

except first lateral divided by an accessory lobe. *Upper Cretaceous (Maastrichtian)*: Iran, Pakistan (Baluchistan).—FIG. 159,2a–c. \**I. baluchistanense*, Baluchistan; X1 (Noetling, 1897).

**Libycoceras** HYATT, 1900, p. 585 [\**Engonoceras ismaeli* ZITTEL, 1895, p. 451; OD (= *Ammonites ismaelis* ZITTEL, 1883, p. 74, *nom. nud.*)] [= *Pacikeras* 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, X0.5; b, X0.4; c, X0.75 (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, X0.5; 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, X3.2; c, X10 (Wiedmann & Kullman, 1979).

## Suborder ANCYCLOCERATINA Wiedmann, 1966

[Ancycloceratina WIEDMANN, 1966b, p. 54]

Heteromorphs or secondary ammoniticones. Primary suture quinquelobate followed by quadrilobate (most Ancylocerataceae, all Scaphitaceae), or quadrilobate throughout (some Ancylocerataceae, possibly all Turrilitaceae), or unstable—quinquelobate or quadrilobate followed by quinquelobate—with elements multiplying subsequently (Douvilleicerataceae, Deshayesitaceae). DOGUZHAEVA and MIKHAILOVA (1982) assigned Ancylocerataceae to Ammonitida and Turrilitaceae to Lytocerata on the grounds that the Ancylocerataceae have a quinquelobate initial suture

and a trifold L, while the Turrilitaceae have a quadrilobate primary suture and bifid L. Phyletic transitions from trifold to bifid L, however, are known, and no ammoniticones 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 Ancylocerataceae. 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 trifold; there are no known intermediate forms in the Tithonian or earlier. Despite the stratigraphic gap between Middle Callovian and Lower Tithonian, the Spirocerataceae remain a conceivable ancestor. WIEDMANN, 1966b; KULLMANN & WIEDMANN, 1970; MIKHAILOVA, 1976a, 1976b; DOGUZHAEVA & MIKHAILOVA, 1982. *Upper Jurassic (Lower Tithonian)–Upper Cretaceous (Upper Maastrichtian)*.

## Superfamily ANCYCLOCERATACEAE Gill, 1871

[*nom. transl.* WRIGHT, 1957b, p. 207, *ex* Ancyloceratidae GILL, 1871, p. 3] [= Protancylocerataceae, *nom. transl.* DIMITROVA, 1970, p. 90, *ex* Protancyloceratidae BREISTROFFER, 1947a, unpagged; Criocerataceae, *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, Ancylocerataceae has entered into general use and is therefore maintained here.]

Most members with heteromorphic coiling. Lateral lobe generally trifold, 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 Douvilleicerataceae and Deshayesitaceae

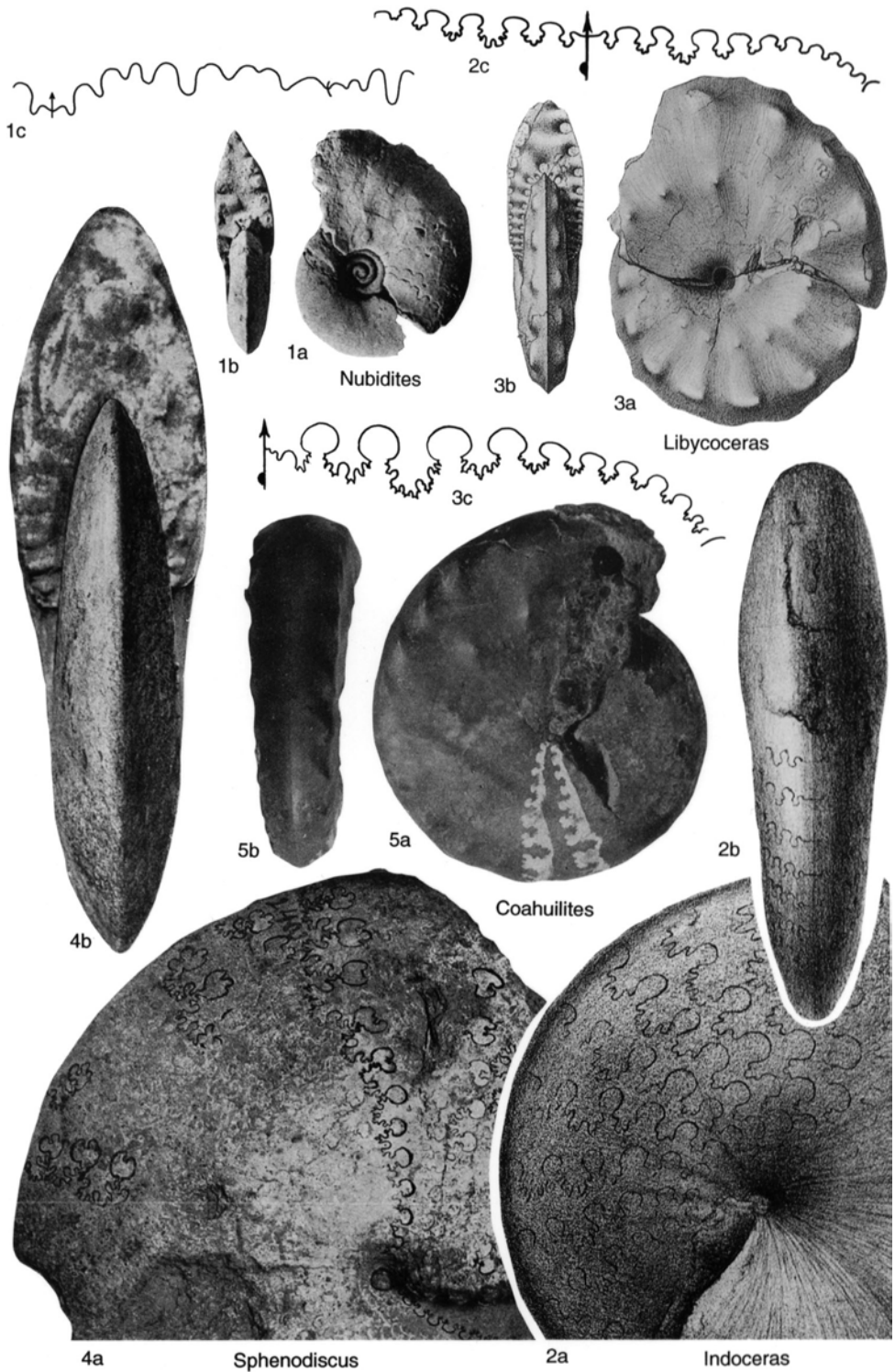


FIG. 159. Sphenodiscidae (p. 205–206)  
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and also genera with hooked body chambers (Ancyloceratinae). Helical forms appeared in the Berriasian (*Cochlocrioceras*), the Barremian (Heteroceratidae), and the Aptian (Helicancyliinae). *Upper Jurassic (Lower Tithonian)–Upper Cretaceous (?Lower Cenomanian)*.

### Family BOCHIANITIDAE Spath, 1922

[*nom. transl.* BREISTROFFER, 1947a, unpagéd, ex Bochianitinae SPATH, 1922b, p. 147] [=Baculinidae GILL, 1871, p. 3 (see Bochianitinae, *Baculina*)]

Loosely coiled to straight; normally with oblique ribs; rarely smooth; tubercles occurring rarely. Suture with trifid lateral lobes. The first *Protancyloceras* and *Bochianites* occur together; which one is derived from the other is uncertain, as is origin of either, but probability is that *Protancyloceras* is phylogenetically primitive. *Upper Jurassic (Lower Tithonian)–Lower Cretaceous (Lower Aptian)*.

### Subfamily PROTANCYLOCERATINAE Breistroffer, 1947

[*nom. transl.* WRIGHT, 1952, p. 218, ex Protancyloceratidae BREISTROFFER, 1947a, unpagéd] [=Leptoceratinae MANOLOV, 1962, p. 531]

Loosely coiled, rarely helical; strongly ribbed; a few with tubercles. *Upper Jurassic (Lower Tithonian)–Lower Cretaceous (Upper Valanginian–Upper Hauterivian)*.

**Protancyloceras** SPATH, 1924a, p. 86 [*\*Ancyloceras guembeli* ZITTEL, 1886, p. 115; OD]. Coiled in very open spiral; whorl section round, oval, or subquadrate; ribs fine on early whorls, typically coarse on later, prorsiradiate to radial, forming chevrons or interrupted on venter; ventrolateral tubercles may occur and pairs of ribs may join at them. Suture with irregularly bifid saddles and trifid lobes. *Upper Jurassic (Lower Tithonian)–Lower Cretaceous (Lower Valanginian)*: France, central Europe, Ukraine (Crimea), northern Africa, Madagascar, Kurdistan, Mexico, Peru, Cuba.—FIG. 160, 2a–c. *P. kurdistanense* SPATH, Tithonian, Kurdistan;  $\times 1$  (Spath, 1950).

**Juddiceras** SPATH, 1924a, p. 84 [*\*Crioceeras curvicosta* KOENEN, 1902, p. 326; OD]. Known only in slightly curved fragments, but probably loosely crioconic; ribs prominent, rather distant, slightly concave, and irregularly stronger or weaker. Lectotype of type species untaberulate; associated specimens with a pair of ventral tubercles on stronger ribs may be microconchs or a different species (or possibly a different genus). *Lower Cretaceous (Upper Valanginian)*: Germany, Hungary.—FIG.

160, 3a, b. *\*J. curvicostum* (KOENEN), Germany;  $\times 1$  (Kemper, Rawson, & Thieuloy, 1981).—FIG. 160, 3c, d. ?*J. ?curvicostum* (KOENEN);  $\times 0.5$  (Koenen, 1902).

?**Pseudomoutoniceras** AUTRAN, DELANOY, & THOMEL, 1986, p. 1063 [*\*Toxoceras annulare* ORBIGNY, 1842b, p. 480; OD]. Ribs continuous over venter; periodic, strongly collared constrictions. Suture relatively simple. *Lower Cretaceous (Upper Hauterivian)*: France, Switzerland.—FIG. 161, 3. *\*P. annulare* (ORBIGNY), France;  $\times 0.5$  (Autran, Delanoy, & Thomel, 1986).

**Leptoceras** UHLIG, 1883, p. 260(136) [*\*Ancyloceras brunneri* OOSTER, 1860, p. 37; SD ROMAN, 1938, p. 354] [=Protoloptoceras NIKOLOV, 1966b, p. 839 (type, *P. jelevi*; OD)]. Small; coiling cyrtocone or criocone and regular or elliptical, with body chamber generally uncoiling; ribs single, rectiradiate or rursiradiate, and crossing venter transversely; no tubercles. Suture with wide, bifid saddles; L generally symmetrically trifid at first, later asymmetric. *Lower Cretaceous (Upper Berriasian–Valanginian)*: central and southern Europe, Colombia.—FIG. 161, 4. *\*L. brunneri* (OOSTER), Upper Berriasian, Switzerland;  $\times 1.5$  (Thieuloy, 1966b).

**Vinalesites** THIEULY, 1966b, p. 287 [*\*Hamulina rosariensis* IMLAY, 1942, p. 1457; OD] [=Pseudoanahamulina JUDOLEY & FURRAZOLA-BERMUDEZ, 1968, p. 54, obj.]. Coiling loosely ancyloceratoid, with short initial spire, long more or less straight shaft, and open hook; ribs simple, slightly prorsiradiate, strengthening on hook. *Upper Jurassic (Middle Tithonian)*: Cuba.—FIG. 161, 2a, b. *\*V. rosariensis* (IMLAY);  $\times 1$  (Wiedmann, 1973a).

**Cochlocrioceras** SPATH, 1950, p. 123 [*\*C. turriculatum*; OD]. Differs from *Protancyloceras* in its helically coiled inner whorls; ribs interrupted on venter. *Upper Jurassic (Tithonian)*: Kurdistan.—FIG. 161, 1a–c. *\*C. turriculatum*;  $\times 1$  (Spath, 1950).

**Parapedioceras** COLLIGNON, 1962a, p. 21 [*\*P. colcanapi*; OD]. Based on a single ancyloceratoid terminal hook. Whorl section high and rectangular; ribs distant, simple, slightly convex, and rursiradiate, with feeble inner and outer ventrolateral tubercles. *Lower Cretaceous (Lower Valanginian)*: Madagascar.—FIG. 160, 1a, b. *\*P. colcanapi*;  $\times 0.75$  (Collignon, 1962a).

### Subfamily BOCHIANITINAE Spath, 1922

[Bochianitinae SPATH, 1922a, p. 147] [=Baculinidae GILL, 1871, p. 3, *nom. oblit.* (taxonomic status of *Baculina*, see below, is doubtful)]

Straight forms, with prorsiradiate annular ribs or smooth. *Upper Jurassic (Lower Tithonian)–Lower Cretaceous (Lower Aptian)*.

**Bochianites** LORY, 1898, p. 133 [*\*Baculites neocomiensis* ORBIGNY, 1842a, p. 560; OD]. With prorsiradiate, annular ribs or smooth. Suture with short elements; U much reduced, no larger than lobule in L. *Upper Jurassic (Lower Tithonian)–Lower*

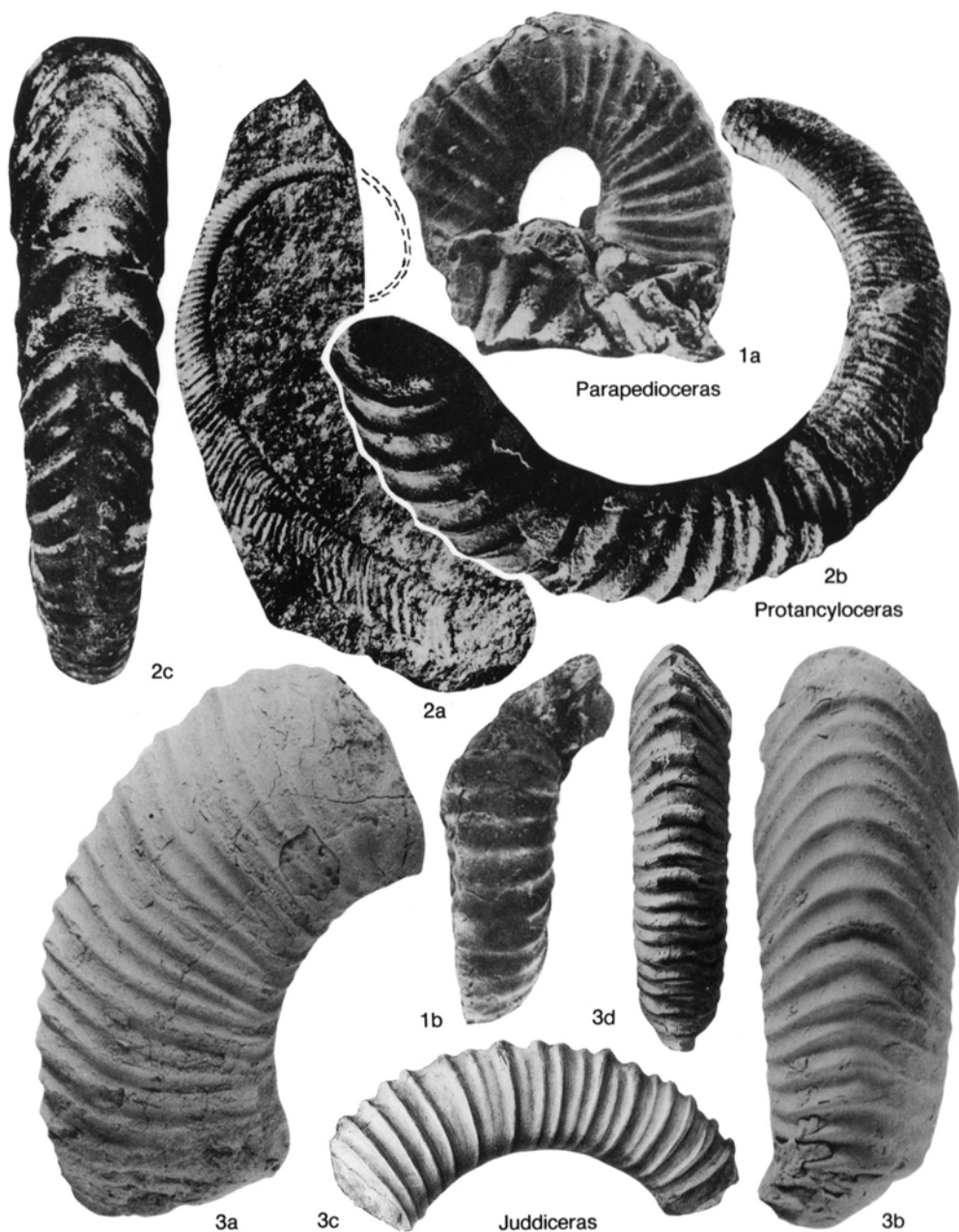


FIG. 160. Bochianitidae (p. 208)

*Cretaceous (Barremian)*: Europe, Cape Verde Islands, northern and southeastern Africa, Madagascar, Himalayas, Indonesia, eastern Siberia, California, Mexico, Russia (Alexandra Land), eastern Greenland. —FIG. 162,3a–c. \**B. neocomiensis* (ORBIGNY), Upper Valanginian, France; *a, b*, restored,  $\times 1$ ; *c*, enlarged (Orbigny, 1842a).

*Umgazaniceras* KLINGER & KENNEDY, 1979, p. 12 [\**U. thieuloyi*; OD]. With distinct, oblique dorsolateral and ventrolateral oblique clavi joined by simple or looped ribs or striae with intercalated ribs or striae. *Lower Cretaceous (Upper Valanginian)*: South Africa. —FIG. 162,2a–d. \**U. thieuloyi*; *a–c*,  $\times 3$ ; *d*,  $\times 9.5$  (Klinger & Kennedy, 1979).





FIG. 161. Bochianitidae (p. 208)

*Baculina* ORBIGNY, 1850a, p. 66 (1849, p. 288, *nom. nud.*) [*\*B. rouyana*; OD]. Smooth; suture pseudoceratitic, with almost entire outlines. Only one specimen known; presumably derived from

*Bochianites*, but relationships uncertain. *Lower Cretaceous (Valanginian)*: France.—FIG. 162, 1a, b. *\*B. rouyana*; a,  $\times 2$ ; b,  $\times 4$  (Cottreau, 1934).

*Janenschites* DURAND DELGA, 1954, p. 137 [*\*Bochianites janenschii* ZWIERZYCKI, 1914, p. 83; OD]. Suture with long and narrow elements, more denticulate than in *Bochianites*. Doubtfully distinct from *Bochianites*. *Lower Cretaceous (Barremian)*: Lake Tanganyika.

*Kabylites* DURAND DELGA, 1954, p. 136 [*\*Bochianites superstes* PERVINQUIÈRE, 1910, p. 22; OD]. Differs from *Bochianites* only in having suture with U more or less the same size as L. *Lower Cretaceous (Barremian–Lower Aptian)*: France, Germany, northern Africa.—FIG. 162, 4. *\*K. superstes* (PERVINQUIÈRE), Barremian, Algeria;  $\times 1$  (Pervinquier, 1910).

### Family ANCYLOCERATIDAE Gill, 1871

[Ancyloceratidae GILL, 1871, p. 3]

Either coiled in a loose or tight, more or less equiangular spiral (criocone) or with an initial spire followed by curved or straight shaft and terminal hook (ancyloceratoid). In several phyletic lines, the tendency is to tighter, normal ammonitic coiling. Whorl section ranging from circular to square or polygonal; tending to develop strong, periodic ribs with umbilical, lateral, and ventrolateral spines, separated by few to many, fine, untuberculate ribs. Ornament rarely constant through growth. Probably strongly dimorphic throughout, but presumed microconchs have rarely been matched with macroconchs; many are here still grouped in a subfamily Heliancyliinae. Sutures florid, with trifid lobes or simplifying. Probably derived by incoiling from *Protancyloceras*. Present division into subfamilies is probably artificial. *Lower Cretaceous (Upper Valanginian–Upper Aptian, ?Lower Albian)*.

### Subfamily CRIOCERATITINAE Gill, 1871

[*nom. transl.* WRIGHT, 1957b, p. 208, ex Cricoceratitidae WRIGHT, 1952, p. 218, *nom. correct.* ex Cricoceratitidae GILL, 1871, p. 3] [=Toxoceratidae GILL, 1871, p. 3; Pedioceratidae HYATT, 1900, p. 587; Himantoceratidae DIMITROVA, 1970, p. 79]

Typically coiled in a regular, plane, loose or tight spiral, but some having irregularly hooked body chambers and possible microconchs having ancyloceratoid coiling (see also Helicanicyliinae); ribbing generally dense; major ribs tuberculate and minor ones

untuberculate; constrictions present or not.  
*Lower Cretaceous (Upper Valanginian–Lower Aptian).*

**Menuthiocrioceras** COLLIGNON, 1949a, p. 75 [\**Crioceras* (*M.*) *lenoblei*; OD]. Whorls touching; whorl section becoming more inflated with growth; venter flat to a late stage; ribs nearly straight and radial at first, then sinuous and finally biconcave, fairly fine and dense; up to 8 plain ribs occurring between enlarged trituberculate ribs. *Lower Cretaceous (Upper Valanginian–Upper Hauterivian):* Madagascar.—FIG. 163,2a,b. *M. hourcqui* COLLIGNON; inner whorls, X1 (Collignon, 1949a).

**Aegocrioceras** SPATH, 1924a, p. 76 [\**Hamites capricornu* F. A. ROEMER, 1841, p. 92; OD] [= ?*Bejucoceras* A. CANTU-CHAPA, 1976, p. 65 (type, *B. simplecostatum*; OD)]. Loosely to tightly coiled, generally in regular, plane spiral; ribs mostly equal and single, crossing venter more or less transversely, uninterrupted except on early whorls in some species; ventrolateral and rarely lateral tubercles may be present on some or all ribs in early stages. RAWSON, 1975b. *Lower Cretaceous (Lower Hauterivian–Upper Hauterivian):* northern Europe, ?Mexico.—FIG. 163,1a–c. *A. bicarinatum* (G. M. YOUNG & BIRD), Lower Hauterivian, England; a, b, X1 (Pavlov, 1892); c, enlarged (Rawson, 1975b).

**Eocrioceratites** WIEDMANN, 1973a, p. 312 [\**Protancyloceras rebillyi* COLLIGNON, 1962a, p. 20; OD]. Main ribs, with 3 tubercles, separated by 1 secondary with no or only feeble lateral tubercle; coiling probably in regular spiral. Doubtfully distinct from *Crioceratites*. *Lower Cretaceous (Upper Valanginian):* Madagascar.—FIG. 163,3a,b. \**E. rebillyi* (COLLIGNON); X0.75 (Collignon, 1962a).

**Crioceratites** LÉVEILLÉ, 1837, p. 313 [\**C. duvalii*; SD DIENER, 1925, p. 191] [= *Crioceras* ORBIGNY, 1842a, p. 457 (illegitimate emendation); ?*Hoplitocrioceras* GIOVINE, 1950, p. 49 (type, *H. gentili*; OD)]. Typically coiled in equiangular spiral, but spiral angle may increase with age; whorl section oval to subquadrate, with more or less trapezoidal top; ribs generally dense, rounded, straight to flexuous, single or bundled at umbilical edge, and untuberculate; stronger major ribs strengthened on shoulders or with ventrolateral or umbilical, lateral, and ventrolateral spines; constrictions may be present. [*Toxoceras* and *Himantoceras* for very loosely coiled forms seem unnecessary.] *Lower Cretaceous (Upper Valanginian–Upper Barremian):* Europe, southern Russia, Turkey, South Africa (Zululand), Madagascar, Japan, California, Mexico, South America.

**C. (Crioceratites)** [= *Toxoceras* ORBIGNY, 1842a, p. 472 (type, *Toxoceras requienianum* ORBIGNY, 1842a, p. 477; SD DIENER, 1925, p. 192); *Himantoceras* THIEULOY, 1965, p. 206 (type, *H. trinodosum*; OD); *Binelliceris* SARKAR, 1977, p. 258 (type, *Ancyloceras binelli* ASTIER, 1851, p. 14; OD)]. Generally with many minor ribs; major ribs with 1 to 3 generally small tubercles; constrictions present or not. Occurrence and

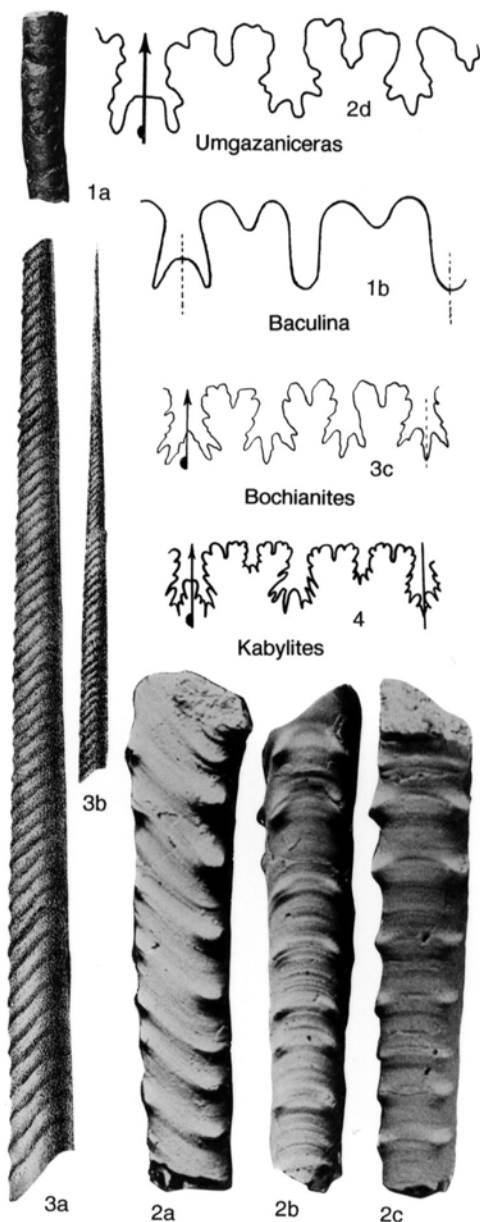


FIG. 162. Bochianitidae (p. 208–210)

distribution as for genus.—FIG. 164,5a–c. *C. (C.) nolani* (KILIAN), Upper Hauterivian, France; a, b, X0.25; c, X0.5 (Orbigny, 1840–1842).—FIG. 164,5d. *C. (C.) trinodosum* (THIEULOY), Upper Valanginian, France; X0.5 (Thieuloy, 1965).—FIG. 164,5e. *C. (C.) binelli* (ASTIER), Upper Hauterivian, France; X1 (Thomel, 1964).  
**C. (Paracrioceras)** SPATH, 1924a, p. 79 [\**Ammonites (Crioceras) occultum* SEELEY, 1865, p. 246; OD]

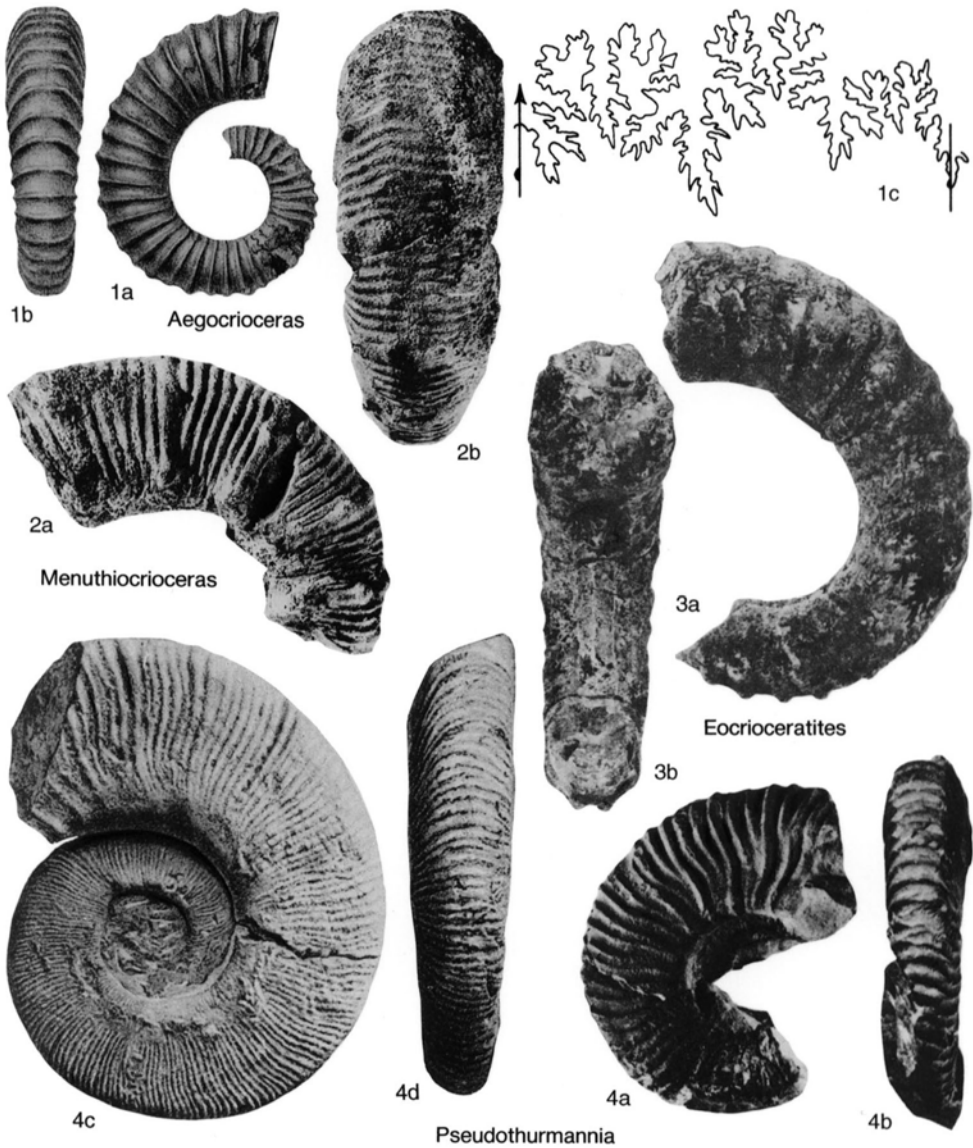


FIG. 163. Ancyloceratidae (p. 211–214)

[=*Emericiceras* SARKAR, 1954b, p. 619(2) (type, *Crioceratites emeric* LÉVEILLÉ, 1837, p. 314; OD)]. Differs from *C. (Crioceratites)* mainly in having more frequent, stronger, periodic ribs, with stronger spines, fewer to no minor ribs, and in greater tendency of later whorls to uncoil; tubercles may weaken and lateral tubercles disappear on body chamber (of questionable microconchs). *Lower Cretaceous (Upper Hauterivian–Upper Barremian)*: Europe, South Africa (Zululand), Japan, South America.—FIG.

164, 3a–c. \**C. (P.) occultum* (SEELEY), Barremian, England; a,  $\times 1$ ; b, c,  $\times 0.75$  (Rawson, 1975a).

*C. (Sornayites)* WIEDMANN, 1962b, p. 140 [*Emericiceras paronai* SARKAR, 1955, p. 97; OD]. Similar to *C. (Paracrioceras)* but with ammonitic coiling. *Lower Cretaceous (Upper Barremian)*: France, northern Italy, Carpathians, southern Russia.

*C. (Spathiocrioceras)* SARKAR, 1955, p. 160 [\**S. sornayi*; OD] [= *Spathiocrioceras (errore pro Spathiocrioceras)* SARKAR, 1954b, p. 620, nom.

