

Early Turonian ammonites from Goulmima, southern Morocco

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Abstract

In recent years, large numbers of Early Turonian ammonites from Morocco have found their way onto the open market. They come from the Cretaceous escarpment to the north of Goulmima, in the province of El Rachidia, southern Morocco. A section measured northeast of the village of Asfla sets the ammonites in stratigraphic context. The fauna belongs to the widely recognised upper lower Turonian *Mammites nodosoides* Zone, and comprises *Romaniceras (Yubariceras) reymonti* (COLLIGNON, 1967), *Mammites nodosoides* (SCHLÜTER, 1871), *Nannovascoceras intermedium* RENZ & ALVAREZ, 1979, *Fagesia peroni* PERVINQUIÈRE, 1907, *Neoptychites cephalotus* (COURTILLER, 1860), *Neoptychites* aff. *hottingeri* COLLIGNON, 1967, *Choffaticeras (Choffaticeras) segne* (SOLGER, 1903) and *Wrightoceras munieri* (PERVINQUIÈRE, 1907).

Keywords: Upper Cretaceous, Turonian, ammonites, Morocco.

Résumé

Ces dernières années, un grand nombre d'ammonites du Turonien inférieur du Maroc ont été mises sur le marché. Elles proviennent de l'escarpement crétacé au nord de Goulmima, province d'El Rachidia, Maroc méridional. Une coupe, levée et mesurée au nord-est du village d'Asfla permet de replacer les ammonites dans leur contexte stratigraphique. Les faunes appartiennent à la Zone à *Mammites nodosoides*, de la partie supérieure du Turonien inférieur, zone largement reconnue. L'assemblage comprend: *Romaniceras (Yubariceras) reymonti* (COLLIGNON, 1967), *Mammites nodosoides* (SCHLÜTER, 1871), *Nannovascoceras intermedium* RENZ & ALVAREZ, 1979, *Fagesia peroni* PERVINQUIÈRE, 1907, *Neoptychites cephalotus* (COURTILLER, 1860), *Neoptychites* aff. *hottingeri* COLLIGNON, 1967, *Choffaticeras (Choffaticeras) segne* (SOLGER, 1903) et *Wrightoceras munieri* (PERVINQUIÈRE, 1907).

Mots-clefs: Crétacé supérieur, Turonien, ammonites, Maroc.

Introduction

In recent years, large numbers of well-preserved Early Turonian ammonites, notably *Mammites*, have appeared in rock and fossil shops, dealers' lists, and for sale on the World Wide Web. They have a distinctive preservation, commonly as internal moulds of buff, brown and black calcite, with traces of calcite-replaced shell. They have commonly been 'improved' by mechanical polishing and acid treatment. It is our purpose in this brief article to provide an illustrated account of this well-preserved fauna, and place it in the Turonian ammonite succession.

The presence of Turonian ammonites in the Goulmima region (Fig. 1) was noted already by DUBAR (1949) and they were listed by BASSE & CHOUBERT (1959) as '*Hoplites mirabilis* PERV., *Fagesia peroni* PERV., *Pseudotissotia* sp., *Vascoceras* sp. indét., *Mammites* sp. indét.'. This is very much the fauna we list and describe below. In recent years, the area has attracted attention as the source of important fish and reptile faunas (CAVIN *et al.*, 2001; BARDET *et al.*, 2003a, b, and references therein), but we are unaware of any detailed account of the ammonite assemblage described below since that of BASSE & CHOUBERT (1959). MEISTER & RHALMI (2002) have, however, recorded from the region a late Cenomanian *Neolobites* faunule, and one with *Coilopoceras* group of *requienianum* (D'ORBIGNY, 1841) and *Coilopoceras* aff. *newelli* BENAVIDES-CÁCERES, 1956, that they regarded as late Turonian.

Locality details

The Goulmima fauna described below comes from the Cretaceous escarpment a few kilometres northeast of the village of Asfla, some 30 km north of Goulmima, in the

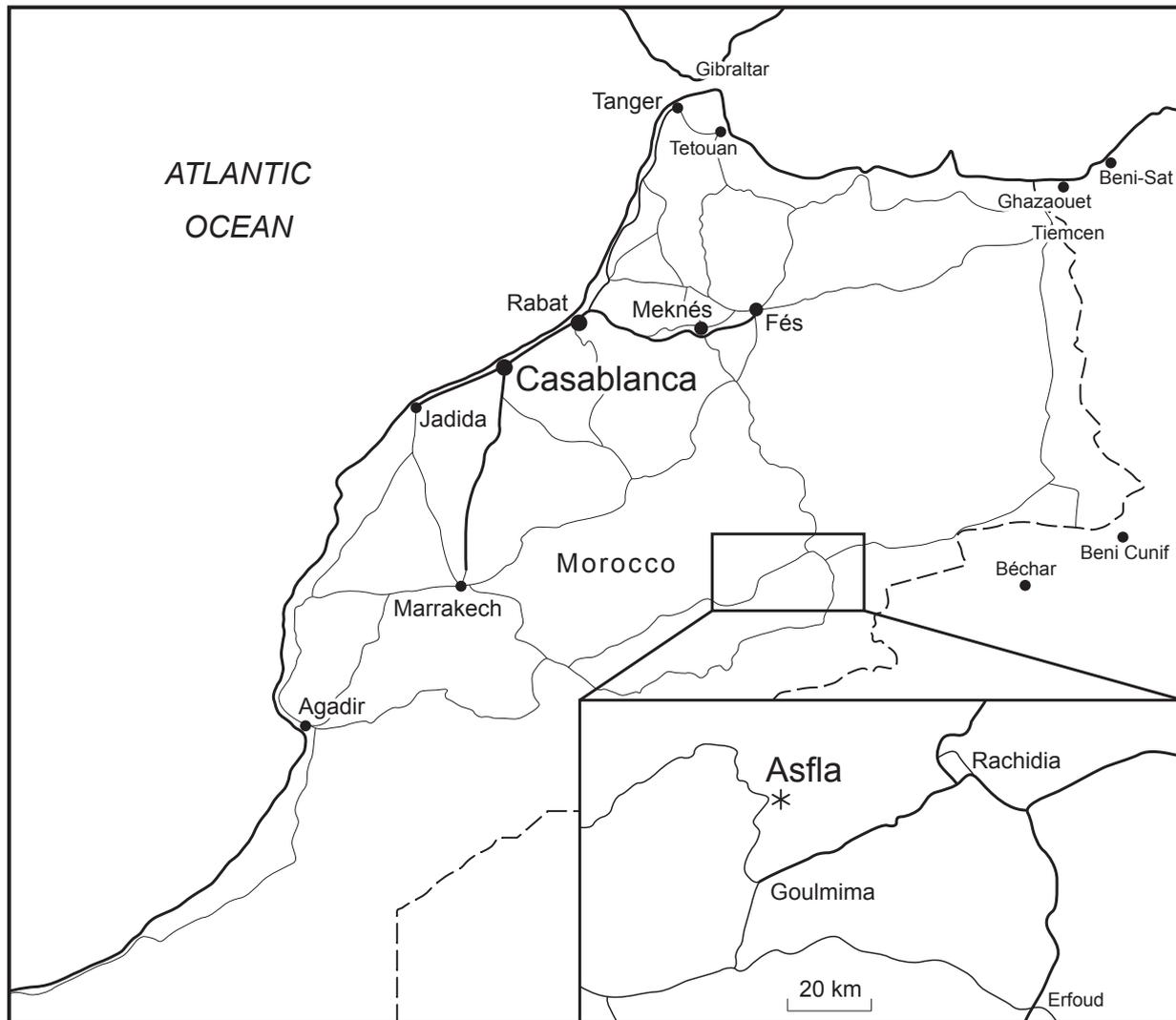


Fig. 1 — Locality map, the inset showing the position of the logged section, northeast of Asfla.

province of El-Rachidia, in southern Morocco (Fig. 1). The co-ordinates of the logged section are $31^{\circ}55'30''\text{N}$, $004^{\circ}50'30''\text{W}$.

The marine Cretaceous section overlies some tens of metres of mottled green and red palaeosols that in turn rest on Palaeozoic basement. The lower part of the section, and the boundary with the underlying non-marine unit, is obscured by talus; above, one of us (ASG) logged the 27 m section shown in Fig. 2 in 2006; Fig. 3A, B provide photographs of the outcrop.

The lowest visible unit (A; see Fig. 2) comprises approximately 7 m of thinly bedded micritic limestones and calcareous shales containing sparse calcareous concretions, of which the upper 4.5 m are shown in Fig. 2. Composite moulds of originally aragonitic bivalves are common, and large oysters (*Ctenostreon*) occur at a few levels.

Unit B comprises approximately 4 m of massive bioclastic limestone, forming a distinctive scarp. The lower 0.8 m contains abundant moulds of originally aragonitic

bivalves. The middle part of the unit contains numerous small, domed stromatolites, 20–30 cm high, and up to a metre long. The uppermost 1.8 m is characterised by abundant large *Ctenostreon*. The top of unit B is a sharply defined planar surface.

Unit C comprises irregular masses of concretionary limestone set in platy-weathering marls with an abundant fauna of poorly preserved composite moulds of originally aragonitic bivalves.

Unit D forms a conspicuous pale recess in the Cretaceous escarpment around Goulmima (Fig. 3A, B), and consists of white-weathering, pale brown, organic-rich calcareous marls. These yield poorly preserved, sometimes crushed ammonites (OUM KX 15451–15468) at the 15 m level (Fig. 2). All those that are identifiable are juvenile *Wrightoceras munieri*. The upper part of unit D has been extensively mined and quarried for its fossil content. The laminated marls contain thin beds of silty, micritic limestone and irregular lenses of carbonate concretions that yield abundant, well-preserved

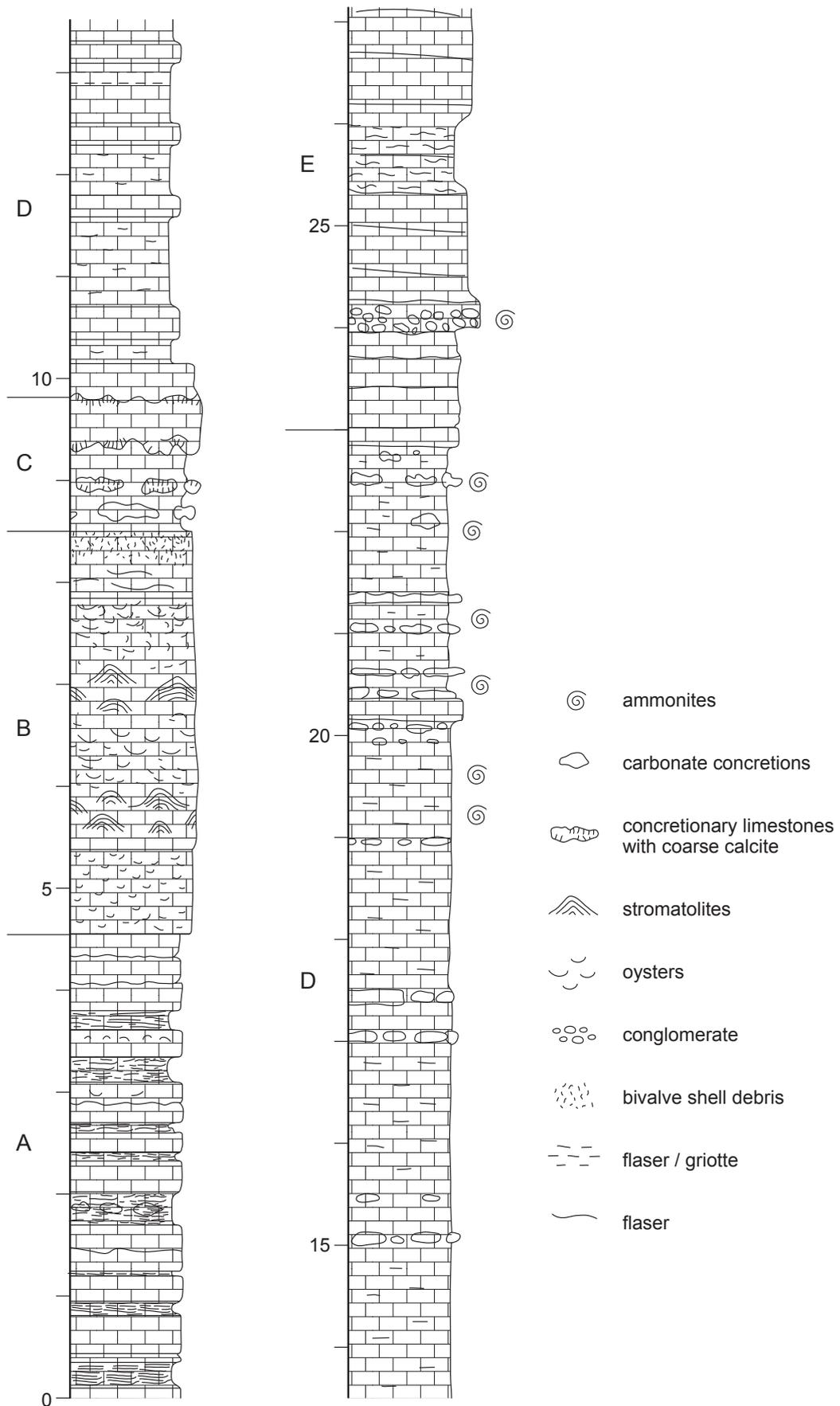


Fig. 2 — The marine Turonian section northeast of Asfla.



