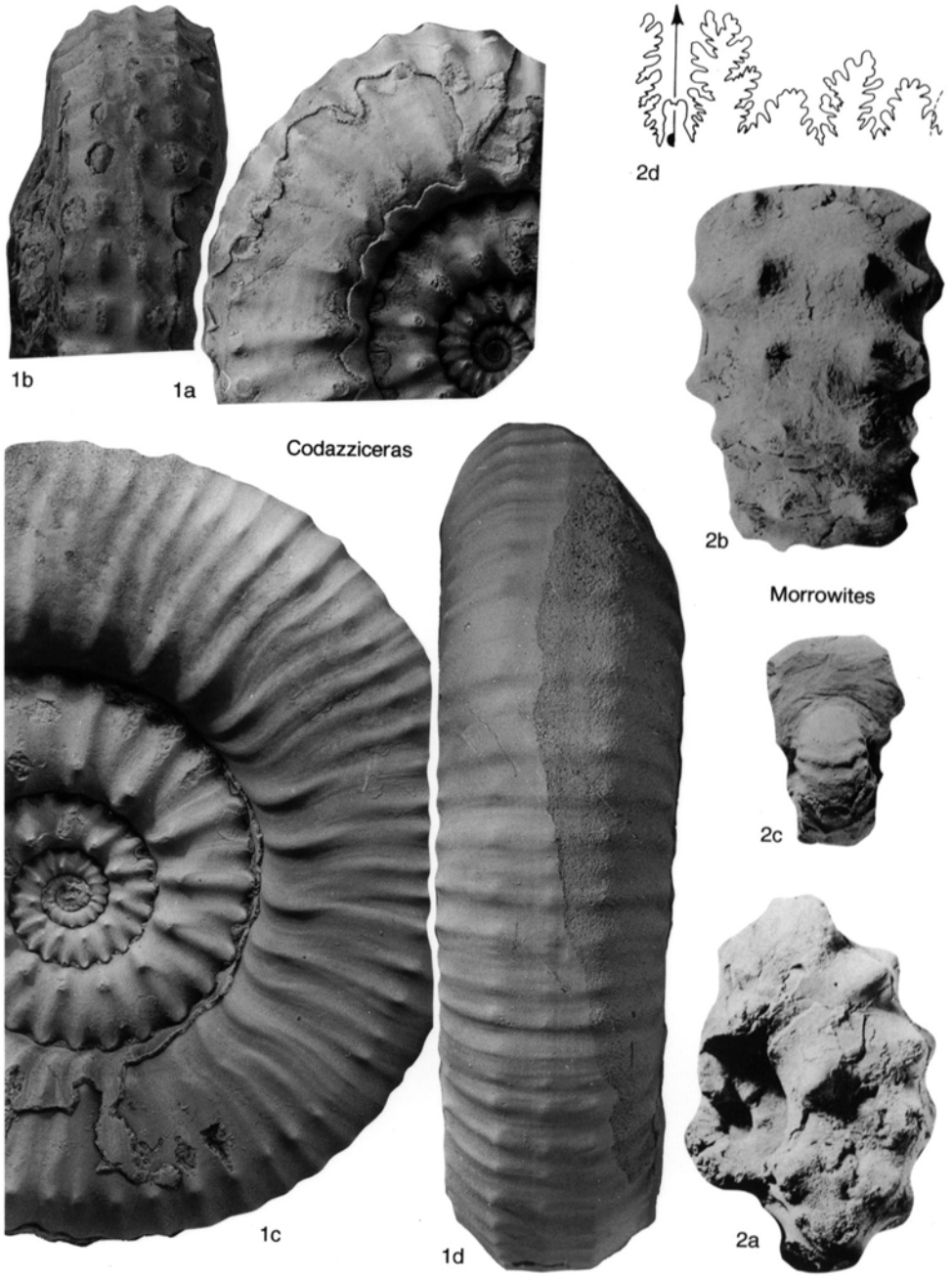

FIG. 127. Acanthoceratidae (p. 167–171)

square or rectangular section; ribs weaken and may be looped on sides; outer ventrolateral tubercles weakening or disappearing. Suture with moderately short to long elements. *Upper Cretaceous (Lower Turonian–Middle Turonian):* western Europe, western Africa, Egypt, Madagascar, Oman, southern India, Texas, Venezuela, Brazil.——FIG. 128,*1a–c.* **P. footeanum* (STOLICZKA), Lower Turonian, southern India; *a,* ×0.25; *b,* ×1; *c,* enlarged (Stoliczka, 1863–1866).——FIG. 128,*1,d,e. P. auriculatum*

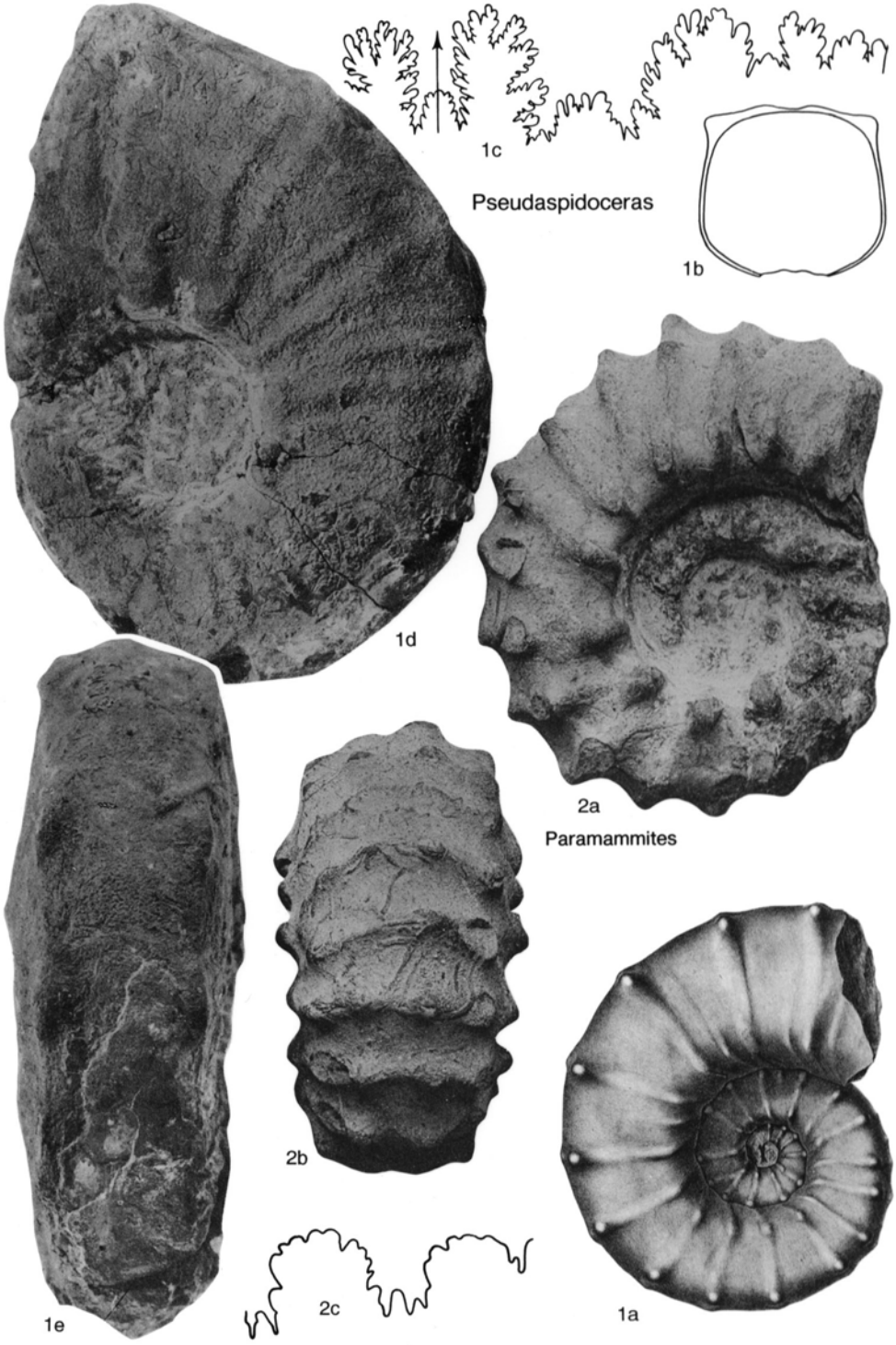

FIG. 128. Acanthoceratidae (p. 167–171)

(COLLIGNON), Lower Turonian, Madagascar; ×0.75 (Collignon, 1965a).

?Paramammites FURON, 1935, p. 58 [**Vascoceras polymorphum* PERVINQUIÈRE, 1907, p. 336; SD REYMENT, 1954b, p. 255]. Variable, rather involute to evolute; whorl section compressed to depressed, rounded to subquadrate; at first with very prominent umbilical bullae and weak inner and strong, spinate outer ventrolateral tubercles; later, ribs may strengthen and all tubercles approximate in size and spacing; later still, ribs become dominant and ventrolateral tubercles disappear; ribs, when present, may cross venter or be interrupted. *Upper Cretaceous (Lower Turonian):* France, Spain, northern Africa, Venezuela.——FIG. 128,*2a–c. *P. polymorphum* (PERVINQUIÈRE), Tunisia; ×1 (Pervinquière, 1907).

Romaniceras SPATH, 1923b, p. 144 [**Ammonites deverianus* ORBIGNY, 1841, p. 356; OD] [=*Kossmatia* YABE, 1927, p. 42, *non* UHLIG, 1907, p. 470 (type, *Acanthoceras pseudodeverianum* JIMBO, 1894, p. 32(178); M; =*Ammonites deverianus* ORBIGNY); *Proromaniceras* WIEDMANN, 1960, p. 734 (type, *Acanthoceras pseudodeverianum* JIMBO, 1894, p. 32(178); OD; =*Ammonites deverianus* ORBIGNY)]. Rather evolute; whorl section circular, oval, or subquadrate; early whorls with constrictions and associated ribs; later whorls with strong ribs and 9 to 13 rows of more or less equal tubercles, equidistant or not; ventrolateral and siphonal tubercles may be clavate. On mature whorls some or all tubercles disappearing and ribs mainly long and strong, uninterrupted on venter. KENNEDY, WRIGHT, & HANCOCK, 1980a. *Upper Cretaceous (Lower Turonian–Upper Turonian):* western Europe, Czech Republic, northern and western Africa, Madagascar, Syria, Japan, California, Texas, Mexico, Venezuela.

R. (Romaniceras). Whorl section oval, round, or depressed; with 9 more or less equidistant tubercles, the ventrolateral and siphonal in some cases clavate. *Upper Cretaceous (Upper Turonian):* western Europe, northern and western Africa, Madagascar, Syria, Japan.——FIG. 129,*3a–c. *R. (R.) deverianum* (ORBIGNY), France; ×0.5 (Kennedy, Wright, & Hancock, 1980a).

R. (Neomphaloceras) MATSUMOTO & OBATA, 1982, p. 71 [**Yubariceras pseudomphalum* MATSUMOTO, 1975, p. 146; OD]. Phragmocone with ribs differentiated into primaries and intercalated secondaries. Somewhat resembles *Euomphaloceras. Upper Cretaceous (Lower Turonian–Middle Turonian):* Japan.——FIG. 129,*4a,b. *R. (N.) pseudomphalum* (MATSUMOTO); ×1 (Matsumoto & Suekane, 1987).

R. (Yubariceras) MATSUMOTO, SAITO, & FUKADA, 1957, p. 26 [**Y. yubarense;* OD; =*Ammonites ornatissimus* STOLICZKA, 1864, p. 75]. Whorl section rounded or square; with 11 rows of tubercles and with constrictions up to diameter of 40 mm; ribs may be doubled on venter as in *Euomphaloceras. Upper Cretaceous (Lower Turonian–Upper Turonian):* England, France, Tunisia, Madagascar, Lebanon, Israel, southern India, Japan, California, Texas, Mexico, Venezuela. ——FIG. 129,*5a–c. *R. (Y.) ornatissimum* (STOLICZKA), Middle Turonian, Japan; ×0.4 (Matsumoto, Saito, & Fukada, 1957).

R. (Obiraceras) MATSUMOTO, 1975, p. 150 [**R. (O.) ornatum;* OD]. More or less square-whorled; secondary ribs, with no or weak tubercles, persisting to end; on later whorls inner and outer ventrolateral tubercles doubled. Occurrence as for genus: Japan, New Mexico.——FIG. 129,*2a,b. *R. (O.) ornatum;* ×0.5 (Matsumoto, 1975).

R. (Shuparoceras) MATSUMOTO, 1975, p. 110 [**R. (S.) yagii;* OD]. High-whorled, with 9 tubercles (the midlateral weak) and frequent, strong constrictions throughout. *Upper Cretaceous (Upper Turonian):* Japan.——FIG. 129,*1a,b. *R. (S.) yagii;* ×0.5 (Matsumoto, 1975).

Codazziceras ETAYO SERNA, 1979, p. 83 [**Lyelliceras scheibei* RIEDEL, 1938, p. 55; OD]. Very evolute, serpenticone; early whorls rounded, smooth, with constrictions; later whorls with whorl section square to rectangular, becoming rounded on body chamber; with strong ribs branching from umbilical tubercles, bearing inner and outer ventrolateral and siphonal tubercles; all tubercles tending to disappear on body chamber, which resembles inner whorls of *Pedioceras. Upper Cretaceous (Lower Coniacian):* Australia, Colombia.——FIG. 127,*1a–d. *C. scheibei* (RIEDEL), Colombia; ×1 (new).

Subfamily MAMMITINAE Hyatt, 1900

[*nom. transl.* WRIGHT & WRIGHT, 1951, p. 27, *ex* Mammitidae HYATT, 1900, p. 588] [=Buchiceratidae HYATT, 1903, p. 26; Metoicoceratidae HYATT, 1903, p. 115; Fallotitinae WIEDMANN, 1960, p. 741; Mitoniainae RENZ & ALVAREZ, 1979, p. 975]

Moderately to very involute; inner whorls typically with trapezoidal whorl section, rather sparse ribs, and bullate or spinate umbilical and clavate inner and outer ventrolateral tubercles; siphonal line may be slightly raised but venter normally lacking keel or row of siphonal tubercles. On outer whorl ornament may strengthen to extremes or may disappear. Suture tending to simplify. *Upper Cretaceous (Upper Cenomanian–Coniacian).*

Phylogeny seems to be from *Plesiacanthoceras* (Acanthoceratinae) to *Metoicoceras* to *Spathites (Jeanrogericeras)* to *S. (Spathites)* to *Buchiceras;* a further branch from *S. (Jeanrogericeras)* leads to *Mammites* and to *Pseudaspidoceras, Paramammites,* and *Metasigaloceras.*

Metoicoceras HYATT, 1903, p. 115 [**Ammonites swallovi* SHUMARD, 1860, p. 591; SD SHIMER & SHROCK, 1944, p. 56]. Venter on phragmocone flat,

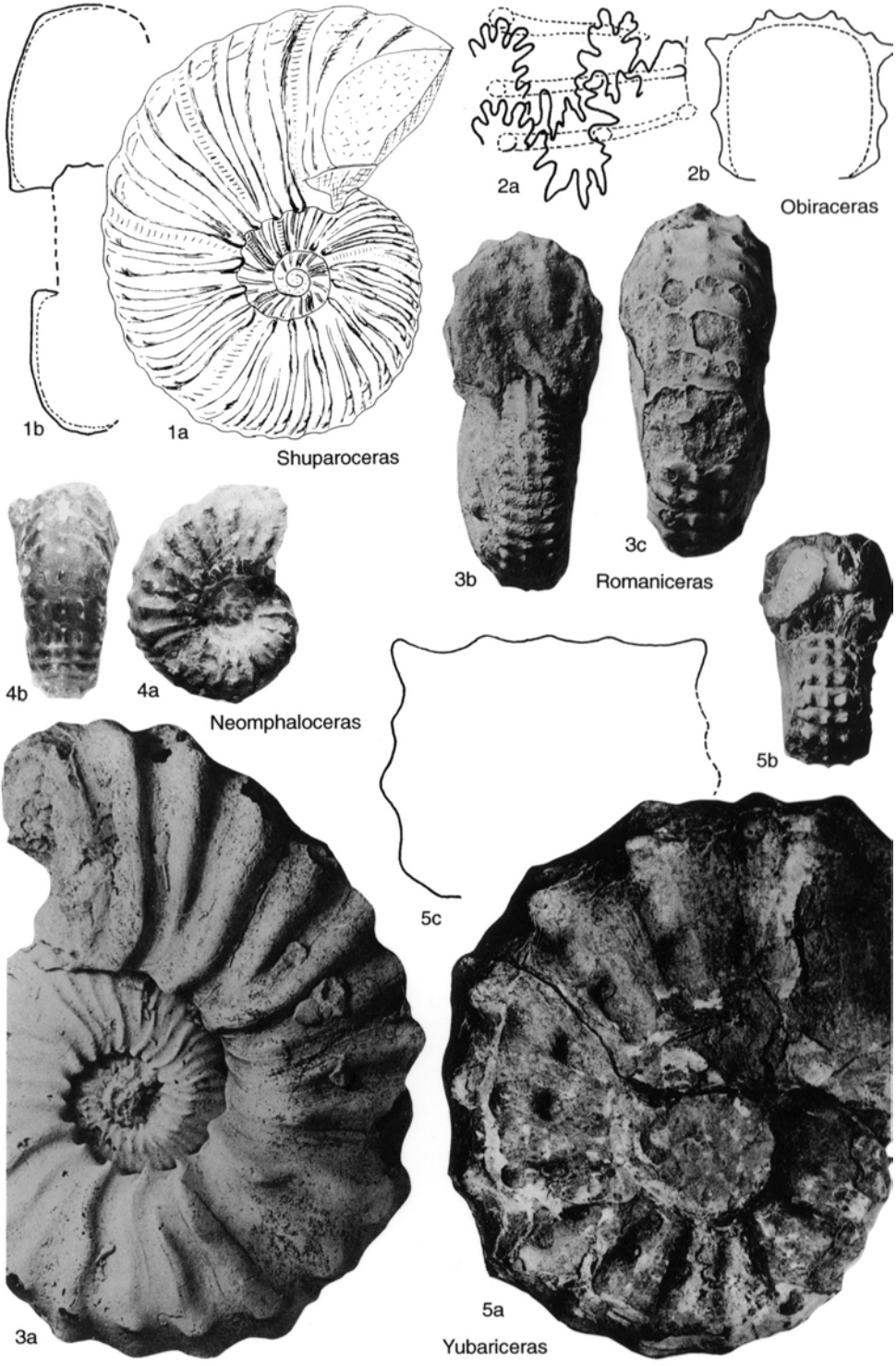

FIG. 129. Acanthoceratidae (p. 171)

on body chamber generally rounded; ribs straight to slightly flexuous, tending to become flat on outer part of sides; inner and outer ventrolateral tubercles present, former weakening and disappearing before end of phragmocone. Macroconchs tending to be more involute and feebly ornamented and microconchs more evolute and strongly ornamented. Differs from its presumed ancestor *Plesiocanthoceras* mainly in its simpler suture, pseudoceratitic in some, and absence of row of siphonal tubercles (except on early whorls of earliest species). Includes smooth or ribbed, compressed, involute forms and coarsely ornamented, evolute forms. *Upper Cretaceous (upper Middle Cenomanian–middle Upper Cenomanian):* Europe, northern and western Africa, Madagascar, Israel, Iran, southern India, USA, Peru, Brazil.——Fig. 130,*1a,b. *M. swallovi* (Shumard), Texas; *a,* ×0.75; *b,* ×0.5 (Hyatt, 1903).

Cryptometoicoceras Kennedy & Cobban, 1990b, p. 409 [**C. mite;* OD]. Progenetic dwarf offshoot of *Metoicoceras praecox.* Sides flat, almost smooth; conical outer ventrolateral tubercles appearing transiently at beginning of body chamber, followed by plain ribs crossing venter. *Upper Cretaceous (Upper Cenomanian):* Wyoming.

Nannometoicoceras Kennedy, 1988, p. 63 [**Metoicoceras acceleratum* Hyatt, 1903, p. 127; OD]. Dwarf offshoot of *Metoicoceras.* Very involute, compressed, with flat sides and tabulate venter. *Upper Cretaceous (Upper Cenomanian):* Montana, Texas.——Fig. 131,*1a–d. *N. acceleratum* (Hyatt), Texas; *a,b,* macroconch, ×1; *c,d,* microconch, ×1 (Kennedy, 1988).

Buccinammonites Kennedy & Cobban, 1990b, p. 413 [**B. minimus;* OD]. Adult with diameter of 4.5 mm; very involute, depressed; sparse, coarse ribs ending in strong inner ventrolateral tubercles persisting to first part of body chamber, then becoming crowded with minute tubercles; aperture strongly flared. Suture with very simple bifid elements. Probably derived from *Metoicoceras* or ally. *Upper Cretaceous (Upper Cenomanian):* Montana.——Fig. 131,*2,a,b. *B. minimus;* ×3 (Kennedy & Cobban, 1990b).

Spathites Kummel & Decker, 1954, p. 310 [**S. chispaensis;* OD; =*Pseudotissotia? coahuilensis* Jones, 1938, p. 123]. Moderately to very involute; inner whorl with whorl section widest at umbilical shoulder; flat sides converging to sharp ventrolateral shoulder and broad, flat venter; blunt umbilical tubercles giving rise to pairs of low, rounded, distant ribs, each rib having 2 ventrolateral tubercles, inner one on or near the angle. Body chamber with blunt ribs or smooth. Suture simple with more or less bifid saddles. *Upper Cretaceous (Lower Turonian–Upper Turonian):* England, France, Portugal, Spain, southern Germany, Tunisia, Tadzhikistan, Texas.

S. (Jeanrogericeras) Wiedmann, 1960, p. 740 [**Ammonites revelie*reanus Courtiller, 1867, p. 4; OD] [=*Fallotites* Wiedmann, 1960, p. 741 (type, *Vascoceras subconciliatum* Choffat, 1898, p. 64; OD)]. Body chamber oval to rounded-depressed, smooth or with persistent distant ribbing. *Upper Cretaceous (Lower Turonian):* England, France, Portugal, Spain, southern Germany, Tunisia, Tadzhikistan.——Fig. 132*a–c. *S. (J.) revelie*reanus (Courtiller), France; *a,* ×1; *b,c,* ×0.6 (Pervinquière, 1903).——Fig. 132*d,e. S. (J.) subconciliatus* (Choffat), Portugal; ×0.75 (Choffat, 1898).

S. (Ingridella) Wiedmann, 1960, p. 749 [**Vascoceras malladae* Fallot, 1931, p. 5; OD]. Evolute, with regular coiling; inner whorls with distinct but subdued inner and outer ventrolateral tubercles, very feeble ribs, and sparse, very large, rounded umbilical tubercles; umbilical tubercles persisting to outer whorl, where other ornament disappears, leaving a depressed-rounded whorl section. *Upper Cretaceous (Lower Turonian):* Spain.——Fig. 133,*2a,b. *S. (I.) malladae* (Fallot); ×0.5 (Wiedmann, 1964).

S. (Spathites) [=*Amblydiscus* Adkins, 1933b, p. 238, *nom. nud.; Spathitoides* Wiedmann, 1960, p. 754 (type, *Neoptychites (Spathitoides) sulcatus;* OD)]. Very involute; body chamber almost smooth, with whorl section subquadrate and venter broad. [Despite its slightly different body chamber and suture, *Spathitoides* seems not to be distinct.] Occurrence as for genus: Spain, Texas.——Fig. 133,*1a–d. *S. (S.) coahuilensis* (Jones), Lower Turonian, Texas; *a,b,* ×1; *c,d,* ×2 (Kummel & Decker, 1954).——Fig. 133,*1e–g. S. (S.) sulcatus* (Wiedmann), Lower Turonian, Spain; ×0.5 (Wiedmann, 1964).

