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Beitr. Paläont. Österr. 13: 25–78, Wien 1987

Lower Maastrichtian Ammonites from Nagoryanȳ (Ukrainian SSR)

Ammoniten aus dem Untermaastricht von Nagoriani (Ukrainische SSR)

by

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KENNEDY, W.J. & SUMMESBERGER, H., 1987. Lower Maastrichtian Ammonites from Nagoryanȳ (Ukrainian SSR). – Beitr. Paläont. Österr. 13: 25–78, Wien.

This paper is dedicated to the memory of Professor Tove Birkelund

Abstract

The ammonite fauna of the classic locality Nagoryany (formerly Nagorzany) in the Ukrainian SSR is revised. It comprises the following taxa: *Hauericeras sulcatum* (KNER) *Pseudokossmaticeras galicianum* (FAVRE), *Pachydiscus (P.) neubergicus* (VON HAUER), *Nostoceras (N.) schloenbachi* (FAVRE), *Diplomoceras cylindraceum* (DEFRANCE), *Baculites knorrianus* DESMAREST, *Hoploscaphites constrictus* (J. SOWERBY), *Hoploscaphites tenuistriatus* (KNER) and *Acanthoscaphites tridens* (KNER). The stratigraphic age indicated by the ammonites is Lower Maastrichtian, with most of the species being *Belemnella lanceolata*-Zone (sensu lato) forms although some have also been recorded from the Upper Maastrichtian. Most of the species seem to be long ranging ones, although our knowledge of the stratigraphic range of most forms is poor.

Investigation of the belemnite fauna (CHRISTENSEN, this volume) and nannoflora (WAGREICH, this volume) give much preciser results. The presence of *Belemnella (Pachybelemnella) inflata* (ARKHANGELSKY) indicates the *lanceolata* through *pseudobtusa*-Zones (sensu SCHULZ, 1979) of the lower Lower Maastrichtian. The nannoplankton confirms the belemnite data: Zone CC 23b on the scale used by the recent workers (SISSINGH, 1977; PERCH-NIELSEN, 1985).

Zusammenfassung

Eine systematische Revision der Ammonitenfauna von Nagoriani (Ukrainische SSR) wird vorgelegt. Folgende Taxa kommen vor: *Hauericeras sulcatum* (KNER), *Pseudokossmaticeras galicianum* (FAVRE), *Pachydiscus (P.) neubergicus* (VON HAUER), *Nostoceras (N.) schloenbachi* (FAVRE), *Diplomoceras cylindraceum* (DEFRANCE), *Baculites knorrianus* DESMAREST, *Hoploscaphites constrictus* (J. SOWERBY), *Hoploscaphites tenuistriatus* (KNER), *Acanthoscaphites tridens* (KNER).

Die Alterseinstufung aufgrund der Ammoniten ergab einen Schwerpunkt im Untermaastricht. Mehrere Arten reichen bis ins Obermaastricht. Es kann angenommen werden, daß die Reichweiten einiger Arten nur ungenügend bekannt sind.

Die gleichzeitig durchgeführte Untersuchung der Belemnitenfauna (CHRISTENSEN, dieser Band) und der Nannoflora (WAGREICH, dieser Band) ergaben präzisere Alterseinstufungen. Die einzig vorkommende *Belemnella (Pachybelemnella) inflata* (ARKHANGELSKY) zeigt *lanceolata* bis *pseudobtusa* Zone des Untermaastrichts an (sensu SCHULZ, 1979). Die untersuchte Nannoflora ergibt auf der Nannoplankton-Skala eine Einstufung in die Zone CC23b (sensu SISSINGH, 1977; PERCH-NIELSEN 1985). Dies ist auch im Sinne der Nannoplankton-Stratigraphie unteres Untermaastricht. Die überraschend gute Übereinstimmung der beiden Skalen darf nicht darüber hinwegtäuschen, daß derzeit noch keine Korrelationsbasis vorliegt.

Introduction

Nagoryanȳ (Nagorzany in old literature) is situated about 15 kilometres south of Lvov (Lemberg in old literature; Lviv in Ukrainian). A sketch map was given by MIKHAILOV (1951, p. 27). In the time of the Habsburg empire Lemberg was the capital of the associated „Königreich Galicien" (Kingdom of Galicia). Galicia is now part of the USSR (Ukrainian SSR). However collections of fossil invertebrates from the area are preserved in collections outside the USSR e.g. Natural History Museum Vienna, Geological Survey of Austria, Geological Museum of Copenhagen, Museum für Naturkunde, Berlin and British Museum (Natural History), London.

The extensive invertebrate fauna was mentioned by HAUER (1848). Important paleontological descriptions followed, notably by ALTH (1850), KNER (1850, 1852) and FAVRE (1869). The fauna as a whole has never been revised since. Belemnites were studied by NAIDIN (1952), bivalves by PASTERNAK et al. (1968), both in wider context of the Ukrainian fauna as a whole.

The locality was described by KNER (1850, p. 2): he mentioned two small quarries of some „Klafter" (fathoms) depth, the sequence consisting of alternating hard sandstones and soft limestones.

ROGALA (1916, p. 290, table p. 294) assigned the

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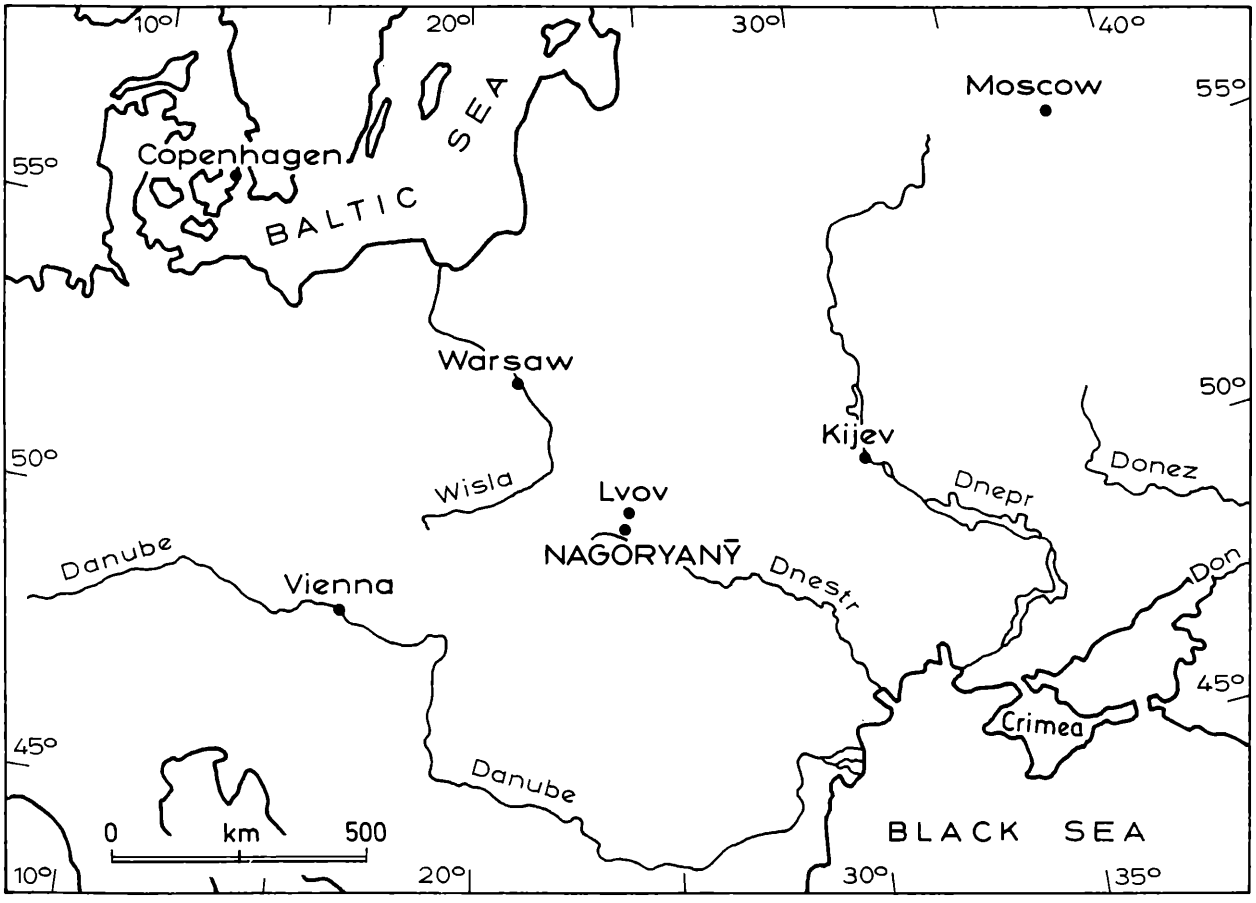

Text-fig. 1. Location map.

Nagoryanÿ fauna to the "Upper Maastrichtian", which he equated with the „Obere Mukronatenkreide" of German authors. NOWAK (1917, p. 138, 146) divided the „Mukronatenkreide" into three zones and placed the Nagoryanÿ fauna at the boundary of his middle and upper divisions; his middle fauna is a mixture of Campanian and Maastrichtian taxa (l.c., p. 146).

MIKHAILOV (1951, p. 26, 27) considered the lower part of the Nagoryanÿ sequence to be lower "Upper Maastrichtian" ($Cr_2mst_2^1$) with *Acanthoscaphites tridens* as index fossil. He listed the accompanying fauna as it was known at that time but without *Pachydiscus neubergicus;* he probably collected this fauna around Nagoryanÿ. The appearance of *P. neubergicus* together with *„Bostrychoceras polyplocum* var. *schloenbachi" (= Nostoceras schloenbachi)* at Nagoryanÿ forced him to assume that the higher part of the sequence belonged to the lower part of the *P. neubergicus*-Subzone ($Cr_2mst_2^2$) which was in his opinion higher in the "Upper Maastrichtian" (l.c., table 32). We do not know MIKHAILOV's reason for subdividing the Nagoryanÿ fauna into two stratigraphically separate parts (l.c., fig. 4), the older with the bulk of the fauna and *A. tridens,* the younger with *P. neubergicus* and *N. schloenbachi.* We assume that precise collecting in the quarries had become impossible by MIKHAILOV's time. We furthermore assume that he was not able to find *P. neubergicus* in the environs of Nagoryanÿ. These circumstances may have led him to conclude that there were two faunal levels at the old quarries. In our opinion *P. neubergicus* belongs to the bulk of the fauna, as there is recent evidence of contemporaneous occurrence of *Acanthoscaphites tridens* and *Pachydiscus neubergicus* in Poland (BLASZKIEWICZ, 1980, table 1).

Subsequent workers recognised that the former "Lower Maastrichtian" Zone of *Belemnitella langei* (Cr_1mst_1 = Zone of *Bostrychoceras polyplocum)* was Upper Campanian (PASTERNAK et al. 1968, p. 76; NAIDIN, 1979, table 4; ATABEKIAN, 1979, table 1). The Maastrichtian sensu stricto is now generally subdivided into Lower and Upper Maastrichtian in the Soviet Union. NAIDIN (l.c., p. 504, table 4) proposed a tripartite division of the Lower Maastrichtian *A. tridens*-Zone. Comparison with the scheme of SCHULZ (1979, fig. 7) suggests that both divisions depend to a certain degree on the definition of the belemnite species, and further investigations are needed to produce a uniform zonal scheme for the boreal Maastrichtian of northern Europe, Poland, the Ukraine and the Russian Platform.

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Location of specimens

The following abbreviations are used to indicate the sources of material cited in the text:

NHMW – Department of Geology & Palaeontology, Naturhistorisches Museum, Vienna.
GBA – Geologische Bundesanstalt, Vienna.
BMNH – British Museum (Natural History), London.
GM, MGUH – Geological Museum, Copenhagen.
MNB – Museum für Naturkunde, East Berlin.

Suture Terminology

The suture terminology of WEDEKIND (1916, see KULLMANN & WIEDMANN 1970) is followed in the present work:

Is = internal lobe with septal lobe
U = umbilical lobe
L = lateral lobe
E = external lobe

Dimensions of specimens

All dimensions given below are in millimetres: D = diameter, Wb = whorl breadth, Wh = whorl height, U = umbilicus. Figures in parentheses are dimensions as a percentage of the total diameter. The term *rib index* as applied to heteromorphs is the number of ribs in a distance equal to the whorl height.

SYSTEMATIC DESCRIPTIONS

Phylum MOLLUSCA; Class CEPHALOPODA CUVIER, 1797
Order AMMONOIDEA ZITTEL, 1884, pp. 355, 392
Suborder AMMONITINA HYATT, 1889, p. 7
Superfamily DESMOCERATACEAE ZITTEL, 1895, p. 426
(nom. transl. WRIGHT & WRIGHT, 1951, p. 18 ex Desmoceratidae ZITTEL, 1895)

Family DESMOCERATIDAE ZITTEL, 1895, p. 426
Subfamily HAUERICERATINAE MATSUMOTO, 1938, p. 193

Genus *HAUERICERAS* DE GROSSOUVRE, 1894, p. 219

(= *Schlüteria* ROLLIER, 1922, p. 359 **non** FRITSCH in FRITSCH & KAFKA, 1887, p. 33; *Pseudogardenia* TOMLIN, 1930, p. 23; *Gardeniceras* MATSUMOTO & OBATA, 1955, p. 134)

Type species: By original designation: *Ammonites pseudogardeni* SCHLÜTER, 1872, p. 54, pl. 16, figs. 3–6.

Discussion: *Gardeniceras* MATSUMOTO & OBATA, 1955 (p. 134) with *Ammonites gardeni* BAILY, 1855 (p. 450, pl. 9, fig. 3) as type species for evolute forms with low whorls and generally sinuous constrictions seems unnecessary.

Occurrence: Coniacian to Maastrichtian. Europe, North and South Africa, Madagascar, southern India, Australia.

Hauericeras sulcatum (KNER, 1848)

Plate 1, figs, 1–7; Plate 13, fig. 2.

1848 *Ammonites sulcatus* KNER, p. 8, pl. 1, figs. 3 a, b.
1869 *Ammonites Gardeni* BAILY; FAVRE, p. 12, pl. 4, fig. 1.
1898 *Ammonites Gardeni* FAVRE; KOSSMAT, p. 123 (188).
1913 *Hauericeras Gardeni* BAILY sp.; NOWAK, p. 371, pl. 41, fig. 12; pl. 43, fig. 34; pl. 45, figs. 44, 45.
1925 *Hauericeras sulcatum* KNER; DIENER, p. 96.
1951 *Hauericeras sulcatum* KNER; MIKHAILOV, p. 79, pl. 11, fig. 49; pl. 12, fig. 51.
1959 *Hauericeras sulcatum* KNER; NAIDIN & SHIMANSKIJ, p. 190, pl. 14, figs. 1, 2.
1964 *Hauericeras sulcatum* KNER; TZANKOV, p. 153, pl. 8, fig. 2; pl. 9, figs. 2, 3; pl. 10, fig. 1.
1966 *Hauericeras sulcatum* KNER; BLASZKIEWICZ, table.
1979 *Hauericeras sulcatum* KNER; BLASZKIEWICZ, table 2.
1979 *Hauericeras sulcatum* (KNER); ATABEKIAN, table 1, p. 523 et seq.
1980 *Hauericeras sulcatum* (KNER, 1850); BLASZKIEWICZ, p. 41, pl. 54, fig. 3.
1982 *Hauericeras sulcatum* (KNER, 1848); TZANKOV, p. 29, pl. 11, fig. 1.

Types: KNER (1848, p. 8) mentions several specimens from Nagoryanȳ which are syntypes of the species, illustrated one in side view (Pl. 1, fig. 3a, given as 2a by error in the text) and a suture (pl. 1, fig. 3b). The figured specimen should be designated lectotype if it still survives.

Material: 7 specimens, NHMW 1948. II. 16 is the same diameter as FAVRE's pl. 4, figs. 1a, 1b, shows the sutures and is probably the original of the figures. NHMW 1862. V. 22 and 1862. V. 23 may be the other two specimens cited by FAVRE, but none match the diameter of 131 mm he gives on p. 13; MGUH 16.813, GM 1984.1698–700.

Dimensions:	D	Wb	Wh	Wb : Wh	U
NHMW 1862.V.23	94.5(100)	15.1(16)	32.0(33.9)	0.47	37.0(39.1)
MGUH 16.813	107.5(100)	16.0(14.9)	39.2(36.5)	0.41	39.7(36.9)

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Description: All the specimens are crushed composite moulds of phragmocones, varying from 79 to 110 mm in diameter. Coiling is evolute, with approximately 15 % of the previous whorl being covered. The umbilicus is broad (37–39 % in crushed specimens) and shallow with a low, flat vertical umbilical wall. The umbilical shoulder is narrowly and abruptly rounded. The whorls are very compressed, although this has been accentuated by **post-mortem** crushing, the measured whorl breadth to height ratios being 0.41 to 0.47. The whorl section is lanceolate with flattened flanks, the greatest breadth below mid-flank. The venter is blunt and narrowly rounded or bears a calcite filling of an originally hollow keel. One specimen, GM 1984.1698, shows the external mould of a sharp siphonal keel with spiral striations. The surface of the mould is smooth, except for constrictions. These vary in prominence according to preservation and appear to number 7–8 per whorl. They are shallow, narrow, prorsiradiate and slightly concave on the flank but project sharply forwards over the ventrolateral shoulders.

The suture line is moderately subdivided with broad E, deeper, asymmetrically trifid L and asymmetrically bifid saddles.