Fig. 3A (top), B (right) — Views of the section northeast of Asfla; the Turonian ammonite level is the white interval indicated by the arrows.

ammonites in the upper part (20.3-21.1 m level: Fig. 2), including *Mammites*, *Fagesia*, *Neoptychites*, *Choffaticeras* and *Wrightoceras* (OUM KX 15386-15450).

Unit E, of which 4 m are exposed, is made up of shelly wackestones containing poorly preserved composite moulds of originally aragonitic bivalves. An intraformational conglomerate 0.2-0.3 m in thickness is present one metre above the base of the unit. It yields fragments of *Wrightoceras munieri* (OUM KX 15469).

The ammonite fauna

Ammonites are common at two levels in the sequence. The lower part of unit D (15 m level) yields numerous small specimens, typically calcite spar-filled juveniles up to 23 mm in diameter, with calcite-replaced shell, together with external moulds up to 50 mm in diameter (OUM KX 15467; see Pl. 3, Fig. 3). The majority are referred to a variable *Wrightoceras munieri*, but a juvenile vascoceratid and perhaps other taxa are present. Above, the concretions in the upper part of unit D (20.3-21.1 m) yield the main fauna, preserved crushed in the marls, with calcite-replaced shell (Pl. 4, Fig. 4) and uncrushed in the concretions. The phragmocones are filled with buff, brown or black sparry calcite. Body chambers have peloidal micrite fills. Original shell has been replaced by calcite. In all, sixty-three specimens were available for study from this interval. The

composition of the assemblage is as follows:

<i>Mammites nodosoides</i>	34.9 %
<i>Fagesia peroni</i>	25.4 %
<i>Choffaticeras (Ch.) segne</i>	17.5 %
<i>Wrightoceras munieri</i>	14.3 %
<i>Neoptychites cephalotus</i>	4.8 %
<i>Romaniceras (Yubariceras) reymonti</i>	1.6 %
<i>Nannovascoceras intermedium</i>	1.6 %
<i>Neoptychites aff. hottingeri</i>	1.6 %

The common occurrence of *Mammites nodosoides* shows the assemblage to be equivalent to the upper lower Turonian *nodosoides* Zone of the European sequence (WRIGHT & KENNEDY, 1981; BENGTON, 1996), recognisable from southern England through France, Belgium, Germany, the Czech Republic, Romania and Spain. The same zone is recognised in the United States Western Interior (COBBAN & SCOTT, 1973) and the index species has been recorded from Turkmenistan, Mexico, Colombia, Peru, Brazil, Nigeria, Madagascar, Lebanon, Israel and Egypt. In Algeria and Tunisia, an upper lower Turonian *nodosoides* Zone succeeds a lower lower Turonian *Thomasites rollandi* Zone (CHANCELLOR *et al.*, 1994).

Closer to hand, the faunas of the Tarfaya Basin described by COLLIGNON (1967) include *nodosoides* Zone assemblages at a number of localities. Directly associated with the index species are: *Gaudryceras* sp., *Watinoceras inerme* COLLIGNON, 1967, *W. guentheri* REYMENT, 1954, *W. cobbani* COLLIGNON, 1967, *W. aff. cobbani*, *W. semicostatum* COLLIGNON, 1967, *W. aff. reesidei* WARREN, 1930, *W. aff. coloradoense* HENDERSON, 1908, *Pseudaspidoceras* sp., *Kamerunoceras lecointrei* COLLIGNON, 1967, *K. aff. jacobsoni* REYMENT, 1955, *Benueites benueensis* REYMENT, 1954, *B. spinosus* REYMENT, 1954, *B. reymonti* COLLIGNON, 1967, *Neoptychites cephalotus*, *Wrightoceras munieri* (= *Proplacentoceras zeharaense* COLLIGNON, 1967) and *Scalarites* sp.

Repositories of specimens

The following abbreviations are used to indicate the repositories of specimens cited in the text: BMNH – The Natural History Museum, London; GSM – British Geological Survey, Keyworth, Nottinghamshire; OUM – Oxford University Museum of Natural History, Oxford.

Conventions

Dimensions are given in millimetres: D = diameter; Wb = whorl breadth; Wh = whorl height; U = umbilicus; c = costal dimension; ic = intercostal dimension. Figures in parentheses are dimensions as a percentage of diameter. Suture terminology is that of KORN *et al.* (2003): E = external lobe; A = adventive lobe (= lateral lobe, L, of KULLMANN & WIEDMANN, 1970); U = umbilical lobe; I = internal lobe.

Systematic palaeontology (W. J. Kennedy)

Order Ammonoidea VON ZITTEL, 1884

Suborder Ammonitina HYATT, 1889

Superfamily Acanthoceratoidea DE GROSSOUVRE, 1894

Family Acanthoceratidae DE GROSSOUVRE, 1894

Subfamily Euomphaloceratinae COOPER, 1978

Genus *Romaniceras* SPATH, 1923

Type species: Ammonites deverianus D'ORBIGNY, 1841, p. 356, pl. 110, figs 1, 2, by original designation.

Subgenus *Yubariceras* MATSUMOTO, SAITO & FUKADA, 1957

Type species: Yubariceras yubarensis MATSUMOTO, SAITO & FUKADA, 1957, p. 27, pl. 8, fig. 1; pl. 10, fig. 1; pl. 11, fig. 1; pl. 13, fig. 1; pl. 15, fig. 1; text-figs 8, 9 (= *Ammonites ornatissimus* STOLICZKA, 1864, p. 75, pl. 40).

Romaniceras (Yubariceras) reymonti

(COLLIGNON, 1967)

Pl. 4, Fig. 4

*1967 – *Selwynoceras reymonti* COLLIGNON, p. 44, pl. 26, fig. 1.

1967 – *Selwynoceras zeharaense* COLLIGNON, p. 45, pl. 26, figs 2-5.

1988 – *Romaniceras (Yubariceras) reymonti* (COLLIGNON, 1967) – KENNEDY & COBBAN, p. 602, figs 5/11, 12; 6/3, 8, 9.

Type

The holotype, by original designation, is the original of COLLIGNON (1967, pl. 26, fig. 1) from Oued ez Zehar-Oued el Ouaâr, north of Legdem el Tait (Tarfaya Basin, Morocco).

Material

OUM KX 15427, from the upper part of unit D in the section northeast of Asfla.

Description

The specimen is 78 mm in diameter, crushed but retaining calcite-replaced shell. Coiling is evolute, the broad umbilicus comprising 29 % of the diameter. There 18-19 coarse umbilical bullae on the outer whorl which give rise to single coarse, straight, prorsiradiate ribs, while there are occasional non-bullate primaries and intercalated ribs to give a total of an estimated 30 ribs on the outer whorl. Over most of the outer whorl, there are coarse outer lateral, plus what are taken to be inner and outer ventrolateral, rows of tubercles. At the greatest diameter preserved an inner lateral row of tubercles appears. Details of the ventral ornament are not preserved.

Discussion

That this specimen is conspecific with COLLIGNON's *Selwynoceras reymonti* is not in doubt; however, the generic position of the species is less clear. COLLIGNON (1967, p. 45) noted the similarity of the earliest whorls to species of *Kamerunoceras*, while the multituberculate nature of the outer whorls suggested to him the possibility that *reymonti* represented a new genus. KENNEDY & COBBAN (1988, p. 602) recorded the species from the upper middle Turonian of northern

Mexico, illustrating a specimen (their fig. 5/11, 12) with inner whorls very like those of *Selwynoceras zeharensense* COLLIGNON, 1967 (pl. 26, figs 2-5), here regarded as a synonym. Demonstration here that the species appears in the lower Turonian places it at a much lower horizon than previously documented *Romaniceras* (*Yubariceras*), and the possibility that it is a heterochronous homoeomorph has to be entertained. This cannot be resolved without more, and better-preserved, material.

Occurrence

Lower Turonian *Mammites nodosoides* Zone, northeast of Asfla, and Tarfaya Basin, Morocco; middle Turonian *Prionocyclus hyatti* Zone of northern Mexico.

Subfamily Mammitinae HYATT, 1900

Genus *Mammites* LAUBE & BRUDER, 1887

Type species: Ammonites nodosoides SCHLÜTER, 1871, p. 19, pl. 8, figs 1-4, by monotypy (see WRIGHT & KENNEDY, 1981, p. 75).

Mammites nodosoides (SCHLÜTER, 1871)

Fig. 4; Pl. 1, Figs 1-5; Pl. 2, Fig. 8

- *1871 – *Ammonites nodosoides* SCHLÜTER, p. 19, pl. 8, figs 1-4.
- 1967 – *Mammites chouberti* COLLIGNON, p. 41, pl. 22, fig. 1.
- 1981 – *Mammites nodosoides* (SCHLÜTER, 1871) – WRIGHT & KENNEDY, p. 75, pl. 17, fig. 3; pl. 19, fig. 3; pl. 20, fig. 4; pl. 22, fig. 4; pl. 23, figs 1-3; pl. 24, figs 2, 3; text-figs 19b, 23, 24 (with synonymy).
- 2002 – *Mammites nodosoides* (SCHLÜTER) – EL HEDENY, p. 402, fig. 3c.
- 2003 – *Mammites nodosoides* (SCHLÜTER) – WITTLER & ROTH, p. 273, fig. 17.
- 2007 – *Mammites nodosoides* ((SCHLÜTER, 1871) – BARROSO-BARCENILLA, p. 148, pl. 11, figs a-d (with additional synonymy).

Types

The lectotype, by subsequent designation of WRIGHT & KENNEDY (1981, p. 76), is specimen no. C555 in the Museum für Naturkunde of the Humboldt-Universität Berlin, one of the syntypes on which SCHLÜTER based his species (1871, p. 21, footnote 1), refigured by WRIGHT & KENNEDY as their text-fig. 23. It is from the lower Turonian of Měcholup in the Czech Republic. There are two paralectotypes, both from the lower Turonian of Westphalia, Germany.

Material

Twenty-three specimens, OUM KX 15386-15408,

from the upper part of unit D in the section northeast of Asfla.

Dimensions

	D	Wb	Wh	Wb:Wh	U
KX 15396c	63.6 (100)	29.2 (45.9)	34.2 (53.8)	0.85	12.1 (19.0)
KX 15407c	65.7 (100)	33.7 (51.3)	34.4 (52.4)	0.98	12.3 (18.7)
KX 15365c	79.9 (100)	28.9 (36.2)	42.2 (52.8)	0.68	14.6 (18.3)
KX 15393c	124.6 (100)	49.4 (39.6)	59.7 (47.9)	0.83	28.9 (23.2)
KX 15403c	100.1 (100)	49.9 (49.9)	48.6 (48.6)	1.03	20.1 (20.1)
KX 15391c	127.6 (100)	55.0 (43.1)	62.9 (49.3)	0.87	24.3 (19.0)
KX 15405c	143.0 (100)	83.9 (58.7)	68.1 (47.6)	1.23	39.8 (27.8)
KX 15388c	155.0 (100)	71.2 (45.9)	71.3 (46.01)	1.00	34.9 (22.5)
KX 15386c	200 (100)	86.0 (43.0)	90.0 (45.0)	0.95	46.9 (23.5)

Description

All but one of the specimens studied are phragmocones. The collection shows wide intraspecific variation, from compressed, feebly ornamented gracile individuals (Pl. 1, Figs 4, 5) to depressed, coarsely ornamented, robust ones (Pl. 1, Figs 1-3).

OUM KX 15393 (Pl. 1, Figs 4, 5) is a typical gracile individual. Coiling is moderately involute, with 66% of the previous whorl covered. The umbilicus comprises 23% of the diameter and is shallow, with a low, flattened wall on the internal mould. The umbilical shoulder is narrowly rounded. The whorl section is compressed in intercostal whorl section, with a whorl breadth to height ratio of 0.78, the greatest breadth low on the flanks. The inner flanks are feebly convex, the outer flanks convergent, the ventrolateral shoulders broadly rounded and the venter very feebly convex. There are no umbilical bullae on the greater part of this specimen; two very feeble bullae are present between 115 and 124.6 mm diameter. There are 7-8 inner ventrolateral clavi on the adapertural half of the outer whorl that strengthen progressively as size increases. At the adapical end of the outer whorl, there are small outer ventrolateral clavi, but these efface progressively as size increases and are absent beyond a diameter of 100 mm. There are no ribs on the adapical parts of the outer whorl, but feeble prorsiradiate primary ribs, near effaced on the flanks, appear at the adapertural end of the specimen. Other gracile individuals, such as OUM KX 15390 have somewhat better-developed, but always feeble, primary ribs, which alternate regularly with very short intercalated ribs, or intercalated ventrolateral tubercles.