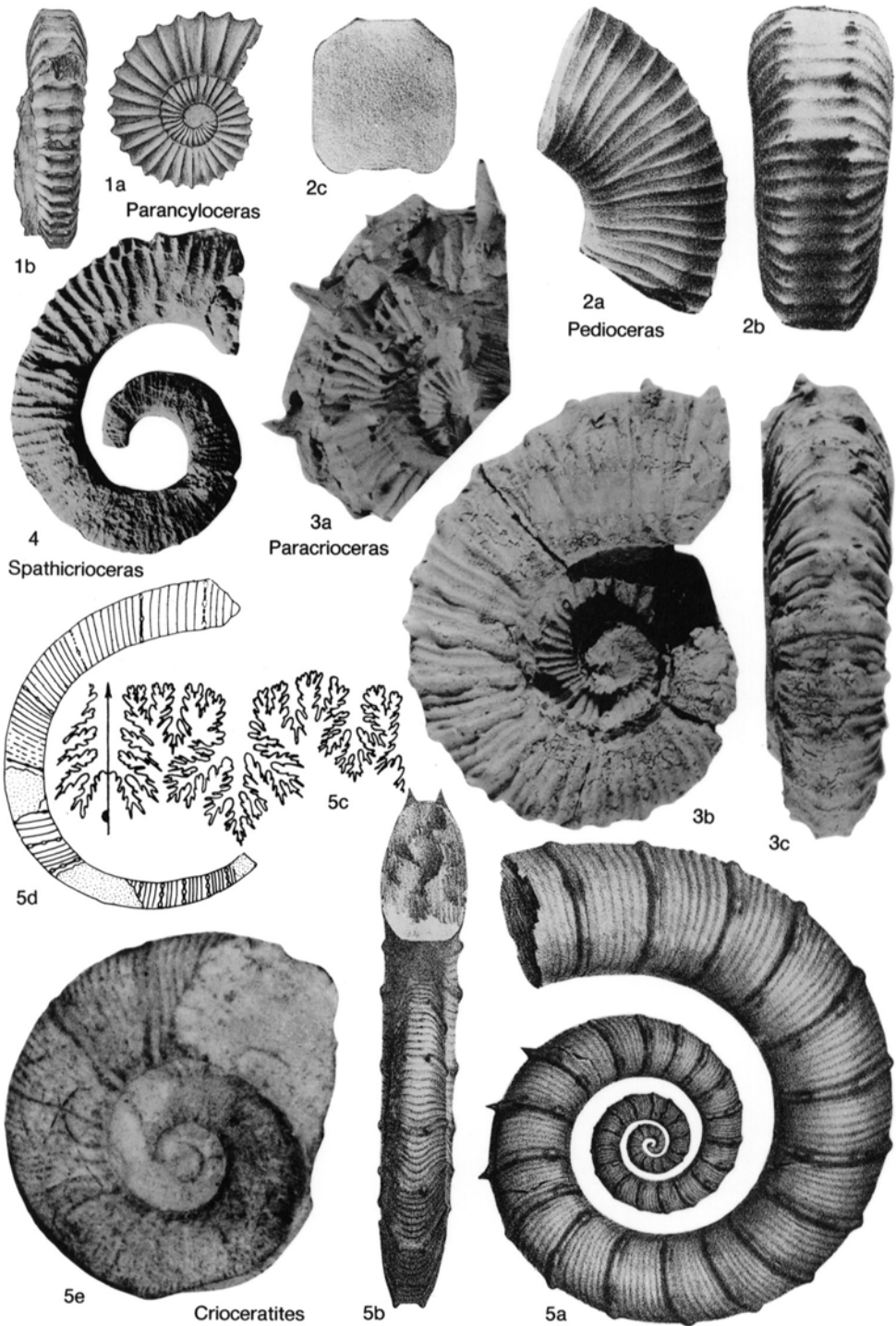


FIG. 164. Ancyloceratinae (p. 211–215)

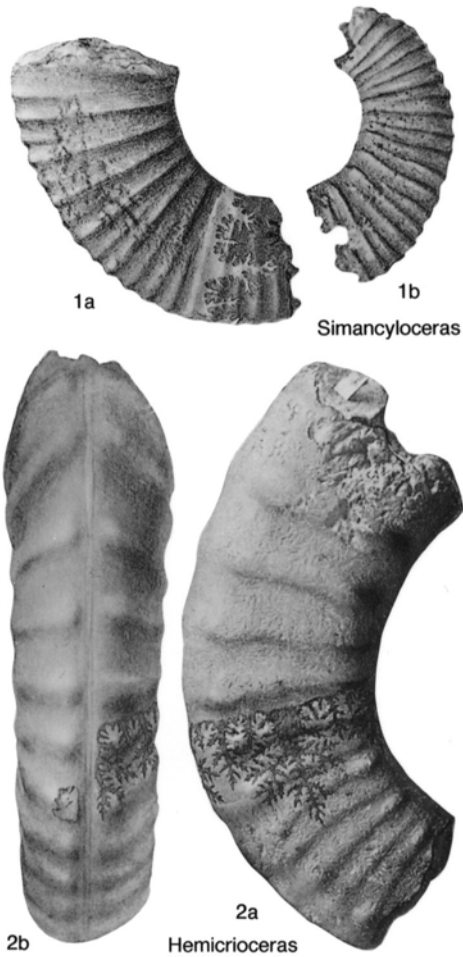


FIG. 165. Ancyloceratidae (p. 214)

*nud.*] Small; early whorls with major ribs having umbilical and lateral tubercles and separated by 2 or 3 minor ribs. Later whorls foreshadow *Pseudothurmannia*, with strong, uniform, distant, and untuberculate ribs branching at umbilical edge. *Lower Cretaceous (Hauterivian)*: southern and central Europe.—FIG. 164, 4. \**C. (S.) sornayi* (SARKAR), France;  $\times 1$  (Sarkar, 1955).

**Megacrioceras** DELANOY, AUTRAN, & THOMEL, 1987, p. 312 [\**Ancyloceras doublieri* JAUBERT, 1854, p. 326; OD]. After early whorls, equiangular spiral straightening into long shaft, probably with terminal hook; periodic, collared constrictions with dense, fine ribs between; no tubercles. Probably macroconch, perhaps of *Paraspinoceras* (see *Helicancyliinae*). *Lower Cretaceous (Upper Hauterivian)*: France, Switzerland.

**Pseudothurmannia** SPATH, 1923d, p. 66 [\**Ammonites angulicostatus* ORBIGNY, 1841, p. 146; OD]

[=*Balearites* SARKAR, 1954a, p. 98 (type, *Crioceras baleari* NOLAN, 1894, p. 193; OD); ?*Georgioceras* WILCKENS, 1947, p. 21 (type, *G. kohllarseni*; OD)]. Whorls not in contact to slightly involute; compressed, with flat or slightly convex sides; venter arched to flat; ribs flexuous, branching from umbilical tubercles or further up sides, fine and dense throughout (*Balearites*) or becoming coarse and distant on outer whorls; weak ventrolateral tubercles may occur on body chamber, lateral tubercles rarely. *Upper Cretaceous (Upper Hauterivian–Lower Barremian)*: southern and central Europe, Turkey, Georgia, ?Russia (Alexandra Land).—FIG. 163, 4a, b. \**P. angulicostata* (ORBIGNY), Lower Barremian, France;  $\times 1$  (Lapeyre, 1974).—FIG. 163, 4c, d. *P. baleari* (NOLAN), Upper Hauterivian, Balearic Islands;  $\times 1$  (Nolan, 1894).

**Pedioceras** GERHARDT, 1897b, p. 170 [\**P. cundinamarcae* GERHARDT, 1897b, p. 172; SD HYATT, 1903, p. 108] [= ?*Pseudocrioceras* SPATH, 1924a, p. 78 (type, *Scaphites abichii* SIMONOVICH & BATSEVICH, 1873, p. 29; OD)]. Early whorls (which may be shallowly helical) involute, subquadrate in section; ribs equal, straight or sinuous, mainly single, angulate or with inner and outer ventrolateral tubercles, weakened or not on venter; later ribs differentiated into minor plain and major trituberculate ribs; outer whorls with looser coiling and weaker and more distant ribbing. *Lower Cretaceous (Barremian–Lower Aptian)*: France, Caucasus, California, Mexico, Colombia.—FIG. 164, 2a–c. \**P. cundinamarcae*, Barremian, Colombia; inner whorls,  $\times 1$  (Gerhardt, 1897b).

**Hemicroceras** SPATH, 1924a, p. 85 [\**Crioceras rude* KOENEN, 1902, p. 311; OD]. Large; coiling questionably crioconic; at first with straight ribs not continuous across venter; later alternate ribs with and without umbilical tubercles but probably all with subdued inner and outer ventrolateral tubercles; later still, all ribs similar and tubercles weaker. Should probably include a wide range of large criocones with early stages having few or no tubercles and later stages with subdued trituberculation and broad, blunt ribs. *Lower Cretaceous (Barremian)*: England, Germany.—FIG. 165, 2a, b. \**H. rude* (KOENEN), Germany;  $\times 1$  (Koenen, 1902).

**Simancyloceras** KEMPER, 1973b, p. 43 [\**S. stolleyi*; OD]. Coiling ancyloceratid; with rather coarse, rounded primary ribs and short intercalatories; typically untuberculate, but some species having weak umbilical and ventrolateral bulges on hook. Perhaps a microconch of *Hemicroceras*. *Lower Cretaceous (Upper Barremian)*: Germany.—FIG. 165, 1a, b. \**S. stolleyi*;  $\times 1$  (Koenen, 1902).

**Parancyloceras** SPATH, 1924a, p. 79 [\**Crioceras bidentatum* KOENEN, 1902, p. 329; OD]. Coiled either in plane spiral (with whorls just touching or not in contact) or straightening (possibly then hooked) after a few coiled whorls; ribs uniform, distant, sharp, equal, steep, radial or oblique, with more or less distinct outer and (in some species) also inner ventrolateral tubercles; ribs may be

doubled between outer tubercles. *Lower Cretaceous (Upper Barremian)*: England, Germany.—FIG. 164, 1a, b. *P. bidentatum* (KOENEN), Germany;  $\times 1$  (Koenen, 1902).

**Spinocrioceras** KEMPER, 1973b, p. 47 [*\*S. polyspinosum*; OD]. Inner whorls presumably having sharp umbilical, midlateral, and inner ventrolateral tubercles and feebler outer ventrolateral tubercles on equal ribs; umbilical, midlateral, and inner ventrolateral tubercles persisting. *Lower Cretaceous (Upper Barremian)*: Germany.—FIG. 166, 3. *\*S. polyspinosum*;  $\times 0.5$  (Kemper, 1973b).

?**Acantholytoceras** SPATH, 1923d, p. 21 [*\*Hamites (Pictetia) longispinus* UHLIG, 1883, p. 222(96); OD] [=?*Pseudocrioceratites* EGOIAN, 1969, p. 171 (type, *P. pseudoelegans*; OD)]. Crioconic, with whorls well separated; whorl section oval; distant, periodic, enlarged ribs with very long, hollow umbilical, lateral, and ventrolateral spines; other ribs very fine. Suture (attributed to this species by UHLIG) florid, with slightly asymmetrically bifid L. Relationships doubtful until better material is available. *Lower Cretaceous (Barremian)*: Austria. *Lower Cretaceous (?Aptian)*: Caucasus.—FIG. 166, 2. *\*A. longispinum* (UHLIG), Barremian, Austria;  $\times 0.5$  (Uhlig, 1883).

?**Shastrioceras** ANDERSON, 1938, p. 203 [*\*S. poniente*; SD WRIGHT, 1957b, p. 208]. Medium-sized to large; whorls just touching or not; compressed, with slightly convex sides and flat venter; ribs sinuous or biconcave, rarely branching or intercalated, each with round or clavate ventrolateral tubercle; ribs may become coarse and distant on body chamber. Suture with wide-necked L. *S. anglicum* DOYLE (1963, p. 575), Lower Hauterivian, England, is loosely coiled and has L with narrow neck but probably belongs here. *Lower Cretaceous (?Lower Hauterivian, Lower Barremian–Upper Barremian)*: ?England, Japan, California.—FIG. 166, 1. *\*S. poniente*, Upper Barremian, California;  $\times 1$  (Anderson, 1938).

[*Neohoplites* GERTH, 1921, p. 144 (*nom. nud.*)].

### Subfamily ANCYLOCERATINAE Gill, 1871

[*nom. transl.* WRIGHT, 1957b, p. 210, ex Ancyloceratidae GILL, 1871, p. 3]

Typically large forms with early whorls forming a more or less regular, open, plane spire followed by curved or straight shaft and terminal hook, commonly with trituberculate main ribs and fine intermediaries. Suture normally florid, with trifid L. *Lower Cretaceous (Lower Barremian–Upper Aptian, ?Lower Albian)*.

The trend along several phylogenetic lines is to increasingly close coiling, differentiation of ornament on the hook, and loss of trituberculation, at least in middle growth.



1  
Shastrioceras



2  
Acantholytoceras



3  
Spinocrioceras

FIG. 166. Ancyloceratidae (p. 215)

In other lines the shaft straightens and lengthens to produce pythoceratoid coiling. Small forms with similar coiling and ornament are here grouped as Helicancylinae but may be a collection of microconchs of Crioceratitinae and Ancyloceratitinae. Origin appears to lie in *Crioceratites* (*Paracrioceras*). THOMEL, 1964.

**Ancyloceras** ORBIGNY, 1842a, p. 491 [\**A. matheronianum* ORBIGNY, 1842a, p. 497; SD HAUG, 1889, p. 212] [= *Hoplancyloceras* NOWAK, 1913, p. 382, *nom. nud.*]. Open, plane spiral followed by long shaft and terminal hook; ribs straight, radial or prorsiradiate, with periodic, enlarged trituberculate ribs at least on early whorls and hook. Known with *Praestriaptychus*. *Lower Cretaceous* (*Lower Barremian–Lower Aptian*): Europe, southeastern Africa, Madagascar, Japan, California, Colombia.

**A. (Ancyloceras)**. Trituberculate major ribs throughout. Occurrence and distribution as for genus.—FIG. 167,2. \**A. (A.) matheronianum*, Lower Aptian, France;  $\times 0.125$  (Orbigny, 1840–1842).

**A. (Audouliceras)** THOMEL, 1964, p. 55 [\**Ancyloceras audouli* ASTIER, 1851, p. 22; OD]. Initial spire with more or less irregular, wide spines disappearing early or late; shaft long, at least some part with no major trituberculate ribs; hook may be much inflated, with very strong ribs and spines. *Lower Cretaceous* (*Upper Barremian–Lower Aptian*): western and central Europe, Mozambique, South Africa (Zululand), California.—FIG. 167,1a,b. \**A. (A.) audouli*, ?Barremian, France;  $\times 0.25$  (Klinger & Kennedy, 1977).

**A. (Jaubertites)** SARKAR, 1955, p. 98 (1954b, p. 619(2), *nom. nud.*) [\**J. dubius*; OD]. Only rather closely coiled spires known, with dense, fine ribs and, periodically, wide umbilical, lateral, and ventrolateral spines irregularly overriding several ribs. Possibly a senior synonym of *Audouliceras*. At present a *nomen dubium*. *Lower Cretaceous* (*Lower Barremian*): France.

**A. (Tonoceras)** HYATT, 1900, p. 537 [\**Ancyloceras duvalianum* ORBIGNY, 1842a, p. 500; OD]. Differs from *A. (Ancyloceras)* in its shorter, curved shaft and prominent, clavate lateral and ventrolateral tubercles. Doubtful taxon; KILIAN and REBOUL, 1915 regarded type species as a *Crioceratites* from the Upper Hauterivian. *Lower Cretaceous* (*Lower Aptian*): France.

‡**Moutoniceras** SARKAR, 1954b, p. 620(3) [\**Toxoceras moutonianum* ORBIGNY, 1850a, p. 101; OD]. Very large, with loose, crioconic spire followed by long shaft and hook; ribs simple, projected, and in some interrupted on venter; dorsal intercalated ribs present in some species; inner and outer ventrolateral tubercles may be present at end of spire and beginning of shaft; constrictions commonly present on spire. Suture florid. Perhaps should be placed in

Crioceratitinae. *Lower Cretaceous* (*Barremian*): France, central Europe, Colombia.—FIG. 168,2a–c. \**M. moutonianum* (ORBIGNY), France; a,b,  $\times 0.5$  (Cottreau, 1937); c,  $\times 0.25$  (Sarkar, 1955).

**Acanthoptychoceras** MANOLOV, 1962, p. 529 [\**A. spinatocostatum*; OD]. Based on fragment of straight shaft and large terminal hook with strong trituberculate ribs. Possibly a *Hamulina* but more probably *Lithancylus* or *Audouliceras*. At present a *nomen dubium*. *Lower Cretaceous* (*Lower Barremian*): Bulgaria, ?Colombia.

**Lithancylus** CASEY, 1960c, p. 16 [\**Hamites grandis* J. DE C. SOWERBY, 1828, p. 187; OD]. Probably with small initial coil followed by long, slender shaft as in *Hamulina* with fine, oblique ribbing and terminal hook and short final shaft with coarse, trituberculate major ribs. Probably derived from *Ancyloceras* (*Audouliceras*) by lengthening of shaft and reduction of spire. *Lower Cretaceous* (*Barremian–Lower Aptian*): England, Austria, Mozambique, Australia (Queensland), California, Argentina (Patagonia), Antarctica (Alexander Island).—FIG. 167,3. *L. tirolensis* CASEY, Upper Barremian, Austria;  $\times 0.5$  (Casey, 1960c).

**Shastoceras** ANDERSON, 1938, p. 212 [\**S. californicum*; OD]. Very large; spire rather compressed, with feeble ribs that may have bullate ventrolateral tubercles; shaft becoming more inflated, smooth or with faint oblique ribs; hook inflated, rounded, and smooth, with a few enlarged ribs at end. *Lower Cretaceous* (*Lower Aptian*): California.—FIG. 167,4. \**S. californicum*;  $\times 0.2$  (Anderson, 1938).

**Peltocrioceras** SPATH, 1924a, p. 85 [\**Crioceras deeckei* FAVRE, 1908, p. 636; OD]. Rather close, crioconic coiling; ribs more or less uniform, fine at first, coarsening gradually, all trituberculate. *Lower Cretaceous* (*Upper Aptian*): Argentina (Patagonia).—FIG. 168,3. \**P. deeckei* (FAVRE);  $\times 0.125$  (Urreta, 1985).

**Australiceras** WHITEHOUSE, 1926, p. 208 [\**Crioceras jacki* R. ETHERIDGE, JR., 1880, p. 305; OD] [= *Colombiaticeras* ROYO Y GOMEZ, 1945, p. 469 (type, *C. bolivari*; OD); *Proaustraliceras* KAKABADZE, 1977, p. 132 (type, *Hamites gigas* J. DE C. SOWERBY, 1828, p. 188; OD)]. Coiling in early species more or less ancyloceratoid, with closely coiled spire and distinct hook; later species closely coiled criocones; initial whorls with trituberculate ribs, middle whorls with fine, mainly untuberculate ribs, and body chamber normally with enlarged, trituberculate ribs. [Subgeneric distinction based on minor coiling and sutural differences seems unnecessary.] *Lower Cretaceous* (*Lower Aptian–Upper Aptian*): England, France, Germany, Caucasus, South Africa (Zululand), Madagascar, Pakistan, Japan, Australia, California, Colombia.—FIG. 169,1a. \**A. jacki* (ETHERIDGE), Lower Aptian, Australia (Queensland); inner whorls,  $\times 0.75$  (Whitehouse, 1926).—FIG. 169,1b. *A. gigas* (J. DE C. SOWERBY), Lower Aptian, England;  $\times 0.25$  (Casey, 1960c).

**Pseudoaustraliceras** KAKABADZE, 1981, p. 114 [\**Crioceras ramosseptatum* ANTHULA, 1899, p.

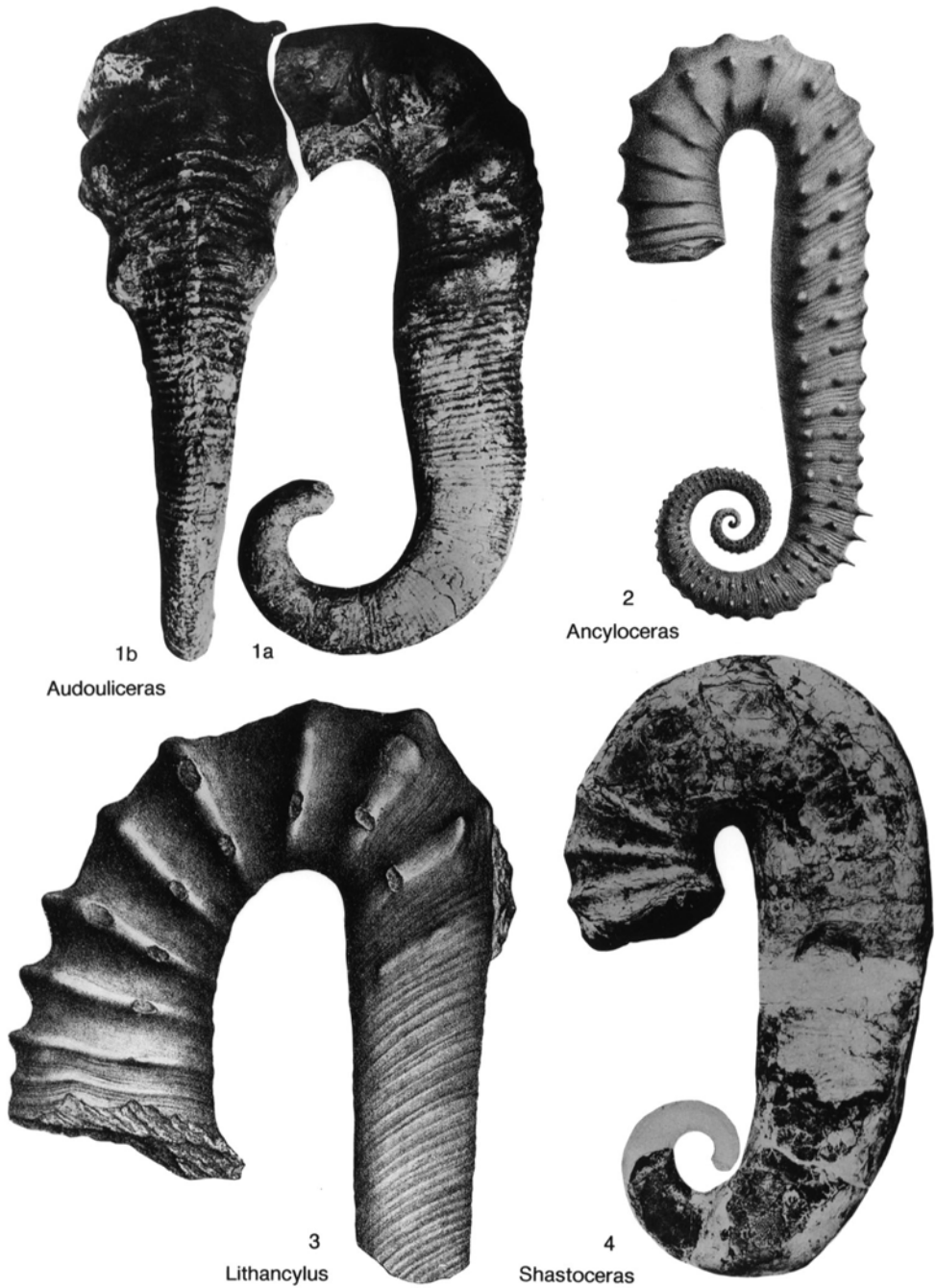


FIG. 167. Ancyloceratidae (p. 216)

127(73); OD]. Differs from *Australiceras* only in early whorls having dense, equal ribs without tubercles. Doubtfully distinct. *Lower Cretaceous (Aptian)*: Georgia, Angola, Madagascar, Colombia.

*Tropaeum* J. DE C. SOWERBY, 1837, p. 535 [\**T. bowerbanki*; OD (*nom. nud.*); =*Crioceratites bowerbanki* J. DE C. SOWERBY, 1840, p. 410]. Very large; differs from *Australiceras* by progressive loss of



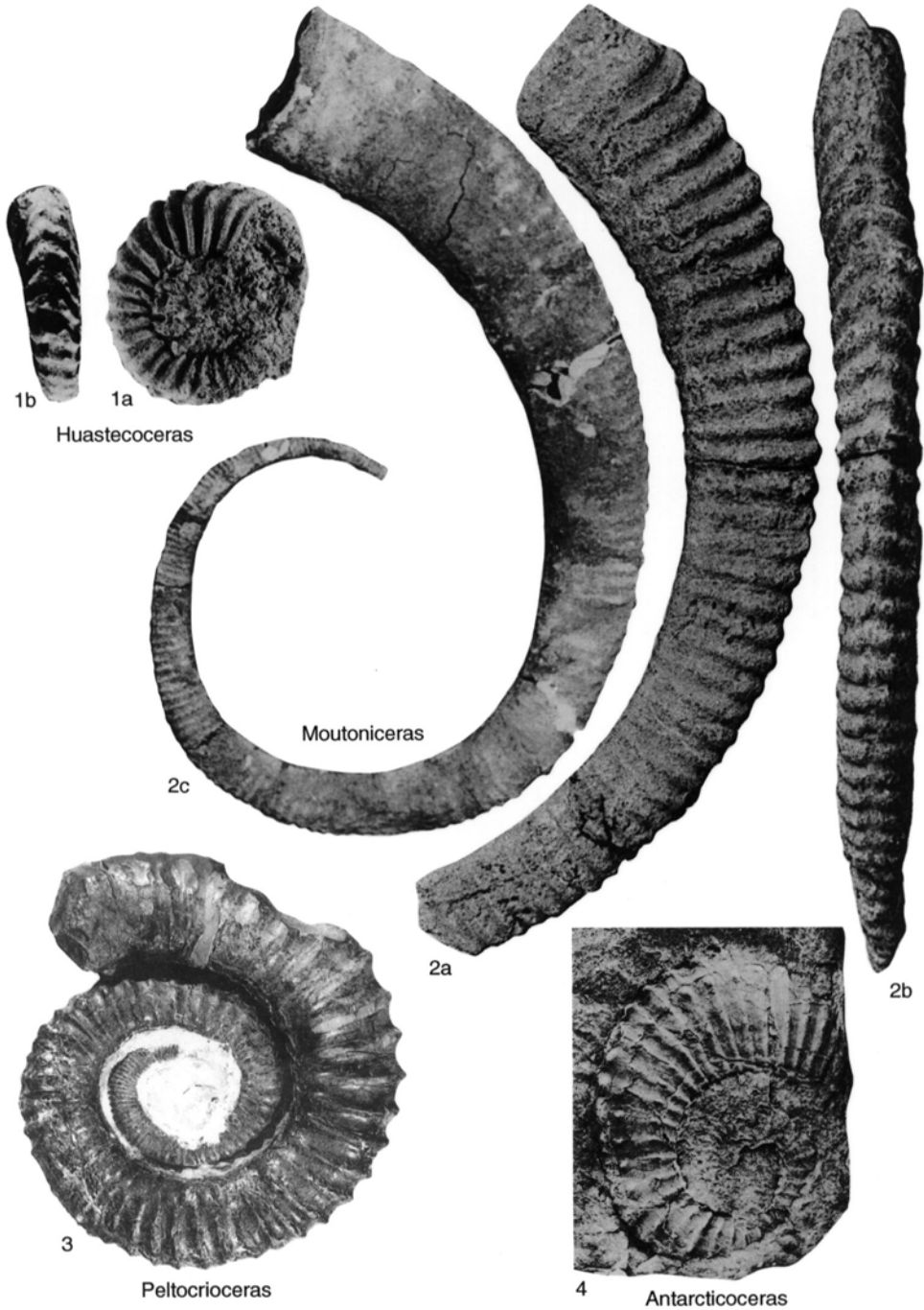


FIG. 168. Ancyloceratidae (p. 216–222)

tubercles; earliest whorls with some trituberculate ribs; then all ribs fine and dense, normally no more than slightly angulate on shoulders, until last whorl, on which they may become coarse and distant.

*Lower Cretaceous (Lower Aptian–Upper Aptian):* Europe, Russia, western and southeastern Africa, Madagascar, India, Australia, Alaska, California, Argentina (Patagonia), Greenland.

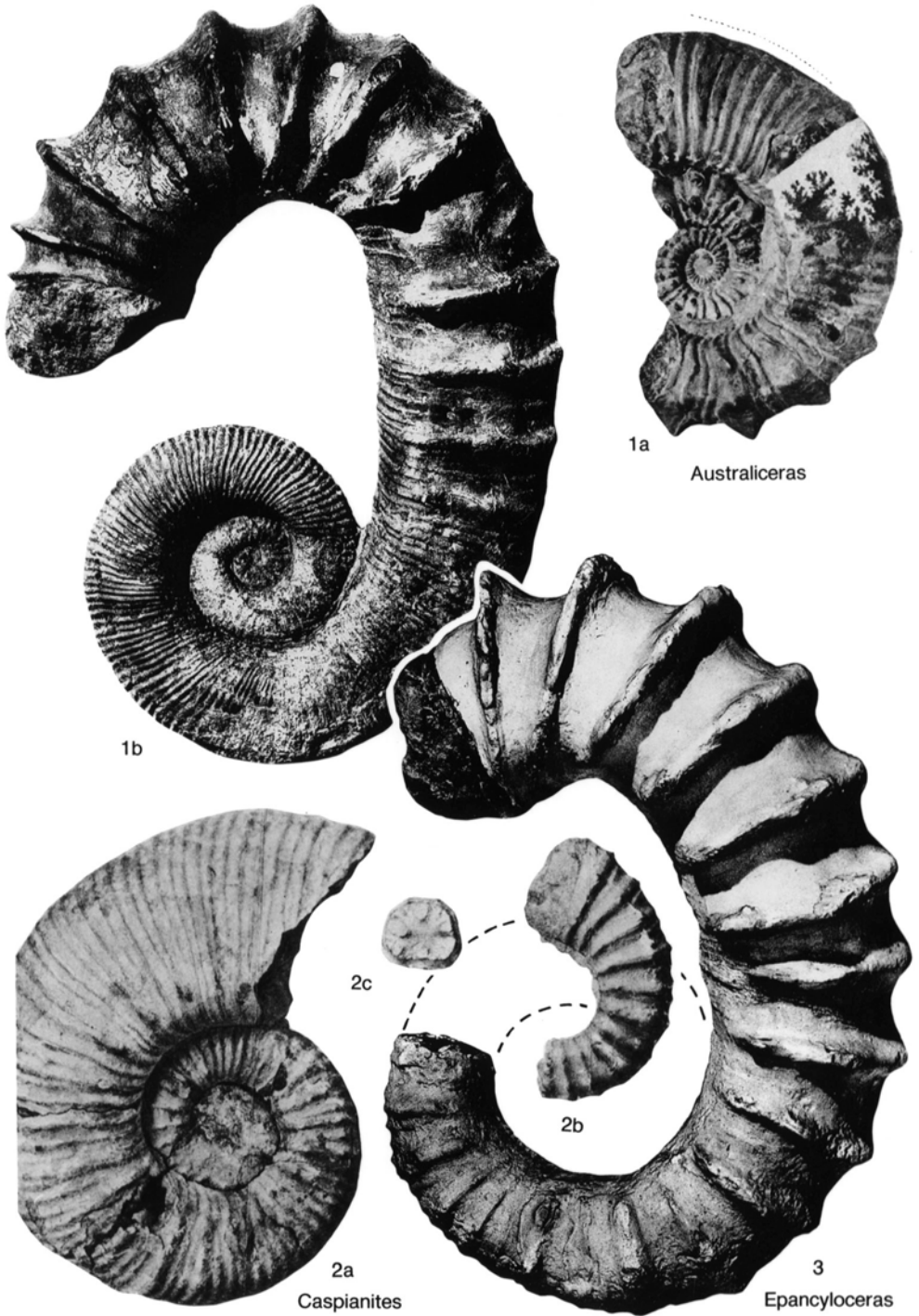


FIG. 169. Ancyloceratidae (p. 216–222)

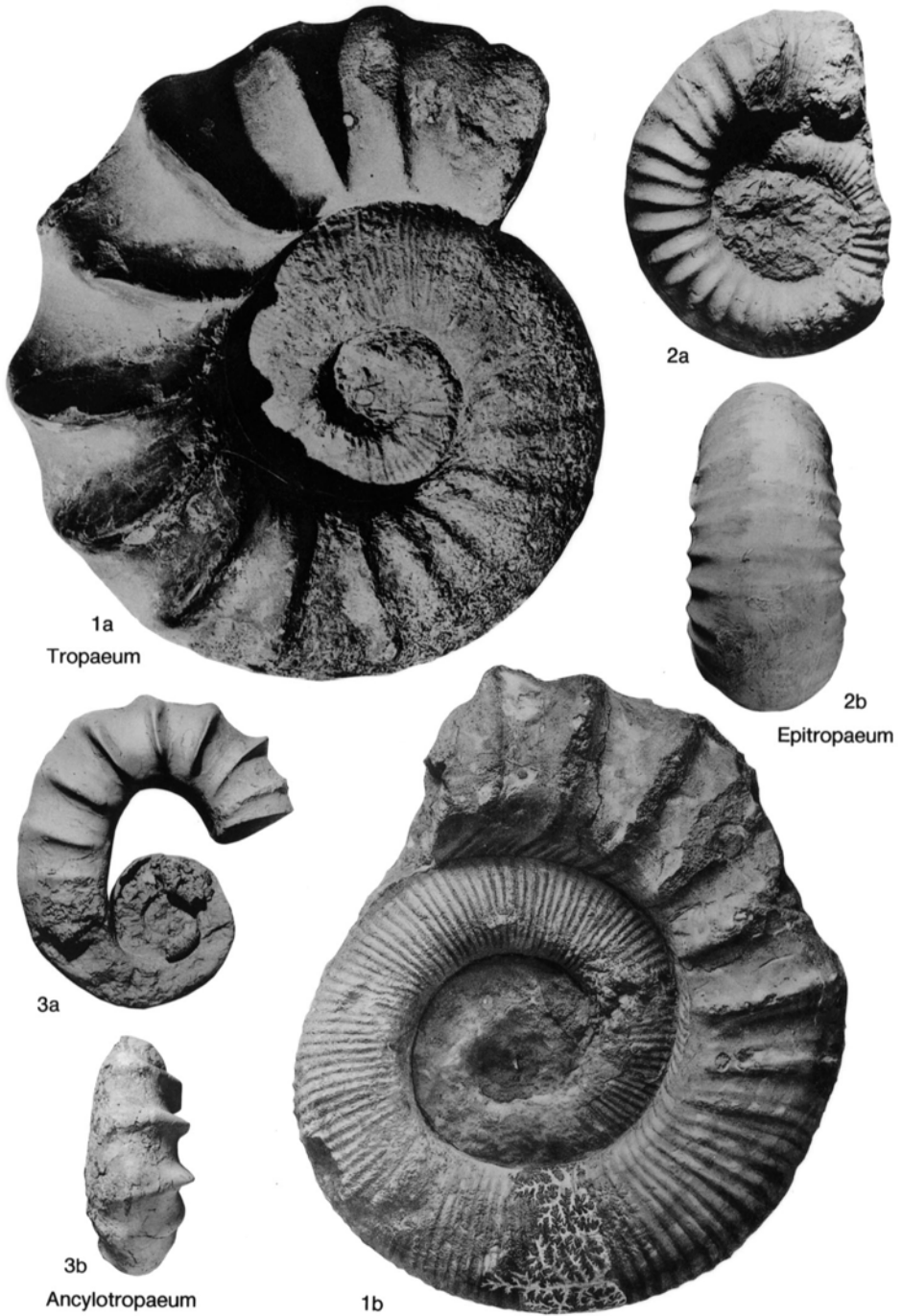


FIG. 170. Ancyloceratidae (p. 220–221)

T. (*Epitropaeum*) KAKABADZE, 1977, p. 132 [\**T. subarcticum* CASEY, 1960c, p. 40; OD]. Body chamber with prolonged contraction and with

uniform ribbing tending to disappear on venter. *Lower Cretaceous (Upper Aptian)*: western Europe, Russia, South Africa (Zululand).—FIG.

