

## Additional Late Cretaceous ammonite records from the Maastrichtian type area

by W. James KENNEDY & John W.M. JAGT

### Abstract

Early twentieth century subsurface collections from mine shafts in northeast Belgium and adjacent parts of the Netherlands and recent outcrop collections include ammonite assemblages of early Campanian to latest Maastrichtian age. In the present paper additional material of the pachydiscids *Eupachydiscus levyi* (DE GROSSOUVRE, 1894), *Pachydiscus (P.) launayi* DE GROSSOUVRE, 1894 and *P. (P.) colligatus* (BINKHORST, 1861) and the scaphitids *Scaphites (S.) gibbus* SCHLÜTER, 1872 and *Trachyscaphites s. spiniger* (SCHLÜTER, 1872) is described. Ammonites not recorded previously from the area include *Hauericeras (Gardeniceras) cf. rembda* (FORBES, 1846), *Pachydiscus (P.) haldemisi* (SCHLÜTER, 1867), *Patagiosites* sp., *Neancyloceras? phaleratum* (GRIEPENKERL, 1889), *Trachybaulites columna* (MORTON, 1834) and *Hoploscaphites* sp. nov. The diplomoceratid *Glyptoxoceras rugatum* (FORBES, 1846), well known from the upper Maastricht Formation and Kunrade Limestone facies of that unit, is recorded from the Vijlen Member (Gulpen Formation, early Late Maastrichtian) for the first time.

**Key-words:** Ammonoidea, Late Cretaceous, taxonomy, stratigraphy.

### Résumé

Des collections datant du début du vingtième siècle et provenant de puits de mines situés dans le nord-est de la Belgique et dans les régions voisines des Pays-Bas, ainsi que des récoltes récentes dans des affleurements incluent des assemblages d'ammonites d'âge Campanien inférieur à Maastrichtien terminal. Dans cette publication est décrit un matériel complémentaire de pachydiscidés, *Eupachydiscus levyi* (DE GROSSOUVRE, 1894), *Pachydiscus (P.) launayi* DE GROSSOUVRE, 1894 et *P. (P.) colligatus* BINKHORST, 1861 et de scaphitidés, *Scaphites (S.) gibbus* SCHLÜTER, 1872 et *Trachyscaphites s. spiniger* (SCHLÜTER, 1872).

Les ammonites non signalées antérieurement dans cette région sont: *Hauericeras (Gardeniceras) cf. rembda* (FORBES, 1846), *Pachydiscus (P.) haldemisi* (SCHLÜTER, 1867), *Patagiosites* sp., *Neancyloceras? phaleratum* (GRIEPENKERL, 1889), *Trachybaulites columna* (MORTON, 1834) and *Hoploscaphites* sp. nov. Le diplomocératidé *Glyptoxoceras rugatum* (FORBES, 1846), bien connu dans la partie supérieure de la Formation de Maastricht et dans le Calcaire de Kunrade, un faciès de cette formation, est signalé pour la première fois dans le Membre de Vijlen (Formation de Gulpen, début du Maastrichtien supérieur).

**Mots-clés:** Ammonoidea, Crétacé supérieur, taxinomie, stratigraphie.

### Introduction

Subsequent to KENNEDY's (1987) revision of, in particular, Late Maastrichtian ammonites from the type area of

that stage, re-examination of old collections as well as recent collecting at various disused quarries in the Liège-Maastricht area have yielded numerous new ammonite records, especially from Lower and Upper Campanian strata. The present account is based on collections of the Institut royal des Sciences naturelles de Belgique (Brussels), the Natuurhistorisch Museum Maastricht and on the surviving specimens of VAN DER WEIJDEN's (1943) collection at the NITG-TNO (Nederlands Instituut voor Toegepaste Geowetenschappen, formerly Geologisch Bureau Heerlen).

The scaphitids *Trachyscaphites s. spiniger* and *Scaphites (S.) gibbus* and the diplomoceratid *Glyptoxoceras rugatum* have been previously recorded from the area, but the new material is stratigraphically well documented and, in the case of the last-named species, considerably extends its stratigraphic range. The same holds true for the pachydiscids *Pachydiscus (P.) colligatus*, *P. (P.) launayi* and *Eupachydiscus levyi*. All other species described in the present paper have not been recorded previously from the area, and include the first NW European specimens of the otherwise exclusively North American baculitid *Trachybaulites columna*.

### Geographic and stratigraphic setting

The present material was collected from mine shafts in southern Limburg (Geleen-Lutterade) and Belgian Limburg (Eisden area) and from disused quarries and outcrops in the area (Fig. 1). Figure 2 illustrates the current lithostratigraphy and chronostratigraphy of Late Cretaceous strata in the (extended) Maastrichtian type area, and shows the ranges of the ammonite species.

Specimens of *Eupachydiscus levyi* and *Pachydiscus launayi* are from the Vaals Formation and lateral equivalents of this unit in the Belgian Campine area (province of Limburg) and at Battice (Liège). The Vaals Formation, and the so-called smectite facies in particular, are now well dated as early (but not earliest) Campanian (*lingua/quadrata* Zone *sensu germanico*; see CHRISTENSEN & SCHMID, 1987; JAGT, 1989; KENNEDY & JAGT, 1995) on the basis of ammonites and coleoid cephalopods.



Fig. 1. — Locality map for southern Limburg (The Netherlands) and Limburg and Liège provinces (Belgium) showing localities mentioned in the text.

Material collected from mine shafts of the former Limburg collieries, described by VAN DER WEIJDEN (1943), was originally housed at the Geologisch Bureau Heerlen (now NITG-TNO). In post-war years, however, the collections were moved several times and specimens were misplaced or disappeared altogether. The stratigraphy of the most important specimen that remains, that of *P. (P.) colligatus*, is as follows:

Shaft 1 of the Maurits colliery (Geleen-Lutterade), at a depth of 251-253 m. Associated benthic Foraminifera (HOFKER, 1957) and belemnites (VAN DER WEIJDEN, 1943; JELETZKY, 1951) suggest these strata to represent the upper part of the Vaals Formation, which has recently been shown to be coeval with the early Late Campanian Zeven Wegen Member of the Gulpen Formation (JAGT, 1988; JAGT *et al.*, 1995).