The only adult specimen, OUM KX 15386 (Pl. 2, Fig. 8), is intermediate in morphology between gracile and robust end members. It has an intercostal whorl breadth to height ratio of 0.87. There are 9-10 umbilical bullae on the outer whorl that become very coarse on

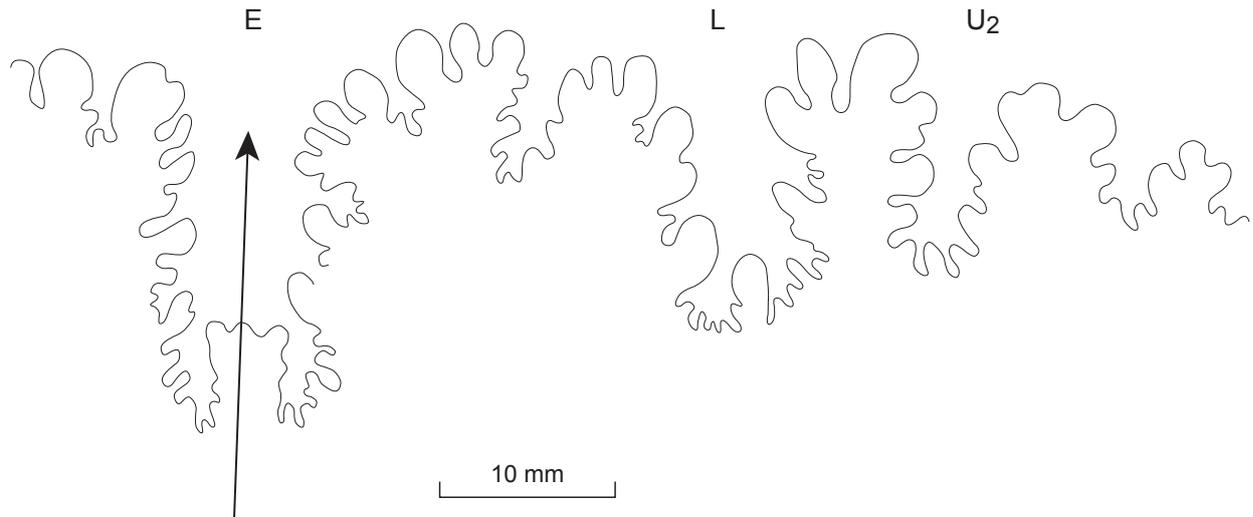


Fig. 4 — External suture of *Mammites nodosoides* (SCHLÜTER, 1871) (OUM KX 15401).

the adpartural half. Strong, pinched inner ventrolateral clavi and much weaker outer ventrolateral clavi are present at the adapical end of the outer whorl. The latter are rapidly lost as size increases, merging into progressively strengthening ventrolateral horns that project above the venter, which is broadly concave between them.

Robust individuals have intercostal whorl breadth to height ratios of up to 1.23 and are thus slightly depressed, the whorl section being rounded trapezoidal. These individuals have well-developed umbilical bullae, 9-10 per whorl, from the smallest diameters seen (96 mm). These give rise to broad, coarse, prorsiradiate ribs that efface across the middle of the flanks before strengthening and linking to strong conical, inner ventrolateral tubercles that are in turn linked to clavate outer ventrolateral tubercles. The ribs arise either singly or in pairs from the bullae and short ribs intercalate, to give a total of 18-20 ribs per whorl. The inner and outer ventrolateral tubercles are differentiated to the greatest preserved diameter in these individuals.

The suture line (Fig. 4; Pl. 1, Figs 2, 5) has a broad, bifid, moderately incised E/A, narrow A and large, bifid A/U₂.

Discussion

This exceptionally well-preserved assemblage mirrors the intraspecific variation seen in the poorly preserved material from the English Middle Chalk described by WRIGHT & KENNEDY (1981). Gracile individuals in the present assemblage can be matched with BMNH C82561b, the original of WRIGHT & KENNEDY, 1981 (pl. 24, fig. 3) and robust individuals by others such as GSM

5281, the original of WRIGHT & KENNEDY (1981, pl. 24, fig. 2). The lectotype (WRIGHT & KENNEDY, 1981, text-fig. 23) corresponds to intermediate individuals (Pl. 2, Fig. 8). None of the various named varieties/subspecies merit separation on the basis of the present material and earlier accounts. Previous authors have tended to interpret the species in terms of the figures in SCHLÜTER (1871, pl. 8, figs 1-4), the lectotype not having been illustrated until 1981. *Mammites nodosoides chivensis* ARKHANGELSKY, 1916 (p. 51, pl. 8, figs 1, 4-7) is based on rather typical juveniles and an adult, approximately 240 mm in diameter. It has six massive umbilical bullae and ventrolateral horns on the 180° sector with normal ornament immediately adapical of the reduced ornament that precedes the aperture, the same style of ornament as seen in the lectotype and in OUM KX 15386 (Pl. 2, Fig. 8). *Mammites nodosoides afra* PERVINQUIÈRE (1907, p. 310, pl. 18, figs 2, 3), from western Tunisia, was separated from *nodosoides* [*sensu stricto*] on the basis of its compressed whorl section, pinched umbilical bullae and other details. It differs in no significant respects from OUM KX 15386. *Mammites nodosoides armata* KARRENBERG, 1935 (p. 136, pl. 30, fig. 8; pl. 33, fig. 7), from Soncillo (northern Spain), corresponds to robust variants in the present collection. *Mammites nodosoides spinosa* BASSE, 1940 (p. 485, pl. 7, fig. 2; pl. 9, fig. 2), from Deir Mahed (Syria), is based on a half whorl fragment with 4-5 strong umbilical bullae and six massive ventrolateral horns preserved, on which basis BASSE separated it from the 'type figure de Schlotheim'. However, VON SCHLOTHEIM did not figure the species and the Syrian fragment has the same style of ornament as the lectotype, seemingly at

a smaller diameter (BASSE failed to indicate the size of her specimen). *Mammites* from the Tarfaya Basin were described by COLLIGNON (1967), who noted and figured a single juvenile example of what he termed *M. nodosoides* (p. 39, pl. 20, fig. 11), coarsely and sparsely ribbed and tuberculate juveniles 35–65 mm in diameter that he referred to var. *spinosa* BASSE (p. 40, pl. 20, fig. 12) and var. *afra* PERVINQUIÈRE (p. 40, pl. 20, fig. 13). Somewhat larger is the more densely ribbed var. *tassagdeltensis* COLLIGNON, 1967 (p. 40, pl. 21, fig. 1), based on an individual over 60 mm in diameter, with sixteen primary ribs per whorl, and var. *zebaiensis* COLLIGNON, 1967 (p. 40, pl. 21, fig. 2), based on an individual > 80 mm in diameter with more numerous ribs and tubercles, *i.e.* fourteen umbilical bullae and sixteen ventrolateral tubercles on the outer 240° sector of the outer whorl. *Mammites chouberti* COLLIGNON, 1967 (p. 41, pl. 22, fig. 1) co-occurs with *M. nodosoides* in the Tarfaya Basin; WRIGHT & KENNEDY (1981) regarded it as a synonym of *Mammites wingi* MORROW, 1935, the type species of the genus *Morrowites* (see below). COLLIGNON (1967, p. 42) entertained the possibility that it might be an extreme variety of *M. nodosoides*, a view confirmed here on the basis of robust variants in the present assemblage (OUM KX 15403; see Pl. 1, Figs 1–3). Reference is made to WRIGHT & KENNEDY (1981) for a discussion of other species.

The genus *Morrowites* (type species: *Mammites wingi* MORROW, 1935, p. 467, pl. 51, fig. 2; pl. 52, fig. 2; text-fig. 2), introduced for *Mammites* homoeomorphs with constricted inner whorls and a very broad A (= L), is referred to the Euomphaloceratinae. On the basis of the distinctive sutural character (an exceptionally wide A), COBBAN & HOOK (1983) referred *Mammites michelobensis* LAUBE & BRUDER, 1887 (p. 231, pl. 2, figs 1, 2; pl. 15, fig. 8) to *Morrowites*. Accordingly, it should be excluded from the synonymy of *Mammites nodosoides*, in contrast to views expressed by WRIGHT & KENNEDY (1981) and BARROSO-BARCENILLA (2007). The species was discussed by KONEČNÝ & VAŠIČEK (1987), who clarified the synonymy of Czech species of *Morrowites*.

Occurrence

Upper lower Turonian (*Mammites nodosoides* Zone and correlatives), Germany, France, Belgium, England, Spain, Czech Republic, Romania, Turkmenistan, Lebanon, Israel, Egypt, Tunisia, Algeria, Morocco, Nigeria, Madagascar, Peru, Brazil, Colombia, Mexico and the United States Western Interior.

Family Vasoceratidae H. DOUVILLÉ, 1912
Genus *Nannovascoceras* RENZ & ALVAREZ, 1979

Type species: Nannovascoceras intermedium RENZ & ALVAREZ, 1979, p. 978, fig. 2i–q, by original designation.

Discussion

WRIGHT (1996, p. L175) regarded *Nannovascoceras* as a synonym of *Vascoceras*. It is in fact a pedomorphic dwarf offshoot of an as yet unidentified vasoceratid ancestor. The genus is characterised by its small size, crowded ribbing that extends over all of the flanks and a flared adult aperture, preceded by a constriction and with a short, blunt ventral projection.

Nannovascoceras intermedium

RENZ & ALVAREZ, 1979

Pl. 2, Figs 1–6

- 1979 – *Nannovascoceras constrictum* RENZ & ALVAREZ, p. 978, fig. 2e–h.
*1979 – *Nannovascoceras intermedium* RENZ & ALVAREZ, p. 978, fig. 2i–q.
1979 – *Nannovascoceras costatum* RENZ & ALVAREZ, p. 979, fig. 2r–v.
1982 – *Nannovascoceras constrictum* RENZ & ALVAREZ – RENZ, p. 76, pl. 22, figs 10, 14, 17, 18; text-fig. 57a, d.
1982 – *Nannovascoceras intermedium* RENZ & ALVAREZ – RENZ, p. 76, pl. 22, figs 13, 16.
1982 – *Nannovascoceras costatum* RENZ & ALVAREZ – RENZ, p. 77, pl. 22, figs 11, 12; text-fig. 57b–c.

Type

Re6799–49 in the collections of Maravan S.A. (Caracas, Venezuela), the original of RENZ & ALVAREZ (1979, fig. 2i–k), from the lower Turonian Chejendé Member of the La Luna Formation, La Morita (State of Trujillo, Venezuela).

Material

OUM KX 15431, from the upper part of unit D in the section northeast of Asfla.

Dimensions

	D	Wb	Wh	Wb:Wh	U
KX 15431c	28.1 (100)	12.7 (45.2)	13.3 (47.3)	0.95	6.1 (21.7)

Description

The specimen retains recrystallised shell. Coiling is involute, the umbilicus comprising 21.7% of the diameter, with a low, feebly convex wall and relatively

narrowly rounded umbilical shoulder. The whorl section is slightly compressed, with a whorl breadth to height ratio of 0.95, the flanks flattened and subparallel, the ventrolateral shoulders broadly rounded and the relatively broad venter feebly convex. There are an estimated twelve primary ribs on the outer whorl; they arise from incipient umbilical bullae, are straight and prorsiradiate on the flanks, strengthen, flex forwards and are concave over the ventrolateral shoulders, project forwards and remain strong over the venter, which they cross in a broad, shallow convexity. One or two short intercalated ribs are inserted between successive primaries; they arise on the outer flank and strengthen to match the primaries on ventrolateral shoulders and venter. Interspaces succeeding primary ribs are periodically strengthened into constrictions. Ornament weakens on the adapical sector of the body chamber. The adult aperture is preceded by a relatively broad, shallow constriction. The mouth border is slightly prorsiradiate and sinuous on the flanks, projects forwards and is concave at the ventrolateral shoulder, and is broadly and feebly convex on the venter. Sutures not seen.

Discussion

In their original description, RENZ & ALVAREZ (1979, pp. 978, 979) recognised three co-occurring species of *Nannoscoceras*. They noted that, 'An alternative to the taxonomic interpretation here proposed is to establish a single new species (*N. intermedium*), and assign variety status to the remaining forms', having previously noted (p. 976) that, 'The three species here described are connected by a range of intermediate varieties, not named'. Taxonomic habits change and the Venezuelan material is here regarded as a single variable species, for which *intermedium* is adopted as the specific name. The present specimen is closely comparable to the specimens of *Nannoscoceras* figured by RENZ (1982, pl. 22, figs 11, 16).

Occurrence

Lower Turonian of Venezuela and Morocco.

Genus *Fagesia* PERVINQUIÈRE, 1907

Type species: Olcostephanus superstes KOSSMAT, 1897, p. 26 (133), pl. 6 (17), fig. 1 only, by original designation (PERVINQUIÈRE, 1907, p. 322).

Fagesia peroni PERVINQUIÈRE, 1907

Figs 5-6; Pl. 3, Figs 1-2; Pl. 4, Figs 1-3; Pl. 5, Figs 1-2; Pl. 7, Figs 4-6; Pl. 9, Figs 7-9

- 1907 – *Fagesia peroni* PERVINQUIÈRE, p. 329, pl. 20, figs 7, 8.
 ?1921 – *Fagesia peroni* (PERVINQUIÈRE) var. *columbiana* FRITZSCHE, p. 277, pl. 4, fig. 1; text-fig. 9.
 ?1958 – *Fagesia peroni* PERVINQUIÈRE – LUPPOV & DRUSHCHITS, p. 312, pl. 61, fig. 4.
 non 1969 – *Fagesia peroni* PERVINQUIÈRE – STANKIEVICH & POJARKOVA, p. 91, pl. 1, fig. 1.
 1982 – *Fagesia levis* RENZ, p. 78, pl. 22, fig. 20; pl. 23, figs 1-3; text-figs 53, 59a-c.
 ?1986 – *Fagesia peroni* PERVINQUIÈRE – SZÁSZ, p. 128, pl. 5, fig. 5.
 1994 – *Fagesia peroni* PERVINQUIÈRE – CHANCELLOR *et al.*, p. 66, pl. 14, figs 6-10.