170,2a,b. \**T. (E.) subarcticum*, England;  $\times 0.1$  (Casey, 1980).

**T. (Tropaeum)** [=?*Australotropaeum* URRETA, 1985, p. 192 (type, *T. (A.) magnum*; OD)]. Body chamber just in contact or uncoiled, with short contraction and bold, distant ribbing. Occurrence and distribution as for genus.—FIG. 170,1a. \**T. (T.) bowerbanki* (J. DE C. SOWERBY), Lower Aptian, England;  $\times 0.25$  (Casey, 1960c).—FIG. 170,1b. *T. (T.) drewi* CASEY, Lower Aptian, Germany;  $\times 0.25$  (Koenen, 1902).

**T. (Ancylostropaeum)** CASEY, 1980, p. 639 [\**T. (A.) baylissi*; OD]. Body chamber a massive hook with depressed-suboctagonal section and bold, feebly trituberculate ribs. *Lower Cretaceous (Upper Aptian)*: England.—FIG. 170,3a,b. \**T. (A.) baylissi*;  $\times 0.1$  (Casey, 1980).

**Helicancyloceras** KLINGER & KENNEDY, 1977, p. 325 [\**Heteroceras (Argvethites?) vohimaranitraense* COLLIGNON, 1962b, p. 14; OD] [= *Nonyaniceras* KLINGER & KENNEDY, 1977, p. 327 (type, *Helicancyloceras (N.) nonyani*; OD)]. Medium-sized, with initial, shallow, open helix followed by closely coiled, planispiral whorls; helix with strong, rounded ribs; ribs regular with slight ventral interruption and small ventrolateral tubercles to irregular with strong lateral and ventrolateral tubercles on all or some; outer whorls untuberculate. Probably derivative of *Tropaeum*. *Lower Cretaceous (Upper Aptian)*: South Africa (Zululand), Madagascar.—FIG. 171a–c. \**H. vohimaranitraense* (COLLIGNON), Zululand; a,  $\times 0.5$ ; b,c,  $\times 1$  (Klinger & Kennedy, 1977).—FIG. 171d,e. *H. nonyani* (KLINGER & KENNEDY), Zululand;  $\times 1$  (Klinger & Kennedy, 1977).

**Ammonitoceras** DUMAS, 1876, p. 405 [\**A. ucetiae*; OD]. Criocone; body chamber may touch preceding whorl or not; whorl section depressed and coronate, as in some *Chelonicerases*; with periodic, septate umbilical and lateral spines, from which ribs may branch, and, in young, feeble ventrolateral tubercles; body chamber with coarse, single ribs as in *Tropaeum*. Suture with narrow E, very narrow E/L, and long, asymmetrically trifid L. *Lower Cretaceous (Lower Aptian–Upper Aptian)*: England, France, Transcaasia, Turkey, southeastern Africa.—FIG. 172a. \**A. ucetiae* DUMAS, Lower Aptian, France;  $\times 0.2$  (Casey, 1960c).—FIG. 172b,c. *A. lahuseni* (SINZOW), Upper Aptian, Mangyshlak;  $\times 0.2$  (Sinzow, 1906).—FIG. 172d. *A. aff. lahuseni* (SINZOW), Lower Aptian, southern Russia;  $\times 0.5$  (Vasilievskij, 1909).

**Epancyloceras** SPATH, 1930a, p. 454 [\**E. hythense*; OD]. Much as in *Ammonitoceras* but with short, curved shaft, hook, and strong ventrolateral tubercles on early and adult whorls. Holotype of type species is malformed. *Lower Cretaceous (Lower Aptian)*: England, ?France, Switzerland.—FIG. 169.3. \**E. hythense*, England;  $\times 0.2$  (Casey, 1960c).

**Caspianites** CASEY, 1961a, p. 56 [\**Crioceras (Ammonitoceras) wassiliewskyi* RENNGARTEN, 1926, p. 30; OD]. Differs from *Ammonitoceras* in its more delicate ornament and persistent ventral tubercles.

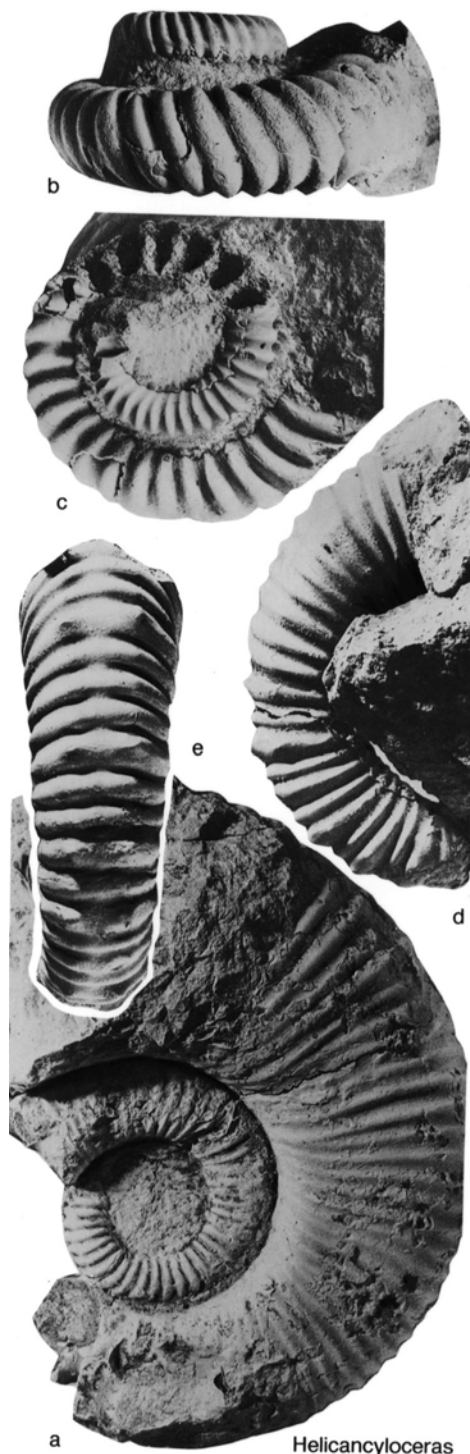


FIG. 171. Ancyloceratina (p. 221)

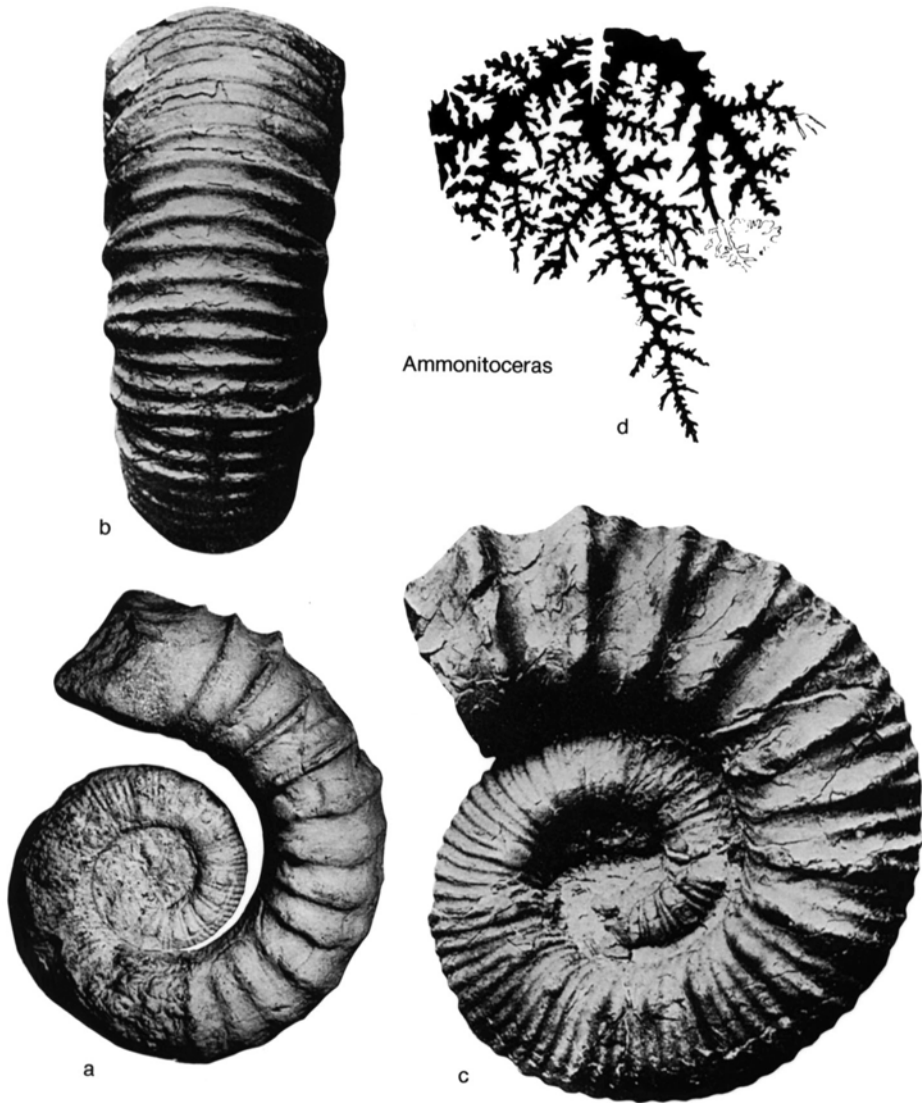


FIG. 172. Ancyloceratidae (p. 221)

On nucleus, all primary ribs trituberculate; intermediaries confined to venter. *Lower Cretaceous (Aptian)*: England, Transcaspia.—FIG. 169, 2a–c. \**C. wassiliewskyi* (RENNGARTEN), Transcaspia;  $\times 1$  (Sinzow, 1908).

?*Antarcticoceras* THOMSON, 1974, p. 20 [\**A. antarcticum*; OD]. Small criocone with regular, distant, simple ribs; at first with umbilical and inner and outer ventrolateral tubercles; later with umbilical tubercles moving up sides and then disappearing. Comparable to inner whorls of *Caspianites*. *Lower Cretaceous (?Lower Albian)*: Antarctica

(Alexander Island).—FIG. 168, 4. \**A. antarcticum*;  $\times 1$  (Thomson, 1974).

?*Huastecoceras* C. M. CANTU-CHAPA, 1976, p. 12 [\**Crioceras trispinosoides* BURCKHARDT, 1925, p. 42; OD]. Criocone; ribs strong, flexuous, with umbilical and inner ventrolateral tubercles; ribs bending forward strongly from inner to outer ventrolateral tubercles, forming chevrons on venter. Perhaps close to *Caspianites*. *Lower Cretaceous (Upper Aptian)*: Mexico.—FIG. 168, 1a, b. \**H. trispinosoides* (BURCKHARDT);  $\times 1$  (C. M. Cantu-Chapa, 1976).

## Subfamily HELICANCYLINAE

Hyatt, 1894

[*nom. transl.* CASEY, 1961a, p. 76, ex *Helicancylidae* HYATT, 1894, p. 565] [=Protacrioceratidae DIMITROVA, 1970, p. 85; Epacrioceratidae EGOIAN, 1974, p. 939]

Small; coiling variable, with or without distinct shaft and terminal hook; initial whorls in some cases shallowly helical; ornament generally differentiated between spire and hook. *Lower Cretaceous (Upper Hauterivian–Upper Aptian)*.

Not a natural subfamily but a collection of small forms and microconchs of various late Crioceratitinae and Ancyloceratinae. Possible microconchs of earlier Crioceratitinae are merely rather smaller forms of those species with differentiated ornament on the body chamber; the hooked form only appears in late Hauterivian.

**Acrioceras** HYATT, 1900, p. 587 [*\*Ancyloceras tabarelli* ASTIER, 1851, p. 453(19); OD] [=Mesocrioceras BREISTROFFER, 1951a, p. 54, *nom. nud.* (no designation of type species, no differentia)]. Small; spire of 1 or 2 loosely coiled whorls followed by short or long, straight or curved shaft, terminal hook, and short or long final shaft; ribs generally fine and untuberculate, but sometimes major ribs enlarged and carrying 1 to 2 tubercles; ribs single on spire and shaft but may branch from umbilical tubercles on hook and final shaft; dorsum tending to become flat and dorsolateral margin to become angular on shaft and hook. *Lower Cretaceous (Upper Hauterivian–Lower Aptian)*: western and central Europe, Caucasus, Madagascar, Japan, California.

**A. (Acrioceras)**. With long, straight shaft and trituberculate major ribs on spire and shaft. Occurrence and distribution as for genus.—FIG. 173,1. *\*A. (A.) tabarelli* (ASTIER), Lower Barremian, France;  $\times 1$  (Sarasin & Schöndelmayer, 1902).

**A. (Protacrioceras)** SARKAR, 1955, p. 101 [*\*Ancyloceras ornatum* ORBIGNY, 1850a, p. 101; OD]. Short, curved shaft; trituberculate major ribs; ornament hardly differentiated on hook. *Lower Cretaceous (Upper Hauterivian–Lower Barremian)*: France, central Europe, Madagascar.—FIG. 173,3. *\*A. (P.) ornatum* (ORBIGNY), Lower Barremian, France;  $\times 1$  (Sarkar, 1955).

**A. (Paraspinoceras)** SARKAR, 1955, p. 101 (BREISTROFFER, 1952c, p. 54, virtual *nom. nud.* for lack of differentia) [*\*Ancyloceras pulcherrimum* ORBIGNY, 1842a, p. 495; OD]. Shaft long; major ribs, if present, untuberculate; whorl height increasing rapidly. *Lower Cretaceous (Upper Hauterivian–Lower Barremian)*: France, central Europe.—FIG. 173,2. *\*A. (P.) pulcherrimum*

(ORBIGNY), Upper Hauterivian or Lower Barremian;  $\times 0.75$  (Thomel, 1964).

**A. (Dissimilites)** SARKAR, 1954b, p. 618(1) [*\*Hamites dissimilis* ORBIGNY, 1842a, p. 529; OD]. Straight shaft having trituberculate major ribs and long final shaft with ribs branching from distinct umbilical tubercles. *Lower Cretaceous (Barremian–Lower Aptian)*: France, Austria, Romania, California.—FIG. 173,4. *\*A. (D.) dissimilis* (ORBIGNY), Barremian, Austria;  $\times 1$  (Uhlig, 1883).

**A. (Epacrioceras)** EGOIAN, 1974, p. 940 [*\*E. rarum*; OD]. Spire with trituberculate main ribs, shaft without. Doubtfully distinct. *Lower Cretaceous (Aptian)*: Caucasus.—FIG. 173,5a,b. *\*A. (E.) rarum* (EGOIAN);  $\times 1$  (Egoian, 1974).

**Lytocrioceras** SPATH, 1924a, p. 84 [*\*Ancyloceras jauberti* ASTIER, 1851, p. 455(25); OD]. Loosely coiled, with long shafts and irregular hook; whorl section increasing very slowly; periodic, trituberculate ribs on spire, but otherwise all ribs equal, dense, fine, and straight. *Lower Cretaceous (Barremian)*: France, Switzerland.—FIG. 174,1. *\*L. jauberti* (ASTIER), France; diagram,  $\times 0.3$  (Trueman, 1941).

**Hoplocrioceras** SPATH, 1924a, p. 78 [*\*Hamites phillipsi* PHILLIPS, 1829, p. 124; OD] [=?Aspinoceras ANDERSON, 1938, p. 207 (type, *A. hamlini*; OD); Subaspinoceras THOMEL, DELANOY, & AUTRAN, 1987, p. 216 (type, *Ancyloceras mulsanti* ASTIER, 1851, p. 448(18); OD)]. Variably open spire followed by curved shaft and gently rounded hook; ribs irregularly long and short; no tubercles. [Horizon of *Aspinoceras* is uncertain but probably Hauterivian rather than Valanginian as stated by ANDERSON.] RAWSON, 1975a. *Lower Cretaceous (Upper Hauterivian–Lower Barremian)*: western Europe, California.—FIG. 175,3a–d. *\*H. phillipsi* (PHILLIPS), Lower Barremian, England;  $\times 0.75$  (Rawson, 1975a).—FIG. 175,3e. *H. dilatatum* (ORBIGNY), Lower Barremian, France;  $\times 0.75$  (Orbigny, 1840–1842).

**Toxoceratoides** SPATH, 1924a, p. 78 [*\*Toxoceras royerianum* ORBIGNY, 1842a, p. 481; OD]. Small initial spire followed by more or less curved shaft and short final hook; ornament as in *Ancyloceras*, but final hook with close, narrow, sharp ribs branching in twos or threes from umbilical tubercles. *Lower Cretaceous (Upper Barremian–Lower Aptian)*: Europe, western Asia, eastern Africa, South Africa (Zululand), ?Australia (Queensland), California, Argentina (Patagonia), Antarctica.—FIG. 176,2a–c. *\*T. royerianus* (ORBIGNY), Lower Aptian, France;  $\times 1$  (Casey, 1961a).

**Tonohamites** SPATH, 1924a, p. 85 [*\*T. decurrens*; OD] [=?Colomboceratoides ETAYO SERNA, 1979, p. 20 (type, *Toxoceratoides (Colomboceratoides) renzoni*; OD)]. Like *Toxoceratoides* but tuberculation reduced and less persistent, in some cases confined to venter, and ribs blunter, not branching on final hook. *Lower Cretaceous (Lower Aptian–Upper Aptian)*: England, Spain, Germany, ?Georgia, South

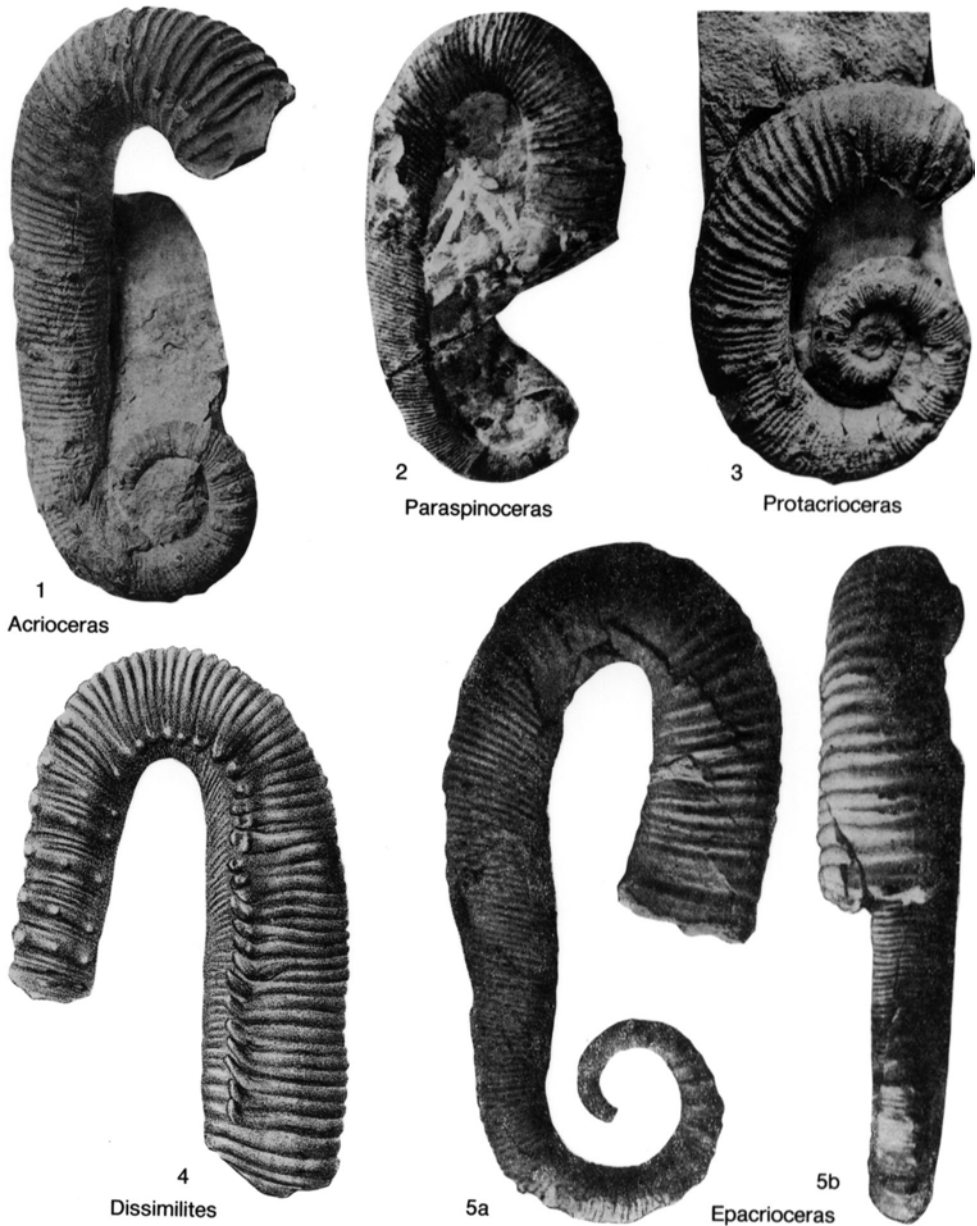


FIG. 173. Ancyloceratidae (p. 223)

Africa (Zululand), Madagascar, Argentina (Patagonia), ?Colombia.—FIG. 176, 1a, b. \**T. decurrens*, Lower Aptian, England;  $\times 1$  (Casey, 1960c).

*Helicancyclus* GABB, 1869, p. 140 [\**Ptychoceras aequicostatum* GABB, 1864, p. 74; M] [= *Hamiticeras* ANDERSON, 1938, p. 215 (type, *H. pilsburyi*; OD)]. With long, subparallel shafts, presumably after initial spire; ribs on main shaft alternately simple and uni- or trituberculate; ribs on final shaft sharp and

distant, without tubercles. [The type species by monotypy of *Helicancyclus* is *Ptychoceras aequicostatum* GABB, 1864. GABB indicated that he had an unspecified number of specimens attributed to this species; he figured one (pl. 13, fig. 20), which consists of part of a body chamber hook and straight shaft. ANDERSON (1938, p. 217), referring to this specimen, wrote: "The holotype of this species, a fragment of the body chamber only, is in the Mu-

seum of Paleontology, University of California.” This may be taken as a valid lectotype designation. ANDERSON illegitimately placed this species in his new genus *Hamiticer*, restricting *Helicancyclus* to a form with strongly trituberculate, helical early whorls, which he named *H. gabbi*. According to ANDERSON, *aequicostatus* has weak ventrolateral tubercles irregularly on the ribs of the main shaft, compared with the strongly trituberculate alternate ribs of *Hamiticer* *pilsburyi* ANDERSON, the designated type species of *Hamiticer*. However, *aequicostatus* and *pilsburyi* agree well, and I regard them as congeneric. *Hamiticer* is thus a subjective synonym of *Helicancyclus*.] *Lower Cretaceous (Aptian)*: Switzerland, Romania, Caucasus, California, Argentina (Patagonia).—FIG. 174,2a,b. \**H. aequicostatus* (GABB), California;  $\times 1$  (Anderson, 1938).—FIG. 174,2c. *H. pilsburyi* (ANDERSON), California;  $\times 0.5$  (Anderson, 1938).

**Luppovia** BOGDANOVA, KAKABADZE, & MIKHAILOVA in KAKABADZE, BOGDANOVA, & MIKHAILOVA, 1978, p. 83 [\**L. dostshanensis*; OD]. Small; perforate spire followed by straight shaft and probably hook; spire with single ribs having small umbilical, lateral, and ventrolateral spines; on shaft ribs may branch at umbilical tubercle. Suture with trifid or bifid lobes. *Lower Cretaceous (Upper Aptian)*: Turkmenistan (Kopet-Dag).—FIG. 175,1a,b. \**L. dostshanensis*;  $\times 1$  (Kakabadze, Bogdanova, & Mikhailova, 1978).

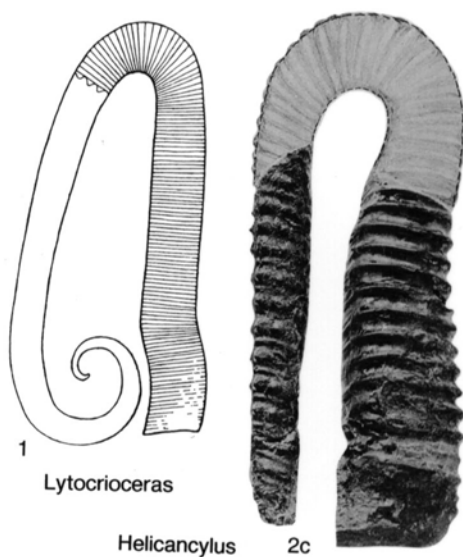
**Epanisoceras** COLLIGNON, 1962b, p. 15 [\**Protanisoceras raulinianiforme* BREISTROFFER in COLLIGNON, 1937b, p. 126(22); OD]. Based on fragments of loosely coiled forms with principal, trituberculate ribs separated by 12 fine, close intermediaries. Suture with asymmetrically trifid lateral and umbilical lobes. *Lower Cretaceous (Upper Aptian)*: Madagascar.—FIG. 175,2. \**E. raulinianiforme* (BREISTROFFER);  $\times 1$  (Collignon, 1962b).

### Subfamily LEPTOCERATOIDINAE Thieuloy, 1966

[Leptoceratoidinae THIEULOY, 1966b, p. 290; Karsteniceratinae IMMEL, 1987, p. 118]

Very small, loosely coiled forms with more or less annular, simple ribs, with or without ventrolateral tubercles, and very simple sutures. Homeomorphs of *Leptoceras* and allies (Tithonian and Berriasian Protancyloceratinae). *Lower Cretaceous (Barremian–Lower Aptian)*.

**Leptoceratoides** THIEULOY, 1966b, p. 289 [\**Crioceras (Leptoceras) pumilum* UHLIG, 1883, p. 270(146); OD]. Small, irregular criocones; approximate homeomorphs of *Leptoceras*; ribs simple, annular; occasional enlarged ribs with constrictions. Suture with wide saddles and rather simple, trifid lobes. *Lower Cretaceous (Barremian)*: central and southern Europe, Cape Verde Islands, northern Africa, Japan.—FIG. 177,3. \**L. pumilum* (UHLIG), Austria;  $\times 1$  (Uhlig, 1883).



1

Lytocrioceras

Helicancyclus

2c

2a

2b

FIG. 174. Ancyloceratidae (p. 223–225)

**Hamulinites** PAQUIER, 1900, appendix p. vi [\**Hamulina muniere* NICKLES, 1894, p. 59; OD] [=*Eoleptoceras* MANOLOV, 1962, p. 532 (type, *Crioceras (Leptoceras) parvulum* UHLIG, 1883, p. 273(147); OD); *Wrightites* MANOLOV, 1962, p. 534, obj.; *Tzankoviceras* MANOLOV, 1962, p. 533 (type, *Crioceras (Leptoceras) assimile* UHLIG, 1883, p. 274(148); OD)]. Coiling more or less ancyloceratoid; ribs equal, annular, and simple; homeomorph



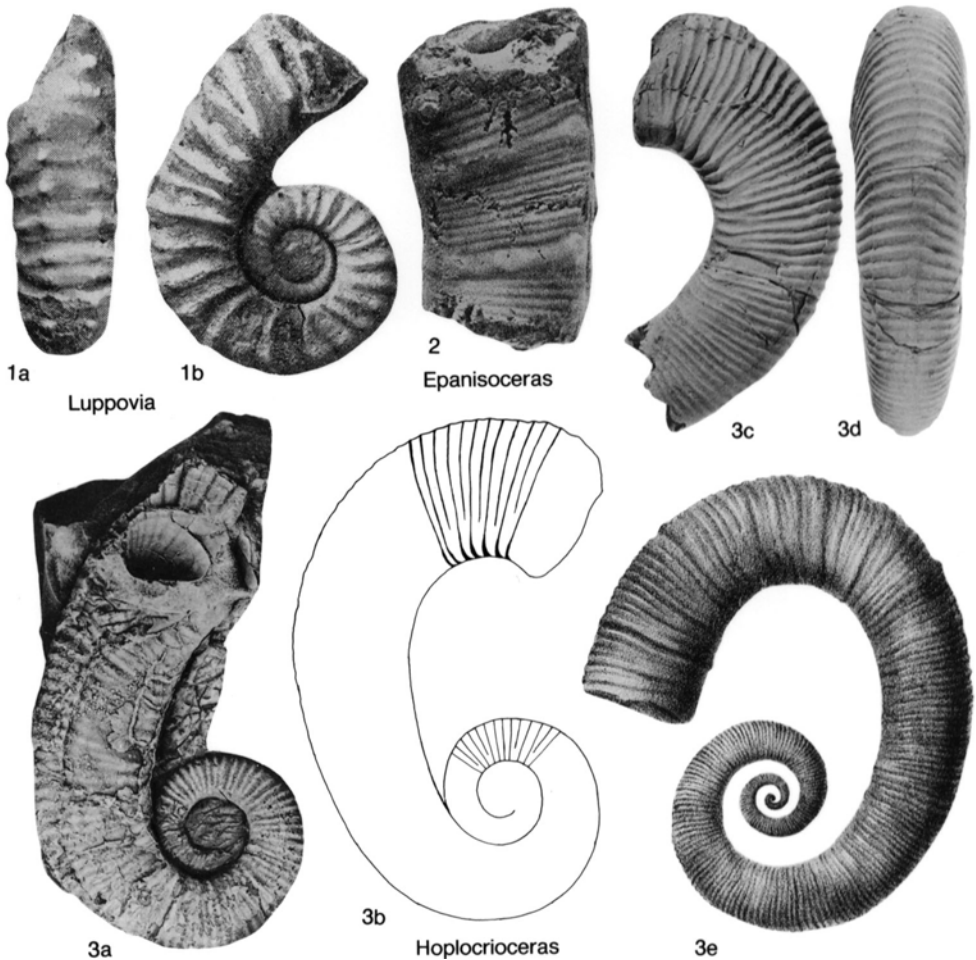


FIG. 175. Ancyloceratidae (p. 223–225)

of *Vindalites*. *Lower Cretaceous* (Barremian): France, Spain, Austria, Romania.—FIG. 177, 2a, b. \**H. minieri* (NICKLES), Spain;  $\times 2$  (Nicklès, 1894).—FIG. 177, 2c–e. *H. parvulum* (UHLIG), Austria; c, d,  $\times 1$ ; e, enlarged (Uhlig, 1883).

**Karsteniceras** ROYO Y GOMEZ, 1945, p. 460 [\**Ancyloceras beyrichi* KARSTEN, 1858, p. 103; OD]. Like *Leptoceratooides* but with bullate ventrolateral tubercles on every rib. Suture with fingerlike lobes and feebly bifid, square saddles. *Lower Cretaceous* (Barremian–Lower Aptian): central Europe, Colombia.—FIG. 177, 4a–d. \**K. beyrichi* (KARSTEN), Colombia; a,  $\times 1$ ; b,  $\times 4$  (Royo y Gomez, 1945); c, d,  $\times 1$  (Etayo Serna, 1968).

**Orbignyceras** ROYO Y GOMEZ, 1945, p. 462 [\**O. veleziense*; OD] [= *Veleziceras* WRIGHT, 1957b, p. 210 (unnecessary *nom. nov.* since *Orbignyceras* is not a homonym of *Orbignyceras* GÉRARD & CONTACT, 1936, p. 34), obj.]. Straight or slightly curved shafts alone known; with fairly prominent,

oblique ribs without tubercles. Suture much as in *Karsteniceras*. *Lower Cretaceous* (Barremian): Czech Republic, Colombia.—FIG. 177, 1a, b. *O. ubligi* (VÁŠIČEK), Czech Republic; a, reconstruction; b, enlarged (Vášíček, 1972).