Discussion: The high whorls and simple, distant concave constrictions, 7–8 per whorl, readily separate this species from *Hauericeras gardeni* (BAILY, 1855, p. 456, pl. 11, fig. 3) (see revision in SUMMESBERGER 1979, p. 133, pl. 6, fig. 27; text-fig. 19), *H. fayoli* DE GROSSOUVRE, 1894 (p. 220, pl. 27, fig. 3) (see revision by KENNEDY & SUMMESBERGER 1984, p. 157, pl. 1, figs. 8, 12; pl. 2, figs. 4, 13–15), *H. angustum* YABE, 1904 (p. 33, pl. 5, figs. 5, 6) (see revision by MATSUMOTO & OBATA 1955, p. 137, pl. 24, fig. 6; pl. 28, figs. 1, 2; pl. 29, figs. 1–5; text-figs. 5, 7) and *H. madagascariense* COLLIGNON, 1961, p. 81, fig. 1; pl. 32, fig. 1; text-figs. 15–17, which are stouter-whorled, and have more prominent, more concave and sometimes markedly flexuous constrictions; all are significantly older than the present species. The Coniacian *Hauericeras antiquum* COLLIGNON, 1961 (p. 76, text-fig. 12) has distinctive ribs; the Santonian *H. nodatum* (SCHLÜTER, 1899) (p. 411 = *Hauericeras pseudogardeni* of MÜLLER & WOLLEMANN 1906, p. 14, pl. 4, figs. 1–4, pl. 8, fig. 3) and *Hauericeras buszi* WEGNER, 1905, p. 208, pl. 8, fig. 1, including varieties *nodosa* and *costata)* has more numerous, flexuous constrictions plus ventral ribs and tubercles. The Lower Maastrichtian *Hauericeras rembda* (FORBES, 1846) (p. 111, pl. 7, fig. 3; see also STOLICZKA 1865, p. 63, pl. 33, fig. 5) also has compressed, high whorls, but the constrictions are markedly flexuous.

SCHLÜTER's figures of *Hauericeras pseudogardeni* (SCHLÜTER, 1872) (p. 54, pl. 16, figs. 4–6) show an internal mould of a very large specimen (pl. 16, figs. 3, 4) and sutures (pl. 16, figs. 5, 6). From the illustration it appears to be smooth at a diameter where *H. sulcatum* is already constricted, while the shell is more involute with a significantly smaller umbilicus and stouter whorls. The syntype from which the sutures were taken is in the Collections of Geologisches und Paläontologisches Institut of Bonn University, reg. no. 48. It is also wholly septate, rather poorly preserved, with the following dimensions: D = 230.0(100), Wb = 40.5(17.6), Wh = 98.0(42.6), Wb : Wh = .41, U = 56.8(24.7). It is again more involute than *H. sulcatum* with a significantly smaller umbilicus and although the overall proportions are like those of SCHLÜTER's pl. 16, figs. 3 and 4, the constrictions are flexuous, and biconcave. MÜLLER & WOLLEMANN (1906, p. 16) suggest that *nodatum* is a synonym of *pseudogardeni,* the differences being due to different preservation.

Occurrence: Lower Maastrichtian of Nagoryanȳ, Lvov, Ukrainian SSR, Donbass and Kopet-Dag, Bulgaria and Vistula Valley, Poland.

Family KOSSMATICERATIDAE SPATH, 1922, p. 134
(**nom. transl.** SPATH, 1923, p. 35 **ex** Kossmaticeratinae SPATH, 1922, p. 134)
Subfamily KOSSMATICERATINAE SPATH, 1922, p. 134

Genus *PSEUDOKOSSMATICERAS* SPATH, 1922, p. 160

Type species: By original designation, *Ammonites pacificus* STOLICZKA, 1865, p. 160, pl. 77, fig. 9.

Discussion: THIEDIG & WIEDMANN (1976, p. 15) provide the most recent discussion of this genus.

Occurrence: *Pseudokossmaticeras* generally characterises the Lower Maastrichtian, with records from southern France, northern Spain, Poland, Austria, Lombardy, Italy, the present occurrences in the Ukraine, the Donbass and Kopet Dag in the USSR, Turkey and Bulgaria. Records from Patagonia are *Neograhamites* SPATH, 1953 according to THIEDIG & WIEDMANN. There are a few records from the Upper Campanian, as with the Polish specimen illustrated by BLASZKIEWICZ (1980, pl. 56, figs. 1, 3).

Pseudokossmaticeras galicianum **(FAVRE, 1869)**
Plate 2, fig. 6; Plate 3, figs. 7–9

1869 *Ammonites galicianus,* E. FAVRE, p. 16, pl. 3, figs. 5, 6.

non 1872 *Ammonites Galicianus* E. FAVRE; SCHLÜTER, p. 63, pl. 19, figs. 3–5; pl. 20, fig. 9 (= *Pachydiscus koeneni* DE GROSSOUVRE, 1894 = *Pachydiscus haldemsis* SCHLÜTER, 1967, fide KENNEDY & SUMMESBERGER 1984).

non 1890 *Pachydiscus* aff. *galicianum* FAVRE; SEUNES, p. 283, pl. 9, fig. 5 (= *Pseudokossmaticeras tercense* (SEUNES, 1891)).

1894 *Pachydiscus galicianus* E. FAVRE sp.; DE GROSSOUVRE, p. 177.

1898 *Pachydiscus negri* MARIANI, p. 54(4), pl. 8(1), fig. 3.

1898 *Pachydiscus galicianus,* E. FAVRE sp.; MARIANI,

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p. 55(5), pl. 8(1), fig. 4.
1913 *Kossmaticeras galicianum* FAVRE sp.; NOWAK, p. 365, pl. 41, fig. 17; pl. 43, fig. 33; pl. 44, fig. 41.
1925 *Kossmaticeras galizianum* FAVRE; DIENER, p. 98.
? 1927 *Kossmaticeras tchihatcheffi* BÖHM, p. 221, pl. 13, fig. 1.
? 1934 *Pachydiscus Galicianus* FAVRE; SHELEV, p. 198, pl. 4, fig. 1.
1935 *Kossmaticeras brandti* REDTENBACHER; TZANKOV, p. 11, pl. 3, fig. 2.
1951 *Pseudokossmaticeras* cf. *galicianum* FAVRE; MIKHAILOV, p. 78, pl. 7, fig. 38; text-fig. 26.
? 1953 *Pachydiscus* cf. *galicianus* FAV.; PETKOVIC, p. 38, pl. 4, fig. 9.
non 1959 *Pseudokossmaticeras galicianum* (FAVRE); NAIDIN & SHIMANSKIJ, p. 189, pl. 13, fig. 1.
1964 *Pseudokossmaticeras brandti* (REDT.); TZANKOV, p. 156, pl. 3, fig. 1.
? 1964 *Pseudokossmaticeras galicianum* (FAVRE); TZANKOV, p. 157, pl. 4, fig. 1; pl. 5, fig. 2.
1970 *Pseudokossmaticeras tchihatcheffi* (BÖHM); ATABEKIAN & AKOPIAN, p. 35, pl. 1, fig. 3.
1970 *Pseudokossmaticeras* cf. *galicianum* (FAVRE); ATABEKIAN & AKOPIAN, p. 36, pl. 1, fig. 4.
non 1974 *Pseudokossmaticeras galicianum* (FAVRE, 1869); NAIDIN, p. 179, pl. 65, fig. 4.
1976 *Pseudokossmaticeras galicianum* (FAVRE); THIEDIG & WIEDMANN, p. 17, pl. 2, figs. 1, 3.
1980 *Pseudokossmaticeras galicianum* (FAVRE, 1869); BLASZKIEWICZ, p. 41, pl. 56, figs. 1–3.
1982 *Pseudokossmaticeras galicianum* (FAVRE, 1869); TZANKOV, p. 31, pl. 13, figs. 1–3.
1982 *Pseudokossmaticeras tchihatcheffi* (BÖHM, 1927); TZANKOV, p. 32, pl. 13, figs. 4, 5.

Types: Lectotype, by the subsequent designation of WIEDMANN & THIEDIG, 1976, p. 17 is the original of FAVRE 1869, pl. 3, fig. 5, figured photographically by NOWAK 1913, pl. 41, fig. 17, now missing; NOWAK'S figure is reproduced here as Pl. 2, fig. 6; paralectotype, GBA unregistered, is the original of FAVRE 1869, Pl. 3, fig. 6, illustrated here as Pl. 3, figs. 7–9.

Description: The surviving paralectotype before us is a fragment only 30 mm long, with a maximum whorl height of 21 mm. It preserves an ornament of coarse ribs, sometimes arising in pairs from weak umbilical bullae and with occasional intercalatories. The larger lectotype shown in FAVRE's pl. 3, fig. 5 has not been traced. It was reillustrated by NOWAK (1913, pl. 41, fig. 17), a copy of whose rather poor photograph is reproduced here as Pl. 2, fig. 6. It is distorted, with approximately 25 umbilical bullae giving rise to ribs singly or in pairs, with a single intercalatory; long and short ribs alternate regularly at the largest diameter preserved.

Discussion: *Pseudokossmaticeras tchihatcheffi* (BÖHM, 1927) from the Maastrichtian of the Bithynian Peninsula, Turkey, appears to be a synonym of *P. galicianum;* the holotype is shown in Plate 2, fig. 7. Several workers have regarded *P. galicianum tercense* (SEUNES, 1891) (p. 16, pl. 6(4), fig. 4) as a synonym of *P. galicianum,* others have regarded it as a separate species; the latter view is followed here. The ornament is much finer, with secondary ribs extending low on the flank and markedly differentiated from the primaries, as shown in the figures of THIEDIG & WIEDMANN (1976, pl. 1, fig. 2; pl. 2, fig. 2). Most specimens are crushed, but the whorls seem to have been somewhat higher. The holotype has 22 primary ribs and a total of 47 ribs at the ventrolateral shoulder versus 27 and 42 in the lectotype of *galicianum. P. brandti* (REDTENBACHER, 1873) (p. 106, pl. 24, fig. 1) (see the recent revision by THIEDIG & WIEDMANN 1976, p. 15, pl. 1, fig. 1), of which *P. aturicus* (SEUNES, 1891) (p. 17, pl. 6(4), figs. 2, 3) is a synonym is a coarsely ribbed species with 21 primary ribs and a total of 34 at the ventrolateral shoulder in the holotype. The primaries occasionally bifurcate and are separated by a single strong intercalatory. Strong constrictions persist to a large size (see figures of the lectotype in REYMENT, 1958, p. 34, pl. 10, fig. 1).

Pseudokossmaticeras cerevicianum (PETHÖ, 1906) (p. 95, pl. 6, figs. 2, 3) has branching ribs on the inner whorl and very coarsely ribbed outer whorls with coarse umbilical bullae. *Pseudokossmaticeras muratovi* MIKHAILOV, 1951 (p. 77, pl. 13, fig. 52) shows rather similar strength of ornament, lacks prominent umbilical bullae and has ribs which bi- or trifurcate at or around midflank.

Occurrence: Lower Maastrichtian of Galicia, Ukrainian SSR, Bulgaria, the Crimea, the Vistula Valley, Poland and Krappfeld, Carnia, Austria. Also described from the Upper Campanian *Nostoceras pozaryskii* Zone of the Vistula Valley of Poland by BLASZKIEWICZ (1980, p. 41, pl. 56, figs. 1, 3).

Family PACHYDISCIDAE SPATH, 1922, p. 132
(nom. transl. SPATH, p. 1923, p. 39 for Pachydiscinae SPATH, 1922, p. 132).

Genus *PACHYDISCUS* ZITTEL, 1884, p. 466

Type species: *Ammonites neubergicus* HAUER, 1858, p. 12, pl. 2, figs. 1–4, pl. 3, figs. 1–2, by the subsequent designation of DE GROSSOUVRE, 1894, p. 177.

Diagnosis: See KENNEDY & SUMMESBERGER 1986, p. 188.

Subgenus *PACHYDISCUS* ZITTEL, 1884, p. 466 (= *Parapachydiscus* HYATT, 1900, p. 570; *Joaquinites* ANDERSON, 1938, p. 218).

Discussion: See KENNEDY & SUMMESBERGER 1986, p. 188 for diagnosis and discussion of *Pachydiscus (Pachydiscus).*

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Occurrence: Campanian to Maastrichtian, worldwide.

Pachydiscus (Pachydiscus) neubergicus **(VON HAUER, 1858)**
not figured

1848 *Ammonites Lewesiensis* SOW.-D'ORB.; KNER, p. 7.
1848 *Ammonites peramplus* MÜNST.; KNER, p. 8.
1858 *Ammonites neubergicus* HAUER, p. 12 (pars), pl. 2, figs. 1–3, only, non pl. 3, figs. 1–2 = *Pachydiscus haueri* COLLIGNON (= *Pachydiscus epiplectus* REDTENBACHER; fide KENNEDY & SUMMESBERGER 1986).
1869 *Ammonites neubergicus* V. HAUER; FAVRE, p. 14, pl. 4, figs. 2–3.
1986 *Pachydiscus (Pachydiscus) neubergicus* (VON HAUER, 1858); KENNEDY & SUMMESBERGER, p. 188, pl. 2, figs. 1, 2; pl. 3, figs. 1–3; pl. 4, figs. 1–5; pl. 5, figs. 1, 4, 5; pl. 6, figs. 1, 2, 5; pl. 15, figs. 7, 8; text-figs. 5A, B (with synonymy).

Lectotype: By the subsequent designation of DE GROSSOUVRE 1894, p. 209; GBA 1858.01.6, the original of HAUER 1858, p. 12, pl. 2, figs. 1–2. The specimen is reillustrated by KENNEDY & SUMMESBERGER 1986, pl. 3, figs. 1–3.

Discussion: FAVRE (1869, p. 14, pl. 4, figs. 2, 3) illustrated two specimens from Nagoryanȳ, one complete (pl. 4, figs. 2a, 2b), the other a nucleus (pl. 4, figs. 3). Both are now missing. He gives the following dimensions:

D	Wb	Wh	Wb : Wh	U
98.0	(27)	(41.5)	0.65	(25)

The complete specimen has 13–14 umbilical ribs, the fragmentary one 12 in the figures, and FAVRE gives a similar figure in the text. The figure shows more than 60 ventral ribs on the outer whorl of the larger specimen, but FAVRE mentions 45–50 only in the text. MIKHAILOV (1951, p. 65) introduced the subspecies *Pachydiscus neubegicus nowaki* with the original of NOWAK 1913, p. 4, pl. 41, fig. 13 as holotype, also referring to FAVRE's specimens which are thus paratypes of the subspecies. Topotype specimens of *Pachydiscus (Pachydiscus) neubergicus* have 14–17 umbilical bullae and 48–60 ventral ribs; the figures for the lectotype at a diameter of 93 mm are 16 and 50. In spite of the difference between FAVRE's description and figures and the fact we have failed to trace the specimens, the description and figures show a style of ornament and rib density (whichever numbers are adopted) that overlap with the topotype assemblage described by KENNEDY & SUMMESBERGER (1986), and we regard these specimens as *neubergicus*. The holotype of *P. neubergicus nowaki* is closer to *P. (P.) gollevillensis* (D'ORBIGNY, 1850). This species, recently revised by KENNEDY (1986a) is from the Upper Maastrichtian, and appears to be a descendent of *P. (P.) neubergicus;* it typically has 9–11 umbilical bullae, ornament effaced at mid-flank, and approximately 80 ventral ribs. Differences from other species are discussed by KENNEDY & SUMMESBERGER (1986).

Occurrence: Where well-localised, *P. (P.) neubergicus* is Lower Maastrichtian, as in Poland and as with the present records from the Lvov region. It also occurs in the Lower Maastrichtian of southeastern France and southern India. In northern Germany the precise records of SCHULZ, ERNST, ERNST & SCHMID (1984) show it restricted to the upper part of the lower Lower Maastrichtian *Belemnella obtusa* Zone of SCHULZ (1979) of Lüneburg. BIRKELUND (1979, text-fig. 1) records but does not illustrate specimens from the top of the Lower Maastrichtian *Belemnella occidentalis* Zone *(sensu lato)* and the base of the Upper Maastrichtian *Belemnella junior* Zone in Denmark.

Suborder ANCYLOCERATINA WIEDMANN, 1966, p. 54
Superfamily TURRILITACEAE GILL, 1871, p. 3
(= Diplomoceratacea BRUNNSCHWEILER, 1966, p. 14)
Family NOSTOCERATIDAE HYATT, 1894, p. 568
(= Jouaniceratidae WRIGHT, 1952, p. 218; Bostrychoceratinae SPATH, 1953, p. 16; Emperoceratinae SPATH, 1953, p. 17; Hyphantoceratinae SPATH, 1953, p. 16)

Genus *NOSTOCERAS* HYATT, 1894, p. 569.

Type species: *Nostoceras stantoni* HYATT, 1894, p. 569, by original designation.

Subgenus *NOSTOCERAS* HYATT, 1894, p. 569

Discussion: A number of nostoceratid genera and subgenera are in current usage, some based on fragmentary type material where coiling is uncertain. There is wide variation in coiling and ornament, and several named forms integrade. Present classification is clearly unsatisfactory.

Nostoceras (Nostoceras) schloenbachi **(FAVRE, 1869)**
Plate 2, figs. 1–5

1848 *Crioceras plicatilis,* KNER, p. 9, pl. 2, fig. 3.
1869 *Helicoceras schloenbachi,* E. FAVRE, p. 30, pl. 7, fig. 5.

