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Giant scaphitid ammonites from the Maastrichtian of Europe

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Abstract

Giant scaphitid ammonites from the Maastrichtian of Europe have generally been assigned to *Acanthoscaphites* NOWAK, 1911. Prior to the present study, this genus comprised five species: *A. tridens* (KNER, 1848), *A. varians* (ŁOPUSKI, 1911), *A. verneuilianus* (D'ORBIGNY, 1841), *A.* sp. of KENNEDY (1987) and *A.* sp. of KENNEDY & CHRISTENSEN (1997). Of the first-named taxon, material from Aachen-Schneeberg of Early Maastrichtian age, including the specimen illustrated by HOLZAPFEL (1887-89) long thought to have been lost, is described. Recently collected topotype material from Kazimierz Dolny, and from Rejowiec (Poland), of latest Maastrichtian age (*Belemnella kazimiroviensis* Zone), allows *A. varians* to be revised. Specimens from the late Early and early Late Maastrichtian of NW Europe, assigned to *A. varians*, differ consistently in details of ornament, and are assigned to a new subspecies, *A. v. blaszkiewiczi* n. subsp. Style of ribbing and tuberculation of the *varians* stock differs from that of *A. tridens* to such an extent that a new subgenus, *Euroscaphites* n. subgen., is erected, with *varians* as type species. The Late Maastrichtian *"Acanthoscaphites" verneuilianus*, only known from phragmocones, is provisionally assigned to the new subgenus. The other two species previously referred to *Acanthoscaphites*, viz. *A.* sp. of KENNEDY (1987) and *A.* sp. of KENNEDY & CHRISTENSEN (1997), both of Late Maastrichtian age, cannot be assigned confidently to either subgenus.

Key words: Ammonoidea, Scaphitidae, Late Cretaceous, new taxa, Europe.

Résumé

Les ammonites scaphitides géantes du Maastrichtien d'Europe ont généralement été assignées à *Acanthoscaphites* NOWAK, 1911. Avant cette étude, le genre comprenait cinq espèces: *A. tridens* (KNER, 1848), *A. varians* (ŁOPUSKI, 1911), *A. verneuilianus* (D'ORBIGNY, 1841), *A.* sp. de KENNEDY (1987) et *A.* sp. de KENNEDY & CHRISTENSEN (1997). Du matériel d'âge maastrichtien inférieur provenant de Aachen-Schneeberg et appartenant au premier taxon est décrit; il inclut le spécimen, longtemps considéré comme perdu, figuré par HOLZAPFEL (1887-89). Du matériel topotypique récemment récolté à Kazimierz Dolny et Rejowiec (Pologne), d'âge maastrichtien terminal (Zone à *Belemnella kazimiroviensis*), a permis de réviser *A. varians*. Les spécimens de la fin du Maastrichtien inférieur et du début du Maastrichtien supérieur du nord-ouest de l'Europe, attribués à *A. varians* diffèrent de façon consistante de cette espèce par des détails de l'ornementation et sont assignés à une nouvelle sous-espèce, *A. v. blaszkiewiczi* n. subsp. Les côtes et tubercules du groupe *varians* diffèrent de celles et ceux de *A. tridens* à tel point qu'un nouveau sous-genre, *Euroscaphites* n. subgen., est fondé avec *A. varians* comme espèce-type. *"Acanthoscaphites" verneuilianus*, du Maastrichtien supérieur et connu uniquement par des phragmocones, est assigné provisoirement au nouveau sous-genre. Les deux autres espèces attribuées antérieurement au genre *Acanthoscaphites*, *A.* sp. de KENNEDY (1987) et *A.* sp. de KENNEDY & CHRISTENSEN (1997), toutes deux d'âge maastrichtien supérieur, ne peuvent être attribuées avec certitude à un sous-genre.

Mots-clefs: Ammonoidea, Scaphitidae, Crétacé supérieur, nouveaux taxa, Europe.

Introduction

Subsequent to JELETZKY (1951), who used *Acanthoscaphites tridens* as index for the lowest macrofossil zone of the Maastrichtian Stage, use of this giant scaphitid as an Early Maastrichtian index fossil has appeared in a number of recent syntheses of Late Cretaceous stratigraphy (KENT & GRADSTEIN, 1985; HARLAND *et al.*, 1989). However, during the 1995 Brussels meeting of the Maastrichtian Working Group the genus was not considered as relevant to the discussion of the definition of the base of the stage (ODIN, 1996).

Prior to the present study, this genus comprised five species: *A. tridens* (type of the genus), *A. varians*, *A. verneuilianus*, *A.* sp. of KENNEDY (1987) and *A.* sp. of KENNEDY & CHRISTENSEN (1997).

The aim of the present paper is fourfold:

1 - to illustrate specimens of *A. tridens* (IRScNB, Bosquet Colln) from Aachen-Schneeberg, not previously figured. The original of HOLZAPFEL (1887, pl. 5, fig. 1), long thought to have been lost in air raids on the city of Aachen during World War 2, has recently been traced by Norbert Keutgen and is here refigured;

2 - to document the stratigraphic range of *A. tridens* into the late Early Maastrichtian (*sumensis* Zone);

3 - to record a second specimen of *"A. varians"* from the early Late Maastrichtian Vijlen 6 Member (*sensu* FELDER, 1997) of the Haccourt-Lixhe area (Liège, Belgium);

4 - to revise *Acanthoscaphites varians* from the latest Maastrichtian (*kazimiroviensis* Zone) of central Poland, based on recently collected material. Various authors (e.g. BŁASZKIEWICZ, 1980 and BIRKELUND, 1993) have pointed out that the ornament of NW European material from lower in the Maastrichtian assigned to this species differed from that of the Polish type. Late Early/early Late Maastrichtian specimens from Belgium, Germany

and Denmark merit separation at the subspecific level, as *A. v. blaszkiewiczi* n. subsp. Style of ribbing and details of ornament of *A. varians* differ from that of *A. tridens* to such an extent that the erection of a new subgenus, *Euroscaphites* n. subgen., with *A. varians* as type species, is proposed.

Conventions

To denote the repositories of specimens the following abbreviations are used in the text: EMP - École des Mines collections, Université Claude Bernard, Lyon; GPIUH - Geologisch-paläontologisches Institut der Universität Hamburg, Hamburg; IRScNB - Institut royal des Sciences naturelles de Belgique, Brussels; MGUH - Geological Museum of Copenhagen University, Copenhagen; MKD - Muzeum Przyrodnicze, Kazimierz Dolny; NHMM - Natuurhistorisch Museum Maastricht, Maastricht (MB = M. van Birgelen Colln); NLfB - Niedersächsisches Landesamt für Bodenforschung, Hannover; RWTH - Rheinisch-Westfälische Technische Hochschule, Aachen; ZPAL - Instytut Paleobiologii, Polska Akademia Nauk, Warsaw.

Systematic palaeontology

Family Scaphitidae GILL, 1871
Subfamily Scaphitinae GILL, 1871
Genus and subgenus *Acanthoscaphites* NOWAK, 1911, p. 565

TYPE SPECIES: *Scaphites tridens* KNER, 1848, p. 10, pl. 2, fig. 1a, b, by the subsequent designation of DIENER (1925, p. 205).

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 nontuberculate ribs. Aperture with marked constriction. Suture complex for family.'' (KENNEDY & SUMMESBERGER, 1987, p. 35).

REMARKS: This genus is restricted to the Early Maastrichtian; records from the Late Campanian (see e.g. WRIGHT, 1996) have been shown to be based on species of the scaphitid *Jeletzkytes* RICCARDI, 1983. *Acanthoscaphites praequadrispinosus* BŁASZKIEWICZ, 1980 (p. 38, pl. 19, figs. 2, 3, 6-8; pl. 20, figs. 1-3, 6-8; pl. 21, figs. 1-6), which lacks siphonal tubercles, is a junior synonym of the type species of *Jeletzkytes*, *Scaphites nodosus* OWEN, 1852 (p. 581, pl. 8, fig. 4) (see KENNEDY & COBBAN, 1993, p. 430, figs. 9.5, 17.22-17.25; COBBAN & KENNEDY, 1994, p. B8, pl. 9, figs. 7-11).

COOPER (1994, p. 188) considered the genus *Acanthoscaphites* to be in the same clade as the North American *Rhaeboceras* MEEK, 1876 (see revision by COBBAN, 1987) and the micromorphic *Ponteixites* WARREN, 1934, for which he erected the subfamily Rhaeboceratinae, noting that derived forms had multinodose body chambers with siphonal tubercles. Features that *Acanthoscaphites* and *Rhaeboceras* have in common include large size, tightly coiled body chamber, prorsiradiate flank ribbing and an intricately subdivided suture.