New and additional records of *Pachydiscus (P.) haldensis*, *Patagiosites* sp., *Pachydiscidae incertae sedis*, *Neancyloceras (?) phaleratum*, *Scaphites (S.) gibbus*, *Trachyscaphites s. spiniger* and baculitid lower jaws from

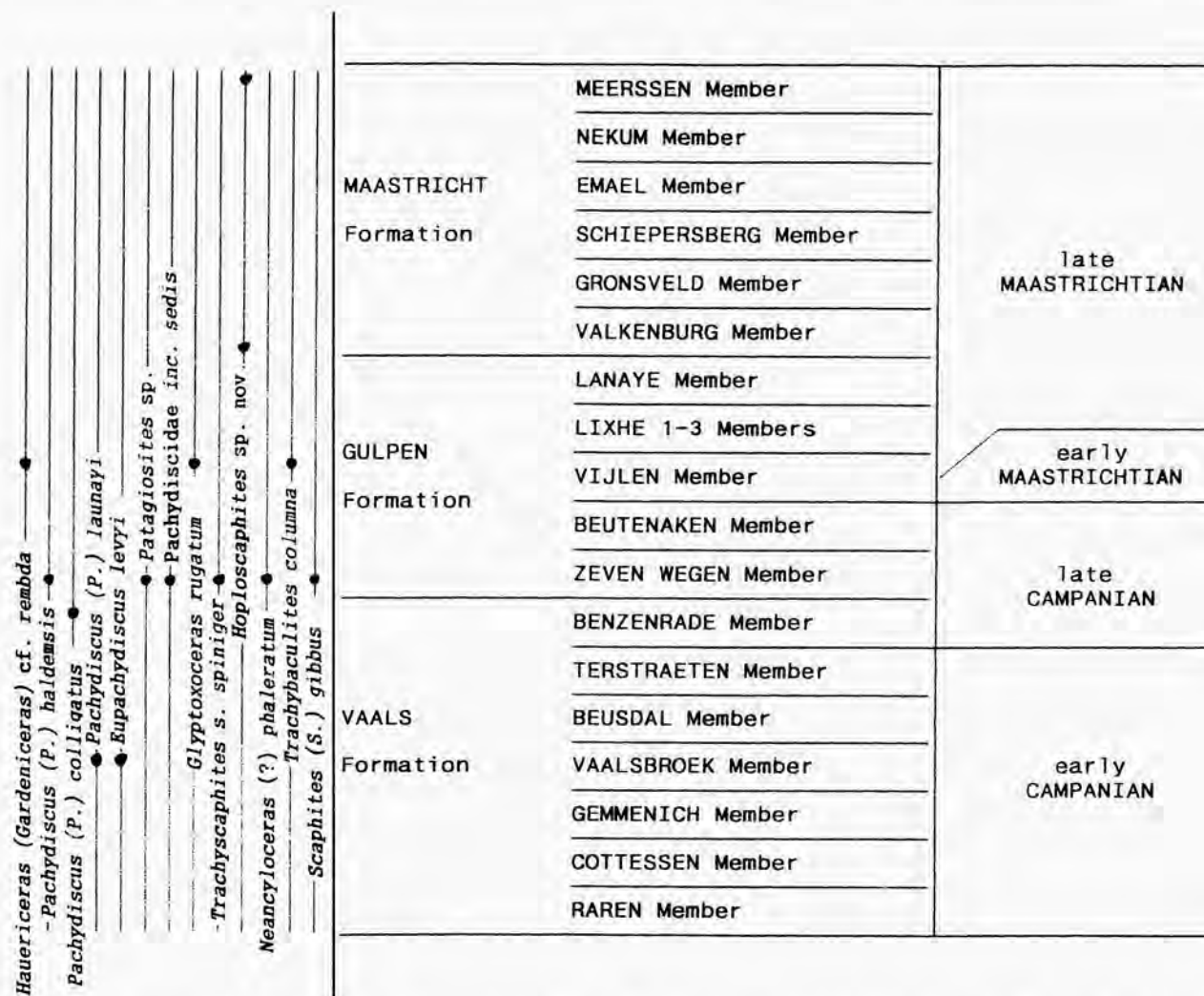


Fig. 2. — Lithostratigraphic subdivision and chronostratigraphy of late Cretaceous strata in southern Limburg and contiguous areas (modified after W.M. FELDER & BOSCH, in press), and stratigraphic provenance of ammonite species described herein.

the Zeven Wegen Member (Gulpen Formation) are of early Late Campanian age. On the basis of echinoids, asteroids and coleoid cephalopods (KEUTGEN & JAGT, in prep.) this member correlates well with the *conica/mucronata*, *basiplana/spiniger* and (part of) *roemeri* zones of the NW German standard section (SCHÖNFELD *et al.*, 1996). For the Hannover-Misburg area (Germany), NIEBUHR *et al.* (1997) have recently pointed out that genuine *Galerites roemeri* (DESOR, 1847) is confined to the upper Upper Campanian (correlatives of *langei* Zone), and that representatives of the genus *Galerites* in the lower Upper Campanian are best referred to as *G. 'vulgaris'* (see also ERNST *et al.*, 1997a, b). The lower Upper Campanian of these authors comprises, from bottom to top, the *conica/mucronata*, *stobaei/basiplana*, *'vulgaris'/basiplana* and *'vulgaris'/stolleyi* zones. This alternative interpretation is followed here. The present ammonite records from the Zeven Wegen Member corroborate such an age assignment, with typical *phaleratum* Zone (*sensu* BLASZKIEWICZ, 1980) taxa present.

Records from the Vijlen Member (Gulpen Formation), and from P.J. FELDER & BLESS's (1994; see also KEUTGEN, 1996) Intervals 5 and 6 in particular include *Hauericeras* cf. *rembda*, *Glyptoxoceras rugatum* and *Trachybaculites columna*. The two first-named taxa were collected at the CBR-Lixhe quarry, while the third species has been shown to be particularly well represented at a single outcrop at Snouwenberg (Voer, Belgium).

Two specimens of *Hoploscaphites* sp. nov. from the base and top of the Maastricht Formation are of Late Maastrichtian (*junior* Zone of authors) and latest Maastrichtian (*kazimiroviensis* Zone) age, and represent an interesting addition to the ammonite fauna of this unit, being most closely related to a late Cretaceous scaphitid stock, previously known only from Greenland.

## Conventions

The following abbreviations are used to indicate the depositories of specimens mentioned in the text: BMNH - Natural History Museum, London; IRScNB - Institut royal des Sciences naturelles de Belgique, Brussels; NHMM - Natuurhistorisch Museum, Maastricht (JJ = J.W.M. JAGT Colln; MB = M.J. VAN BIRGELEN Colln); PIB - Institut für Paläontologie, Rheinische Friedrich-Wilhelms-Universität, Bonn; NITG-TNO - Nederlands Instituut voor Toegepaste Geowetenschappen, Heerlen.

All dimensions are given in millimetres; D - diameter, Wb - whorl breadth, Wh - whorl height, U - umbilicus. Figures in parentheses are dimensions as a percentage of diameter.

## Systematic palaeontology

Suborder Ammonitina HYATT, 1889

Superfamily Desmocerataceae VON ZITTEL, 1895

Family Desmoceratidae VON ZITTEL, 1895

Subfamily Puzosiinae SPATH, 1922

For synonymy see WRIGHT & KENNEDY, 1984, p. 54 (= *Hauericeratinae* MATSUMOTO, 1938).

## Genus *Hauericeras* DE GROSSOUVRE, 1894

(= *Schlueteria* ROLLIER, 1922, p. 359, non FRITSCH in FRITSCH & KAFKA, 1887, p. 33; *Pseudogardenia* TOMLIN, 1930, p. 23).

Type species: *Ammonites pseudo-gardeni* SCHLÜTER, 1872, p. 54, pl. 16, figs. 3-6, by the original designation of DE GROSSOUVRE (1894, p. 219).

## Subgenus *Gardeniceras* MATSUMOTO & OBATA, 1955

Type species: *Ammonites gardeni* BAILY, 1855, p. 450, pl. 11, fig. 3, by the original designation of MATSUMOTO & OBATA (1955, p. 134).