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1848 *Crioceras plicatilis,* KNER, p. 9, pl. 2, fig. 3.
1869 *Helicoceras schloenbachi,* E. FAVRE, p. 30, pl. 7, fig. 5.
1913 *Heteroceras polyplocum* ROEMER var. *Schlönbachi* FAVRE sp.; NOWAK, p. 385, pl. 41, fig. 14; pl. 44, fig. 42.
1925 *Bostrychoceras Schloenbachi* NOWAK; DIENER, p. 88.
non 1931 *Turrilites (Bostrychoceras) schloenbachi* FAVRE; BASSE, p. 19, pl. 2, figs. 11–15.
1934 *Bostrychoceras polyplocum* ROEM.; SHELEV, p. 196 (pars), pl. 4, fig. 5 only.
non 1951 *Bostrychoceras polyplocum* ROEM. var. *schloenbachi* (FAVRE); MIKHAILOV, p. 51, pl. 2, figs. 13, 14; pl. 3, fig. 19 only; pl. 4, figs. 20–22.
non 1951 *Bostrychoceras polyplocum* ROEM. var. *renngarteni* var. nov. MIKHAILOV, p. 54, pl. 3, figs. 17, 18.
non 1951 *Bostrychoceras polyplocum* ROEM. (?) var. *doneziana* var. nov. MIKHAILOV, p. 53, pl. 4, figs. 23, 24.
non 1958 *Bostrychoceras renngarteni* MIKHAILOV; LUPPOV & DRUSHITS, pl. 24, fig. 2.
non 1959 *Bostrychoceras schloenbachi* (FAVRE); NAIDIN & SHIMANSKIJ, p. 180, pl. 4, figs. 1–5.
non 1962 *C. (Cirroceras) schloenbachi schloenbachi* (FAVRE); WIEDMANN, p. 204, pl. 11, fig. 2.
non 1962 *C. (Cirroceras) schloenbachi densecostatum* WIEDMANN, p. 204.
1964 *Bostrychoceras polyplocum schloenbachi* (FAVRE, 1869); TZANKOV, p. 151, pl. 3, figs. 2, 3.
non 1971 *Didymoceras schloenbachi* FAVRE; COLLIGNON, p. 13, pl. 644, figs. 2385, 2386.
non 1974 *Bostrychoceras schloenbachi* (FAVRE, 1869); NAIDIN, p. 166, pl. 55, figs. 2–8.
non 1976 *Didymoceras schloenbachi schloenbachi* (FAVRE), 1869; KLINGER, p. 67, pl. 29, fig. 4; pl. 30, fig. 4.
non 1976 *Didymoceras schloenbachi* (FAVRE); ATABEKIAN & KHAKIMOV, p. 44, pl. 4, figs. 2, 3, 5.
1980 *Nostoceras* (?) *schloenbachi* (FAVRE, 1869); BLASZKIEWICZ, p. 27, pl. 10, figs. 6, 7, 10.
1982 *Bostrychoceras schloenbachi* (FAVRE, 1869); TZANKOV, p. 18, pl. 4, figs. 1, 2.

Holotype: By monotypy; NHMW 1862.V.49.

Description: The holotype is a composite internal mould of part of the body chamber and although broken, appears to include the beginning of the final hook. The whorl section is compressed oval intercostally. The upper whorl face bears 34 ribs. These arise within the coil as mere striae, sweep back and strengthen across the upper whorl face, where they are markedly concave. They are slightly prorsiradiate on the outer whorl face, strong, and narrower than the interspaces. At the smallest diameter the ribs link in pairs to prominent bullate lateral tubercles, with occasional ribs unattached. As size increases the ribbing becomes less regularly looped, with alternately long and short ribs dominating, the latter stronger than the former. Nontuberculate ribs decline on the lower part of the outer whorl face. There are 13 tubercles preserved in the upper row. These are linked by a weak broad rib to a second row of pinched tubercles at the bottom of the outer whorl face, the weakening of ribs giving the impression of a feebly ornamented spiral zone on the lower flank. On the lower whorl face the tuberculate ribs strengthen again, while in some cases the lower tubercles link to pairs of ribs; in other cases single intercalated ribs appear between the tuberculate groups. The last completely preserved rib lacks well-developed tubercles and is succeeded by a constriction, possible indicating the proximity of the adult aperture.

Discussion: We agree with BLASZKIEWICZ (1980, pp. 24, 27) that this species has been too widely interpreted, and that Campanian specimens referred to it belong elsewhere. In the case of loosely coiled specimens (e.g. KLINGER 1976, pl. 29, fig. 4) they may even belong to other genera.

Nostoceras mendryki COBBAN, 1974 (p. 13, pl. 10, figs. 1–17; text-fig. 11) from the Lower Maastrichtian Navesink Formation of New Jersey, USA, is a very close ally, showing the same pattern of paired ribs on the upper flank linking to an upper row of tubercles, a weakly ornamented mid-flank zone and a corresponding row of tubercles below on the body chamber (COBBAN 1974, pl. 10, figs. 15–17). It differs chiefly in size, the ontogenetic stage of *mendryki* corresponding to the holotype of *schloenbachi* being 41 versus 68 mm across. Apart from this, there are nontuberculate ribs more prominently developed in *schloenbachi* and single tuberculate ribs in *mendryki.* The differences in ornament may simple be that of individuals; the differences in size may be that of macroconch and microconch, but in the absence of more and better European material, the two are left separate.

Occurrence: Lower Maastrichtian of the Vistula Valley, Poland, Nagoryanȳ near Lvov, Ukrainian SSR and Maastrichtian of Bulgaria (?).

Family DIPLOMOCERATIDAE SPATH, 1926, p. 81
(= Neocrioceratinae SPATH, 1953, p. 17)
Subfamily DIPLOMOCERATINAE SPATH, 1926, p. 81
(= Scalaritinae WARD, 1976, p. 455)

Genus *DIPLOMOCERAS* HYATT, 1900, p. 571
(= *Eudiplomoceras* BRUNNSCHWEILER, 1966, p. 18)

Type species: *Baculites cylindracea* DEFRANCE, 1816, p. 160, by original designation.

Discussion: See KENNEDY 1986, 1987, for diagnosis and discussion of this genus.

Occurrence: Maastrichtian of western and central Europe, the transcaucasian region of the USSR, Greenland, Zululand, Madagascar, southern India, Japan, Alaska, British Columbia, California, South America, Antarctica, New Zealand and Australia.

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Diplomoceras cylindraceum (DEFRANCE, 1816)
Plate 3, figs. 1–5, 10–12

1816 *Baculites cylindracea* DEFRANCE, p. 160.
1869 *Hamites cylindraceus* DEFRANCE, sp.; FAVRE, p. 26, pl. 7, fig. 1.
1913 *Hamites cylindraceus* DEFRANCE sp.; NOWAK, p. 382, pl. 41, fig. 10; pl. 42, fig. 35; pl. 45, fig. 7.
1951 *Diplomoceras* cf. *cylindraceum* (DEFRANCE); MIKHAILOV, p. 41, pl. 2, figs. 9, 10; text-fig. 10.
1951 *Diplomoceras cylindraceum* DEFR. var. *lvovensis* var. nov. MIKHAILOV, p. 42, figs. 7, 8; text-figs. 11a–b.
1986a *Diplomoceras cylindraceum* (DEFRANCE, 1816); KENNEDY, p. 51, pl. 4, figs. 1, 2; pl. 9, figs. 8–10; pl. 10: text-figs. 3I–L, 6, 7G–M (with synonymy).
1986b *Diplomoceras cylindraceum* (DEFRANCE, 1816); KENNEDY, p. 181, pl. 17, fig. 3; pl. 18, fig. 5; pl. 21, figs. 2, 3, 5, 6; pl. 22, fig. 6; pl. 23, figs. 1, 2; pl. 24, figs. 1, 2, 3; pl. 25, figs. 1–8; pl. 26, fig. 18; pl. 33, fig. 16; pl. 36, fig. 6; text-figs. 9, 10 (with synonymy).
1986 *Diplomoceras cylindraceum* (DEFRANCE, 1916); KENNEDY & SUMMESBERGER, p. 194, pl. 15, figs. 1, 2, 5; pl. 16, figs. 14, 15; text-fig. 6.

Type: Neotype, designated by KENNEDY 1986 b is IRSNB 10511 from the Upper Maastrichtian Nekum or Meerssen Chalk of St. Pietersberg, Maastricht, The Netherlands.

Material: NHMW 1862.V.56, the original of KNER 1869 pl. 7, fig. 1 (reillustrated here as Plate 3, figs. 1–4); MGUH 16.1814–15.

Description: All the specimens are crushed and distorted composite moulds. FAVRE's specimen is the best-preserved, and here the **post-mortem** crushing is asymmetric, with a rib index of 16 at an apparent whorl height of 41 mm, the apparent whorl breadth to height ratio being 0.78 (Plate 3, figs. 1–4). MGUH 16.1814 is even more crushed (Plate 3, figs. 5, 10), with an apparent rib index of 21. In MGUH 16.1815 the apparent figures are 0.67 and 16/17. The ribs are even and slightly (Plate 3, figs. 10, 12) to markedly prorsiradiate (Plate 3, figs. 1, 3) depending on preservation, annular and narrower than the interspaces.

Discussion: KENNEDY (1986 a, pp. 51, 52; 1987, p. 181) provides lenghty synonymies for this species, to which the reader is referred. The interest of the present material lies in the fact that MIKHAILOV (1951, p. 42, pl. 2, figs. 7, 8; text-figs. 11a–b) introduced the name *Diplomoceras cylindraceum lvovensis* for FAVRE's and NOWAK's specimens plus his own material, designating the original of NOWAK, 1913, pl. 41, fig. 10, a specimen from Nagoryanȳ, holotype. This name has been used by a number of later authors, but study of the present material shows beyond doubt that the supposedly characteristic whorl section is due to **post-mortem** crushing.

Occurrence: *Diplomoceras cylindraceum* ranges throughout the Maastrichtian. It has a world-wide distribution, with records from north-west France, Holland, Denmark, north Germany, Poland, Austria, the USSR, southern India (?), Zululand, Madagascar, Australia, the Antarctic, South America, California, British Columbia and Alaska plus doubtful records from Greenland and New Zealand.

Family BACULITIDAE GILL, 1871, p. 3
(= Eubaculitidae BRUNNSCHWEILER, 1966, p. 4)
Genus *BACULITES* LAMARCK, 1799, p. 80
(= *Homaloceratites* HÜPSCH, 1768, p. 110 (**non binomen**); *Euhomaloceras* SPATH, 1926, p. 80).

Type species: By the subsequent designation of MEEK, 1876 (p. 391): *Baculites vertebralis* LAMARCK, 1799, p. 80.

Discussion: See KENNEDY 1984, p. 142 for a recent diagnosis and discussion of this genus.

Occurrence: Turonian to Maastrichtian, world-wide.

Baculites knorrianus DESMAREST, 1817
Plate 4, figs. 4–6; Plate 5, figs. 1–14; Text-fig. 2.

1755 *Baculites* KNORR & WALCH, p. 202, pl. 12.
1817 *Baculites Knorrianus* DESMAREST, p. 48, pl. 1, fig. 3.
1824 *Baculites Knorri* BLAINVILLE, p. 191.
1834 *Baculites Knorriana* KEFERSTEIN, p. 423.
1842 *Baculites maximus* HAGENOW, p. 567.
1847 *Baculites anceps* LAMARCK; HAUER, p. 4.
1848 *Baculites anceps?* KNER, p. 13, pl. 3, fig. 1.
1849 *Baculites knorri* GEINITZ, p. 122, pl. 5, figs. 4, 5.
1850 *Baculites anceps,* ALTH, p. 208, pl. 11, figs. 1, 2.
1852 *Baculites knorri* DESM.; KNER, p. 301, pl. 15, fig. 15.
non 1860 *Baculites knorri* BOSQUET, p. 368.
1863 *Baculites anceps* PLACHETKO, p. 12.
1863 *Baculites Knorrianus* STROMBECK, p. 139.
non 1868 *Baculites anceps* DEWALQUE, p. 358.
1869 *Baculites knorrianus,* DESMAREST; FAVRE, p. 27, pl. 7, figs. 2, 3, 4.
1876 *Baculites knorrianus* DESM. GEIN.; SCHLÜTER, p. 146 (pars) pl. 39, figs. 16, 17, 18, 20 only.
1891 *Baculites knorrianus* DESM. GEIN.; BÖHM, p. 50.
1902 *Baculites knorrianus* DESMAREST; WOLLEMANN, p. 98 (pars).
non 1902 *Baculites knorrianus* DESMAREST; RAVN, p. 251.
1908 *Baculites anceps* LAM. sp. em. NOWAK, var. *leopoliensis* p. 328 (pars).
1925 *Baculites knorrianus* DESMAREST; DIENER, p. 61 (pars).
1951 *Baculites anceps* LAM. var. *Leopoliensis* NOWAK: MIKHAILOV, p. 46, pl. 3, fig. 15.
1974 *Baculites anceps leopoliensis* NOWAK, 1908; NAIDIN, p. 164.
1979 *Baculites knorrianus* DESMAREST; BIRKELUND, p. 53.

Type: DESMAREST based *Baculites knorrianus* on the figure in KNORR & WALCH (1755, pl. 12) which he reproduced as his pl. 1, fig. 3:

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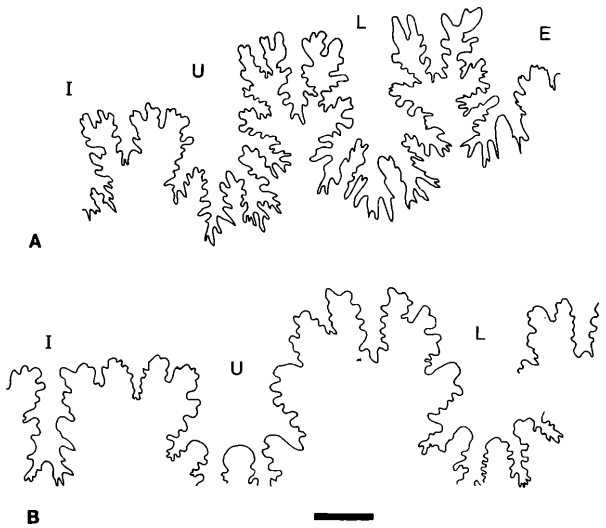

Text-fig. 2. Sutures of *Baculites knorrianus* DESMAREST, 1817. A: NHMW 7459c; B: NHMW 1848.II.29, last simplified suture of an adult. Bar scale is 10 mm.

„DEUXIÈME ESPÈCE

Baculites de Knorr. (Baculites knorriana) Nob. Je ne la connois que par la figure qui est à la fin du supplément plément du grand Ouvrage de Knorr sur les Fossiles, tome IV, pl. XII, et par la trés-courte description que l'accompagne, pag. 202 du même volume. Ses sutures ne sont point apparentes, parce que le test semble exister, mais la cassure transversale de cette coquille indique que les productions rameuses qui la forment sont peu développées.

Cette baculite est remarquable par sa compression excessive et par ses grandes dimensions; son grand diametre transversale à Om, 067, et le petit Om, 023 seulement.

Elle à été trouvé, comme celle de Klein, aux environs de Dantzick; elle paroit changée en matière silicieuse.

Walch croit avoir trouvé un vestige de siphon dans l'echatillon represente par Klein (**Oryctographia, p. 111**, fig. 2 et 3a)." (DESMAREST 1817, p. 48).

The original specimen was from Pleistocene deposits (**fide** NOWAK 1908, p. 327) it has not been traced, and in the interests of nomenclatural stability we here designated NHMW 7459a (Plate 5, figs. 5, 7, 8) neotype of the species.

Material: NHMW 7459a, probably the original of FAVRE 1869, pl. 7, figs. 3, 4, reproduced here as Plate 5, figs. 5, 7, 8 (neotype); NHMW 7459b, the original of FAVRE 1869, pl. 7, fig. 2, reproduced here as Plate 5, figs. 11, 12; NHMW 7459c; NHMW 1848.II.31, the original of KNER 1848, pl. 3, figs. 1a, b, reproduced here as Plate 5, figs. 1–4; NHMW 1862.V.50a–c; NHMW 1848.II. 29; NHMW 1862.V.54, NHMW 1862.V.50, 6682; NHMW 1862.V.53, 6601; GM 1984. 1695, 1704, 1714–19, GM 1951. 12; BMNH 74030a–d.

Description: All the material is in the form of composite internal moulds, phragmocones varying from a whorl height of 17.2 mm to 75 mm. The largest body chamber fragment has a whorl of 80 mm. Undeformed specimens show the whorl section to have been very compressed, with a whorl breadth to height ratio of 0.47 at a whorl of 17 mm. The dorsum is somewhat flattened, the dorsolateral region flattened and divergent, the mid-flank region broadly rounded, the dorsoventral area flattened and convergent, the venter narrowly rounded. The shell expands slowly, and an apparently undeformed specimen with a whorl height of 44 mm has a whorl breadth to height ratio of 0.43. The largest specimen seen has a whorl breadth to heigh ratio of 0.63 at 80 mm, suggesting a decrease in compression through ontogeny. The whorl section at this size shows a broadly rounded dorsum, flattened dorsolateral area with markedly convergent ventrolateral areas and narrowly rounded venter, the overall section being compressed ovoid.

Most specimens are complete smooth. Ornament, where visible, consists of growth striae, riblets and shallow grooves. These cross the dorsum in a broad convexity, are markedly concave on the inner flank and project strongly forwards and are straight on the mid to outer flank, intersecting the line of the venter at an acute angle. A few specimens show relatively fine riblets over the venter (Plate 5, figs. 11, 12), which they cross in a narrow arch.

The largest specimens are up to 50 cm long; reconstructing the available fragments gives phragmocones a length in excess of 100 cm.

The suture is complex for *Baculites* with broad bifid lobes and saddles (Text-fig. 2).

Discussion: Large, smooth *Baculites* from the Campanian and Maastrichtian are commonly referred to *Baculites knorrianus,* but the species is here restricted to the very compressed Maastrichtian species with characteristic whorl section, growth lines and suture. None of the examples studied shows the strong ribs that characterise *Baculites leopoliensis* NOWAK, 1908 (p. 328 (pars), pl. 14, figs. 1–5, 10–11), NOWAK included specimens of *knorrianus* in his *Leopoliensis,* which he proposed as a replacement name for the former, but the ornament serves to distinguish them. Of other Maastrichtian species, the Upper Maastrichtian *Baculites vertebralis* LAMARCK, 1801 has a less compressed, more symmetrically oval whorl section, includes smooth and ribbed variants and is much smaller (see revision in KENNEDY 1986 a, p. 57); *Baculites anceps* LAMARCK, 1822 (see revision in KENNEDY 1986 a, p. 58) is also Upper Maastrichtian; it includes both smooth and ribbed variants and has an utterly characteristic whorl section with a sharp, accute venter.