Acanthoscaphites (A.) tridens (KNER, 1848)
(Text-figs. 1, 2; Pls 1, 2)

* 1848 *Sc. tridens, m.* KNER, p. 10, pl. 2, fig. 1a, b.
1987 *Acanthoscaphites tridens* (KNER, 1848) - KENNEDY & SUMMESBERGER, p. 36, pl. 4, figs. 1-3; pl. 6, figs. 1-5, 25-28; pl. 7, figs. 1-5; pl. 8, figs. 1-5; pl. 9, figs. 1-4; pl. 10, figs. 1, 2; pl. 11, figs. 1, 2; pl. 12, figs. 1, 2; pl. 13, figs. 1, 3, 4; pl. 14, figs. 1-3; pl. 15; pl. 16, figs. 1-6 (with full synonymy).
1987 *Acanthoscaphites tridens* (KNER, 1848) - KENNEDY, p. 158, pl. 37, figs. 1-4.
1993 *Acanthoscaphites tridens* (KNER, 1848) - BIRKELUND, p. 55, pl. 8, figs. 2-4; pl. 9, fig. 2.

TYPE
The whereabouts of KNER's material is unknown. KENNEDY & SUMMESBERGER (1987, p. 36) indicated that the original of KNER (1848, pl. 2, fig. 1) should be designated lectotype, if found. It was from the ''Kreidemergel'' (= Lower Maastrichtian) of Lemberg (now L'vov, western Ukraine).

MATERIAL
Five macroconchs (IRScNB 10542, IRScNB 10544, RWTH KJI/3, RWTH KJI/1, RWTH Lam I/6), five microconchs (RWTH KJI/5, IRScNB 10540, J. Keutgen Coll. AT 3; H. Knoll Coll. no. 183, RWTH HO.I/2) and four nuclei (RWTH Lam I/7, RWTH KJI/4; IRScNB 10541, IRScNB 10543), all from the Vijlen Member (Gulpen Formation) of Aachen-Schneeberg and Aachen.

DESCRIPTION
Acanthoscaphites (A.) tridens is the largest known European scaphitid, and shows marked sexual dimorphism of the general type discussed by MAKOWSKI (1963) and COBBAN (1969), and demonstrated for this species by KENNEDY & SUMMESBERGER (1987).

Microconchs (Pl. 1, Figs. 2, 4-6; Pl. 2, Fig. 5) vary from 80-130 mm in diameter, macroconchs (Pl. 1, Fig. 1; Pl. 2, Figs. 2, 4; Text-figs. 1, 2) from 130-250 mm. All of the specimens from the (extended) type area of the Maastrichtian Stage that we have seen are crushed to varying degrees, but the phragmocone seems to have had a de-

Fig. 1 – *Acanthoscaphites (A.) tridens* (KNER, 1848), IRScNB 10542 (IG 4285, Bosquet Colln), a macroconch, Craie marneuse glauconifère (= Vijlen Member in current terminology), Aachen-Schneeberg, x 0.8.

pressed, reniform whorl section with a small, deep conical umbilicus. 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 30 mm diameter (Pl. 1, Fig. 3). These persist and generally strengthen in microconch phragmocones (Pl. 1, Figs. 2, 4).

Macroconch phragmocones may retain bullae to the outer whorl or may lose them. The bullae give rise to two or more ribs, while intercalated ribs arise 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 microconchs, the umbilical bullae migrate out to an umbilicolateral position around the last whorl, and give rise to groups of two or three ribs with occasional nontuberculate ribs extending to the umbilical seam. 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 several nontuberculate ribs. Groups of two or three ribs loop between umbilicolateral and ventral tubercles and between ventral tubercles across the venter (Pl. 1, Figs. 4-6).

Siphonal tubercles appear at variable growth stages; some specimens possess them on the penultimate whorl of the phragmocone, most develop them at the beginning of the outer whorl, 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 weaker than the ventral tubercles to the end of the phragmocone. There are generally 8-9 umbilicolateral tubercles on the body chamber. They are linked to the umbilical shoulder by a single rib, and usually separated by a single nontuberculate rib. Pairs of ribs loop to prominent ventral spines. On the venter, groups of ribs loop between the ventral spines, with simple nontuberculate ribs passing straight across the venter between the tuberculate groups.

Macroconchs generally lose their umbilical tubercles on the outer whorl of the phragmocone (Pl. 1, Fig. 1; Pl. 2, Fig. 2). The umbilical seam of the first part of the body chamber occludes the umbilicus so that coiling appears scaphitoid, although the whorls are actually in contact

Fig. 2 – *Acanthoscaphites (A.) tridens* (KNER, 1848), IRScNB 10544 (IG 4285, Bosquet Colln), a macroconch, Craie marneuse glauconifère (= Vijlen Member in current terminology), Aachen-Schneeberg, x 0.8.

throughout. Ribs coarsen on the body chamber and ventral tubercles appear. They 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 present but variably developed.

DISCUSSION

On the basis of a large suite of specimens from Nagorȳany near L'vov (the Ukraine), KENNEDY & SUMMESBERGER (1987) described and discussed *A. tridens* at length, and showed that *Scaphites tridens* KNER, 1848, *S. tridens trispinosus* GEINITZ, 1850 (p. 116, pl. 7, fig. 1), and *A. tridens bispinosus* NOWAK, 1911 (p. 577, pl. 32, figs. 1-3; text-fig. 14) were macroconchs, and *S. trinodosus* KNER, 1848, and *S. quadrispinosus* GEINITZ, 1850 (p. 116, pl. 7, fig. 2; pl. 8, fig. 2) microconchs of a single species.

Acanthoscaphites innodosus NAIDIN, 1974 (p. 178, pl. 62, fig. 1) seems to be a synonym of *A. tridens*, based on a macroconch phragmocone. *A. schmidi* BIRKELUND, 1982 (p. 17, pl. 1, figs. 7-10; pl. 2, figs. 1-4) is better considered a specialised offshoot of *Hoploscaphites* NOWAK, 1911 (KENNEDY, 1986a, b, 1987), as is *Ammonites pungens* BINKHORST, 1861 (p. 32, pl. 5a3, fig. 1), assigned earlier to *Acanthoscaphites* by some authors (e.g. BIRKELUND, 1982). The latter species was revised by KENNEDY (1987, p. 202, pl. 23, figs. 3, 4; pl. 32, figs. 22-25; pl. 34, figs. 2-6, 10, 11, 18, 19; pl. 35, figs. 1-11) and has subsequently been recorded from the Maastrichtian type area by JAGT & KUYPERS (1994, fig. 3) and JAGT (1995, p. 31, pl. 5, figs. 5-14).

OCCURRENCE

Acanthoscaphites tridens is confined to the Early Maastrichtian, ranging from the *lanceolata* Zone to the (upper) *sumensis* Zone. Records in the literature are from Nagorȳany (the Ukraine), Rügen, Aachen and Lüneburg (Germany), Belgium (Voeren, Limburg), Denmark, Poland, Donbass and elsewhere in southern European Russia (Text-fig. 7).

BIRKELUND (1993, p. 56) referred to a specimen from below the hardground at Hvidskud (Møns Klint, Denmark), of *obtusa*, or possibly lowermost *sumensis* Zone age. In the extended Maastrichtian type area, *A. tridens* is confined to the Vijlen Member (Gulpen Formation). KEUTGEN & VAN DER TUUK (1991) mentioned it from the upper *sumensis* Zone of temporary exposures at Aachen-Vaalserstraße and -Schurzelterstraße, while KEUTGEN (1996) recorded the stratigraphically oldest *A. tridens* from Interval 0 of FELDER & BLESS (1994) at the Bovenste Bos quarry (Epen, The Netherlands), of *sumensis* Zone age. KEUTGEN's (1996) "*Acanthoscaphites tridens* Zone" comprises Vijlen Member Intervals 0-3 of FELDER & BLESS (1994), but it should be noted that the index taxon extends into the overlying Interval 4.

The record of *A. tridens* from the lower Vijlen Member at Gulpenerberg (The Netherlands; JAGT *et al.*, 1992) was referred to nannofossil zone CC24, which is no older than the upper part of the *sumensis* Zone *sensu* SCHULZ (1979). These authors suggested a *cimbrica* Zone age, which would correspond to Interval 5 of FELDER & BLESS (1994). KEUTGEN (1996, p. 70) expressed doubts over this assignment, and considered an upper *sumensis* Zone age more likely. This view is accepted here, which means that *A. tridens* does not extend beyond the *sumensis* Zone.

Specimens of *A. tridens* from Altembroeck (Voeren/Limburg, Belgium; JAGT *et al.*, 1995) are the most precisely dated from the area, and are of middle *sumensis* Zone age (see KEUTGEN, 1997).

In the Maastrichtian type area, *A. tridens* is apparently confined to this zone. However, it cannot be ruled out that the species occur in strata of early Early Maastrichtian age (*lanceolata* to *obtusa* zones) as well, but these are generally extremely condensed and poorly exposed.

KEUTGEN (1996, pp. 32-34, fig. 12) noted that at the Schneeberg locality, roughly between Vaals and Lemiers-Oud Lemiers, all intervals of FELDER & BLESS (1994) were exposed, generally of *sumensis* Zone age. Since all specimens of *A. tridens* in the RWTH and IRScNB collections lack details of stratigraphic provenance, this is here taken to be their minimum age.

Subgenus *Acanthoscaphites (Euroscaphites)* n. subgen.