## *Hauericeras* (*Gardeniceras*) cf. *rembda* (FORBES, 1846)

(Pl. 1, Fig. 1)

compare:

- \* 1846 *Ammonites rembda* FORBES, p. 111, pl. 7, fig. 3.
- 1992a *Hauericeras rembda* (FORBES, 1846) - KENNEDY & HENDERSON, p. 408, pl. 6, figs. 10-24; pl. 17, fig. 1; text-fig. 3h (with synonymy).
- 1993 *Hauericeras rembda* (FORBES, 1846) - WARD & KENNEDY, p. 24, fig. 16.7.
- 1995 *Hauericeras rembda* (FORBES, 1846) - COBBAN & KENNEDY, p. 4, figs. 2.6, 2.7, 3.

## DESCRIPTION

NHMM 1994631 is a fragmentary composite mould with a maximum preserved whorl height of 8.5 mm, and an estimated original diameter of 20 mm. Coiling is evolute, the umbilicus shallow, with a subvertical wall and narrowly rounded umbilical shoulder. The flanks are feebly convex and subparallel. The surface of the mould is smooth, but for a single feebly biconvex prospiradial constriction.

## DISCUSSION

The fragmentary nature of the specimen makes specific identification difficult, but the overall proportions and form of constrictions suggest *H. (G.) rembda*. Reference is made to KENNEDY & HENDERSON (1992a) for a revision of the type material, which is comparable in size to the present specimen.

## OCCURRENCE

The present specimen is from the lower four metres of the Vijlen Member as exposed at the CBR-Lixhe quarry (early Late Maastrichtian). *Hauericeras (G.) rembda* is otherwise known from the Upper Maastrichtian of South India, the Biscay region of Spain, and the Maastrichtian of Madagascar, Zululand (South Africa) and Sumter County, Alabama.

Family Pachydiscidae SPATH, 1922

Genus and subgenus *Pachydiscus* VON ZITTEL, 1884

Type species: *Ammonites neubergicus* VON HAUER, 1858,

p. 12, pl. 2, figs. 1-3; pl. 3, figs. 1, 2, by the subsequent designation of DE GROSSOUVRE (1894, p. 177).

*Pachydiscus (Pachydiscus) haldemsi* (SCHLÜTER, 1867)  
(Pl. 1, Figs. 2-4)

- \* 1867 *Ammonites haldemsi* SCHLÜTER, p. 19, pl. 3, fig. 1.
- 1894 *Pachydiscus koeneni* DE GROSSOUVRE, p. 178.
- 1984 *Pachydiscus (Pachydiscus) haldemsi* (SCHLÜTER, 1867) - KENNEDY & SUMMESBERGER, p. 158, pl. 4, figs. 1-5; pl. 5, fig. 1; pl. 6, fig. 2; pl. 7, figs. 1-11; pl. 13, fig. 1 (with synonymy).
- 1986a *Pachydiscus (Pachydiscus) haldemsi* (SCHLÜTER, 1867) - KENNEDY, p. 45, pl. 4, figs. 1-3; pl. 5, figs. 7-14; text-figs. 11a-d, 17.
- 1997 *Pachydiscus (Pachydiscus) haldemsi* (SCHLÜTER, 1867) - KENNEDY & CHRISTENSEN, p. 92, fig. 11 (with additional synonymy).

TYPES

Lectotype of *Ammonites haldemsi* is PIB 22a in the SCHLÜTER Collection, the original of his pl. 3, fig. 1, designated by KENNEDY & SUMMESBERGER (1984, p. 158). The lectotype of *Pachydiscus koeneni*, designated by KENNEDY & SUMMESBERGER (1984, p. 158) is PIB 50b, the original of SCHLÜTER (1872, p. 63, pl. 19, figs. 3, 4). Paralectotype PIB 50a is the original of SCHLÜTER (1872, p. 63, pl. 20, fig. 9, and possibly pl. 19, fig. 5).

DESCRIPTION

We follow KENNEDY & SUMMESBERGER (1984) and KENNEDY & CHRISTENSEN (1997) in regarding the lectotype of *Ammonites haldemsi* SCHLÜTER, 1867 (p. 19, pl. 3, fig. 1; pl. 4, figs. 5, 6) as a microconch, of which the macroconch is *Pachydiscus koeneni* DE GROSSOUVRE, 1894 (= *Ammonites galicianus* SCHLÜTER, 1872, pl. 19, figs. 3-5; pl. 20, fig. 9, non FAVRE, 1869).

NHMM GK 3704 (W.M. FELDER Colln) is a crushed composite mould of a macroconch fragment with a maximum preserved whorl height of 38.5 mm. The whorl section appears to have been compressed oval, the umbilicus shallow, the umbilical wall flattened, and the umbilical shoulder narrowly rounded. Eight primary ribs arise at the umbilical seam and strengthen across the umbilical wall and shoulder. They are straight, narrow and prorsiradiate on the inner flank, sweeping forwards and feebly concave on the outer flank and ventrolateral shoulder and feebly convex across the venter, where they reach their maximum strength. There are one or two long or short intercalated ribs, arising on the inner to outer flank and strengthening across the ventrolateral shoulder to match the primary ribs and give a total of eighteen ribs in all on the fragment.

OCCURRENCE

Middle/upper part of Zeven Wegen Member as exposed at the CBR-Lixhe quarry. The type material is from Haldem, Stemweder Berg (northern Germany). Elsewhere the species characterises the lower Upper Campa-

nian, and is known from northern Ireland, Norfolk (England), Köpinge (southern Sweden), the Gschlieffgraben (Austria), Poland, the Ukraine and Turkmenia.

*Pachydiscus (Pachydiscus) colligatus* (BINKHORST, 1861)  
(Pl. 3, Figs. 1-3)

- \* 1861 *Ammonites colligatus* BINKHORST, p. 25 (*pars*), pl. 8, fig. 1 only.
- 1943 *Pachydiscus colligatus* (BINKHORST) - VAN DER WEIJDEN, p. 123 (*pars*).? pl. 13, fig. 4.
- 1986a *Pachydiscus (Pachydiscus) colligatus* (BINKHORST, 1861) - KENNEDY, p. 36, text-figs. 13, 14.
- 1987 *Pachydiscus (Pachydiscus) colligatus* (BINKHORST, 1861) - KENNEDY, p. 162, pl. 1, figs. 1, 2; pl. 2, figs. 1, 2; pl. 3; pl. 4, figs. 4, 5 (with complete synonymy).
- 1997 *Pachydiscus colligatus* - WARD & ORR, p. 412, fig. 4-7.
- 1997 *Pachydiscus (Pachydiscus) colligatus* (BINKHORST, 1861) - KENNEDY & CHRISTENSEN, p. 88, figs. 7-10.

TYPES

Lectotype, by subsequent designation of KENNEDY (1986a, p. 36) is the original of BINKHORST (1861, pl. 8), an unregistered specimen in the collections of the Museum für Naturkunde, Humboldt Universität (Berlin), from the Upper Campanian of Jauche, Brabant (Belgium). The surviving paralectotypes belong to a range of other species, as discussed by KENNEDY (1987), who reillustrated the lectotype (KENNEDY, 1986a, text-fig. 13a, b; 1987, pls. 1, 2).