Buchiceras Hyatt, 1875, p. 369 [**B. bilobatum;* OD] [=*Roemeroceras* Hyatt, 1903, p. 30 (type, *Ammonites bilobatus* Gabb, 1877, p. 270, *non* Hyatt, 1875, p. 370; SD Diener, 1925, p. 216; =*Roemeroceras gabbi* Hyatt, 1903, p. 30)]. Moderately to very involute; variable; whorl section more or less square; venter varying from broad and flat to rounded; early whorls with rounded keel that weakens and may disappear; low bulging ribs branching from umbilical tubercles. Suture variable; saddles broad, simple, feebly indented, tending to be entire; up to 3 auxiliary saddles. Despite resemblances to some other stocks, *Buchiceras* seems to be descended from *Spathites* by loss of one row of ventrolateral tubercles and appearance of weak keel. *Upper Cretaceous (Coniacian):* northern Africa, Israel, Peru.——Fig. 130,*3a,b. *B. bilobatum,* Peru; ×1 (Brüggen, 1910).

Mammites Laube & Bruder, 1887, p. 229 [**Ammonites nodosoides* Schlüter, 1871, p. 19; M (all 3 species described in Laube & Bruder, 1887, are believed to be synonymous; earliest type designation is Roman, 1938, p. 449)] [=*Schluetericeras* Hyatt, 1903, p. 111 (type, *S. laubei;* OD; =*M. nodosoides*)]. Inner whorls trapezoidal to almost rectangular or square, with moderate to very strong tuberculation; venter slightly concave, flat, or with slight siphonal ridge. Outer whorls with fewer tubercles and with inner and outer ventrolaterals fused, in most species, into large horns directed sideways or obliquely upward. Suture moderately incised, variable, with first lateral lobe narrower than external saddle. *Upper Cretaceous (Lower Turonian–Upper Turonian):*

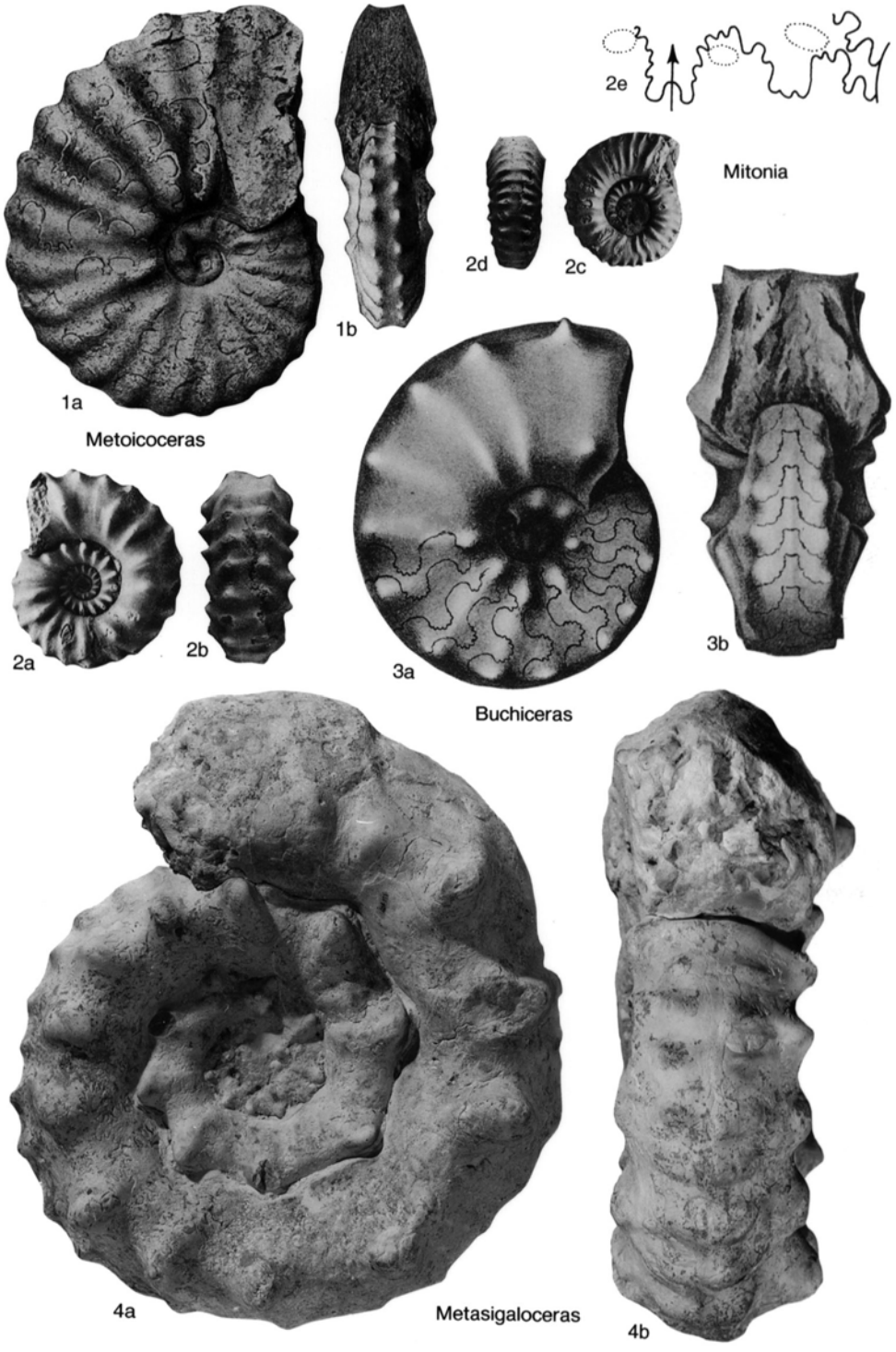

FIG. 130. Acanthoceratidae (p. 171–175)

Europe, northern Africa, western Africa, Madagascar, Syria, Israel, Turkestan, southern India, Texas, Colorado, Montana, Mexico, Colombia, Peru, Venezuela, Brazil.——Fig. 134,*a–d. *M. nodosoides* (Schlüter), Lower Turonian, Czech Republic; *a,b,* lectotype, ×0.4; *c,d,* topotype, ×0.4 (Wright & Kennedy, 1981).

Rhamphidoceras Kennedy & Cobban, 1990c, p. 667 [**R. saxatile;* OD]. Progenetic dwarf offshoot, probably of *Mammites.* Differs from *Mitonia* by larger ribs and absence of ventral tubercles. *Upper Cretaceous (Lower Turonian):* Texas.——Fig. 131,*3,a,b. *R. saxatile,* holotype; ×2 (Kennedy & Cobban, 1990c).

Metasigaloceras Hyatt, 1903, p. 106 [**Ammonites rusticus* J. Sowerby, 1817c, p. 171; OD]. Early whorls similar to those of *Mammites;* later whorls very evolute, with trapezoidal whorl section and very large, blunt lateral tubercles giving rise to broad, low ribs ending in low ventrolateral tubercles; venter flat and smooth. *Upper Cretaceous (Lower Turonian):* England, France, Turkestan.——Fig. 130,*4a,b. *M. rusticum* (J. Sowerby), England; ×0.2 (Wright & Kennedy, 1981).

Mitonia Renz & Alvarez, 1979, p. 975 [**M. venezolana;* OD]. Dwarfs (less than 32 mm in diameter); ornament as in adult *Metasigaloceras,* but tubercles weaker and ribs stronger on body chamber. Suture rather simple. *Upper Cretaceous (Lower Turonian):* Venezuela.——Fig. 130,*2a–e. *M. venezolana; a,b,* ?macroconch, ×1; *c,d,* ?microconch, ×1; *e,* ×5 (Renz & Alvarez, 1979).

Family VASCOCERATIDAE H. Douvillé, 1912

[*nom. correct. et transl.* Spath, 1925c, p. 198, *ex* Vascoceratinés H. Douvillé, 1912, p. 300] [=Neoptychitinae Collignon, 1965a, p. 70]

Derivatives of Acanthoceratidae that rapidly lose ribbing and tuberculation and are smooth or retain only sparse, blunt umbilical or ventrolateral tubercles or short, coarse ribs. Suture generally with shallow, irregular, and slightly indented elements, but some genera with longer, well-indented elements. Whorl section and degree of involution very variable, even within species. Typically Tethyan in occurrence. *Upper Cretaceous (Upper Cenomanian–Upper Turonian).*

Vascoceras Choffat, 1898, p. 51 [**V. gamai;* OD] [=*Pachyvascoceras* Furon, 1935, p. 58 (type, *P. crassum;* SD Reyment, 1954b, p. 257); *Paracanthoceras* Furon, 1935, p. 59 (type, *Vascoceras (P.) chevalieri;* OD); *Paravascoceras* Furon, 1935, p. 60 (type, *Vascoceras cauvini* Chudeau, 1909, p. 68; OD); *Broggiiceras* Benavides-Cáceras, 1956, p. 469 (type, *B. ohlssoni;* OD); *Greenhornoceras* Cobban & Scott, 1972, p. 84 (type, *V. (G.) birchbyi* Cobban & Scott, 1972, p. 84; OD); *Provascoceras* Cooper, 1979, p. 123 (type, *Ammonites diartianus* Orbigny, 1850a, p. 146; OD); *Nannovascoceras* Renz & Alvarez, 1979, p. 978 (type, *M. intermedium;* OD)]. Very variable; early whorls involute to evolute, depressed to compressed; with strong constrictions; ribs bordering constrictions may have umbilical bullae; intermediate ribs, if present, mainly on outer part. Later whorls evolute, moderately compressed to cadicone, smooth or with ventrolateral bulges strengthening into strong, prorsiradiate ribs on outer part of sides and venter, but without regular umbilical tubercles. Suture irregular, with wide, shallow, feebly indented elements. *Upper Cretaceous (Upper Cenomanian; ?Lower Turonian):* France, Portugal, Spain, Israel, northern and western Africa, Oman, Japan, Texas, Mexico, Colombia, Venezuela, Peru, Brazil.——Fig. 135*a–c. *V. gamai,* Upper Cenomanian, Portugal; ×0.5 (Choffat, 1898).——

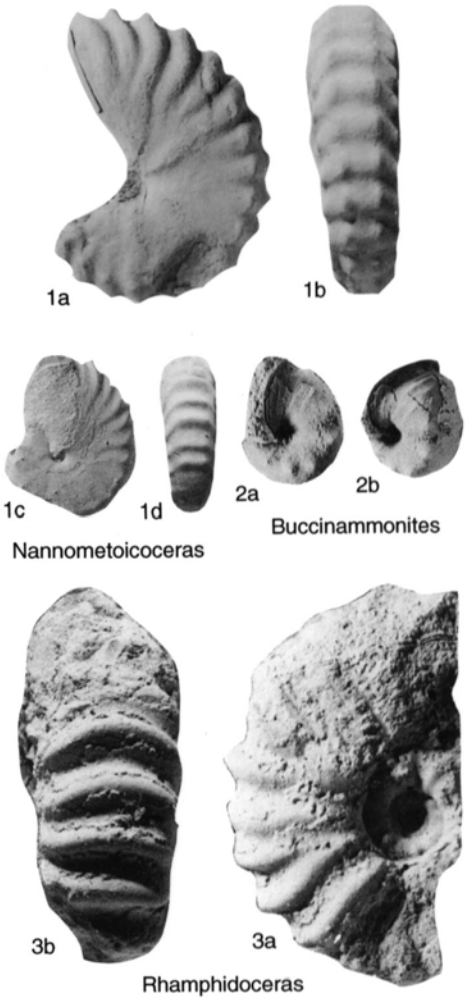

Fig. 131. Acanthoceratidae (p. 173–175)

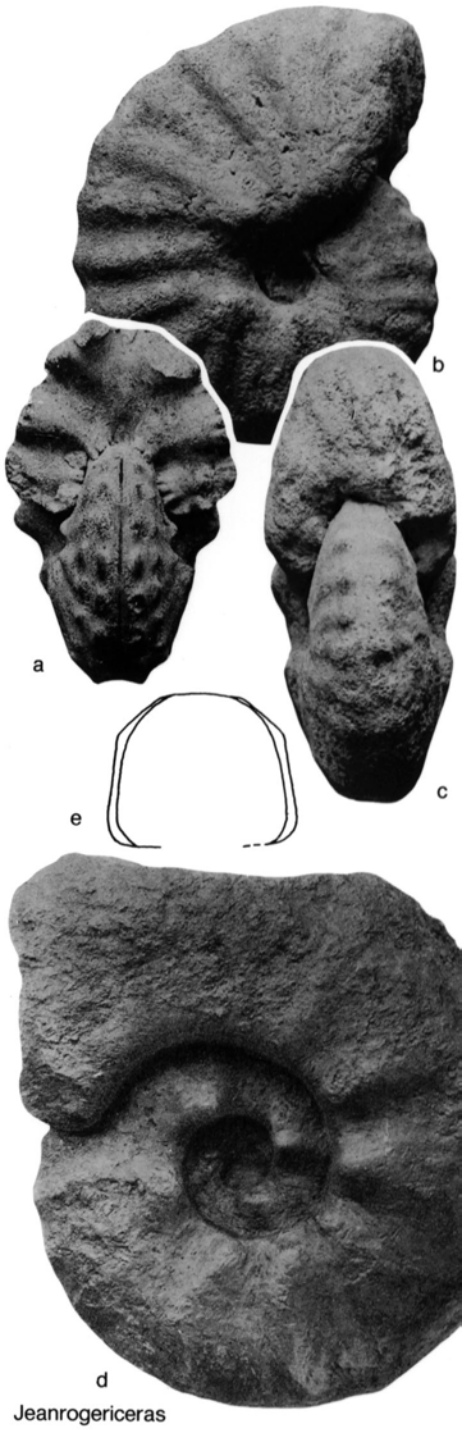

FIG. 132. Acanthoceratidae (p. 173)

FIG. 135*d. V. chevalieri* (FURON), Upper Cenomanian, Niger; ×0.5 (Furon, 1935).

Ezilloella REYMENT, 1954b, p. 263 [**E. ezilloensis;* OD]. Similar to some evolute *Vascoceras* but with more compressed inner whorls, narrowly arched to subcarinate venter, broad bulges on sides, and feeble ventrolateral and siphonal tubercles on outer whorl. *Upper Cretaceous (Lower Turonian):* Nigeria.

Neoptychites KOSSMAT, 1895, p. 168(72) [**Ammonites telinga* STOLICZKA, 1865, p. 125; SD SOLGER, 1904, p. 105; =*Ammonites cephalotus* COURTILLER, 1860, p. 248] [=*Betiokytes* COLLIGNON, 1965a, p. 56 (type, *Hemitissotia (B.) besairiei;* OD); *Pseudoneoptychites* A. F. LEANZA, 1967b, p. 202 (type, *P. andinus;* OD); *Franciscoites* ETAYO SERNA, 1979, p. 87 (type, *Ammonites toroanus* KARSTEN, 1858, p. 109; OD)]. Very involute, with minute umbilicus covered by a callosity or not (*Betiokytes*); whorl section compressed to very inflated, widest at rounded umbilical edge; venter narrowly rounded or slightly flattened; inner whorls variable, at first smooth except for sparse constrictions and associated collars, then with many, broad, low ribs bearing umbilical bullae in some species (*Pseudoneoptychites*), and finally smooth. Suture much as in *Vascoceras. Upper Cretaceous (Lower Turonian–Upper Turonian):* France, Spain, northern Africa, Nigeria, Madagascar, Syria, Israel, southern India, Japan, Colorado, Texas, Mexico, Trinidad, Venezuela, Colombia, Brazil.——FIG. 136,*2a,b. *N. cephalotus* (COURTILLER), Lower Turonian, Tunisia; ×0.25 (Pervinquière, 1907).——FIG. 136,*2c,d. N. andinus* (A. F. LEANZA), Lower Turonian, Venezuela; ×1 (A. F. Leanza, 1967b).

Fagesia PERVINQUIÈRE, 1907, p. 319 [**Olcostephanus superstes* KOSSMAT, 1897, p. 26(133); OD] [=*Plesiovascoceras* SPATH, 1925c, p. 198 (type, *Ammonites catinus* MANTELL, 1822, p. 198; OD)]. Typically cadicones with strong, blunt umbilical tubercles, from which branch 2 or 3 strong, rounded ribs that may persist or be lost at early stage; inner whorls may retain distinct ventrolateral tubercles. Suture regular, with long, narrow, much indented elements and asymmetrically trifid to bifid L. *Upper Cretaceous (Lower Turonian):* western Europe, northern Africa, Nigeria, Madagascar, Oman, southern India, Japan, California, Montana, Texas, New Mexico, Mexico, Colombia, Venezuela.——FIG. 136,*1a–c. *F. superstes* (KOSSMAT), Lower Turonian, southern India; ×0.5 (Kossmat, 1895–1898).——FIG. 136,*1d,e. F. catinus* (MANTELL), Lower Turonian, Montana; *d,* ×0.25; *e,* ×0.5 (Reeside, 1923).

Infabricaticeras COBBAN, HOOK, & KENNEDY, 1989, p. 51 [**I. lunaense;* OD]. Whorl section trapezoidal, with massive umbilical tubercles and single or branched, low ribs with intercalatories, all ribs ending in low ventrolateral tubercles or swellings. Derived from *Fagesia* or *Vascoceras* by prolongation of coarse juvenile ornamentation to adult stage. *Upper Cretaceous (Lower Turonian):* New Mexico, ?Spain.

Rubroceras COBBAN, HOOK, & KENNEDY, 1989, p. 54 [**R. alatum;* OD]. Inner whorls coarsely ribbed,

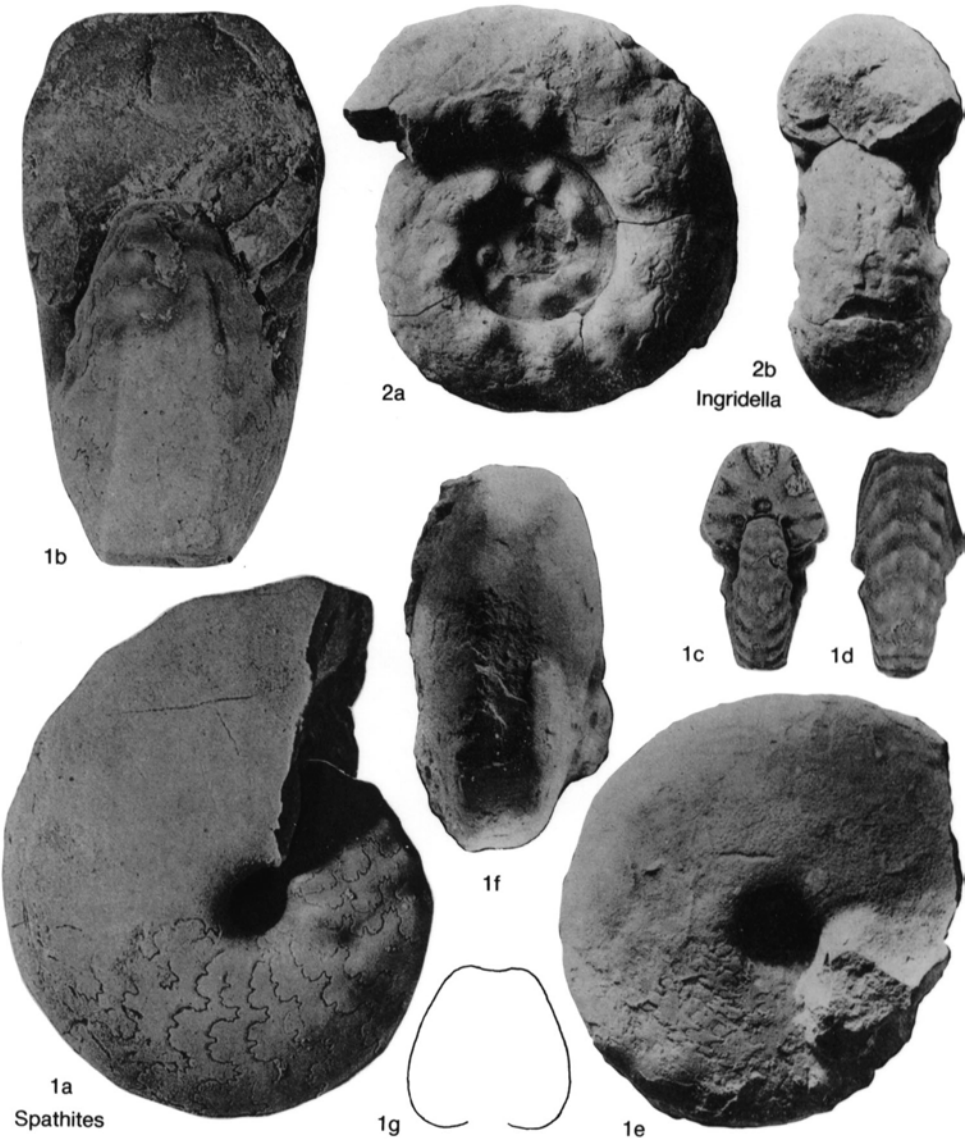

FIG. 133. Acanthoceratidae (p. 173)

with weakly trituberculate, rounded venter; body chamber with very coarse, rounded ribs angulate on shoulder. *Upper Cretaceous (Upper Cenomanian):* New Mexico.——FIG. 136,*3a,b. *R. alatum;* ×1 (Cobban, Hook, & Kennedy, 1989).

?Microdiphasoceras COBBAN, HOOK, & KENNEDY, 1989, p. 53 [**M. novimexicanum;* OD]. Progenetic dwarf derivative, probably of some vascoceratid. Involute, compressed, with trituberculate, fastigiate venter. *Upper Cretaceous (Upper Cenomanian):* New Mexico.——FIG. 136,*4a,b. *M. novimexicanum;* ×1 (Cobban, Hook, & Kennedy, 1989).

Family PSEUDOTISSOTIIDAE Hyatt, 1903

[Pseudotissotiidae HYATT, 1903, p. 34]

Generally involute, with degenerate acanthoceratine ornament, the ventrolateral and siphonal tubercles tending to form keels, but all ornament may disappear on outer whorls. *Upper Cretaceous (Lower Turonian–Coniacian).*

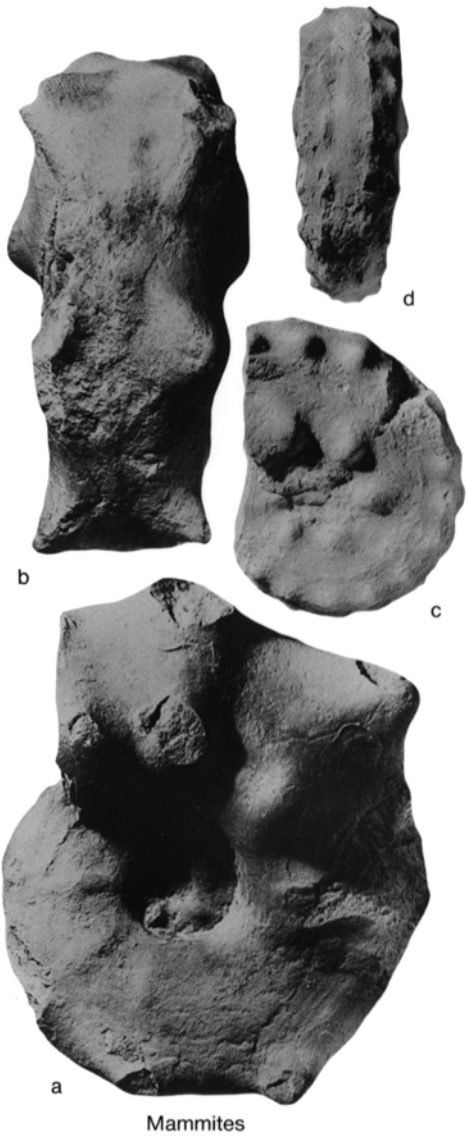

FIG. 134. Acanthoceratidae (p. 173–175)

Subfamily PSEUDOTISSOTIINAE Hyatt, 1903

[*nom. transl.* WRIGHT, 1952, p. 221, *ex* Pseudotissotiidae HYATT, 1903, p. 34] [=Hemitissotiinae PARNES, 1964, p. 13]

Moderately to very involute; whorl section compressed with flat sides to globose or triangular; venter varying from oxyconic to rounded-fastigiate; primitively with ventrolateral and siphonal rows of tubercles tending to become keels; siphonal keel may be lost or become dominant over ventrolateral keels or tubercles; umbilical tubercles normally present at some stage; ribs broad and sparse or absent. Suture variable, tending to simplify. *Upper Cretaceous (Lower Turonian–Coniacian).*

Thomasites PERVINQUIÈRE, 1907, p. 339 [**Pachydiscus rollandi* PERON, 1889, p. 25; SD DIENER, 1925, p. 103] [=*Gombeoceras* REYMENT, 1954a, p. 150 (type, *Vascoceras gongilense* WOODS, 1911, p. 282; OD); *Koulabiceras* ATABEKIAN, 1966, p. 75 (type, *Pseudotissotia koulabica* KLER, 1908, p. 157; OD); *Ferganites* STANKIEVICH & POJARKOVA, 1969, p. 94 (type, *Pseudotissotia koulabica* KLER, 1908, p. 157, objective junior synonym of *Koulabiceras*)]. Involute and globose when young; later whorl section becoming bluntly triangular, with 4 or 5 umbilical tubercles to each whorl, each giving rise to 2 or 3 faint, broad ribs that end in slight, blunt ventrolateral tubercles; a row of siphonal tubercles, commonly weak, also present; finally all ornament disappearing; aperture may be (always?) constricted. Suture variable, with moderately long to short, simplifying elements. *Upper Cretaceous (Lower Turonian):* England, Spain, northern and western Africa, Madagascar, Syria, Israel, Oman, Turkestan, Texas, Peru.——FIG. 137,*1a–c.* **T. rollandi* (PERON), Tunisia; *a,b,* ×1; *c,* enlarged (Pervinquière, 1907). ——FIG. 137,*1d,e. T. gongilense* (WOODS), Nigeria; ×0.75 (Woods, 1911).