TYPE SPECIES: *Scaphites varians* ŁOPUSKI, 1911, p. 120, pl. 4, figs. 1-3.

DERIVATION OF NAME: In allusion to its being restricted to Europe, with records from the Maastrichtian of Belgium, Germany, Denmark, Poland and (?)Russia.

DIAGNOSIS: Large, strongly dimorphic scaphitids with whorls in contact throughout; microconchs with open umbilicus throughout, macroconchs with umbilicus partly occluded by early part of body chamber. Flank ornament of phragmocone consists of broad prorsiradiate straight ribs arising singly from umbilical shoulder with intercalatories of varying lengths. Ribs with umbilical bullae and four rows of strong, near-equal, rounded tubercles on flank and ventrolateral shoulder. Up to three nontuberculate ribs intercalate on outer flank and alternate with broader tuberculate ribs. Primary ribs have a maximum of nine rows of tubercles (one siphonal, three or four on flanks); ribs may split into riblets and link tubercles, with fine intercalated ribs arising low on flanks. Ventral and siphonal tubercles may continue to end of body chamber or disappear altogether. Aperture constricted. Suture intricately subdivided.

DISCUSSION: In style of ribbing and multiple tuberculation from an early stage, representatives of this new subgenus consistently differ from *Acanthoscaphites tridens*, which have denser ribbing with no or only weak umbilical bullae on most of the phragmocone in macroconchs. In microconchs, the umbilical bullae migrate to an umbilicolateral position on the last whorl, while ventrolateral

clavi appear on the penultimate whorl of most microconchs, separated by two to six nontuberculate ribs.

JAGT & KENNEDY (1989, p. 238) noted that there was a striking similarity between *Acanthoscaphites varians*, with its multiple tuberculation, and certain multituberculate *Discoscaphites* MEEK, 1870. The type species, *Ammonites conradi* MORTON, 1834, was reviewed by JELETZKY & WAAGE (1978), who showed it to be much smaller than *Acanthoscaphites*, with rather open scaphitoid coiling, as in *Discoscaphites cheyennensis* (OWEN, 1852) and *D. abyssinus* (MORTON, 1842). LANDMAN & WAAGE (1993) and COBBAN & KENNEDY (1995) have subsequently fully discussed representatives of this genus, which appears to be restricted to the Late Maastrichtian of the Atlantic and Gulf Coastal Plain and central Dakota in the United States, and possibly south Saskatchewan (Canada). COOPER (1994, p. 189) placed *Discoscaphites* in his subfamily Hoploscaphitinae, and considered it to be an offshoot of the *Hoploscaphites-Tovebirkelundites* phyletic lineage.

Acanthoscaphites (Euroscaphites) n. subgen. has much in common with *Acanthoscaphites* s. str., from which it probably derived during the late Early Maastrichtian, the early onset of multiple tuberculation in the former probably being a peramorphic trait. The close similarity between representatives of *A. (Euroscaphites)* and *Discoscaphites* seems best interpreted as convergence.

Acanthoscaphites (Euroscaphites) varians varians (ŁOPUSKI, 1911)

(Text-figs. 3, 4; Pls 3-7)

* 1911 *Scaphites varians* ŁOPUSKI, pp. 120, 137, pl. 4, figs. 1-3.
1980 *Acanthoscaphites varians* (ŁOPUSKI) – BŁASZKIEWICZ, p. 40, pl. 25, figs. 1, 2, 5, 6.
1996 *Acanthoscaphites varians* (ŁOPUSKI, 1911) – MACHALSKI, p. 378, fig. 6.

TYPE

Holotype, by monotypy, is the original of ŁOPUSKI (1911, pl. 4, figs. 1-3), which may be considered lost.

MATERIAL

Six macroconchs (ZPAL Am. XII/400, ZPAL Am. XII/401,

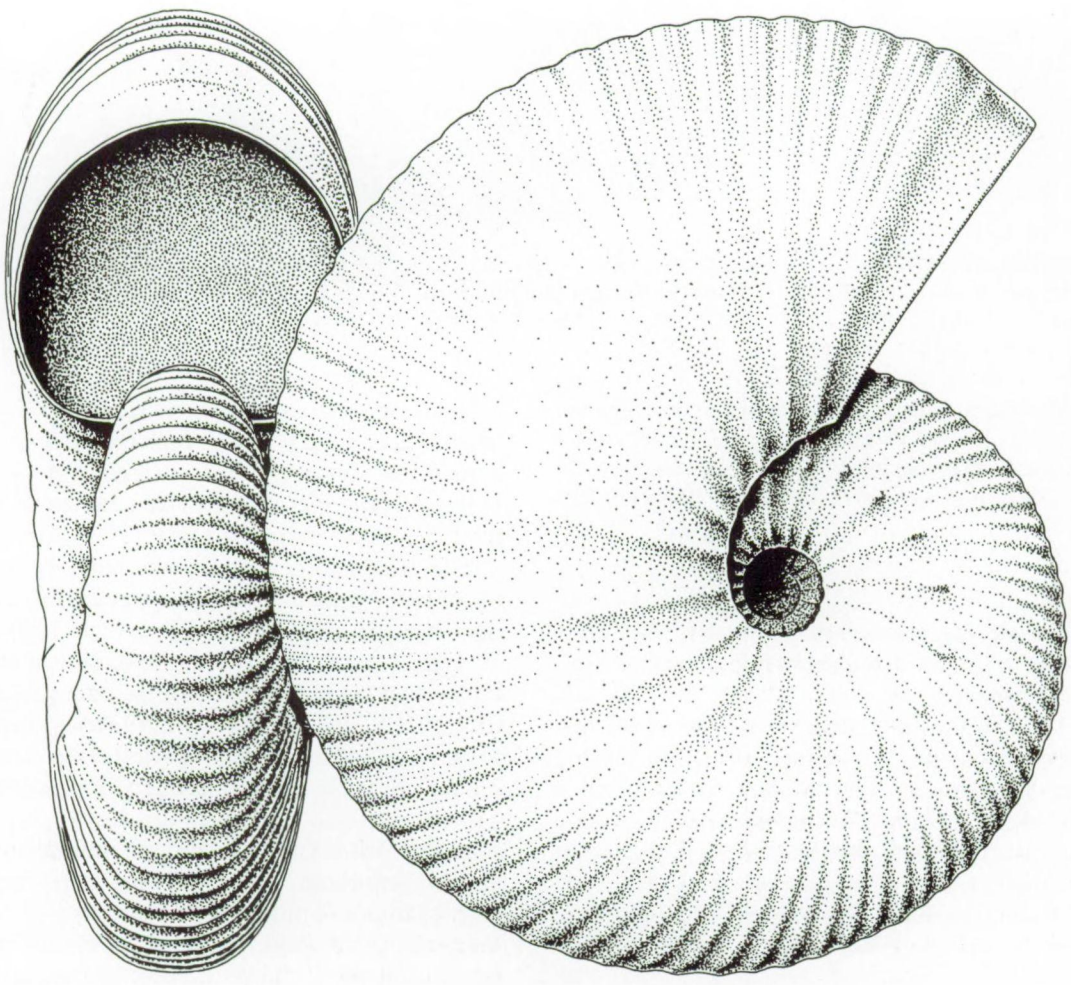

Fig. 3 – *Acanthoscaphites (Euroscaphites* n. subgen.*) varians varians* (OPUSKI, 1911), reconstruction of macroconch, based on specimen ZPAL Am. XII/401.