### Family HETEROCERATIDAE Spath, 1922

[*nom. transl.* SPATH, 1924a, p. 86, ex *Heteroceratinae* SPATH, 1922a, p. 148]  
[= *Colchiditinae* KAKABADZE, 1967, p. 441]

Initial whorls helically coiled, followed by long or short, straight shaft and final hook or by more or less plane spiral, loosely or tightly coiled. Ribs normally fairly dense, weak to strong throughout; ventrolateral tubercles may be present and rarely umbilical and lateral also. Perhaps no more than a subfamily

of Ancyloceratidae. *Lower Cretaceous (Lower Barremian–Lower Aptian).*

**Uhligia** KOENEN, 1904, p. 57 [\**Crioceras minutum* NEUMAYR & UHLIG, 1881, p. 196(67); OD]. Earliest known part straight, then curved to a hook, followed by second curved shaft and final hook; ribs fine, weak, and irregular, with many short intercalatories; no tubercles. Possibly transitional from some Helicancylinae to *Heteroceras*. May be a junior synonym of *Hemibaculites*. *Lower Cretaceous (Lower Barremian)*: Germany.—FIG. 178, 1a–c. \**U. minuta* (NEUMAYR & UHLIG);  $\times 1$  (Koenen, 1902).

**Heteroceras** ORBIGNY, 1849, p. 291 [\**Turrilites emericianus* ORBIGNY, 1842a, p. 580; SD MEEK, 1876, p. 477] [= *Lindigia* KARSTEN, 1858, p. 103 (type, *L. helicocerooides*; OD)]. More or less tightly coiled helix is followed by long, slightly curved shaft; ribs concave on helix but straight and radial later, commonly some biplicate or triplicate; tubercles present or not. [The type species designated by MEEK (1876, p. 477), *Turrilites emericianus* ORBIGNY, 1842a, p. 580, was based on fragments of spire only. KILLIAN (1889a, p. 687) placed it in the synonymy of the later *Heteroceras astierianum* ORBIGNY, 1851, p. 219, but on p. 688 said that *emicianus* was probably the same as *astierianum* but that it was uncertain. KAKABADZE & THIEULOY (1991, p. 94) concluded that in accordance with Article 70(b) of the Code *astierianum* was the type species of *Heteroceras*. However, Article 70(b) refers only to possible action by the Commission under the Plenary Powers to replace a misidentified type species; *T. emericianus* was not misidentified, although it might be regarded as unidentifiable. Pending any application to the Commission, *T. emericianus* remains the type species of *Heteroceras*.] *Lower Cretaceous (Barremian)*: France, central Europe, Caucasus, South Africa (Zululand), Japan, California, Peru.

**H.** (**Heteroceras**). No tubercles. Occurrence and distribution as for genus.—FIG. 178, 4. *H. (H.) tardieui* KILLIAN, France;  $\times 0.38$  (Kilian, 1907–1913).

**H.** (**Argvethites**) ROUCHADZÉ, 1933, p. 233 [\**H. (A.) lashense*; OD]. Venter of shaft and hook flat, in some bearing paired ventral tubercles; ribs on shaft may join pairs of ventral tubercles. Occurrence as for genus: Caucasus, ?Czech Republic.—FIG. 178, 3a, b. \**H. (A.) lashense*, Caucasus;  $\times 1$  (Rouchadze, 1933).

**Hemibaculites** HYATT, 1900, p. 586 [\**Toxoceras obliquatum* ORBIGNY, 1842a, p. 486; OD]. Type specimen of type species lost; it was perhaps a fragment of the shaft of a *Heteroceras* or *Uhligia*. DRUSHCHITS (1960, pl. 41, fig. 1) figured an initial helix and shaft that may belong to *Hemibaculites*. *Lower Cretaceous (Barremian)*: France.

**Colchidites** DJANÉLIDZÉ, 1926, p. 254 [\**C. colchicus*; M] [= *Santandericeras* ROYO Y GOMEZ, 1945, p. 468 (type, *S. apolinari*; OD)]. Differs from *Heteroceras* in having one or more planispiral whorls, more or

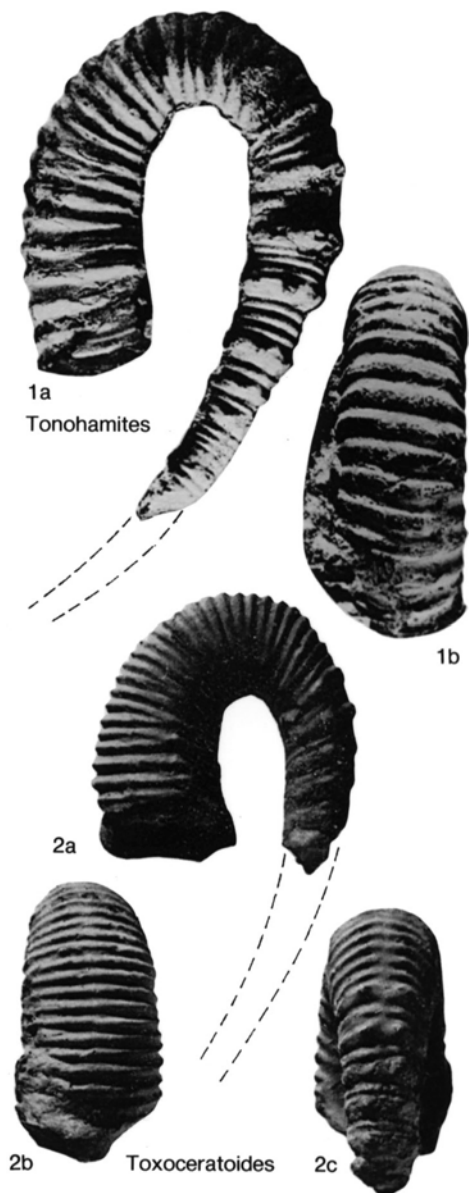


FIG. 176. Ancyloceratidae (p. 223–224)

less tightly coiled, with the axis of coiling at a right angle to that of the helix, between the initial helix and the final shaft and hook; macroconchs probably having 1 planispiral whorl, microconchs 2 or more; whorl height increasing rather fast; tubercles absent or weak. *Lower Cretaceous (Barremian)*: France, Bulgaria, Ukraine (Crimea), Caucasus, Transcaspia, Turkmenistan, South Africa (Zululand), Colombia, Argentina.—FIG. 179, 2. \**C. colchicus*, Caucasus;  $\times 0.5$  (Djanélidzé, 1926).

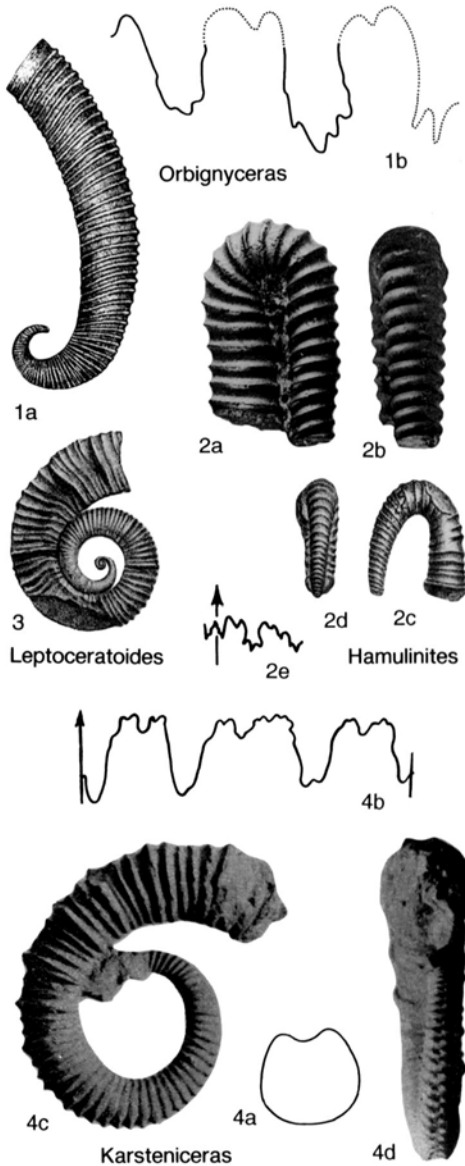


FIG. 177. Ancyloceratidae (p. 225–226)

**Martelites** CONTE, 1989, p. 43 [\**M. marteli*; OD]. Large, neotenous descendants of *Colchidites* without the uncoiling shaft. *Lower Cretaceous (Lower Aptian)*: France, Caucasus.—FIG. 179, 3. *M. sarasini* (ROUCHADZÉ), Caucasus;  $\times 0.75$  (Rouchadzé, 1933).

**Imerites** ROUCHADZÉ, 1933, p. 255 [\**Heteroceras giraudi* KILIAN, 1889b, p. 435; OD; =*Crioceras cristatum* ORBIGNY, 1842a, p. 467] [=*Atopoceras* JAUBERT in KILIAN, 1889a, p. 685, *nom. nud.*; *Escragnolleites* SARKAR, 1954b, p. 620(3), *obj.*; *Paraimerites* KAKABADZE, 1967, p. 440 (type,

*Imerites densecostatus* RENNIGARTEN, 1926, p. 36; OD); *Eristavia* KAKABADZE, 1971a, p. 44 (1967, p. 440, *nom. nud.*, no type species) (type, *Colchidites (Imerites) dichotomus* ERISTAVI, 1955, p. 128; OD)]. Small; whorl height increasing slowly; ribbing distant, with single (*Paraimerites*) or inner and outer ventrolateral tubercles on ribs at some stage doubled between dorsum and inner ventrolateral tubercle (*Eristavia*), or single and more or less straight throughout. *Lower Cretaceous (Barremian)*: France, Caucasus, Transcaspia, Turkmenistan, South Africa (Zululand).—FIG. 178, 2a, b. \**I. cristatus* (ORBIGNY), France;  $\times 1$  (Kilian, 1889b). —FIG. 178, 2c, d. *I. favrei* ROUCHADZÉ, Turkmenistan;  $\times 1$  (Tovbina, 1963).

**Kutatissites** KAKABADZE, 1970, p. 734 [\**K. bifurcatus*; OD] [=?*Simionescites* AVRAM, 1976, p. 77 (type, *S. princeps*; OD)]. Short helix, more or less wrapped in planispiral whorls; trituberculate main ribs on helix; minor ribs, if present, with no or only ventrolateral tubercles; ribs may branch at umbilical or midlateral tubercle and tend to be interrupted on venter; tubercles on spire weakening and may disappear, but umbilical tubercles normally persisting and ribs may again become trituberculate near aperture. [The larger *Simionescites* are probably macroconchs of *Kutatissites*.] *Lower Cretaceous (Upper Barremian–Lower Aptian)*: France, Romania, Georgia, Colombia.—FIG. 179, 1a, b. \**K. bifurcatus*, Upper Barremian, Georgia;  $\times 0.75$  (Kakabadze, 1970). —FIG. 179, 1c. ?*K. princeps* (AVRAM), Lower Aptian, Romania;  $\times 0.25$  (Avram, 1976).

### Family HEMIHOPLITIDAE Spath, 1924

[Hemihoplitidae SPATH, 1924a, p. 84]

Whorls overlapping slightly; venter flat; ribs simple and straight, rarely branched; umbilical and ventral tubercles may occur. Suture with lobes generally trifid but sometimes bifid. *Lower Cretaceous (Upper Hauterivian–Upper Barremian)*.

Derived from *Pseudothurmannia* (Ancyloceratidae, Crioceratitinae) and perhaps from other crioceratine genera with similar suture. Hemihoplitidae are separated from Crioceratitinae only because ammonitic coiling is fully realized and the last traces of crioceratine ribbing have disappeared.

**Hemihoplites** SPATH, 1924a, p. 84 [\**Ammonites feraudianus* ORBIGNY, 1841, p. 324] [=*Matheronites* RENNIGARTEN, 1926, p. 27 (type, *Ammonites soulieri* MATHERON, 1879 in 1878–1880, pl. C-21, fig. 1; OD); *Ornicephalites* SKWARKO & THIEULOUY, 1989, p. 31 (type, *Pseudothurmannia (O.) indonesiana*; OD)]. Evolute; compressed; whorl section rectangular; ribs simple or branching or long and short, well spaced, straight or slightly flexuous, crossing

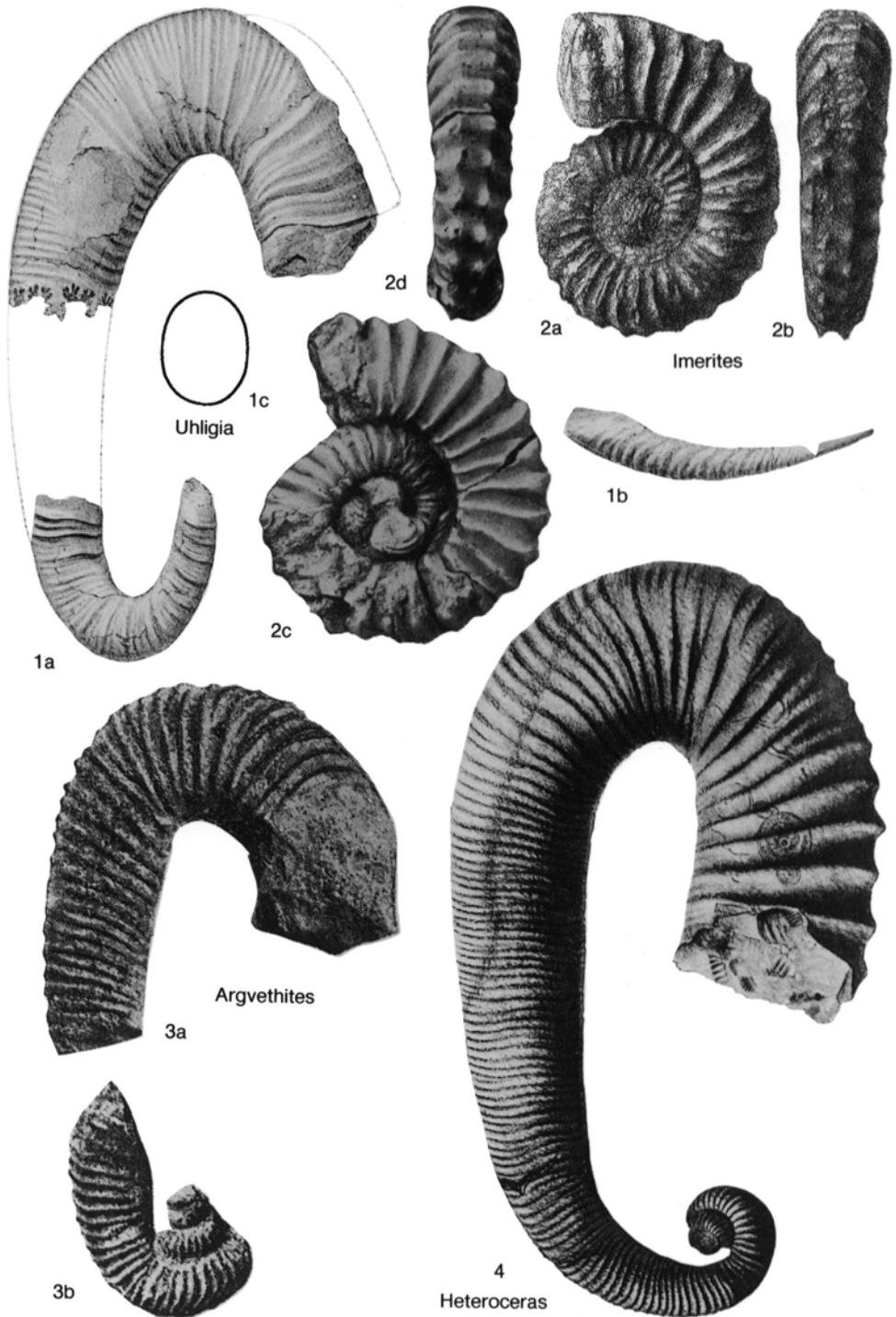


FIG. 178. Heteroceratidae (p. 227–228)

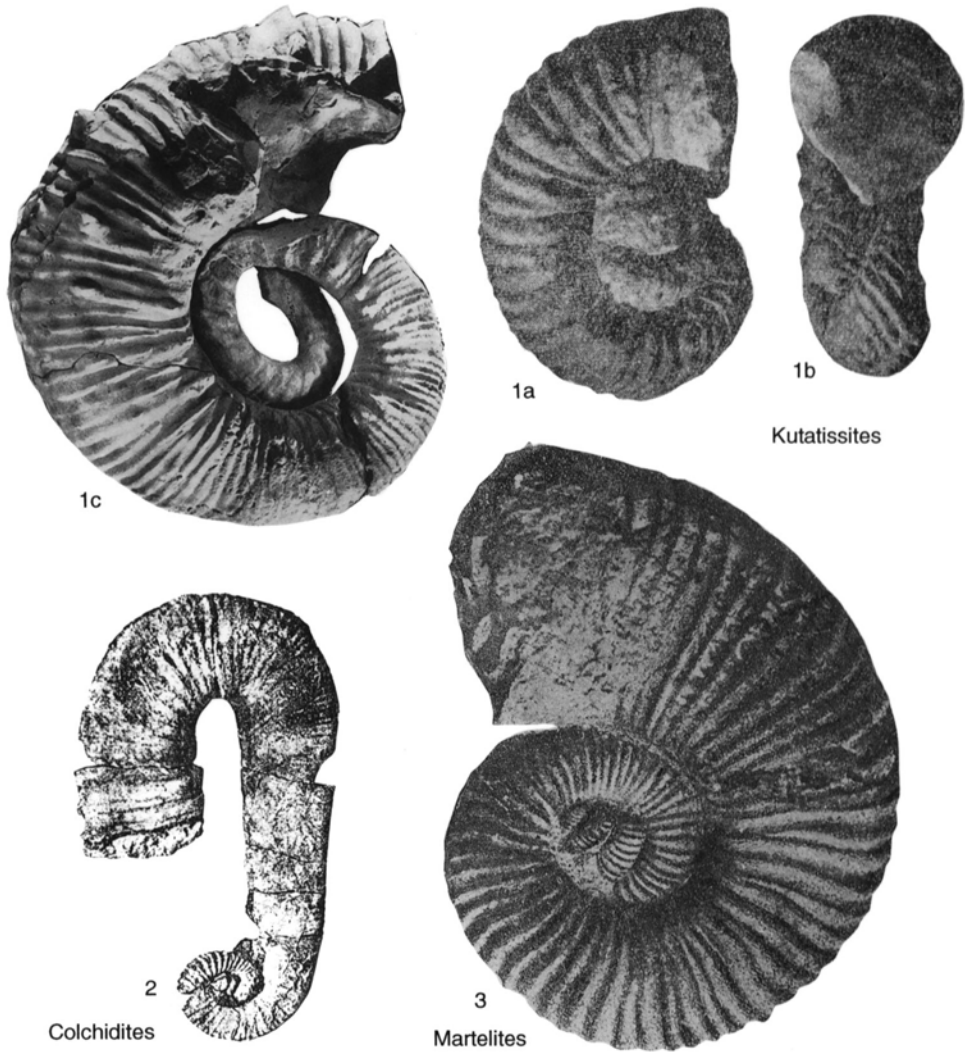


FIG. 179. Heteroceratidae (p. 227–228)

flat venter transversely, typically with distinct umbilical and ventrolateral tubercles. *Lower Cretaceous* (Upper Hauterivian–Barremian): France, Balearic Islands, Georgia, Antarctica (Alexander Island). —FIG. 180, 2a–c. \**H. ferudianus* (ORBIGNY), Barremian, France; a, b,  $\times 1$  (new); c, enlarged (Orbigny, 1840–1842).

**Camericeras** DELANOY, 1990, p. 74 [\**Matheronites limentinus* THIEULOY, 1979, p. 307; OD]. Juvenile stage with strong, clavate umbilical, inner ventrolateral, and outer ventrolateral tubercles; in midgrowth inner ventrolaterals disappearing and umbilicals becoming bullate. Adult whorls with strong, untuberculate ribs. *Lower Cretaceous* (Middle Barremian): France, Austria.

?**Pascocites** SPATH, 1933a, p. 827 [\**P. budavagensis*; OD]. Apparently intermediate between *Pseudothur-*

*mannia* and *Hemiboplites* and perhaps synonymous with one or the other. *Lower Cretaceous* (?Barremian): western India. —FIG. 180, 1a, b. \**P. budavagensis*; a,  $\times 1$ ; b,  $\times 3$  (Spath, 1933a).

#### Family HAMULINIDAE Gill, 1871

[Hamulinidae GILL, 1871, p. 3] [=Anahamulinidae BREISTROFFER, 1951a, p. 54]

Initial stages unknown; long main shaft followed by hook and shorter, close, parallel or slightly divergent final shaft. Suture with subtrifid or bifid L; U normally reduced or undifferentiated in adult. *Lower Cretaceous* (Lower Barremian–Upper Barremian).

Despite coiling probably not closely related to Ptychoceratidae but derived by lengthening of shafts from some ancyloceratine forms, as in case of later approximately homeomorphous *Lithancylus*.

**Hamulina** ORBIGNY, 1850a, p. 66 [\**H. astieriana* ORBIGNY, 1850a, p. 102; SD ROMAN, 1938, p. 47]. May be large; whorl section generally increasing rapidly; short final shaft straight or curved; main shaft with dense, fine, prorsiradiate minor ribs and distant, periodic, weakly trituberculate major ribs; minor ribs weakening or disappearing on hook and final shaft, major ribs strengthening and approximating. Suture finely divided. *Lower Cretaceous (Lower Barremian—Upper Barremian)*: southern and central Europe, California.——FIG. 181, 4a, b. \**H. astieriana* ORBIGNY, Barremian, France; a,  $\times 0.2$  (Orbigny, 1852); b,  $\times 0.25$  (Thomel, 1964).——FIG. 181, 4c. *H. silesiaca* UHLIG, Barremian, Austria;  $\times 1$  (Uhlig, 1883).

**Anahamulina** HYATT, 1900, p. 571 [\**Hamulina subcylindrica* ORBIGNY, 1850a, p. 102; OD]. Medium-sized, with long main shaft rapidly or slowly increasing in diameter, bending sharply, commonly with constriction at bend, to a shorter, parallel or divergent final shaft; ribs fine, dense, equal, untuberculate; ribs annular and prorsiradiate on first shaft, radial and stronger on second. Suture less florid than in *Hamulina*. *Lower Cretaceous (Barremian)*: southern and central Europe, Japan, California.——FIG. 181, 1a–c. \**A. subcylindrica* (ORBIGNY), Austria;  $\times 1$  (Uhlig, 1883).

### Family PTYCHOCERATIDAE

Gill, 1871

[Ptychoceratidae GILL, 1871, p. 3]

With 3 close, parallel, straight shafts; smooth or with distant, coarse ribs mainly on venter and final hook. Suture with trifid or bifid lobes; U may split into two lobes in adult sutures. MIKHAILOVA, 1974a. *Lower Cretaceous (?Upper Valanginian, Upper Hauterivian—Upper Albian)*.

Ptychoceratidae are probably derived from an undescribed Tithonian genus of *Bochianitidae*; the direct ancestor is more likely to be one of ancyloceratoid coiling than the baculitoid *Bochianites* with a single, straight shaft.

**Euptychoceras** BREISTROFFER, 1952c, p. 50 [\**Ptychoceras meyrati* OOSTER, 1860, p. 82; OD] [=?*Pseudoptychoceras* ETAYO SERNA, 1979, p. 21 (type, *P. gilberti*; OD)]. With long, straight, slowly increasing initial shaft, followed by rather longer second shaft that is parallel and barely or not touching, and finally by third shaft that may slightly overlap first;

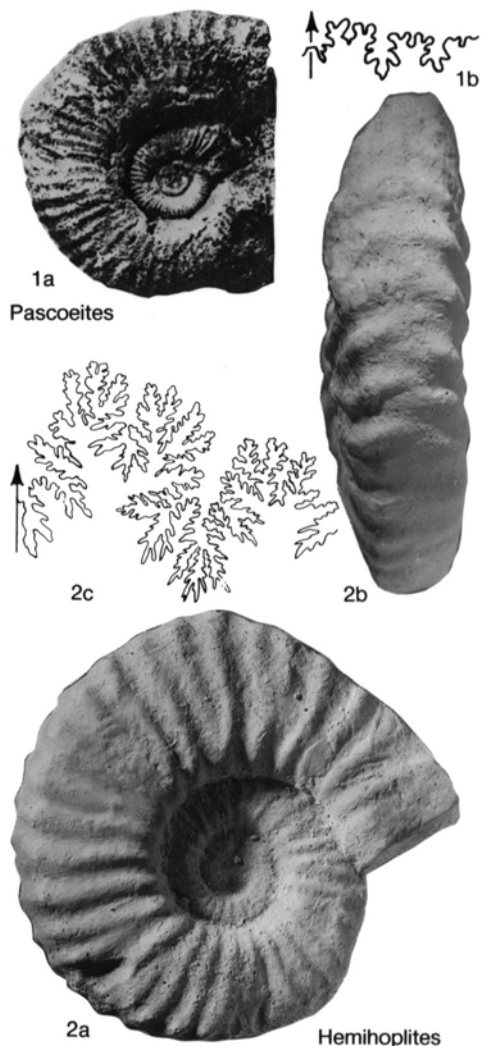


FIG. 180. Hemihoplitidae (p. 228–230)

smooth or with rather weak ribbing, except that broad, scalelike ribs may occur on last shaft. Suture with trifid L. [The slightly more strongly ribbed *Pseudoptychoceras* probably belongs here. *E. teschenense* UHLIG, 1902, p. 63 (Upper Valanginian) may be generically distinct.] *Lower Cretaceous (?Upper Valanginian, Upper Hauterivian—Barremian, ?Upper Aptian)*: southern and central Europe, California, ?Colombia.——FIG. 181, 2. \**E. meyrati* (OOSTER), Barremian, Switzerland;  $\times 0.5$  (Sarasin & Schöndelmayer, 1902).

**Ptychoceras** ORBIGNY, 1842a, p. 554 [\**P. emericianum*; SD DIENER, 1925, p. 77] [=?*Diptychoceras* GABB, 1869, p. 143 (type, *P. gabbi* PERVINQUIÈRE, 1907, p. 91, *nom. nov. pro D. laeve* GABB, 1869, *non* MATHERON, 1842, p. 266); *Mastigohamites* BREISTROFFER, 1947b, p. 100(84), *nom. nov. pro*

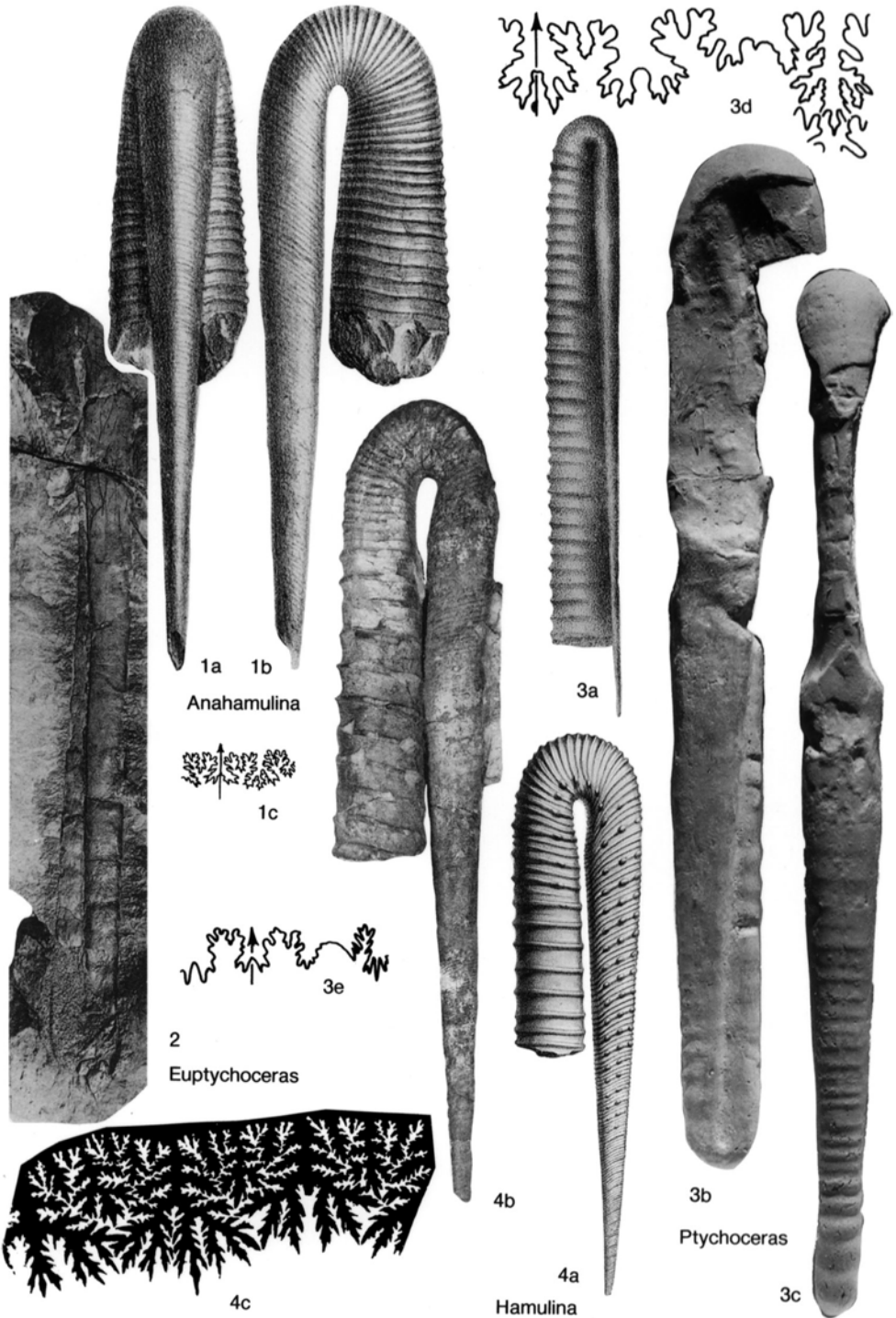


FIG. 181. Hamulinidae and Ptychoceratidae (p. 231–233)

*Mastigoceras* BÖHM, 1926, p. 202, non HANDSCHIN, 1924, p. 22 (type, *Hamites adpressus* J. SOWERBY, 1814b, p. 140; OD); ?*Tricoloceras* WHITEHOUSE, 1928b, p. 278 (type, *Ptychoceras? closteroides* R. ETHERIDGE, JR., 1904, p. 110)]. Differs from *Euptychoceras*, by initial shaft closely pressed into dorsum of second shaft; suture with bifid lobes but trifold lobes may occur. Shell may have been covered by mantle in life (DOGUZHAIEVA & MUTVEI, 1989). [*Diptychoceras* could be distinguished only on the presence of feeble constrictions. The slight difference in the way in which U of suture of *P. adpressum* accommodates to the sharpened edge of the dorsal impression does not justify the separation of *Mastigohamites*.] *Lower Cretaceous (Upper Aptian–Upper Albian)*: England, France, Caucasus, Madagascar, southern India, ?Australia (Queensland), New Zealand, Alaska, British Columbia, California, Mexico.—FIG. 181,3a–d. \**P. emericianum* (ORBIGNY), Upper Aptian, France; a, first and part of second shaft, X1 (Orbigny, 1840–1842); b, c, X0.75 (new); d, X4 (Wiedmann, 1962a).—FIG. 181,3e. *P. adpressum* (J. SOWERBY), Upper Albian, England; e, X4 (Spath, 1923–1943).

### Family LABECERATIDAE Spath, 1925

[Labeceratidae SPATH, 1925c, p. 191; ICZN Opinion No. 556, 1959, Family-Group Name No. 266] [=Alteceratidae WHITEHOUSE, 1926, p. 231; Myloceratidae SPATH, 1939c, p. 601]

Early whorls with coiling open, shallowly helical or planispiral; later whorls in contact or not; shell ending in hook; whorl section slightly inflated to very compressed; all genera with fine, branching ribs passing over venter; some genera also with umbilical or ventrolateral tubercles or both. Suture with bifid saddles and trifold lobes. *Lower Cretaceous (?Middle Albian, Upper Albian)*; ?*Upper Cretaceous (?Lower Cenomanian)*.

The family includes forms closely resembling some Helicancyliinae and with its trifold lobes is best placed in Ancylocerataceae. This is a southern-hemisphere family; northern species referred here may belong to Anisoceratidae.