Pseudotissotia PERON, 1897, p. 26 [**Ammonites galliennei* ORBIGNY, 1850a, p. 190; SD PERVINQUIÈRE, 1907, p. 349] [=*Bauchioceras* REYMENT, 1954a, p. 157 (type, *Hoplitoides nigeriensis* WOODS, 1911, p. 284; OD); ?*Discovascoceras* COLLIGNON, 1957, p. 123(11) (type, *D. tesselitense;* OD); *Furoniceras* COLLIGNON, 1957, p. 129(17) (type, *F. trumpyi;* OD)]. Compressed to slightly depressed; whorl section more or less rectangular or trapezoidal, with flat venter; inner whorls with 2 or 3 fairly persistent keels, the ventrolateral ones clavate and the siphonal ones nodate in depressed, strongly ornamented individuals, and all keels entire in compressed, smooth individuals; sparse, broad ribs on inner whorls may persist; outer whorls tending to be rounded in section. Suture with 4 saddles, normally feebly denticulate, but inner ones may be entire. Appears to be derived from *Thomasites* but may occur earlier. *Upper Cretaceous (Lower Turonian–Middle Turonian):* France, Spain, northern and western Africa, Syria, Israel, Texas, Mexico, Central America, Colombia, Brazil.——FIG. 137,*2a,b.* **P. galliennei* (ORBIGNY), Middle Turonian, Tunisia; ×0.5 (Peron, 1896–1897).——FIG. 137,*2c,d. P. nigeriensis* (WOODS), Lower Turonian, Nigeria; ×0.75 (Woods, 1911).

Wrightoceras REYMENT, 1954a, p. 159 [**Bauchioceras (W.) wallsi;* OD] [=*Imlayiceras* A. F. LEANZA, 1967b, p. 196 (type, *I. washbournei;* OD); ?*Herrickiceras* COBBAN & HOOK, 1980, p. 22 (type, *Placenticeras costatum* HERRICK & JOHNSON, 1900, p. 214; OD)].

Involute, with sides generally inflated on inner part in young but later similar or subparallel; venter concave, with sharp ventrolateral keels or slight clavi; feeble siphonal ridge may be present; inner whorls typically with weak ribs. [*Herrickiceras* differs only in having falciform ribbing and is probably unnecessary.] *Upper Cretaceous (Lower Turonian–Middle Turonian):* Spain, Tunisia, Nigeria, Oman, New Mexico, Texas, Mexico, Venezuela, Colombia.——Fig. 138,*2a,b. *W. wallsi* (Reyment), Lower Turonian, Nigeria; ×1 (Reyment, 1954a).

Eotissotia Barber, 1957, p. 53 [**E. simplex;* OD]. Involute, compressed, and smooth. Venter tabulate, then rounded, and finally narrowly arched. Suture with first lateral saddle broad and weakly denticulate, second and third entire and oblique. *Upper Cretaceous (Lower Turonian):* Nigeria, Oman.——Fig. 137,*3a,b. *E. simplex;* ×1 (Barber, 1957).

Donenriquoceras Wiedmann, 1960, p. 758 [**D. forbesiceratiforme;* OD]. Very involute and compressed, with venter tabulate or broadly rounded and later narrowly arched; smooth except for fine, opposite ventrolateral clavi. Suture with the 3 outer saddles divided by deep lobules but with simple folioles. Differs from *Eotissotia* only in the suture and the ventrolateral clavi. *Upper Cretaceous (Lower Turonian):* Spain.——Fig. 138,*3a–c. *D. forbesiceratiforme; a,b,* ×0.75; *c,* ×1 (Wiedmann, 1960).

Choffaticeras Hyatt, 1903, p. 37 [**Pseudotissotia meslei* Peron, 1897, p. 33; OD]. Compressed to inflated, lanceolate to cordate in section, some with biconcave flanks and bell-shaped section; venter sharp to bluntly rounded, with subdued siphonal keel, with or without weak ventrolateral keels or rows of tubercles; inner whorls smooth or with dense ribs and umbilical and ventrolateral tubercles; ribs and tubercles disappearing at varying diameters. Suture very variable in detail and in number and position of elements in external suture line; first lateral saddle deeply indented, others feebly. Presumably derived from *Pseudotissotia* by raising of siphonal line. *Upper Cretaceous (Lower Turonian):* Spain, France, northern and western Africa, Syria, Israel, Jordan, Madagascar, Colorado.

C. (Choffaticeras). Distinct ventrolateral keels or rows of tubercles on early whorls. Occurrence and distribution as for genus.——Fig. 139,*1a–c. *C. (C.) meslei* (Peron), Algeria; *a,* ×0.5; *b,* ×0.25; *c,* ×0.5 (Peron, 1896–1897).

C. (Leoniceras) H. Douvillé, 1911, p. 86 [**Pseudotissotia (Choffaticeras) luciae* Pervinquière, 1907, p. 354; OD]. Whorl section more or less lanceolate; without perceptible tubercles or ventrolateral keels even on inner whorls. Occurrence and distribution probably as for genus.——Fig. 139,*2a–c. *C. (L.) luciae* (Pervinquière), Tunisia; ×0.5 (Pervinquière, 1907).

Hemitissotia Peron, 1897, p. 73 [**H. cazini;* OD] [=*Heterammonites* Coquand, 1880, p. 39, *nom. dub.; Plesiotissotia* Peron, 1897, p. 79 (type, *P. michaleti;* OD); *Allotissotia* Parnes, 1964, p. 14 (type, *Hemitissotia galeppei* Pervinquière, 1907, p. 359; OD)]. More or less compressed and lanceolate, with sharp venter; sparse, rounded, branching ribs may be present on early whorls or throughout (*Plesiotissotia*). Suture simplifying, generally irregular, with 1 or more inner saddles entire. Little if any significant difference from *Choffaticeras (Leoniceras). Upper Cretaceous (Coniacian):* Austria, southern Europe, northern Africa, Israel.——Fig. 138,*1a. *H. cazini,* Algeria; slightly enlarged (adapted from Peron, 1896–1897).——Fig. 138,*1b,c. H. michaleti* (Peron), Algeria; ×1 (Peron, 1896–1897).——Fig. 138,*1d–f. H. galeppei* Pervinquière, Tunisia; *d,e,* ×0.5; *f,* ×1 (Pervinquière, 1907).

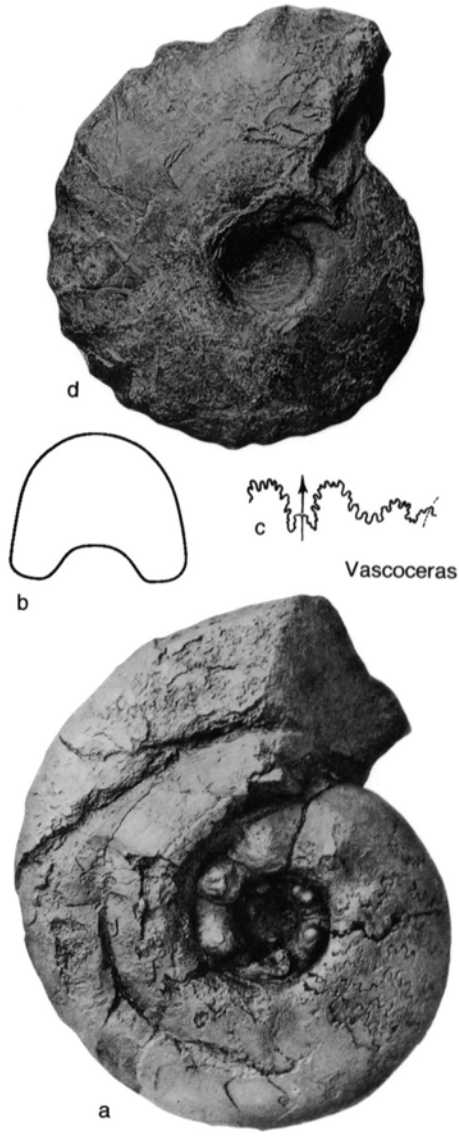

Fig. 135. Vascoceratidae (p. 175–176)

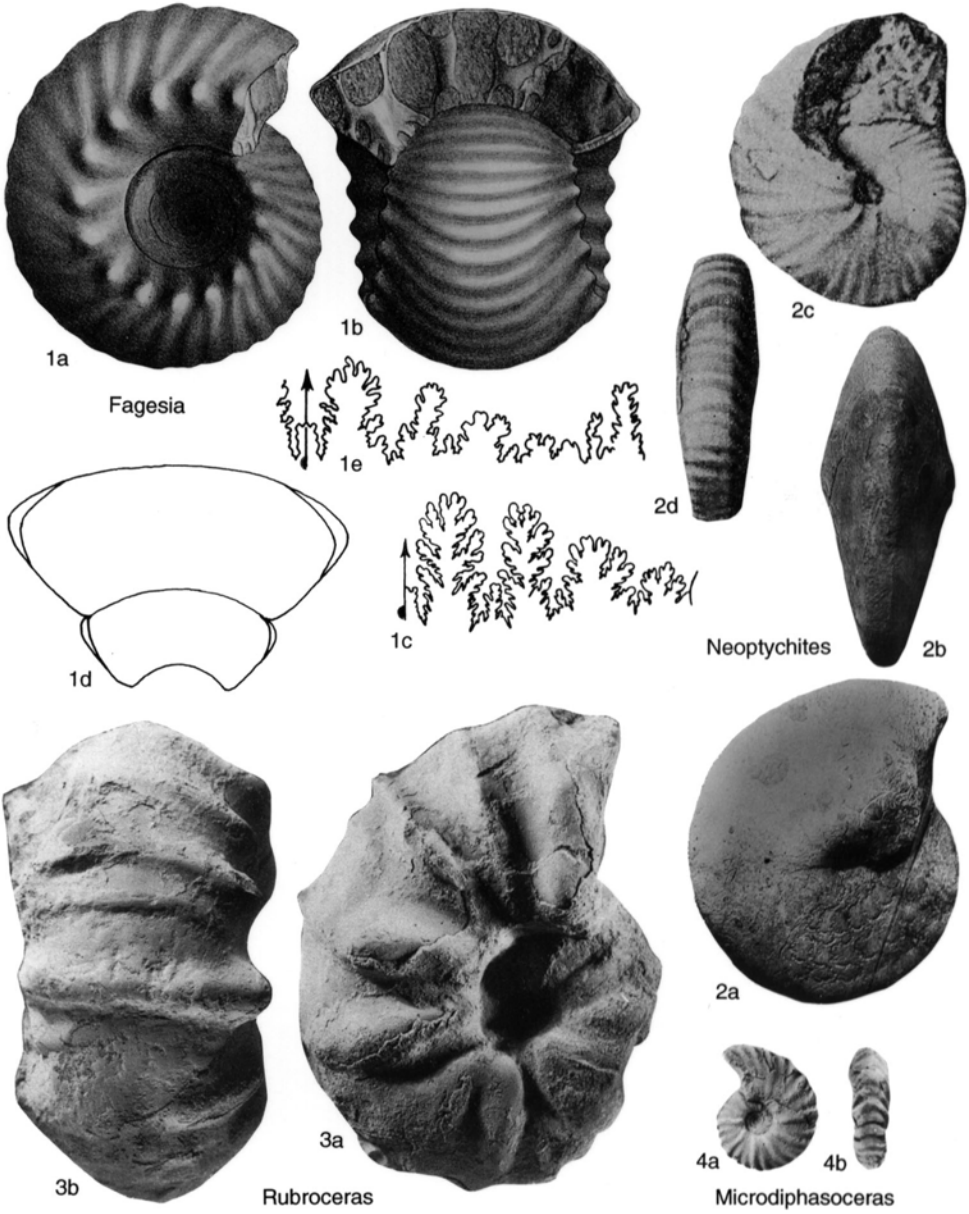

FIG. 136. Vascoceratidae (p. 176–177)

Subfamily HOURCQIINAE Renz, 1982

[*nom. transl.* MATSUMOTO & TOSHIMITSU, 1984, p. 243, *ex* Hourcqiidae RENZ, 1982, p. 103]

Strongly ornamented, with coarse ribs, umbilical and ventrolateral tubercles, and blunt keel. Suture with long, well-indented elements. *Upper Cretaceous (Upper Turonian, ?Coniacian).*

Masiaposites COLLIGNON, 1965a, p. 69 [**M. carinatus;* OD]. Rather involute, high-whorled, with distinct ventrolateral shoulders and blunt keel; inner part of side more or less strongly inflated and separated by spiral depression from outer part; umbilical

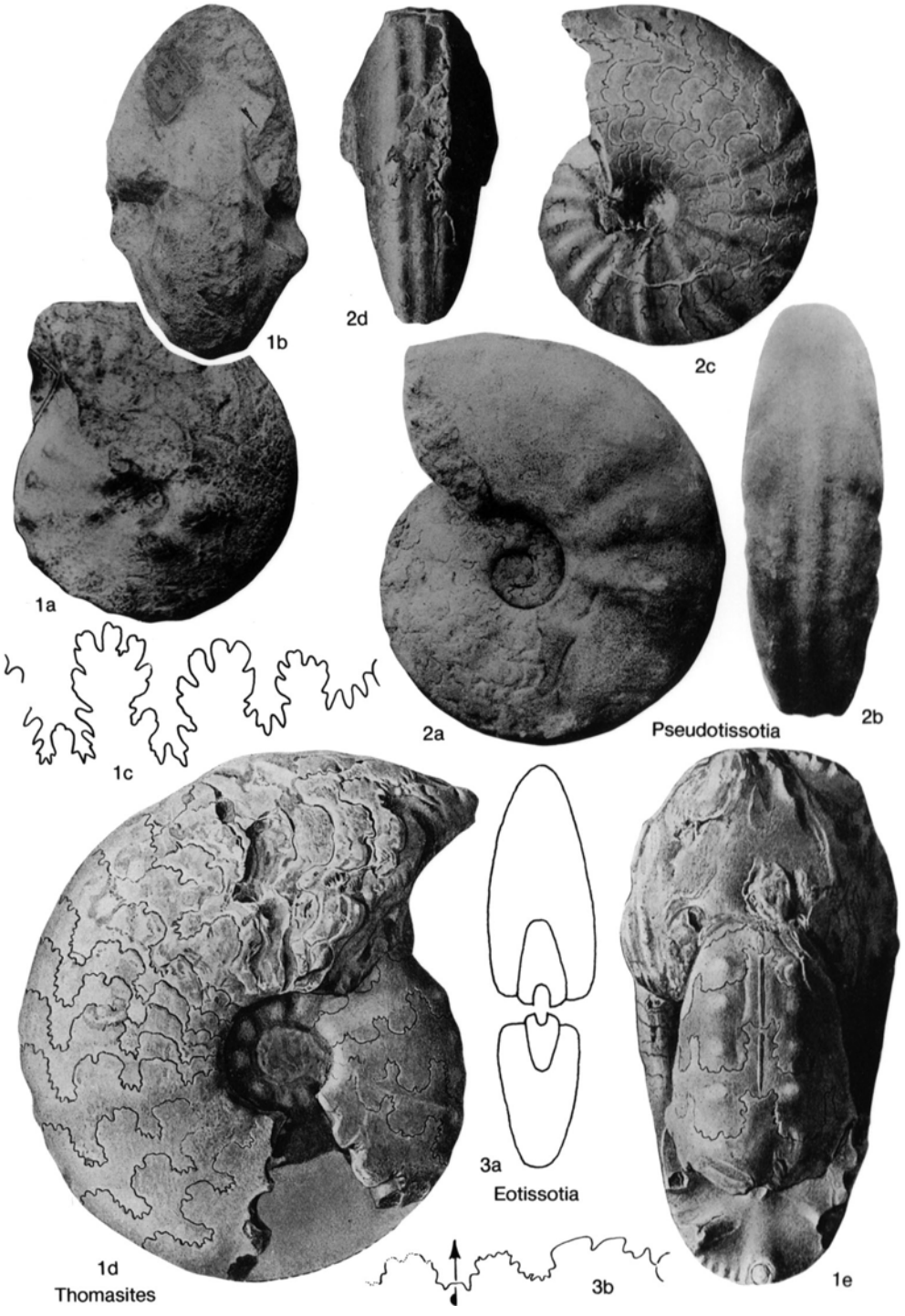

FIG. 137. Pseudotissotiidae (p. 178–179)

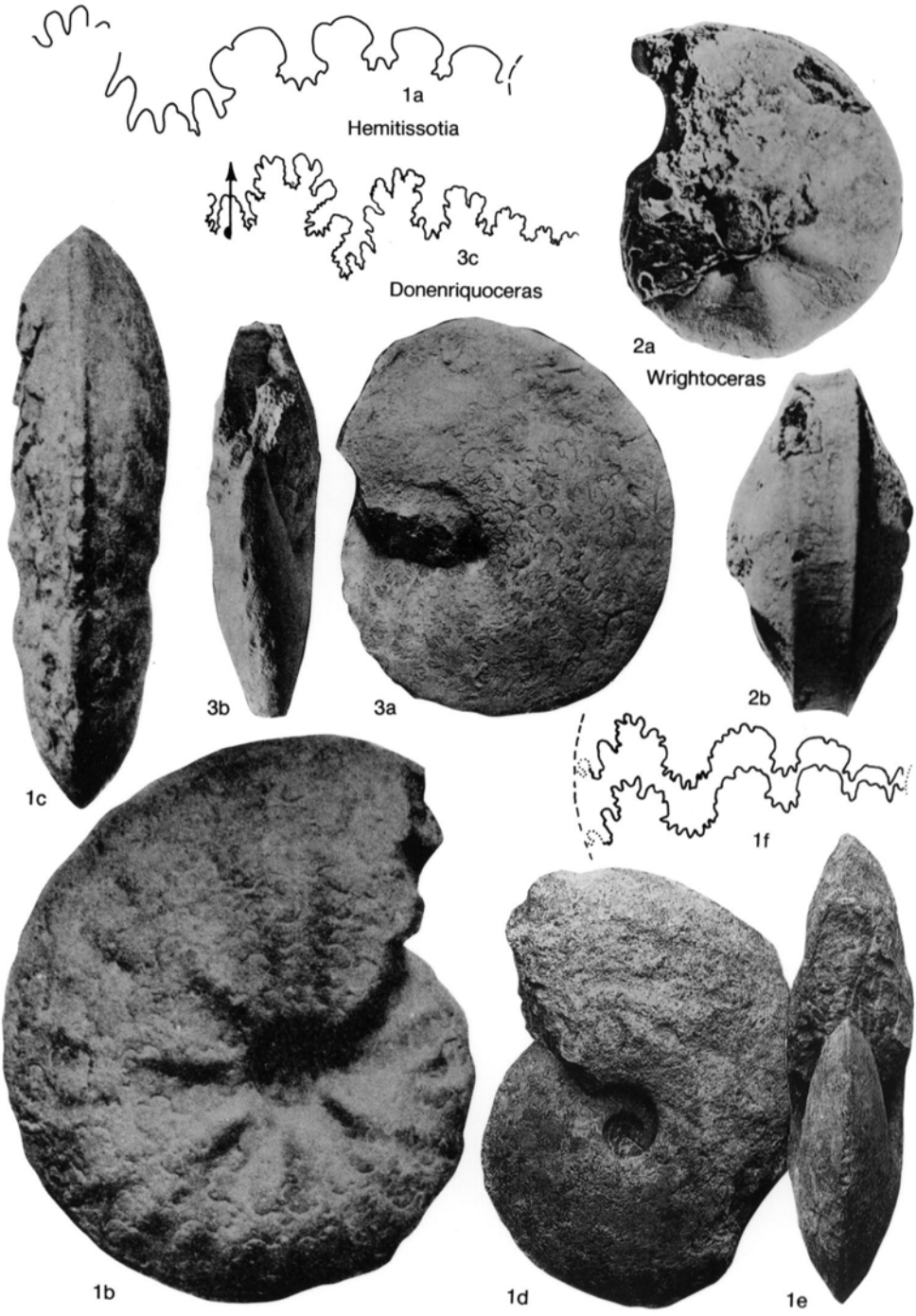

FIG. 138. Pseudotissotiidae (p. 178–179)

tubercles weak to strongly rounded; strong ventrolateral tubercles sometimes present. Suture with narrow, elongate elements, the lobes asymmetric.

Upper Cretaceous (Upper Turonian): Madagascar. ——FIG. 140,*2a,b.* **M. carinatus;* ×0.75 (Collignon, 1965a).

Hourcqia COLLIGNON, 1965a, p. 77 [**H. mirabilis;* OD]. Moderately involute, with strong, coarse ribs, rounded siphonal keel, and rounded to bullate umbilical and slightly clavate ventrolateral tubercles; in adults a marked depression at midflank may interrupt ribs. Suture with more massive lobes than in *Masiaposites. Upper Cretaceous (Upper Turonian, ?Coniacian):* ?France, Madagascar, Sakhalin, New Mexico, Venezuela.——FIG. 140,*1a,b. H. ingens* COLLIGNON, Upper Turonian, Madagascar; ×0.75 (Collignon, 1965a).——FIG. 140,*1c–e. H. pacifica* MATSUMOTO, ?Coniacian, Sakhalin; *c,d,* ×0.85; *e,* ×2 (Matsumoto, 1970b).

Family COLLIGNONICERATIDAE Wright & Wright, 1951

[Collignoniceratidae WRIGHT & WRIGHT, 1951, p. 30, *nom. nov. pro* Prionotropidae ZITTEL, 1895, p. 430 (*ex Prionotropis* MEEK, 1876, p. 453, *non* FIEBER, 1853, p. 127; =*Collignoniceras* BREISTROFFER, 1947a, unpaged)] [=Prionocyclidae BREISTROFFER, 1947a, unpaged (*ex Prionocyclus* MEEK, 1871b, p. 298, ineligible as family type)]

Typically rather involute to evolute; compressed; oval or square-whorled, with serrate or entire keel and ribs bearing 1 to 5 tubercles. *Upper Cretaceous (Upper Cenomanian–Middle Campanian).*

The nominate subfamily was probably derived from *Thomelites* and late in the Turonian gave rise in a short time to 3 other subfamilies, 2 of which persisted to the Campanian. These subfamilies might be treated as families but are closely related.