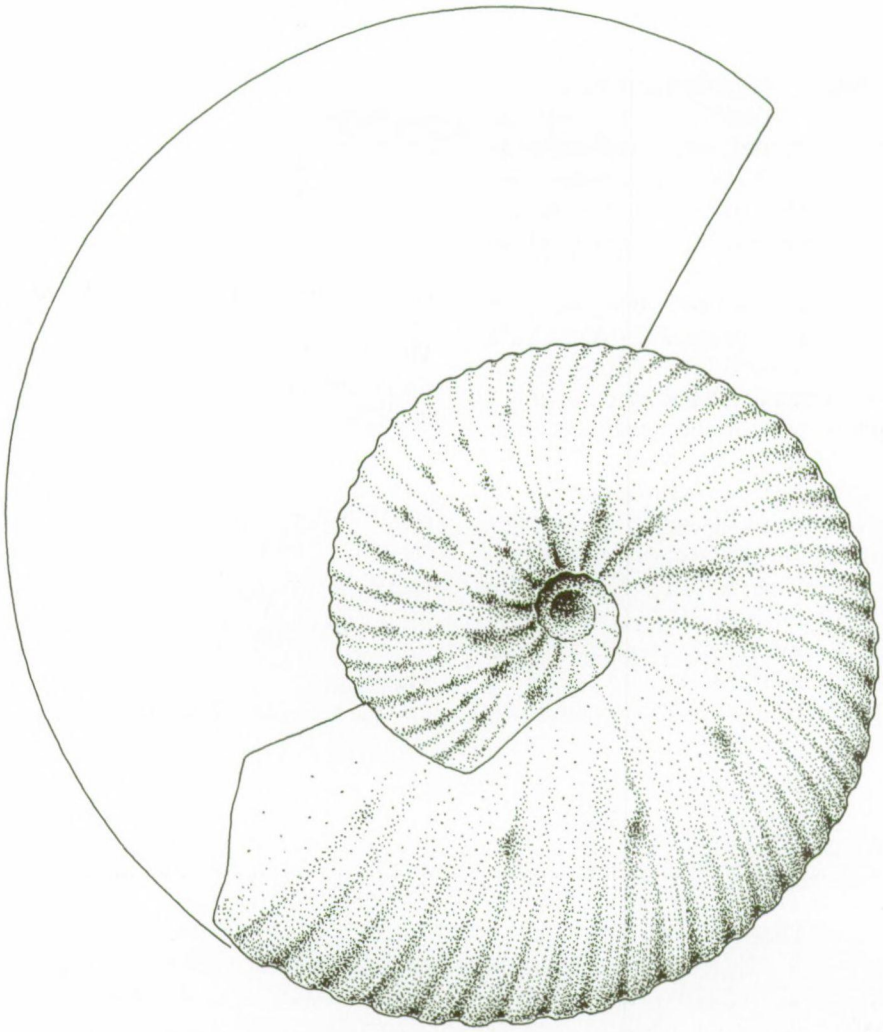

Fig. 4 – *Acanthoscaphites (Euroscaphites* n. subgen.*) varians varians* (OPUSKI, 1911), reconstruction of macroconch phragmocone, based on a specimen in the Marcinowski Collection (unregistered).

MKD/MP-135, Marcinowski Colln unregistered, and two unregistered specimens in the Praszkier & Dembicz Colln) and a single fragmentary microconch (ZPAL Am. XII/152), from the *kazimiroviensis* Zone at Kazimierz Dolny and Rejowiec (Poland).

DESCRIPTION

Since only a single, fragmentary microconch (Pl. 4, Fig. 1) is known nothing can be stated about microconch dimensions, but macroconchs (Pl. 3; Pl. 4, Figs. 2, 3; Pls 5-7) vary from 113-256 mm in diameter. All specimens that we have seen are composite moulds, crushed to varying degrees, but the phragmocone appears to have had a compressed whorl section. The umbilical wall is high and undercut, the umbilical shoulder rounded, the flanks and venter broadly rounded, with the greatest breadth just below mid-flank. The body chamber, compressed ovate in whorl section, occupies 300° or more of the ultimate whorl.

The ornament of the microconch body chamber, depressed in whorl section, consists of straight and flexuous prorsiradiate primary ribs, with short secondaries and intercalatories, both arising high on the flank. Ribs efface across the venter. A total of five ventrolateral clavi, umbilical (umbilicolateral) bullae and weak, bullate flank tubercles occur on primary ribs (Pl. 4, Fig. 1).

The ornament of macroconch phragmocones consists of straight, prorsiradiate tuberculate ribs and narrower nontuberculate ribs (Pl. 3; Pl. 5, Figs. 1, 3, 4). Between 13 and 18 primaries arise at the umbilical shoulder with bullae that become progressively stronger adaperturally (Pl. 3; Pl. 5, Figs. 1, 4; Pl. 7). Primaries may branch into secondaries at the umbilicolateral tubercles. Additional intercalatories occur on mid and outer flank (Pl. 5, Figs. 3, 4). All ribs cross the venter in a broad convexity (Pl. 4, Figs. 2, 3; Pl. 5, Fig. 2; Text-fig. 3). There are between 60 and 74 ventral ribs. The umbilicolateral tubercles connect with umbilical bullae via strengthened portions of primary ribs (Pl. 3; Pl. 5, Fig. 4; Pl. 7). On the phragmocone occur (indistinct) siphonal tubercles but these efface at a very early stage.

To an estimated diameter of c. 65 mm (Pl. 5, Fig. 3),

there are an estimated 11 coarse, distant tuberculate primary and intercalatory ribs, with 24 ventral ribs on the same interval (Pl. 5, Fig. 2). Four rows of coarse flank tubercles occur, the innermost being distinctly bullate. At a diameter of 65 mm approximately, ventrolateral tubercles disappear, while the outer and midlateral tubercles weaken. Only umbilicolateral tubercles persist to the early part of the body chamber (Pl. 3; Pl. 5, Figs. 1, 4; Pl. 6; Text-fig. 4).

The ribs on the phragmocone and early body chamber are rounded and comparatively narrow (Pl. 4, Fig. 2; Pls 6, 7); from diameters between 130 and 185 mm, the straight, prorsiradiate ribs become flatter and acquire a distinctive striated appearance, with the ribs being wider than the interspaces (Pl. 4, Fig. 3; Pl. 6).

The aperture is constricted (Pl. 6; Text-fig. 3).

OCCURRENCE

Except for specimen A in the Praszkier & Dembicz Colln and ZPAL AM. XII/401, all specimens are from the lower portion of the so-called Kazimierz Opoka as exposed at the Town Quarry south of Kazimierz Dolny, and are of latest Maastrichtian age (*kazimiroviensis* Zone). The only precisely localised specimens from the Town Quarry are specimen B in the Praszkier & Dembicz Collection and ZPAL Am. XII/152, which come from its upper third. The remainder lacks stratigraphic details; however, ZPAL Am. XII/400 is preserved in indurated opoka, and it may safely be assumed to have come from the upper third of the section as well. That part of the section is characterised by indurated opoka intercalations (see ABDEL-GAWAD, 1986 for details). ŁOPUSKI's (1911) type may be assumed to have come from the Town Quarry since this was actively worked in the early part of the twentieth century. Prior to the present study, only two specimens of *A. (E.) v. varians* were known, viz. ŁOPUSKI's type and that illustrated by BŁASZKIEWICZ (1980; see Text-fig. 4 herein).

The other two specimens are from the upper level of exploitation in the working quarry at Rejowiec, some 100 km east of Kazimierz Dolny, from an unnamed opoka unit of latest Maastrichtian age (*kazimiroviensis* Zone, W.K. Christensen, pers. comm.).

MACHALSKI (1996) assumed *A. (E.) v. varians* to be confined to the lower part of the Kazimierz Opoka unit, which he thought to possibly be coeval with the upper *junior* Zone in Denmark, based on a comparison of details of ornament in *Hoploscaphites constrictus* (J. SOWERBY, 1817). The upper part of that unit would then correspond to the lower *kazimiroviensis* Zone (= *casimirovensis* Zone of authors) of Danish sections.

Acanthoscaphites (Euroscaphites) varians blaszkiewiczi n. subsp.
(Text-figs. 5, 6; Pl. 8)

1965 *Acanthoscaphites tridens varians* (Lopuski) – SCHMID, p. 684, pl. 62, fig. 1; pl. 63, figs. 1-3.

1982 *Acanthoscaphites varians* (ŁOPUSKI, 1911) – BIRKELUND, p. 16, pl. 1, fig. 5 only (*non* figs. 4, 6 = *Hoploscaphites schmidi*).

1989 *Acanthoscaphites varians* (Lopuski, 1911) – JAGT & KENNEDY, p. 238, figs. 1-3.

1993 *Acanthoscaphites varians* (Lopuski, 1911) – BIRKELUND, p. 56, pl. 9, figs. 3-7; pl. 10, figs. 2, 3.

TYPES

Holotype is MGUH 20129 (BIRKELUND, 1993, pl. 10, fig. 3), refigured herein (Text-fig. 6); paratypes are MGUH 20125-20128 and 20130, all from the late Early/early Late Maastrichtian interval of Rørdal (Jylland, Denmark).

DERIVATION OF NAME

Named after Andrzej Błaszkiewicz (Warsaw), who was the first to note that the Polish *"Acanthoscaphites" varians* differed consistently from specimens of northwest European localities.

MATERIAL

In addition to the type material (see above), NHMM 198840/1-3, NHMM MB 1147, GPIUH 821-823 and NLfB kma 179.

DESCRIPTION

All material that we have seen is fragmentary and distorted to varying degrees, including the holotype.

Amongst macroconchs available the holotype (Text-fig. 6) is the best preserved, measuring 160 mm in total diameter and 100 mm at the last suture. The early part of the phragmocone is rather involute, with later parts becoming more evolute (Text-fig. 6). The ornament consists of almost straight, coarse primary and secondary ribs and up to seven, occasionally nine, longitudinal rows of nodes (one siphonal and three or four on the flanks) (Pl. 8, Figs. 2, 3; Text-fig. 6). The nodes are typically arranged in radiating rows on primary ribs; these tuberculate ribs are separated by one or two intercalated non-tuberculate ribs (Pl. 8, Figs. 2, 4). The nodes are well developed on the younger portion of the phragmocone and on the body chamber to a diameter of c. 135 mm (Pl. 8, Fig. 2; Text-fig. 6). On the younger portions of the body chamber only the siphonal row and two rows on the outer flanks are well developed, while the nodes on the inner flanks appear to fade out. Sutures are poorly preserved, but show a very incised pattern (Pl. 8, Fig. 2).