*Labeceras* SPATH, 1925c, p. 191, ICZN Opinion 556, 1959, Generic Name No. 1351 [\**L. bryani* WHITEHOUSE, 1926, p. 227; ICZN Specific Name No. 1632] [=Myloceras SPATH, 1925c, p. 192 (type, *Crioceras ammonoides* R. ETHERIDGE, JR., 1909, p. 151; OD); *Alteceras* WHITEHOUSE, 1926, p. 231 (type, *Crioceras plectoides* R. ETHERIDGE, JR., 1909, p. 152; OD); *Flindersites* WHITEHOUSE, 1926, p. 236 (type, *F. baccatus*; OD); *Ellipsoceras* COLLIGNON, 1950b, p. 79 (type, *E. expansum*; OD); *Abadieceras* COLLIGNON, 1950b, p. 81 (type, *A. altissimum*; OD); *Euhemihoplites* COLLIGNON, 1964,

p. 38 (type, *E. paradoxus*; OD); *Calliscaphites* A. F. LEANZA, 1970, p. 202 (type, *C. andinus*; OD); *Paraleptoceras* LEANZA, 1970, p. 209 (type, *P. singulare*; OD)]. There is little doubt that *Labeceras*, here selected against *Myloceras* of the same date, comprises microconchs and *Myloceras* macroconchs of the same genus. Macroconchs much larger than microconchs; spire open at first, then closely coiled and with terminal hook; whorl section moderately to highly compressed, with flat venter; generally with strong ventrolateral spines. Microconchs with open spire of a few whorls followed by curved shaft and final hook with inturned aperture; ribs fine, concave, and prorsiradate, normally branching; no ventrolateral tubercles, but ribs may be raised into umbilical tubercles on shaft and hook. *Lower Cretaceous (Upper Albian)*; ?*Upper Cretaceous (?Lower Cenomanian)*: southeastern Africa, Madagascar, Australia (Queensland), South Australia, ?New Zealand, New Guinea, Argentina (Patagonia).—FIG. 182,1a–c. *L. ammonoides* (ETHERIDGE), Upper Albian, Queensland, macroconch; a, b, X0.43; c, X0.75 (McNamara, 1978).—FIG. 182,1d. *L. serotinum* SPATH, Upper Albian, Mozambique, macroconch; X0.5 (Spath, 1925c).—FIG. 182,1e–g. *L. plasticum* SPATH, Upper Albian, Mozambique, microconch; e, X1; f, X1.5; g, X4 (Spath, 1925c).

?*Hamitoides* SPATH, 1925c, p. 191 [\**Hamites studerianus* PICTET, 1847, p. 393; OD]. Nature of coiling uncertain, since only fragments known; whorl section circular to oval; ribs branching irregularly at umbilical edge or on sides; in many shells ribs forming tubercle at point of branching. Suture inadequately known, with bifid saddles and trifold lobes. *Lower Cretaceous (Middle Albian–Upper Albian)*: France, Switzerland, Poland, Mozambique, Madagascar, Pakistan.—FIG. 182,2. \**H. studerianus* (PICTET), Upper Albian, France; X1 (Pictet, 1847).

### ?Family MACROSCAPHITIDAE Hyatt, 1900

[Macroscaphitidae HYATT, 1900, p. 571] [=Cicatrutidae SPATH, 1927a, p. 64]

Evolute, ammoniticonic macroconchs and scaphitoid microconchs having dense, simple, rarely branched ribs with or without spines. Adult suture quadrilobate, florid, with bifid L and U. *Lower Cretaceous (Barremian–Upper Aptian)*.

It is uncertain whether the family was derived by recoiling from some member of quadrilobate Ancyloceratina or represents an independent quadrilobate derivative from quinquelobate Lytocerataceae. *Cicatrutes* differs from the others only in its suture with somewhat asymmetrical elements and family separation seems unnecessary.



**Macroscaphites** MEEK, 1876, p. 414 [\**Scaphites yvani* PUZOS, 1832, p. 355; SD ROMAN, 1938, p. 38] [= *Costidiscus* UHLIG, 1882a, p. 87 (type, *Ammonites recticostatus* ORBIGNY, 1841, p. 134; OD)]. Macroconchs medium-sized to large, coiled normally; microconchs small, with septate whorls as in macroconchs, then with straight or recurved shaft and final hook; radial ribs dense, strong, straight, and in some species thickened on umbilical edge or tuberculate; some ribs also with small but distinct ventrolateral tubercles; constrictions normally present, with slightly enlarged ribs on either side. Suture with more or less symmetrical L. *Lower Cretaceous (Barremian–Lower Aptian)*: southern and central Europe, northern Africa, Egypt (Sinai), Mexico. —FIG. 183, 1a–e. *M. recticostatus* (ORBIGNY), Barremian, Silesia; a, b, macroconch,  $\times 0.75$ ; c, d, macroconch,  $\times 1$ ; e, microconch,  $\times 0.75$  (Uhlig, 1883).

**Cicatrix** ANTHULA, 1899, p. 100 [\**C. abichi*; OD]. Very evolute, with depressed whorl section; umbilical spine bases regular and flat, each covering 3 of the dense, straight ribs. Suture with irregular elements and asymmetrical L. *Lower Cretaceous (Lower Aptian–Upper Aptian)*: France, Caucasus. —FIG. 183, 2a–c. \**C. abichi*, Upper Aptian, Caucasus;  $\times 1$  (Anthula, 1899).

## Superfamily TURRILITACEAE Gill, 1871

[*nom. transl.* WRIGHT, 1957b, p. 214, ex Turritulidae GILL, 1871, p. 3. Turritulaceae was established as superfamily (WRIGHT, 1957b, p. 214) to replace Hamitidae (*nom. transl.* WRIGHT & WRIGHT, 1951, p. 13) because Turritulidae was thought to date from MEEK, 1876, p. 477, whereas Hamitidae was attributed to HYATT, 1900, p. 586. In fact, both date from GILL, 1871, p. 3, and the change at superfamily level was unnecessary. However, Turritulaceae has entered into general use and is therefore maintained here.] [=Diplomocerataceae BRUNNSCHWEILER, 1966, p. 14]

Comprises a series of families, directly or indirectly derived from Anisoceratidae or Hamitidae, with almost every known form of heteromorph coiling. Includes ribbed, tuberculate, and smooth genera. The suture, quadrilobate throughout in contrast with the initially quinquelobate suture of Ancylocerataceae, generally has bifid lateral lobes, but trifid lobes may occur in early genera. Anisoceratidae may range from Upper Aptian; if so, Hamitidae would be derived from Anisoceratidae rather than the other way around, as commonly held. Early Anisoceratidae tending to have subtrifid L and trifid U, both becoming bifid later in phylogeny. Separation of Turritulaceae from Ancylocerataceae seems justified by a renewed evolutionary radiation having stabilized quadrilobate suture with generally bifid lobes throughout. However, given the tran-

sitions and variability in early sutures now known, it is here held that Turritulaceae were derived from Ancylocerataceae and did not have a separate origin in Lytoceratina. DOGUZHAIEVA & MIKHAILOVA, 1982. *Lower Cretaceous (?Upper Aptian, Lower Albian)–Upper Cretaceous (Upper Maastrichtian)*.

## Family ANISOCERATIDAE Hyatt, 1900

[Anisoceratidae HYATT, 1900, p. 587] [=Algeritidae SPATH, 1925c, p. 190; Phlycticioceratidae SPATH, 1926a, p. 80]

Loosely coiled; early whorls typically irregularly helical; later whorls with several, more or less straight shafts in one plane, but some are helical throughout. Ventrolateral tubercles normally on at least some ribs and commonly lateral tubercles as well (*Phlycticrioceras* has sharp siphonal tubercles). Constrictions in some late forms. Suture moderately florid to simple; lobes generally bifid but trifid lobes may occur; even in helicoid forms suture not markedly asymmetrical. *Lower Cretaceous (?Upper Aptian, Lower Albian)–Upper Cretaceous (Santonian, ?Campanian)*.

**Protanisoceras** SPATH, 1923a, p. 75 [\**Hamites raulinianus* ORBIGNY, 1842a, p. 546; OD]. Coiled in open spiral, in one plane or slightly helicoid, with terminal hook or with several more or less straight shafts; ribs rectiradiate, weak or absent on dorsum, with ventrolateral and in some species midlateral tubercles on some or all ribs; ribs joining tubercles across venter may be flattened but not doubled; in later species tubercles may be septispinate. Suture rather simple with bifid saddles, subtrifid or bifid L, and small trifid U. [*P. cuerdai* WIEDMANN, 1962b, p. 106, Upper Aptian, Spain, with bifid L, known only in small fragments, probably belongs here.] *Lower Cretaceous (?Upper Aptian, Lower Albian–Middle Albian)*: western and central Europe, Madagascar, India, Peru.

**P. (Protanisoceras)**. Shaft and body chamber hook coiled in same plane. Occurrence and distribution as for genus. —FIG. 184, 2a–c. \**P. (P.) raulinianum* (ORBIGNY), Lower Albian, France; a, b,  $\times 1$  (Orbigny, 1840–1842); c,  $\times 2$  (Casey, 1961a).

**P. (Torquistylus)** CASEY, 1961a, p. 113 [\**Probelioceras anglicum* SPATH, 1939c, p. 562; OD]. Bluntly ribbed, with body chamber rolled over to one side, twisting ribs. *Lower Cretaceous (Lower Albian)*: western Europe, Madagascar. —FIG. 184, 1a–c. \**P. (T.) anglicum* (SPATH), England; a, b, reconstruction, c,  $\times 2$  (Casey, 1961a).

**P. (Heteroclinus)** CASEY, 1961a, p. 98 [\**Hamites*

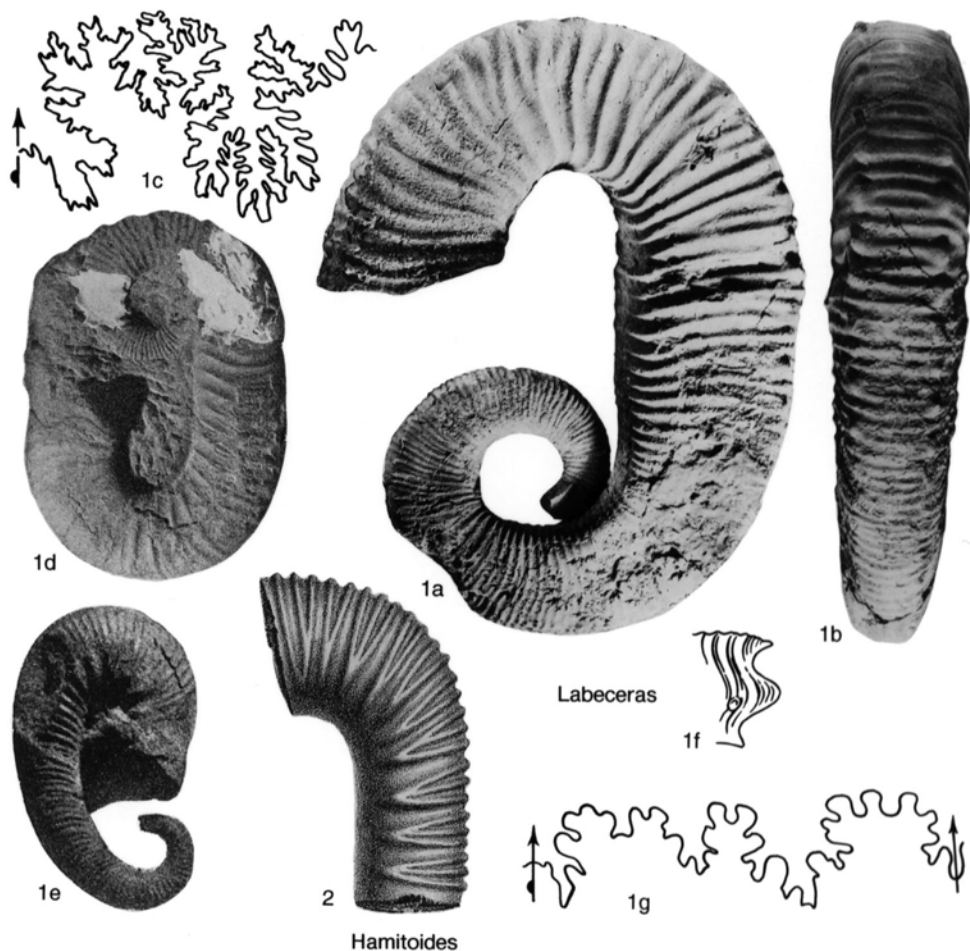


FIG. 182. Labeceratidae (p. 233)

*nodosus* J. SOWERBY, 1818a, p. 30; OD]. Like *P. (Protanisoceras)* but with more or less prolonged, helicoid beginning, slightly fibulate lateral ribs and tubercles, and larger umbilical lobe in suture. *Lower Cretaceous (Middle Albian)*: western Europe.—FIG. 184,3. \**P. (H.) nodosum* (J. SOWERBY), England; crushed,  $\times 0.75$  (Spath, 1923–1943).

**Rencurelites** THIEULOY, 1964, p. 114 [\**Protanisoceras (R.) ambiguum* THIEULOY, 1964, p. 114; OD]. Differs from *Protanisoceras* in having spire with simple, untuberculate ribs, but body chamber with prominent dorsolateral (umbilical) tubercles and ribs branching irregularly at these or further up side. *Lower Cretaceous (Lower Albian)*: southeastern France.—FIG. 185, 1a–e. \**R. ambiguum*; a–d,  $\times 1$ ; e,  $\times 2$  (Thieuloy, 1964).

**Metahamites** SPATH, 1930b, p. 57 [\**Hamites sablieri* ORBIGNY, 1842a, p. 543; OD]. With 3 subparallel shafts; ribbing on phragmocone oblique, fine or almost obsolete; ribs of phragmocone on and be-

tween periodic, strong folds or with periodic, large flat spine bases covering several ribs; on body chamber ribs bolder and distant; tubercles, if persisting, covering only 1 rib. Suture more florid than in *Protanisoceras*. *Lower Cretaceous (Lower Albian–Middle Albian)*: western Europe, Madagascar, India, Colombia.—FIG. 186, 1a, b. *M. elegans* (ORBIGNY), Middle Albian, France;  $\times 0.75$  (Orbigny, 1840–1842).—FIG. 186, 1c. *M. gignouxii* COLLIGNON, Lower Albian, Madagascar;  $\times 0.75$  (Collignon, 1949b).

**Rossalites** CASEY, 1961a, p. 115 [\**Protanisoceras? superbum* COLLIGNON, 1949b, p. 53; OD]. Large; straight shafts and terminal hook alone known; phragmocone like *Metahamites* but with weak tubercles at midside, from which ribs run in pairs to rejoin at ventrolateral spine bases; body chamber hook with large lateral bulges. Suture florid, with reduced U. *Lower Cretaceous (Lower Albian)*: England, France, Madagascar.—FIG. 185, 6a–c. \**R. superbum* (COLLIGNON), Madagascar;  $\times 0.5$

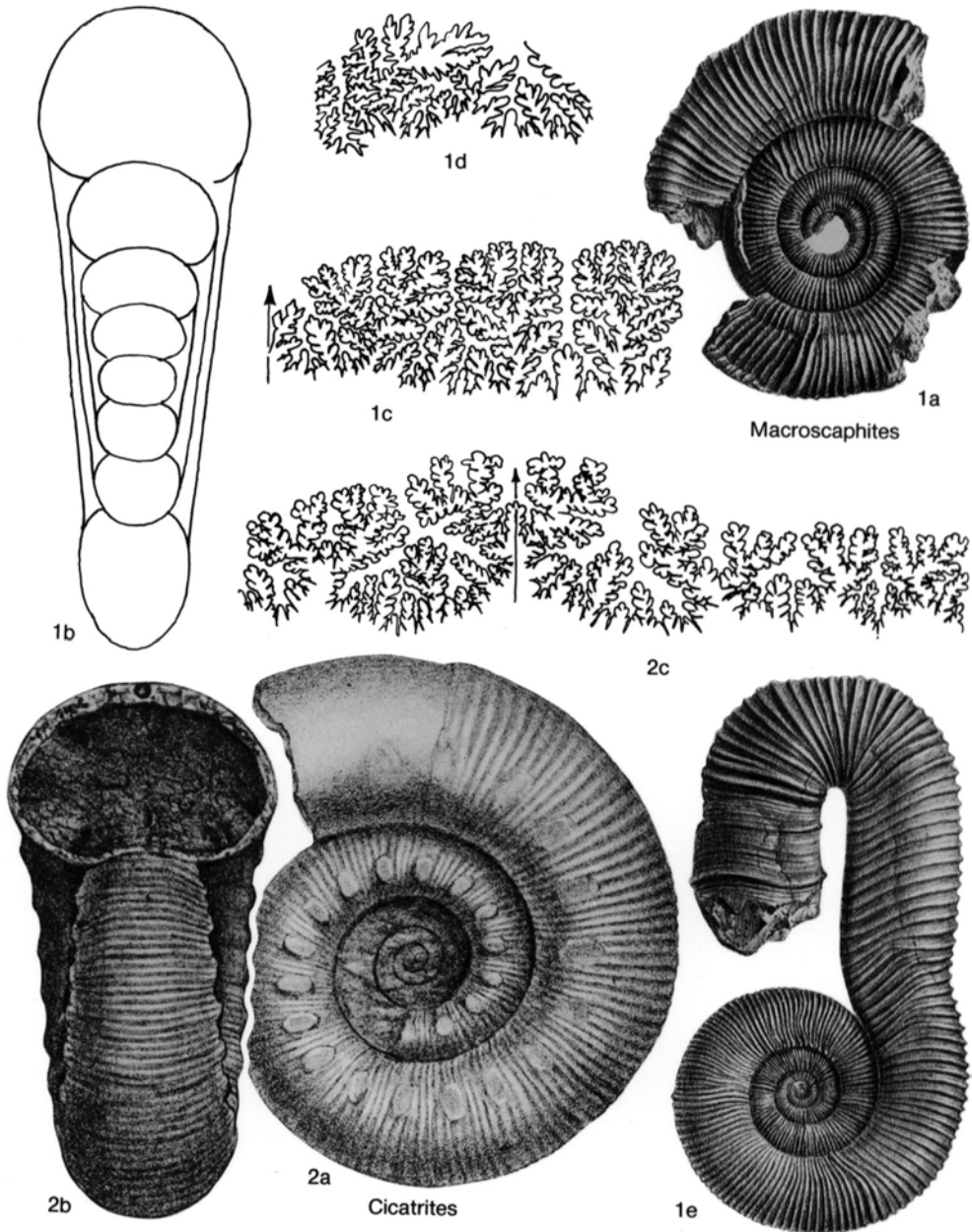


FIG. 183. Macroscaphitidae (p. 234)

(Collignon, 1949b).—FIG. 185,6d. *R. oweni* CASEY, England; X1 (Casey, 1961a).

**Ephamulina** COLLIGNON, 1963, p. 27 [*Anisoceras?* *trituberculatum* COLLIGNON, 1949b, p. 52; OD]. Coiled in more or less regular, open spiral, perhaps with terminal hook; whorl section subhexagonal to circular; close, fine ribs periodically with triple spine bases or septispinate tubercles covering 2 or 3 ribs. Suture with very large, widely splayed, bifid

first lateral lobe and much reduced, trifid umbilical lobe. *Lower Cretaceous (Lower Albian–Middle Albian)*: Madagascar.—FIG. 186,2a,b. *\*E. trituberculatum* (COLLIGNON), Lower Albian; X0.75 (Collignon, 1963).

**Prohelicoceras** SPATH, 1925c, p. 190 [*Helicoceras thurmanni* PICTET & CAMPICHE, 1861, p. 118; OD]. Coiling twisted at all stages; with sharp, annular ribs; in some species, ribs normally with

paired midlateral and ventrolateral tubercles, between which ribs may be looped irregularly. *Lower Cretaceous (Lower Albian—Middle Albian)*: western Europe, Madagascar.—FIG. 185, 2a, b. \**P. thurmanni* (PICTET & CAMPICHE), Middle Albian, Switzerland; X1 (Pictet & Campiche, 1861).

**Anisoceras** PICTET, 1854, p. 705 [\**Hamites saussureanus* PICTET, 1847, p. 374; OD]. Differs from *Protanisoceras* primarily in its more helicoid coiling, fibulate ribbing, and more complex suture with regularly bifid L and U; occasional subtrifid lobes occur. *Lower Cretaceous (Upper Albian)—Upper Cretaceous (Upper Turonian)*: Europe, northern and eastern Africa, Madagascar, Pakistan, India, New Zealand, Alaska, Texas, Mexico.—FIG. 187, 3a–c. \**A. saussureanum* (PICTET), Upper Albian, France; a, b, X1; c, enlarged (Pictet, 1847).

**Appurdiceras** WHITEHOUSE, 1926, p. 229 [\**Ancyloceras cordycepoides* R. ETHERIDGE, Jr., 1905, p. 14; OD]. Coiling ancyloceratoid; whorl section subcircular; shaft with strong ventrolateral tubercles covering 1 to 3 ribs; umbilical tubercles appearing only on intermediate ribs; ribs branching at umbilical tubercles and may also do so at midside. *Lower Cretaceous (Upper Albian)*: South Australia.—FIG. 187, 4a–c. \**A. cordycepoides* (ETHERIDGE); X1 (McNamara, 1980).

**Prophlycticioceras** CLARK, 1965, p. 33 [\**Hamites tanima* ADKINS & WINTON, 1920, p. 20; OD]. Based on slightly curved fragments with rounded to compressed section; primary ribs very coarse, with irregular, fine secondary ribs on and between them; primary ribs bearing large ventrolateral and siphonal tubercles, between which secondaries are doubled. The few specimens may be malformed *Anisoceras*. *Lower Cretaceous (Upper Albian)*: Sardinia, Texas.—FIG. 185, 4a, b. \**P. tanima* (ADKINS & WINTON); X2 (Clark, 1965).

**Idiohamites** SPATH, 1925c, p. 189 [\**Hamites tuberculatus* J. SOWERBY, 1818b, p. 50; OD]. Coiling rather irregular, in one plane; ribs radial or oblique, with a pair of ventral tubercles joined normally only by single rib on venter; lateral tubercles rarely present. *Lower Cretaceous (Upper Albian)—Upper Cretaceous (Middle Cenomanian)*: western and central Europe, northern Africa, Madagascar, New Zealand, Texas.—FIG. 187, 2a–c. *I. dorsetensis* SPATH, Upper Albian, England; a, b, X1; c, enlarged (Spath, 1923–1943).—FIG. 187, 2d. *I. spiniger* (J. SOWERBY), Upper Albian, England; X0.4 (Spath, 1923–1943).

**Algerites** PERVINQUIÈRE, 1910, p. 46 [\**A. sayni*; OD]. At first coiled in one plane, with perforate umbilicus, then whorls just in contact, then uncoiling to nearly straight shaft and terminal hook; phragmocone and beginning of body chamber with regular or occasional, branched or intercalated ribs, generally all tuberculate ventrolaterally, and with constrictions. *Lower Cretaceous (Upper Albian)—Upper Cretaceous (Lower Cenomanian)*: England, northern Africa.—FIG. 187, 1a–c. \**A. sayni*; a, b, X1; c, X4 (Pervinquierè, 1910).

**Alloriceras** SPATH, 1926a, p. 80 [\**Crioceras ellipticum* WOODS, 1896, p. 84, non *Hamites ellipticus* MAN-

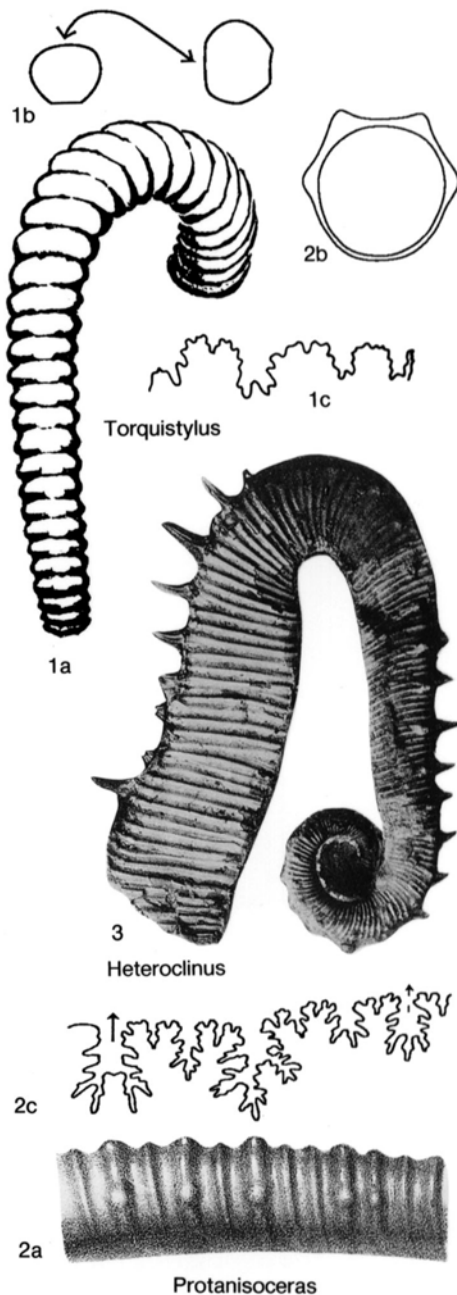


FIG. 184. Anisoceratidae (p. 234–235)

TELL, 1822, p. 122; OD; =*Hamites angustus* J. de C. SOWERBY in DIXON, 1850, p. 346 (non *A. woodsi* SPATH, 1939c, p. 598)]. Similar to the more finely ribbed and sharply tuberculate species of *Idiohamites*, but early whorls at least distinctly helicoid and twisted. *Upper Cretaceous (Upper Cenomanian—Lower Coniacian)*: western Europe, South Af-

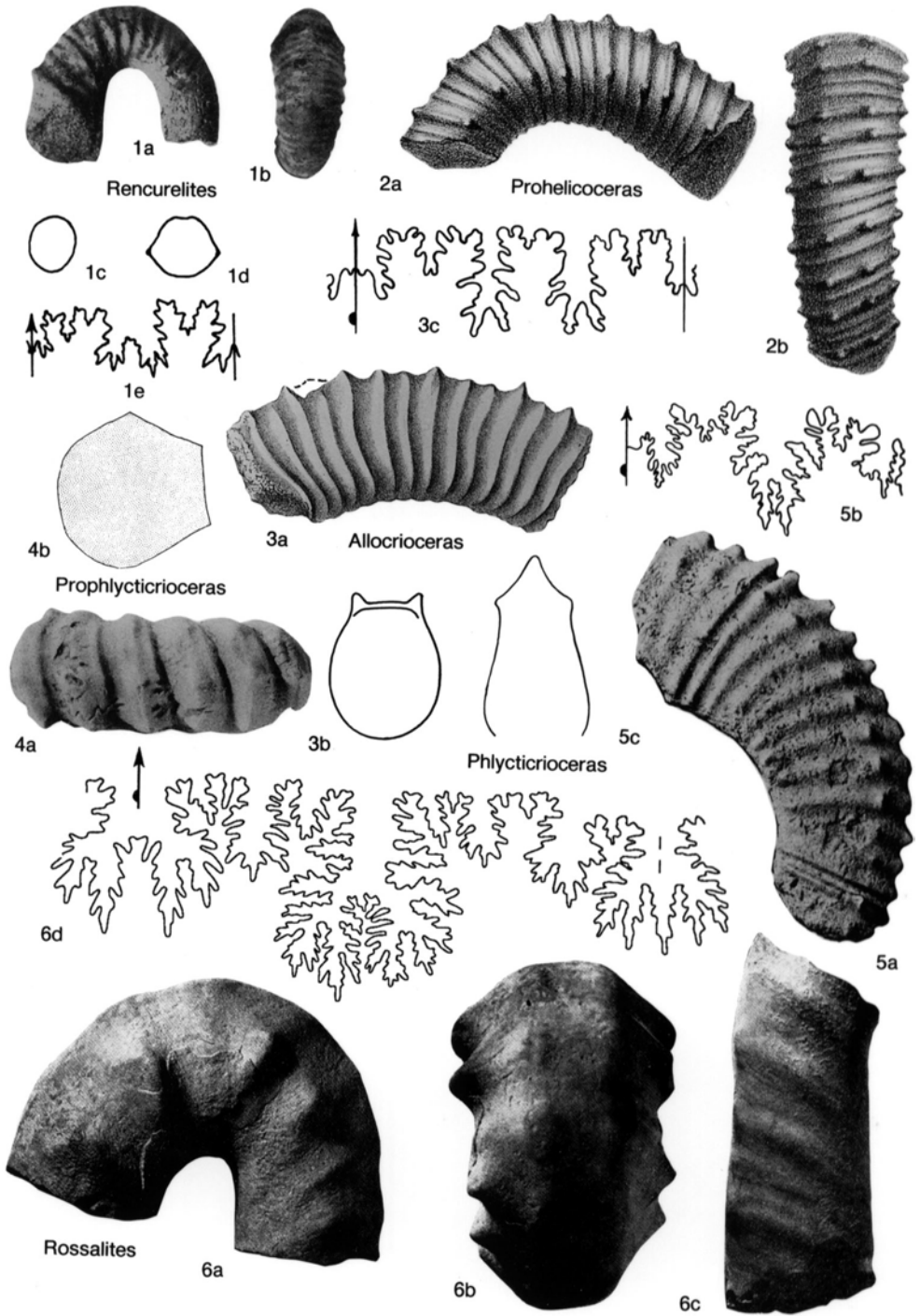


FIG. 185. Anisoceratidae (p. 235–239)

rica (Zululand), USA.—FIG. 185,3a–c. \**A. angustum* (J. de C. SOWERBY), Upper Turonian, England; *a, b*,  $\times 0.75$ ; *c*, enlarged (Billingshurst, 1927).

**Phlycticrioceras** SPATH, 1926a, p. 80 [\**Ancyloceras? douvillei* GROSSOUVRE, 1894, p. 254; OD; =*Hamites trinodosus* GEINITZ, 1850 in 1849–1850, p. 118 (= ?*Hamites triseriatus* ROMINGER, 1847, p. 659, *nom. dub., nom. oblit.*)]. Questionably planispiral but with straight parts; ribs sharp, straight, more or less rursiradiate, with strong ventrolateral and siphonal tubercles; siphonal tubercles forming serrate keel; collared constrictions normally present. *Upper Cretaceous (Coniacian–Santonian, ?Campanian)*: France, Germany, Madagascar, Wyoming, Texas, Mexico.—FIG. 185,5a–c. \**P. trinodosus* (GEINITZ), Coniacian, France; *a, b*,  $\times 1$ ; *c*,  $\times 2$  (Grossouvre, 1894).

### Family HAMITIDAE Gill, 1871

[Hamitidae GILL, 1871, p. 3]

Coiling rather irregular, typically in open, plane spiral ending in 2 or 3 more or less parallel shafts; early part may be helical. Section circular to compressed; ribs annular or interrupted on dorsum; no tubercles.

The earliest hamitids, some with subtrifid L, appear in the upper Lower Albian and are presumably derived from early Anisoceratidae by loss of tubercles. SPATH, 1923–1943; CASEY, 1960–1980. *Lower Cretaceous (Lower Albian)–Upper Cretaceous (Upper Turonian)*.

**Hamites** PARKINSON, 1811, p. 145 [\**H. attenuatus* J. SOWERBY, 1814b, p. 137; SD DIENER, 1925, p. 65] [= *Torneutoceras* HYATT, 1900, p. 586, *obj.*; *Stomohamites* BREISTROFFER, 1940, p. 155(85) (type, *H. virgulatus* BRONGNIART in CUVIER & BRONGNIART, 1822, pl. O, fig. 6; OD); *Hamitella* BREISTROFFER, 1947b, p. 100(84), *nom. nov. pro Helicoceras* ORBIGNY, 1842a, p. 611, *non* KOENIG, 1825 in 1820–1825, p. 19 (type, *H. annulatum* ORBIGNY, 1842a, p. 611; SD DIENER, 1925, p. 88)]. Typically with 3 well-separated, subparallel shafts, but initial spiral or even helical coiling may persist; whorl section circular, depressed or compressed; straight, rectiradiate or oblique ribs typically fine and dense to coarse and distant, but may be obsolescent. Suture florid to rather simple, with wide, bifid L and smaller, trifid or subbifid U. Forms with strong apertural collar and constriction (*Stomohamites*) are microconchs; their sutures are not consistently different. *Lower Cretaceous (Lower Albian)–Upper Cretaceous (Upper Cenomanian)*: Europe, Africa, Madagascar, India, Australia (Northern Territory), New Zealand, USA, Mexico.