Occurrence: Lower Maastrichtian of the environs of Lvov, Ukraine and elsewhere in the USSR and north Germany. In Denmark BIRKELUND (1979) records the species from the top of the Lower and, possibly, the base of the Upper Maastrichtian.

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Superfamily SCAPHITACEAE GILL, 1871, p. 3
(nom. transl. WRIGHT & WRIGHT, 1951, p. 13 ex Scaphitidae GILL)
Family SCAPHITIDAE GILL, 1871, p. 3
Subfamily SCAPHITINAE GILL, 1871, p. 3
(nom. transl. WRIGHT, 1953, p. 473 ex Scaphitidae GILL)

Genus *HOPLOSCAPHITES* NOWAK, 1911, p. 565
(= *Mesoscaphites* ATABEKIAN, 1979, p. 523 (nom. nud.))

Type species: By original designation: *Ammonites constrictus* J. SOWERBY, 1817, p. 189, pl. A, fig. 1.

Occurrence: Upper Campanian to Upper Maastrichtian. Europe, Israel, Chile, Grahamland, USA, Canada and Greenland.

Hoploscaphites constrictus (J. SOWERBY, 1817)
Plate 6, figs. 6–24

1817 *Ammonites constrictus* J. SOWERBY, p. 189, pl. A, fig. 1.
1837 *Ammonites constrictus* SOW.; PUSCH, p. 159, pl. 14, fig. 3.
1848 *Scaphites compressus* D'ORBIGNY; KNER, p. 10, pl. 1, fig. 4.
1850 *Scaphites constrictus* D'ORB.; ALTH, p. 207, pl. 10, figs. 29–30.
1852 *Scaphites constrictus* D'ORB. var.; KNER, p. 300(8), pl. 15 (1), figs. 7, 8.
1869 *Scaphites constrictus* SOWERBY, sp.; FAVRE, p. 18, pl. 5, figs. 1–4.
1872 *Scaphites constrictus* SOW. sp.; SCHLÜTER, p. 92, pl. 28, figs. 5–9 (with synonymy).
1986 a *Hoploscaphites constrictus* (J. SOWERBY, 1817); KENNEDY, p. 64, pl. 13, figs. 1–13; 16–24; pl. 14, figs. 1–38; pl. 15, text-figs. 9, 11A–H (with synonymy).
1986 b *Hoploscaphites constrictus* (J. SOWERBY, 1817); KENNEDY, p. 197, pl. 31, figs. 1, 8–26; pl. 32, figs. 1–12, 18–21.
1986 *Hoploscaphites constrictus* (J. SOWERBY, 1817): KENNEDY & SUMMESBERGER, p. 198, pl. 16, figs. 1–5, 8–10, text-fig. 7.

Types: Lectotype, by the subsequent designation of KENNEDY 1986a, p. 68; BMNH C36733, the original of J. SOWERBY 1817, pl. A, fig. 1; paralectotypes are C43988 and C70645–7.

Material: NHMW 1862.V.44, 8072; 1848.II.28, 8077a–b, the latter said to be the original of *Scaphites compressus* of KNER 1848, pl. 1, fig. 4, although bearing little relationship to the figure (see Plate 6, figs. 7–9). GBA unregistered, four specimens, the originals of KNER's pl. 5, figs. 1, 2, 4 and 5.

Description: All the specimens are crushed to varying degrees; two are undoubted microconchs one an undoubted macroconch with three additional probable macroconchs and one probable microconch. The best-preserved microconch (Plate 6, fig. 6), is 28.5 mm long and shows the flexuous primary ribs branching on the outer flank with some additional intercalatories on the phragmocone, which appears to lack ventral tubercles. The body chamber is slender, with a wide umbilicus. The shaft bears three feeble umbilical bullae, with additional ribs extending to the umbilical shoulder without developing bullae and some ribs arising in pairs from bullae. The ribs are rather coarse at this stage and bear small conical ventral tubercles. Bullae disappear on the final hook where there are fine primary ribs, generally branching into two or three secondaries on the outer flank with additional intercalatories inserted at the same level. The aperture is constricted. The other probable microconch (Plate 6, figs. 7–9) shows a similar ontogenetic development but has coarser ventral clavi which appear at the end of the phragmocone and extend onto the early shaft. It is 28 mm long.

The best-preserved of the macroconchs is 52 mm long (Plate 6, figs. 13–15). The spire is relatively coarsely ribbed, with four conical ventral tubercles on the last part. There is a prominent umbilical bulge covering part of the umbilicus, umbilical bullae and ventral tubercles that extend around the final hook.

The remaining specimens (Plate 6, figs. 10–12, 16–24) show varying degrees of distortion, all have ventral tubercles at the end of the phragmocone and body chamber shaft, disappearing at various points around the hook.

Discussion: KENNEDY (1986a) has recently illustrated the range of variation in the types and other Upper Maastrichtian specimens from the Calcaire à *Baculites* of the Cotentin Peninsula, France and the Upper Maastrichtian of the Maastricht area (1986b), BIRKELUND (1982) described and illustrated material from around the Lower/Upper Maastrichtian boundary in North Germany while KENNEDY & SUMMESBERGER (1986) illustrate Lower Maastrichtian material from Neuberg, Steiermark, Austria. All these studies show *H. constrictus* to be a highly variable, dimorphic species, as is seen in the present small assemblage. *Scaphites compressus* D'ORBIGNY of KNER, 1848 (p. 10, pl. 1, fig. 4) is a crushed *H. constrictus*, as is his *Scaphites constrictus* var. (1852, p. 300 (8), pl. 15 (1), figs. 7, 8), the holotype of *Mesoscaphites kneri* ATABEKIAN, 1979 (p. 523), a **nomen nudum.** Other synonyms are discussed by KENNEDY (1986, 1987). Of particular interest in the present collection are specimens in which the ventral tubercles extend around the final hook, as this is one of the features of the *crassus* forms of the species that are generally held to be restricted to the upper Upper Maastrichtian.

Occurrence: *H. constrictus* first appears just above the base of the lower Lower Maastrichtian *Belemnella lanceolata* Zone in north Germany and ranges high in, if not to the top of the upper Upper Maastrichtian *Belemnella casimirovensis* Zone in Denmark. It ranges from northern Spain (ERNST Coll.; Lleida: MARTINEZ 1982, p. 172,

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pl. 30, fig. 3) where it is rare to the Petites Pyrénées (Haute-Garonne and Hautes-Pyrénées) and Tercis (Landes), Cotentin Peninsula (Manche) in France, Limburg and Hainault in Belgium and Holland, the Germanies, Denmark, Southern Sweden, Poland, Austria, the Ukraine, Donbass, Transcaspia and Kopet-Dagh in the USSR and Bulgaria.

Hoploscaphites tenuistriatus (KNER, 1848)
Plate 11, fig. 3

1848 *Scaphites tenuistriatus* m. KNER, p. 10, pl. 1, fig. 5.
1850 *Ammonites diversesulcatus* ALTH., p. 203, pl. 10, fig. 8.
1863 *Ammonites tenuistriatus* KNER; PLACHETKO, p. 12.
1869 *Scaphites tenuistriatus* KNER; FAVRE, p. 21, pl. 5, figs. 6, 7.
1982 *Scaphites tenuistriatus* (KNER, 1848); BIRKELUND, p. 21, pl. 2, figs. 8, 10.
1986b *Scaphites tenuistriatus* (KNER, 1848); KENNEDY, p. 201, pl. 31, figs. 2–7 (with synonymy).

Material: MNB unregistered: 1 specimen, labelled Lemberg.

Discussion: *Hoploscaphites tenuistriatus* was originally described from Nagoryanȳ (KNER, 1848, pl. 10, pl. 1, fig. 5). We have failed to locate either KNER's or FAVRE's specimens from this locality, but an unregistered macroconch in the MNB Collections labelled 'Lemberg' is shown as Plate 11, fig. 3.

Occurrence: Lower Maastrichtian of Limburg, Holland, north Germany, Denmark, the Ukraine and southern USSR; lower Upper Maastrichtian of north Germany and Denmark. In the White Chalk facies the species has a definite range from the *Belemnella fastigiata/Belemnella cimbrica* Zone boundary sensu SCHULZ (1979) (e.g. high in the *Belemnella occidentalis* Zone of authors) to low in the *Belemnitella junior* Zone with a probable extension down to the *Belemnella sumensis* Zone sensu SCHULZ (1979).

Genus *ACANTHOSCAPHITES* NOWAK, 1911, p. 565

Type species: By the subsequent designation of DIENER, 1925, p. 205: *Scaphites tridens* KNER, 1848, p. 10, pl. 2, fig. 1.

Diagnosis: Giant, strongly dimorphic scaphitids with whorls in contact throughout; microconchs with open umbilicus throughout, macroconchs with umbilicus partly occluded by early part of body chamber. Phragmocone with dense ribs arising singly or in pairs from umbilical shoulder with intercalatories of various lengths, ribs sometimes branching. No tubercles, some or all of umbilical, lateral, ventral and siphonal tubercles on some ribs on later parts of phragmocone and early body chamber. End of body chamber invariably bears at least ventrolateral and siphonal tubercles on some ribs, the latter varying from a strong clavus to a mere elevation on the rib. Ribs loop between tubercles which are separated by non-tuberculate ribs. Aperture with marked constriction. Suture complex for family.

Discussion: NOWAK introduced *Acanthoscaphites* in 1911 (p. 565) and reviewed at length the range of variation shown by material from Nagoryanȳ. He was impressed by the range of variation in tubercle development, both in terms of numbers of rows present and their timing of appearence. NOWAK recognised a series of named variants of *Acanthoscaphites tridens*, and these have been elevated to specific or subspecific status by later writers (MIKHAILOV 1951, NAIDIN and SHIMANSKIJ 1959; SCHMID 1965, NAIDIN 1974, BLASZKIEWICZ 1980, BIRKELUND 1982). The present material shows the same variation as is well-documented by previous writers, but our interpretation is quite different. Of species from Nagoryanȳ, all specimens referred to *Acanthoscaphites tridens, A. trispinosus* (GEINITZ, 1850) and *A. bispinosus* (NOWAK, 1911) are macroconchs. All specimens referred to *Acanthoscaphites trinodosus* (KNER, 1848) and *A. bispinosus* NOWAK, 1911 are microconchs. Of the present 40 specimens from Nagoryanȳ, 17 are undoubted macroconchs and 18 undoubted microconchs, with five unassigned juveniles. As will be shown below, we believe these to be a pair, and suggest that the above five named forms record merely intraspecific variability of a type well-known in Scaphitidae. Very few other species can be referred to *Acanthoscaphites* with confidence, these include the nominate taxa *A. verneuilianius* (D'ORBIGNY, 1842), *A. varians* (LOPUSKI, 1911) and *A. innodosus* NAIDIN, 1974. Of other species referred to the genus, *Scaphites pungens* (BINKHORST, 1861) and *Acanthoscaphites schmidi* BIRKELUND, 1982 are specialised offshoots of *Hoploscaphites constrictus* (J. SOWERBY, 1817) in which siphonal clavi, feeble in the latter, are accentuated with, in addition, the development of inner ventrolateral tubercles for part of the development in *pungens*.

Scaphites tuberculatus GIEBEL, 1849, lacks siphonal tubercles, is finely ribbed, and belongs to *Hoploscaphites* of the *H. monasterensis* (SCHLÜTER, 1872) – *H. ikorfakensis* BIRKELUND, 1965 group.

Acanthoscaphites praequadrispinosus BLASZKIEWICZ, 1980 (p. 38, pl. 19, figs. 2, 3, 6–8; pl. 20, figs. 1–3, 6–8; pl. 21, figs. 1–6) does not, so far as we can judge from the text and figures, develop siphonal tubercles at any stage, although the flank ribbing recalls that of some specimens of the type species, *A. tridens*.

A. tridens and *A. varians* are the only species known as adults, and are clearly recoiled giants, while the ornament of *A. verneuilianus* suggests it is based on nuclei of such forms. Size plus recoiling are the chief diagnostic features of the genus, for the numbers of rows of tubercles varies enormously in scaphitids, and a siphonal tubercle develops in several lineages, as COBBAN (1973) notes. The highly complex sutures of *Acanthoscaphites* is also distinctive. *Rhaeboceras* MEEK, 1876 is a parallel giant recoiled scaphitid stock from the uppermost Campanian – lower Maastrichtian of the western interior of North America (see recent review by RICCARDI 1983). It differs, however, in the lack of multiple tuberculation so characteristic of all *Acanthoscaphites* at some stage of development (the specimen of *Rhaeboceras* aff. *halli*

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MEEK, 1876 figured by RICCARDI as his pl. 13, fig. 9 with siphonal nodes is pathological).

There is no clear indication of the evolutionary origin of *Acanthoscaphites*. The evolutionary mechanism is, however, obvious. The large size is a result of hypermorphosis, with the retention of typically scaphitine phragmocone development to a very large size.

Occurrence: Maastrichtian, northern France, the Germanies, Denmark, Poland, Ukrainian SSR, Donbass.

Acanthoscaphites tridens (KNER, 1848)

Plate 4, figs. 1–3; Plate 6, figs. 1–5, 25–28; Plate 7, figs. 1–5; Plate 8, figs. 1–5; Plate 9, figs. 1–4; Plate 10, figs. 1–2; Plate 11, figs. 1–2; Plate 12, figs. 1–2; Plate 13, figs. 1, 3, 4; Plate 14, figs. 1–3; Plate 15; Plate 16, figs. 1–6.

1847 *Scaphites* n. sp. HAUER, p. 3.
1848 *Scaphites tridens*, m. KNER, p. 10, pl. 2, fig. 1.
1848 *Scaphites trinodosus*, m. KNER, p. 11, pl. 2, fig. 2.
1850 *Scaphites tridens* KNER *(Scaphites trispinosus* GEIN. in litt.); GEINITZ, p. 116, pl. 7, fig. 1.
1850 *Scaphites quadrispinosus* GEINITZ, p. 116, pl. 7, fig. 2, pl. 8, fig. 2.
1850 *Scaphites trinodosus* KNER; GEINITZ, p. 116, pl. 8, fig. 1.
1850 *Scaphites tridens* KNER; ALTH., p. 208.
1869 *Scaphites trinodosus* KNER; FAVRE, p. 22, pl. 5, figs. 8–9.
1869 *Scaphites tridens* KNER; FAVRE, p. 24, pl. 6.
1872 *Scaphites tridens* KNER; SCHLÜTER, p. 94, pl. 28, figs. 1–4 (with additional synonymy).
1888 *Scaphites tridens* KNER; HOLZAPFEL, p. 63, pl. 5, fig. 1.
? 1899 *Scaphites tridens* KNER; SEMENOV, p. 135.
1902 *Scaphites tridens* KNER; WOLLEMANN, p. 107.
1912 *Acanthoscaphites tridens* KNER; NOWAK, p. 570, pl. 32, figs. 1–5, 7; pl. 33, figs. 25–29; text-figs. 8–11.
1912 *Acanthoscaphites tridens-trinodosus* KNER; NOWAK, p. 576, pl. 32, figs. 5, 7; pl. 33, figs. 25–26; text-fig. 13.
1912 *Acanthoscaphites tridens-quadrispinosus* GEINITZ; NOWAK, p. 577, pl. 33, fig. 28.
1912 *Acanthoscaphites tridens-bispinosus* n.v. NOWAK, p. 577, pl. 32, figs. 1–3; text-fig. 14.
1912 *Acanthoscaphites tridens trispinosus* GEINITZ; NOWAK, p. 578, pl. 32, figs. 5, 7.
1912 *Acanthoscaphites tridens-varians* LOPUSKI; NOWAK, p. 578 (pars), pl. 33, fig. 29 (non LOPUSKI).
1925 *Acanthoscaphites tridens* KNER; DIENER, p. 207.
1925 *Acanthoscaphites tridens-bispinosus* NOWAK; DIENER, p. 208.
1925 *Acanthoscaphites tridens-quadrispinosus* GEINITZ; DIENER, p. 208.
1925 *Acanthoscaphites tridens-trispinosus* GEINITZ; DIENER, p. 208.
1932 *Acanthoscaphites tridens* var. *quadrispinosus* NOWAK; WOLANSKY, p. 10, pl. 3, fig. 2.
1951 *Acanthoscaphites tridens* (KNER); MIKHAILOV, p. 101, pl. 17, fig. 76; text-fig. 34.
1951 *Acanthoscaphites tridens* (KNER) var. *trinodosa* (KNER); MIKHAILOV, p. 103, pl. 18, fig. 88; pl. 19, figs. 90, 91; text-fig. 35.
1951 *Acanthoscaphites tridens* (KNER) var. *quadrispinosa* (GEINITZ); MIKHAILOV, p. 104, pl. 19, fig. 93.
1951 *Acanthoscaphites tridens* (KNER) var. *bispinosa* NOWAK; MIKHAILOV, p. 104.
1959 *Acanthoscaphites tridens tridens* (KNER); NAIDIN and SHIMANSKIJ, p. 196, pl. 7, fig. 5.
1959 *Acanthoscaphites tridens* (KNER) var. *bispinosa* NOWAK, 1911; NAIDIN and SHIMANSKIJ, p. 196, pl. 7, fig. 4.
1974 *Acanthoscaphites tridens tridens* (KNER, 1848); NAIDIN, p. 176, pl. 60, figs. 2, 3.
1974 *Acanthoscaphites tridens bispinosus* NOWAK, 1911; NAIDIN, p. 176, pl. 59, fig. 4; pl. 60, fig. 4.
1974 *Acanthoscaphites tridens trinodosus* (KNER, 1848); NAIDIN, p. 177, pl. 59, fig. 3; pl. 61, fig. 1.
1974 *Acanthoscaphites innodosus* NAIDIN, p. 178, pl. 62, fig. 1.
1980 *Acanthoscaphites quadrispinosus* (GEINITZ, 1850); BLASZKIEWICZ, p. 39, pl. 22, figs. 1–10.
1980 *Acanthoscaphites bispinosus* NOWAK, 1911; BLASZKIEWICZ, p. 40, pl. 23, figs. 1–3, 5–7; pl. 24, fig. 1, 2, 4, 5.
? 1981 *Acanthoscaphites* sp. ex. gr. *tridens* (KNER); PASTERNAK & DANYSH, pp. 43–45, fig. 1.
1986b *Acanthoscaphites tridens* (KNER, 1846); KENNEDY, p. 205, pl. 37, fig. 1–5.