Microconchs (Pl. 8, Figs. 1, 5, 6) are of small size. In the largest specimen (Pl. 8, Fig. 1) the last suture is at an estimated 45 mm diameter. Phragmocones are characterised by straight or flexuous prorsiradiate ribs similar to those of macroconchs, with secondaries and intercalatories occurring at various flank positions, and weak nodes (Pl. 8, Fig. 5; BIRKELUND, 1993, pl. 9, fig. 6a, b). Body chambers have fine ribs and striae and only a single row of fine, ventrolateral nodes (Pl. 8, Fig. 1). The specimen in Pl. 8, Fig. 5 is close to the single microconch of *A. (E.) v. varians* described above (see Pl. 4, Fig. 1).

The second specimen of the present taxon to be recorded from the Maastrichtian type area is a distorted, fragmentary composite mould of a macroconch phragmocone (NHMM MB 1147) from the basal Vijlen Member (Interval 6) of the CBR-Lixhe quarry (Text-fig. 5). It matches NHMM 198840/1-3 from Interval 6 of the Vijlen Member at the CPL SA quarry, described by JAGT & KENNEDY (1989), in showing coarse prorsiradiate nearly straight ribs with umbilical bullae and four rows of strong, subequal and rounded tubercles on the flank and ventrolateral shoulder, in addition to a siphonal row. One or two nontuberculate ribs intercalate with the broader tuberculate ribs, and nodes become more prominent adaperturally. Sutures are poorly preserved.

DISCUSSION

The present early subspecies differs from the later *A. (E.) v. varians* in retaining multiple tuberculation on macroconch body chambers (especially the siphonal row and two rows on the outer flanks; see BŁASZKIEWICZ, 1980; BIRKELUND, 1993; MACHALSKI, 1996); microconchs of both taxa are more closely comparable. Similar multituberculate ribs characterise the macroconch phragmocone of *A. (E.) v. varians* (Text-fig. 4), while the body chamber has nodes only on the early portion, and flattened, striated ribbing on the remainder.

OCCURRENCE

Material from Denmark, and from Rørdal and Hillerslev in particular, was not collected *in situ*. However, at both localities strata of latest Early Maastrichtian and earliest Late Maastrichtian age are exposed. At Hemmoor (NW Germany), the present subspecies has been shown to range from the *cimbrica* Zone to low in the *junior* Zone (SCHMID, 1965; BIRKELUND, 1982).

In the Haccourt-Lixhe area (NE Belgium), *A. (E.) v. blaszkiewiczi* co-occurs with other scaphitids: *Hoploscaphites constrictus* (J. SOWERBY, 1817) and *Jeletzkytes dorfi* LANDMAN & WAAGE, 1993 and other age-diagnostic baculitid and puzosiine ammonites (JAGT & KENNEDY, 1994; KENNEDY & JAGT, 1998). KEUTGEN (1996) recorded *A. (E.) v. blaszkiewiczi* (as *A. varians*) from the top of

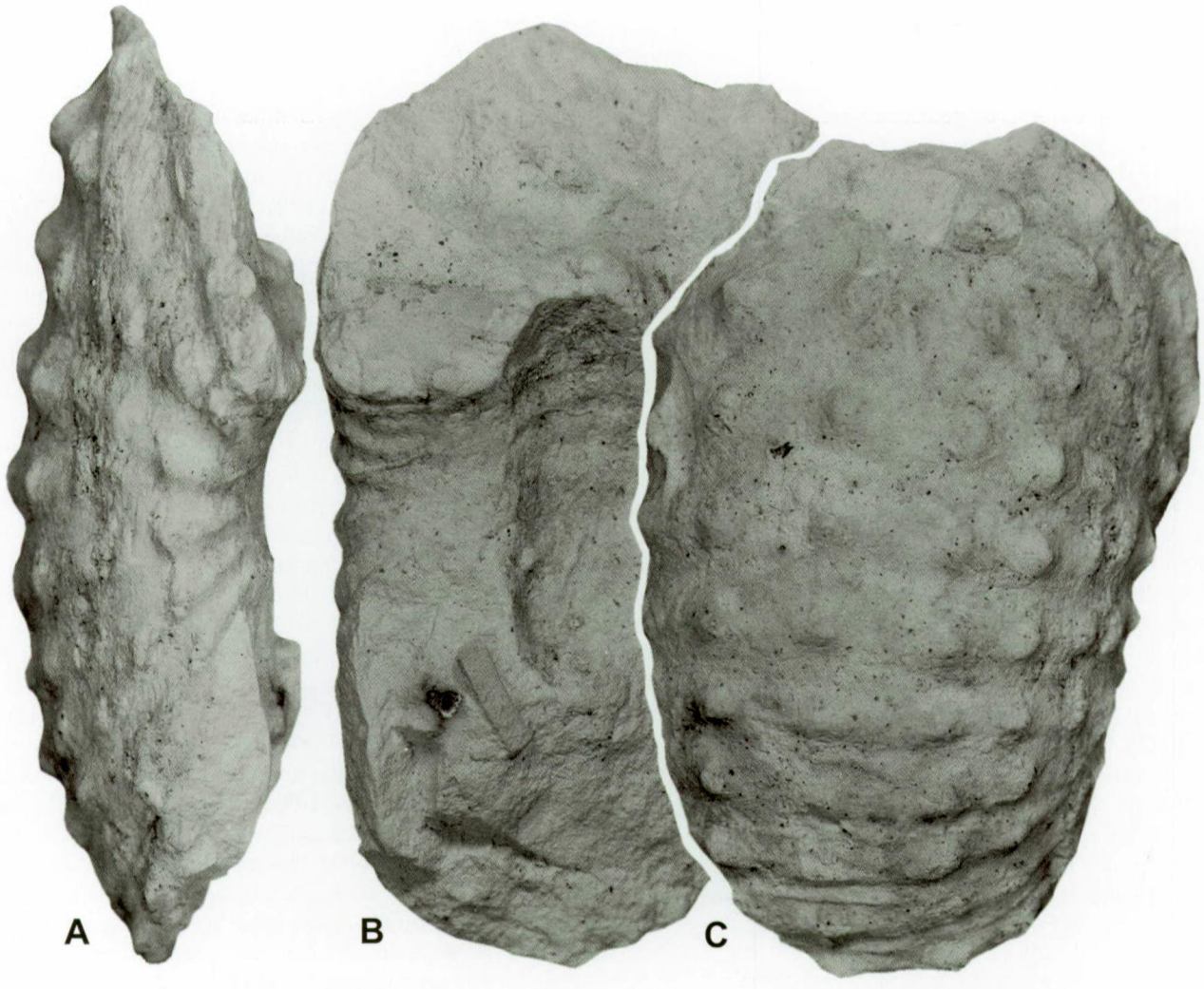

Fig. 5A-C – *Acanthoscaphites (Euroscaphites* n. subgen.*) varians blaszkiewiczi* n. subsp. , NHMM MB 1147, deformed phragmocone, Gulpen Formation, Vijlen Member (basal metre), CBR-Lixhe quarry, Lixhe (Liège, Belgium), x 3.

Fig. 6 – *Acanthoscaphites (Euroscaphites* n. subgen.*) varians blaszkiewiczi* n. subsp., holotype, MGUH 20129, x 0.7.

Interval 5 of FELDER & BLESS (1994) at Aachen-Wilkensberg and from Interval 6 at the CPL SA quarry (Haccourt; based on JAGT & KENNEDY, 1989), which means that the first appearance datum in that area falls within the upper *cimbrica* Zone. This in turn suggests that the base of KEUTGEN's (1996) "*Acanthoscaphites varians* Zone" appoximates the base of the *fastigata* Zone of the NW German standard section (SCHULZ *et al.*, 1984; SCHÖNFELD *et al.*, 1996). It should be noted, however, that KEUTGEN (1996) did not consider the base of the *junior* Zone to equate with the base of the Late Maastrichtian, and that he placed the Early/Late Maastrichtian boundary between the Vijlen and Lixhe 1 members (Gulpen Formation).

BIRKELUND (1993) noted that the fragmentary phragmocone of "*A. varians*" from the "middle" Maastrichtian of European Russia illustrated by MIKHAILOV (1951) was not very diagnostic.