Subfamily COLLIGNONICERATINAE Wright & Wright, 1951

[*nom. transl.* WRIGHT, 1957b, p. 426, *ex* Collignoniceratidae WRIGHT & WRIGHT, 1951, p. 30]

Compressed; rectangular to square-whorled, with coarsely to finely serrate keel and more or less prominent umbilical and inner and outer ventrolateral tubercles; ventrolateral tubercles may fuse in adult into large horns; in some forms all ornament weakening with age. *Upper Cretaceous (Upper Cenomanian–Upper Coniacian).*

Cibolaites COBBAN & HOOK, 1983, p. 16 [**C. molenaari;* OD]. Moderately compressed to slightly inflated; venter flat or fastigiate; primary ribs bearing strong, rounded or bullate umbilical tubercles; secondaries branching or intercalated; all ribs bearing single ventrolateral and siphonal clavi. Suture rather irregular, with simplified outline. Transitional from *Thomelites* to *Collignoniceras. Upper Cretaceous (Upper Cenomanian–Lower Turonian):* England, France, western Germany, New Mexico.——FIG.

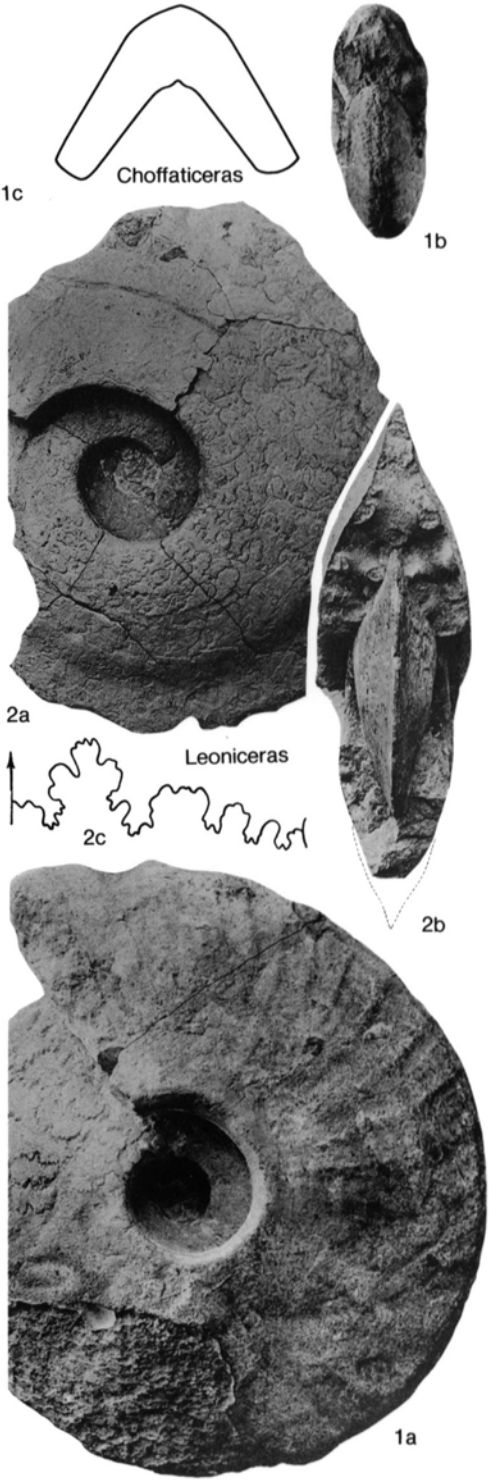

FIG. 139. Pseudotissotiidae (p. 179)

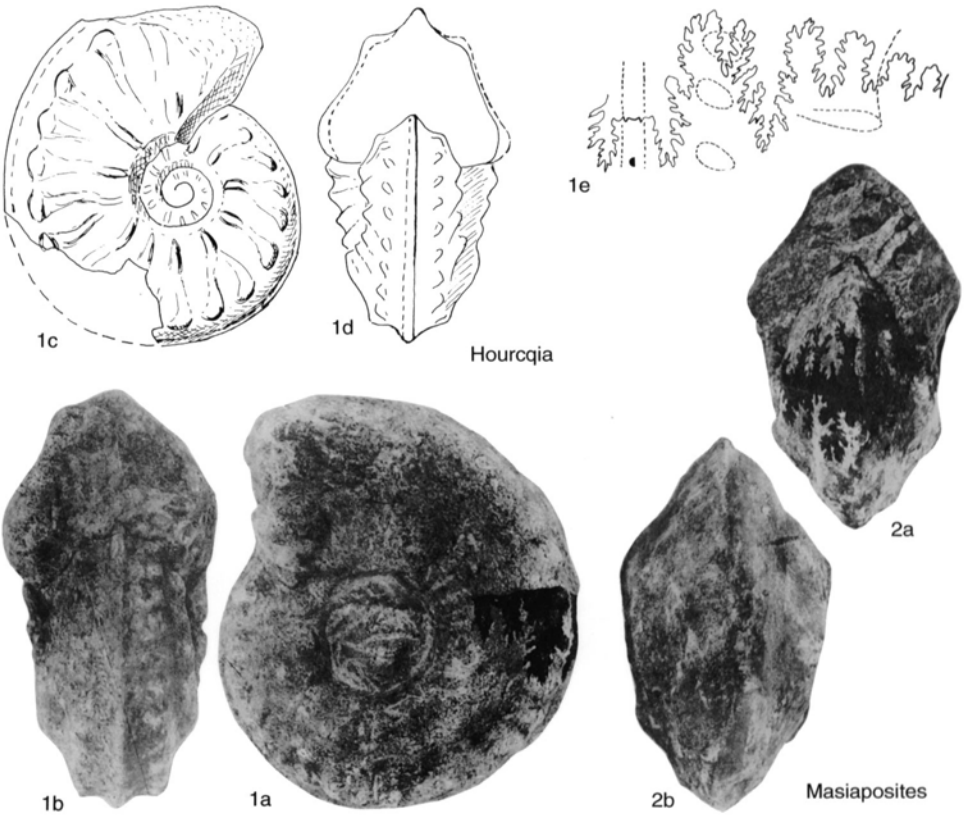

FIG. 140. Pseudotissotiidae (p. 180–183)

141,*5a,b.* **C. molenaari*, Lower Turonian, New Mexico; ×1 (Cobban & Hook, 1983).

Collignoniceras BREISTROFFER, 1947a, unpaged, ICZN Opinion 861, 1968, Generic Name No. 1798 (*non* HOEPEN, 1955b, p. 361), *nom. nov. pro Prionotropis* MEEK, 1876, p. 453, *non* FIEBER, 1853, p. 127 [**Ammonites woollgari* MANTELL, 1822, p. 197; OD; ICZN Specific Name No. 2251] [=*Selwynoceras* WARREN & STELCK, 1940, p. 151, ICZN Generic Name No. 1799 (type, *Prionotropis borealis* WARREN, 1930a, p. 25; OD)]. Compressed in early stages; siphonal tubercles rounded or high and clavate, forming a serrate keel, the serrations corresponding in number with the ribs; ribs straight or slightly sinuous, with weak umbilical and strong inner and outer ventrolateral tubercles; later whorls may be squarer in section, with an exaggerated ventrolateral horn that may absorb even the umbilical tubercle. [*Prionotropis borealis* WARREN, the type species of *Selwynoceras,* is a typical, though small, species of *Collignoniceras.*] KENNEDY, WRIGHT, & HANCOCK, 1980b. *Upper Cretaceous (Turonian):* Europe, Turkestan, Japan, Bathurst Island, Canada, USA, Mexico, Colombia.——FIG. 141,*3a,b.* **C. woollgari* (MANTELL), England; ×0.5 (Sharpe, 1853–1857).

Lecointriceras KENNEDY, WRIGHT, & HANCOCK, 1980b, p. 588 [**Ammonites fleuriausianus* ORBIGNY, 1841, p. 350; OD]. Whorl section trapezoidal at first, then square; sparse, conical umbilical tubercles giving rise to pairs of low, broad ribs, each with rounded inner and clavate outer ventrolateral tubercles; venter at first fastigiate with siphonal clavi, but later broadening and flattening and ventrolateral tubercles fusing into a single tubercle; end of body chamber tubular and smooth. *Upper Cretaceous (Lower Turonian):* western and central Europe.——FIG. 141,*4a–d.* **L. fleuriausianum* (ORBIGNY), France; *a,b,* ×1; *c,d,* ×0.4 (Kennedy, Wright, & Hancock, 1980b).

Subprionocyclus SHIMIZU, 1932, p. 2 [**Prionocyclus hitchinensis* BILLINGHURST, 1927, p. 516; OD] [=*Oregoniceras* ANDERSON, 1958, p. 263 (1943, p. 185, *nom. nud.*) (type, *Schloenbachia oregonensis* ANDERSON, 1902, p. 122; OD); *Ledoceras* BASSE DE MÉNORVAL, 1963, p. 871 (type, *L. massoni;* OD)]. Small; compressed to square-whorled; involute to rather evolute; prominent keel finely or coarsely serrate according to the ribbing; ribs sharp at first but may be flat on outer whorls, springing in pairs from weak umbilical tubercles or intercalated; outer ventrolateral clavi on all ribs and inner at least at

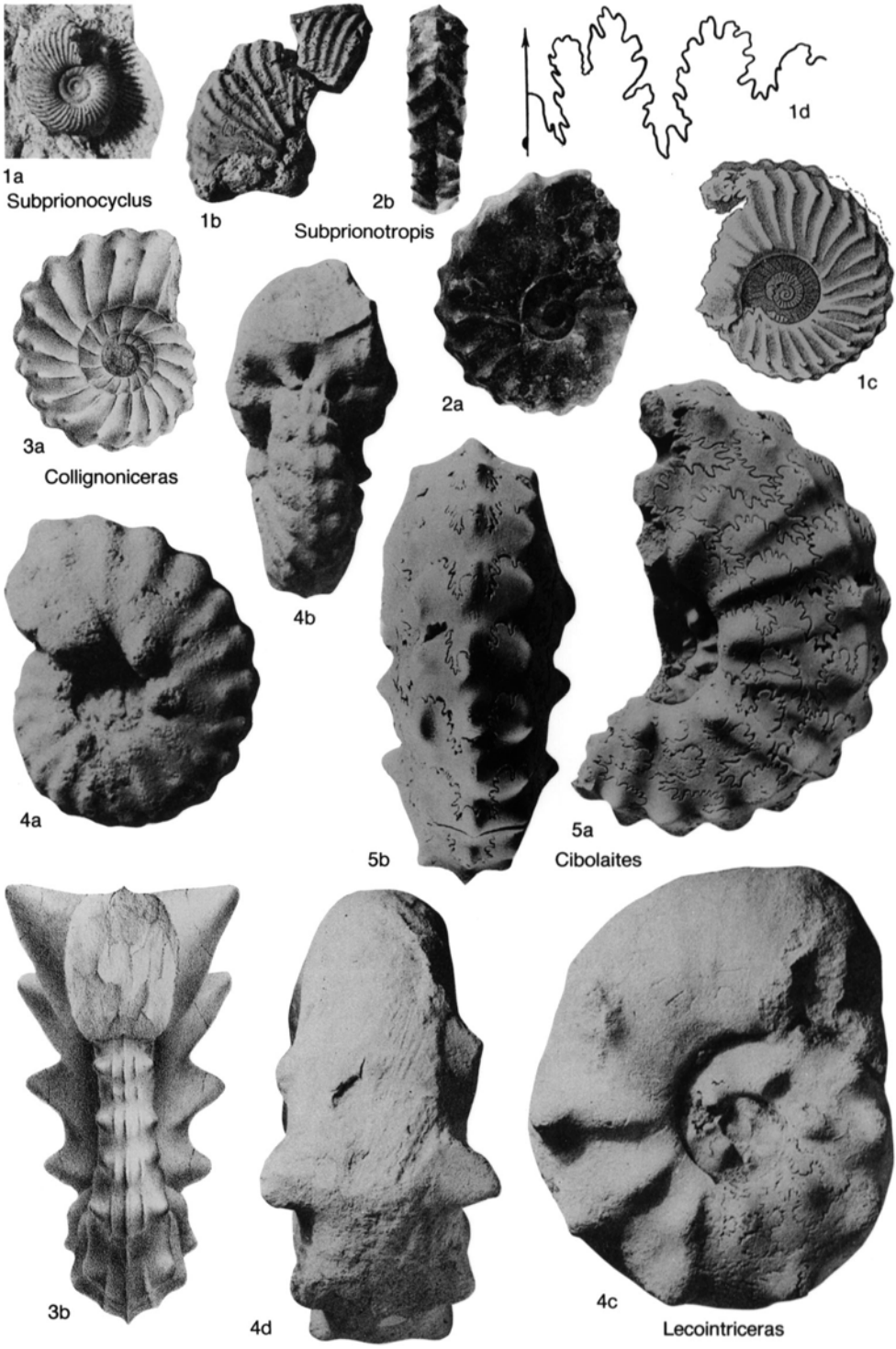

FIG. 141. Collignoniceratidae (p. 183–186)

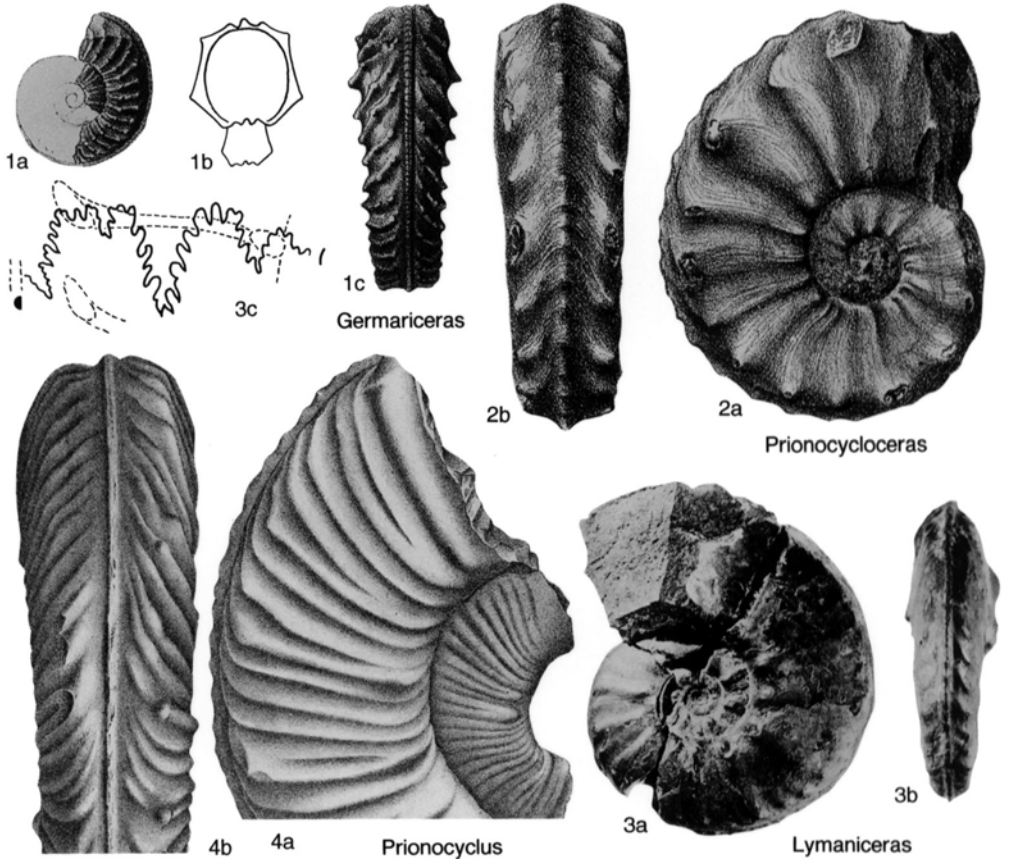

FIG. 142. Collignoniceratidae (p. 186–187)

some growth stage. Outer side of saddle E/L may be obliquely trifid. *Upper Cretaceous (Upper Turonian):* western Europe, Angola, Japan, California, Oregon, Brazil.——FIG. 141,*1a,b.* **S. hitchinensis* (BILLINGHURST), England; ×1 (Wright, 1979).——FIG. 141,*1c,d. S. neptuni* (GEINITZ), England; *c,* ×1; *d,* enlarged (Woods, 1896).

Lymaniceras MATSUMOTO, 1965a, p. 29 [**L. planulatum;* OD]. Small; involute; high-whorled and compressed; with nearly parallel sides, fastigiate venter, and finely crenate, narrow keel; ribs alternately long and short, the long ones rising from umbilical bullae; each rib having a small ventrolateral tubercle homologous with inner ventrolateral in *Prionocyclus,* of which *Lymaniceras* appears to be a local offshoot. Suture with shallow, simple minor elements. *Upper Cretaceous (Upper Turonian):* Japan.——FIG. 142,*3a–c.* **L. planulatum; a,b,* ×1; *c,* ×3 (Matsumoto, 1965a).

Subprionotropis BASSE, 1950, p. 250 [**S. colombianus;* OD]. Small; moderately involute; sides flat and parallel or widest at shoulders; ribs rather strong, distant, branching in pairs from sharp umbilical tubercles and joining sharp ventrolateral tubercles to distant siphonal clavi in chevrons across fastigiate venter; feeble tubercles may appear between ventrolateral and siphonal tubercles. *Upper Cretaceous (Upper Turonian–Lower Coniacian):* South Africa (Pondoland), Japan, Colombia, Venezuela.——FIG. 141,*2a,b.* **S. colombianus,* Lower Coniacian, Colombia; ×1 (Basse, 1950).

Prionocyclus MEEK, 1871b, p. 298 [**Ammonites serratocarinatus* MEEK, 1871a, p. 429, *non* STOLICZKA, 1864, p. 57; =*Prionocyclus wyomingensis* MEEK, 1876, p. 452; SD]. Differs from *Collignoniceras* in its generally denser and finer ribs, which are irregular in strength and length on outer whorl and dominant over tubercles at least at some stage; venter rather broad, with ribs joining keel, which has more serrations than there are ribs. *Upper Cretaceous (Turonian):* Germany, Croatia, Tunisia, Angola, Japan, USA, Mexico.——FIG. 142,*4a,b.* **P. wyomingensis*, Wyoming; ×0.75 (White, 1880).

Germariceras BREISTROFFER, 1947a, unpaged [**Ammonites germari* REUSS, 1845, p. 22; OD]. Differs from square-whorled species of *Subprionocyclus* in its fine ribs with sharp tubercles and its keel with more serrations than there are ribs. Perhaps a synonym of

Prionocyclus, from which it differs only in thinness of the ribs. *Upper Cretaceous (Upper Turonian, ?Lower Coniacian):* central Europe.——Fig. 142,*1a–c. *G. germari* (Reuss), Upper Turonian, Czech Republic; *a,* ×1; *b,c,* ×2 (Fritsch, 1872).

Prionocycloceras Spath, 1926a, p. 80 [**Prionocyclus guayabanus* Gerhardt, 1897b, p. 197; OD] [=*Donjuaniceras* Basse, 1950, p. 245 (type, *D. longispinata;* OD)]. Evolute; whorl section more or less rectangular, with angular to sharply rounded shoulders; keel mainly distinct with grooves on either side but may weaken on outer whorls; keel with crenulations more numerous than ribs; ribs generally simple but may be intercalated, typically distant, rursiradiate at shoulder, strongly projected on venter, crossing keel as riblets; ventrolateral tubercles may be double, but inner ones dominant and enlarging into a septate horn. *Upper Cretaceous (Coniacian):* Spain, Armenia, northern Africa, Madagascar, Texas, Venezuela, Colombia, Brazil.——Fig. 142,*2a,b. *P. guayabanum* (Gerhardt), Colombia; ×1 (Gerhardt, 1897b).

[**Spathinella** Shimizu, 1935a, p. 197 (*nom. nud.*)].

Subfamily BARROISICERATINAE Basse, 1947

[Barroisiceratinae Basse, 1947b, p. 159(63)] [=Diaziceratinae Basse, 1947b, p. 159(63)]

Very evolute to very involute; compressed to inflated; with crenulate, rarely entire, keel weakening and disappearing on outer whorls in some; fine to strong ribs rising from umbilical tubercles, forming ventrolateral clavi and bending forward to keel; one stock with and the other without midlateral tubercles; some forms may be smooth after early whorls. Suture with variable number of short and moderately incised saddles; external saddle commonly with oblique outer slope and in some obliquely trifid. Derived from later Collignoniceratinae, the Barroisiceratinae may be distinguished by the absence at any stage of an inner ventrolateral tubercle and, generally, by the sparseness of the ribs. Kennedy, Wright, & Klinger, 1983. *Upper Cretaceous (Upper Turonian–Upper Santonian).*

Niceforoceras Basse, 1948, p. 694 [**N. columbianum;* OD]. Involute; compressed, with flat or slightly convex sides; venter rounded with weak crenulations corresponding in number to ribs or fastigiate with stronger crenulations; umbilical wall vertical; more or less distinct umbilical tubercles giving rise to fine, sinuous ribs or striae ending in single ventrolateral clavi. Close to *Barroisiceras* and probably synonymous. *Upper Cretaceous (Coniacian):* Venezuela, Colombia.——Fig. 143,*3a,b. N. umbulaziforme* Basse, Colombia; ×1 (Basse, 1948).

Barroisiceras Grossouvre, 1894, p. 50, *nom. nov. pro Barroisia* Grossouvre, 1894, p. 50, *non* Munier-Chalmas, 1882, p. 425 [**Ammonites haberfellneri* Hauer, 1866, p. 301; SD Solger, 1904, p. 163] [=*Subbarroisiceras* Basse, 1947a, p. 71 (type, *S. mahafalense;* OD); *Reesidites* Wright & Matsumoto, 1954, p. 130 (Matsumoto, 1942b, p. 197, *nom. nud.*) (type, *Barroisiceras minimum* Hayasaka & Fukada, 1951, p. 325; OD); *Basseoceras* Collignon, 1965b, p. 73 (type, *B. colnacapi;* OD); *Itwebeoceras* Hoepen, 1968b, p. 184 (type, *I. lornae;* OD); *Buenoceras* Etayo Serna, 1979, p. 101 (type, *B. loboi;* OD)]. Rather involute to rather evolute; compressed to moderately inflated; high-whorled, with flat to slightly convex sides and fastigiate venter; dense to sparse, bullate to spinate umbilical tubercles giving rise to 2 or 3 straight to slightly sinuous, narrow to broad ribs; additional ribs may be intercalated; each rib bearing a distinct ventrolateral and siphonal clavus; ornament weakening on body chamber and may disappear except for fine striae and traces of siphonal tubercles. Primitive forms (e.g., *B. minimus*) differ from *Subprionocyclus* only in the absence of inner ventrolateral tubercles at any stage. Reyment, 1975. *Upper Cretaceous (Upper Turonian–Lower Coniacian):* England, Spain, Germany, Austria, northern and western Africa, South Africa (Zululand), Madagascar, Armenia, Japan, Texas, Venezuela, Colombia, Peru.——Fig. 144*a,b. *B. haberfellneri* (Hauer), ?Upper Turonian, Austria; ×1 (Redtenbacher, 1873).——Fig. 144*c–e. *B. minimum* Hayasaka & Fukada, Upper Turonian, Japan; *c,d,* ×0.5; *e,* ×2.5 (Matsumoto, 1965a).——Fig. 144*f,g. *B. mahafalense* (Basse), Lower Coniacian, Madagascar; ×0.4 (Basse, 1947a).——Fig. 144*h,i. *B. colnacapi* (Collignon), Lower Coniacian, Madagascar; ×0.75 (Collignon, 1965b).

?Kondiloceras Fucini, 1901, p. 14 [**K. manciatii;* OD]. Described as from Lower Jurassic, Sinemurian, but from a collection without stratigraphical information; the single specimen appears to be a poorly preserved *Barroisiceras* and name should be treated as a *nomen dubium.*

Forresteria Reeside, 1932, p. 14 [**Barroisiceras (Forresteria) forresteri* Reeside, 1932, p. 17; SD Wright, 1957b, p. 432; =*Acanthoceras (Prionotropis) alluaudi* Boule, Lemoine, & Thevenin, 1907, p. 12(32)]. Whorl section and ornament variable but readily distinguished from those of *Barroisiceras* by presence on inner whorls of at least mediolateral tubercle, which later may disappear or fuse with umbilical or ventrolateral tubercle. *Upper Cretaceous (Lower Coniacian):* France, Germany, Tunisia, western Africa, South Africa (Zululand), Madagascar, New Caledonia, Israel, Japan, Utah, Wyoming, Colombia, Peru, Venezuela, Brazil.