DESCRIPTION

A single specimen (NITG/TNO, no. P.246), the original of VAN DER WEIJDEN (1943, p. 123, *pars*) from the 'Heruvian' (= Vaals Formation) of the former Maurits colliery, shaft 1, Geleen-Lutterade, southern Limburg (The Netherlands), at a depth of 251-253 m.

Dimensions

D	Wb	Wh	Wb:Wh	U
153.0(100)	72.5(47.4)	77.5(50.7)	0.94	25.0(16.3)
-(-)	52.3(-)	51.5(-)	1.02	-(-)
4.0(100)	37.5(58.5)	32.5(50.8)	1.15	-(-)

Specimen is a wholly septate internal mould of half a whorl. The broken face shows the whorl section to be initially depressed and reniform, thereafter becoming equidimensional, and eventually slightly compressed with a whorl breadth to height ratio of 0.94 at a diameter of 153 mm. The inner whorl at a diameter of 64 mm shows well-developed umbilical bullae and primary ribs, perhaps ten per half whorl, on the inner flank. On the outer whorl the umbilicus is of moderate depth, with a markedly convex umbilical wall that is undercut on the internal mould. The umbilical shoulder is broadly rounded, the inner flanks very broadly rounded, the outer

flanks converging to a broadly arched venter. Eight primary ribs per half whorl arise at the umbilical seam and strengthen across the umbilical wall and shoulder, where they are initially incipiently bullate. They give rise to pairs of low long ribs, while additional ribs intercalate both low and high on the flank to give a total of 28 ribs on the ventrolateral shoulder of the fragment. The ribs are straight and prorsiradiate on the inner to mid-flank, flexing forwards and feebly concave on the outermost flanks and ventrolateral shoulders, where they strengthen, to cross the venter in a shallow convexity interrupted on the mould by a narrow groove marking the siphonal line. The suture is deeply and intricately subdivided, as is typical for the genus.

#### DISCUSSION

KENNEDY (1987) provided an exhaustive discussion of this much misinterpreted species. The present specimen is comparable to juveniles from northern Aquitaine (e.g. DE GROSSOUVRE, 1894, pl. 33; KENNEDY, 1986a, text-fig. 14).

#### OCCURRENCE

Where precisely dated, this is an early Late Campanian species, known from Brabant (Belgium), northern Aquitaine (France), Madagascar and possibly Tercis, Landes (France) and the present record from southern Limburg (The Netherlands). WARD & ORR (1997) have recently recorded this species from the upper Upper Campanian of Tercis (SW France). In southern Sweden, the species occurs in the uppermost Lower Campanian at Ivö Klack (KENNEDY & CHRISTENSEN, 1997).

#### *Pachydiscus (Pachydiscus) launayi* DE GROSSOUVRE, 1894 (Pl. 6, Figs. 1, 2)

- \* 1894 *Pachydiscus launayi* DE GROSSOUVRE, p. 184, pl. 19.
- 1986a *Pachydiscus (Pachydiscus) launayi* DE GROSSOUVRE, 1894 - KENNEDY, p. 38, pl. 2, figs. 1, 2; pl. 7, figs. 6, 7; pl. 10, fig. 15; pl. 13, figs. 2, 3, 6; text-figs. 4c, 5b (with full synonymy).
- 1989 *Pachydiscus (Pachydiscus) aff. launayi* DE GROSSOUVRE, 1894 - JAGT, p. 8, pl. 6, figs. 2-5.

#### TYPE

The holotype, by monotypy, is an unregistered specimen formerly in the Sorbonne Collections, in the Université de Paris VI, but recently transferred to the Muséum national d'Histoire naturelle (Paris), the original of DE GROSSOUVRE (1894, pl. 2, figs. 1, 2) from the Lower Campanian, lower part of Assize P1 at Voulgezac, Charente (France).

#### MATERIAL

IRScNB 10373 from the 'Hervian' of Voort (Charbonnage Zolder), province of Limburg (Belgium), shaft 1, at a depth of 535 m.

#### DESCRIPTION

Coiling of this crushed, wholly septate composite internal

mould is moderately involute, the umbilicus comprising 29% of the diameter approximately. Nineteen to twenty primary ribs arise on the umbilical wall, and strengthen across the umbilical shoulder. They are incipiently bullate, relatively strong, straight and prorsiradiate across the inner to middle flank, projecting forwards and concave on the outer flank. There are one or two intercalated ribs that arise low on the flank, and may be tenuously linked to the incipient bullae; the total rib density is forty per whorl.

#### DISCUSSION

KENNEDY (1986a, p. 38) revised the type and other material from northern Aquitaine (France) and discussed differences from other species.

#### OCCURRENCE

Lower Campanian of northern Aquitaine, southeast Netherlands, northeast Belgium and Madagascar.

#### Genus *Eupachydiscus* SPATH, 1922

Type species: *Ammonites isculensis* REDTENBACHER, 1873, p. 122, pl. 29, fig. 1, by the original designation of SPATH (1922, p. 124).

#### *Eupachydiscus levyi* (DE GROSSOUVRE, 1894) (Pl. 4, Figs. 1-3; Pl. 5, Figs. 1-3; Pl. 6, Figs. 3, 4)

- 1861 *Ammonites colligatus* BINKHORST, p. 25 (*pars*), pl. 7, fig. 1 only.
- \* 1894 *Pachydiscus levyi* DE GROSSOUVRE, p. 178, pl. 21; pl. 30, figs. 1, 2.
- 1987 *Eupachydiscus cf. levyi* (DE GROSSOUVRE, 1894) - KENNEDY, p. 163, pl. 5, figs. 1, 2.
- 1988 *Eupachydiscus levyi* DE GROSSOUVRE, 1893 - THOMEL, p. 39, pl. 8, fig. 2; pl. 9, figs. 2-4; pl. 11, figs. 1, 2; pls. 12-16; pl. 17, fig. 1; pl. 20; text-fig. 1 (with full synonymy).
- 1995 *Eupachydiscus levyi* (DE GROSSOUVRE 1894) - WIPPICH, p. 54, pl. 2, figs. 5-8; pl. 3, figs. 5-9; pl. 4, figs. 10-12; pl. 5, figs. 1-3; text-figs. 6-8.

#### TYPE

The holotype, by original designation, is the original of DE GROSSOUVRE (1894, pl. 21), an unregistered specimen in the Sorbonne Collections, now in the Université Paris VI (Pierre et Marie Curie), from the Lower Campanian of Contes-les-Pins, Alpes-Maritimes (France).

#### MATERIAL

IRScNB 10374 (*ex C. UBAGHS* Colln, IG 6521), from the 'Hervian' of Teuven; IRScNB 10375 (*ex A. RUTOT* Colln, IG 5425), from the 'Hervian' of Battice (Croix Polinard); IRScNB 10376 (IG 9435) from the Charbonnage Limburg-Meuse (Eisden), shaft 2, at a depth of 407 m; NHMM 1993056a, b (plaster cast, *ex M.J. VAN BIRGELEN* Colln), from the upper 6-8 metres of the Vaals Formation, CPL SA quarry, Haccourt (Liège).