REMARKS

One of us (MM) has recently re-examined the originals of BIRKELUND (1982), and noted that the specimens illustrated in pl. 1, figs. 4 and 6 (NLfB kma 178 and kma 180, respectively), under *Acanthoscaphites varians* are in fact better assigned to *Hoploscaphites schmidi* (BIRKELUND, 1982), the specimen in pl. 1, fig. 5 (NLfB kma 179) being the only true *varians* (= *v. blaszkiewiczi*). In addition, specimen NLfB kma 204 illustrated in pl. 3,

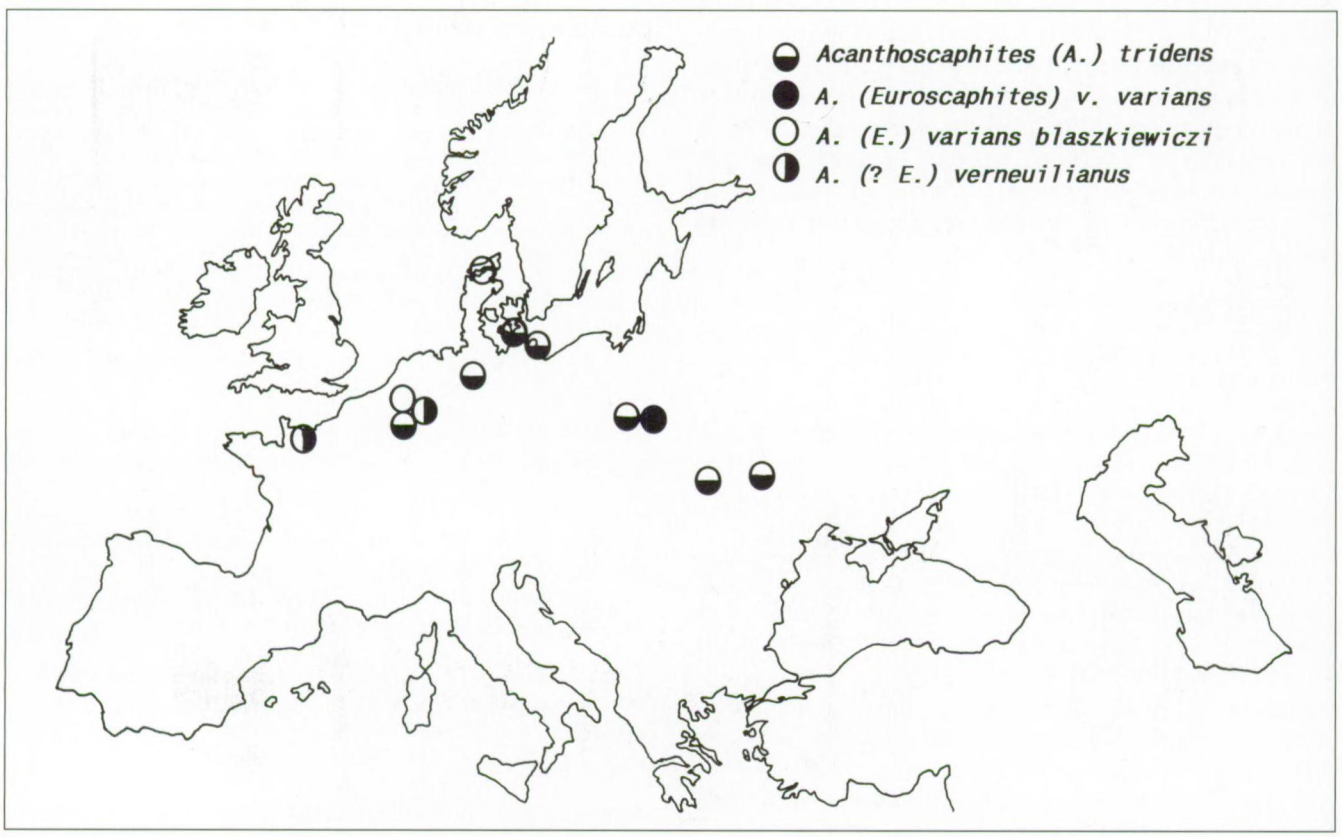

Fig. 7 – Geographic distribution of giant scaphitid ammonites from the Maastrichtian of Europe, as based on literature sources and the present records.

fig. 12, assigned to *H. constrictus* (J. SOWERBY, 1817), is best considered a microconch of *H. schmidi*, as well.

The collections of the Niedersächsisches Landesamt für Bodenforschung at Hannover also comprise a number of uncatalogued specimens of genuine *varians* (= *v. blaszkiewiczi*), representing mainly small spires.

Acanthoscaphites (?Euroscaphites) verneuilianus (D'ORBIGNY, 1841)

* 1841 *Ammonites verneuilianus* D'ORBIGNY, p. 329, pl. 98, figs. 3-5.
1986a *Acanthoscaphites verneuilianus* (d'Orbigny, 1841) – KENNEDY, p. 74, pl. 16, figs. 15-17; text-fig. 10c (with additional synonymy).
1986a *Acanthoscaphites* cf. *verneuilianus* (d'Orbigny, 1841) – KENNEDY, p. 74, pl. 16, figs. 20, 21.
? 1986a *Acanthoscaphites* sp. – KENNEDY, p. 74, pl. 16, figs. 7-10; text-fig. 10d.
1987 *Acanthoscaphites* cf. *verneuilianus* (d'Orbigny, 1841) – KENNEDY, p. 207, pl. 34, fig. 1.

TYPE

Holotype by monotypy is an unregistered specimen in the EMP collections, illustrated by DE GROSSOUVRE (1894, pl. 36, fig. 2) and refigured by KENNEDY (1986a, pl. 16, figs. 15-17).

DISCUSSION

This species is based on poorly preserved nuclei only. KENNEDY (1986a) provided the most detailed description and noted that the multiple tuberculation of the phragmocone was very different from that of the giant type species of the genus *Acanthoscaphites*, *A. tridens*. In the absence of body chambers of both micro- and macroconchs, it is impossible to determine whether or not the present species should be assigned to *A. (Euroscaphites)* as well. It is therefore left in open nomenclature for the time being.

Acanthoscaphites (?Euroscaphites) verneuilianus appears to be restricted to the Late Maastrichtian of the Cotentin Peninsula (France). However, KENNEDY (1987, p. 207, pl. 34, fig. 1) recorded a poorly preserved phragmocone from the Late Maastrichtian Kunrade Limestone facies of the Maastricht Formation of southern Limburg (The Netherlands), which may be placed here.

Two other forms have previously been assigned to *Acanthoscaphites*. From the Late Maastrichtian of southern Sweden, KENNEDY & CHRISTENSEN (1997, p. 124, fig. 40) described *Acanthoscaphites* sp., which was interpreted as a possible microconch of, "*Acanthoscaphites* close to *A. varians* (ŁOPUSKI, 1911)", but poor preservation of the venter precluded definite assignment.

Another Late Maastrichtian form is *Acanthoscaphites* sp. of KENNEDY (1987, p. 208, pl. 32, figs. 15-17; see also JAGT, 1995, p. 32, pl. 7, figs. 5, 6, 8, 9) from the Kunrade Limestone facies and Nekum Member of the Maastricht Formation in southern Limburg (The Netherlands) and Liège (Belgium). It is characterised by flexuous flank ribs, strengthened at the ventrolateral shoulder into weak inner ventrolateral tubercles, and lack of umbilical bullae. In the absence of specimens preserving body chambers the generic assignation of this form is uncertain; it may well prove to be closer to the *Hoploscaphites constrictus* lineage.

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PLATE 1

Acanthoscaphites (A.) tridens (KNER, 1848)

Fig. 1 – RWTH KJI/3, a macroconch, provenance unknown, but inferred to be from the Vijlen Member of the Aachen-Schneeberg area, x 0.75.
Fig. 2 – RWTH KJI/5, a microconch, Vijlen Member of the Aachen-Schneeberg area inferred, x 1.
Fig. 3 – RWTH Lam I/7, a nucleus, Vijlen Member of the Aachen-Schneeberg area inferred, x 1.
Fig. 4 – IRScNB 10540 (IG 4285, Bosquet Colln), a microconch, Craie marneuse glauconifère (= Vijlen Member in current terminology), Aachen-Schneeberg, x 1.
Fig. 5 – AT 3 (J. Keutgen Colln), a microconch, Aachen-Schurzelterstraße, Vijlen Member, upper *sumensis* Zone, x 1.
Fig. 6 – No. 183 (H. Knoll Colln), a microconch, Aachen-Vaalserstraße (Westfriedhof I), Vijlen Member, upper *sumensis* Zone, x 1.
Fig. 7 – RWTH KJI/4, a nucleus, Vijlen Member of the Aachen-Schneeberg area inferred, x 1.

PLATE 2

Acanthoscaphites (A.) tridens (KNER, 1848)

Fig. 1 – IRScNB 10543 (IG 4285, Bosquet Colln), a nucleus, Craie marneuse glauconifère (= Vijlen Member in current terminology), Aachen-Schneeberg, x 1.
Fig. 2 – RWTH KJI/1, a macroconch, provenance unknown, but inferred to be from the Vijlen Member of the Aachen-Schneeberg area, x 1.
Fig. 3 – IRScNB 10541 (IG 4285, Bosquet Colln), a nucleus, Craie marneuse glauconifère (= Vijlen Member in current terminology), Aachen-Schneeberg, x 1.
Fig. 4 – RWTH Lam I/6, a macroconch, Vijlen Member of the Aachen-Schneeberg area inferred, x 1.
Fig. 5 – RWTH HO.I/2, a microconch, the original of HOLZAPFEL (1887, pl. 5, fig. 1), Aachen-Schneeberg, Vijlen Member, x 1.