F. (Forresteria) [=*Solgerites* Reeside, 1932, p. 14 (type, *Barroisiceras brancoi* Solger, 1904, p. 174; OD); *Eboroceras* Basse, 1947a, p. 73 (type, *E. magnumbilicatum;* OD); ?*Zumpangoceras* Basse,

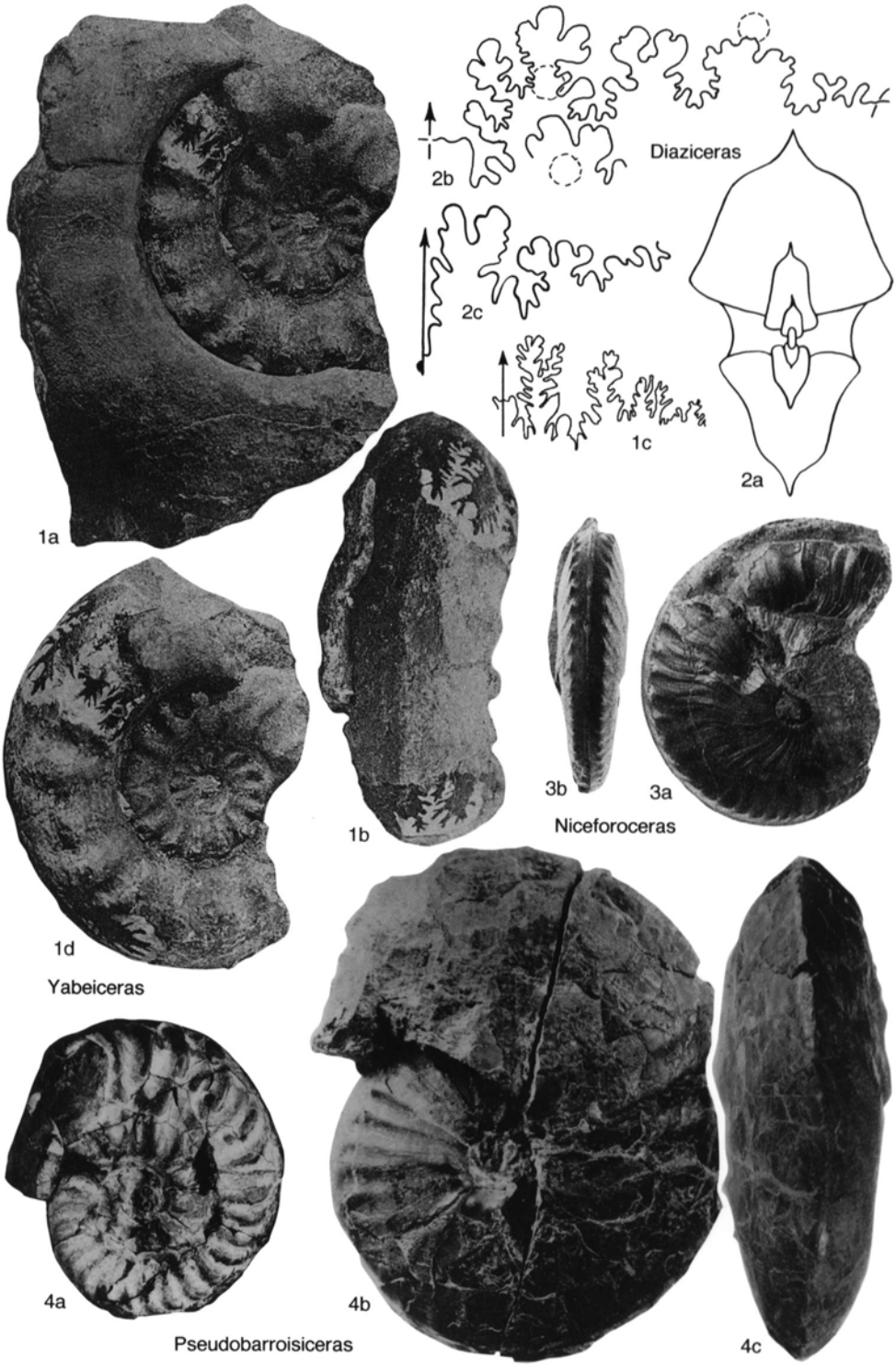

FIG. 143. Collignoniceratidae (p. 187–189)

1947b, p. 144(48) (type, *Z. burkhardti;* OD), on basis of lectotype of type species designated by Etayo Serna, 1979, p. 99; *Collignonella* Hoepen, 1957, p. 350, *nom. nov. pro Collignoniceras* Hoepen, 1955b, p. 361, *non* Breistroffer, 1947a, unpaged (type, *C. hammersleyi;* OD); *Neokanabiceras* Collignon, 1965b, p. 42 (type, *N. madagascariense;* OD; =?*Barroisiceras (F.) hobsoni* Reeside, 1932, p. 18); *Basseoceras* Hoepen, 1968a, p. 162, *non* Collignon, 1965b, p. 73 (type, *B. krameri;* M); *Eedenoceras* Hoepen, 1968a, p. 171 (type, *E. multicostatum;* OD); *Muramotoa* Matsumoto, 1969, p. 315 (type, *F. (M.) yezoensis* Matsumoto, 1969, p. 315; OD)]. Midlateral tubercle disappearing or fusing eventually with ventrolateral; whorl section moderately to very inflated. *Upper Cretaceous (Lower Coniacian):* South Africa (Zululand), Madagascar, Israel, Japan, Wyoming, Utah, Colombia, Peru, Brazil.——Fig. 145,*2a–c. *F. (F.) alluaudi* (Boule, Lemoine, & Thevenin), Madagascar; ×1 (Reeside, 1932).

F. (Harleites) Reeside, 1932, p. 14 [**Barroisia haberfellneri* var. *harlei* Grossouvre, 1894, p. 56; OD; =*Ammonites petrocoriensis* Coquand, 1859, p. 995] [=*Alstadenites* Reeside, 1932, p. 14 (type, *Ammonites alstadenensis* Schlüter, 1876, p. 151; SD Kennedy, Wright, & Klinger, 1983, p. 259); *Reesideoceras* Basse, 1947b, p. 132(36) (type, *R. gallicum;* OD)]. Less inflated than *F. (Forresteria);* ribbing very weak to strong; mediolateral tubercle fusing on later whorls with umbilical; keel disappearing on outer whorl leaving venter flat to concave, bordered by ventrolateral clavi. *F. (H.) harlei* is at the smooth end of a wide range of variation. [Species *F. (H.) alstadenensis* and *F. (H.) gallicum* are junior subjective synonyms of *F. (H.) petrocoriensis*.] *Upper Cretaceous (Lower Coniacian):* France, Spain, Germany, Tunisia, Israel, Cameroon, Madagascar, New Caledonia, ?Utah, Colombia, Peru, Venezuela.——Fig. 145,*1a–e. *F. (H.) petrocoriensis* (Coquand); *a,b,* syntype of *harlei* Grossouvre, France, ×1; *c,d,* syntype of *gallicum* Basse, ×1 (Grossouvre, 1894); *e,* lectotype of *alstadenensis* Schlüter, Germany, ×1 (Schlüter, 1871–1876).

Yabeiceras Tokunaga & Shimizu, 1926, p. 199 [**Y. orientale;* OD]. Very evolute. Inner whorls depressed and like *Forresteria,* but tubercles blunter; later whorls with ventrolateral tubercles disappearing and keel becoming smooth; finally all ornament disappearing on high body chamber. Matsumoto & others, 1964. *Upper Cretaceous (Coniacian):* ?Spain, South Africa, Madagascar, Japan.——Fig. 143,*1a–d. *Y. orientale,* Japan; ×1 (Tokunaga & Shimizu, 1926).

Pseudobarroisiceras Shimizu, 1932, p. 1 [**P. nagaoi;* OD]. Rather involute and compressed, with flat sides, fastigiate venter, and entire keel; ribs flexed on inner whorls but straighter on outer, arising in twos or threes from feeble umbilical tubercles, with some intercalated and bearing one, rounded ventrolateral tubercle or swelling; ribs disappearing near keel. *Upper Cretaceous (Coniacian):* ?France, Japan.——Fig. 143,*4a–c. *P. nagaoi,* Japan; *a,* ×1; *b,c,* ×0.75 (Matsumoto, 1970b).

Diaziceras Spath, 1921a, p. 217 [**D. tissotiaeforme;* OD]. Compressed to inflated, with fastigiate venter and entire, high, sharp keel; umbilical tubercles sparse and prominent, giving rise to pairs of weak ribs ending in weak to strong, pointed to clavate ventrolateral tubercles. Suture with shallow, plump, only slightly indented elements; first lateral saddle obliquely trifid. *Upper Cretaceous (Upper Santonian):* Austria, South Africa (Zululand), Madagascar.——Fig. 143,*2a–c. *D. tissotiaeforme,* Zululand; *a,* ×1; *b,c,* ×2 (Spath, 1921a).

Subfamily PERONICERATINAE Hyatt, 1900

[*nom. transl.* Wright, 1957b, p. 428, *ex* Peroniceratidae Hyatt, 1900, p. 589] [=Gauthiericeratidae Hoepen, 1955b, p. 367]

Evolute to involute, with oval, trapezoidal, or subquadrate whorl section; keel losing its close relationship with ribbing and either nodate or entire; lateral keels tending to develop, producing tricarinate venter; typically with umbilical and ventrolateral tubercles only, joined by ribs, but may have up to 4 tubercles on a rib. *Upper Cretaceous (Coniacian).*

Many genera have been established on slight differences, including that between the two types of suture characteristic of *Gauthiericeras* and *Peroniceras;* it is doubtful whether this is as important as is commonly held.

Peroniceras Grossouvre, 1894, p. 93 [**P. moureti;* OD; =*Ammonites tridorsatus* Schlüter, 1867, p. 26] [=*Gloriaceras* Etayo Serna, 1979, p. 96 (type, *G. correai;* OD)]. Very evolute to rather involute, with oval, trapezoidal, or square whorl section; venter having 3 entire keels, at least during middle growth, with siphonal one as high as or higher than the others; regular, rounded or conical umbilical tubercles joined to a slightly larger number of similar ventrolateral ones by short, straight or slightly curved, single or branching ribs. Suture varying from simple with short elements, as in Collignoniceratinae, to complex with long, deeply incised elements; L generally more or less bifid; U2 small and tucked under saddle L/U. *Upper Cretaceous (Coniacian):* Europe, southeastern Africa, Madagascar, southern India, Mexico, Colombia, Venezuela.

P. (Peroniceras) [=*Fraudatoroceras* Hoepen, 1965, p. 35 (type, *F. besairei;* OD); *Cobbanoceras* Matsumoto, 1965b, p. 219 (type, *C. tanakai;* OD)]. Very evolute; ornament persisting to end. Occurrence and distribution as for genus.——Fig. 146,*2a–c. *P. (P.) tridorsatus* (Schlüter), France;

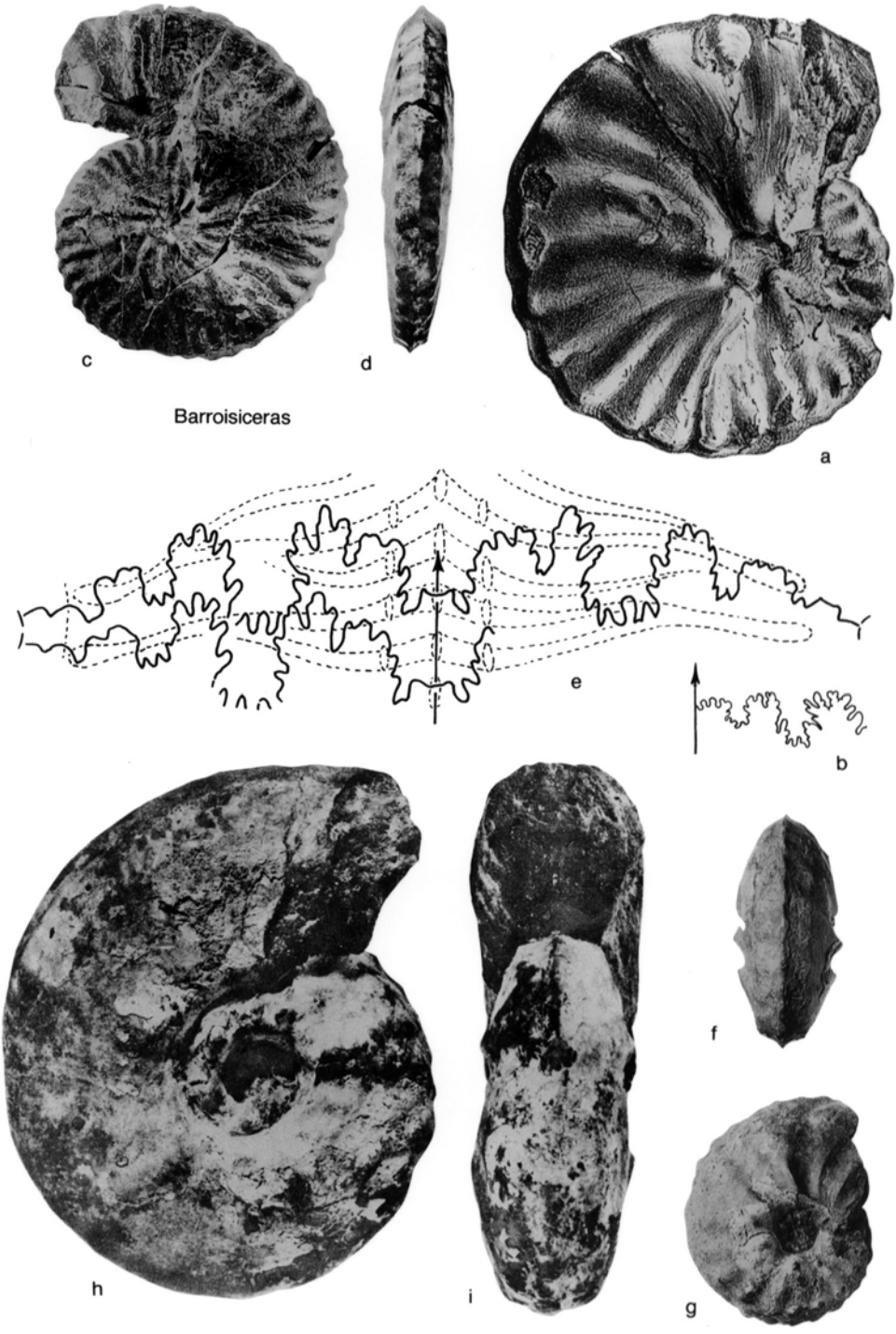

FIG. 144. Collignoniceratidae (p. 187)

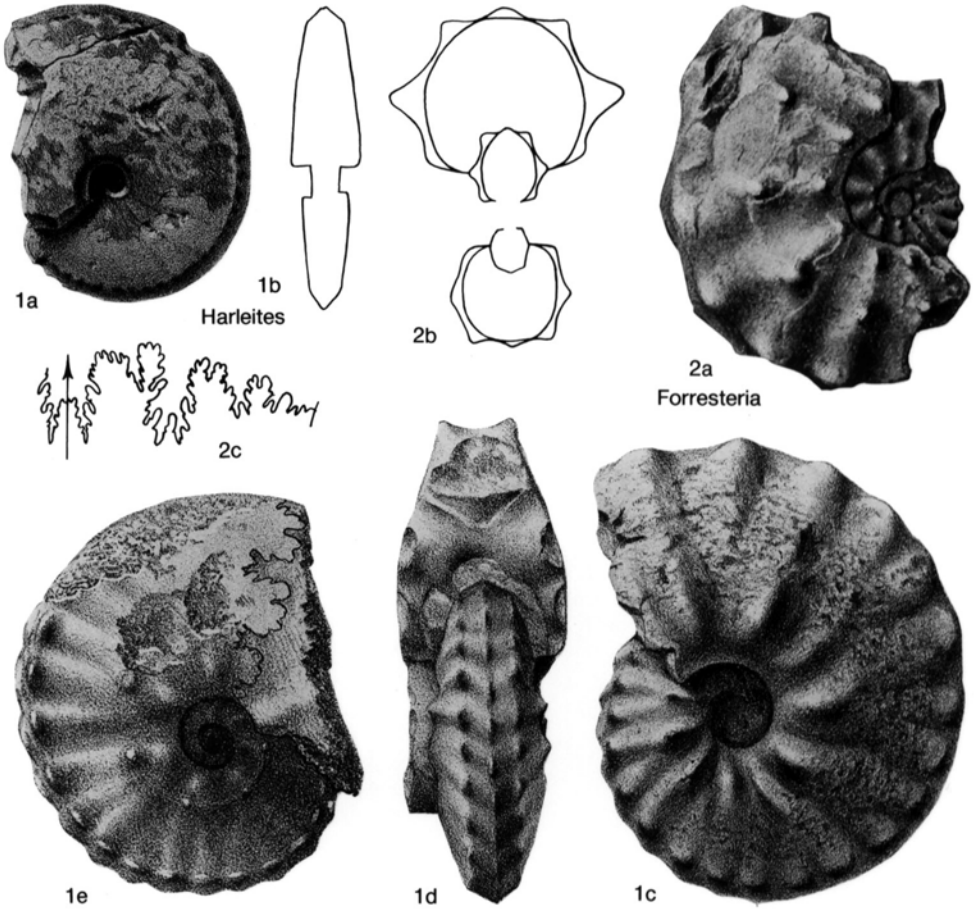

FIG. 145. Collignoniceratidae (p. 187–189)

×1 (Grossouvre, 1894).——FIG. 146,*2d,e. P. (P.) tanakai* (MATSUMOTO), Japan; ×1 (Matsumoto, 1965b).

P. (**Zuluiceras**) HOEPEN, 1965, p. 9 [**P. (Z.) zulu;* OD] [=*Zuluites* HOEPEN, 1965, p. 23 (type, *P. (Z.) modestum* HOEPEN, 1965, p. 23; OD); *Sornayceras* MATSUMOTO, 1965b, p. 226 (type, *S. proteus;* OD)]. Increasingly involute; side keels disappearing; siphonal keel may be serrate; ribs tending to be dominant over tubercles; last whorl in most species high, inflated, rounded, and smooth. Suture simple or complex. Occurrence as for genus: Romania, South Africa (Zululand), Japan.——FIG. 146,*1a. *P. (Z.) zulu,* Zululand; ×0.25 (Hoepen, 1965).——FIG. 146,*1b. P. (Z.) modestum,* Zululand; ×1 (Hoepen, 1965).——FIG. 146,*1c,d. P. (Z.) proteus* (MATSUMOTO), Japan; *c,* ×1; *d,* ×2 (Matsumoto, 1965b).

Ishikariceras MATSUMOTO, 1965b, p. 235 [**I. binodosum;* OD]. Very evolute; inner whorls subquadrate, with straight, mostly single ribs, umbilical and strong ventrolateral tubercles, and siphonal keel with shallow grooves on either side but no or very weak side keels; outer whorls oval in section, almost smooth, with shallow constrictions and weak keel. Suture rather simple. *Upper Cretaceous (Coniacian):* Madagascar, Japan.——FIG. 147,*1a,b. *I. binodosum; a,* ×1; *b,* ×2 (Matsumoto, 1965b).

Gauthiericeras GROSSOUVRE, 1894, p. 87 [**Ammonites margae* SCHLÜTER, 1867, p. 29; OD] [=*Ciryella* WIEDMANN, 1960, p. 763 (type, *Gauthiericeras (Ciryella) vascogoticum* WIEDMANN, 1960, p. 763; OD); *Andersonites* HOEPEN, 1965, p. 29 (type, *A. listeri;* OD); *Fluminites* HOEPEN, 1965, p. 31 (type, *F. albus;* OD); *Hluhluweoceras* HOEPEN, 1965, p. 33 (type, *H. fugitivum;* OD); *Falsebayites* HOEPEN, 1965, p. 34 (type, *F. peregrinus;* OD)]. Rather evolute; whorl section trapezoidal to subquadrate; keel feebly nodate or entire, with distinct groove on either side; strong ribs springing at first in pairs, later

normally singly, from single or double umbilical bullae and ending in strong ventrolateral clavi; midlateral tubercles may be present and, if so, ribs branch there. Suture with rather simple, shallowly incised elements; saddles more or less square; L not distinctly bifid. [*Ciryella,* for very evolute species with slight lateral keels, transitional to *Peroniceras,* seems unnecessary.] *Upper Cretaceous (Upper Coniacian):* France, Spain, central Europe, northern, eastern, and western Africa, Madagascar, New

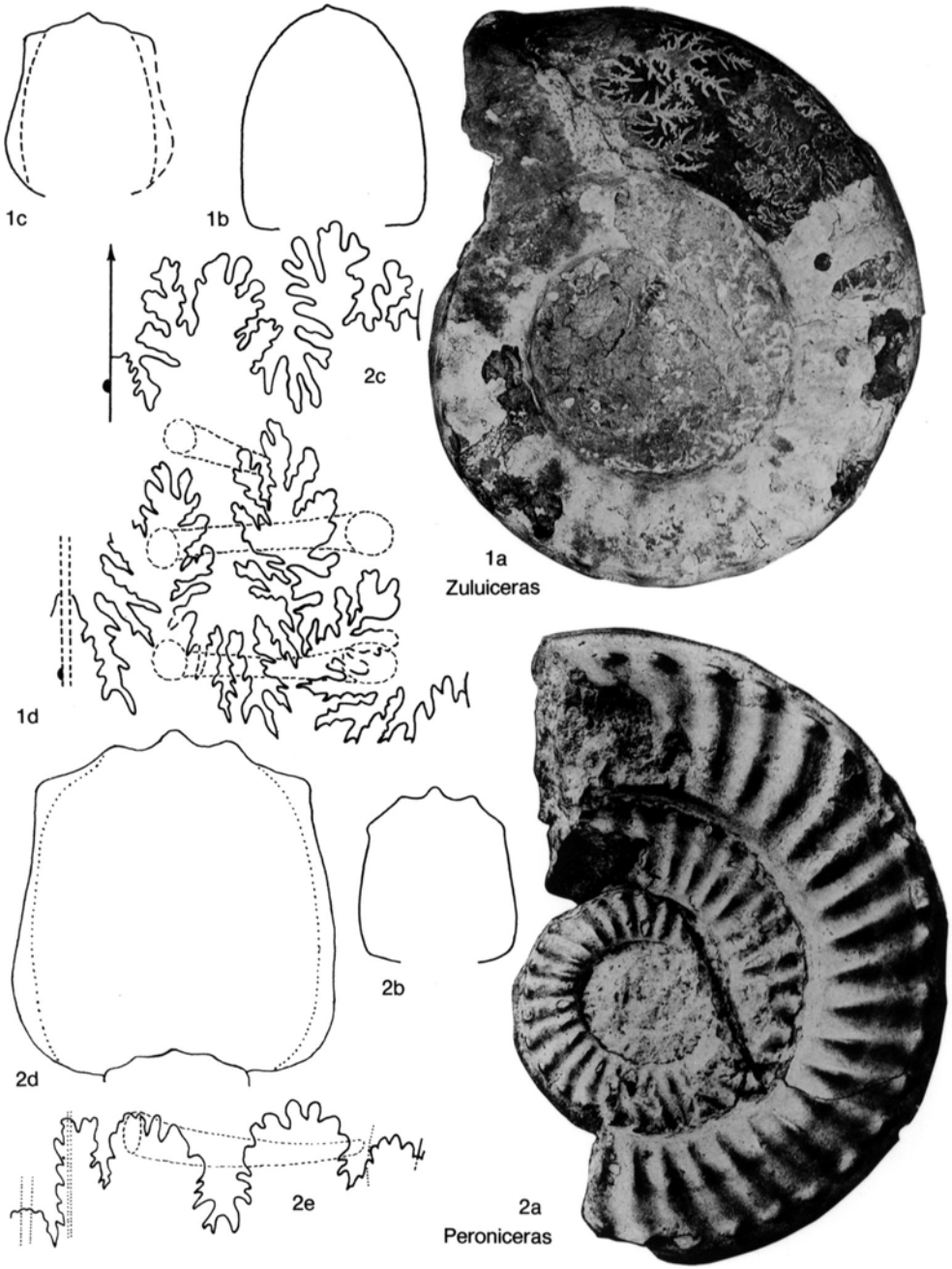

FIG. 146. Collignoniceratidae (p. 189–191)

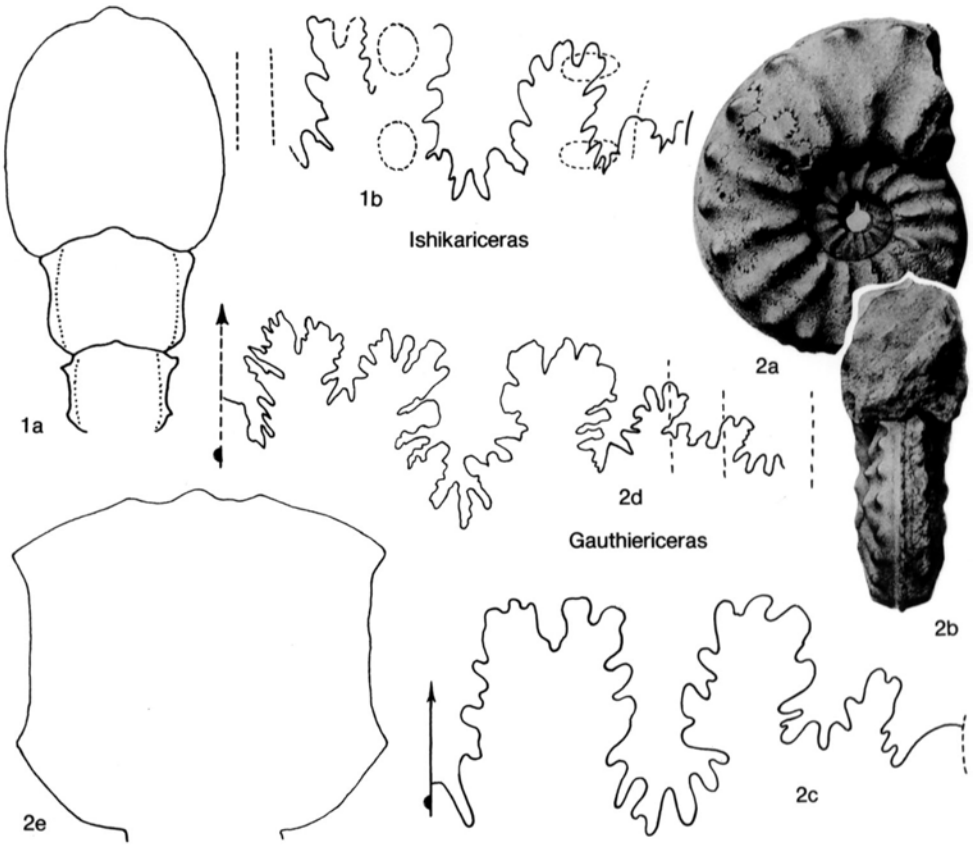

FIG. 147. Collignoniceratidae (p. 191–193)

Caledonia, Mexico, Colombia, Peru, Venezuela, Argentina.——FIG. 147,*2a–c.* **G. margae* (SCHLÜTER), Upper Coniacian, France; *a,b,* ×0.5; *c,* ×2 (Grossouvre, 1894).——FIG. 147,*2d,e. G. listeri* (HOEPEN), Upper Coniacian, South Africa (Zululand); *d,* ×1; *e,* ×0.75 (Hoepen, 1965).