## DESCRIPTION

All specimens are crushed composite moulds. The best preserved is IRScNB 10376, which is wholly septate to a diameter of 250 mm. Coiling is moderately evolute, the umbilicus comprising 27.6% of the diameter, shallow, with a flattened umbilical wall and broadly rounded umbilical shoulder. The inner flanks appear to have been broadly rounded, the outer flanks flattened and convergent, with broadly rounded ventrolateral shoulders and venter. There are twelve to thirteen ribs on the umbilical wall, where they are low and poorly differentiated. They strengthen into pronounced umbilical bullae that give rise to narrow, very distant primary ribs. These are strong, straight and prorsiradiate on the inner to mid-flank, but weaken, flex slightly forwards and are feebly concave on the outer flank, and cross the venter in a very shallow convexity. There are two shorter intercalated ribs between primaries at the beginning of the outer whorl, connected to the umbilicus by mere striae, the adapical one arising on the outer flank, the adapertural one a little below mid-flank. These are reduced to a single intercalatory at the largest preserved diameter. There are quite strong growth lines and striae on the surface of the composite mould between the ribs. The inner whorls are poorly visible, but seem to have been densely ribbed with more primaries and long secondaries per whorl than on the outermost whorl of the specimen. IRScNB 10375 is a coarsely ornamented fragment, while IRScNB 10374 shows what may be the inner whorls of this species at a diameter of 103 mm. There are an estimated fourteen umbilical bullae of variable strength; these give rise to straight, distant primary ribs, with two or three intercalated ribs.

Much larger are NHMM 1993056a and b from the Vaals Formation at Haccourt, fragments of the same specimen with whorl heights of *c.* 63 and 78 mm, showing the coarse ornament of large phragmocones.

## DISCUSSION

THOMEL (1988) provided an extensive revision of the present species, and illustrated a range of topotypes from Contes-les-Pins. The present material differs in no significant respect from that described by him.

## OCCURRENCE

Lower Campanian of northeastern Belgium, southeast Netherlands, northern Germany and Alpes-Maritimes, France.

Genus *Patagiosites* SPATH, 1953

Type species: *Ammonites patagiosus* SCHLÜTER, 1867, p. 22, pl. 4, figs. 4, 5, by the original designation of SPATH (1953, p. 38) = *Ammonites stobaei* NILSSON (1827, p. 5, pl. 1, figs. 1, 2).

*Patagiosites* sp.

(Pl. 1, Figs. 5, 6)

## DESCRIPTION

NHMM 1994632/1-2 (*ex* JAGT Colln, no. 8047a, b) are

fragmentary crushed, composite moulds of the same specimen. The smaller fragment is a portion of phragmocone with a maximum preserved whorl height of 45 mm. The inner flanks are feebly convex, the outer flanks convergent, the venter broadly rounded. The surface of the mould is smooth, but for two poorly differentiated prorsiradiate constrictions, the adapical one preceded by a feeble collar rib on the flanks that strengthens markedly on ventrolateral shoulders and venter. The larger fragment is also wholly septate, with a maximum preserved whorl height of 85 mm.

## DISCUSSION

The present fragments differ from *Patagiosites stobaei* (NILSSON, 1827) (see revision in KAPLAN *et al.*, 1996, p. 31, pl. 7, figs. 1, 2; pl. 10, figs. 1, 2; pl. 11, figs. 1-6; pl. 12, figs. 1-4, 8; pl. 13, figs. 1-9; pl. 14, figs. 1-6; pl. 15, figs. 1-4; pls. 16, 17; pl. 18, figs. 1-3; pl. 41) and KENNEDY & CHRISTENSEN, 1997, p. 95, figs. 13-17) in the absence of ribs. They may well belong to *P. griffithi* (SHARPE, 1855) (p. 28, pl. 11, fig. 3), but are inadequate for confident identification.

## OCCURRENCE

Zeven Wegen Member, *c.* 12-13 metres below top, at CPL SA quarry, Haccourt (Liège).

*Pachydiscidae incertae sedis*

(Pl. 1, Figs. 11, 12)

## DISCUSSION

NHMM JJ 7508 is a tiny pachydiscid only 14 mm in diameter. Coiling appears to have been moderately involute, the whorl section depressed reniform. Flank ornament is of coarse ribs, all of which appear to have been primaries. They are prorsiradiate on the flank, and transverse on the venter. There are five ventral tubercles on the adapertural part of the fragment, at which the ribs join in pairs, and are in turn linked across the venter by a broad rib that may be doubled. The specimen appears to be a microconch pachydiscid, resembling *Pseudomenuites katschthaleri* IMMEL *et al.*, 1982 (p. 20, pl. 7, figs. 2-5), from the Santonian of Brandenberg (Tirol, Austria).

## OCCURRENCE

Zeven Wegen Member, 9-10 metres below top, at CPL SA quarry, Haccourt (Liège).

Suborder Ancyloceratina WIEDMANN, 1966

Superfamily Turrilitaceae GILL, 1871

Family Diplomoceratidae SPATH, 1926

Subfamily Diplomoceratinae SPATH, 1926

Genus *Glyptoxoceras* SPATH, 1925

Type species: *Hamites rugatus* FORBES, 1846, p. 117, pl. 11, fig. 2, by the original designation of SPATH (1925, p. 30).

***Glyptoxoceras rugatum*** (FORBES, 1846)  
(Pl. 1, Fig. 7)

- \* 1846 *Hamites rugatus* FORBES, p. 117, pl. 11, fig. 2.  
1992 *Glyptoxoceras rugatum* (FORBES, 1846) - HENDERSON *et al.*, p. 143, figs. 8-13 (with full synonymy).  
? 1993 *Glyptoxoceras* cf. *rugatus* FORBES, 1846 - HANCOCK & KENNEDY, p. 164, pl. 15, figs. 1-12; pl. 17, fig. 9; pl. 20, figs. 5-8, 12, 13.  
1993 *Glyptoxoceras rugatum* (FORBES, 1846) - WARD & KENNEDY, p. 49, figs. 8.14, 43.10-43.12, 45.4.  
1993 *Glyptoxoceras rugatum* (FORBES, 1846) - KENNEDY & HANCOCK, p. 592.

## TYPE

Lectotype, by the subsequent designation of KENNEDY & HENDERSON (1992b, p. 696), is BMNH C51110, the original of FORBES (1846, pl. 11, fig. 2) from the Upper Maastrichtian of Pondicherry (South India).

## DISCUSSION

A series of very crushed fragments from the Zeven Wegen Member (Gulpen Formation) of the CPL SA quarry (Haccourt), which may belong here, and a single specimen (NHMM JJ 7093) from the Vijlen Member, have whorl heights of up to 14 mm, and a rib index of five. They can be matched in fragments from Pondicherry (KENNEDY & HENDERSON, 1992b), and those figured by HENDERSON *et al.* (1992), who discussed differences from other species referred to the genus.

## OCCURRENCE

Vijlen Member, 3-5 metres above base, at CBR-Lixhe quarry. The species is typically Maastrichtian in age, with records from South India, Brazil, Chile (?), western Australia and the Biscay region of France and Spain. In the Liège-Maastricht area the species is well known from the upper Maastricht Formation and the so-called Kunrade Limestone facies of that unit (KENNEDY, 1987).

Genus *Neancyloceras* SPATH, 1926

Type species: *Hamites bipunctatus* SCHLÜTER, 1872, p. 98, pl. 29, figs. 1-3, by the original designation of SPATH (1926, p. 80).