Types: The whereabouts of KNER's material is not known. The original of his pl. 2, fig. 1 should be designated lectotype if found.

Material: BMNH 39834, 42906a–c, C15428. MGUH 16.816–828; GM 1984.1696, 1707–9, 1722–23, 1725–26, 1729–30, 1951.5; NHMW 1847.II.20, 1848.2.26, 1862.5.32, 7404, 7405, 7407, 7408, 8068, 8069 (the original of FAVRE 1869, pl. 5, fig. 8), 8071, 8073, 8074.

Description: The species is strongly dimorphic, microconchs in the present collection vary from 103–130 mm in diameter, macroconchs from 130–210 mm, with an incomplete specimen an estimated 250 mm in diameter (Plate 15).

All specimens are crushed to varying degrees, but the phragmocone appears to have had an originally depressed, reniform section with a small, deep conical umbilicus (Plate 6, figs. 1–5). The umbilical wall is high and rounded, the umbilical shoulder rounded, the flanks and venter broadly rounded, with the greatest breadth just below mid-flank. Primary ribs arise at the umbilical seam and pass straight across the umbilical wall, varying in number from 25–35 in adult phragmocones. They strengthen into weak umbilical bullae, which are present in individuals of as little as 15 mm diameter. These persist and generally strengthen in phragmocones that are demonstrably those of microconchs (Plate 6, figs. 25–28; Plate 7, figs. 1–6); phragmocones that are demonstrably those of macroconchs (Plate 4, figs. 1–3; Plate 13, fig. 1; Plate 15; Plate 16, figs. 1–6) may retain bullae to the outer whorl or may loose them. The bullae give rise

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to pairs of ribs, while intercalated ribs are inserted at various points on the flank and sometimes branch, to give a total of 60–90 ribs per whorl at the ventrolateral shoulder. The ribs are narrow, rounded, straight and prorsiradiate and vary from straight to feebly concave on the outer flank and cross the venter transversely or in a broad convexity. In general, individuals with fine, dense ribs have feeble bullae; those with coarser ribs have stronger bullae at the same diameter.

In microconchs, the umbilical bullae migrate out to an umbilicolateral position around the last whorl, the bullae giving rise to groups of two or three ribs with occasional nontuberculate ribs extending to the umbilical seam (Plate 7, figs. 3, 5; Plate 8, figs. 2, 4). Ventrolateral clavi appear on the penultimate whorl of most specimens and are generally present on the outer whorl. They vary from weak to strong and are separated by from two to six nontuberculate ribs. Groups of two or three ribs loop between umbilicolateral and ventral tubercles and between ventral tubercles across the venter.

Siphonal tubercles appear at variable points in ontogeny; some specimens possess them on the penultimate whorl of the phragmocone, most develop them at the beginning of the outer whorl (Plate 7, figs. 2, 4), a few develop them only at the end of the phragmocone, others lack them. These tubercles are initially weaker than the ventrolaterals and begin as mere swellings the same width as the ribs. They enlarge through ontogeny, become clavate in some individuals but are always subordinate to the ventral tubercles to end of the phragmocone. The adult body chamber of microconchs extends for approximately two thirds of a whorl (Plate 7, figs. 1–5; Plate 8, figs. 4, 5; Plate 9, figs. 1–4). The coiling is regular, without occlusion of the umbilicus. The whorl section is markedly depressed, reniform intercostally, with the greatest breadth at the umbilicolateral tubercles. These strengthen and migrate to a mid-lateral position before declining just before the adult aperture. There are generally 8–9 such tubercles on the body chamber. They are linked to the umbilical shoulder by a single rib, and separated by a single nontuberculate rib in most cases. Each tubercle gives rise to a pair of ribs, and these connect in a loop to prominent ventral spines that increase markedly in prominence towards the adult aperture. On the venter, groups of ribs loop between the ventral spines, with simple nontuberculate ribs passing straight across the venter between the tuberculate groups. In most specimens, the siphonal tubercles strengthen markedly on the body chamber, developing into prominent spines between the ventral spines, giving such specimens a characteristic cockscomb profile when crushed (Plate 8, fig. 4). Occasional specimens lack siphonal tubercles on most of the body chamber, developing only a narrow elevation on one of the ribs that loop between the ventral tubercles on the last formed section of body chamber (Plate 9, figs. 1, 2).

Tubercles decline immediately before the adult aperture, which is simple with a broad, deep constriction.

Macroconchs generally loose their umbilical tubercles on the outer whorl of the phragmocone (Plate 16, figs. 4, 5), although they persist onto the beginning of the body chamber of the smallest macroconch seen (Plate 14, figs. 1–3). The umbilical seam of the first part of the body chamber occludes the umbilicus so that coiling appears markedly scaphitoid, although the whorls are actually in contact throughout (Plates 10, 11, 12, 14, 15). Ribbing coarsens on the body chamber. All specimens develop prominent ventral tubercles. There are seven in most specimens (Plates 10, 11), but as little as three in others (Plate 12; Plate 13, fig. 4). These are large, prominent, and link groups of two or three flank ribs, with up to five ribs looping between tubercles over the venter and one to three ribs between the tuberculate ribs. Siphonal tubercles are variably developed. In some specimens they only appear at the end of the body chamber as a mere elevation on one or two of the looped ribs (Plate 11, Plate 13, fig. 3). In others, they appear with the first ventral tubercles, are strong and clavate and link to the ventral tubercles by a single broad rib rather than a group of ribs (Plate 10).

Tuberculation declines in strength immediately before the adult aperture. This is preceded by a deep, broad constriction and is simple and flared (Plate 10, fig. 1; Plate 11, fig. 1; Plate 12, fig. 1).

The suture line is intricately subdivided with asymmetrically bifid lobes and bifid saddles.

Discussion: The giant scaphitids from Nagoryanȳ have been treated in very different ways by previous authors. KNER described *Scaphites tridens* and *trinodosus* as different species, providing very clear figures of both. His figure of *tridens* (1848, pl. 2, figs. 1a, 1b) shows an adult with seven ventral and siphonal tubercles on the body chamber, his figures of *trinodosus* (1848, pl. 2, figs. 2a, 2b, 2c) show a near complete adult with what appear to be rather irregularly developed tubercles on the outer whorl and a nontuberculate nucleus. GEINITZ (1850, p. 116, pl. 7, fig. 1) figured Nagoryanȳ specimens, a specimen of *tridens* that agrees with KNER's specimen, citing it as „*Scaphites tridens* KNER *(Scaphites trinodosus* GEIN in litt)." He also figured a specimen with umbilical and ventrolateral tubercles as *Scaphites quadrinodosus* GEINITZ, 1850 (p. 116, pl. 7, fig. 2, pl. 8, fig. 2). KNER's and GEINITZ's *tridens* are obviously macroconchs, while the former's *trinodosus* and the latter's *quadrinodosus* are microconchs. FAVRE (1869) provides excellent figures of both *tridens* (pl. 6, fig. 1) and *trinodosus* (pl. 5, fig. 8) from Nagoryanȳ; the latter again an obvious macroconch, the former an obvious microconch. SCHLÜTER (1872, p. 94) regarded *tridens, trinodosus* and *quadrispinosus* as synonyms, and figured two specimens. The original of his pl. 28, figs. 1 is from the Mucronaten-Kreide of Lüneburg, German Federal Republic, now preserved in Göttingen University (no. 65–8). It is a very small macroconch with, according to the figure, small umbilicolateral tubercles that extend onto the body chamber and tiny ventral tubercles that appear on the phragmocone. Dr. H. C. KLINGER tells us that the side view is a composite based on both sides of the actual specimen, while the venter is a restoration. The original of SCHLÜTER's pl. 28, fig. 4, also from Lüneburg is part of a microconch, while the original of his fig. 3 is a complete microconch from the „Mucronaten-Schichten" of Vaals, near Aachen, German Federal Republic.

The next reviser, HOLZAPFEL (1888, p. 63, pl. 5, fig. 1) described, as *Scaphites tridens,* a typical micro-

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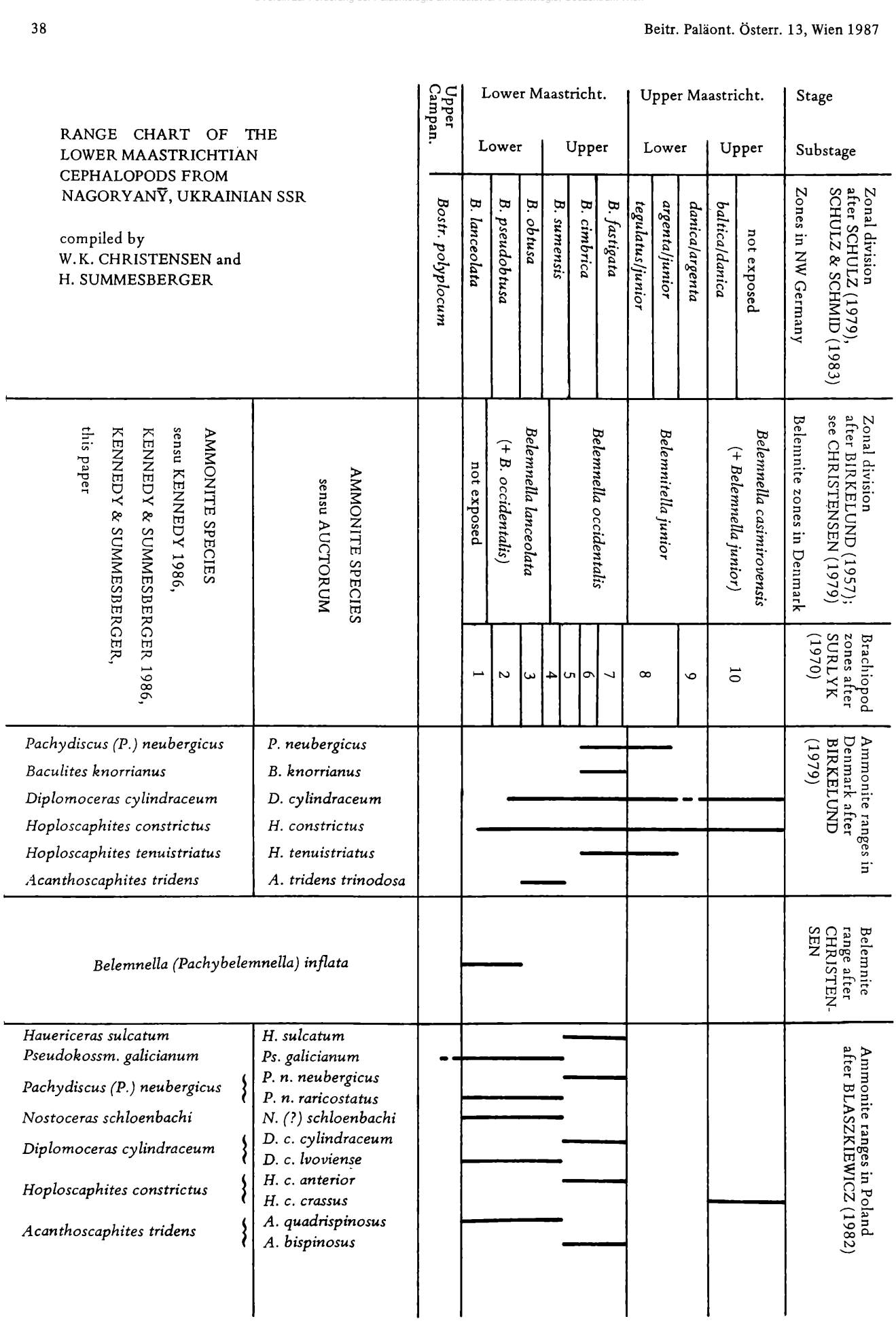
RANGE CHART OF THE LOWER MAASTRICHTIAN CEPHALOPODS FROM NAGORYANŸ, UKRAINIAN SSR

compiled by
W.K. CHRISTENSEN and
H. SUMMESBERGER



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conch of *trinodosus* type, also from near Vaals.

The most complete revision of Nagoryanȳ material is provided by NOWAK (1911). He recognised no less than five varieties of *Scaphites tridens: tridens-trinodosus* KNER, *tridens bispinosus* NOWAK, *tridens-trispinosus* GEINITZ, *tridens-varians* LOPUSKI and *tridens quadrispinosus* GEINITZ. WOLANSKY (1932), MIKHAILOV (1951), NAIDIN and SHIMANSKIJ (1959), NAIDIN (1974) and SCHMID (1965) accepted NOWAK'S treatment and regarded the five forms recognised by NOWAK as varieties. BLASZKIEWICZ (1980) and BIRKELUND (1979, 1982) have, however, regarded *varians, quadrispinosus* and *bispinosus* as separate species.

A study of the present material and the literature suggests a different approach. All specimens that correspond to *trispinosus* (e.g. Plate 10, figs. 1, 2) as used by NOWAK are macroconchs and are identical in tuberculation style to KNER's figure. As GEINITZ recognised already in 1850, the name is superfluous. All forms referred to *bispinosus* NOWAK are also macroconchs (e.g. Pl. 11, Pl. 12, fig. 4). These may or may not have feeble umbilical or umbilicolateral tubercles on the phragmocone and, rarely, the early body chamber. Forms referred to as *trispinosus tridens sensu stricto* have up to seven ventral and siphonal tubercles on the body chamber (Plate 10). Forms referred to as *bispinosus* have a similar complement of ventral tubercles, but fail to develop the corresponding siphonal nodes, apart from the strengthening of a rib or ribs over the siphonal line between the last few tubercles (Plate 11, Plate 13, fig. 3). These differences are slight and comparable in degree and extent to the variation in other scaphitids (see for instance COBBAN 1969), and are regarded as within the range of intraspecific variation.

All specimens corresponding to *trinodosus* of KNER and NOWAK are microconchs (e.g. Plate 7, figs. 1–5; Plate 8, figs. 4, 5; Plate 9, figs. 3, 4) as are all specimens referred to *quadrispinosus* of GEINITZ (Plate 9, figs. 1, 2). These have identical umbilicolateral and ventral tubercles and ribs. They differ in that *trinodosus* forms always have siphonal tubercles on some of the phragmocone and on the body chamber. In contrast, *quadrispinosus* forms lack siphonal tubercles on the phragmocone and most of the body chamber, only developing an elevation on a rib or ribs between the last few ventral tubercles in a manner analogous to that shown by macroconch *bispinosus* forms.

None of the present specimens show the development of the additional row of tubercles on each flank that characterises *varians*. The specimen from Nagoryanȳ compared to *varians* by NOWAK (1912, pl. 33, fig. 29) does have seven rows of tubercles, but the additional rows are produced by the development of a new umbilical bulla on the outer whorl as the umbilical tubercle of the inner whorl migrates out to an umbilicolateral position; it is not a true *varians* (compare with the figures of *varians* in SCHMID 1965 and BIRKELUND 1982).

Forms referred to as *trinodus* and *quadrispinosus* thus differ in the point at which siphonal tubercles appear but are identical in flank ribbing and flank and ventrolateral tuberculation, comparable differences to those between the *tridens/trispinosus* and *bispinosus* forms of the macroconchs they occur with.

The Nagoryanȳ specimens thus fall into two groups, macroconchs with late acquisition of ventral and siphonal tubercles that are restricted to the last half of the body chamber and no or weak umbilical/umbilicolateral tubercles on the outer phagmocone whorl and microconchs that acquire umbilical and ventral tubercles on the phragmocone whorls and a siphonal tubercle that appears a little later in development in most specimens. Both groups include individuals that develop siphonal elevations or ribs between the ventral clavi at the end of the body chamber only *(bispinosus* and *quadrispinosus)*. Macroconchs and microconchs occur together at all localities where reasonable numbers of specimens have been found, and always differ in the details of ornament noted above. We regard the two groups as the dimorphs of a single species, for which SCHLÜTER (1872) selected the name *tridens,* KNER's *tridens* and *trinodosus* being regarded as published simultaneously for nomenclatural purposes.

This degree of difference is macroconch: microconch ornament is unusual if not unique within scaphitids, although the range of intraspecific variation, which shows a degree of parallelism in the macro- and microconch groups, is less exceptional.

Acanthoscaphites innodosus NAIDIN, 1974 (p. 178, pl. 62, fig. 1), compared with *Rhaeboceras* by RICCARDI (1983) is no more than the phragmocone of a macroconch *tridens.*

As already noted, the presence of seven rows of tubercles immediately distinguishes *Acanthoscaphites varians. A. verneuilianus* (D'ORBIGNY, 1842) is known only from small phragmocones, but these are immediately distinguished by marked differentiation of ribbing and the presence of additional rows of tubercles (KENNEDY, 1986). As noted under the generic discussion, most other species referred to the genus are *Hoploscaphites. Acanthoscaphites praequadrispinosus* BLASZKIEWICZ, 1980 (p. 38, pl. 19, figs. 2, 3, 6–8; pl. 20, figs. 1–3, 6–8; pl. 21, figs. 1–6) is an Upper Campanian species that lacks siphonal tubercles and seems closer to *Hoploscaphites.*

Occurrence: *Acanthoscaphites tridens* is restricted to the Lower Maastrichtian. Apart from the present occurrences it is known from the upper part of the *Belemnella lanceolata* Zone in Denmark (BIRKELUND, 1979), imprecise horizons in the Lower Maastrichtian of Rügen, German Democratic Republic, Limburg and near Aachen in the German Federal Republic, the Lower Maastrichtian *Belemnella lanceolata* Zone of the Vistula Valley and Miechow trough in Poland, the Donbass and elsewhere in the southern part of European Russia.