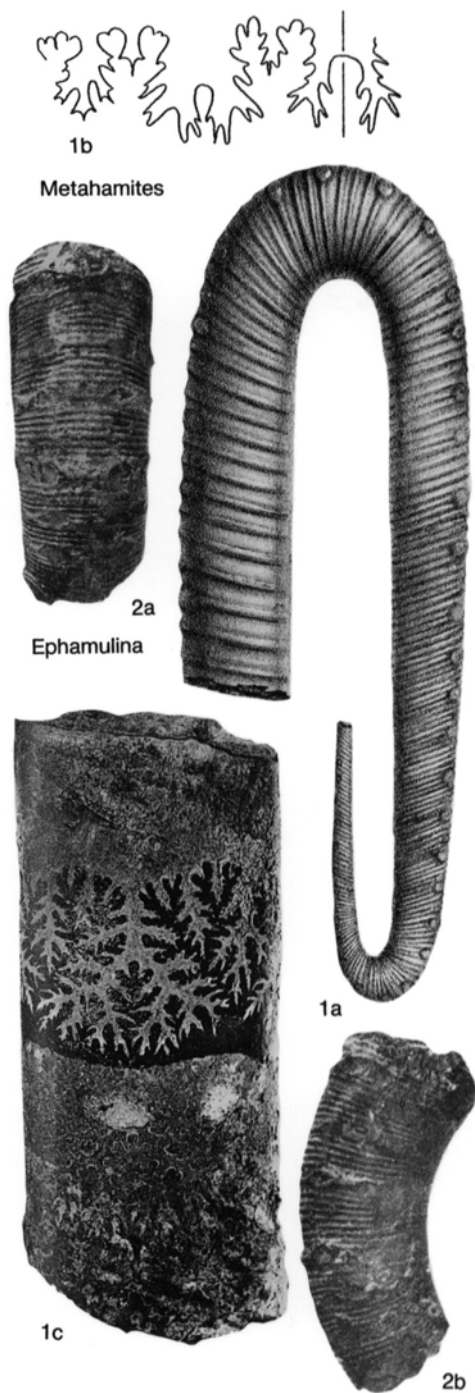


FIG. 186. Anisoceratidae (p. 235–236)

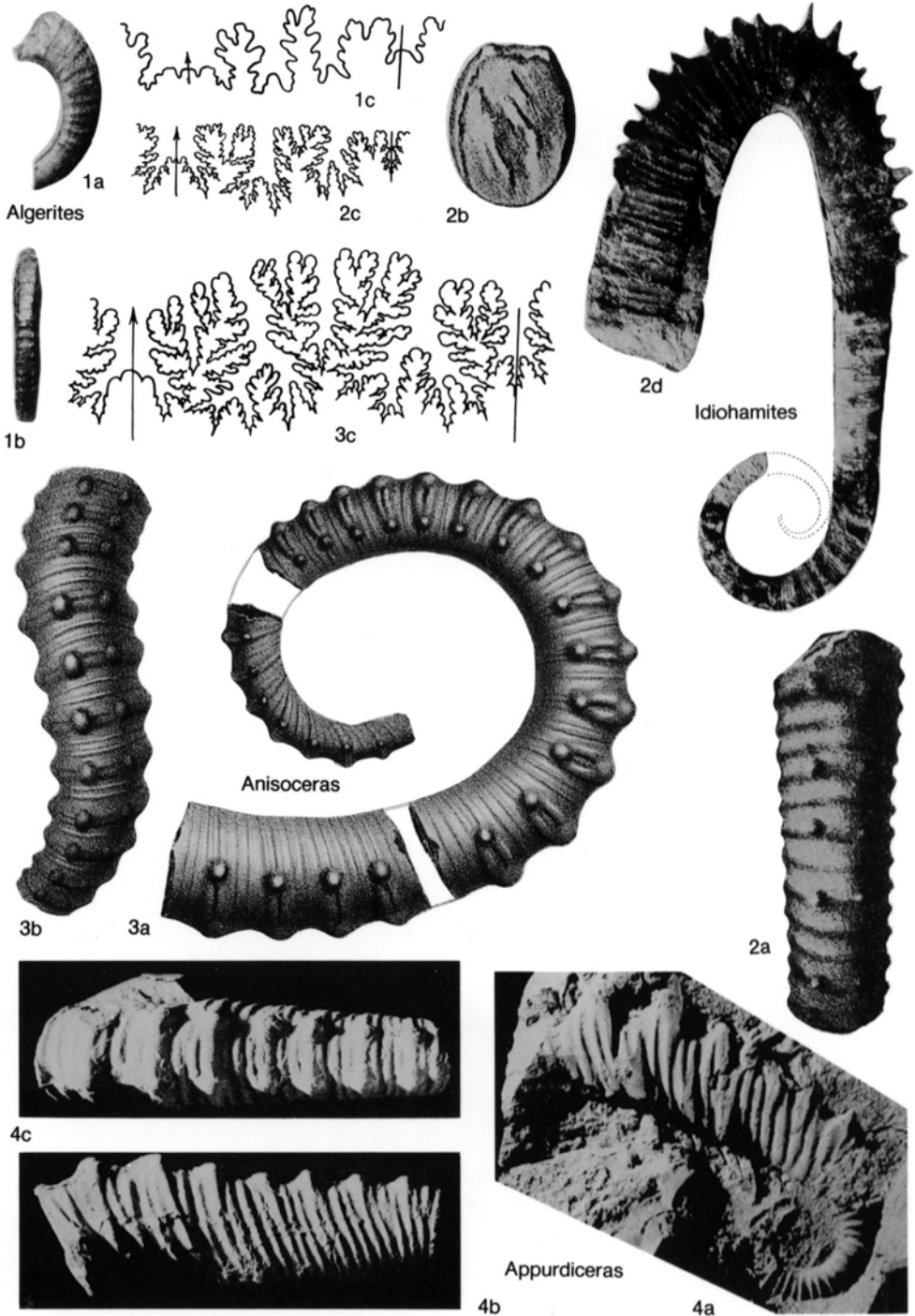


FIG. 187. Anisoceratidae (p. 237)

- H. (Hamites).** Ribs always present. Occurrence and distribution as for genus.—FIG. 188, 3a–c. \**H. (H.) attenuatus*, Middle Albian, England; *a, b*,  $\times 1$ ; *c*, enlarged (Spath, 1923–1943).—FIG. 188, 3d–g. *H. (H.) duplicatus* PICTET & CAMPICHE, Upper Albian, France; *d, e*, microconch,  $\times 1$  (Pictet, 1847); *f, g*,  $\times 3$  (Spath, 1923–1943).
- H. (Psilohamites)** SPATH, 1941, p. 654 [\**Hamites bouchardianus* ORBIGNY, 1842a, p. 540; OD]. Almost smooth; only straight shafts known. *Lower Cretaceous (Upper Albian)*: western Europe.—FIG. 188, 5a, b. \**H. (P.) bouchardianus*, Upper Albian, France; *a*,  $\times 1$ ; *b*, enlarged (Orbigny, 1840–1842).
- H. (Lytohamites)** CASEY, 1961a, p. 92 [\**L. similis*; OD]. With straight shafts; ribs rather fine, oblique; suture florid. *Lower Cretaceous (Upper Albian)*: western Europe.—FIG. 188, 4a, b. \**H. (L.) similis* (CASEY), England; *a*,  $\times 1$ ; *b*,  $\times 2$  (Spath, 1923–1943).
- Hemiptychoceras** SPATH, 1925c, p. 189 [\**Ptychoceras gaultinum* PICTET, 1847, p. 363; OD] [= *Protobaculites* COLLIGNON, 1964, p. 9 (type, *Baculites (P.) ambiguus*; OD)]. Similar to *Hamites*, but 3 shafts closely pressed together and ribs on second bend may be scalelike, changing density on final shaft; constrictions may be present. *Lower Cretaceous (Upper Albian)*: western and central Europe, South Africa (Zululand), Japan.—FIG. 188, 7. \**H. gaultinum* (PICTET), France;  $\times 1$  (Pictet, 1847).
- Scaphamites** WIEDMANN & MARCINOWSKI, 1985, p. 451 [\**S. passendorferi*; OD]. Coiled in shallow helix followed by shaft and terminal hook and twisted throughout; ribs mainly simple. *Lower Cretaceous (Albian, precise horizon uncertain)*: Poland.—FIG. 188, 2a, b. \**S. passendorferi*; reconstruction,  $\times 1$  (Wiedmann & Marcinowski, 1985).
- Puebloites** COBBAN & SCOTT, 1972, p. 45 [\**Helicoceras? corrugatum* STANTON, 1894, p. 165; OD]. Coiled in shallow helix, regular or elliptical. Body chamber tending to be depressed in section and to bulge adapically. Ribs generally oblique. *Upper Cretaceous (Lower Turonian)*: France, Spain, Austria, Colorado.—FIG. 188, 6a, b. \**P. corrugatum* (STANTON);  $\times 1$  (Cobban & Scott, 1972).—FIG. 188, 6c. *P. spiralis* COBBAN & SCOTT;  $\times 1$  (Cobban & Scott, 1972).
- Metaptychoceras** SPATH, 1926a, p. 80 [\**Ptychoceras smithi* WOODS, 1896, p. 74; OD]. Small; much like *Hemiptychoceras* but with finer ribs and no constrictions after the first shaft. Perhaps a subgenus of *Hemiptychoceras*. *Upper Cretaceous (Lower Turonian–Upper Turonian)*: England, Spain, South Dakota, Texas, Colombia.—FIG. 188, 1a, b. \**M. smithi* (WOODS), Upper Turonian, England;  $\times 2$  (Wright, 1979).

### Family UNCERTAIN

- Plesiohamites** BREISTROFFER, 1947b, p. 93(77) [\**Hamites multicostatus* BROWN, 1837 in 1837–1849, p. 3; OD]. A *nomen dubium* since the holo-

type is specifically and generically indeterminate. *H. multicostatus* auctt. is synonymous with the Upper Albian *Hamites (Lytohamites) similis* CASEY, 1961a, p. 92. *Cenomanian*: England.

### Family TURRILITIDAE Gill, 1871

[Turrititidae GILL, 1871, p. 3] [=Pseudhelicoceratinae BREISTROFFER, 1953a, p. 1350]

Helical forms, dextral or sinistral, loosely or tightly coiled; typically regular, but later whorls may be unstable; apical angle normally acute; in early species siphon in middle of exposed side, later migrating to upper margin or even upper internal angle of whorl; with strong ribs or tubercles or both; rarely smooth. Suture asymmetrical to accord with helical coiling; lobes primitively bifid but variable, tending to trifidity. *Lower Cretaceous (Middle Albian)–Upper Cretaceous (Upper Cenomanian)*.

Two genera appeared in lower Middle Albian, *Proturrititoides* (without tubercles) and *Pseudhelicoceras* (with tubercles). The former seems at first sight to be derived from a helical hamitid and the latter from *Protanisoceras*, suggesting subfamily division on this basis. However, the ornament of *Pseudhelicoceras* is not very close to that of contemporary anisoceratids, and it is at least possible that the family is monophyletic and that *Pseudhelicoceras* was derived from *Proturrititoides*, which certainly has some tuberculate derivatives.

- Proturrititoides** BREISTROFFER, 1940, p. 150(80) [\**Turritilites astierianus* ORBIGNY, 1842a, p. 578; OD]. Whorl section more or less circular, with siphuncle at middle of exposed part; apical angle variable; umbilicus wide; aperture slightly constricted and collared; ribs more or less dense, radial or prorsiradial, strong and simple, without tubercles. *Lower Cretaceous (Middle Albian)*: France, Poland.—FIG. 189, 1. \**P. astierianus* (ORBIGNY), Middle Albian, France;  $\times 1$  (Orbigny, 1840–1842).
- Turrititoides** SPATH, 1923a, p. 75 [\**Turritilites hugardianus* ORBIGNY, 1842a, p. 588; OD]. More tightly coiled than *Proturrititoides*, with apical angle more acute, whorl section oval or angular, and sides flatter; siphuncle at upper margin of side; aperture with strong constriction, collared on both sides. *Lower Cretaceous (Upper Albian)*: Europe, Madagascar, Pakistan.—FIG. 189, 3a, b. *T. densicostatus* PASSENDORFER, Upper Albian, England; *a*,  $\times 1$ ; *b*,  $\times 2$  (Spath, 1937b).
- Ostlingoceras** HYATT, 1900, p. 587 [\**Turritilites puzosianus* ORBIGNY, 1842a, p. 587; OD]. Very



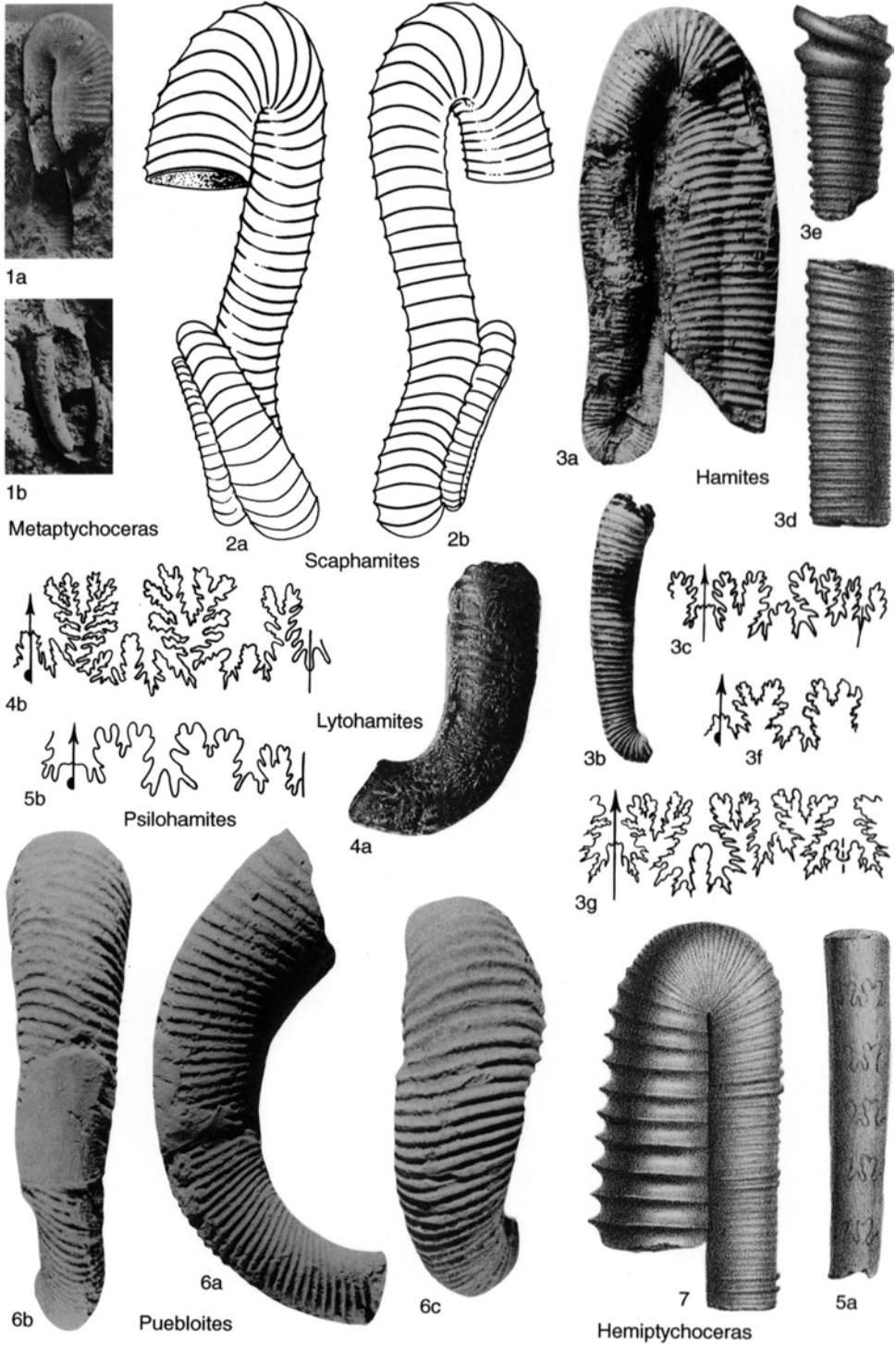


FIG. 188. Hamitidae (p. 239–241)

closely coiled, with acute apical angle; whorl section more angular and flat-sided than in *Turrilitoides*; ribs dense, straight or slightly flexuous, with up to 3 tubercles at lower end. Derived from *Proturrilitoides* in parallel with *Turrilitoides*. Lower Cretaceous (Middle Albian)—Upper Cretaceous (Lower Cenomanian): Europe, northern Africa, South Africa (Zululand), Madagascar, Japan, Texas.

**O. (Parostlingoceras)** BREISTROFFER, 1953a, p. 1350 [\**Turrilites moutonianus* ORBIGNY, 1842a, p. 584; OD]. Ribs rather irregular, angulate or weakly tuberculate at lower angle of side. Lower Cretaceous (Middle Albian): France, Poland.

**O. (Ostlingoceras)**. Ribs regular, with 2 or 3 distinct tubercles at lower end of each. Lower Cretaceous (Upper Albian)—Upper Cretaceous (Lower Cenomanian): distribution as for genus.—FIG. 189,4. \**O. (O.) puzosianum* (ORBIGNY), Upper Albian, France;  $\times 1$  (ORBIGNY, 1842a).

**Neostlingoceras** KLINGER & KENNEDY, 1978, p. 14 [\**Turrilites carcitanensis* MATHERON, 1842, p. 267; OD]. Shell form as in *Ostlingoceras* but with median row of sparse tubercles more numerous than lower rows; analogue of *Hypoturrilites*. Upper Cretaceous (Lower Cenomanian—Upper Cenomanian): Europe, northern Africa, South Africa, Madagascar, Iran, southern India, Japan, New Mexico, Colorado, Wyoming.—FIG. 189,5. \**N. carcitanense* (MATHERON), England;  $\times 1$  (Kennedy, 1971).

**Raynaudia** DUBOURDIEU, 1953, p. 44 [\**Turrilites (Carthaginites) raynaudiensis* COLLIGNON, 1932, p. 19; OD]. Smooth; siphuncle at external upper angle of whorl. Suture simplified. Lower Cretaceous (Upper Albian): Madagascar.—FIG. 189,2. \**R. raynaudiensis* (COLLIGNON);  $\times 2$  (Collignon, 1932).

**Carthaginites** PERVINQUIÈRE, 1907, p. 101 [\**Turrilites (Carthaginites) kerimensis*; OD]. Differs from *Raynaudia* in having a spiral groove along the middle of the side, with or without single row of small tubercles, and siphuncle at inner upper angle of whorl. Upper Cretaceous (Lower Cenomanian—Upper Cenomanian): England, northern Africa, Wyoming, New Mexico.—FIG. 190,2. \**C. kerimensis* (PERVINQUIÈRE), Tunisia;  $\times 2$  (Pervinquierè, 1907).

**Pseudohelicoceras** SPATH, 1922a, p. 112 [\**Turrilites robertianum* ORBIGNY, 1842a, p. 585; OD] [= *Spiroceras* MEEK, 1876, p. 486, non QUENSTEDT, 1858 in 1856–1858, p. 407 (type, *Turrilites robertianus* ORBIGNY, 1842a, p. 585; M); *Subhelicoceras* BREISTROFFER, 1953a, p. 1349 (type, *Turrilites bituberculatus* ORBIGNY, 1842a, p. 582; OD); *Parahelicoceras* BREISTROFFER, 1953a, p. 1350 (type, *Turrilites catenatus* ORBIGNY, 1842a, p. 574; OD)]. Apical angle moderately to very acute; coiling loose or tight; ribbing variable, simple or branching, radial or prorsiradial, with 2 or 4 tubercles (which may cover several ribs) and with or without intermediate nontuberculate ribs; siphuncle at or near middle of exposed side. Lower Cretaceous (Middle Albian—Upper Albian): western and central Europe, South Africa (Zululand), Madagascar, British Columbia, California, Texas.—FIG. 190,1a–c. \**P.*

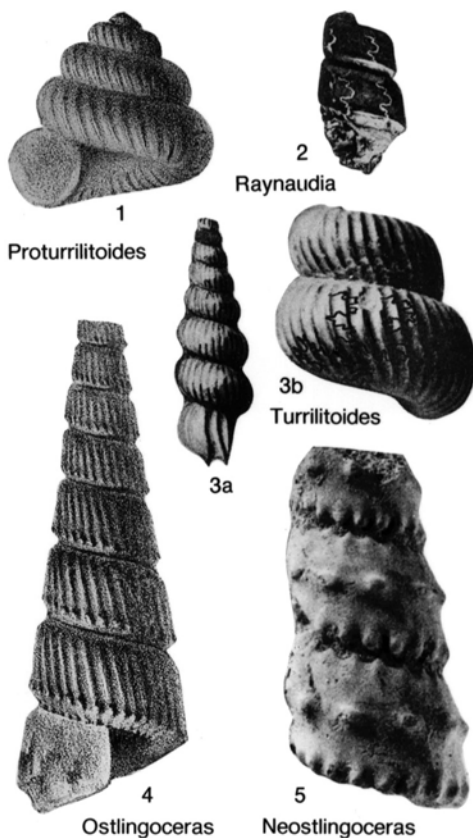


FIG. 189. Turrilitidae (p. 241–243)

*robertianum* (ORBIGNY), Upper Albian, France; a, b,  $\times 1$ ; c, enlarged (Orbigny, 1840–1842).

**Mariella** NOWAK, 1916, p. 10 (not invalidated, despite the statements of many authors, by *Mariaella* PFEIFFER in GRAY, 1855, p. 62, nor by *Mariaella* MOERCH, 1865, p. 269, an error for *Mariaella* GRAY) [\**Turrilites bergeri* BRONGNIART in CUVIER & BRONGNIART, 1822, p. 395; OD] [= *Paraturrilites* BREISTROFFER, 1947b, p. 96(80) (type, *Turrilites gresslyi* PICTET & CAMPICHE, 1861, p. 132; OD); *Hemiturrilites* BREISTROFFER, 1953a, p. 1350 (type, *Turrilites elegans* ORBIGNY, 1842a, p. 577; OD); *Bergericeras* WIEDMANN, 1962a, p. 224, obj.]. Apical angle variable, generally large; closely coiled; whorl section more or less circular; ribs slightly oblique, rather feeble, each with 4 more or less equal tubercles. Lower Cretaceous (Upper Albian)—Upper Cretaceous (Lower Cenomanian): Europe, northern Africa, South Africa (Zululand), Madagascar, Iran, southern India, New Zealand, Texas, Mexico, Argentina.

**M. (Mariella)**. Tubercles more or less equidistant; intercostal section rounded. Differentiation of size and spacing of rows of tubercles leads to *Turrilites* and of numbers in rows to

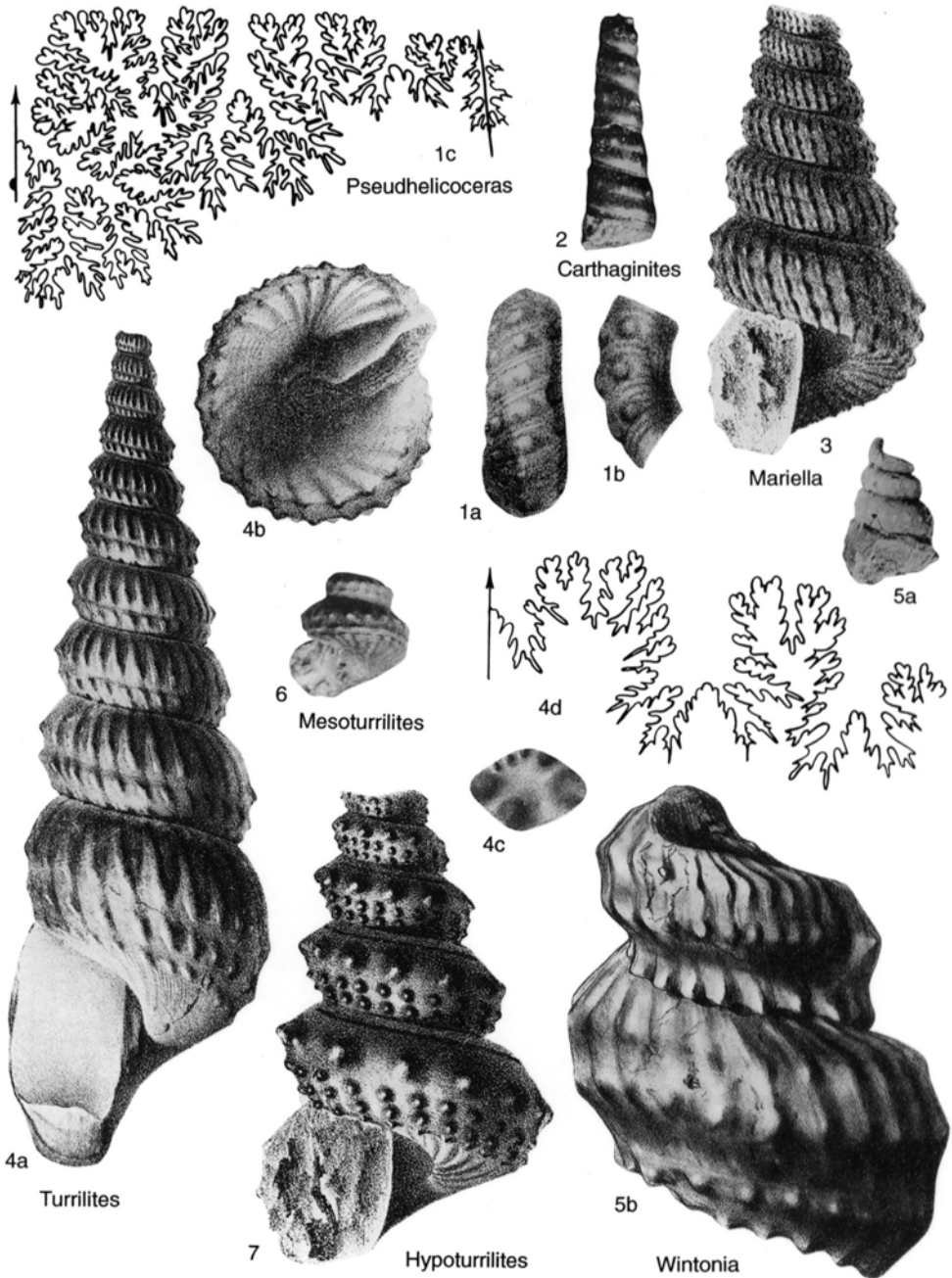


FIG. 190. Turrilitidae (p. 243–245)

*Hypoturrilites*. Occurrence and distribution as for genus.—FIG. 190.3. \**M. (M.) bergeri* (BRONGNIART in CUVIER & BRONGNIART), Upper Albian, France;  $\times 1$  (Orbigny, 1840–1842).

*M. (Wintonia)* ADKINS, 1928, p. 213 [\**W. graysonensis*; OD; =*Turrilites bosquensis* ADKINS,

1920, p. 76] [=*Plesioturrilites* BREISTROFFER, 1953a, p. 1351 (type, *Turrilites brazoensis* ROEMER, 1852, p. 37; OD)]. Upper and lower pairs of tubercles separated by marked spiral furrow; body chamber uncoiling. Initial straight shaft, said to characterize *Wintonia*, is artifact of

fossilization. *Lower Cretaceous (Upper Albian)–Upper Cretaceous (Lower Cenomanian)*: Madagascar, southern India, California, Texas, Mexico. —FIG. 190,5a. \**M. (W.) bosquensis* (ADKINS), Lower Cenomanian, Texas; initial straight shaft,  $\times 2$  (Clark, 1965). —FIG. 190,5b. *M. (W.) brazoensis* (ROEMER), Lower Cenomanian, Texas;  $\times 0.5$  (Lasswitz, 1904).

**Hypoturrilites** DUBOURDIEU, 1953, p. 44 (SHIMIZU, 1935a, p. 195, *nom. nud.*) [\**Turrilites gravesianus* ORBIGNY, 1842a, p. 596; OD; ICZN pending] [= *Eohypoturrilites* SCHOLZ, 1973, p. 123 (type, *Turrilites manelli* SHARPE, 1857, p. 63; OD)]. May be large; ribs almost absent; tubercles in midflank row fewer and generally much larger than remainder; test with long spines (tubercles on molds). *Upper Cretaceous (Cenomanian)*: Europe, Africa, India, Australia (Northern Territory), New Zealand, Japan, Texas, Argentina. —FIG. 190,7. \**H. gravesianus* (ORBIGNY), France;  $\times 1$  (Orbigny, 1840–1842).

**Mesoturrilites** BREISTROFFER, 1953a, p. 1351 [\**Turrilites aumalensis* COQUAND, 1862, p. 323; OD]. Apical angle rather large, with 4 rows of tubercles or of ribs and tubercles, the upper row consisting of short ribs or large, round tubercles, the second and third rows of spirally elongated tubercles or semi-continuous ridges separated by a groove, and the fourth row of weak, elongate tubercles on lower whorl surface. *Upper Cretaceous (Lower Cenomanian)*: England, Germany, Poland, Algeria, Tunisia, Turkmenistan. —FIG. 190,6. \**M. armalense* (COQUAND), Algeria;  $\times 1$  (Pervinrière, 1910).

**Turrilites** LAMARCK, 1801, p. 102 [\**T. costatus*; OD] [= *Euturrilites* BREISTROFFER, 1953a, p. 1351 (type, *T. scheuchzerianus* BOSCH, 1801, p. 190; OD); *Turbinites* DUBOURDIEU, 1953, p. 42, *non* MARTIN, 1809, pl. 38 (type, *T. scheuchzerianus* BOSCH, 1802, p. 190; OD)]. Apical angle moderately to very acute; tightly coiled; whorl section flattened or angular; ribs simple or depressed in the middle or with 2 to 4 bullate or spinate tubercles. Derived from *Mariella*, from which distinction may be difficult. *Upper Cretaceous (Cenomanian)*: Europe, Africa, Oman, India, Japan, USA, Mexico. —FIG. 190,4a–d. \**T. costatus*, Lower Cenomanian, France; *a, b*,  $\times 0.75$ ; *c*,  $\times 0.5$ ; *d*, enlarged (Orbigny, 1840–1842).

## Family NOSTOCERATIDAE

Hyatt, 1894

[Nostoceratidae HYATT, 1894, p. 568] [=Jouaniceratidae WRIGHT, 1952, p. 218; Bostrychoceratinae SPATH, 1953, p. 16; Hyptocerotatinae SPATH, 1953, p. 16; Emperoceratinae SPATH, 1953, p. 17; Proavtocerotatinae SPATH, 1953, p. 17, *errore pro* Pravitocerotatinae]

Helicoid forms with coiling commonly irregular in early or late stages or both or throughout. Ribs prominent, with or without tubercles; constrictions common. Suture normally florid. *Upper Cretaceous (Turonian–Maastrichtian)*.

Although shell form is variable, the genera are closely related and division into subfamilies is unnecessary. The family seems to have been derived from Albian *Turrilitoides*, but the boundary with Turrilitidae is uncertain owing to lack of ammonoids in Upper Cenomanian and Lower Turonian rocks.

**Nostoceras** HYATT, 1894, p. 569 [\**N. stantoni*; OD; = *Ancyloceras? approximans* CONRAD, 1856, p. 266]. A series from Turonian to Maastrichtian of mostly tightly coiled, turrilitoid forms with body chamber incipiently U-shaped and pendent; apical angle acute to obtuse; ribs simple, close or distant, and flexuous; normally with deep, collared constrictions. In the Campanian, rapid morphological radiation produced interconnected but varying species with coiling tight or loose, apical angle acute or obtuse, ribs fine or coarse, simple or variously looped, and tuberculation lacking, weak, or strong, regular or irregular. Some faunas contain only a few morphotypes, others a wide range of intergrading forms. A selection of these are listed here as subgenera but are mostly no more than examples in a variable plexus. *Upper Cretaceous (Turonian–Lower Maastrichtian)*: Europe, Africa, Madagascar, southern India, Japan, Canada, USA, Western Australia, central Asia.

**N. (Eubostrychoceras)** MATSUMOTO, 1967, p. 332 [\**E. indopacificum*; OD]. Initially J-shaped, then turricone; whorls typically touching but in some specimens free; body chamber twisted to face obliquely upward but still touching preceding whorl; ribs mostly simple; no tubercles; collared constrictions throughout, more or less parallel to ribs. *Upper Cretaceous (Turonian–Santonian)*: western Europe, northern Africa, Madagascar, southern India, Japan, ?Oregon, Wyoming, New Mexico, Texas. —FIG. 191,4a,b. \**N. (E.) indopacificum* (MATSUMOTO), Coniacian, Japan;  $\times 1$  (Matsumoto, 1967).

**N. (Yezoceras)** MATSUMOTO, 1977, p. 316 [\**Y. nodosum*; OD]. Similar to early *N. (Eubostrychoceras)* but with siphuncle at base of whorl and body chamber, retroversed or not, with up to 4 large tubercles on periodic ribs. *Upper Cretaceous (Lower Coniacian–Upper Coniacian)*: ?Germany, Japan. —FIG. 191,7. \**N. (Y.) nodosum* (MATSUMOTO), Lower Campanian, Japan;  $\times 1$  (Matsumoto, 1977).