Types

The lectotype, by subsequent designation of CHANCELLOR *et al.* (1994, p. 66), is the original of PERVINQUIÈRE (1907, pl. 20, fig. 8), refigured by CHANCELLOR *et al.* (1994, pl. 14, figs 7, 8, 10), from Ain Sfaia (Djebel Bireno, Tunisia). There are four paralectotypes. All of these specimens were in the Sorbonne collections, and are now housed in the collections of the Muséum national d'Histoire naturelle, Paris.

Material

Sixteen specimens, OUM KX 15409-15424, from the upper part of unit D in the Asfla section.

Dimensions

	D	Wb	Wh	Wb:Wh	U
KX 15411c	42.7 (100)	37.7 (88,3)	18.8 (44,0)	2.0	11.8 (27,6)
KX 15414	87.7 (100)	64.1 (73,1)	36.2 (41,3)	1.77	19.9 (22,3)
KX 15415	82.3 (100)	64.6 (78,5)	38.7 (47,0)	1.67	20.3 (24,7)
KX 15409	114.0 (100)	98.1 (86,1)	52.1 (45,7)	1.87	23.6 (20,7)
KX 15412	124.7 (100)	84.4 (67,7)	51.6 (41,4)	1.64	34.0 (27,3)
KX 15413	147.0 (100)	- (-)	52.3 (35,6)	-	49.7 (33,8)

Description

Specimens range from 42.7 to 147 mm in diameter, and vary from very depressed with whorl breadth to height ratios of 2.38 (OUM KX 15416) to depressed with whorl breadth to height ratios of 1.77 (OUM KX 15414).

The smallest individual in the collection is OUM KX 15411 (Pl. 7, Figs 4-6), which is 42.7 mm in diameter. The umbilicus is very deep, crater-like, the wall flattened and outward-inclined. The umbilical shoulder is narrowly rounded; there are no flanks, the venter broad and evenly convex. Ten coarse bullae perch on the umbilical shoulder of the outer whorl and give rise to low, broad, feeble ribs that rapidly efface and are absent from the greater part of the venter.

OUM KX 15416 is a larger individual of the same

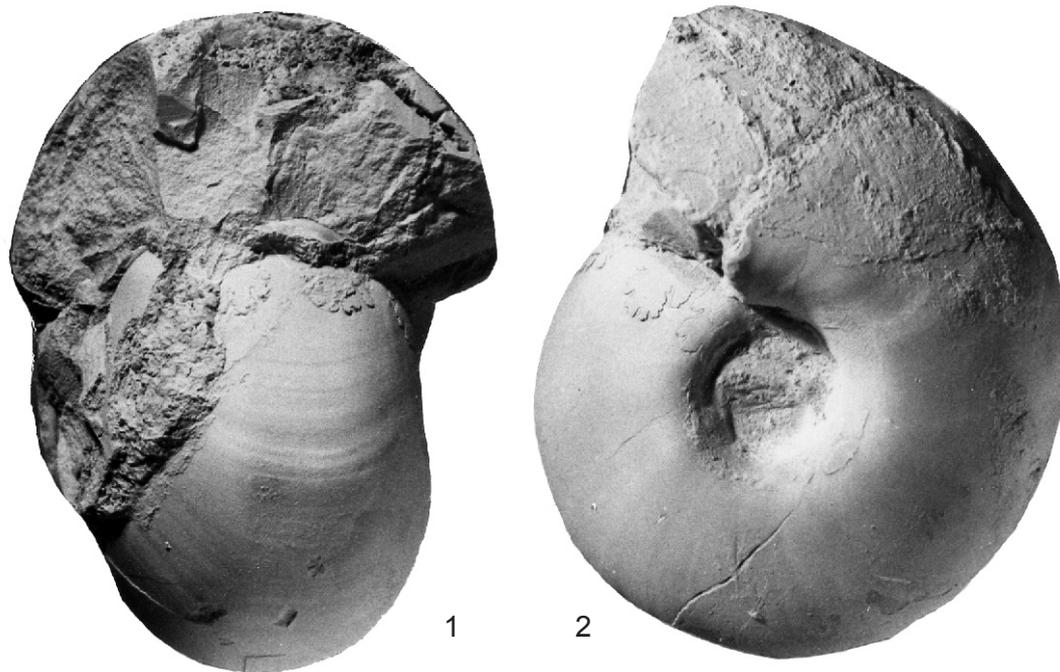


Fig. 5 — *Fagesia peroni* PERVINQUIÈRE, 1907 (OUM KX 15415), a possible adult microconch, x 1.

type, 80 mm in diameter, with ten conical bullae on the outer whorl. OUM KY 15409 (Pl. 4, Figs 1-3) is a phragmocone 114 mm in diameter, with a whorl breadth to height ratio of 1.87. There are no umbilical bullae on the outer whorl. The surface of the internal mould is ornamented by obscure striae, ridges and folds that are feebly convex cross the venter.

OUM KX 15413 (Pl. 5, Figs 1, 2) appears to be an adult macroconch, 147 mm in diameter. All of the outer whorl is body chamber. The outer whorl shows eccentric coiling associated with maturity. The whorl breadth to height ratio, measured adaperturally of the damaged apertural region, is 2.52. The umbilical shoulder bears coarse, irregular undulations. The venter of the internal mould is ornamented by low, coarse, convex folds and striae.

OUM KX 15420, 130 mm in diameter, retains extensive areas of recrystallised shell, the surface of which is ornamented by dense growth lines and striae and low, broad folds. These are concave across the umbilical shoulder, sweep forwards and cross the venter in a very broad, shallow convexity. It too appears to be an adult macroconch.

Small, less depressed individuals such as OUM KX 15410 (Pl. 3, Figs 1, 2) have well-developed bullae and convex ventral ornament as described above and lose the bullae as size increases; they are absent from the

outer whorl of OUM KX 15412, an individual 133 mm in maximum diameter.

OUM KX 15417 is a distinctive variant, the umbilical bullae well developed, with distant narrow ribs that are concave close to the umbilicus and convex over the venter.

OUM KY 15415 (Fig. 5) may be an adult microconch; it is 89.5 mm in maximum diameter, all of the outer whorl is body chamber, and regular umbilical bullae are present on the adapical part of the outer whorl only.

The suture line (Fig. 6) is only moderately incised, with relatively narrow elements.

Discussion

This suite of specimens encompasses individuals like the lectotype, a crushed and distorted individual with a major diameter of 66.5 mm, while the small paralectotype (see PERVINQUIÈRE, 1907, pl. 20, fig. 7; CHANCELLOR *et al.*, 1994, pl. 14, figs 6, 9) closely resembles the smallest of the present specimens (Pl. 7, Figs 4-6), differing only in the presence of a prominent convex ventral rib flanked by feeble grooves. The present specimens also include individuals that correspond to *Fagesia levis* RENZ, 1982. The holotype (RENZ, 1982, pl. 23, fig. 2) differs from our smallest specimen in size only; it is regarded as a synonym. Reference is made to CHANCELLOR *et al.*

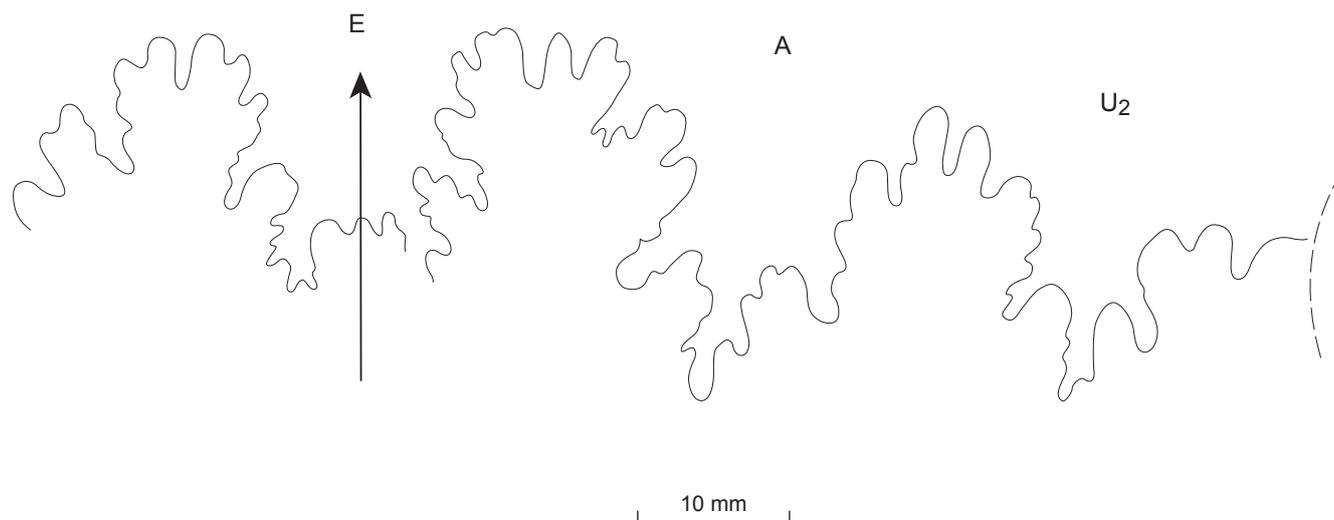


Fig. 6 — External suture of *Fagesia peroni* PERVINQUIÈRE, 1907 (OUM KX 15419).

(1994, p. 64) for observations on the references to this species queried in the synonymy above.

Occurrence

Lower Turonian of Algeria, Morocco, Venezuela and, possibly, Romania, Central Asia of the former Soviet Union and Colombia.

Genus *Neoptychites* KOSSMAT, 1895

Type species: Ammonites telinga STOLICZKA, 1865, p. 125, pl. 62, figs 1, 2, by subsequent designation of SOLGER (1904, p. 105); = *Ammonites cephalotus* COURTILLER, 1860 (p. 248, pl. 2, figs 1-4).

Neoptychites cephalotus (COURTILLER, 1860)

Pl. 3, Figs 6-8; Pl. 6, Figs 1-5

*1860 — *Ammonites cephalotus* COURTILLER, p. 248, pl. 2, figs 1-4.

1983 — *Neoptychites cephalotus* (COURTILLER) — COBBAN & HOOK, p. 14, pl. 3, figs 9-11; pls 9-12; text-fig. 9 (with synonymy).

1994 — *Neoptychites cephalotus* (COURTILLER, 1860) — CHANCELLOR *et al.*, p. 70, pl. 16, figs 1-9; pl. 17, figs 1-5; pl. 18, figs 1-3; pl. 26, figs 2-4 (with synonymy).

Types

The lectotype, by subsequent designation of KENNEDY & WRIGHT (1979, p. 674), is the original of their pl. 83, figs 1-3, no. CS631, in the collections of the Château de Saumur (Touraine, France). There are three additional surviving paralectotypes. All are inferred to be from the

middle Turonian Tuffeau de Saumur in the environs of Saumur.

Material

Three specimens, OUM KX 15425, KX 15428 and KX 15429, from the upper part of unit D of the section northeast of Asfla.

Dimensions

	D	Wb	Wh	Wb:Wh	U
KX 15425	75.8 (100)	62.5 (82,5)	47.4 (62,5)	1.32	~7.0 (~9,2)
KX 15429	92.7 (100)	43.4 (46,8)	52.5 (56,6)	0.83	5.8 (6,3)
KX 15428	126.0 (100)	57.4 (45,6)	65.2 (51,7)	0.88	12.4 (9,8)

Description

OUM KX 15425 (Pl. 3, Figs 6-8) is an internal mould of a phragmocone 75.8 mm in diameter. Coiling is very involute, the umbilicus near-occluded, and an estimated 9.2% of the diameter or less. The whorl section is very depressed, reniform, with a whorl breadth to height ratio of 1.32, the greatest breadth just outside the umbilical shoulder. The umbilical shoulder is rounded-subangular, the flanks and ventrolateral shoulders broadly convex, the venter more narrowly so, resulting in a subtrigonal section. The surface of the internal mould is worn, but there are traces of low, broad, prorsiradiate flank ribs that are near transverse over the venter on the adapical part of the outer whorl.

OUM KX 15429 (Pl. 6, Figs 1-3) is a phragmocone 92.7 mm in diameter that retains traces of recrystallised shell in places. Coiling is very involute with a tiny, shallow umbilicus that comprises 6.3% of the diameter. The whorl section is compressed, with a whorl breadth

to height ratio of 0.83, the greatest breadth just outside the umbilical shoulder. The inner flanks are broadly convex, the outer flanks flattened and convergent, the ventrolateral shoulders broadly rounded, the venter very feebly convex. The ornament is very subdued and consists of low, broad, prorsiradiate ribs. Primary ribs arise at the umbilical shoulder and initially are very weak, strengthening across the outer flank and ventrolateral shoulder where they are feebly concave, thereafter weakening and near transverse over the venter. One or more intercalated ribs are inserted between successive primaries.