Stratigraphy

General problems in Maastrichtian ammonite stratigraphy were discussed at length by KENNEDY (1986, p. 25). Revision of stratigraphically important localities and faunas has led to generally disappointing results and it is still not possible to erect a widely applicable ammonite zonation of the stage. For this reason we use the belemnite zonation of SCHULZ (1979) in this discussion. The Nagoryanȳ fauna includes both long-ranging and ex-

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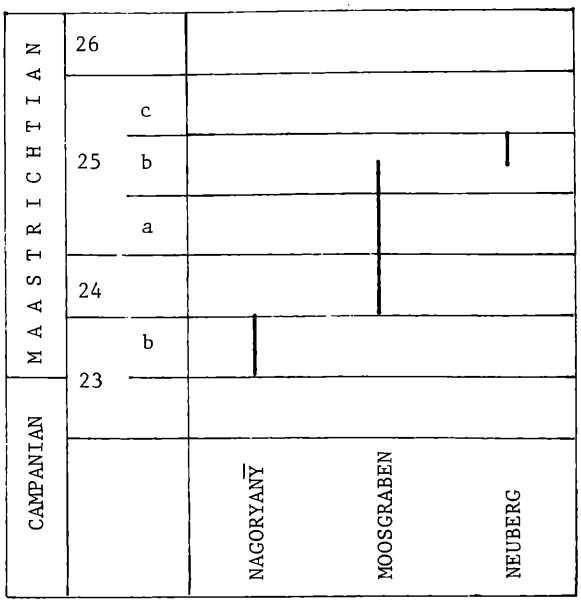
clusively Lower Maastrichtian species. *Diplomoceras cylindraceum* and *Hoploscaphites constrictus* are the longest ranging species, ranging to the Upper Maastrichtian *casimirovensis*-Zone in Denmark (BIRKELUND, 1979, p. 25). *Baculites knorrianus* and *Hoploscaphites tenuistriatus* range from the Lower Maastrichtian *fastigata*-Zone to the Upper Maastrichtian *junior*-Zone in Denmark (BIRKELUND, l.c.).

Following recent investigations by KENNEDY & SUMMESBERGER (1986) *Pachydiscus neubergicus* is a chiefly Lower Maastrichtian species also recorded from the base of the Upper Maastrichtian *junior*-Zone in Denmark. The type occurrence of *P. neubergicus* is Lower Maastrichtian: nannoplankton-Zone CC25b sensu SISSINGH (1977) and PERCH-NIELSEN (1985) (WAGREICH in KENNEDY & SUMMESBERGER, l.c.). In Poland *P. neubergicus* ranges throughout the Lower Maastrichtian (BLASZKIEWICZ, table 1). *Acanthoscaphites tridens* is also a typically Lower Maastrichtian species, and was used recently (NAIDIN, 1979, p. 504) as an index species for the Lower Maastrichtian of the Russian Platform. In Poland the range of *Hauericeras sulcatum* is restricted to the Lower Maastrichtian "occidentalis"-Zone (BLASZKIEWICZ, l.c., p. 41), whereas it is used as an index fossil for the Lower Maastrichtian as a whole in the Kopet Dagh area (ATABEKIAN, 1979, table 1–4) of central Asia.



Textfig. 3. Stratigraphic ranges of the Maastrichtian cephalopod faunas of Nagoryany (USSR), Moosgraben (GFR) and Neuberg (Austria) on the nannopaleontological time scale introduced by SISSINGH (1977).

From published results it seems that only two Nagoryanȳ species are of limited stratigraphic range within the Lower Maastrichtian:

Pseudokossmaticeras galicianum does not extend above the upper limit of the "*lanceolata*"-Zone in Poland (BLASZKIEWICZ, l.c., p. 41), although extending down into the Upper Campanian *pozaryskii*-Zone (sensu BLASZKIEWICZ, l.c., p. 41). In Bulgaria and the Crimea it is recorded from undifferentiated Lower Maastrichtian. *Nostoceras schloenbachi* is recorded with certainty only from Poland (BLASZKIEWICZ, l.c., p. 27), where it is restricted to the "*lanceolata*"-Zone (sensu BLASZKIEWICZ, l.c.).

CHRISTENSEN (this volume) studied the belemnite fauna of Nagoryanȳ. The only species present is *Belemnella (Pachybelemnella) inflata* (ARKHANGELSKY), which indicates the Lower Maastrichtian *lanceolata* to *pseudobtusa*-Zones (sensu SCHULZ, 1979, tabl. 7), a conclusion supported by the nannoflora (WAGREICH, this volume) which indicates nannoplankton-Zone CC 23b. Following SISSINGH (1977) and PERCH-NIELSEN (1985) this is the lowest zone in the Maastrichtian in nannoplankton terms although there is no published correlation of belemnite and nannofossil zones across the Campanian-Maastrichtian boundary and we still do not know if the belemnite and nannofossil based boundaries correspond.

Acknowledgements

We thank Prof. Dr. D.P. NAIDIN (Moscow) for kind support of our studies and Dr. A.V. DHONDT for helpful discussions. Our thanks are also due to Dr. F. STOJASPAL for giving access to the collections of the Austrian Geological Survey and Dr. W.K. CHRISTENSEN for reading the manuscript. Printing was supported by a grant of the „Freunde des Naturhistorischen Museums Wien".

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Explanation of Plates

Plate 1

Figs. 1–7. *Hauericeras sulcatum* (KNER, 1848). 1, 2, 6 are MGUH 16.813; 3, 4, 5 are NHMW 1862.V.23; 7 is NHMW 1848.II.16, probably the original of FAVRE's pl. 4, figs. 1a, 1b.
All figures are natural size.

Plate 2

Figs. 1–5. *Nostoceras (Nostoceras) schloenbachi* (FAVRE, 1869). NHMW.1862.V.549, the holotype, the original of FAVRE's pl. 7, fig. 5.

Fig. 6. *Pseudokossmaticeras galicianum* (FAVRE, 1869). Copy of NOWAK's photograph of the specimen figured by FAVRE as his pl. 3, fig. 5.

Fig. 7. *Pseudokossmaticeras tchihatcheffi* (BÖHM, 1927). The holotype, BMNH C29540, from near Kandili-Elpizly-Inevizly Kurtschally, Bithynian Peninsula, Turkey.
All figures are natural size.

Plate 3

Figs. 1–6, 10–12. *Diplomoceras cylindraceum* (DEFRANCE, 1816). 1–4, 6 is NHMW 1862.V.56, the original of KNER 1869 pl. 7, fig. 1; 5, 10, MGUH 16.814; 11, 12 MGUH 16.815.

Figs. 7–9. *Pseudokossmaticeras galicianum* (FAVRE, 1869). GBA unregistered, the original of FAVRE 1869 pl. 3 fig. 6.
All figures are natural size.

Plate 4

Figs. 1–3. *Acanthoscaphites tridens* (KNER, 1848). MGUH 16.816, the inner whorls of a finely-ribbed macroconch.

Figs. 4–6. *Baculites knorrianus* DESMAREST, 1817. NHMW 1862.V.53, 6601, the largest specimen seen, the whorl section is shown as pl. 5, fig. 9.
The original of figs. 1–3 is shown x 1; figs. 4–6 are reduced x 0.75.

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Plate 5

Figs. 1–14. *Baculites knorrianus* DESMAREST, 1817. 1–4 are NHMW 1848.II.31, the original of KNER, 1848 pl. 3, fig. 1; 5, 7, 8 the neotype, NHMW 7459a the original of FAVRE, 1869 pl. 7, figs. 3, 4; 6, NHMW 1862.V.50; 9, NHMW 6601, also illustrated as pl. 4, figs. 4–6; 10, NHMW 1848.II.29; 11, 12, NHMW 7459, the original of FAVRE 1869 pl. 7, fig. 2; 13, 14, NHMW 7459c. All figures are natural size.

Plate 6

Figs. 1–5, 25–28. *Acanthoscaphites tridens* (KNER, 1848). 1, MGUH 16.817; 2, 3, MGUH 16.818; 4, 5, MGUH 16.819; 25, 26, MGUH 16.820; 27, 28, MGUH 16.821.

Figs. 6–24. *Hoploscaphites constrictus* (J. SOWERBY, 1817). 6, GBA 8077a, a microconch; 7–9, GBA 8077b, a microconch; 10–12, GBA unregistered, the original of FAVRE'S pl. 5, fig. 5; 13–15 GBA unregistered, a macroconch, the original of FAVRE 1869 pl. 5, fig. 6; 16–18, GBA unregistered, the original of FAVRE 1869 pl. 5, fig. 1; 19–21, GBA unregistered, the original of FAVRE 1869 pl. 5, fig. 4; 22–24 NHMW unregistered.
All figures are natural size.

Plate 7

Figs. 1–5. *Acanthoscaphites tridens* (KNER, 1848). 1, 4, 5 NHMW 8069, the original of FAVRE 1869 pl. 5, fig. 8, a microconch of *trinodosus* type; 2, 3, NHMW 8073, a microconch of *trinodosus* type.
All figures are natural size.

Plate 8

Figs. 1–5. *Acanthoscaphites tridens* (KNER, 1848). 1–3, NHMW 8071, a microconch phragmocone; 4, 5, MGUH 16.822, an adult microconch. Both specimens are of *trinodosus* type.
All figures are natural size.

Plate 9

Figs. 1–4. *Acanthoscaphites tridens* (KNER, 1848). 1, 2, MGUH 16.823, an adult microconch of *quadrispinosus* type; 3, 4, NHMW 8068, an adult microconch of *trinodosus* type.
All figures are natural size.

Plate 10

Figs. 1, 2. *Acanthoscaphites tridens* (KNER, 1848). MGUH 16.824, an adult macroconch of *trispinosus* type.
Reduced x 0.85.

Plate 11

Figs. 1, 2. *Acanthoscaphites tridens* (KNER, 1848). NHMW 7405, an adult macroconch of *bispinosus* type. The ventral view of this specimen is shown in Pl. 13, fig. 3.
Reduced x 0.85.

Fig. 3. *Hoploscaphites tenuistriatus* (KNER, 1848). MNB unregistered, an adult macroconch labelled 'Lemberg'.

Plate 12

Figs. 1, 2. *Acanthoscaphites tridens* (KNER, 1848). MGUH 16.825, an adult macroconch of *trispinosus* type with only three sets of tubercles, labelled Nechey, Nagoryanȳ. The ventral view of this specimen is shown in Pl. 13, fig. 4.
Reduced x 0.85.

Plate 13

Figs. 1, 3, 4. *Acanthoscaphites tridens* (KNER, 1848). 1, MGUH 16.826 a juvenile macroconch; 3 NHMW 7405, an adult macroconch of *bispinosus* type. Other views are shown in Pl. 11; 4, MGUH 16.825, an adult macroconch of *trispinosus* type with only three sets of tubercles. Other views are shown in Pl. 12.

Fig. 2. *Hauericeras sulcatum* (KNER, 1848). NHMW 1862.V.22. Figs. 1 and 2 are natural size; Figs. 3 and 4 are reduced x 0.85.

Plate 14

Figs. 1–3. *Acanthoscaphites tridens* (KNER, 1848). GBA unregistered, the smallest adult microconch seen.
All figures are natural size.

Plate 15

Acanthoscaphites tridens (KNER, 1848). NHMW 7404, incomplete adult macroconch of *bispinosus* type.
Figure is natural size.

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Plate 16

Figs. 1–6. *Acanthoscaphites tridens* (KNER, 1848). 1, 4, 5 MGUH 16.827 + 16.828; 2, 3, NHMW 1848.II.26; 6, GBA unregistered; all specimens are juvenile macroconchs.
All figures are natural size.

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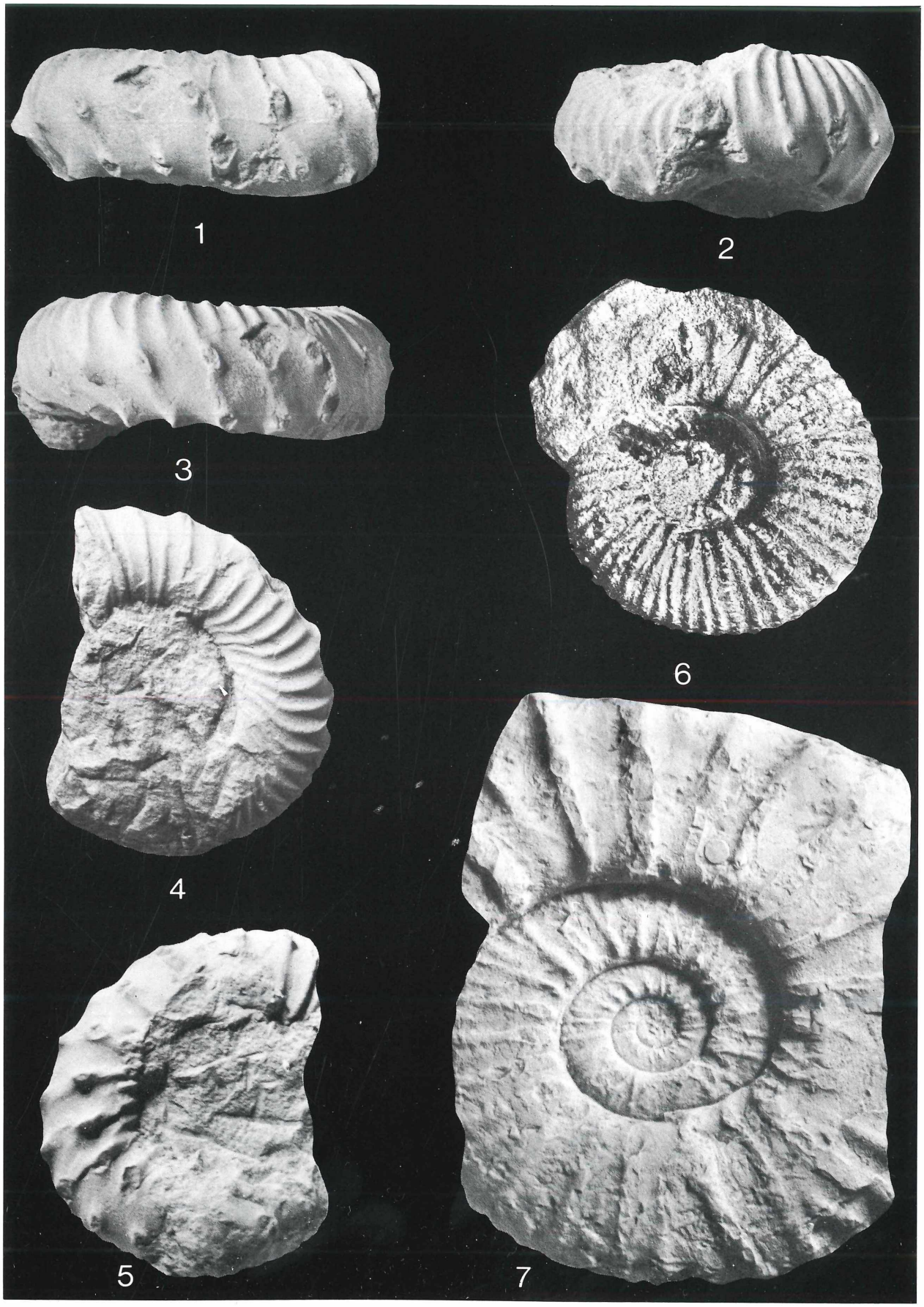

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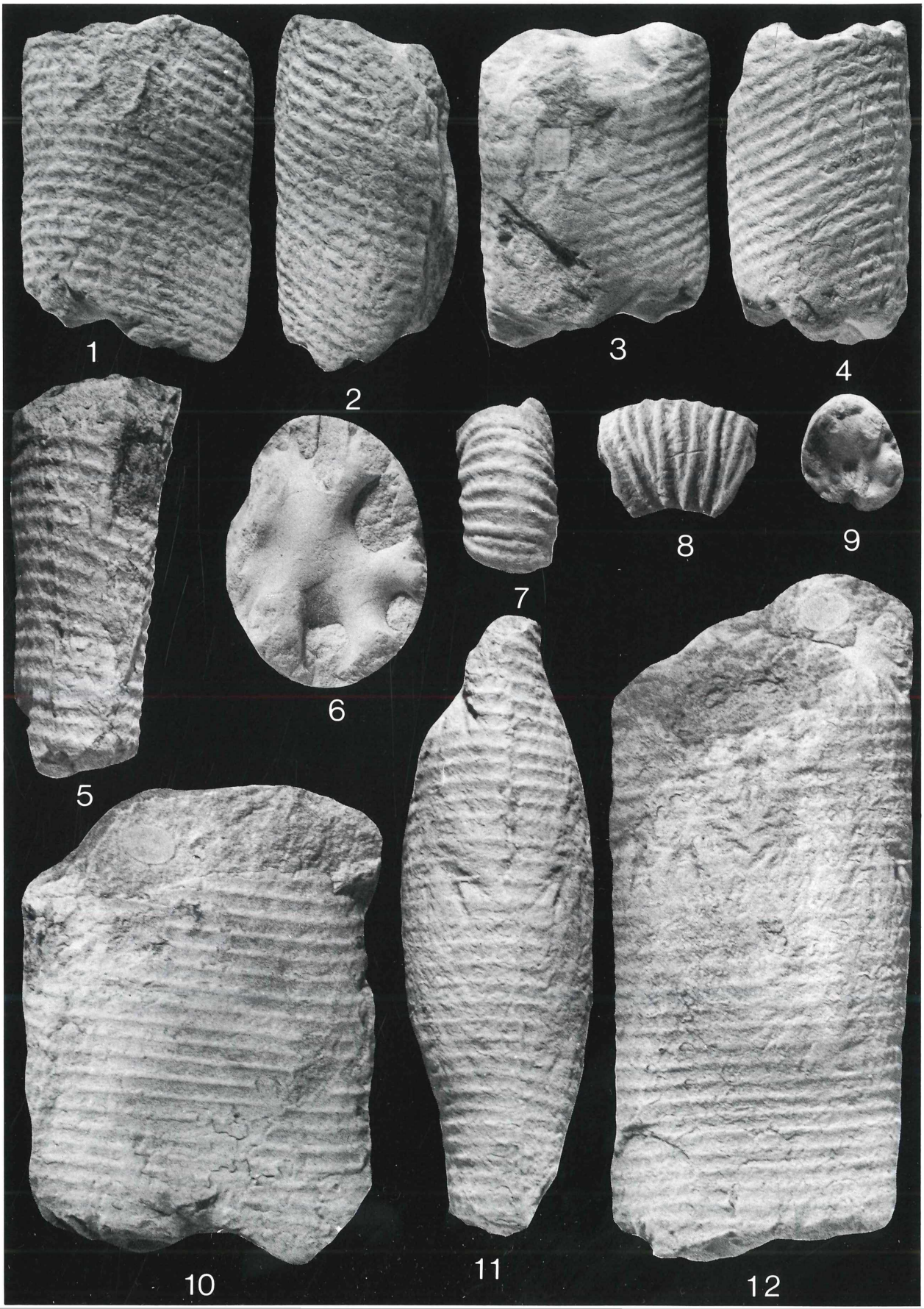