**N. (Bostrychoceras)** HYATT, 1900, p. 588 [\**Turrilites polyplocus* ROEMER, 1841, p. 92; OD] [= *Mobergoceras* SCHMID & ERNST, 1975, p. 342 (type, *Turrilites junior* Moberg, 1885, p. 31; OD)]. Apical angle acute to obtuse; whorls more or less circular in section, sometimes touching; body chamber tending to be free and U-shaped; ribs typically simple, close or distant, and untuberculate; small tubercles may occur on later whorls or throughout on simple or looped ribs. [*Mobergoceras* for acutely conical species with

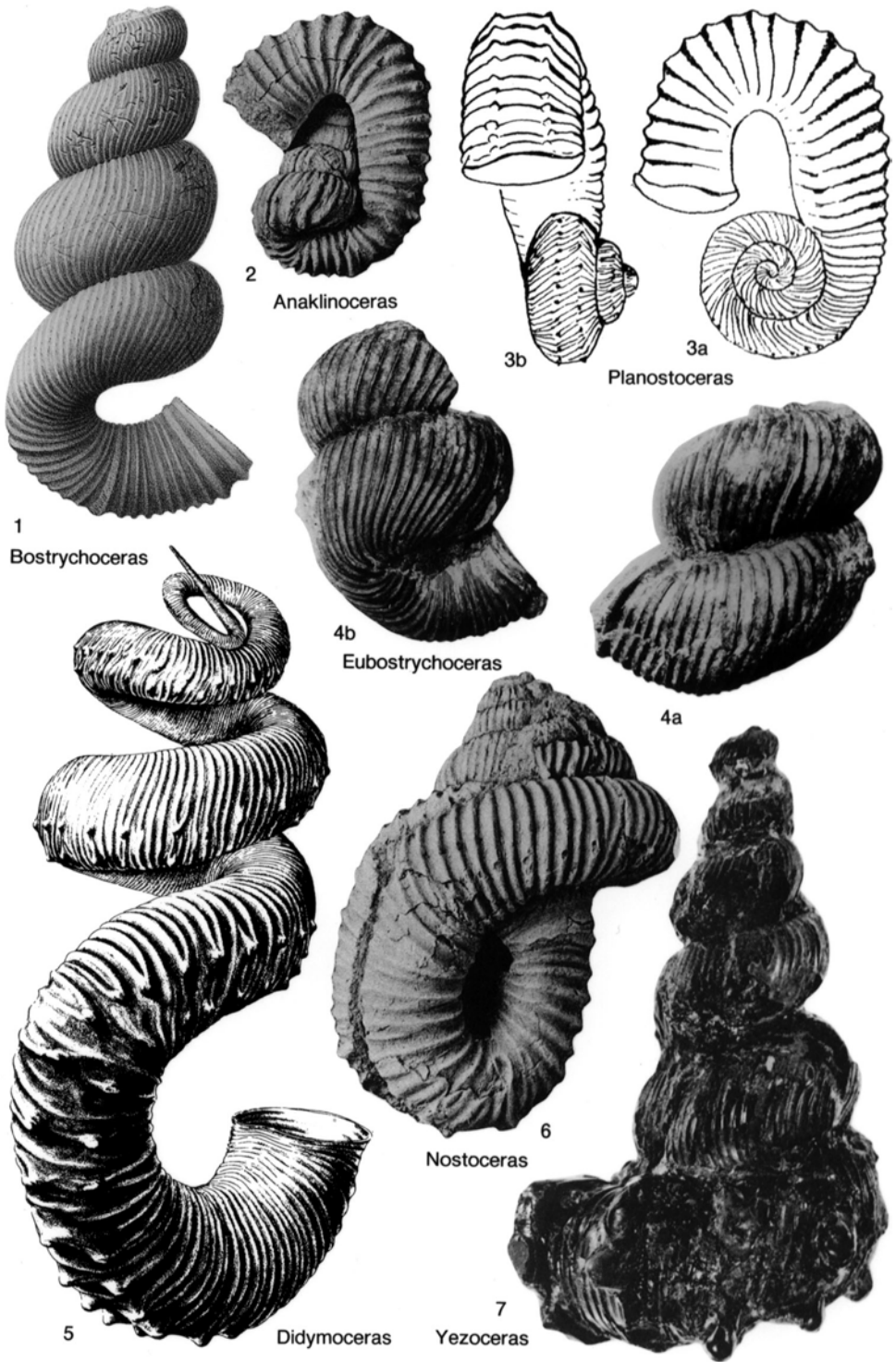


FIG. 191. Nostoceratidae (p. 245–247)

- distant ribs seems unnecessary.] *Upper Cretaceous (Campanian–Lower Maastichtian)*: Europe, northern Africa, Madagascar, southern India, Japan, Western Australia, Texas, Mexico.—FIG. 191,1. \*N. (*B.*) *polyplacum* (ROEMER), Campanian, northern Germany;  $\times 0.5$  (Schlüter, 1871–1876).
- N. (Nostoceras)**. Apical angle rather to very obtuse; whorls circular to polygonal in section, in contact until body chamber; body chamber U-shaped, hanging free; 2 or more rows of distinct, small or large tubercles throughout on simple or looped, close or distant ribs. *Upper Cretaceous (Campanian)*: Ukraine, western and southeastern Africa, Madagascar, central Asia, Canada, USA.—FIG. 191,6. \*N. (*N.*) *approximans* (CONRAD), Texas;  $\times 1$  (Stephenson, 1941).
- N. (Didymoceras)** HYATT, 1894, p. 573 [\**Ancyloceras? nebrascense* MEEK & HAYDEN, 1857, p. 71; OD] [=?*Cirroceras* CONRAD, 1868, p. 730 (type, *Ammonoceratites conradi* MORTON, 1843, p. 109; OD), *nom. dub.* because holotype of type species is indeterminate (HOWARTH, 1965); *Emperoceras* HYATT, 1894, p. 575 (type, *E. beecheri*; OD)]. Loosely and irregularly coiled at first, even hamitoid; then helicoid with whorls just or not touching; body chamber pendent, U-shaped; ribs numerous, irregularly branching and looped, some with 2 rows of ventral tubercles. *Upper Cretaceous (Campanian)*: ?Germany, Austria, Angola, Israel, Alaska, Colorado, North Dakota, Delaware.—FIG. 191,5. \*N. (*D.*) *nebrascense* (MEEK & HAYDEN), Colorado; restored,  $\times 0.5$  (Scott & Cobban, 1965).
- N. (Anakinoceras)** STEPHENSON, 1941, p. 414 [\**A. reflexum*; OD]. Final part bent up one side of spire and down other. *Upper Cretaceous (Campanian)*: Texas.—FIG. 191,2. \*N. (*A.*) *reflexum* (STEPHENSON);  $\times 1$  (Stephenson, 1941).
- N. (Planostoceras)** LEWY, 1967, p. 168 [\*N. (*P.*) *rehavami*; OD]. Apical angle generally obtuse; plane of body chamber at right angles to axis of spire. *Upper Cretaceous (Upper Campanian)*: Israel, ?Angola.—FIG. 191,3a,b. \*N. (*P.*) *rehavami*, Israel;  $\times 0.5$  (Lewy, 1967; courtesy of Laser Pages Publishing, Ltd.).
- Didymoceratoides** KENNEDY & COBBAN, 1993a, p. 90 [\**D. binodosum*; OD]. Early, low, open helix followed by loose, elliptical whorls; with distant, sharp, rursiradiate ribs bearing small ventrolateral tubercles. Progenetic derivative of *Didymoceras*, losing the latter's tightly coiled later helix. *Upper Cretaceous (Middle Campanian)*: Arkansas, Texas.
- Nipponites** YABE, 1904, p. 20 [\*N. *mirabilis*; OD]. Coiled initially in loose helix, then in succession of U's in 3 dimensions, forming a tangle; with or without final retroversal hook; ribs single and regular; constrictions present, may be flared on final whorl. *Upper Cretaceous (Upper Turonian–Lower Santonian)*: Madagascar, Japan, Kamchatka, Sakhalin, Oregon.—FIG. 192,3a,b. \*N. *mirabilis*, Coniacian, Japan; *a*,  $\times 0.75$ ; *b*, diagram of coiling,  $\times 0.5$  (Yabe, 1904).
- Hyphantoceras** HYATT, 1900, p. 587 [\**Heteroceras* (“*roissyanum* SCHLÜTER,” error for) *reussianum* ORBIGNY, 1850a, p. 216; OD] [=?*Eubhyphantoceras* SHIMIZU, 1935a, p. 181 (type, *E. maestrichtiense*; OD); *Orientoceras* SHIMIZU, 1935a, p. 198 (type, *Heteroceras? orientale* YABE, 1904, p. 19); *Ankinatsytes* COLLIGNON, 1965b, p. 16 (type, *A. yabei*; OD)]. Heterostrophic; spire loosely and commonly irregularly coiled; body chamber U-shaped or irregular; whorl section circular to oval; ribs dense, slightly oblique, weak, nontuberculate; periodic ribs thin and flared, normally with 2 or 4 tubercles; no constrictions. Markedly dimorphic in size. Suture with long, deeply divided elements. [Ankinatsytes, said to differ only in suture, has suture of same general plan.] *Upper Cretaceous (Upper Turonian–Santonian)*: Europe, northern Africa, South Africa (Zululand), Madagascar, southern India, New Zealand, Japan, Venezuela.
- H. (Hyphantoceras)**. Flared ribs all single. Occurrence and distribution as for genus.—FIG. 192,2a,b. \*H. (*H.*) *reussianum* (ORBIGNY), Upper Turonian, England; *a*,  $\times 1$ ; *b*,  $\times 2$  (Woods, 1896).
- H. (Madagascarites)** COLLIGNON, 1966, p. 26 [\**M. andimakensis*; OD]. With midlateral and ventrolateral tubercles joined by doubled ribs. The type species at least is coiled in loose spire embraced by U-shaped body chamber. *Upper Cretaceous (Middle Santonian)*: ?Austria, South Africa (Zululand), Madagascar, Japan.—FIG. 192,4. \*H. (*M.*) *andimakensis* (COLLIGNON);  $\times 0.5$  (Collignon, 1966).
- Muramotoceras** MATSUMOTO, 1977, p. 334 [\**M. yezoense*; OD]. Initially straight, then helical, and then helical in reversed sense; body chamber may uncoil; ribbing at first fine and simple, later very distant and flared, with indistinct umbilical and distinct, septispinate ventrolateral tubercles. *Upper Cretaceous (Middle Turonian)*: Japan.—FIG. 192,1a–c. \*M. *yezoense*; *a,b*,  $\times 1.2$ ; *c*,  $\times 3$  (Matsumoto, 1977).
- Jouaniceras** BASSE, 1939, p. 43 [\**Heteroceras? sicardi* GROSSOUVRE, 1894, p. 223; OD]. Initial whorls tightly helical, then with plane spiral whose axis is at right angles to that of initial spire; on plane part at least ribs distant, thin, and high. *Upper Cretaceous (Santonian, ?Lower Campanian)*: France, Algeria, Japan.
- J. (Jouaniceras)**. Planispiral whorls tightly coiled; some ribs may be flared. *Upper Cretaceous (Santonian)*: France, Algeria.—FIG. 193,3a–c. \*J. (*J.*) *sicardi* (GROSSOUVRE), France; *a,c*,  $\times 2$ ; *b*,  $\times 1$  (Basse, 1939).
- J. (Ainoceras)** MATSUMOTO in MATSUMOTO & KANIE, 1967, p. 350 [\**A. kamuy*; OD]. Like *J. (Jouaniceras)* but with the planispiral whorls loosely coiled. *Upper Cretaceous (?Lower Campanian)*: Japan.—FIG. 193,1a,b. \*J. (*A.*) *kamuy* (MATSUMOTO & KANIE), Hokkaido; *a*,  $\times 1$ ; *b*, suture,  $\times 5$  (Matsumoto & Kanie, 1967).
- Tridenticeras** WIEDMANN, 1962a, p. 193 [\**Turritilites tridens* SCHLÜTER, 1876, p. 136; OD]. Turricone; 1

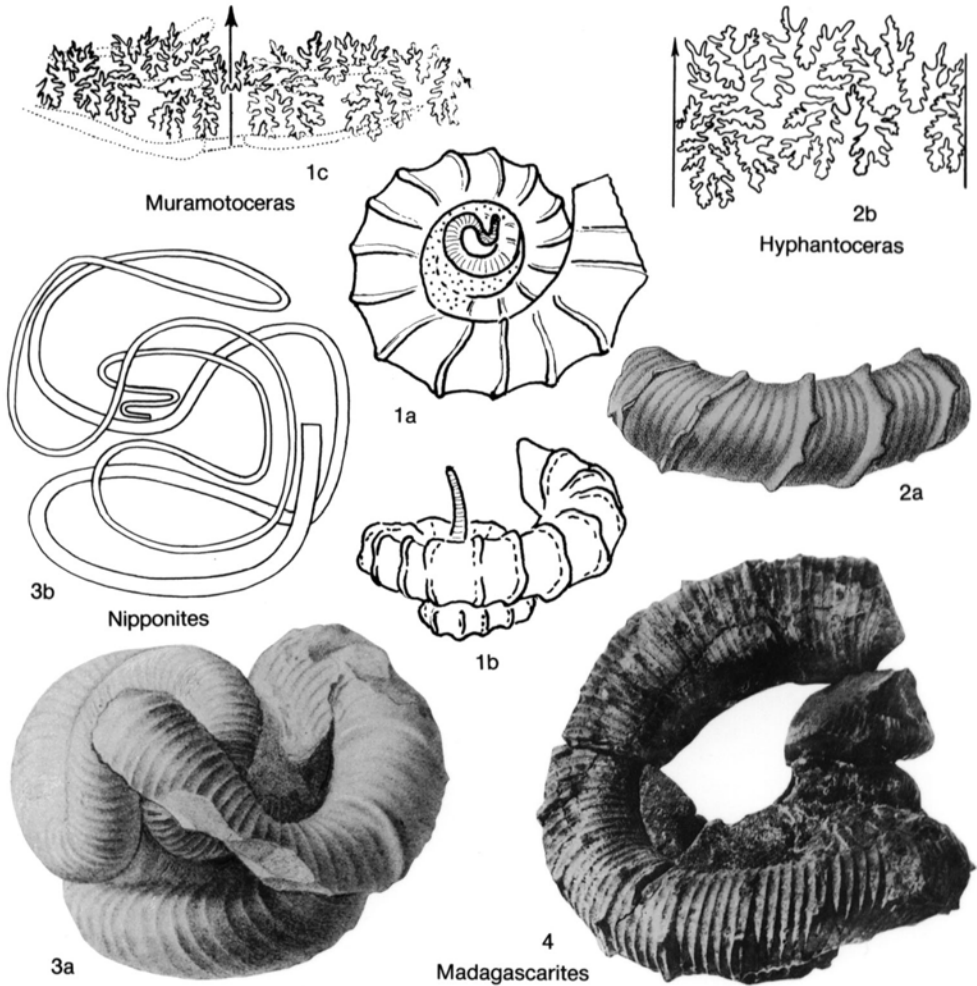


FIG. 192. Nostoceratidae (p. 247)

or 2 weak, untuberculate ribs between main ribs; main ribs with 3 visible tubercles, the lower 2 close together, and perhaps a fourth in the suture between the whorls. Presumably a recoiled *Hyphantoceras*. *Upper Cretaceous (Coniacian)*: Germany, Spain, Texas.—FIG. 193, 4. \**T. tridens* (SCHLÜTER), Germany;  $\times 1$  (Wiedmann, 1962a).

**Pravitoceras** YABE, 1902, p. 6 [\**P. sigmoidale*; OD]. Initially helical, then apical angle increasing until whorls regularly coiled in one plane and just touching; body chamber S-shaped; whorl section more or less circular; ribs on early whorls distant, nearly straight, all or alternate ones with sharp ventrolateral tubercles; later whorls with ribs slightly flexuous and dense, fewer with tubercles; constrictions irregular and shallow. *Upper Cretaceous (Campanian)*: Japan.—FIG. 193, 2a, b. \**P. sigmoidale*; a,

$\times 0.5$  (Matsumoto & others, 1981); b,  $\times 0.4$  (Yabe, 1902).

[*Neoturillites* SHIMIZU, 1935a, p. 180 (*nom. nud.*)].

### Family DIPLOMOCERATIDAE Spath, 1926

[Diplomoceratidae SPATH, 1926a, p. 81] [=Neocioceratinae SPATH, 1953, p. 17]

Variable offshoots of Nostoceratidae tending to lose helical coiling. Initial stage commonly (perhaps always) straight, smooth, and with constrictions (TANABE, OBATA, & FUTAKAMI, 1981). Extreme ptychoceratoid forms develop. Typically with sharp, annular,

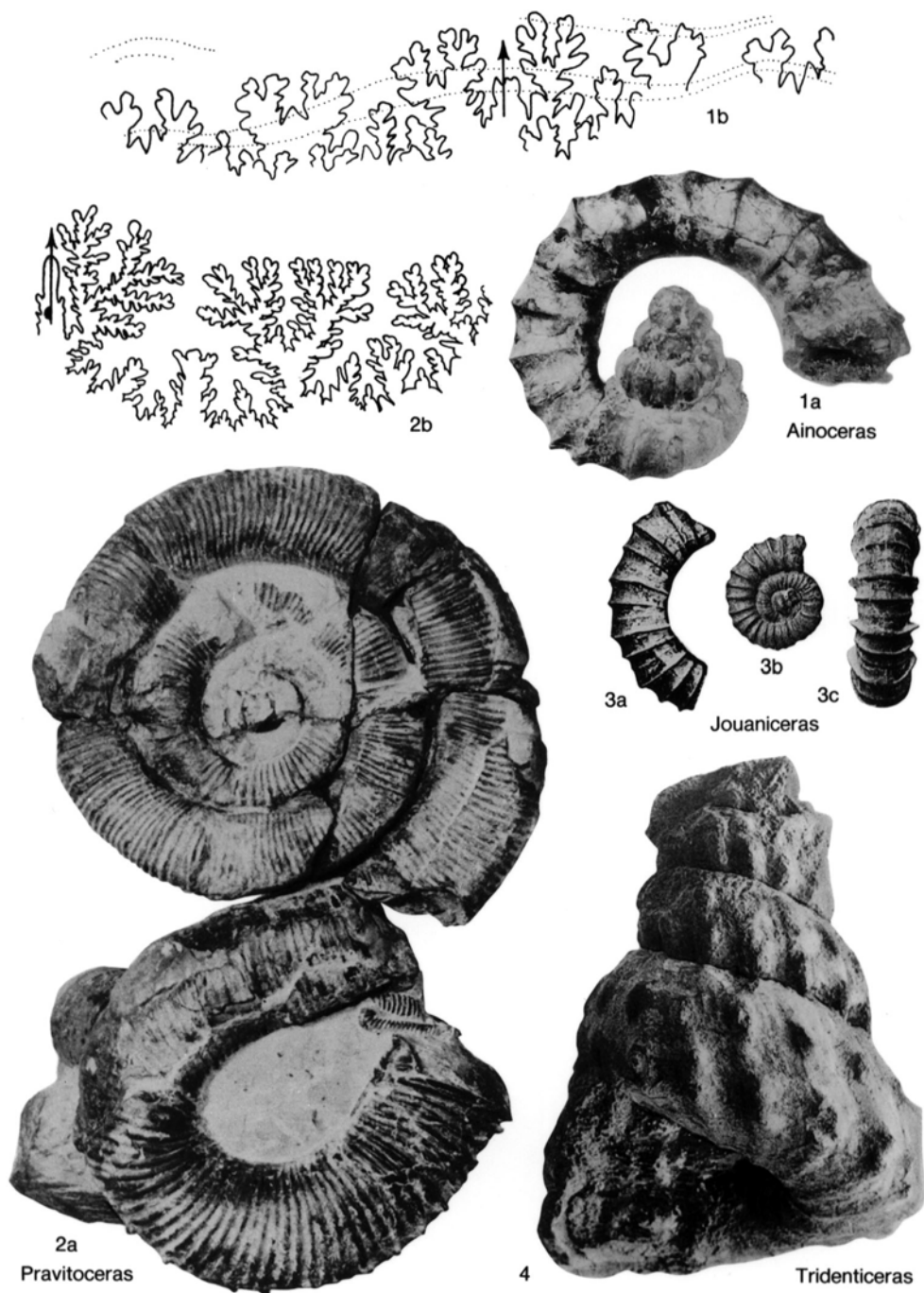


FIG. 193. Nostoceratidae (p. 247–248)

nontuberculate ribs, but ventrolateral spines occurring in some genera. Suture florid in Diplomoceratidae, as in Nostoceratidae, but

tending to simplify in the Polyptychoceratinae. *Upper Cretaceous (Turonian–Upper Maastrichtian).*



### Subfamily DIPLOMOCERATINAE Spath, 1926

[Diplomoceratinae SPATH, 1926a, p. 81] [=Scalaritinae WARD, 1976, p. 455]

Coiling mostly crioconic or elliptical; suture florid. *Upper Cretaceous (Turonian–Maastrichtian)*.

**Scalarites** WRIGHT & MATSUMOTO, 1954, p. 115 (MATSUMOTO, 1938b, p. 193, *nom. nud.*) [\**Helicoceras scalare* YABE, 1904, p. 9; OD] [=*Trianglites* MATSUMOTO, 1977, p. 350 (type, *T. antiquus*; OD)]. Very open, shallowly helicoid spire followed by loose, irregular coiling in one plane; section more or less circular; ribs simple, annular, with sparse, flared ribs or constrictions or both. [*Trianglites*, based on one specimen, differs only in coiling.] *Upper Cretaceous (Turonian–Coniacian)*: France, Bornholm, Japan. —FIG. 194,1a. \**S. scalare* (YABE), Turonian, Japan; diagrammatic, X0.5 (Wright & Matsumoto, 1954). —FIG. 194,1b. *S. antiquus* (MATSUMOTO), Turonian, Japan; X0.9 (Matsumoto, 1977).

**Glyptoxoceras** SPATH, 1925f, p. 30 [\**Hamites rugatus* FORBES, 1846, p. 117; OD] [=*Neohamites* BRUNNSCHWEILER, 1966, p. 48 (type, *N. giraliensis*; OD)]. Initial helix followed by loose, regular or elliptical coiling, normally with more or less straight shaft and hook in questionable microconchs; section circular to oval; ribs annular, sharp, straight, close or distant; a few collared constrictions present. *Upper Cretaceous (Santonian–Upper Maastrichtian)*: Europe, South Africa (Zululand), southern India, central Asia, Japan, Canada, USA, Venezuela, Brazil. —FIG. 194,2a–c. *G. indicum* (FORBES), Campanian, southern India; X1 (Kossmat, 1895). —FIG. 194,2d. *G. subcompressum* (FORBES), Campanian, Vancouver Island; X0.5 (Ward & Westermann, 1976).

**Neoglyptoxoceras** COLLIGNON, 1969, p. 35 [\**N. magnificum*; OD] [=?*Epiglyptoxoceras* COLLIGNON, 1969, p. 35 (type, *E. abnorme*; OD)]. Macroconchs large, more or less regularly crioconic; microconchs smaller, ancyloceratoid in coiling; ribs strong, thin, well-spaced, rursiradiate. Suture with massive auxiliary lobe in ?second lateral saddle. [*Epiglyptoxoceras*, apparently based on a single pathological specimen without such a massive auxiliary lobe, is probably a synonym.] *Upper Cretaceous (Lower Campanian–Middle Campanian)*: England, France, Germany, Austria, Ukraine, Madagascar. —FIG. 194,3. \**N. magnificum*, Lower Campanian, Madagascar; X0.5 (Collignon, 1969).

**Neancyloceras** SPATH, 1926a, p. 80 [\**Ancyloceras bipunctatum* SCHLÜTER, 1872, p. 98; OD]. Differs from open-whorled, distant-ribbed species of *Neoglyptoxoceras* in its bituberculate periphery. *Upper Cretaceous (Campanian)*: Europe, Angola, South Africa (Zululand). —FIG. 194,4. \**N. bipunctatum* (SCHLÜTER), Germany; X0.75 (Schlüter, 1871–1876).

**Smedaliceras** K. YOUNG, 1963, p. 47 [\**S. durhami*; OD]. Coiling ?crioconic; ribs fairly sharp, dense,

periodically with midlateral bulla and siphonal node, not necessarily on same rib. Suture simplified. *Upper Cretaceous (Lower Campanian)*: Texas. —FIG. 194,5a–d. \**S. durhami*; X1 (K. Young, 1963).

**Chesapeakekella** KENNEDY & COBBAN, 1993b, p. 884 [\**C. nodatum*; OD]. Probably open criocone or low, open helix; with distant ribs bearing a bullate siphonal tubercle. *Upper Cretaceous (Lower Campanian)*: Delaware.

**Diplomoceras** HYATT, 1900, p. 571 [\**Baculites cylindracea* DEFANCE, 1816, p. 160; OD] [=*Eudiplomoceras* BRUNNSCHWEILER, 1966, p. 18 (type, *E. raggatti*; OD)]. Loose, helicoid spire at least in some specimens, followed by 2 or 3 subparallel, straight or curved shafts or crioconic whorls; section circular to oval; ribs fine, dense, rather subdued, and single, weaker on inside than outside of shell; collared constriction at aperture. Suture very florid. *Upper Cretaceous (Campanian–Upper Maastrichtian)*: Europe, South Africa (Zululand), Madagascar, southern India, Japan, New Zealand, Alaska, British Columbia, Antarctica (Graham Land). —FIG. 195,3a,b. *D. notabile* WHITEAVES, Campanian, British Columbia; a, X0.5; b, X1 (Usher, 1952).

**Exiteloceras** HYATT, 1894, p. 576 [\**Ancyloceras jenneyi* WHITFIELD, 1880, p. 452; SD DIENER, 1925, p. 88] [=*Axonoceras* STEPHENSON, 1941, p. 422 (type, *A. compressum*; OD); *Exicrioceras* ANDERSON, 1958, p. 207 (type, *E. ortigalicense*; OD)]. Coiling more or less elliptical, almost in one plane, at least until beginning of U-shaped body chamber; whorl section oval to trapezoidal; ribs simple at first, later some branching, looped or intercalated, all or some with ventrolateral spines. [*Axonoceras* was based on inner whorls or juveniles.] *Upper Cretaceous (Campanian)*: Israel, Angola, Delaware, North Dakota, Texas, Colombia. —FIG. 195,1a–d. \**E. jenneyi* (WHITFIELD), North Dakota; a, b, X0.5; c, X2 (Whitfield, 1880); d, restored, X0.5 (Scott & Cobban, 1965). —FIG. 195,1e,f. *E. sp.*, Texas; X1.5 (Stephenson, 1941).

**Neocrioceras** SPATH, 1921b, p. 51 [\**Crioceras spinigerum* JIMBO, 1894, p. 38(184); OD (as “*Neocrioceras* cf. *spinigerum* Jimbo sp.”)] [=*Cyrtohamites* SHIMIZU, 1933, p. 14, obj.]. Initially ?helicoid, then more or less crioconic, and finally gently arcuate; section circular to depressed; ribs dense, rather prorsiradiate, some with lateral and ventrolateral tubercles, the latter opposite or alternating on venter; ribs commonly looped between tubercles. *Upper Cretaceous (Middle Turonian–Campanian)*: Spain, Austria, ?South Africa (Pondoland), Japan. —FIG. 195,2a–c. \**N. spinigerum* (JIMBO), Santonian, Japan; a, b, X1; c, enlarged (Shimizu, 1933).

### Subfamily POLYPTYCHOCERATINAE Matsumoto, 1938

[*nom. transl.* WIEDMANN, 1962a, p. 185, ex Polyptychoceratidae MATSUMOTO, 1938b, p. 193]

Tending to planispiral coiling, mostly with one or more straight shafts after initial

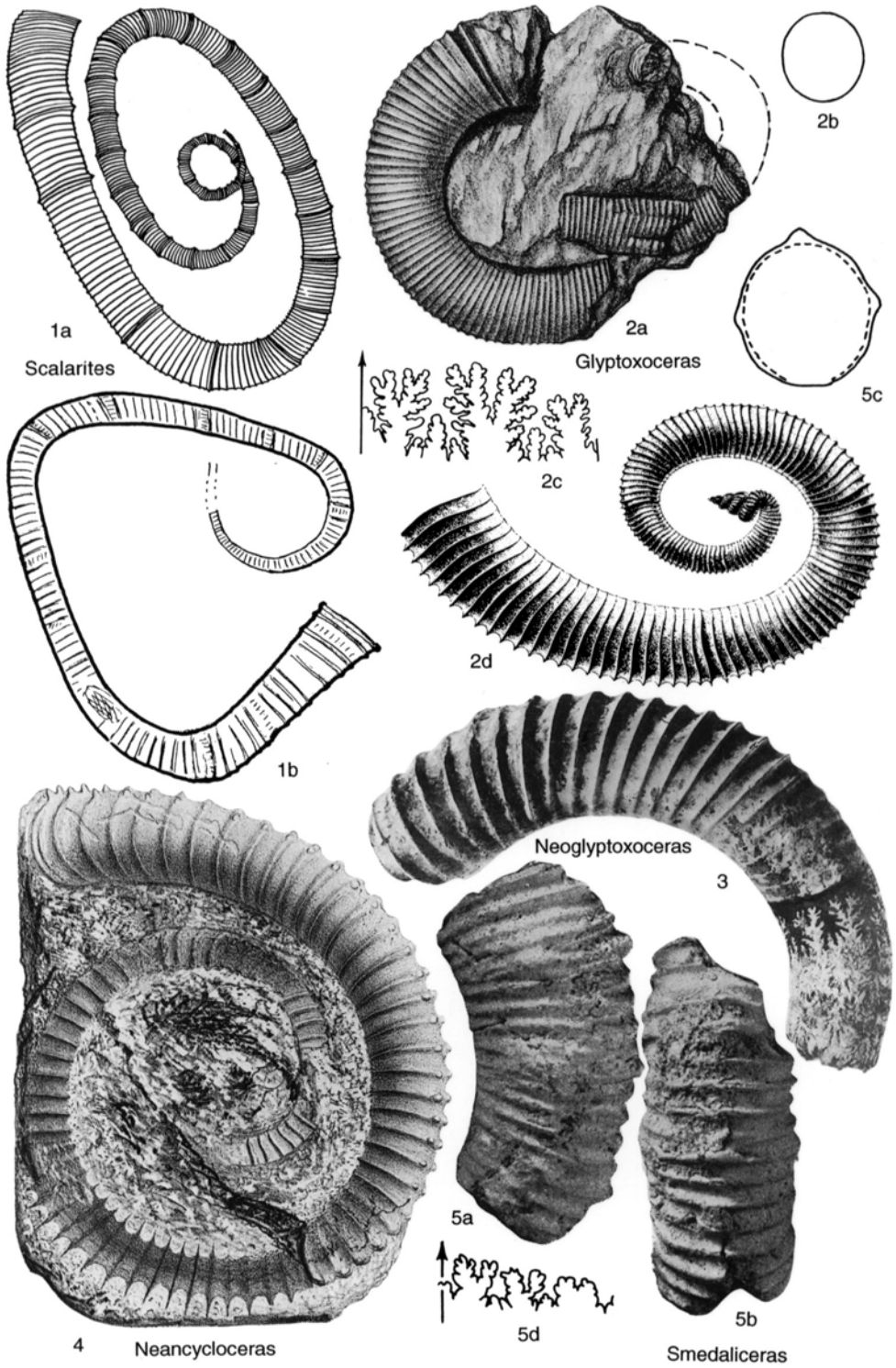


FIG. 194. Diplomoceratidae (p. 250)

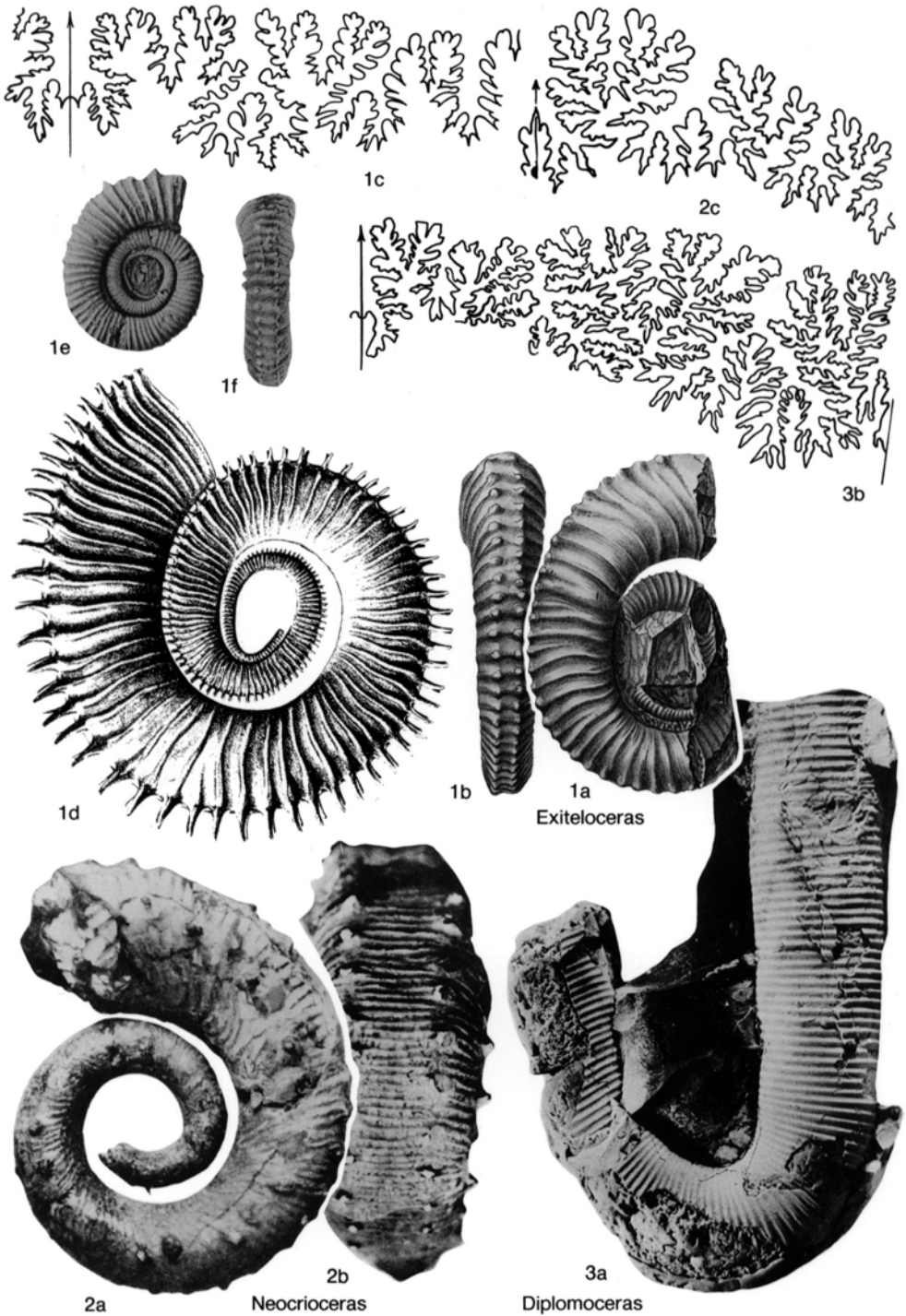


FIG. 195. Diplomoceratidae (p. 250)

curved part; suture tending to simplify. Perhaps derived from *Hyphantoceras*, but some forms resemble *Anisoceras* or *Idiohamites* in some features. *Upper Cretaceous (Upper Turonian—Upper Maastrichtian)*.