***Neancyloceras* (?) *phaleratum*** (GRIEPENKERL, 1889)  
(Pl. 1, Figs. 8-10)

- \* 1889 *Hamites phaleratus* GRIEPENKERL, p. 406, pl. 44, fig. 3; pl. 45, figs. 3, 4.  
1980 *Neancyloceras phaleratum* (GRIEPENKERL, 1889) - BLASZKIEWICZ, p. 28, pl. 11, figs. 1, 2, 4-8; pl. 12, figs. 1-4, 6-9 (with synonymy).  
1984 *Pseudoxybeloceras* (*Parasolenoceras*) cf. *phaleratus* (GRIEPENKERL, 1889) - KENNEDY & SUMMESBERGER, p. 168, pl. 6, figs. 4, 5; pl. 10, figs. 5, 6.  
1991 *Pseudoxybeloceras* (*Parasolenoceras*) *phaleratum* (GRIEPENKERL) - NIEBUHR & ERNST, p. 262, pl. 2, fig. 3.

## TYPE

Lectotype, by the subsequent designation of BLASZKIEWICZ (1980, p. 28), is the original of GRIEPENKERL (1889, pl. 45, fig. 3) from the "Mucronaten-Schichten des Steindorenberges bei Lauingen" (Lower Saxony, Germany).

## DESCRIPTION

NHMM 1994633 (*ex* JAGT Colln, no. 8173) is a very crushed composite mould of a wholly septate shaft and the beginning of a curved sector of the shell, 71 mm long, with a maximum preserved whorl height of 21 mm. The original whorl section cannot be determined because of *post-mortem* crushing, but the dorsum was rounded in costal and intercostal section, the inner flanks feebly convex, the outer flanks flattened and convergent, the venter rounded in intercostal section and flattened in costal section. Ornament is of coarse ribs, grouped in pairs and separated by wider interspaces. Transverse on the dorsum, they are straight and prorsiradiate on the flanks, joining at strong ventral clavi. Opposite clavi are linked across the venter by a broad, rounded swelling bearing two poorly differentiated ribs. On the curved sector, these paired ribs are replaced by a coarse single rib or incipiently split rib bearing coarse ventral clavi.

## DISCUSSION

The present specimen closely resembles the original of GRIEPENKERL's plate 45, figure 3. The generic assignation of this species remains problematic, as discussed by KLINGER (1982).

## OCCURRENCE

The present specimen is from the Zeven Wegen Member, 12-15 metres below top, at CPL SA quarry, Haccourt (Liège). The species is also known from the lower Upper Campanian of Germany; in Poland it is the index of the late Campanian *phaleratum* Zone of BLASZKIEWICZ (1980).

Family Baculitidae GILL, 1871

Genus *Trachybaculites* COBBAN & KENNEDY, 1995

Type species: *Baculites columna* MORTON, 1834, p. 44, pl. 19, fig. 8, by original designation.

***Trachybaculites columna*** (MORTON, 1834)  
(Pl. 2, Figs. 1-6)

- \* 1834 *Baculites columna* MORTON, p. 44, pl. 19, fig. 8.  
1995 *Trachybaculites columna* (MORTON, 1834) - COBBAN & KENNEDY, p. 29, figs. 10.1, 10.3, 13.4-13.6, 14.3, 14.9, 17.1-17.14, 17.17-17.31 (with full synonymy).  
1996 *Baculites* (?) sp. 2 KEUTGEN, pp. 71, 73, 193, fig. 24.

## MATERIAL

Some twenty specimens, NHMM JJ 8882a, JJ 8883 and NHMM MB 1175-1 and MB 1253-15.

## DESCRIPTION

All specimens are crushed composite moulds of fragments up to 55 mm long, with whorl heights of up to 10.5 mm. The shell is straight, the whorls expanding slowly. Ornament consists of coarse distant ribs, effaced and transverse on the dorsum, strengthening across the dorsolateral margin, concave on the inner to middle flank, projecting forwards on the outer flank and crossing the venter in a broad convexity. The rib index is 3.

## DISCUSSION

The material differs in no significant respect from the types, and represents the first record of this species from outside North America.

## OCCURRENCE

Currently known only from the Vijlen Member (Interval 6 of P.J. FELDER & BLESS, 1994) at the CPL SA and CBR-Lixhe quarries (Liège), where it is comparatively rare, and from a mass occurrence at a temporary outcrop near Snouwenberg (Voer, northeast Belgium) exposing correlative strata. The types are from the Late Maastrichtian Prairie Bluff Chalk of Alabama; there are also records from the Late Maastrichtian of Mississippi, Texas, California and South Dakota.

**aptychus of *Baculites***

(Pl. 2, Figs. 16-18)

## DESCRIPTION

The Late Campanian (Zeven Wegen Member, Gulpen Formation) at CPL SA-Haccourt, Heure-le-Romain and CBR-Lixhe has yielded a number of well-preserved aptychi (lower jaw) that can be assigned to the form genus *Rugaptychus* TRAUTH, 1927, corresponding to *Aptychus rugosus* SHARPE, 1857 (p. 57, pl. 24, figs. 8, 9). SCHLÜTER (1876, pl. 39, fig. 16) figured a specimen (now lost) with a variant on this type associated with a large, specifically indeterminate baculitid from the "Mucronatenkreide" of Lüneburg. The reader is referred to KENNEDY & CHRISTENSEN (1997, p. 112, fig. 31) for a discussion of jaws of this type.

Superfamily Scaphitaceae GILL, 1871

Family Scaphitidae GILL, 1871

Subfamily Scaphitinae GILL, 1871

Genus and subgenus *Scaphites* PARKINSON, 1811

(= *Anascaphites* HYATT, 1900, p. 572; *Jahnites* HYATT, 1900, p. 572; *Holcoscaphites* NOWAK, 1911, p. 564).

Type species: *Scaphites equalis* J. SOWERBY, 1813, p. 53, pl. 18, figs. 1-3, by the subsequent designation of MEEK (1876, p. 413).

***Scaphites (Scaphites) gibbus* SCHLÜTER, 1872**  
(Pl. 2, Fig. 7)

- \* 1872 *Scaphites gibbus* SCHLÜTER, p. 87, pl. 26, figs. 6-9.
- 1995 *Scaphites (Scaphites) gibbus* SCHLÜTER, 1872 - JAGT *et al.*, p. 56, pl. 3, figs. 4-10.
- 1995 *Scaphites gibbus* SCHLÜTER 1872 - WIPPICH, p. 62, pl. 1, figs. 13-15; pl. 11, figs. 10-12.
- 1996 *Scaphites (Scaphites) gibbus* SCHLÜTER, 1872a - KAPLAN *et al.*, p. 44, pl. 34, figs. 1-3; pl. 35, figs. 1, 2; pl. 36, figs. 1-5; pl. 37, figs. 1-4; pl. 38, figs. 1-3, 5-11; pl. 39, figs. 1-7; pl. 40, figs. 1-6 (with full synonymy).