OUM KX 15428 (Pl. 6, Figs 4, 5) is an internal mould of an adult, ?microconch 126 mm in diameter, with a 315° sector of body chamber preserved. Coiling is very involute, the umbilicus comprising 9.8% of the diameter. The whorl breadth to height ratio is 0.88, the greatest breadth just outside the umbilical shoulder. The inner flanks are broadly convex, the outer flanks flattened and convergent, the ventrolateral shoulders and venter broadly rounded. Ornament consists of low, broad, prorsiradiate ribs. Primary and single intercalated ribs alternate at the adapical end of the outer whorl; thereafter, this differentiation becomes indistinct. The ribs are low, coarse and broad on the outer flanks, ventrolateral shoulders and venter, feebly concave at the adapical end of the outer whorl, thereafter near-radial. They are accompanied by well-developed growth lines and striae on the outer flanks, ventrolateral shoulders and venter. The aperture of this specimen is markedly contracted, indicating maturity. None of the specimens show the sutures particularly well; E/A is broad, with plump elements, A narrow and deeply incised; U_2 is only slightly smaller than E/A.

Discussion

COBBAN & HOOK (1983, p. 14, pl. 3, figs 9-11; pls 9-12; text-fig. 9) described a large assemblage of >50 specimens of *N. cephalotus* from the *nodosoides* Zone of New Mexico, clarifying the range of intraspecific variation and dimorphism in the species. They developed and clarified the understanding *N. cephalotus* of KENNEDY & WRIGHT (1979). Abundant Tunisian material was described by CHANCELLOR *et al.* (1994, p. 70, pl. 16, figs 1-9; pl. 17, figs 1-5; pl. 18, figs 1-3; pl. 26, figs 2-4). The present specimens fall within the range of variation ascribed to the species by these authors.

Occurrence

The species first occurs in the lower Turonian *Thomasites rollandi* Zone in Tunisia and extends to

the lower part of the middle Turonian *Collignonicerias woollgari* Zone in France. The geographic range is France, Spain, Morocco, Algeria, Tunisia, Egypt, Israel, Syria, Cameroon, Madagascar, southern India; Colorado, New Mexico and Trans-Pecos Texas in the United States; northern Mexico, Trinidad, Venezuela, Colombia, Brazil, Niger and Nigeria.

Neptychites aff. *hottingeri* COLLIGNON, 1967

Figs 7, 8

Material

OUM KX 15426, from the upper part of unit D in the section northeast of Asfla.

Dimensions

	D	Wb	Wh	Wb:Wh	U
KX 15426	85.7 (100)	53.8 (62,8)	42.7 (49,8)	1.26	17.0 (19,8)

Description

The specimen (Fig. 7) is an internal mould of a phragmocone. Coiling is involute, with 74% of the previous whorl covered. The small umbilicus comprises 19.8% of the diameter. It is deep, with a high, flattened wall. The umbilical shoulder is very narrowly rounded. The whorl section is depressed, rounded trapezoidal, with a whorl breadth to height ratio of 1.26, the greatest breadth just outside the umbilical shoulder. The inner flanks are broadly rounded, the outer flanks convergent, the ventrolateral shoulders broadly rounded, the venter broad and feebly convex. The flanks are near smooth, with delicate, low ribs appearing on the outermost flank. They strengthen over the ventrolateral shoulder and are feebly convex across the venter. There are periodically developed coarse ribs, which commonly flank irregularly spaced constrictions on the ventrolateral shoulders and venter.

The external suture (Fig. 8) is deeply incised, with a large bifid E/A and A, with a tall, narrow A/ U_2 .

Discussion

The trapezoidal whorl section, flattened venter, relatively evolute coiling, ventral ribs and constrictions, plus deeply incised suture are distinctive. The whorl section in particular links this specimen to *Vascoceras pioti* (PERON *in* FOURTAU, 1904), as revised by FREUND & RAAB (1969, p. 26, pl. 4, figs 1-9; text-fig. 6d-g), but this appears to be more involute and the small specimens figured by FREUND & RAAB have very angular ventrolateral shoulders and strong, bar-like,

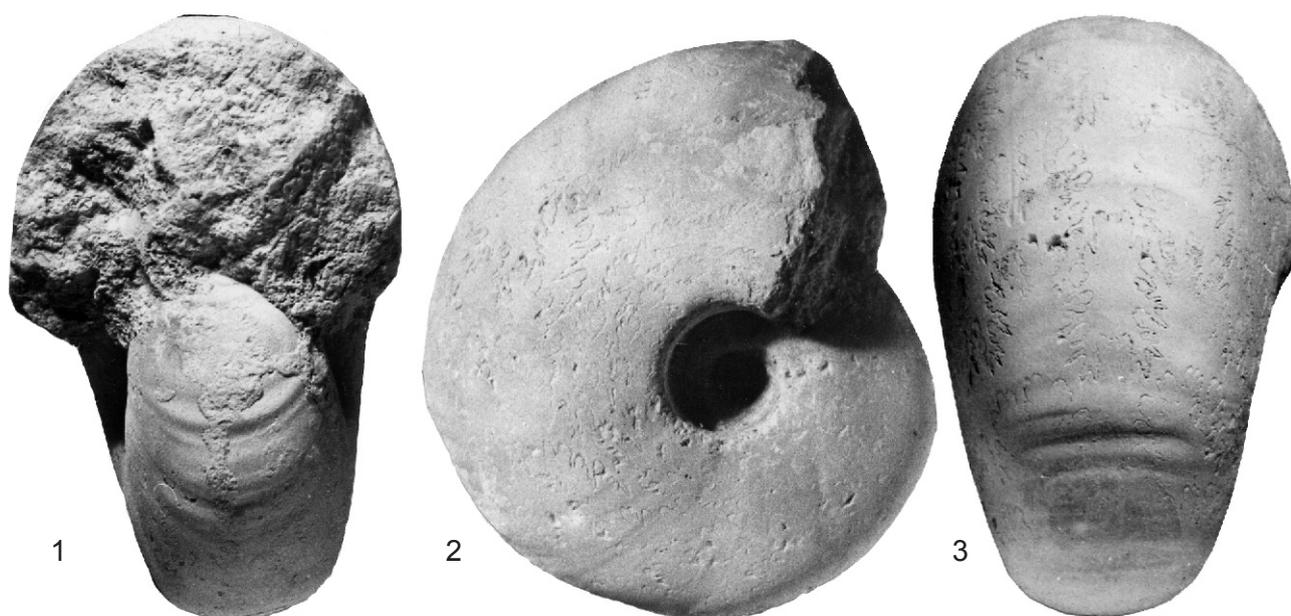


Fig. 7 — *Neoptychites* aff. *hottingeri* COLLIGNON, 1967 (OUM KX 15426), x 1.

transverse ribs on the venter. The suture (FREUND & RAAB, 1969, text-fig. 6f) is quite distinct, with broad, shallow, little-incised elements. *Neoptychites hottingeri* COLLIGNON, 1967 (p. 44, pl. 26, fig. 1) was regarded as possible synonym of *pioti* by FREUND & RAAB, and the whorl section is similar, as it is to the present specimen. The holotype of *hottingeri* is larger than the present specimen and has very subdued ornament, a difference that may be no more than a reflection of maturity. The suture line, insofar as it is visible on COLLIGNON'S

figure, appears to be as deeply incised as in the present specimen. The two differ, however, in the much wider umbilicus (17% vs 5%) of the present specimen. On this basis, it is separated as *Neoptychites* aff. *hottingeri*.

Occurrence

As for material. The holotype of *N. hottingeri* came from Oued el Amra, south of L' Oued Ougnane Telli (Tarfaya Basin, Morocco); there was no associated fauna.

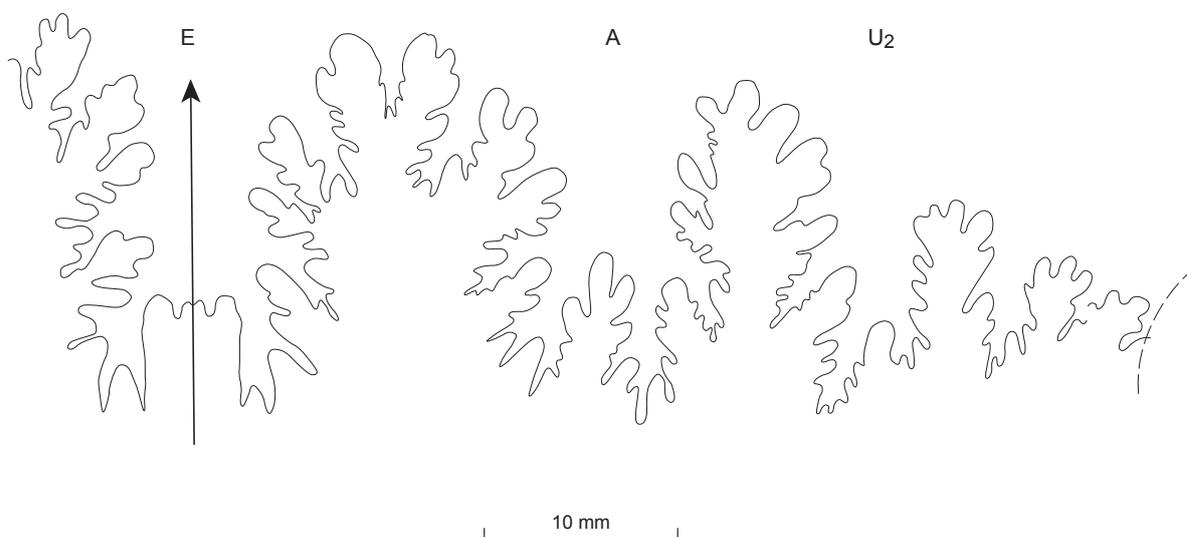


Fig. 8 — External suture of *Neoptychites* aff. *hottingeri* COLLIGNON, 1967 (OUM KX 15426).

Family Pseudotissotidae HYATT, 1903

Genus and subgenus *Choffaticeras* HYATT, 1903

Type species: Pseudotissotia meslei PERON, 1897 (p. 33, pl. 14 (1), fig. 1; pl. 15 (2), figs 1, 2; pl. 16 (3), fig. 2; pl. 11 (17), fig. 1), by original designation (HYATT, 1903, p. 37).

Choffaticeras (Choffaticeras) segne (SOLGER, 1903)

Fig. 9; Pl. 3, Figs 4-5; Pl. 7, Figs 1-2; Pl. 8, Figs 1-6

- 1903 – *Pseudotissotia segnis* SOLGER, p. 77, pl. 4, figs 1, 2; text-figs 16-21.
 1904 – *Schloenbachia Quaasi* PERON, p. 255, pl. 1, figs 1-3.
 2007 – *Choffaticeras (Choffaticeras) quaasi* (PERON, 1904) – BARROSO-BARCENILLA & GOY, p. 464, figs 4.4, 4.5, 5.1 (with full synonymy).
 2007 – *Choffaticeras (Choffaticeras) segne* (SOLGER, 1903) – BARROSO-BARCENILLA & GOY, p. 468, figs 5.5, 6.1-6.3 (with full synonymy).

Type

The lectotype, by subsequent designation of CHANCELLOR *et al.* (1994, p. 88), is the original of *Pseudotissotia segnis* SOLGER, 1903 (p. 77, pl. 4, figs 1-2; text-figs 16-21), from Wadi Mohr (Egypt).

Material

There are eleven specimens, OUM KX 15432-15442, from the upper part of unit D in the section northeast of Asfla.

Dimensions

	D	Wb	Wh	Wb:Wh	U
KX 15437	62.9 (100)	17.3 (27,5)	37.5 (59,6)	- (-)	- (-)
KX 15439	69.6 (100)	21.1 (30,3)	39.2 (56,3)	- (-)	- (-)
KX 15438	96.8 (100)	29.1 (29,7)	56.2 (58,1)	0.51	- (-)
KX 15433	94.5 (100)	35.8 (37,9)	53.6 (56,7)	0.64	9.5 (10,1)
KX 15436	122.8 (100)	45.3 (27,1)	65.0 (52,9)	0.70	18.0 (14,1)
KX 15434	124.7 (100)	47.4 (38,0)	65.5 (52,5)	0.72	12.6 (10,1)
KX 15432	205.0 (100)	68.7 (33,5)	115.0(56,1)	0.6	16.3 (7,9)

Description

All specimens are internal moulds of phragmocones and range from 63 to 205 mm in diameter. The shell is oxycone, with a small umbilicus that comprises up to 14% of the diameter, with a flattened, outward-inclined wall and narrowly rounded umbilical shoulder. The whorl breadth to height ratio varies from 0.51-0.72. The greatest breadth is just outside the umbilical shoulder, the inner flanks feebly convex, the outer flanks flattened and convergent. There is a break in the slope of the whorl profile, where an angulation results in a spiral ridge, such that the shell has what has been termed a tricarinate venter when viewed in profile in all but the largest specimens. Juveniles are ornamented by delicate prorsiradiate, straight primary and intercalated flank ribs, growth lines and striae. The ribs strengthen across the flanks and develop into delicate, crowded, radially elongated ventrolateral bullae at the change in profile of the whorl section. This juvenile ornament varies between individuals, from weak (Pl. 3, Figs 4, 5) to strong (Pl.