Subfamily TEXANITINAE Collignon, 1948

[*nom. transl.* WRIGHT, 1957b, p. 429, *ex* Texanitidae COLLIGNON, 1948, p. 54(9)] [=Menabitinae COOPER, 1991, p. 9]

Evolute to moderately involute; whorl section compressed to inflated; typically with strong ribs bearing 3 to 6 prominent tubercles and with rather subdued, entire keel, but all ornament may weaken on outer whorls. Spinaptychi occur in *Texanites. Upper Cretaceous (Lower Coniacian–Middle Campanian).*

Confusion has arisen from homeomorphy with Albian Mortoniceratinae. Texanitinae was derived from *Subprionocyclus* by the transformation of the row of siphonal tubercles in the latter into a keel.

Protexanites MATSUMOTO, 1955a, p. 38 [**Mortoniceras bourgeoisi* GROSSOUVRE, 1894, p. 73 (*ex* ORBIGNY, 1850a, p. 212); OD]. Evolute to rather involute; whorl section more or less square; ribs simple, branched, or long and short, with umbilical, ventrolateral, and clavate ventral tubercles and rarely with midlateral tubercle on outer whorls; keel entire or weakly undulate. *Upper Cretaceous (Lower Coniacian–Middle Santonian):* France, Spain, Italy, Algeria, South Africa (Zululand), Tunisia, Nigeria, Madagascar, Israel, Japan, Sakhalin, western and southern USA, Peru, Venezuela.

P. (Protexanites). After early smooth stage, ribs trituberculate throughout. Weak undulations on keel of some species recall the serrated keel of *Subprionocyclus. Upper Cretaceous (Lower Coniacian–Lower Santonian):* western and central Europe, Algeria, South Africa (Zululand), Madagascar, Israel, Japan, Sakhalin, western and southern USA, Venezuela, Peru.——FIG.

148,*3a,b. *P. (P.) bourgeoisi* (GROSSOUVRE), Coniacian, France; ×1 (Grossouvre, 1894).

P. (Anatexanites) MATSUMOTO, 1970a, p. 239 [**Mortoniceras fukazawai* YABE & SHIMIZU, 1925, p. 130; OD]. Ribs on later whorls with fourth (lateral) tubercle. Probable macroconch of *P. (Protexanites). Upper Cretaceous (Santonian):* Tunisia, Nigeria, Japan.——FIG. 148,*2. P. (A.) orientalis* (YABE & SHIMIZU), Japan; ×1 (Yabe & Shimizu, 1925).

P. (Miotexanites) MATSUMOTO, 1970a, p. 245 [**P. (M.) minimus;* OD]. Small; ribs weak and ventrolateral tubercle absent until outer whorl. *Upper Cretaceous (Upper Coniacian–Lower Santonian):* Japan.——FIG. 148,*1a,b. *P. (M.) minimus;* ×1 (Matsumoto, 1970a).

Aneuretoceras KENNEDY & COBBAN, 1991, p. 52 [**A. variabile;* OD]. Progenetic dwarf derivative of *P. (Protexanites);* inner whorls smooth, with siphonal ridge; outer whorls with flexuous lirae or ribs forming blunt chevrons on venter. *Upper Cretaceous (Upper Coniacian):* Wyoming.

Haboroceras TOSHIMITSU, 1988, p. 150 [**H. haboroense;* OD]. Progenetic dwarf offshoot, probably of *Protexanites (Miotexanites).* Compressed, keeled, and almost smooth, with terminal constriction and simplified suture. *Upper Cretaceous (Upper Santonian–Lower Campanian):* Japan.——FIG. 149,*3a–c. *H. haboroense; a,b,* ×2; *c,* ×5 (Toshimitsu, 1988).

Pleurotexanites MATSUMOTO, 1970a, p. 232 [**Protexanites superbus* COLLIGNON, 1966, p. 64; OD]. Differs from *Protexanites* in having more ventral than ventrolateral tubercles, a siphonal row of tubercles instead of a keel, and attenuated tubercles and ribs on the last whorl. *Upper Cretaceous (Middle Santonian):* South Africa (Zululand), Madagascar.——FIG. 148,*4a,b. *P. superbus* (COLLIGNON); ×0.75 (Collignon, 1966).

Paratexanites COLLIGNON, 1948, p. 45(102) [**Mortoniceras zeilleri* GROSSOUVRE, 1894, p. 67; OD] [=*Parabevahites* COLLIGNON, 1948, p. 63(18) (type, *Ammonites serratomarginatus* REDTENBACHER, 1873, p. 110; OD)]. Whorl section subquadrate;

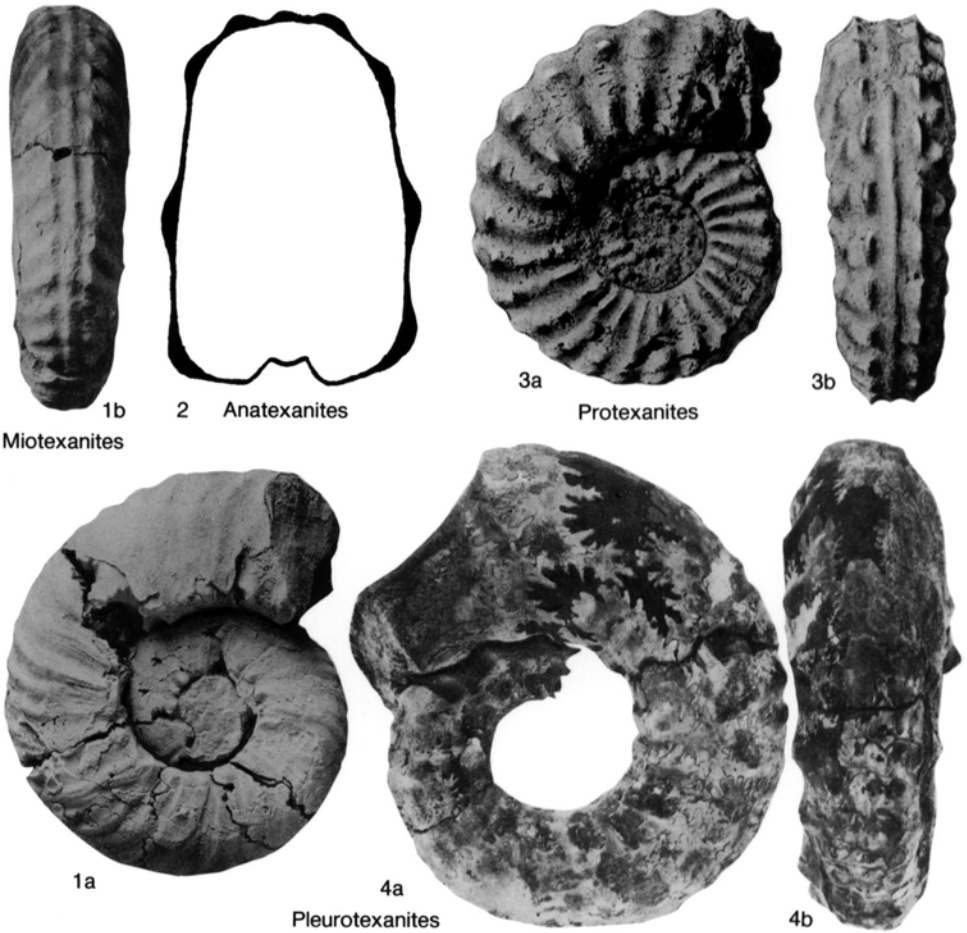

FIG. 148. Collignoniceratidae (p. 193–194)

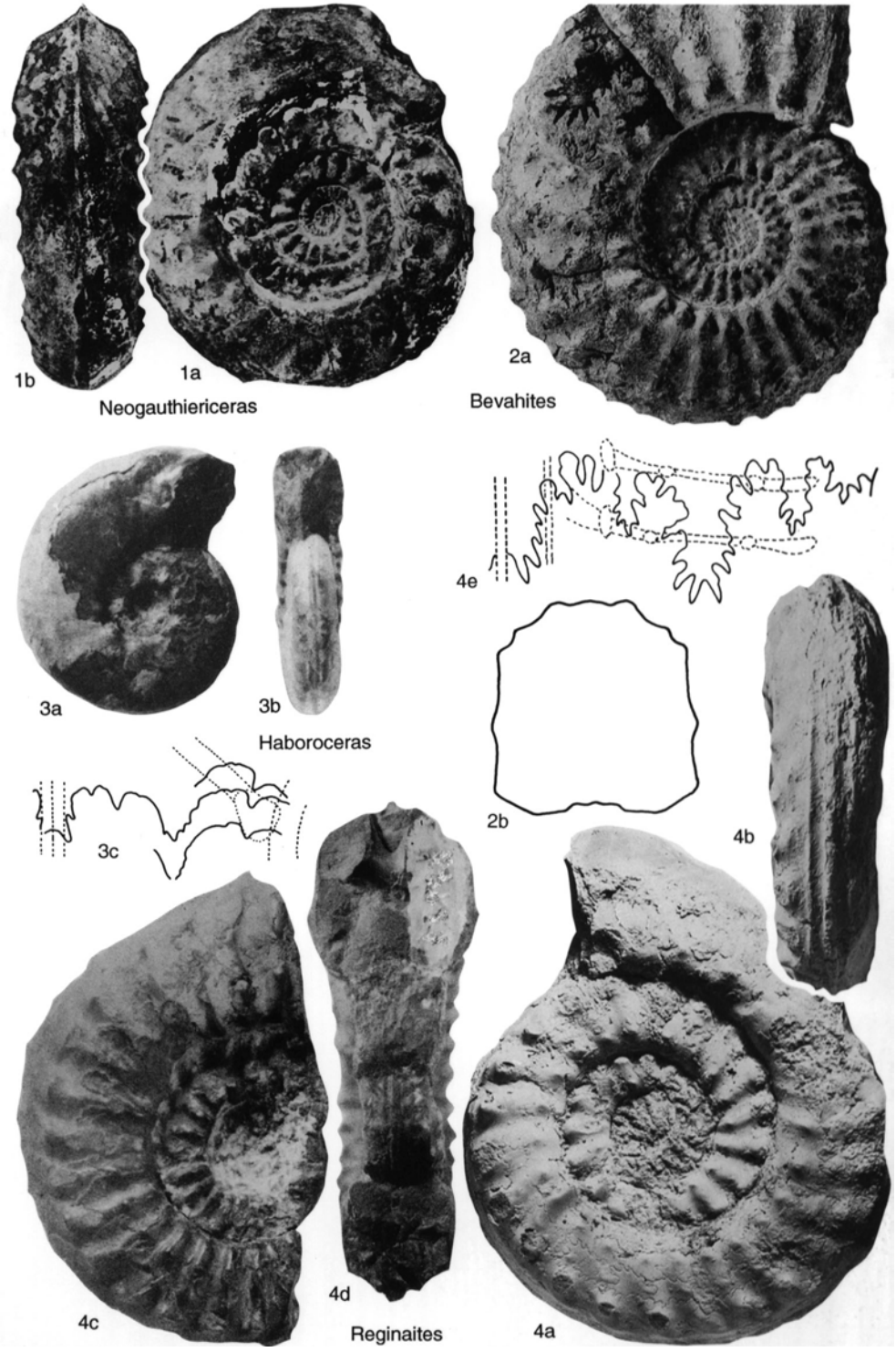

FIG. 149. Collignoniceratidae (p. 194–197)

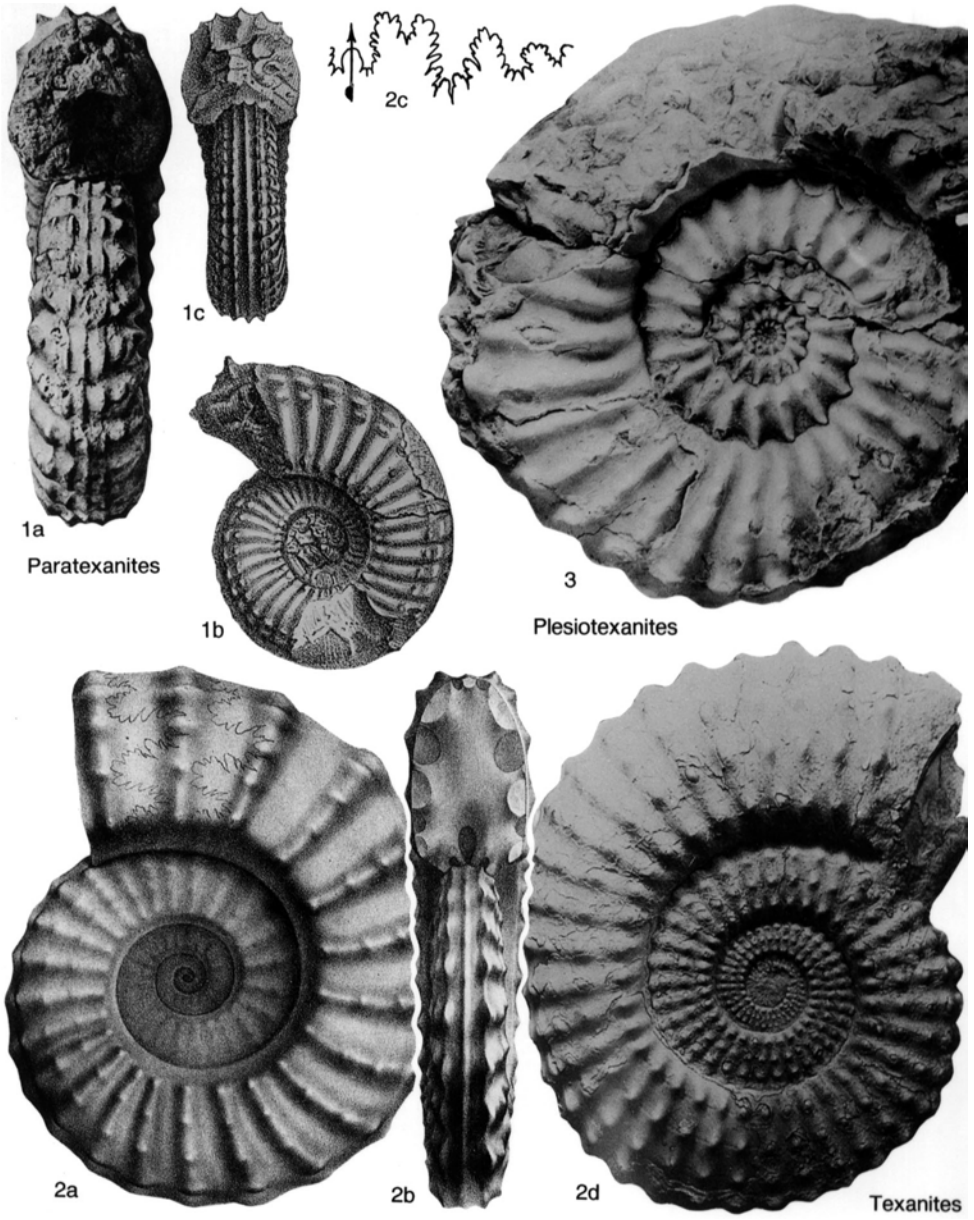

FIG. 150. Collignoniceratidae (p. 194–197)

with strong umbilical, inner and outer ventrolateral, and ventral tubercles; ribs simple, at least on outer whorls; keel entire or undulating. *Upper Cretaceous (Lower Coniacian–Middle Santonian):* France, Spain, Germany, Austria, Tunisia, South Africa (Zululand), Madagascar, Japan, Texas.——FIG. 150,*1a.* **P. zeilleri* (GROSSOUVRE), Coniacian, France; ×0.5 (Grossouvre, 1894).——FIG. 150,*1b,c. P. serratomarginatus* (REDTENBACHER), Coniacian, Austria; ×1 (Redtenbacher, 1873).

Texanites SPATH, 1932, p. 379 [**Ammonites texanus* F. A. ROEMER, 1852, p. 31; OD]. Generally large, compressed, and high-whorled, with sides flat on inner part, then converging to narrow venter with entire keel, but some species are subquadrate; ribs dense, strong, straight or slightly flexuous, first with 3 then with 5 or 6 tubercles, 2 lateral ones being added to those in *Protexanites;* intercalated ribs rare. Spinaptychi are associated with *Texanites.* KENNEDY & KLINGER, 1972. *Upper Cretaceous (Upper*

Coniacian–Lower Campanian): western and central Europe, Africa, Madagascar, Syria, southern India, southwestern Asia, Japan, USA, South America.

T. (Texanites) [=*Neoselwynoceras* COLLIGNON, 1966, p. 133 (type, *N. paradoxum;* OD, pathological)]. Five tubercles from an early stage, equally spaced. Occurrence and distribution as for genus.——FIG. 150,*2a–c.* **T. (T.) texanus* (ROEMER), Santonian, Texas; ×0.5 (Roemer, 1852).——FIG. 150,*2d. T. (T.) texanus ?hispanica* (COLLIGNON), Santonian or Campanian, South Africa (Pondoland); ×0.5 (Klinger & Kennedy, 1980a).

T. (Plesiotexanites) MATSUMOTO, 1970a, p. 267 [**Mortoniceras kawasakii* KAWADA, 1929, p. 4; OD]. Trituberculate stage persisting to variable extent; on the quinquetuberculate whorls, lateral tubercles subordinate to ribs and outer lateral and ventrolateral tubercles approximating. *Upper Cretaceous (Lower Santonian–Lower Campanian):* Germany, western Africa, South Africa, Madagascar, Japan, British Columbia, USA.——FIG. 150,*3.* **T. (P.) kawasakii* (KAWADA), Middle Santonian, Japan; ×0.75 (Matsumoto, 1970a).

T. (Eutexanites) KLINGER & KENNEDY, 1980b, p. 322 [**Plesiotexanites (E.) sextuberculatus* KLINGER & KENNEDY, 1980b, p. 322; OD]. With 6 tubercles on each side, extra one formed by division of umbilical tubercle. *Upper Cretaceous (Lower Santonian):* South Africa (Zululand).

Reginaites REYMENT, 1957, p. 65 [**Peronoceras (R.) quadrituberculatum* REYMENT, 1957, p. 65; OD] [=*Reymentites* MATSUMOTO, 1965b, p. 238 (type, *R. hataii;* OD); ?*Cocuyites* ETAYO SERNA, 1985, p. 24 (type, *C. cocuyensis;* OD)]. Evolute; tricarinate; with distant ribs; early whorls with umbilical and ventrolateral tubercles; later ventrolateral tubercles dividing and feeble lateral tubercles may appear. Suture simple. *Upper Cretaceous (?Coniacian, Santonian–Campanian):* Austria, Nigeria, South Africa (Zululand), Japan, New Mexico.——FIG. 149,*4a,b.* **R. quadrituberculatum* (REYMENT), Coniacian or Santonian, Nigeria; ×0.5 (Klinger & Kennedy, 1980a).——FIG. 149,*4c–e. R. hataii* (MATSUMOTO), Coniacian or Santonian, Japan; *c,d,* ×1; *e,* ×2 (Matsumoto, 1965b).

Neogauthiericeras COLLIGNON, 1969, p. 185 [**N. zafimahovai;* OD]. Evolute, with markedly fastigiate venter; strong, conical umbilical tubercles joined by rather feeble ribs to very strong ventrolateral tubercles that are absent on body chamber. *Upper Cretaceous (Upper Santonian–Lower Campanian):* Madagascar, Texas.——FIG. 149,*1a,b.* **N. zafimahovai,* Lower Campanian, Madagascar; ×0.5 (Collignon, 1969).

Submortoniceras SPATH, 1926a, p. 79 [**Mortoniceras woodsi* SPATH, 1921a, p. 232; OD] [=*Butticeras* ANDERSON, 1958, p. 272 (type, *B. buttense;* OD); ?*Jimenesites* CARRASCO, 1967, not seen; *Antsirasirella* COLLIGNON, 1969, p. 201 (type, *S. (A.) stellata* COLLIGNON, 1969, p. 201; OD)]. Rather involute to evolute; ribs sparse or dense, with 5 tubercles from early stage but weakening; typically all ornament except umbilical tubercles lost on outer whorl and venter becomes rounded. *Upper Cretaceous (Upper Santonian–Middle Campanian):* South Africa (Zululand), Madagascar, Japan, British Columbia, USA, Mexico, Antarctica.

S. (Submortoniceras). Rather involute; ornament relatively persistent. Occurrence and distribution as for genus.——FIG. 151,*1a–c.* **S. (S.) woodsi* (SPATH), Campanian, Zululand; *a,b,* ×0.75; *c,* ×1 (Spath, 1921a).