PLATE 3

Acanthoscaphites (*Euroscaphites* n. subgen.) *varians varians* (ŁOPUSKI, 1911), ZPAL Am. XII/400, a macroconch, lower part of Kazimierz Opoka, Kazimierz Dolny (town quarry), x 0.85 (see also Pl. 4, Figs. 2, 3).

PLATE 4

Fig. 1 – *Acanthoscaphites* (*Euroscaphites* n. subgen.) *varians varians* (ŁOPUSKI, 1911), ZPAL Am. XII/152, a microconch, lower part of Kazimierz Opoka, Kazimierz Dolny (town quarry), x 1.
Figs. 2, 3 – *Acanthoscaphites* (*Euroscaphites* n. subgen.) *varians varians* (ŁOPUSKI, 1911), ZPAL Am. XII/400, a macroconch (see also Plate 3), x 0.85.

PLATE 5

Figs. 1-3 – *Acanthoscaphites* (*Euroscaphites* n. subgen.) *varians varians* (ŁOPUSKI, 1911), Praszkier & Dembicz Colln (specimen B), a macroconch, lower part of Kazimierz Opoka, Kazimierz Dolny (town quarry), x 0.9. Note the healed injury.
Fig. 4 – *Acanthoscaphites* (*Euroscaphites* n. subgen.) *varians varians* (ŁOPUSKI, 1911), Praszkier & Dembicz Colln (specimen A), a macroconch, unnamed opoka unit, Rejowiec quarry, x 1.1.

PLATE 6

Acanthoscaphites (*Euroscaphites* n. subgen.) *varians varians* (ŁOPUSKI, 1911), ZPAL Am. XII/401 (leg. A. Pisera and A. Bitner, 1996), a macroconch, unnamed opoka unit, Rejowiec quarry, x 0.65.

PLATE 7

Acanthoscaphites (*Euroscaphites* n. subgen.) *varians varians* (ŁOPUSKI, 1911), MKD/MP-135, a macroconch, lower part Kazimierz Opoka, Kazimierz Dolny (town quarry), x 1.

PLATE 8

Acanthoscaphites (Euroscaphites n. subgen.) *varians blaszkiewiczi* n. subsp.

All specimens from Rørdal (Ålborg, Jylland, Denmark).

Fig. 1 – MGUH 20130, paratype, a near-complete microconch, x 1.
Fig. 2 – MGUH 20129, paratype, outer part of phragmocone and part of body chamber of a macroconch, x 1.
Fig. 3 – MGUH 20126, paratype, x 1.
Fig. 4 – MGUH 20125, paratype, x 1.
Fig. 5 – MGUH 20127, paratype, x 1.
Fig. 6 – MGUH 20128, paratype, a microconch, x 1.