## TYPE

SCHLÜTER referred to thirty specimens and figured two (1872, pl. 26, figs. 6-9). ATABEKIAN & KHAKIMOV (1976, p. 71) referred to the original of SCHLÜTER's figs. 7-9 as the holotype but this was not a valid lectotype designation. BLASZKIEWICZ (1980, p. 32) designated the same specimen lectotype. It is PIB 63, a macroconch from the Campanian of the Baumberge between Coesfeld and Billerbeck (Westfalen, Germany), refigured by KAPLAN *et al.* (1996, pl. 34, figs. 1-3). The figured paralectotype (SCHLÜTER, 1872, pl. 26, fig. 6; refigured by KAPLAN *et al.*, 1996, pl. 38, figs. 6, 7) is an unregistered microconch in the same collection and from Darup (Westfalen).

## DISCUSSION

NHMM JJ 7876 is part of the adapertural end of the phragmocone, showing coarse, straight, prorsiradiate ribs with occasional small ventrolateral tubercles; the maximum preserved whorl height is 20 mm. Although a fragment only, the specimen clearly belongs to *S. (S.) gibbus*. Reference is made to KAPLAN *et al.* (1996) for a comprehensive revision of the species.

## OCCURRENCE

Late Early to early Late Campanian of Germany, the Mons Basin (Belgium), Aquitaine (France), Poland, Donbass, the Netherlands, the Ukraine and Kazakhstan. The present specimen is from the Zeven Wegen Member, c. 12 metres below top, at CBR-Lixhe.

Genus *Trachyscaphites* COBBAN & SCOTT, 1964

Type species: *Trachyscaphites redbirdensis* COBBAN & SCOTT, 1964, p. E7, pl. 1, figs. 1-7; text-fig. 3, by original designation.

***Trachyscaphites spiniger spiniger* (SCHLÜTER, 1872)**  
(Pl. 2, Figs. 8, 9)

- 1841 *Scaphites pulcherrimus* ROEMER, p. 91 (*pars*), pl. 14, fig. 4.
- \* 1872 *Scaphites spiniger* SCHLÜTER, p. 82, pl. 25, figs. 1-7.



- 1992 *Trachyscaphites spiniger spiniger* (SCHLÜTER, 1872) - COBBAN & KENNEDY, p. 86, pl. 1, figs. 2, 3; pl. 7, figs. 1, 2, 5, 9; pl. 8, figs. 1-9; text-fig. 4a.
- 1993 *Trachyscaphites* cf. *spiniger* (SCHLÜTER, 1872) - KENNEDY, p. 113, pl. 7, fig. 13.
- 1996 *Trachyscaphites spiniger posterior* BLASZKIEWICZ - NIEBUHR, p. 276, pl. 4, fig. 7.
- 1997 *Trachyscaphites spiniger spiniger* (SCHLÜTER, 1872) - KENNEDY & CHRISTENSEN, p. 116, figs. 33-37.

## TYPE

Lectotype, by the subsequent designation of BLASZKIEWICZ (1980, p. 31) is the original of SCHLÜTER (1872, pl. 25, figs. 1-3), a macroconch, from the Upper Campanian of Darup (Westfalen, Germany), an unregistered specimen in the Institut für Paläontologie, Universität Bonn (PIB). Paralectotypes are PIB 61a, the original of SCHLÜTER (1872, pl. 25, fig. 4) from the "Hügelgruppe" of Haldem, an adult microconch and PIB 61b, from the same horizon and locality, the original of SCHLÜTER (1872, pl. 25, fig. 6).

## DISCUSSION

NHMM JJ 7982 is a phragmocone with a maximum preserved whorl height of 22 mm; NHMM JJ 7830 a fragment of the venter of a phragmocone; NHMM JJ 8747 a very crushed individual, seemingly a small microconch, 50 mm long. The specimens differ in no respect from typical examples of this species, fully documented by KENNEDY & CHRISTENSEN (1997).

*Trachyscaphites spiniger posterior* BLASZKIEWICZ, 1980 (p. 31, pl. 13, fig. 4; pl. 14, figs. 1-7; pl. 15, figs. 2, 3; pl. 30, fig. 2) was differentiated from the nominate subspecies because of the "smaller number of ribs running between the tubercles of the same row on the exposed part of normal spiral and the presence of lateroumbilical tuberculation on earlier sectors of the exposed, normal spiral. It also differs on the whole in a smaller degree of freeing the shaft from phragmocone and in a frequent lack of ribs between the tubercles on the same row on the shaft". The holotype is a microconch; we regard it as a synonym of *T. s. spiniger*. In contrast, *T. s. porchi* (ADKINS, 1929) (p. 205, pl. 5, figs. 1-3), of which *Scaphites aricki* (ADKINS, 1929) (p. 206, pl. 5, figs. 7, 8) is a synonym (see COBBAN & SCOTT, 1964, p. E10, pl. 2, figs. 1-23; pl. 3, figs. 1-11; text-fig. 4), differs from the nominate subspecies in having fewer tubercles in all rows on the body chamber and generally lacking the dense ribbing of the present specimens. *Trachyscaphites s. levantinensis* LEWY, 1969 (p. 132, pl. 4, fig. 1), from the Upper Campanian of Israel, is based on a microconch and is a synonym of *T. s. porchi*.

*Trachyscaphites pulcherrimus* (ROEMER, 1841) (see KENNEDY & SUMMESBERGER, 1984, p. 171, pl. 11, figs. 1, 2, 10-22; pl. 13, figs. 2-6; KENNEDY & COBBAN, 1994, p. 108, figs. 8.7, 8.11, 11.1-11.12) is easily distinguished from *T. spiniger* by the presence of five rows of flank tubercles as well as a siphonal row.

## OCCURRENCE

Lower to upper Upper Campanian of Germany, Köpinge, Tosterup and Fredriksberg (southern Sweden), the Ukraine, Armenia, Turkmenistan, the Netherlands and Poland. The present specimens are from the Zeven Wegen Member at the CPL SA-Haccourt and CBR-Lixhe quarries (Liège). Specimens from correlative strata in southern Limburg (The Netherlands) include NHMM GK 965 and NHMM GK 1116 (see KENNEDY, 1987, pl. 36, figs. 1-5) from Vijlenerbosch and NHMM GK 4741, a fragmentary microconch, from Malensbos.

Genus *Hoploscaphites* NOWAK, 1911

(= *Mesoscaphites* ATABEKIAN, 1979, p. 523; *Tovebirkelundites* COOPER, 1994, p. 183).

Type species: *Ammonites constrictus* J. SOWERBY, 1817, p. 189, pl. A, fig. 1, by the original designation of NOWAK (1911, p. 565).

## DISCUSSION

See KENNEDY (1986b) for a discussion of the genus *Hoploscaphites*. *Mesoscaphites* is a *nomen nudum* based on a typical *H. constrictus*. *Hoploscaphites* (*Tovebirkelundites*) COOPER, 1994 (p. 183) has *H. schmidi* BIRKELUND, 1982 (p. 17, pl. 1, figs. 7-10; pl. 2, figs. 1-4) as type species and the subgenus was characterised by the presence of conspicuous siphonal tubercles on the body chamber. The lectotype of *H. constrictus* (see KENNEDY, 1986b, p. 68, pl. 13, figs. 20-22) already has a siphonal swelling on the body chamber, and *Tovebirkelundites* appears to be a synonym of *Hoploscaphites* *sensu stricto*.