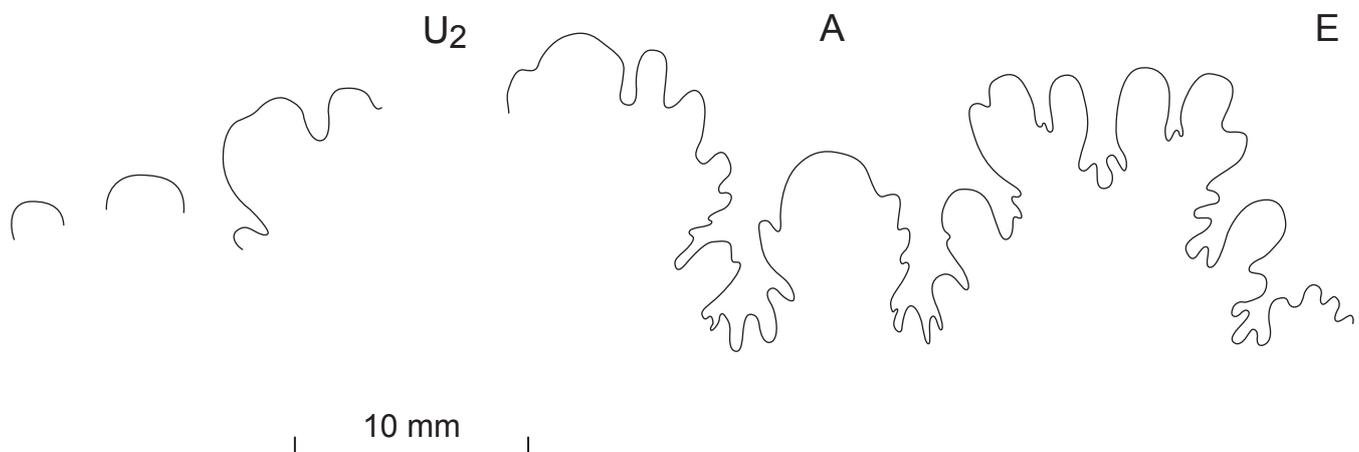


Fig. 9 – External suture of *Choffaticeras (Choffaticeras) segne* (SOLGER, 1903) (OUM KX 15431).

8, Figs 1-3). It begins to efface from diameters of as little as 55 mm (OUM KX 15440), leaving the shell smooth in middle growth, apart from the keels (OUM KX 15434; see Pl. 8, Figs 4-6). Additional weak spiral ridges appear in the largest specimen seen, OUM KX 15432, a phragmocone 205 mm in diameter (Pl. 7, Figs 1, 2). They are accompanied by irregular low radial folds on the surface of the mould. Where recrystallised shell is preserved, it can be seen to be covered in crowded growth lines and striae. The external suture (Fig. 9) is characterised by broad, moderately incised lobes and saddles, with a large median element in A.

Discussion

The inner whorls of the lectotype (SOLGER, 1903, pl. 4, fig. 1) has relatively coarse ribs and tubercles on the lateral keels, a feature of the present material (OUM KX 15433; see Pl. 8, Figs 1-3), and an outer, near-smooth whorl like OUM KX 15434 (Pl. 8, Figs 4-6). The lectotype differs from the present material only in being a little more inflated. The present collection also compares well with the material from Egypt described by DOUVILLÉ (1928) as *Leonicerus quaasi* (PERON, 1904). OUM KX 15439 (Pl. 3, Figs 4, 5), a feebly ornamented juvenile, finds a match in pl. 3, fig. 4 in DOUVILLÉ, while OUM KX 15433 (Pl. 8, Figs 1-3), a coarsely ornamented juvenile, corresponds to pl. 3, fig. 6 in DOUVILLÉ. PERON based his *Schloenbachia Quaasi* (1904, p. 255, pl. 1, figs 1-3) on four small or fragmentary examples, the largest 20 mm in diameter, from what PERON termed the 'Cénomaniens supérieur' of Ouady Abou Elefieh, Egypt. The original figures are very generalised, and the original specimens, said to be in the Muséum national d'Histoire naturelle, Paris, have never been refigured or redescribed.

There have been two recent reviews of species of *Choffaticeras* (*Choffaticeras*). BARROSO-BARCENILLA & GOY (2007, p. 466) stressed the difficulties in separating *C. (C.) quaasi* and *C. (C.) pavillieri* PERVINQUIÈRE, 1907 (p. 353, pl. 23, figs 4-6; text-fig. 134; holotype refigured by CHANCELLOR *et al.*, 1994, pl. 26, figs 10-12), a very compressed, involute form with very fine juvenile ornament, *C. (C.) quaasi* and *C. (C.) segne*. The present material suggests that *quaasi* is a junior synonym of *segne*. None of the present specimens have the delicate ornament of juvenile *pavillieri*, which is kept separate here. KASSAB (2007) concluded that *C. segne* was a markedly dimorphic species of which *C. (C.) securiforme* (ECK, 1909) (p. 187, figs 9-13), *C. schweinfurthi* (ECK, 1909) (p. 184, figs 6-8) and *C. luciae trisellatum* FREUND & RAAB, 1969 (p. 59, pl. 9, figs 7-8; text-figs 12i-q, 13a-h)

represented macroconchs, and *C. quaasi*, *C. (C.) sinaiticum* (DOUVILLÉ, 1928) (p. 25, pl. 4, fig. 4; text-fig. 15), *C. (C.) pavillieri* and *C. (C.) segnis discoidalis* (PERVINQUIÈRE, 1907) microconchs. One awaits full publication and illustration of his material.

Occurrence

Lower Turonian; France, Spain, Syria, Jordan, Israel, Egypt, Tunisia and Morocco.

Genus *Wrightoceras* REYMENT, 1954

Type species: Bauchioceras (Wrightoceras) wallsi REYMENT, 1954, p. 160, pl. 2, fig. 4; pl. 3, fig. 3, by original designation.

Wrightoceras munieri (PERVINQUIÈRE, 1907)

Pl. 2, Fig. 7; Pl. 3, Fig. 3; Pl. 7, Fig. 3; Pl. 9, Figs 1-6, 10, 11

- 1907 – *Hoplitoides munieri* PERVINQUIÈRE, p. 217, pl. 10, figs 1, 2; text-fig. 83.
 1994 – *Wrightoceras munieri* (PERVINQUIÈRE, 1907) – CHANCELLOR *et al.*, p. 96, pl. 26, figs 1, 5, 8; pl. 28, figs 1-4; pl. 29, figs 3-8; pl. 36, figs 1, 2; text-figs 18g-h, 19h-l (with synonymy).
 2007 – *Wrightoceras munieri* (PERVINQUIÈRE, 1907) – BARROSO-BARCENILLA & GOY, p. 480, figs 10.3, 10.4 (with additional synonymy).

Type

The holotype, by original designation, is the original of PERVINQUIÈRE (1907, pl. 10, fig. 2), a specimen in the Sorbonne collections, now housed in the Muséum national d'Histoire naturelle, Paris. It was refigured by CHANCELLOR *et al.* (1994, pl. 26, figs 10-12), and is from the lower Turonian of Draa el Miaad (western Tunisia). There are five cited paratypes, from this and other localities in the same region.

Material

OUM KX 15443-15448 and KX 15450 from the upper part of unit D; OUM KX 15469 from the conglomerate bed at the base of unit E; OUM KX 15467 from the lower part of unit D of the section northeast of Asfla. A series of juveniles, OUM KX 15451, KX 15452, KX 15454-15455, KX 15457-15466 and KX 15468 from the lower part of unit D of the section northeast of Asfla may also belong here.

Dimensions

	D	Wb	Wh	Wb:Wh	U
KX 15443	48.5 (100)	14.2 (29.3)	27.8 (57.3)	0.51	- (-)
KX 15445	61.7 (100)	19.3 (31.3)	36.2 (58.7)	0.53	4.3 (7.0)

Description

Specimens range from 20 to an estimated 100 mm in diameter (OUM KX 15450, a damaged individual). Coiling is very involute, the tiny umbilicus comprising 7% of the diameter in the single measurable specimen, shallow, with a low, feebly convex wall and narrowly rounded umbilical shoulder. The whorls are very compressed, with whorl breadth to height ratios of as little as 0.51 in the smallest of the measured specimens (OUM KX 15443). The inner and middle flanks are feebly convex, the outer flanks flattened, converging to the narrow venter, which is feebly concave with sharp shoulders, or flattened. The very feeble ornament consists of delicate growth lines and striae, superimposed on low, broad folds or flattened, scale-like ribs with a steep adapical face and gently inclined adapertural one. These elements of ornament are feebly concave on the innermost flank, feebly convex across the middle of the flanks, concave on the outer flanks (where they are at their most prominent development), and projected forwards to the ventrolateral shoulder (Pl. 2, Fig. 7; Pl. 3, Fig. 3).

Discussion

The present specimens show the same style of juvenile ornament as the beautifully preserved specimens from the Chejendé Member of the La Luna Formation of Venezuela described by RENZ (1982, p. 100, pl. 31, figs 3-6, 11). Small specimens from the lower part of unit D of the Asfla section, noted above, include much more coarsely ornamented nuclei in the 10-12 mm range that may be variants of the present species. Reference is made to CHANCELLOR *et al.* (1994) and BARROSO-BARCELLINA & GOY (2007) for discussions of this and other species of *Wrightoceras*.

Occurrence

Upper lower Turonian; Spain, Tunisia, Morocco, Texas, Peru, Venezuela, Colombia, Niger and Nigeria.

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Explanation of plates

PLATE 1

Figs 1-5 — *Mammites nodosoides* (SCHLÜTER, 1871); 1-3, OUM KX 15403; 4, 5, OUM KX 15393.

Both specimens are from the upper part of unit D in the section northeast of the village of Asfla, some 30 km north of Goulmima (province of El-Rachidia, southern Morocco), all x 1.

PLATE 2

Figs 1-6 — *Nannovascoceras intermedium* RENZ & ALVAREZ, 1979, OUM KX 15431.

Fig. 7 — *Wrightoceras muniéri* (PERVINQUIÈRE, 1907), OUM KX 15447.

Fig. 8 — *Mammites nodosoides* (SCHLÜTER, 1871), OUM KX 15386.

All specimens are from the upper part of unit D in the section northeast of the village of Asfla, some 30 km north of Goulmima (province of El-Rachidia, southern Morocco). Figures 1-3 and 7 are x 2; Fig 4-6 and 8 are x 1.

PLATE 3

Figs 1-2 — *Fagesia peroni* PERVINQUIÈRE, 1907, OUM KX 15410.

Fig. 3 — *Wrightoceras muniéri* (PERVINQUIÈRE, 1907), OUM KX 15467.

Figs 4-5 — *Choffaticeras (Choffaticeras) segne* (SOLGER, 1903), OUM KX 15439.

Figs 6-8 — *Neoptychites cephalotus* (COURTILLER, 1860), OUM KX 15425.

The originals of Figs 1, 2 and 4-8 are from the upper part, the original of Fig. 3 from the lower part of unit D in the section northeast of the village of Asfla, some 30 km north of Goulmima (province of El-Rachidia, southern Morocco), all x 1.

PLATE 4

Figs 1-3 — *Fagesia peroni* PERVINQUIÈRE, 1907, OUM KX 15409.

Fig. 4 — *Romaniceras (Yubariceras) reymenti* (COLLIGNON, 1967), OUM KX 15427.

Both specimens are from the upper part of unit D in the section northeast of the village of Asfla, some 30 km north of Goulmima (province of El-Rachidia, southern Morocco), all x 1.

PLATE 5

Figs 1-2 — *Fagesia peroni* PERVINQUIÈRE, 1907, OUM KX 15413, from the upper part of unit D in the section northeast of the village of Asfla, some 30 km north of Goulmima (province of El-Rachidia, southern Morocco), x 1.

PLATE 6

Fig. 1-5 — *Neoptychites cephalotus* (COURTILLER, 1860); 1-3, OUM KX 15429; 4, 5, OUM KX 15428.

Both specimens are from the upper part of unit D in the section northeast of the village of Asfla, some 30 km north of Goulmima (province of El-Rachidia, southern Morocco), all x 1.

PLATE 7

- Figs 1-2 — *Choffaticeras (Choffaticeras) segne* (SOLGER, 1903), OUM KX 15432.
Fig. 3 — *Wrightoceras munieri* (PERVINQUIÈRE, 1907), OUM KX 15446.
Figs 4-6 — *Fagesia peroni* PERVINQUIÈRE, 1907, OUM KX15411.

All specimens are from the upper part of unit D in the section northeast of the village of Asfla, some 30 km north of Goulmima (province of El-Rachidia, southern Morocco). Figs 1, 2 and 4-6 are x 1; Fig. 3 is x 2.

PLATE 8

- Figs 1-6 — *Choffaticeras (Choffaticeras) segne* (SOLGER, 1903); 1-3, OUM KX 15433; 4-6, OUM KX 15434.