S. (Ankilizatella) COLLIGNON, 1971, p. 50 [**Texanites (A.) ankilizatensis;* OD]. Very compressed, evolute; ornament reduced at early stage to numerous umbilical and inner and outer ventrolateral tubercles. *Upper Cretaceous (Middle Campanian):* Madagascar.——FIG. 151,*2a,b.* **S. (A.) ankilizatense* (COLLIGNON); ×0.75 (Collignon, 1971).

Bevahites COLLIGNON, 1948, p. 63(18) [**B. quadratus;* OD]. Whorl section more or less square to compressed; quinquetuberculate stage reached early, with 2 ventrolateral tubercles close together while ventral tubercles move nearer keel; lateral tubercles and many intercalated ribs also occurring, making many more outer tubercles than umbilical. *Upper Cretaceous (Lower Santonian–Middle Campanian):* France, South Africa (Zululand), Madagascar, Mississippi, Texas, Mexico.——FIG. 149,*2a,b.* **B. quadratus,* ?Upper Santonian, Madagascar; ×0.75 (Collignon, 1948).

Menabites COLLIGNON, 1948, p. 64(19) [**M. menabensis* COLLIGNON, 1948, p. 7(64); SD WRIGHT, 1957b, p. 432 (diagnosis published in fascicle 13; first valid species referred to in fascicle 14)]. Differs from *Bevahites* in persistence of early trituberculate stage to a diameter of 100 mm or more. *Upper Cretaceous (?Upper Santonian, Lower Campanian–Middle Campanian):* France, Tunisia, South Africa (Zululand), Madagascar, Japan, Texas, Mississippi, Alabama, Delaware, New Jersey, Oklahoma, Mexico.

M. (Menabites). Rather compressed, with strong, fairly dense ribs; quinquetuberculate stage reached more quickly than in other subgenera. *Upper Cretaceous (Lower Campanian–Middle Campanian):* Madagascar, Texas, Mexico.——FIG. 152,*3a,b.* **M. (M.) menabensis*, Campanian, Madagascar; ×1 (Collignon, 1948).

M. (Bererella) COLLIGNON, 1948, p. 64(19) [**M. (B.) bererensis;* OD]. Rather compressed, with sparse, weak ribs but strong, stout tubercles. *Upper Cretaceous (Middle Campanian):* Madagascar.

M. (Australiella) COLLIGNON, 1948, p. 64(19) [**Mortoniceras australe* BESAIRIE, 1930, p. 638; OD] [=*Austinites* ADKINS, 1933a, p. 407, *nom. nud.*]. Inflated, with broad, rounded venter and rarely more than 3 rows of tubercles, the ventral tubercles more numerous than inner ones; middle whorls with large, coarse inner ventrolateral tubercles. In adults of large, coronate species, keel and outer tubercles may disappear, the venter becoming broadly rounded and inner ventrolateral tubercles very large. Occurrence as for genus: South Africa (Zululand), Madagascar,

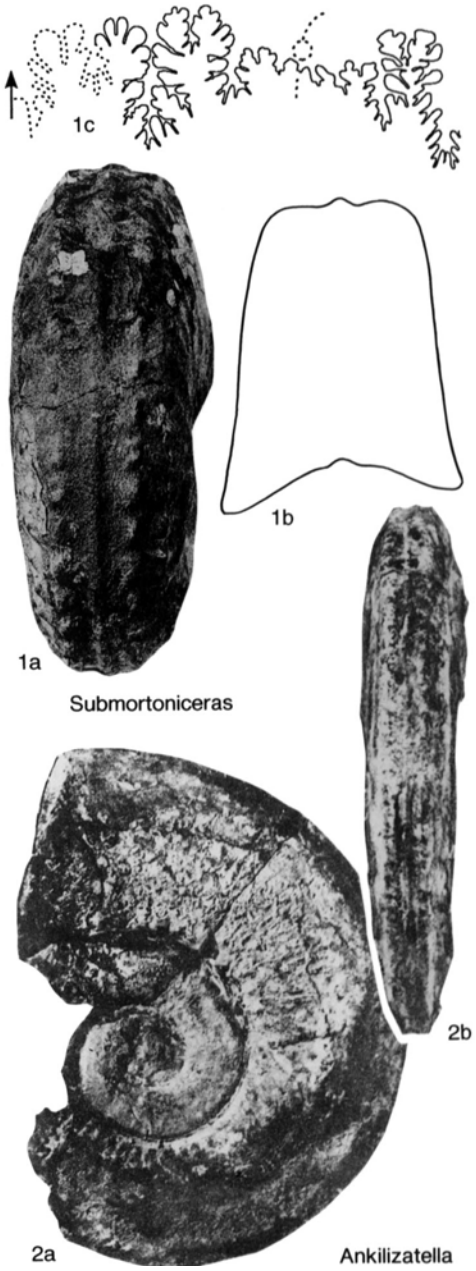

FIG. 151. Collignoniceratidae (p. 197)

Japan, Texas.——FIG. 152,*2a,b.* **M. (A.) australe* (BESAIRIE), Middle Campanian, Madagascar; ×1 (Collignon, 1948).

M. (Delawarella) COLLIGNON, 1948, p. 64(19) [**Ammonites delawarensis* MORTON, 1830, p. 244; OD]. Rather involute; outer ventrolateral tubercles appearing earlier than in *M. (Menabites);* inner whorls like *M. (Australiella),* but section soon becoming higher than wide; all ornament weakening with age and whorl section then becoming rounded. *Upper Cretaceous (Middle Campanian):* France, Tunisia, Madagascar, Texas, Oklahoma, Delaware, New Jersey.——FIG. 152,*1a–c.* **M. (D.) delawarensis* (MORTON), New Jersey; *a,b,* ×1; *c,* enlarged (Whitfield, 1892).

Cryptotexanites KENNEDY & COBBAN, 1993b, p. 842 [**C. paedomorphicus;* OD]. Progenetic dwarf derivative of some texanitine, differing from *Haboroceras* in having feebler ribbing and lacking umbilical bullae, with no keel or constrictions on body chamber. *Upper Cretaceous (Lower Campanian):* Delaware.

Defordiceras K. YOUNG, 1963, p. 118 [**D. hazzardi;* OD]. Keel disappearing. Probably pathological specimens. *Upper Cretaceous (Santonian):* ?Japan, Texas.

Family TISSOTIIDAE Hyatt, 1900

[Tissotiidae HYATT, 1900, p. 590]

Compressed to globular, with at least at some stage serrated or continuous keel and ventrolateral rows of tubercles. Suture normally with denticulate lobes and entire, rounded saddles, but first lateral lobe may be divided by adventive lobe. *Upper Cretaceous (Upper Turonian–Coniacian).*

Almost certainly derived by saltatory evolution of suture from *Barroisiceras* by way of *Tissotioides.*

Tissotioides REYMENT, 1958b, p. 48 [**Ammonites haplophyllus* REDTENBACHER, 1873, p. 100; OD] [=*Tissotioides (Reymentoceras)* WIEDMANN, 1960, p. 760 (type, *T. (R.) hispanicus;* OD)]. Having suture of *Tissotia* but ornament of *Barroisiceras* with siphonal clavi. [*Reymentoceras* as subgenus for species that lose ventrolateral and siphonal tubercles on body chamber seems unnecessary.] *Upper Cretaceous (Lower Coniacian):* France, Spain, Austria.——FIG. 153,*3a–c.* **T. haplophyllus* (REDTENBACHER); *a,b,* France, ×0.75 (Grossouvre, 1894); *c,* Austria, ×2 (Reyment, 1958b).

Metatissotia HYATT, 1903, p. 45 [**Buchiceras fourneli* BAYLE, 1878, pl. 40, fig. 3; SD ROMAN, 1938, p. 479] [=*Dordiella* REYMENT, 1958c, p. 59 (type, *D. bakundu;* OD)]. Venter more or less flat in early stages, with sharp keel and rows of ventrolateral tubercles formed by ends of fairly strong ribs; later stages with keel rising to form angular venter, ribs disappearing, and umbilical and ventrolateral tubercles persisting. [*Dordiella,* distinguished only by slightly more divided first lateral saddle and slightly incised second lateral saddle, seems unnecessary.] *Upper Cretaceous (Coniacian):* France, Spain, northern and western Africa, Borneo, Peru.——FIG. 153,*1a–c.* **M. fourneli* (BAYLE); *a,b,* Peru, ×0.5 (Knechtel, Richards, & Rathbun, 1947); *c,* France,

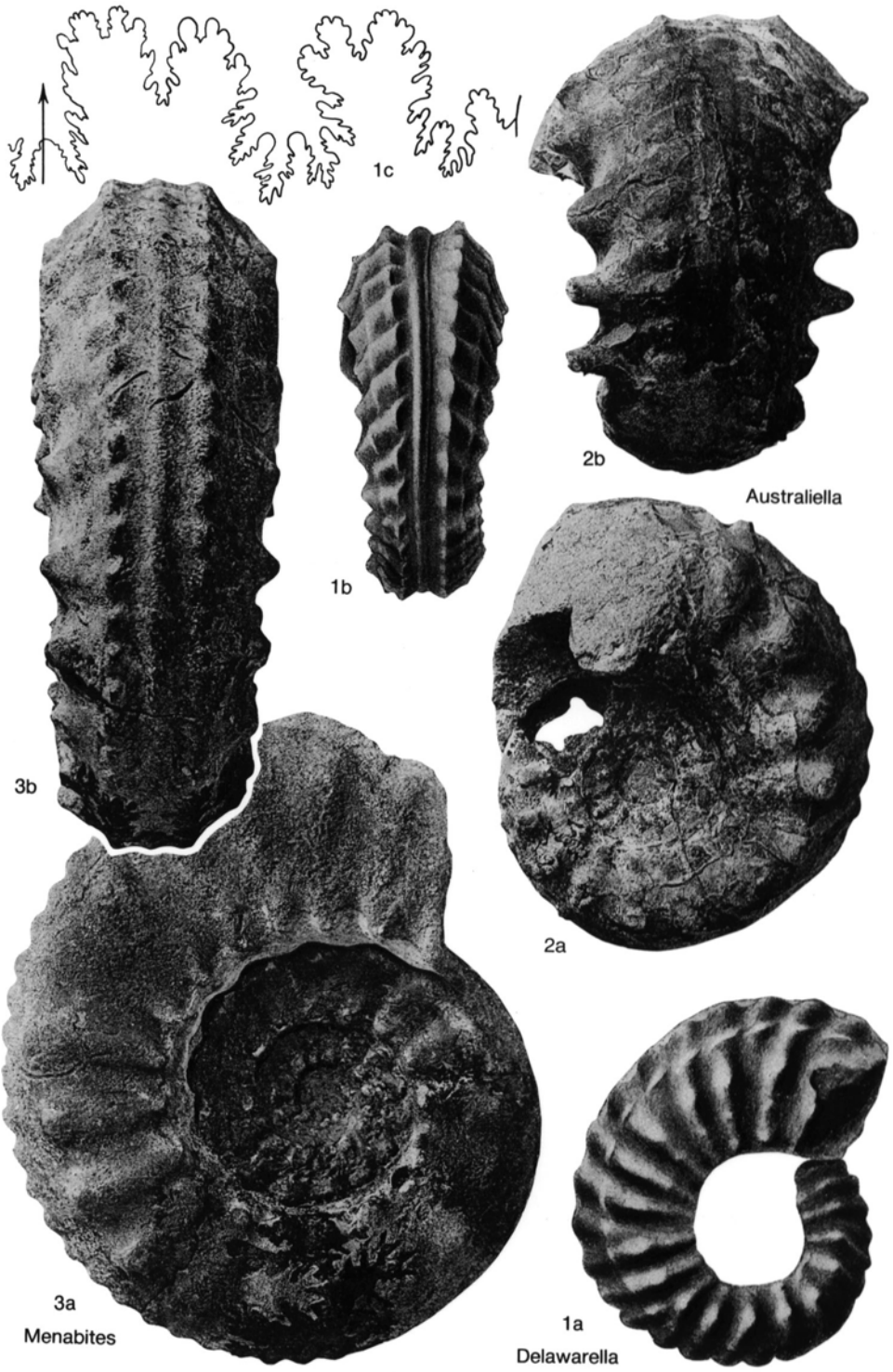

FIG. 152. Collignoniceratidae (p. 197–198)

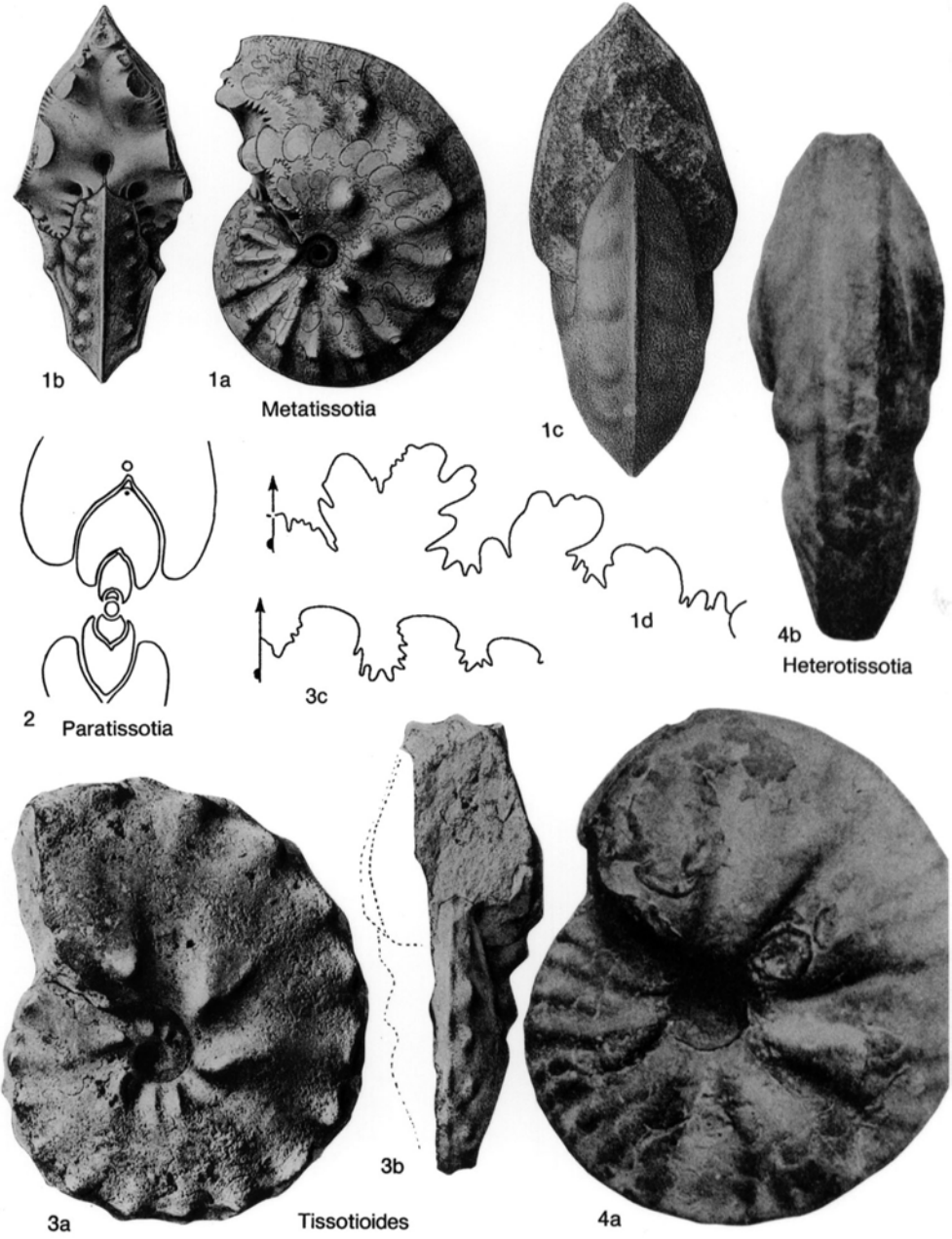

FIG. 153. Tissotiidae (p. 198–201)

×1 (Bayle, 1878).——FIG. 153,*1d. M. bakundu* (REYMENT), Nigeria; ×1 (Reyment, 1958c).

Tissotia H. DOUVILLÉ, 1890, p. 285 [**Buchiceras tissoti* BAYLE, 1878, pl. 40, fig. 1; OD]. Very involute; more or less inflated; early stages with low, branching ribs, siphonal keel, and ventrolateral keels or rows of tubercles, all of which may disappear. Suture with first lateral saddle divided into 2 equal saddles, one or both of which may have a few indentations, but these and other saddles usually entire. *Upper Cretaceous (Coniacian):* France, Spain, central Europe, northern and western Africa, Borneo.

T. (Tissotia). Retains more or less subquadrate whorl section throughout growth; venter flat, with 3 feeble keels separated by sulci that disap-

pear on outer whorls. Occurrence as for genus: France, Spain, central Europe, northern and western Africa, Borneo.——Fig. 154,*2a,b.* **T. (T.) tissoti* (Bayle), France; *a,* ×0.67; *b,* ×1 (Bayle, 1878).

T. (**Subtissotia**) Hyatt, 1903, p. 43 [**T. tissoti* var. *inflata* Peron, 1897, p. 68; SD Roman, 1938, p. 479]. Early whorls globular, with low siphonal keel and rows of ventrolateral tubercles very close to keel; later whorls smooth, with rounded venter. Occurrence as for genus: northern Africa.——Fig. 154,*1.* **T. (S.) inflata;* ×0.75 (Peron, 1896–1897).

?Heterotissotia Peron, 1897, p. 81 [**H. neoceratites;* OD]. Involute; sides flat or inflated; venter flat or concave, with angular or keeled shoulders and weak siphonal keel; ribs strong but low, rounded, and branching, with or without umbilical, midlateral, and inner and outer ventrolateral tubercles. Suture with first lateral saddle deeply bifid; 3 other saddles normally entire. Except in suture, *Heterotissotia* may resemble some *Pseudotissotia. Upper Cretaceous (Upper Turonian–Coniacian):* Israel, northern Africa, Somalia, Peru.——Fig. 153,*4a,b.* **H. neoceratites,* Coniacian, Algeria; ×1 (Peron, 1896–1897).

Paratissotia Hyatt, 1903, p. 50 [**P. regularis;* OD]. Omitting or passing very quickly through stage of fastigiate venter with keel and rows of ventrolateral tubercles that characterizes *Tissotia,* and quickly becoming compressed with acute venter without tubercles but with rather weak ribs. *Upper Cretaceous (Coniacian):* France, northern and western Africa, Peru.——Fig. 153,*2.* **P. regularis,* Peru; ×0.75 (Hyatt, 1903).

Family COILOPOCERATIDAE Hyatt, 1903

[Coilopoceratidae Hyatt, 1903, p. 88] [=Hoplitoidinae Wright, 1952, p. 221, *nom. correct. pro* Hoplitoidinés H. Douvillé, 1912, p. 305]

Moderately to very involute; compressed to inflated; either flat-sided with flat venter becoming narrowly rounded in adult or lanceolate or cordate in section with more or less sharp venter; at some stage, broad, low, rounded ribs springing in pairs from low umbilical tubercles or bulges. Suture with narrow first lateral saddle and very broad, shallow first lateral lobe divided by one or more accessory saddles; folioles and auxiliary saddles tending to have entire endings. *Upper Cretaceous (Lower Turonian–Upper Turonian).*

Hoplitoides closely resembles early *Pseudotissotia,* from which it was probably derived. *Coilopoceras* seems to have been derived from *Hoplitoides.* Members of *Coilopoceras* reported from the Cenomanian seem to be Turonian.

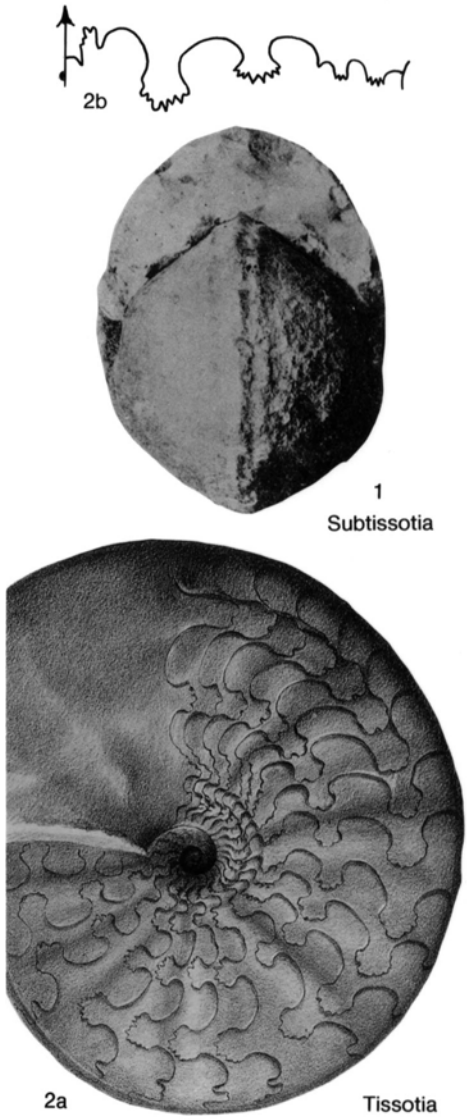

Fig. 154. Tissotiidae (p. 200–201)

Hoplitoides Koenen, 1898, p. 53 [**H. latesellatus* Koenen, 1898, p. 56; OD; =*Neoptychites? ingens* Koenen, 1897, p. 12]. Early whorls with sulcate or flat venter and variable, sparse ribs branching from insignificant umbilical tubercles and fading on shoulder; slight to moderately strong, generally clavate tubercles may be present on shoulder; later whorls smooth, with narrowly rounded venter. Suture very variable and irregular, with wide first lateral lobe divided by 1 or 2 large folioles or accessory saddles. *Upper Cretaceous (Turonian):* Spain, northern and western Africa, Madagascar, Lebanon, Israel, Jordan, New Mexico, Mexico, Trinidad, Venezuela, Colombia, Peru.——Fig. 155,*2a.* **H. ingens*

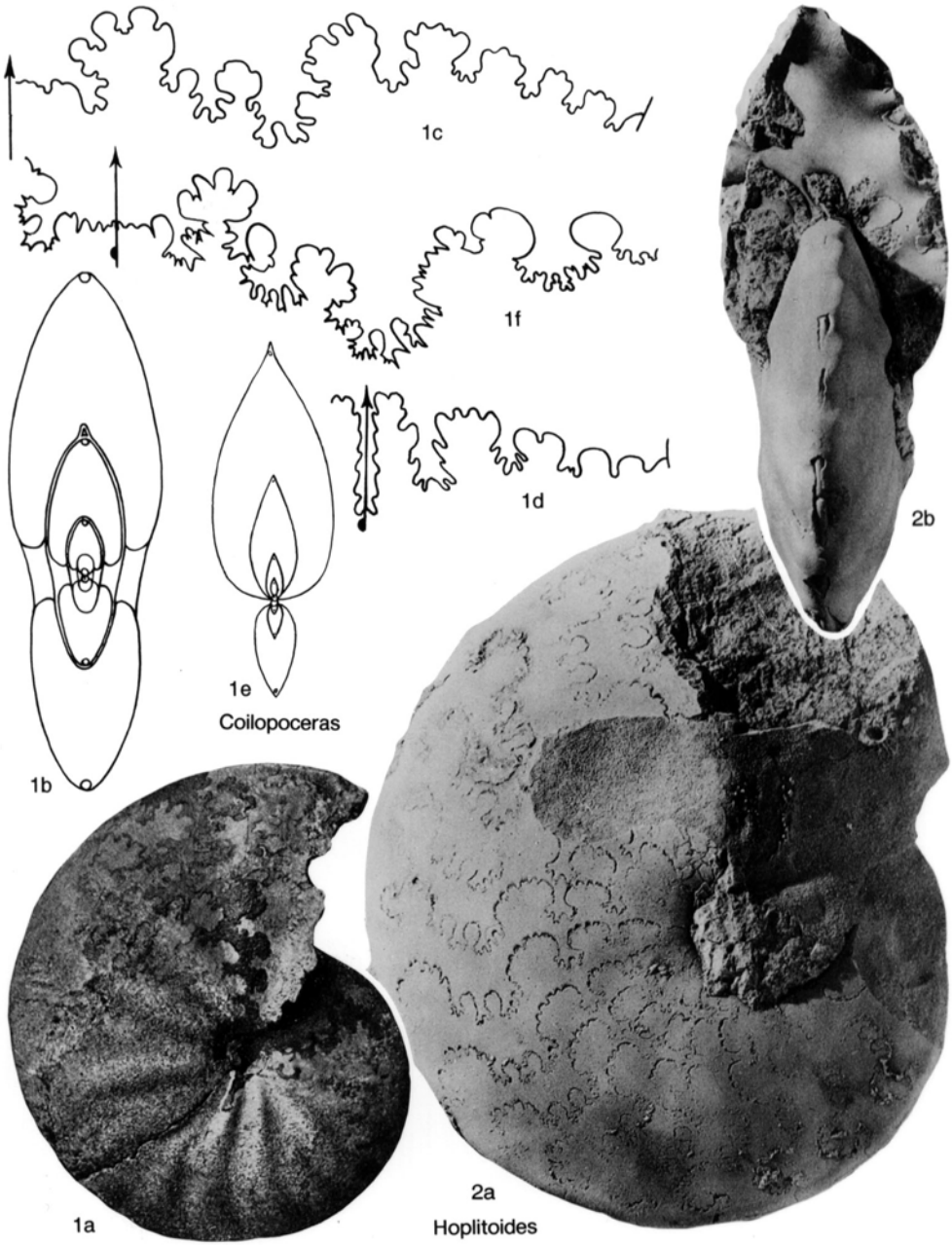

FIG. 155. Coilopoceratidae (p. 201–203)

(KOENEN), Lower Turonian, Nigeria; ×0.75 (Reyment, 1955).——FIG. 155,*2b. H. gibbosulus bipartitus* (SOLGER), Lower Turonian, Nigeria; ×0.75 (Reyment, 1955).