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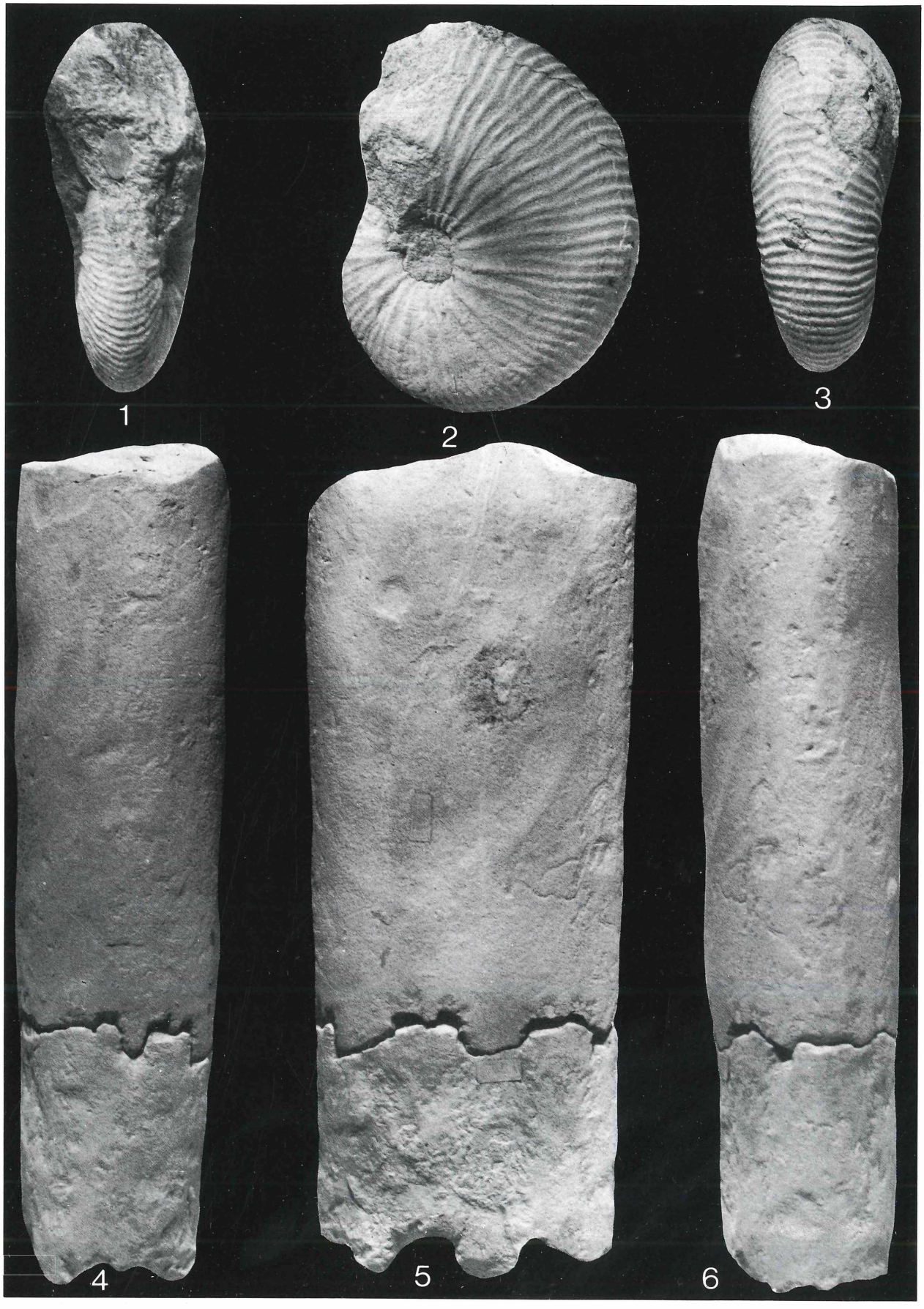

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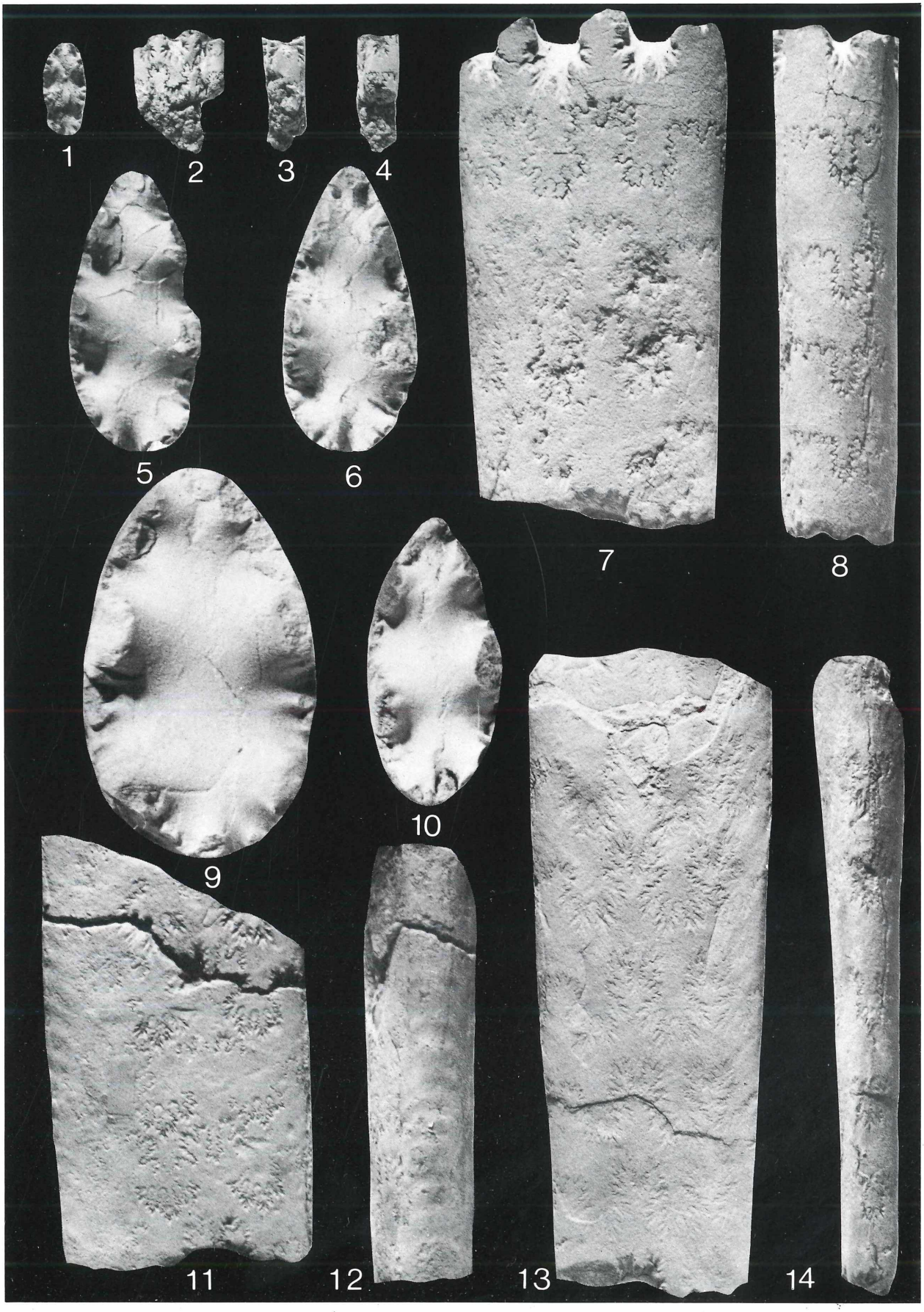

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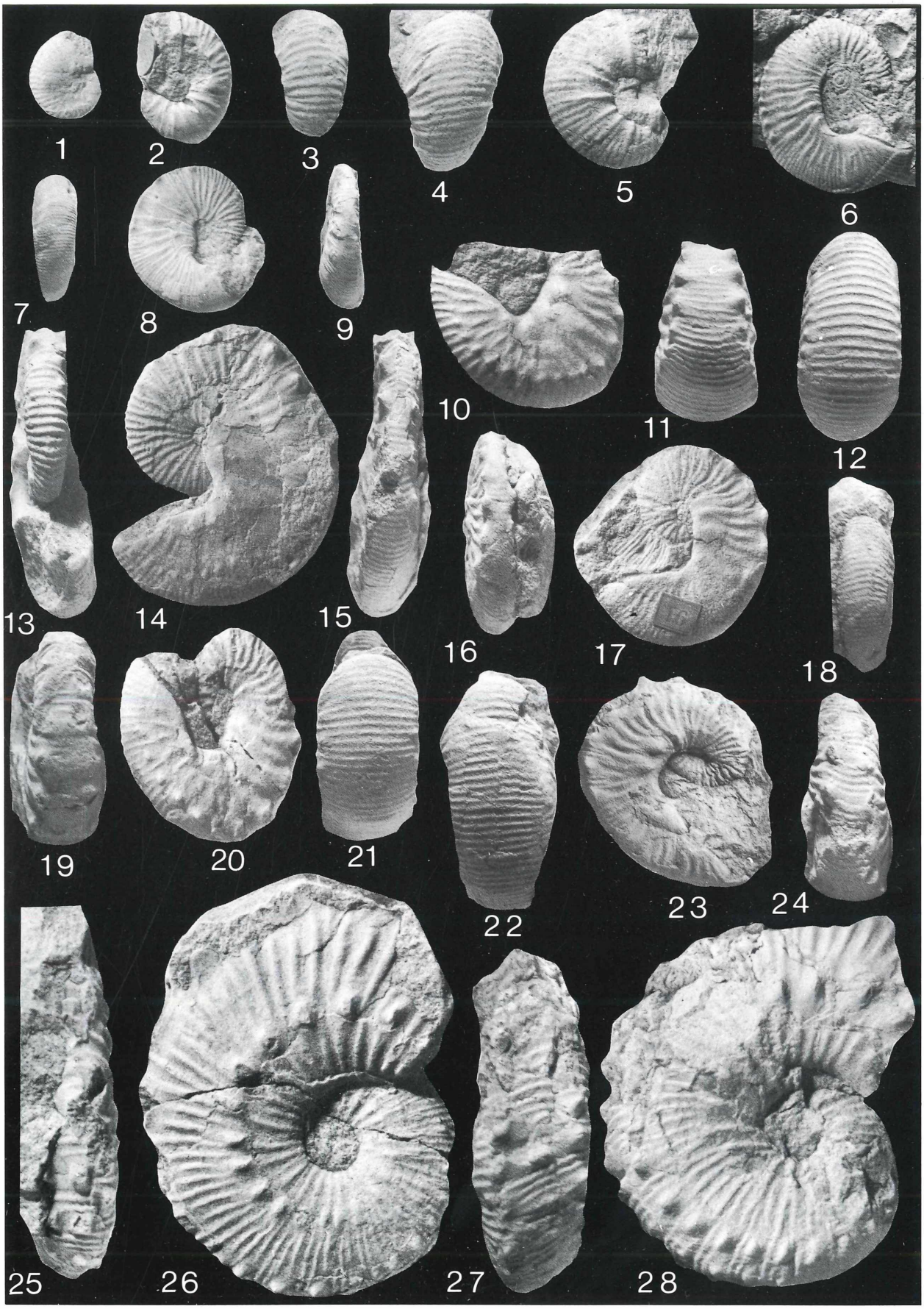

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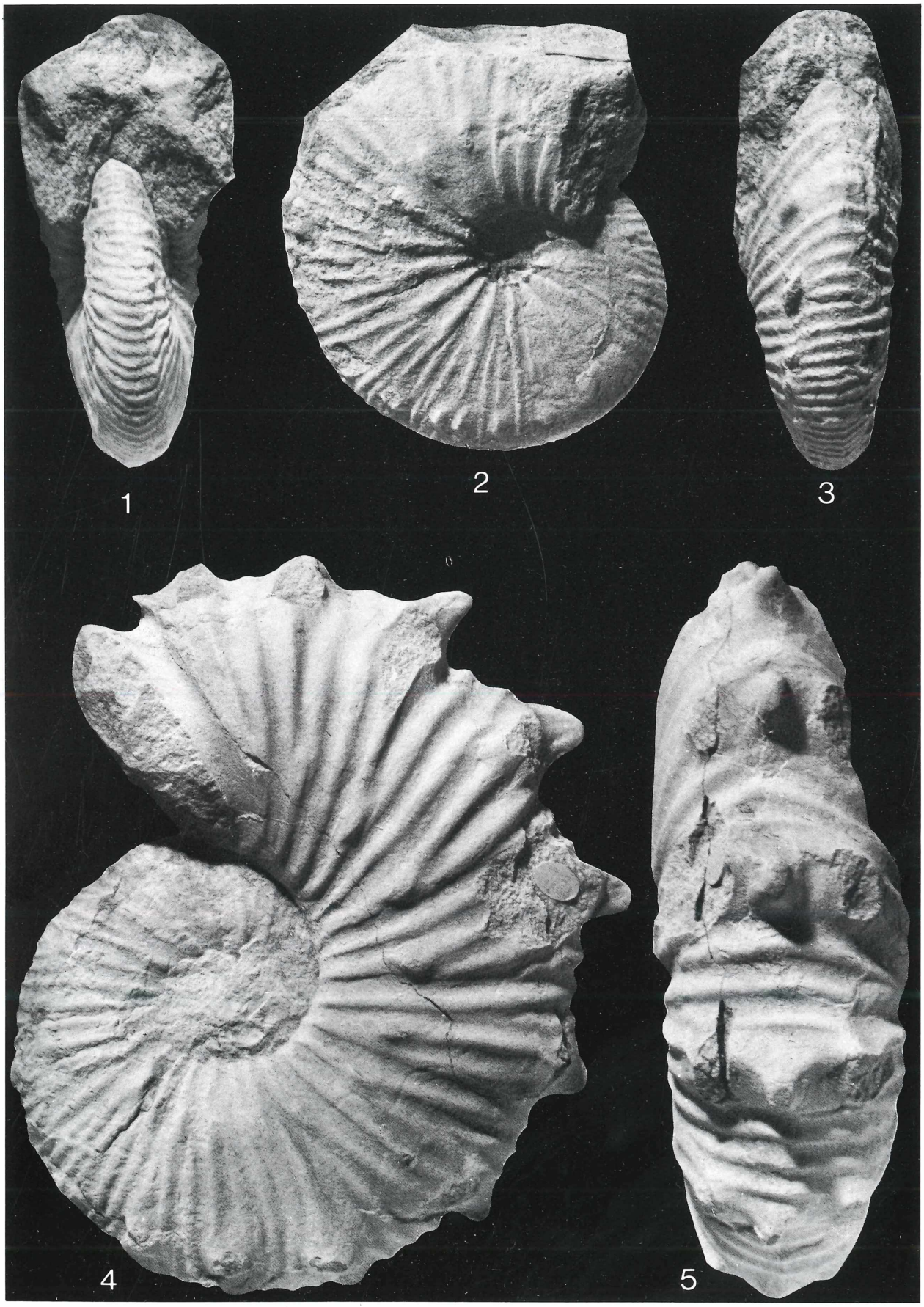