**Pseudoxybeloceras** WRIGHT & MATSUMOTO, 1954, p. 119 (MATSUMOTO, 1938b, p. 193, *nom. nud.*) [*\*Hamites quadrinodosus* JIMBO, 1894, p. 39(185); OD]. Early part variable, then coiled in one plane with up to 5 subparallel, slightly curved to straight, close or distant shafts; ribs fine to rather coarse, radial or prorsiradiate, with outer and sometimes inner ventrolateral spines on all or some ribs; periodic ribs may be differentiated or enlarged. *Upper Cretaceous (Upper Turonian—Upper Campanian)*: Europe, South Africa, Madagascar, Japan, Sakhalin, New Zealand, British Columbia, Washington, California.

**P. (Schlueterella)** WIEDMANN, 1962a, p. 205 [*\*Ancyloceras pseudoarmatum* SCHLÜTER, 1872, p. 99; OD] [= *Christophoceras* COLLIGNON, 1969, p. 47 (type, *C. ramboulai*; OD); *Kawashitaceras dentatum* MATSUMOTO & OBATA, 1981, p. 115; OD]. Periodic ribs enlarged, looped between inner and outer ventrolateral spines and across venter; spines sometimes present on intermediate ribs. [*Kawashitaceras* differs only in having the tubercles clavate and denticulate on top.] *Upper Cretaceous (Upper Turonian—Middle Campanian)*: England, ?France, ?Sweden, Spain, Germany, Poland, Austria, Romania, South Africa (Zululand), Madagascar, Japan.—FIG. 196, 1a, b. *\*P. (S.) pseudoarmatum* (SCHLÜTER), Campanian, Germany;  $\times 0.5$  (Schlüter, 1872).—FIG. 196, 1c, d. *P. (S.) ramboulai*, Lower Campanian, Madagascar;  $\times 0.5$  (Collignon, 1969).

**P. (Pseudoxybeloceras)**. Ribs uniform; inner and outer ventrolateral spines on all ribs. *Upper Cretaceous (Upper Turonian—Campanian)*: Austria, Romania, South Africa (Zululand, Pondoland), Japan, Sakhalin, New Zealand.—FIG. 196, 2a–d. *\*P. (P.) quadrinodosus* (JIMBO), Campanian, Japan; a, b, diagrammatic,  $\times 0.5$  (Wright & Matsumoto, 1954); c, d, Upper Campanian, Romania;  $\times 0.5$  (Szász, 1974).

**P. (Parasolenoceras)** COLLIGNON, 1969, p. 44 [*\*Parasolenoceras splendens*; OD] [= *Cyphoceras* WARD & MALLORY, 1977, p. 611 (type, *Ancyloceras? lineatum* GABB, 1869, p. 139; OD)]. All ribs with outer ventrolateral tubercles only, but there may be slight swellings at inner ventrolateral position; several ribs may be united at slightly enlarged ventrolateral spine, but ribs are not markedly enlarged. *Upper Cretaceous (Coniacian—Upper Campanian)*: Ireland, France, Germany, Austria, Madagascar, Japan, New Zealand, British Columbia, Washington, California.—FIG. 196, 4a, b. *\*P. (P.) splendens*,

Campanian, Madagascar;  $\times 0.5$  (Collignon, 1969).—FIG. 196, 4c. *P. (P.) nanaimoense* (WARD & MALLORY), Campanian, British Columbia; restored,  $\times 0.5$  (Ward & Mallory, 1977).

**P. (Lewyites)** MATSUMOTO & MIYAUCHI in MATSUMOTO, 1984a, p. 64 [*\*Idiohamites(?) oronensis* LEWY, 1969, p. 127; OD]. With ventrolateral tubercles on periodic ribs, which may be bundled at the tubercles. Homeomorph of *Idiohamites*. *Upper Cretaceous (Campanian)*: Israel, Texas.—FIG. 196, 3. *\*P. (L.) oronensis* (LEWY), Israel;  $\times 0.7$  (Lewy, 1969; courtesy of Laser Pages Publishing, Ltd.).

**Polyptychoceras** YABE, 1927, p. 44 [*\*Ptychoceras pseudogaultinum* YOKOYAMA, 1890, p. 181; OD]. Typically with 3 parallel shafts, touching in some, followed by more or less open hook; ribs oblique, nontuberculate on first shaft, later tending to become radial; constrictions on first and in some on later shafts. Suture simple, with rather long, bifid elements, except for trifid I. *Upper Cretaceous (Coniacian—Campanian)*: Spain, Germany, Austria, southern India, Japan, British Columbia, Argentina.

**P. (Polyptychoceras)** [= *Dihamites* MATSUMOTO, 1977, p. 354 (type, *D. obiriaensis*; OD); *Heteroptychoceras* MATSUMOTO, 1977, p. 356 (type, *H. obatai*; OD)]. Ribs remaining simple and sharp throughout. [*Dihamites* and *Heteroptychoceras* seem to be members of this subgenus with aberrant coiling.] Occurrence and distribution as for genus.—FIG. 197, 3a–d. *\*P. (P.) pseudogaultinum* (YOKOYAMA), Santonian, Japan; a, c, d,  $\times 1$ ; b, enlarged (Yokoyama, 1890).—FIG. 197, 3e. *P. (P.) obstructum* (JIMBO), Santonian, Japan; diagrammatic,  $\times 0.5$  (Wright & Matsumoto, 1954).

**P. (Subptychoceras)** SHIMIZU, 1935a, p. 180 [*\*Hamites (Polyptychoceras) yubarensis* YABE, 1927, p. 44; OD]. Ribs on last 2 shafts and hook in groups on broad, low bulges. *Upper Cretaceous (Campanian)*: Japan, British Columbia.—FIG. 197, 5. *\*P. (S.) yubarensis* (YABE), Campanian, British Columbia, Japan; diagrammatic,  $\times 0.4$  (Wright & Matsumoto, 1954).

**P. (Phylloptychoceras)** SPATH, 1953, p. 16 [*\*Ptychoceras sipho* FORBES, 1846, p. 118; OD] [= *Neocyrtocilus* ANDERSON, 1958, p. 189 (type, *N. bryani*; OD)]. Ribs blunt and distant on last shaft, grading to striae on hook. Suture with slightly phylloid folioles. *Upper Cretaceous (Campanian)*: southern India, California, Chile.—FIG. 197, 6a–c. *\*P. (P.) sipho* (FORBES), southern India; a, b,  $\times 0.5$  (Howarth, 1965); c, enlarged (Stoliczka, 1863–1866).

**Cyrtoptychoceras** KENNEDY & HENDERSON, 1992b, p. 710 [*\*Hamites undulatus* FORBES, 1846, p. 118; OD]. Apparently consisting of single, feebly curved shaft, but initial part unknown; ribbing and aperture as in *Polyptychoceras (Phylloptychoceras)*, from which it was probably derived. *Upper Cretaceous (Upper Maastrichtian)*: southern India.

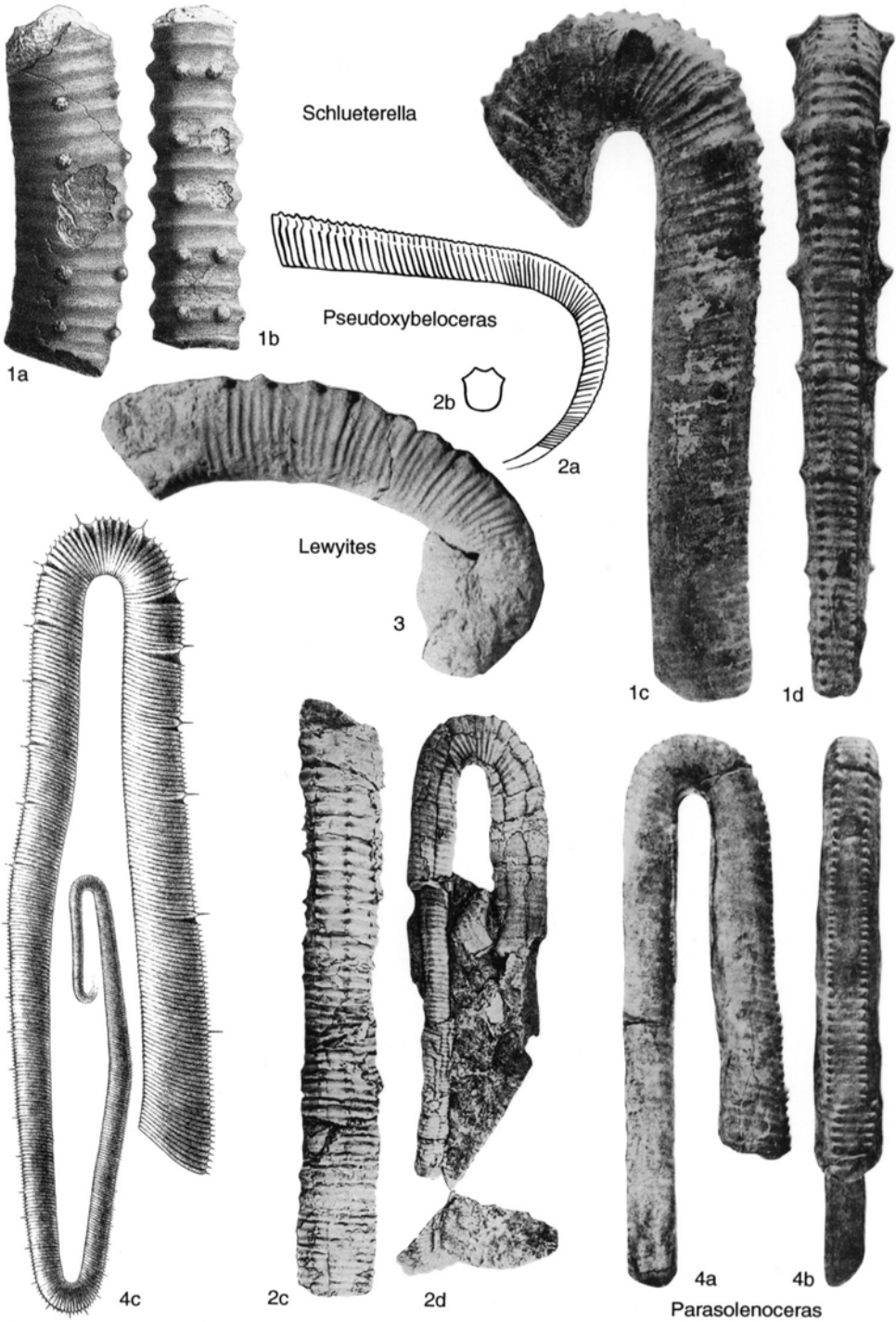


FIG. 196. Diplomoceratidae (p. 253)

- Rhyoptychoceras** MATSUMOTO, 1977, p. 352 [\**R. mikasaense*; OD]. Coiling a unique form of twisted ptychocerotoid; ornament as in *Scalarites*. *Upper Cretaceous (Coniacian)*: Japan.—FIG. 197, 1a–d. \**R. mikasaense*; a–c,  $\times 1$ ; d,  $\times 2$  (Matsumoto, 1977).
- Ryugasella** WRIGHT & MATSUMOTO, 1954, p. 122 (MATSUMOTO, 1942b, p. 167, *nom. nud.*) [\**R. ryugasensis*; OD]. Broadly curved at first, then straight, and finally with short hook; with dense, annular, prorsiradiate, nontuberculate ribs and few, oblique constrictions. *Upper Cretaceous (?Upper Turonian, Santonian–Campanian)*: Japan, Sakhalin, Antarctica (Graham Land).—FIG. 197, 4a, b. \**R. ryugasensis*, Campanian, Sakhalin; a,  $\times 0.75$ ; b, enlarged (Wright & Matsumoto, 1954).
- Astreptoceras** HENDERSON, 1970, p. 28 [\**Ptychoceras zelandicum* MARSHALL, 1926, p. 157; OD]. Straight fragments alone known; subcircular in section, with strong, oblique constrictions; smooth at first, later with weak ribs. Suture simple, with all elements bifid. *Upper Cretaceous (Campanian)*: New Zealand.—FIG. 197, 8a, b. \**A. zelandicum* (MARSHALL); a,  $\times 2$ , b,  $\times 5$  (Henderson, 1970).
- Masonites** HENDERSON, 1970, p. 29 [\**M. biannulatus*; OD]. Straight at first, then an open, elliptical planispire; section more or less circular; dense, fine, annular ribs and frequent, collared constrictions. Suture with very simple, short, square, bifid elements. *Upper Cretaceous (Campanian)*: New Zealand.—FIG. 197, 7a, b. \**M. biannulatus*; a,  $\times 2$ , b,  $\times 7$  (Henderson, 1970).
- Solenoceras** CONRAD, 1860, p. 284 [\**Hamites annulifer* MORTON, 1842, p. 213; OD] [= *Oxybeloceras* HYATT, 1900, p. 588 (type, *Ptychoceras crassum* WHITFIELD, 1880, p. 459; OD)]. Generally small; initial few spiral whorls followed by 2, straight or slightly curved, parallel shafts; section circular to oval; first shaft normally constricted; aperture constricted and collared; ribs straight, radial or rursiradiate, with small ventrolateral spines; ribs may be weak or interrupted on venter. *Upper Cretaceous (Campanian–Maastrichtian)*: northern Europe, Israel, central Asia, Angola, South Africa (Zululand), Madagascar, USA, Antarctica (Graham Land).—FIG. 197, 2a, b. *S. multicostratum* (STEPHENSON), Campanian, Texas;  $\times 2$  (Stephenson, 1941).

### Family BACULITIDAE Gill, 1871

[Baculitidae GILL, 1871, p. 3] [=Eubaculitinae BRUNNSCHWEILER, 1966, p. 4]

Minute initial coil of 1 or 2 whorls followed by straight or slightly curved, single shaft (one genus crioconic); whorl section circular, oval, pear-shaped, or with acute venter; surface smooth or with flexuous striae or ribs, which may be enlarged into tubercles on sides or venter. Aperture of macroconchs oblique and simple; microconchs

with or without collar and with large or small lappets. Suture with all elements more or less bifid, except for internal and rarely external lobes; varying in floridity and detail. Rugaptychi present in *Baculites* at least. *Lower Cretaceous (Upper Albian)–Upper Cretaceous (Upper Maastrichtian)*.

Rather small forms appear in the Upper Albian, probably representing hamitids that have straightened, lost their ribs, and developed oblique apertures, rather than direct descendants of more or less homeomorphous Bochianitidae, which are last known in the Aptian. There is little important change until the Santonian, when some species a meter long or more occur. In the Campanian and Maastrichtian there are forms up to 2 meters long, and the family reaches the maximum of its limited diversity. Baculitids of all ontogenetic stages are commonly found in very large numbers. NOWAK, 1908; SPATH, 1926a, 1941.

**Lechites** NOWAK, 1908, p. 350 [\**Baculites gaudini* PICTET & CAMPICHE, 1861, p. 112; OD]. Section circular or oval; no distinct constrictions; ribs low, prorsiradiate, close or distant, regular or not, generally single, may be grouped in twos and threes or even amalgamated to form scalelike swellings; with ventrolateral tubercles in some; aperture faces dorsum with slight collar and constriction. *Lower Cretaceous (Upper Albian)–Upper Cretaceous (Lower Cenomanian)*: Europe, northern Africa, South Africa (Zululand), Madagascar, southern India, Japan, Mexico.

L. (**Lechites**). Without tubercles. Occurrence and distribution as for genus.—FIG. 198, 3a–e. \**L. (L.) gaudini* (PICTET & CAMPICHE), Upper Albian, England; a–c,  $\times 1$  (Spath, 1941); d, e,  $\times 1$  (Cooper & Kennedy, 1977).

L. (**Tuberolechites**) COOPER & KENNEDY, 1977, p. 654 [\**L. (T.) regifex*; OD]. Ventrolateral tubercles on every rib. *Lower Cretaceous (Upper Albian)*: England.—FIG. 198, 4a, b. \**L. (T.) regifex*;  $\times 1$  (Cooper & Kennedy, 1977).

**Sciponoceras** HYATT, 1894, p. 578 [\**Hamites baculoides* MANTELL, 1822, p. 123; OD] [= *Cyrtochilus* MEEK, 1876, p. 392, *non* JAKOWLEW, 1875, p. 252, obj.; *Cyrtochilella* STRAND, 1929, p. 8, obj.]. With strong, prorsiradiate constrictions; with or without ribs on phragmocone, but ribs generally present on body chamber; aperture differing from that of *Lechites* in having strong folds and high collar. Suture more finely divided than in *Lechites*. In latest species ribs are rursiradiate on inner one-third and prorsiradiate on outer two-thirds, with faint

tubercle at bend, thus foreshadowing *Baculites*. Lower Cretaceous (Upper Albian)—Upper Cretaceous (Upper Turonian): Europe, northern Africa, Madagascar, southern India, USA, Argentina.—FIG. 198, 2a–c. \**S. baculoides* (MANTELL), Cenomanian,

England; a, lateral view of body chamber, venter to right,  $\times 1$  (Crick, 1896); b, c,  $\times 0.75$  (Kennedy, 1971).

*Baculites* LAMARCK, 1799, p. 80 [*Baculites vertebralis* LAMARCK, 1801, p. 103; SD MEEK, 1876, p. 391]

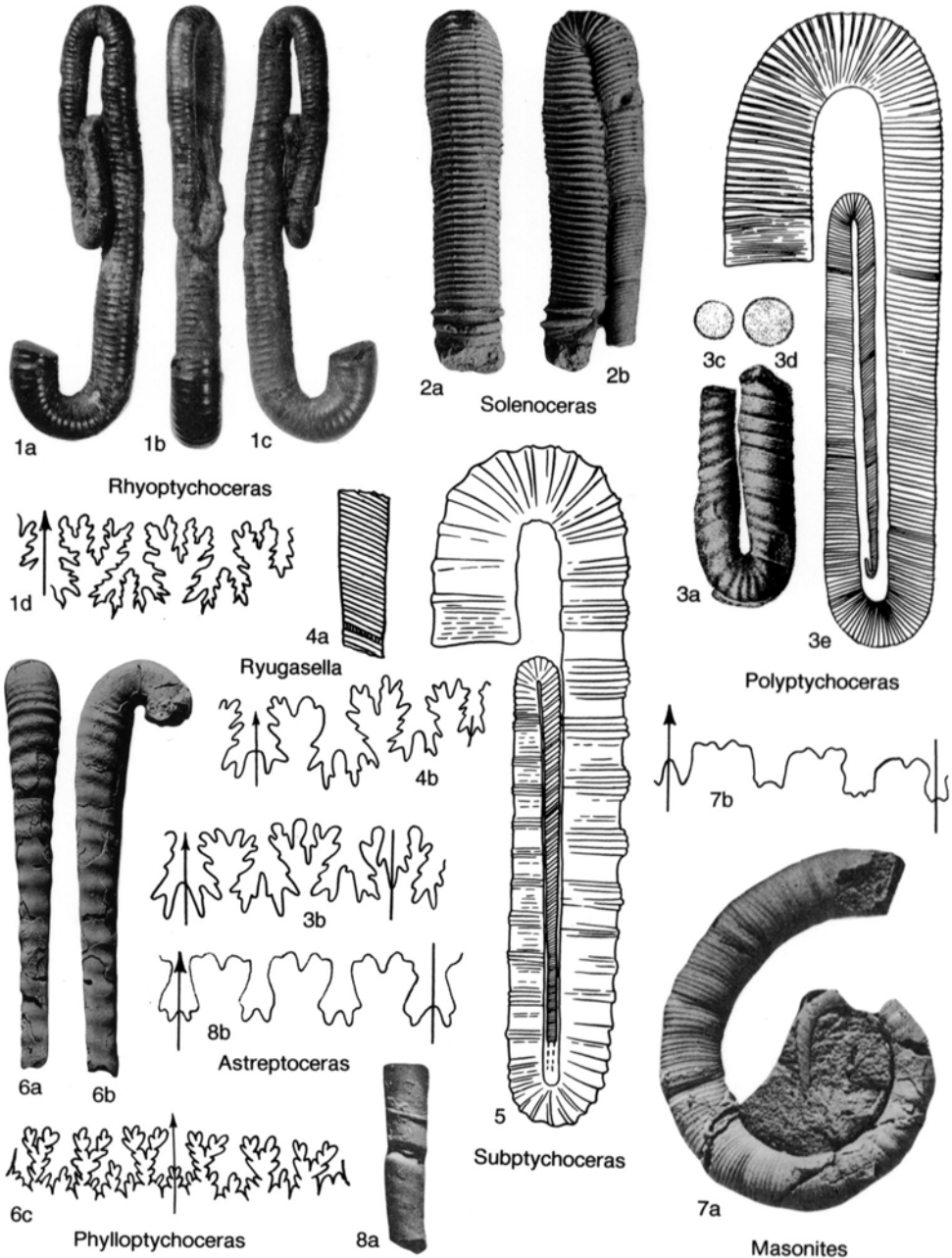


FIG. 197. Diplomoceratidae (p. 253–255)

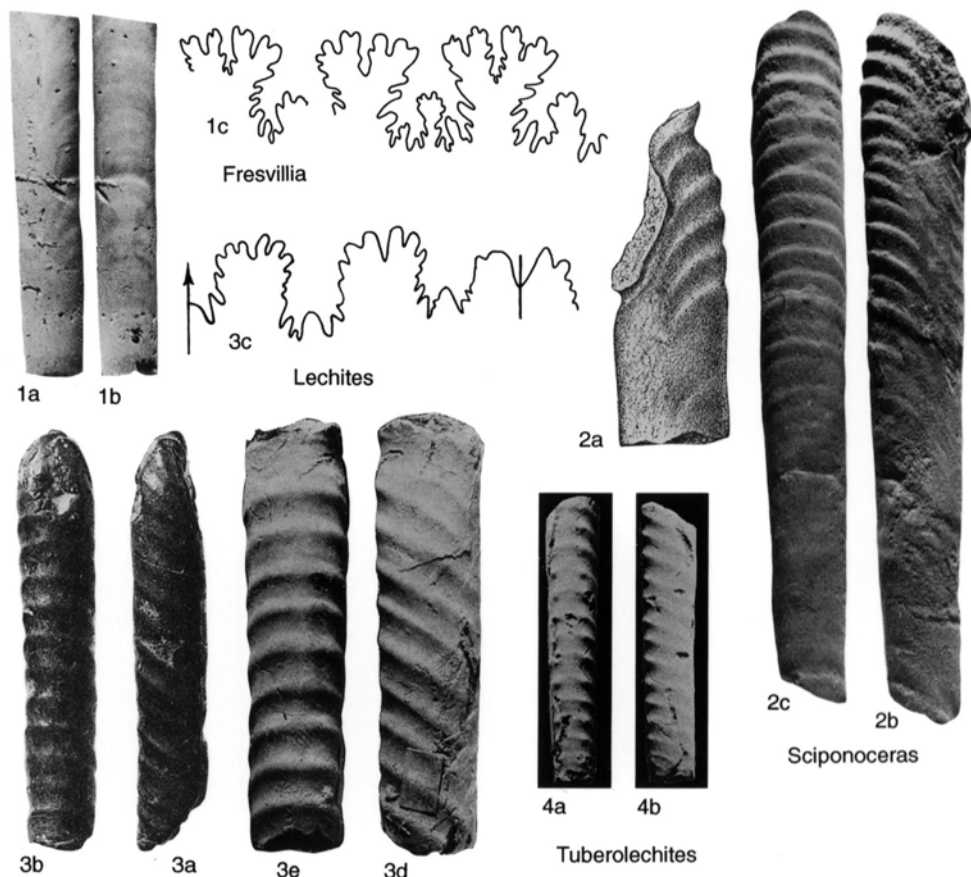


FIG. 198. Baculitidae (p. 255–258)

[=*Homaloceratites* HUPSCH, 1768, p. 110, *non binom.*; *Euhomaloceras* SPATH, 1926a, p. 80 (type, *Baculites incurvatus* DUJARDIN, 1837, p. 232; OD)]. Shell straight to slightly curved, up to 2 meters long; smooth or with sinuous lirae or weak ribs rursiradate on inner part of side and prorsiradate on outer part; in some species with crescentic bulla or large, rounded tubercle at bend in the ribs; no constrictions. Suture more florid than in *Sciponoceras*. *Upper Cretaceous (Upper Turonian–Upper Maastrichtian)*: worldwide.—FIG. 199, 3a–c. \**B. vertebralis*, Maastrichtian, The Netherlands; a, b,  $\times 1$ ; c, enlarged (Binkhorst, 1861).—FIG. 199, 3d, e. *B. incurvatus* DUJARDIN, Santonian, France;  $\times 0.75$  (Orbigny, 1840–1842).

**Pseudobaculites** COBBAN, 1952b, p. 759 [\**P. nodosus*; OD]. Differs from *Baculites* in its more rapidly expanding section and broad, much divided, asymmetric saddles. *Upper Cretaceous (Coniacian)*: Wyoming, Utah.—FIG. 199, 2. \**P. nodosus*, Wyoming;  $\times 2$  (Cobban, 1952b).

**Eubaculites** SPATH, 1926a, p. 80 [\**Baculites vagina ootacodensis* STOLICZKA, 1866, p. 199; OD]

[=*Giralites* BRUNNSCHWEILER, 1966, p. 33 (type, *G. latecarinatus*; OD); *Eubaculiceras* BRUNNSCHWEILER, 1966, p. 36 (type, *E. compressum*; OD); *Cardabites* BRUNNSCHWEILER, 1966, p. 38 (type, *C. tabulatus*; OD)]. Straight or slightly curved; section pear-shaped; venter fastigiate or with tabulate keel from varying stage and smooth, ribbed, or crenulate; sides smooth or with ribs normally faint toward venter but stronger on inner part; ribs may form long, curved bullae; row of inner lateral tubercles may occur. Suture with plump, minutely frilled elements. [Minute differences in suture of *Giralites*, *Eubaculiceras*, and *Cardabites* do not justify generic splitting.] *Upper Cretaceous (?Upper Campanian, Maastrichtian)*: The Netherlands, France, Austria, Mozambique, South Africa (Zululand), Madagascar, southern India, Western Australia, Japan, British Columbia, USA, Chile, Argentina.—FIG. 199, 1a, b. \**E. ootacodensis* (STOLICZKA), Lower Maastrichtian, southern India;  $\times 0.5$  (Kossmat, 1895).—FIG. 199, 1c. *E. vagina* (FORBES), Lower Maastrichtian, southern India; c,  $\times 1$  (Kossmat, 1895).



**Fresvillia** KENNEDY, 1986b, p. 61 [*\*F. constricta*; OD]. Whorl section circular; with constrictions, strongest on venter; feeble ribbing and growth lines strongly prorsiradiate. *Upper Cretaceous (Lower Maastrichtian–Upper Maastrichtian)*: France, southern India, Alaska, California, ?Western Australia.—FIG. 198, 1a–c. *\*F. constricta*, Upper Maastrichtian, France; a, b,  $\times 1$ ; c, enlarged (Kennedy, 1986b).

**Boehmoceras** RIEDEL, 1931, p. 690 [*\*Ancyloceras krekeleri* WEGNER, 1905, p. 210; SD WRIGHT, 1957b, p. 220]. Loose cryptocone; whorl height increasing rapidly; with straight to strongly curved primary ribs, which may form large bulges, splitting into several secondaries on outer part of sides; keel entire, rounded to serrate. *Upper Cretaceous (Middle Santonian–Upper Santonian)*: France, northern Germany, Bornholm, Austria, Texas, Mississippi, Alabama.—FIG. 199, 4a–c. *\*B. krekeleri* (WEGNER), Upper Santonian, northern Germany; a,  $\times 1$ ; b, c, enlarged (Summesburger, 1979).—FIG. 199, 4d. *B. loescheri* RIEDEL, Upper Santonian, Austria;  $\times 1$  (Summesburger, 1979).

## Superfamily SCAPHITACEAE Gill, 1871

[*nom. transl.* WRIGHT & WRIGHT, 1951, p. 13, ex Scaphitidae GILL, 1871, p. 3]

Coiled in loose or tight, plane spiral followed by long or short shaft and terminal hook, but shaft tending to shorten and hook may wrap around spire. Ornament varying, from almost none to strong ribs and numerous rows of tubercles. Suture initially quinquelobate followed by quadrilobate, but in later genera one or more auxiliary lobes appearing in saddle U/L (the pseudolobes of WIEDMANN, 1965); L bifid or trifid. Synptychi have been found in several species. *Lower Cretaceous (Upper Albian)–Upper Cretaceous (Maastrichtian)*.

### Family SCAPHITIDAE Gill, 1871

[Scaphitidae GILL, 1871, p. 3]

Markedly dimorphic; in Otoscapitinae microconchs have long lateral lappets; in Scaphitinae microconchs lack such lappets. Throughout the family microconchs have the umbilicus less occluded by the inner seam of the shaft than macroconchs. *Lower Cretaceous (Upper Albian)–Upper Cretaceous (Maastrichtian)*.

Macroconchs of Otoscapitinae became increasingly involute with time and those of

late members are indistinguishable in characters of generic significance from those of contemporary and earlier Scaphitinae. It therefore seems more probable that basal Upper Albian Scaphitinae diverged from early Otoscapitinae than that the two stocks had independent origins as held by WIEDMANN (1965).

### Subfamily OTOSCAPHITINAE Wright, 1953

[Otoscapitinae WRIGHT, 1953, p. 474 (Name retained under ICZN Article 40, although *Otoscapites* is synonym of *Yezoites*) [=Worthoceratidae MATSUMOTO in MATSUMOTO & YOKOI, 1987, p. 45]

Small; spire generally evolute except in some late macroconchs; umbilicus of macroconchs not concealed by beginning of shaft in early forms but increasingly concealed in later forms; shaft very to moderately long; ornament commonly weaker than in contemporary Scaphitinae. Macroconchs with simple aperture, constricted in some; microconchs with longer shafts, less inflated body chambers, and long lappets. *Lower Cretaceous (Upper Albian)–Upper Cretaceous (Santonian or Campanian)*.

**Worthoceras** ADKINS, 1928, p. 218 [*\*Macroscaphites platydorsus* SCOTT, 1924, p. 18; OD]. Small; with very evolute spire, long, straight shaft, and terminal hook; microconchs with long lappets on aperture and with whorl section of shaft and hook hardly expanding; macroconchs with simple aperture and whorl section expanding noticeably; generally smooth or with fine lirae, rarely with distinct ribs. Suture with generally bifid saddles; lobes very simple, trifid or merely pointed in early forms, tending to become bifid in later forms; saddle U/L not markedly enlarged and no auxiliary lobe. *Lower Cretaceous (Upper Albian)–Upper Cretaceous (Upper Turonian)*: western and central Europe, northern Africa, New Zealand, Texas.—FIG. 200a, b. *\*W. platydorsum* (SCOTT), holotype, ?macroconch, Upper Albian, Texas; a,  $\times 5$  (Scott, 1924); b,  $\times 10$  (Adkins, 1928).—FIG. 200c–f. *W. vermiculus* (SHUMARD), Upper Cenomanian, Texas; c, microconch,  $\times 2$  (new); d–f, macroconch,  $\times 2$  (Wiedmann, 1965).

**Yezoites** YABE, 1910, p. 167 [*\*Scaphites perrini* ANDERSON, 1902, p. 114; SD DIENER, 1925, p. 213] [=Otoscapites WRIGHT, 1953, p. 475 (type, *Ammonites? bladenensis* SCHLÜTER, 1871, p. 30; OD); *Hyposcapites* WIEDMANN, 1965, p. 436 (type, *Scaphites stephanoceroideus* YABE, 1909, p. 442; =?S. *perrini* ANDERSON)]. Whorl section compressed to inflated, even coronate; almost smooth to strongly