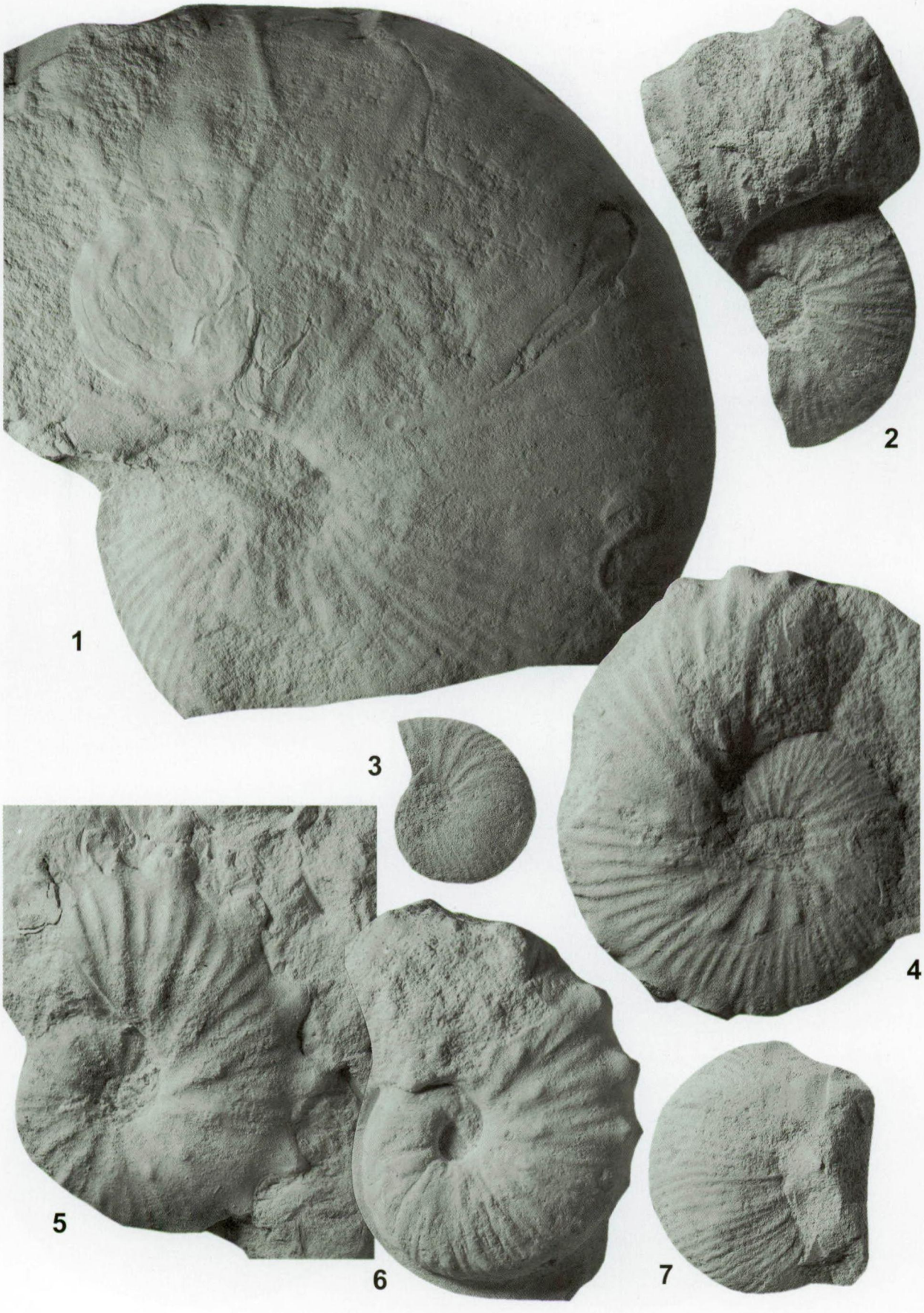

PLATE 1

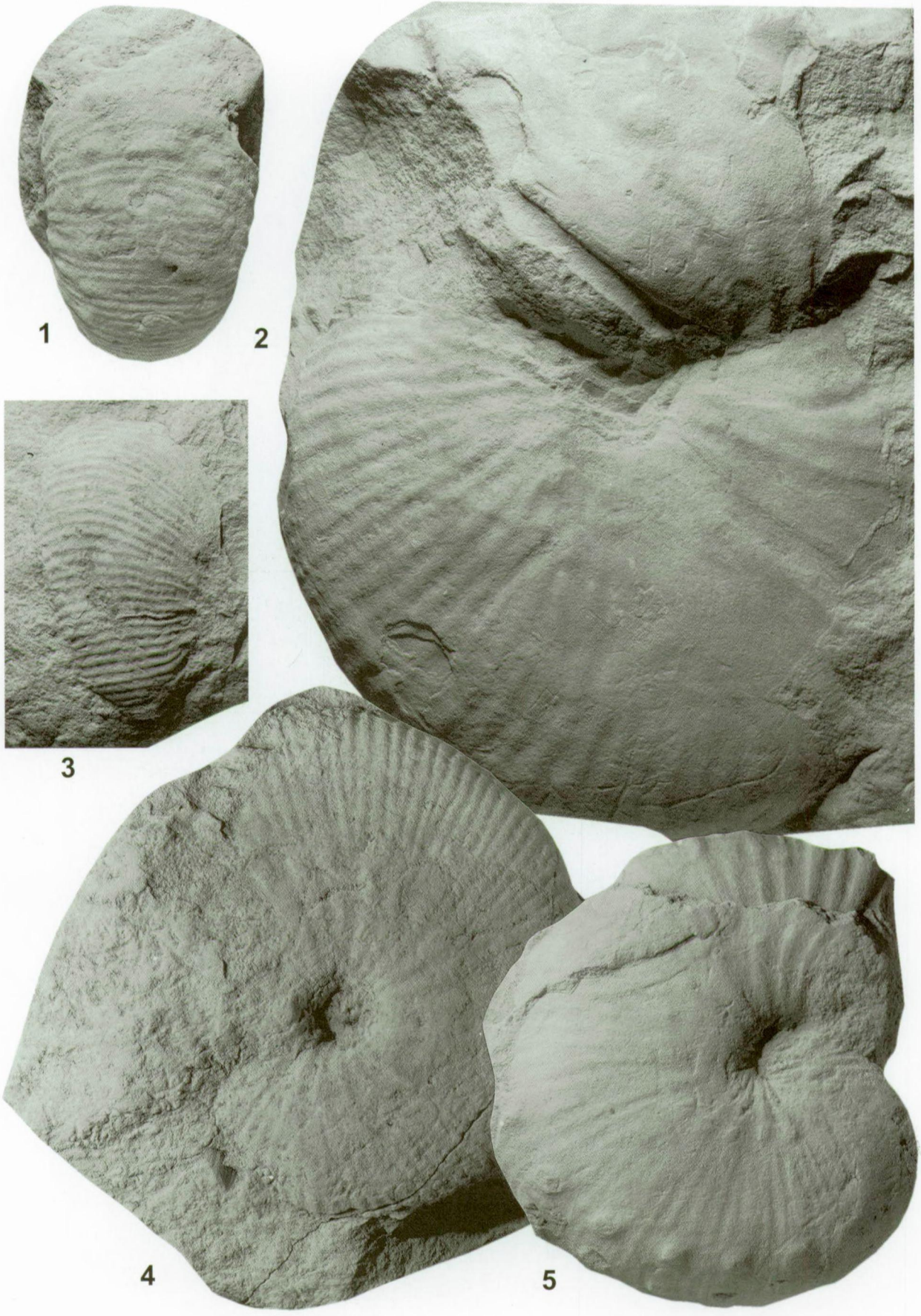

PLATE 2

PLATE 3

PLATE 4

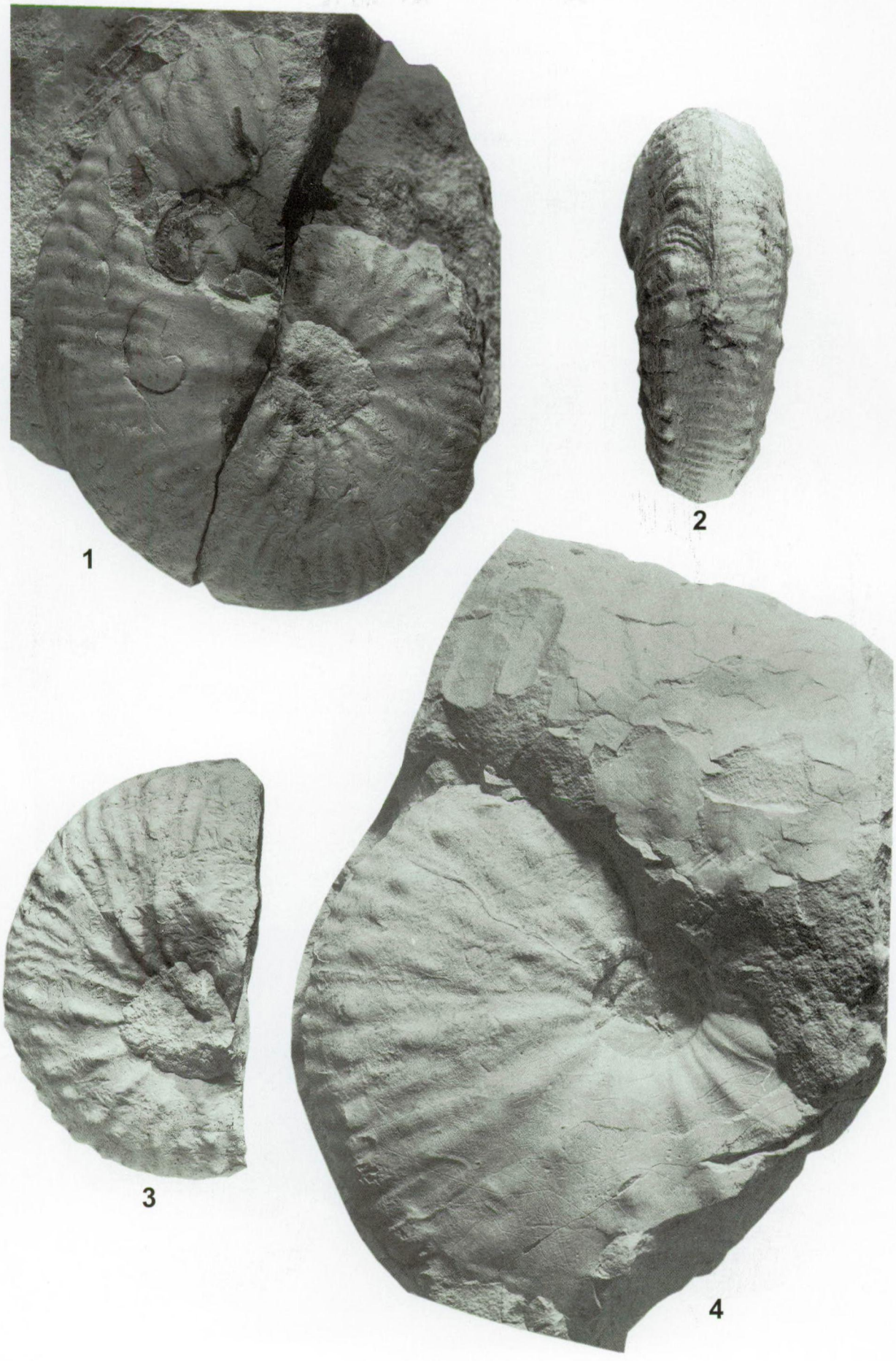

PLATE 5

PLATE 6

PLATE 7

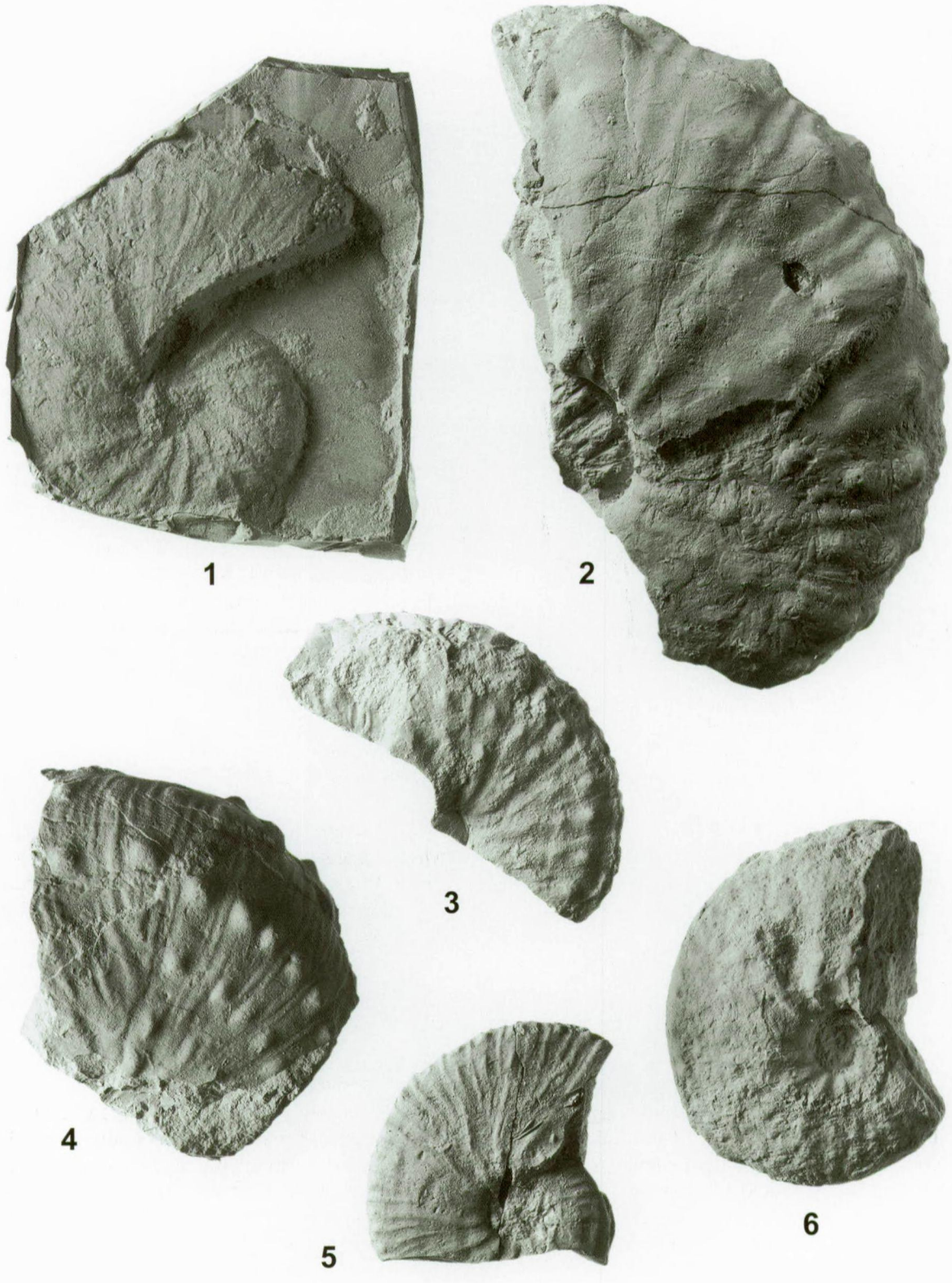

PLATE 8