Both specimens are from the upper part of unit D in the section northeast of the village of Asfla, some 30 km north of Goulmima (province of El-Rachidia, southern Morocco), all x 1.

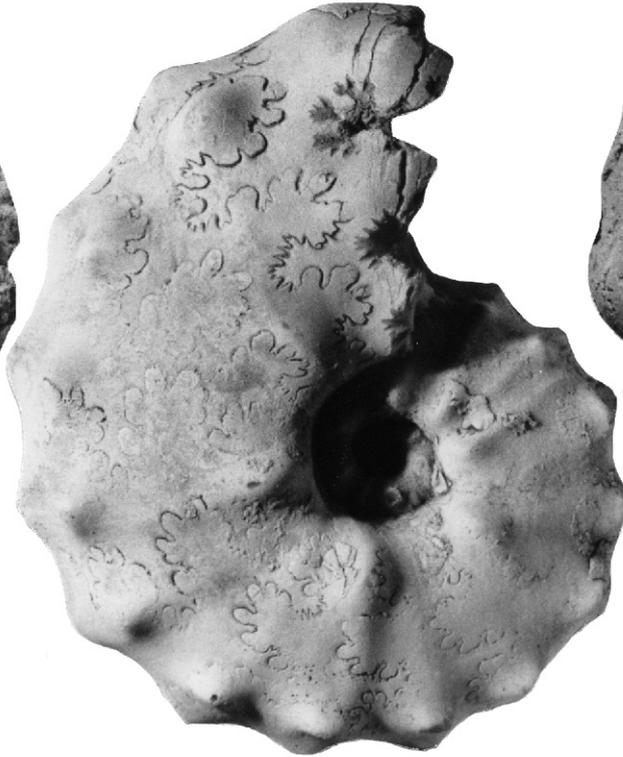
PLATE 9

- Figs 1-6, 10-11 — *Wrightoceras munieri* (PERVINQUIÈRE, 1907); 1-3, OUM KX 15444; 4-6, OUM KX 15443; 10, 11, OUM KX 15444.
Figs 7-9 — *Fagesia peroni* PERVINQUIÈRE, 1907, OUM KX 15416.

All specimens are from the upper part of unit D in the section northeast of the village of Asfla, some 30 km north of Goulmima (province of El-Rachidia, southern Morocco), all x 1.