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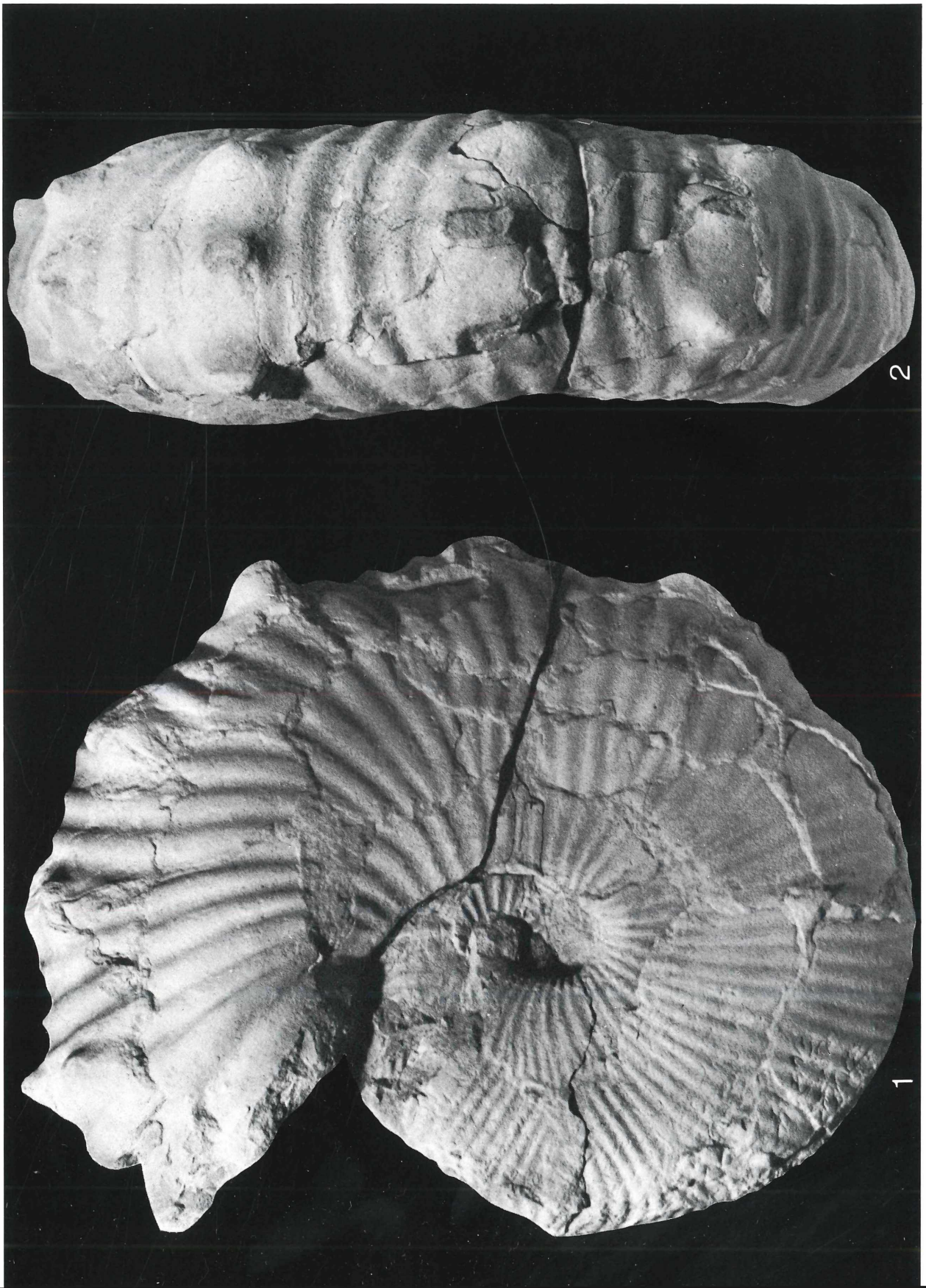

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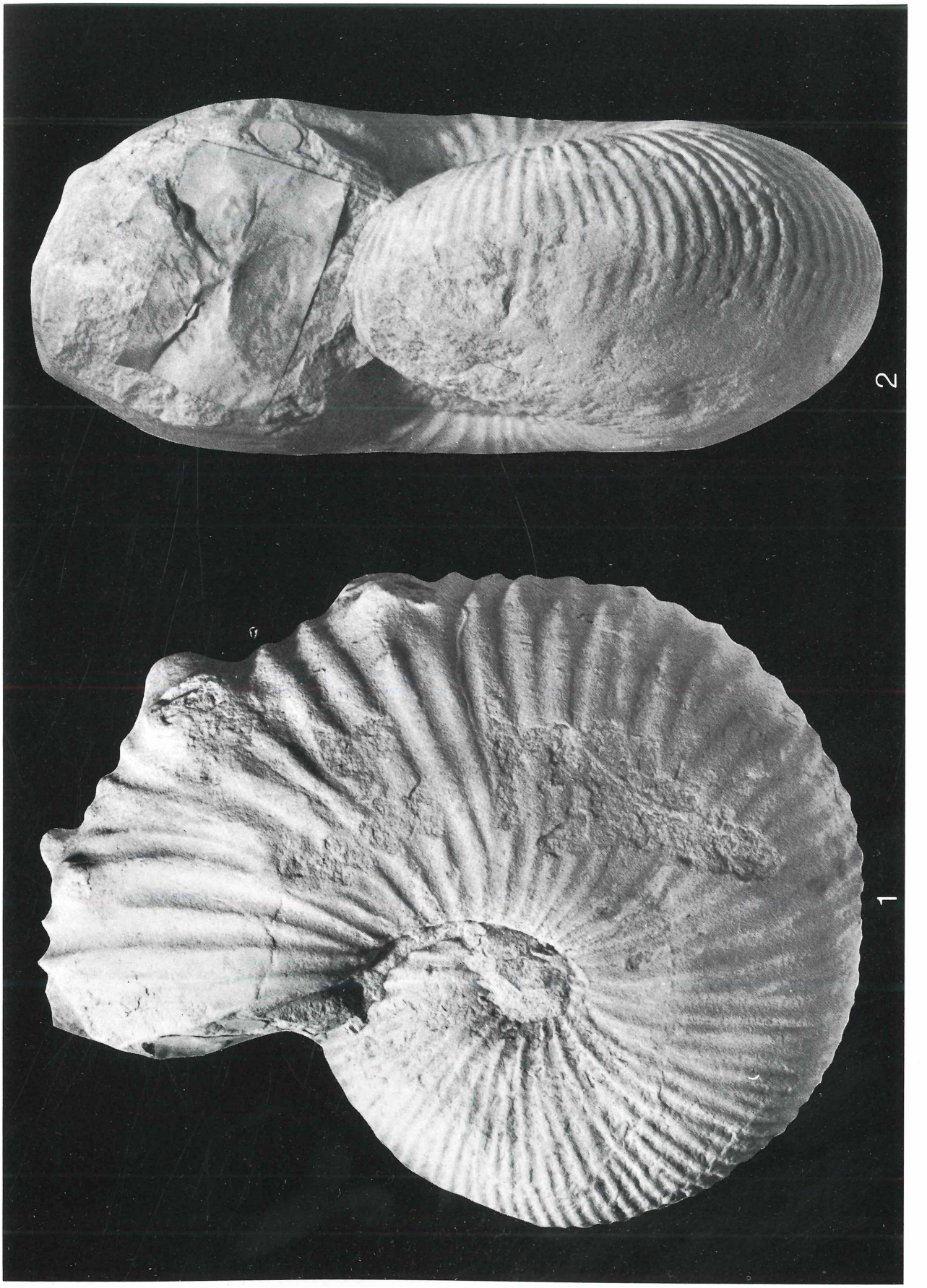

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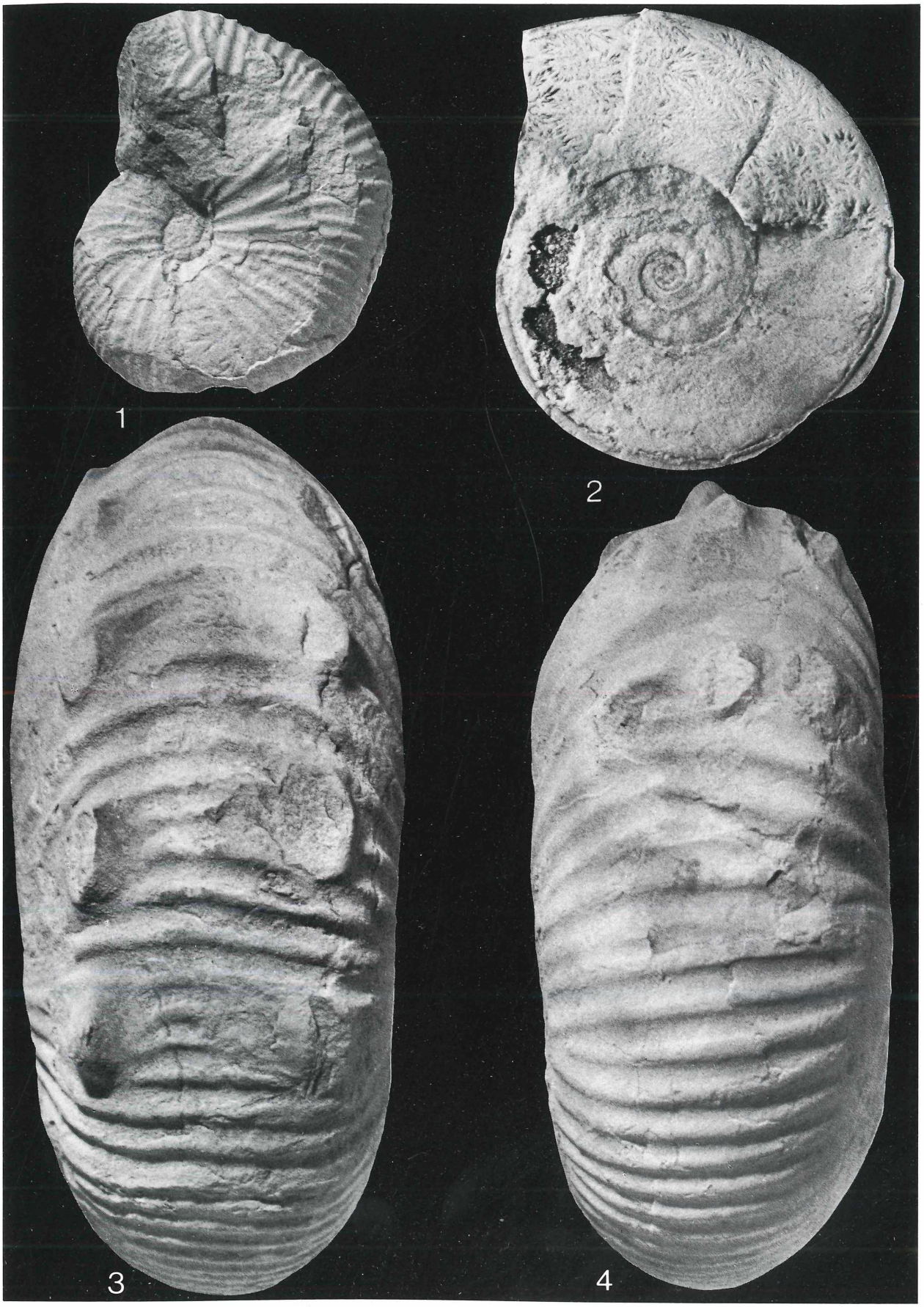

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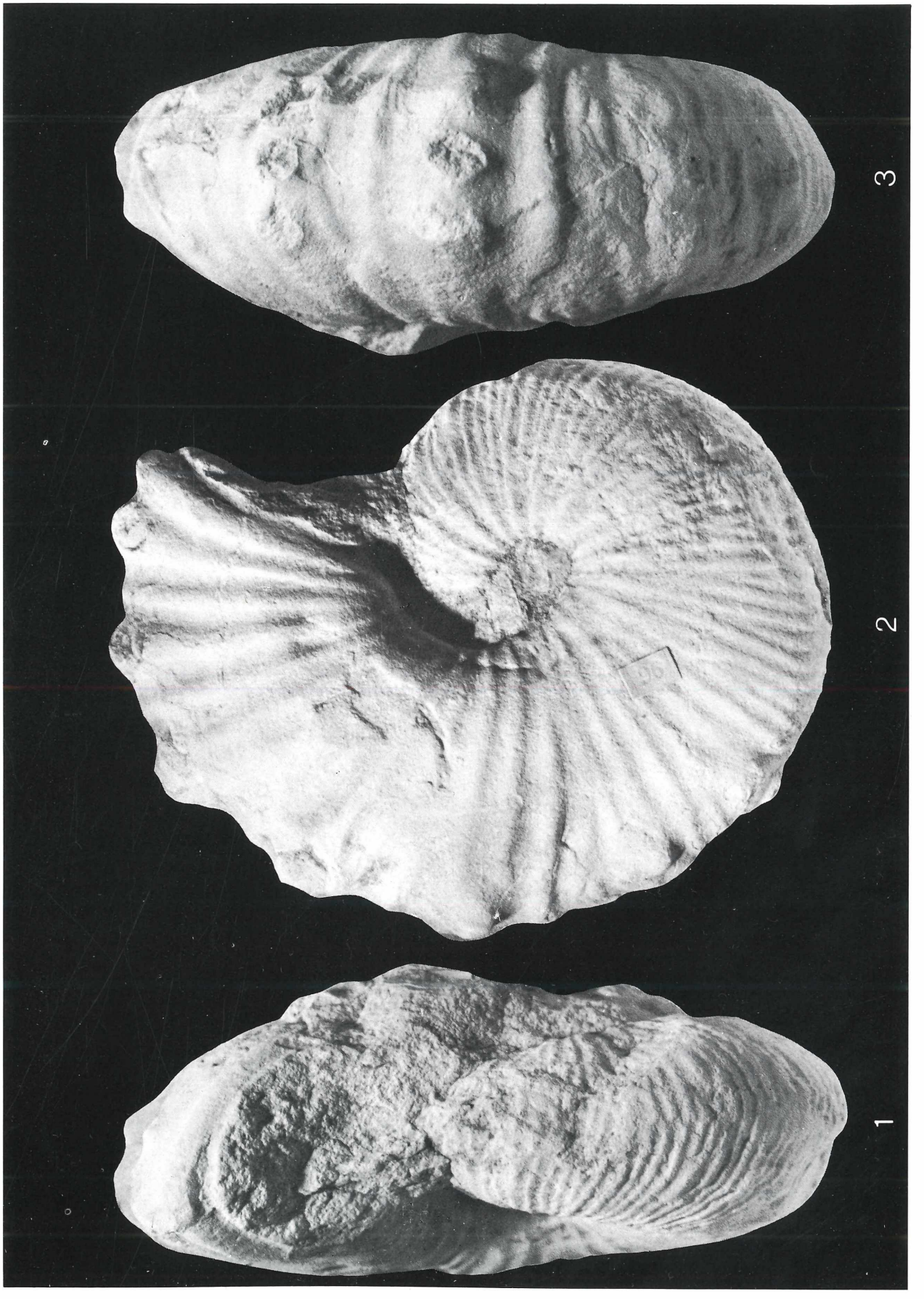

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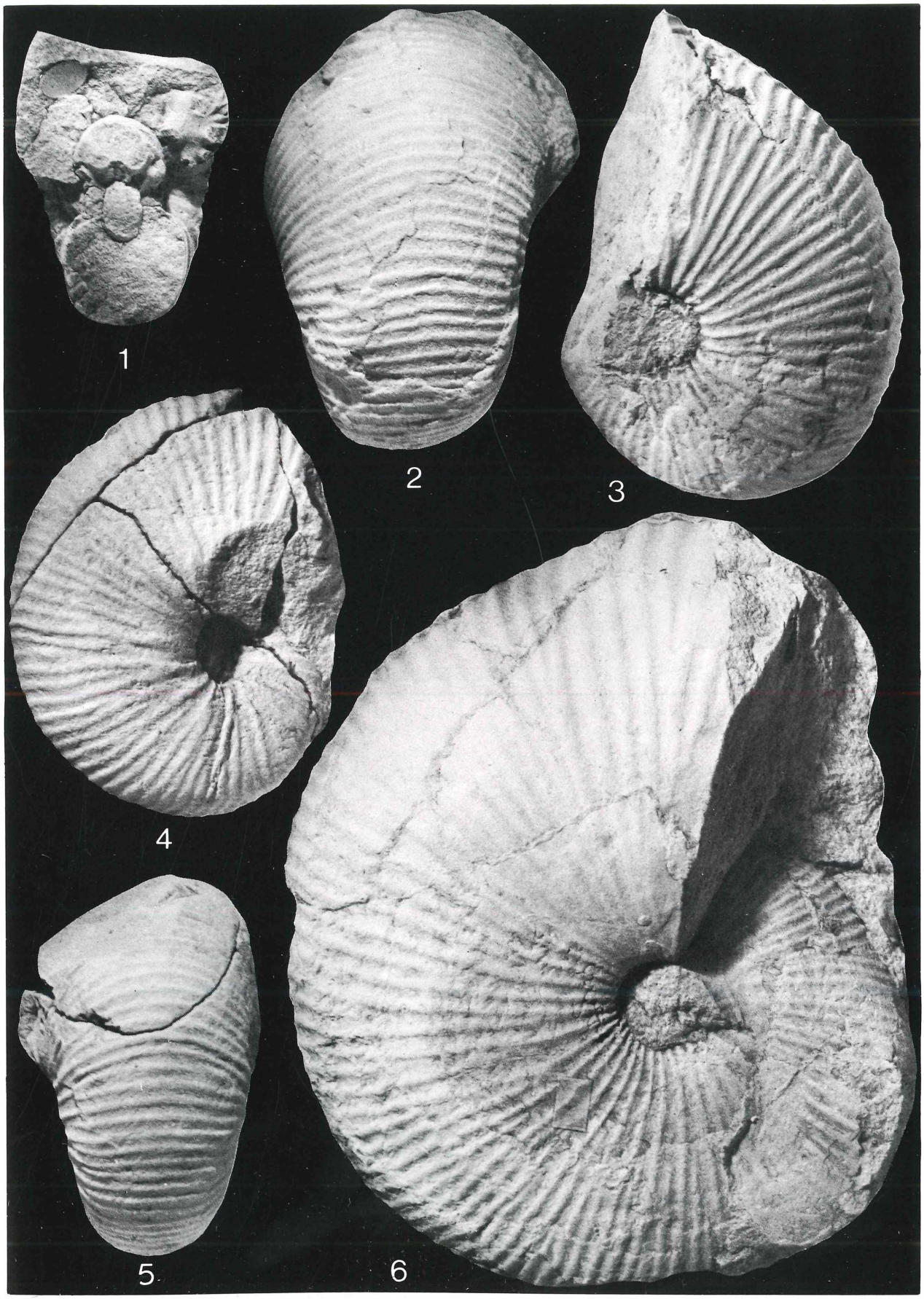

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Zeitschrift/Journal: Beiträge zur Paläontologie

Jahr/Year: 1987

Band/Volume: 13

Autor(en)/Author(s): Kennedy William James, Summesberger Herbert

Artikel/Article: Lower Maastrichtian Ammonites from Nagoryany (Ukrainian SSR) 25-78