Erichsenites MAGALHÃES, 1953, p. 6 [**Hoplitoides mirabilis* PERVINQUIÈRE, 1907, p. 218; OD]. Generally similar to *Wrightoceras,* but with tabulate venter, and suture as in Coilopoceratidae with very broad L. Differing from *Hoplitoides* only in persistence of tabulate venter to body chamber, *Erichsenites* may better be considered a subgenus of *Hoplitoides. Upper Cretaceous (Lower Turonian):* France, northern Africa, Venezuela, Brazil.——FIG. 156*a–c.* **E. mirabilis* (PERVINQUIÈRE), Tunisia; *a,b,* ×0.5; *c,* ×2 (Pervinquière, 1907).

Coilopoceras HYATT, 1903, p. 91 [**C. colleti;* OD]

[=*Namadoceras* Vredenburg, 1907, p. 121 (type, *N. scindiae;* OD); *Glebosoceras* Reyment, 1954a, p. 161 (type, *G. glebosum;* OD); *Vredenburgia* Chiplonkar & Ghare, 1976, p. 7 (type, *V. khadluensis;* OD)]. Large, with diameter up to 800 mm; involute; compressed to inflated; lanceolate to cordate in section, with more or less sharp venter; variable, broad, low ribs may persist; in inflated forms (*Glebosoceras*) ribs raised into large bulges on inner part of side on outer whorls; in some such forms ribs may be strongly projected ventrolaterally, but this is probably not significant. Suture variable; accessory saddle may be larger than the second lateral, which with auxiliary saddles tends to become entire in outline. *Upper Cretaceous (Middle Turonian–Upper Turonian):* France, Spain, northern and western Africa, Madagascar, Lebanon, Israel, Baluchistan, Colorado, Wyoming, Texas, New Mexico, Mexico, Trinidad, Venezuela, Ecuador, Colombia, Peru.——Fig. 155,*1a–d. *C. colleti,* Upper Turonian, New Mexico; ×1 (Hyatt, 1903). ——Fig. 155,*1e,f. C. glebosum* (Reyment), Turonian, Nigeria; *e,* approximately ×0.2; *f,* ×1 (Reyment, 1954a).

Family SPHENODISCIDAE Hyatt, 1900

[Sphenodiscidae Hyatt, 1900, p. 585] [=Libycoceratidae Zaborski, 1982, p. 306]

Involute; compressed; generally with weak lateral and ventrolateral tubercles or smooth; venter sharp or narrowly rounded. A few, less compressed and broader-ventered forms are probably microconchs. Suture with narrow-necked, entire or frilled, and in some cases phylloid saddles; first lateral saddle divided by 1 or 2 adventive lobes; many auxiliary elements. *Upper Cretaceous (Coniacian–Maastrichtian).*

Generic distinction has usually been made on details of sutures, but these are variable and reliance on them can be misleading. Origin of the family is probably in Collignoniceratidae, through Lenticeratinae, with its obliquely trifid first lateral saddle. Coilopoceratidae are superficially similar but have a widening and subdivided first lateral lobe rather than saddle.

Subfamily LENTICERATINAE Hyatt, 1900

[*nom. transl.* Wright, 1952, p. 221, *ex* Lenticeratidae Hyatt, 1900, p. 590] [=Eulophoceratidae Hyatt, 1903, p. 83]

Involute; venter sharp or narrowly rounded; whorl section ranging from lanceolate to stoutly cordate; smooth or with broad, flat ribs. Suture with elements of disparate size and varying number of auxiliary saddles; first lateral saddle very wide and normally trifid with outer part markedly oblique to siphonal line. *Upper Cretaceous (Coniacian–Lower Campanian).*

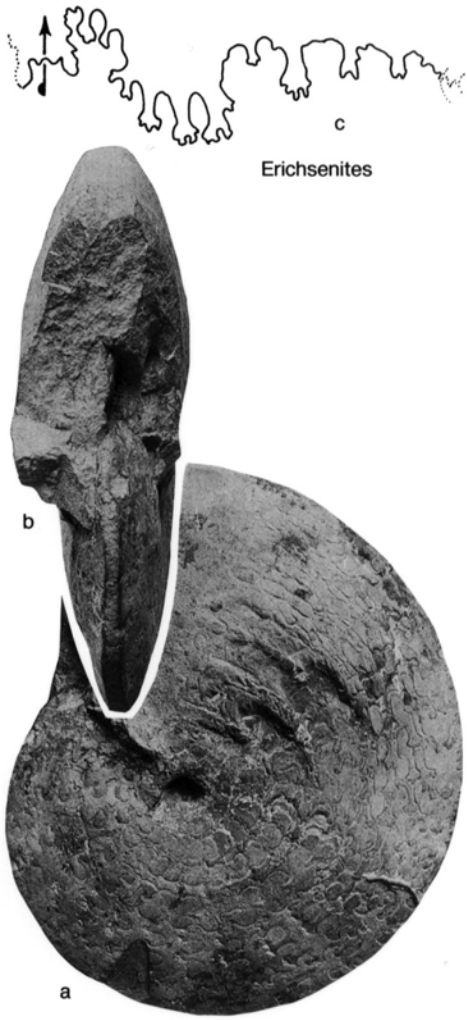

Fig. 156. Coilopoceratidae (p. 202)

Lenticeras Gerhardt, 1897a, p. 81 [**Ammonites andii* Gabb, 1877, p. 275; OD]. Very involute, with more or less cordate whorl section; low, rounded ribs branching in pairs from umbilical bulges and disappearing below venter. External saddle of suture broad, markedly oblique. *Upper Cretaceous (Coniacian–Lower Santonian):* Spain, Peru, Venezuela.——Fig. 157,*2a–c.*L. andii* (Gabb), Coniacian, Peru; *a,b,* ×0.75; *c,* ×1 (Gerhardt, 1897a).

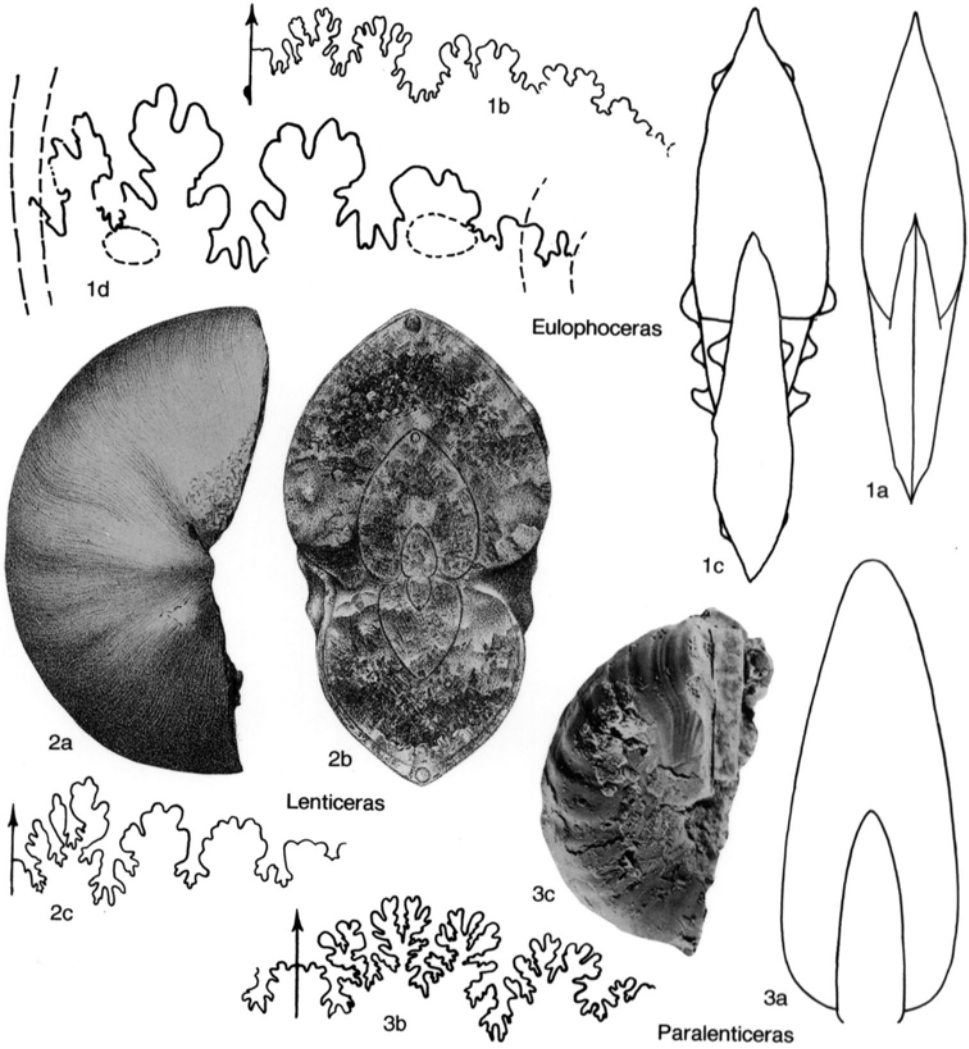

FIG. 157. Sphenodiscidae (p. 203–205)

Paralenticeras HYATT, 1900, p. 590 [**Amaltheus sieversi* GERHARDT, 1897a, p. 79; OD]. Suture much as in *Lenticeras,* but elements deeper and saddles more finely divided. Compressed; inner whorls with flat ribs, fastigiate venter, and sharp keel; outer whorls with weak ribs on inner part of sides, otherwise with dense striae, recurved siphonally. *Lenticeras* and *Paralenticeras* may be inflated and compressed members of the same genus. *Upper Cretaceous (Upper Coniacian–Lower Santonian):* Colombia, Peru, Venezuela, Haiti.——FIG. 157,*3a,b. *P. sieversi* (GERHARDT), Lower Santonian, Haiti; ×1 (Reeside, 1947).——FIG. 157,*3c. P. spathi* (REYMENT), Upper Coniacian, Venezuela; ×2.5 (Reyment, 1958a).

Eulophoceras HYATT, 1903, p. 85 [**E. natalense;* OD] [=*Praelibycoceras* H. DOUVILLÉ, 1912, p. 315 (type, *Lenticeras jullieni* PERVINQUIÈRE, 1910, p. 70; OD); *Pelecodiscus* HOEPEN, 1921, p. 30 (type, *P. umzambiensis;* OD); *Spheniscoceras* SPATH, 1921a, p. 242 (type, *S. africanum;* SD SPATH, 1922b, p. 142); *Skoumalia* SUMMESBERGER, 1979, p. 146 (type, *S. austriaca;* OD)]. Involute; compressed; lanceolate or with fastigiate venter; smooth or with fine, convex ribs or low, rounded ribs and ventrolateral nodes. Suture irregular, with several auxiliary saddles and obliquely trifid first lateral saddle tending to become more complex; folioles commonly fingerlike. HOURCQ, 1949. *Upper Cretaceous (Upper Coniacian–Lower Campanian):* Spain, Austria, Algeria, Nigeria, southeastern Africa, Madagascar, Syria, southern India, Peru, Venezuela.——FIG. 157,*1a,b. E. jacobi* HOURCQ, Upper Santonian, Madagascar;

×1 (Hourcq, 1949).——Fig. 157,*1c,d. E. austriaca* (Summesberger), Austria, *c,* ×1; *d,* enlarged (Summesberger, 1979).

Subfamily SPHENODISCINAE Hyatt, 1900

[*nom. transl.* Wright, herein, *ex* Sphenodiscidae Hyatt, 1900, p. 585]

Suture with elements, including the adventive and auxiliary, tending to form a single, even series and to develop simple, rounded outlines to folioles. Compressed; involute; mostly smooth, but some with lateral and ventrolateral tubercles and fastigiate or broad, flat venter. *Upper Cretaceous (Upper Coniacian–Maastrichtian).*

Manambolites Hourcq, 1949, p. 111 [**M. piveteaui;* OD] [=*Mzezzemceras* Basse, 1954, p. 868 (type, *Coahuilites (Mzezzemceras) pervinquieri* Basse, 1954, p. 868; OD)]. Whorl section lanceolate or with fastigiate venter; body chamber with flat sides or inflated; smooth or with feeble, outer crescents and falcate striae. Suture having irregular first lateral saddle with large adventive lobe and having outer or both parts of saddle indented, outer indentation tending to become second adventive lobe. *Upper Cretaceous (Lower Campanian–Maastrichtian):* Angola, Madagascar, Israel, Iran, Pakistan (Baluchistan).

M. (Praemanambolites) Collignon, 1969, p. 213 [**P. hourcqui;* OD]. Body chamber expanded, then retracted as in *Neoptychites;* keel persisting to end. *Upper Cretaceous (Lower Campanian):* Madagascar.——Fig. 158,*3a,b. *M. (P) hourcqui* (Collignon); ×0.25 (Collignon, 1969).

M. (Manambolites). Body chamber with flat sides and rounded venter. Occurrence and distribution as for genus.——Fig. 158,*2a,b. *M. (M.) piveteaui,* Maastrichtian, Madagascar; ×1 (Hourcq, 1949).

Sphenodiscus Meek, 1871b, p. 298 [**Ammonites lobatus* Tuomey, 1856, p. 168; OD; =*Ammonites lenticularis* Owen, 1852, p. 579, *non* G. M. Young & Bird, 1828, p. 269, fig. 5] [=*Austrosphenodiscus* Olsson, 1944, p. 266(108) (type, *Sphenodiscus pleurisepta* var. *peruviana* Gerth, 1928b, p. 237; OD)]. Generally smooth, involute, and compressed, tending to be oxyconic; some species with weak lateral and ventrolateral tubercles. All saddles of suture normally indented, but some auxiliaries may be entire; first lateral saddle normally with 2 distinct adventive lobes as big as first lateral lobe, but in early species outer one may be smaller; folioles generally but not uniformly with long, narrow necks and kidney-shaped ends. *Upper Cretaceous (Upper Campanian–Maastrichtian):* The Netherlands, France, Poland, Israel, Jordan, Saudi Arabia, Madagascar, southern India, USA, Mexico, Venezuela.——Fig. 159,*4a,b. *S. lobatus* (Tuomey), Mississippi; ×0.4 (Hyatt, 1903).

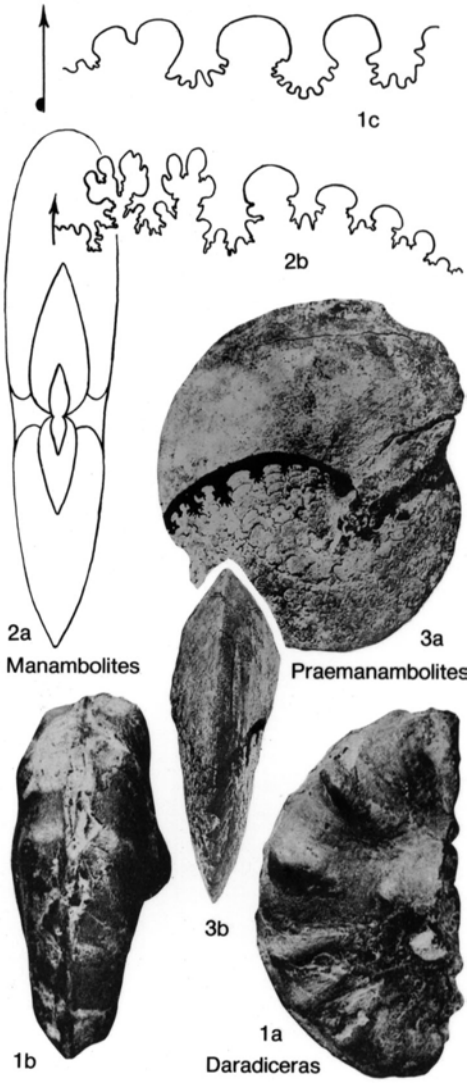

Fig. 158. Sphenodiscidae (p. 205–206)

Coahuilites Böse, 1928, p. 279 [**C. sheltoni;* OD]. Sides flat and parallel; venter at first fastigiate or rounded, then broad and flat; ribs rather prominent, branching from pointed tubercles above umbilical edge and ending in ventrolateral clavi. Suture as in *Sphenodiscus* but simpler. Probable microconch of *Sphenodiscus. Upper Cretaceous (?Upper Campanian, Maastrichtian):* Tunisia, Israel, Mexico, Peru, Colombia, Venezuela.——Fig. 159,*5a,b. C. cavinsi* Böse, Lower Maastrichtian, Mexico; ×1 (Böse, 1928).

Indoceras Noetling, 1897, p. 71 [**I. baluchistanense;* OD]. Inner whorls with feeble outer crescents, ventrolateral ridges, and subacute keel; outer whorls smooth, with rounded venter. All saddles entire,

except first lateral divided by an accessory lobe. *Upper Cretaceous (Maastrichtian):* Iran, Pakistan (Baluchistan).——FIG. 159,*2a–c.* **I. baluchistanense,* Baluchistan; ×1 (Noetling, 1897).

Libycoceras HYATT, 1900, p. 585 [**Engonoceras ismaeli* ZITTEL, 1895, p. 451; OD (=*Ammonites ismaelis* ZITTEL, 1883, p. 74, *nom. nud.*)] [=*Paciceras* OLSSON, 1944, p. 268(110) (type, *P. pacificum;* OD)]. Venter fastigiate or lanceolate but may become broadly rounded on body chamber; smooth or with faint, broad ribs, some with lateral and ventrolateral tubercles, fading on outer whorl. First lateral saddle of suture with one adventive lobe, usually as long as first lateral lobe, or with incipient second adventive lobe; all saddles normally entire but may be feebly indented. *Upper Cretaceous (Upper Campanian–Lower Maastrichtian):* Libya, Chad, Nigeria, Egypt, Israel, Saudia Arabia, Japan, Colombia, Peru.——FIG. 159,*3a–c.* **L. ismaeli* (ZITTEL), Upper Campanian or Lower Maastrichtian, Libya; *a,* ×0.5; *b,* ×0.4; *c,* ×0.75 (Zittel, 1895).

Daradiceras SORNAY & TESSIER, 1949, p. 246 [**D. gignouxi;* OD]. Venter sharp, becoming broad and flat with age, but keel persisting; bulging, falcoid ribs joining 8 umbilical to 16 ventrolateral tubercles; large bulge at base of outer whorl enveloping umbilicus. Analogous to *Coahuilites,* and perhaps a microconch. *Upper Cretaceous (Maastrichtian):* Senegal.——FIG. 158,*1a–c.* **D. gignouxi* (SORNAY & TESSIER); *a,b,* ×0.5; *c,* enlarged (Sornay & Tessier, 1949).

?Nubidites WIEDMANN & KULLMAN, 1979, p. 249 [**N. omarai;* OD]. Small oxycone; suture with all elements entire and 4 adventive lobes. Collected loose in area of Carboniferous but with some Middle Jurassic and Upper Cretaceous not far away. If Upper Cretaceous, perhaps a progenetic offshoot of some sphenodiscoid. *?Upper Cretaceous:* Egypt.——FIG. 159,*1a–c.* **N. omarai; a,b,* ×3.2; *c,* ×10 (Wiedmann & Kullman, 1979).

Suborder ANCYLOCERATINA Wiedmann, 1966

[Ancyloceratina WIEDMANN, 1966b, p. 54]

Heteromorphs or secondary ammoniticones. Primary suture quinquelobate followed by quadrilobate (most Ancyloceratataceae, all Scaphitaceae), or quadrilobate throughout (some Ancyloceratataceae, possibly all Turrilitaceae), or unstable—quinquelobate or quadrilobate followed by quinquelobate—with elements multiplying subsequently (Douvilleiceratataceae, Deshayesitaceae). DOGUZHAEVA and MIKHAILOVA (1982) assigned Ancyloceratataceae to Ammonitida and Turrilitaceae to Lytoceratida on the grounds that the Ancyloceratataceae have a quinquelobate initial suture and a trifid L, while the Turrilitaceae have a quadrilobate primary suture and bifid L. Phyletic transitions from trifid to bifid L, however, are known, and no ammoniticone Lytoceratina are known to have a quadrilobate primary or later sutures, so that it seems more natural to assume that the quadrilobate suture evolved once and that the quadrilobate primary was derived from the quinquelobate primary followed by quadrilobate of Ancyloceratataceae. The position of the siphuncle (central or ventral) in earliest stages is here not considered significant (MATSUKAWA, 1987).

Criocones and baculicones appear suddenly in the Lower Tithonian and turricones in the Upper Tithonian. Their origins are uncertain. Derivation from Lytoceratina would require loss of one element in the early sutures and conversion of bifid L to trifid; there are no known intermediate forms in the Tithonian or earlier. Despite the stratigraphic gap between Middle Callovian and Lower Tithonian, the Spiroceratataceae remain a conceivable ancestor. WIEDMANN, 1966b; KULLMANN & WIEDMANN, 1970; MIKHAILOVA, 1976a, 1976b; DOGUZHAEVA & MIKHAILOVA, 1982. *Upper Jurassic (Lower Tithonian)–Upper Cretaceous (Upper Maastrichtian).*

Superfamily ANCYLOCERATACEAE Gill, 1871

[*nom. transl.* WRIGHT, 1957b, p. 207, *ex* Ancyloceratidae GILL, 1871, p. 3] [=Protancyloceratataceae, *nom. transl.* DIMITROVA, 1970, p. 90, *ex* Protancyloceratidae BREISTROFFER, 1947a, unpaged; Crioceratataceae, *nom. transl.* WRIGHT, 1957b, p. 208, *ex* Crioceratitidae WRIGHT, 1952, p. 218, *nom. correct. ex* Crioceratidae GILL, 1871, erroneously attributed to HYATT, 1900. It was thought in 1957 that Ancyloceratidae dated from MEEK, 1876, whereas Crioceratidae dated from HYATT, 1900. In fact, both dated from GILL, 1871, and change at the superfamily level was unnecessary. However, Ancyloceratataceae has entered into general use and is therefore maintained here.]

Most members with heteromorphic coiling. Lateral lobe generally trifid, but bifid L developing independently in several stocks. Late Jurassic cyrtocones (*Protancyloceras*) apparently gave rise both to straight forms (*Bochianites*) and, later, to more closely coiled forms (*Leptoceras* and Crioceratitinae). These produced both involute forms that led to Douvilleiceratataceae and Deshayesitaceae