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PLATE 1

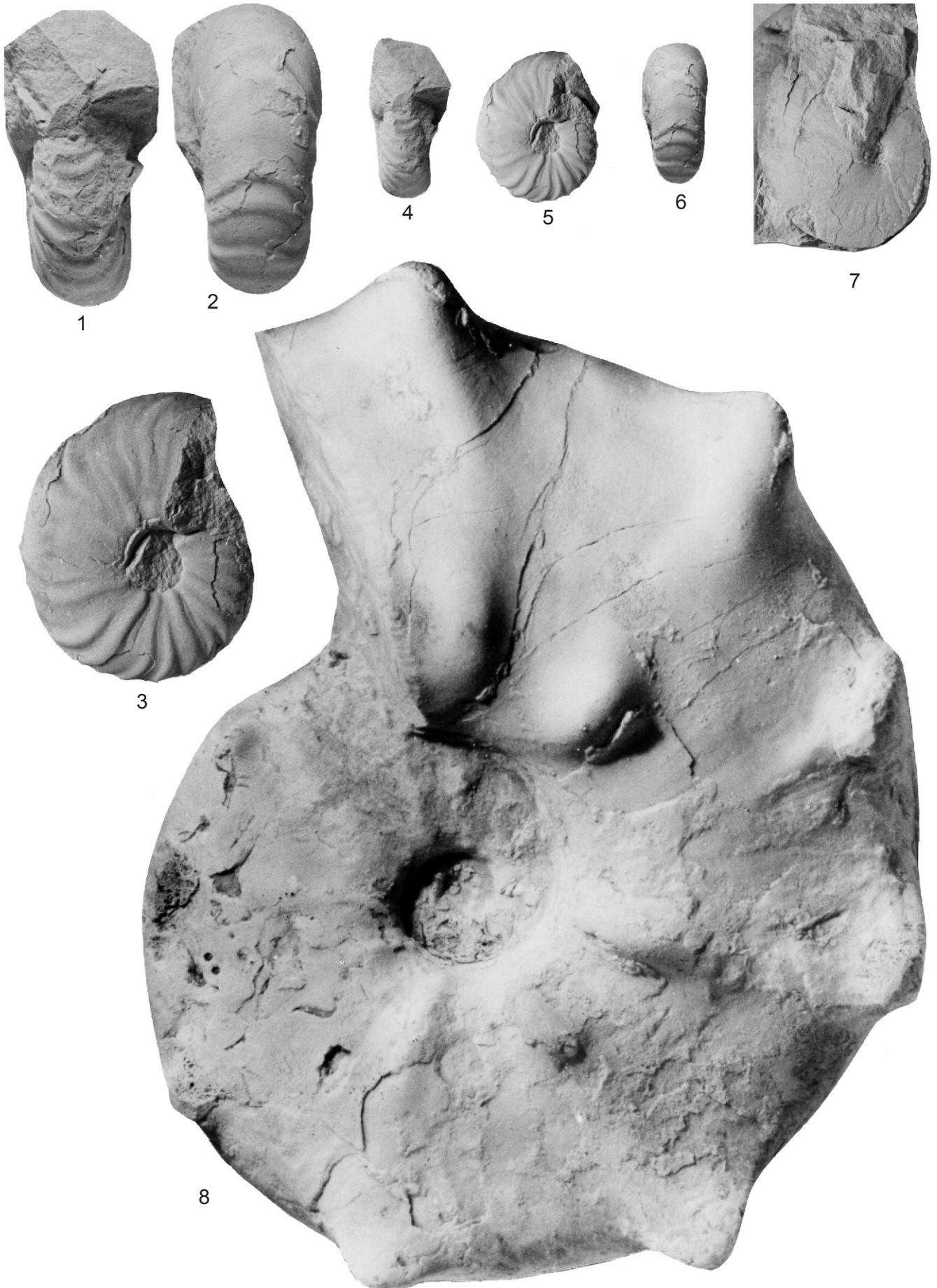


PLATE 2

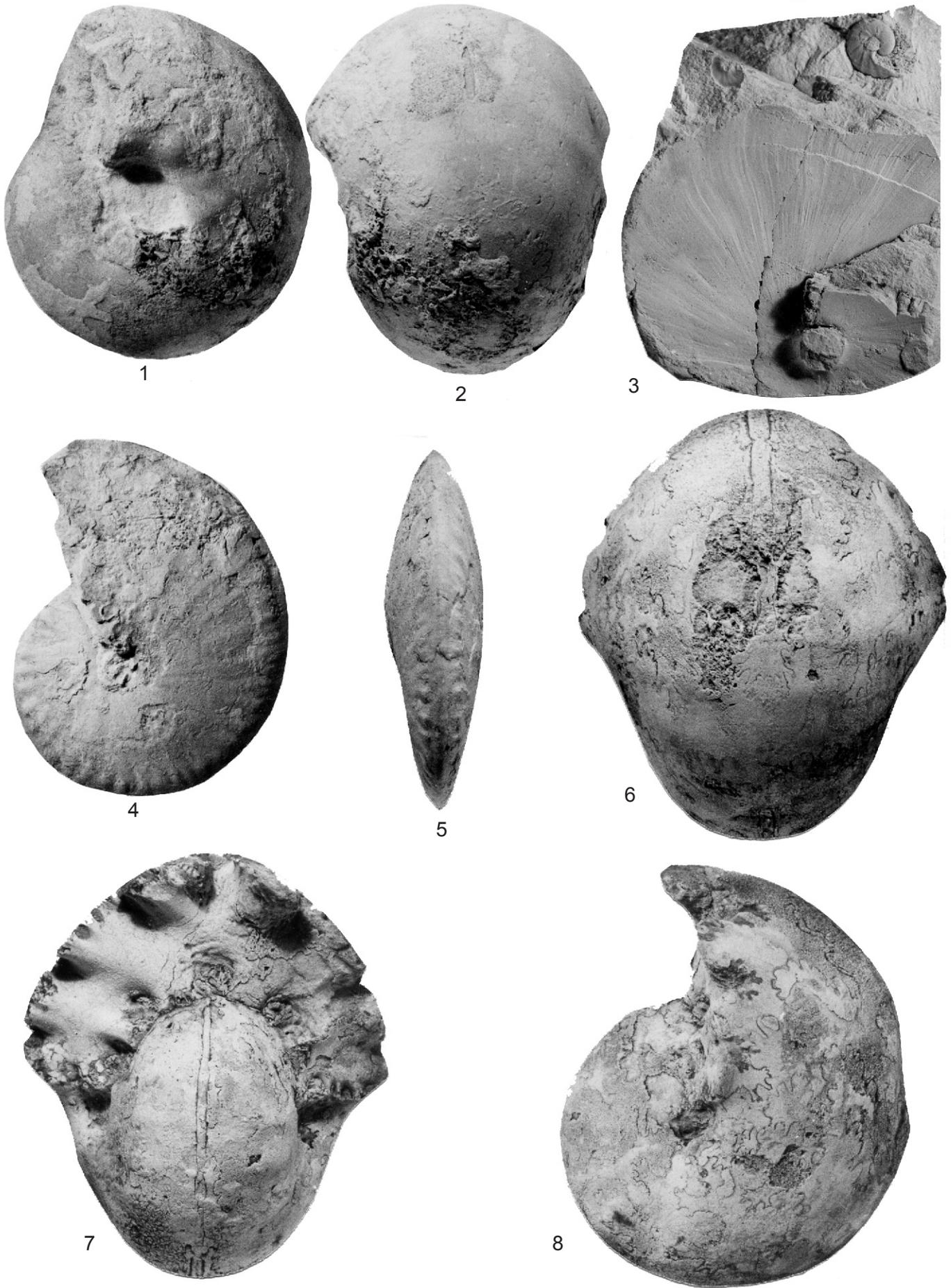


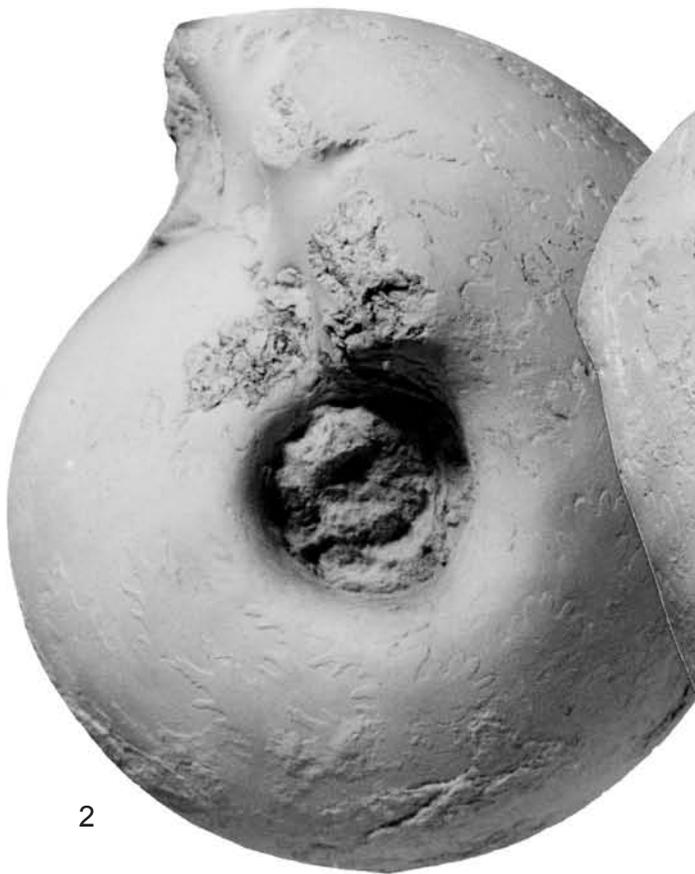
PLATE 3



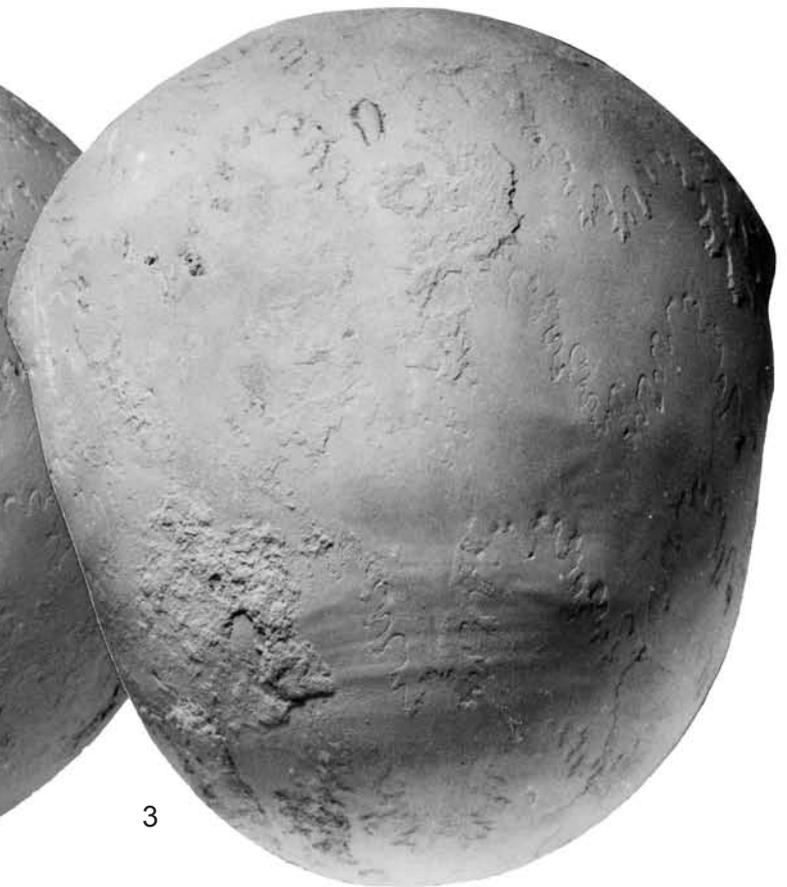
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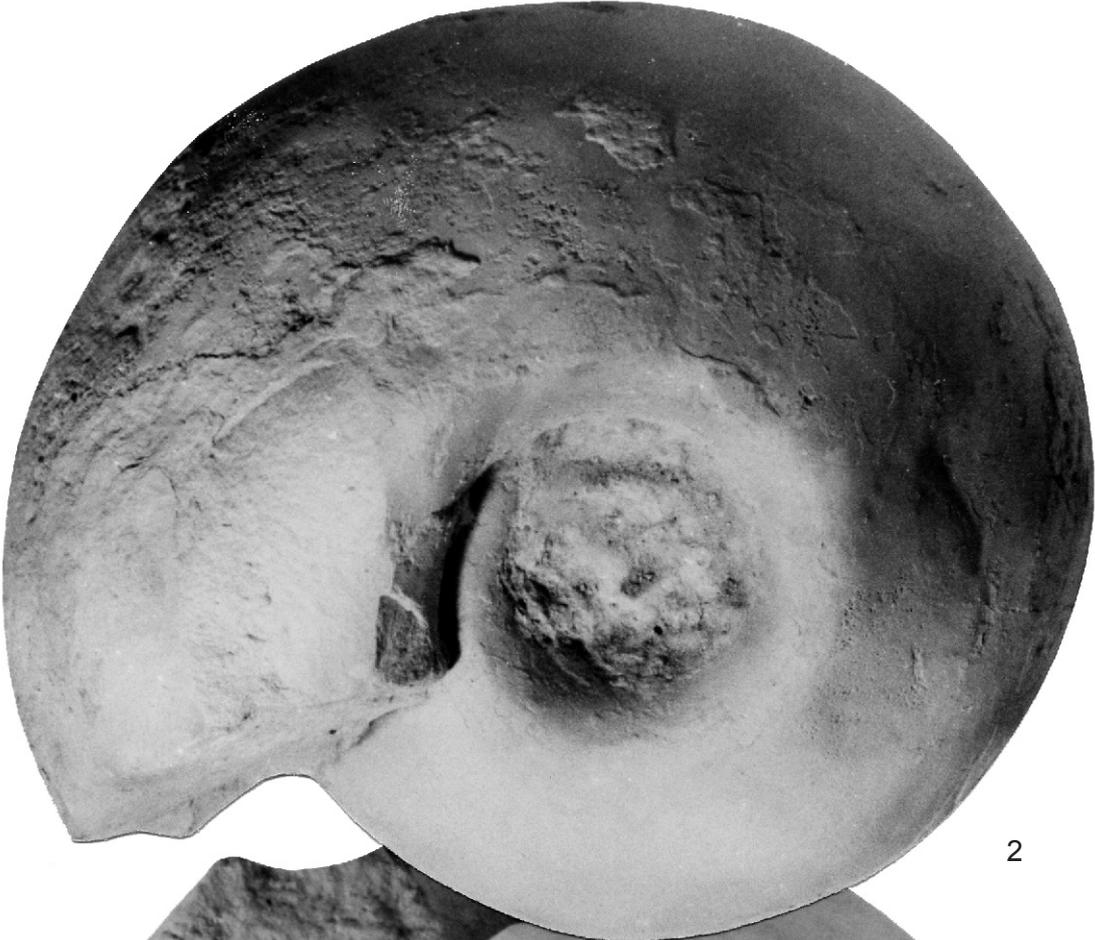
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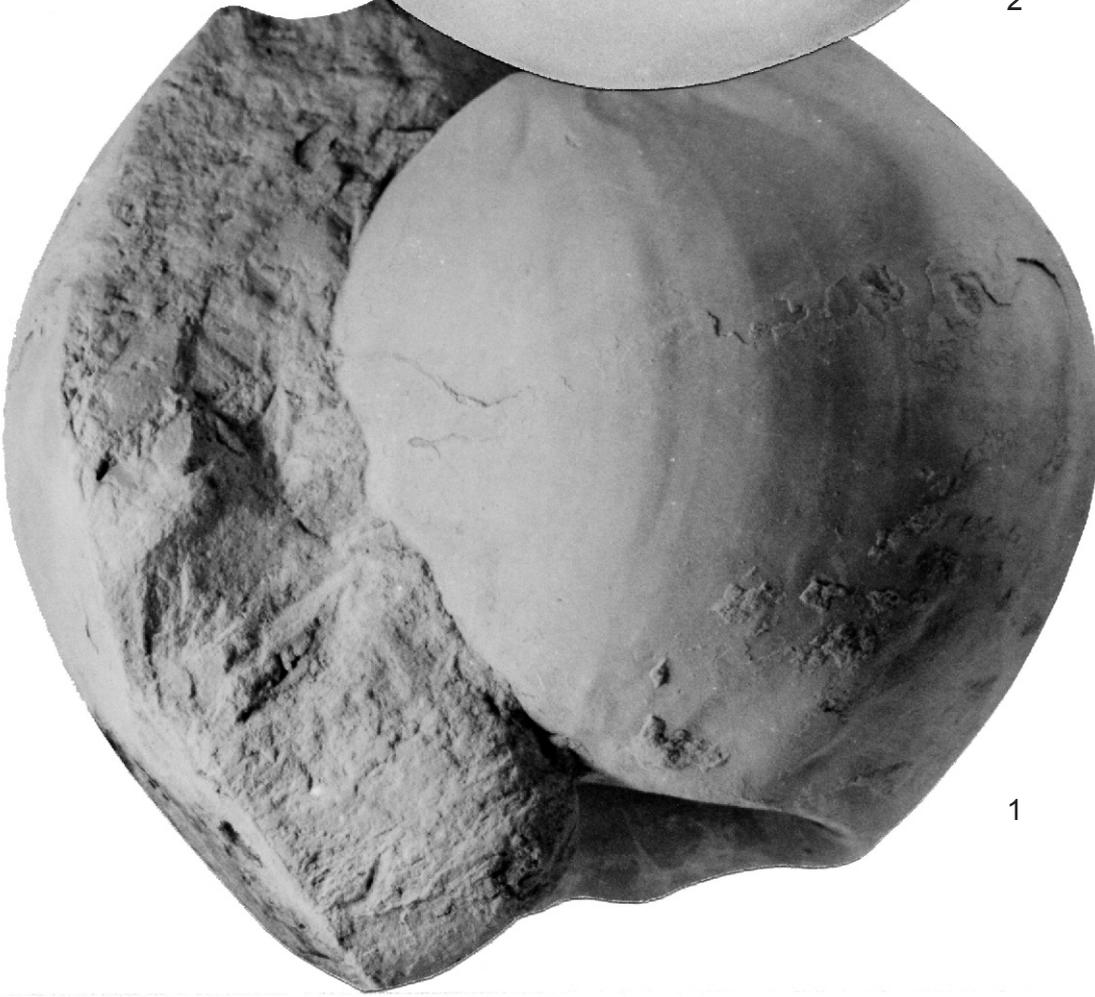
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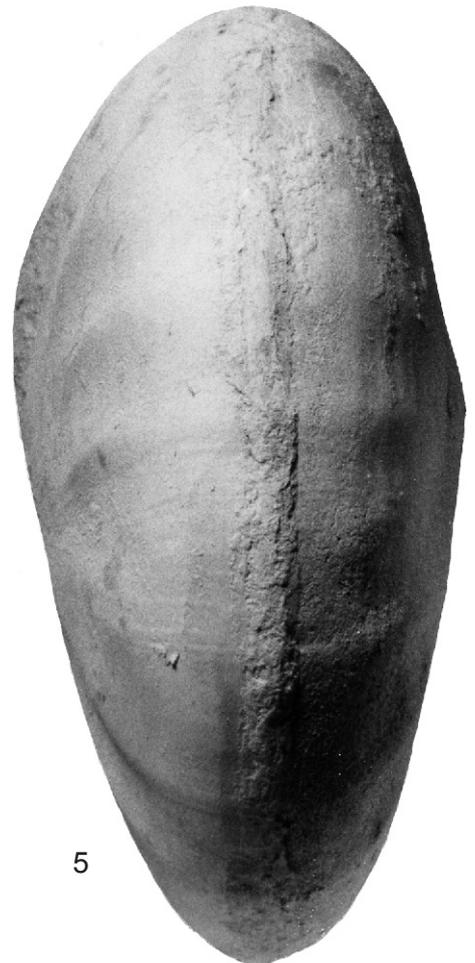
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PLATE 7



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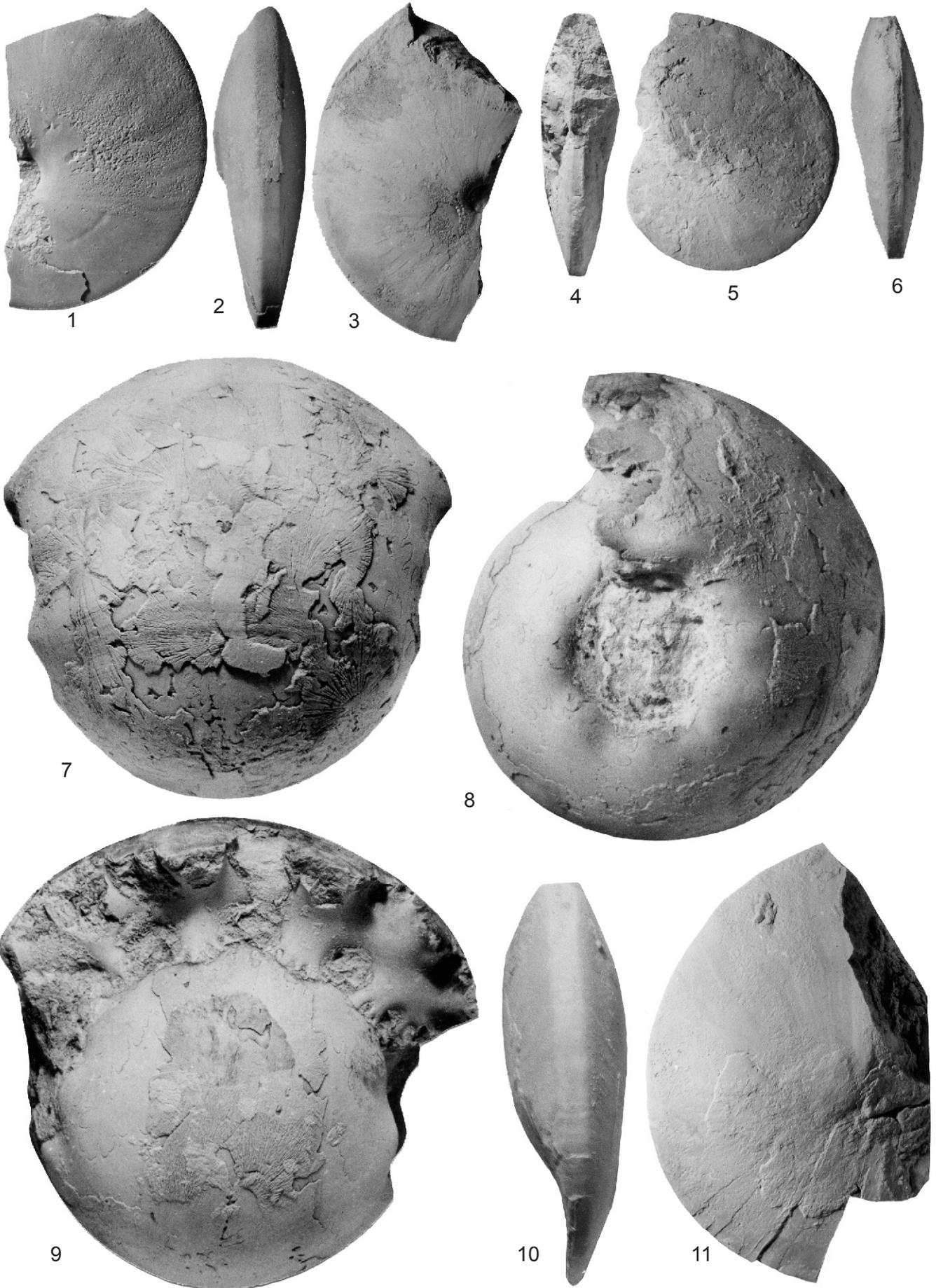


PLATE 9