*Hoploscaphites* sp. nov.  
(Pl. 2, Figs. 10-15)

## DESCRIPTION

A fragmentary body chamber and a number of fragments from the base of the Valkenburg Member and from the top of the Meerssen Member (Maastricht Formation), respectively, represent a large, undescribed species of *Hoploscaphites*. A silicone cast of the phragmocone, taken from a natural external mould is an estimated 55 mm in diameter. Coiling is very involute, the small, deep umbilicus comprising 14% of the diameter, with a feebly concave wall and sharp umbilical shoulder. The whorl section is compressed with flattened subparallel flanks, broadly rounded ventrolateral shoulders and a feebly convex venter. On the adapical 90° sector of the outer whorl ornament is of relatively distant wiry flexuous prorsiradiate primary ribs on the inner to middle flank that increase by branching and intercalation on the outer flank. Over the remainder of the phragmocone this ornament is replaced by dense, crowded, flexuous prorsiradiate ribs that increase by branching and intercalation both low and high on the flanks, the ribs straight on the inner flank,

flexed back and convex across the middle of the flank, swept forwards and concave on the outer flank and crossing the venter in a very feeble convexity. A fragment from the adapertural end of the phragmocone and adapical end of the body chamber shows this delicate ornament to extend (or the internal mould at least) to the end of the phragmocone, beyond which the flanks bear low, broad folds associated delicate riblets and striae, and tiny ventral clavi.

A second fragment comprises the venter of the final hook of the body chamber, flanks preserved to a height of 30 mm, and the constricted adult aperture. It is covered in very fine, dense, prorsiradiate riblets and lirae, concave on the outer flank, and crossing the venter in a very shallow convexity. On the adapical part of the fragment, the ribs and lirae link at minute ventral tubercles, joined across the venter by two or three delicate riblets/lirae.

#### DISCUSSION

These fragmentary specimens belong to a large *Hoploscaphites* allied to the *Scaphites* (*Discoscaphites*) *waagei* BIRKELUND, 1965/*S. (D.) angmartussutensis* BIRKELUND, 1965 group, from the Late Maastrichtian of western Greenland. The shape of the phragmocone is very similar (compare BIRKELUND, 1965, pl. 38, fig. 2), but the ornament of the present material is much finer. The develop-

ment of folds on the adapical part of the body chamber, and of ventral tubercles, are further features in common (compare BIRKELUND, 1965, pl. 39, fig. 1; pl. 40, fig. 1). It is likely that a new taxon is represented but the material is inadequate for formal description.

#### OCCURRENCE

The present fragments are the only specimens known to date: NHMM MB 1303 is from the base of the Maastricht Formation (*junior* Zone of authors) as exposed at the Blankenberg quarry (Cadier en Keer), and NHMM 1994644 (*ex* DORTANGS Colln) is from the uppermost Meerssen Member, and of *kazimiroviensis* Zone age (JAGT, 1996).

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### Captions

#### PLATE 1

- Fig. 1. — *Hauericeras (Gardeniceras) cf. rembda* (FORBES, 1846), NHMM 1994631, CBR-Lixhe quarry, lower 4 metres of Vijlen Member (Gulpen Formation), x 2.
- Figs. 2-4. — *Pachydiscus (P.) haldemsi* (SCHLÜTER, 1867), NHMM GK 3704 (W.M. FELDER Colln), CBR-Lixhe quarry, Zeven Wegen Member (Gulpen Formation), x 1.
- Figs. 5, 6. — *Patagiosites* sp., NHMM 1994632/1-2 (ex JAGT Colln, no. 8047a, b), CPL-SA quarry, Haccourt; Zeven Wegen Member (Gulpen Formation), x 1.
- Fig. 7. — *Glyptoxoceras rugatum* (FORBES, 1846), NHMM JJ 7093, CBR-Lixhe quarry, Vijlen Member (Gulpen Formation), x 1.
- Figs. 8-10. — *Neancyloceras? phaleratum* (GRIEPENKERL, 1889), NHMM 1994633 (ex JAGT Colln, no. 8173a), CPL SA quarry, Haccourt; Zeven Wegen Member (Gulpen Formation), x 1.
- Figs. 11, 12. — *Pachydiscidae incertae sedis*, NHMM JJ 7508, CPL SA quarry, Haccourt; Zeven Wegen Member (Gulpen Formation), x 2.

#### PLATE 2

- Figs. 1-6. — *Trachybaculites columna* (MORTON, 1834), NHMM MB 1175/1a-f, Snouwenberg (Voer, Belgium); Vijlen Member (Gulpen Formation), x 1.
- Fig. 7. — *Scaphites (S.) gibbus* SCHLÜTER, 1872, NHMM JJ 7876, CPL SA quarry, Haccourt; Zeven Wegen Member (Gulpen Formation), x 1.
- Figs. 8, 9. — *Trachyscaphtes spiniger spiniger* (SCHLÜTER, 1872), NHMM 1994635 (ex JAGT Colln, no. 8747), and NHMM 1994634 (ex JAGT Colln, no. 7982), CPL SA quarry, Haccourt; Zeven Wegen Member (Gulpen Formation), respectively, x 1.
- Figs. 10-15. — *Hoploscaphtes* sp. nov., 10, 11 are NHMM MB 1303, Blankenberg quarry, Cadier en Keer; base Valkenburg Member (Maastricht Formation), x 1; 12-15 are NHMM 1994644 (ex DORTANGS Colln), Ankerpoort-Curfs quarry, Geulhem; top Meerssen Member (Maastricht Formation), x 1.

- Figs. 16-18. — Baculitid aptychus of *Rugaptychus rugosus* type, 16 is the original of SHARPE (1857, pl. 24, fig. 9), Norwich Castle Museum Collections, from the 'Upper Chalk' of Norwich; 17, 18 are NHMM JJ 6309, CPL SA quarry, Haccourt; Zeven Wegen Member (Gulpen Formation), x 1.

## PLATE 3

- Figs. 1-3. — *Pachydiscus (P.) colligatus* (BINKHORST, 1861), NITG-TNO P. 246, Maurits colliery (Geleen-Lutterade), shaft 1, depth 251-253 m (mentioned by VAN DER WEIJDEN, 1943), x 1.

## PLATE 4

- Figs. 1-3. — *Eupachydiscus levyi* (DE GROSSOUVRE, 1894), NHMM 1993056a (plaster cast of no. 787a in the van BIRGELEN Colln), CPL SA quarry, Haccourt; Vaals Formation, x 1 (see also Plate 5).

## PLATE 5

- Figs. 1-3. — *Eupachydiscus levyi* (DE GROSSOUVRE, 1894), NHMM 1993056b (plaster cast of no. 787b in the van BIRGELEN Colln), CPL SA quarry, Haccourt; Vaals Formation, x 1 (see also Plate 4).

## PLATE 6

- Figs. 1, 2. — *Pachydiscus (P.) launayi* DE GROSSOUVRE, 1894, IRScNB 10373, Voort-Charbonnage Zolder, shaft 1, at a depth of 535 m; 'Hervian' (= Vaals Formation equivalents), x 2.  
Figs. 3, 4. — *Eupachydiscus levyi* (DE GROSSOUVRE, 1894), IRScNB 10376, Charbonnage Limburg-Meuse (Eisden), shaft 2, at a depth of 407 m; 'Hervian' (= Vaals Formation equivalents), x 0.5.

PLATE 1



1



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3



4



5



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PLATE 2

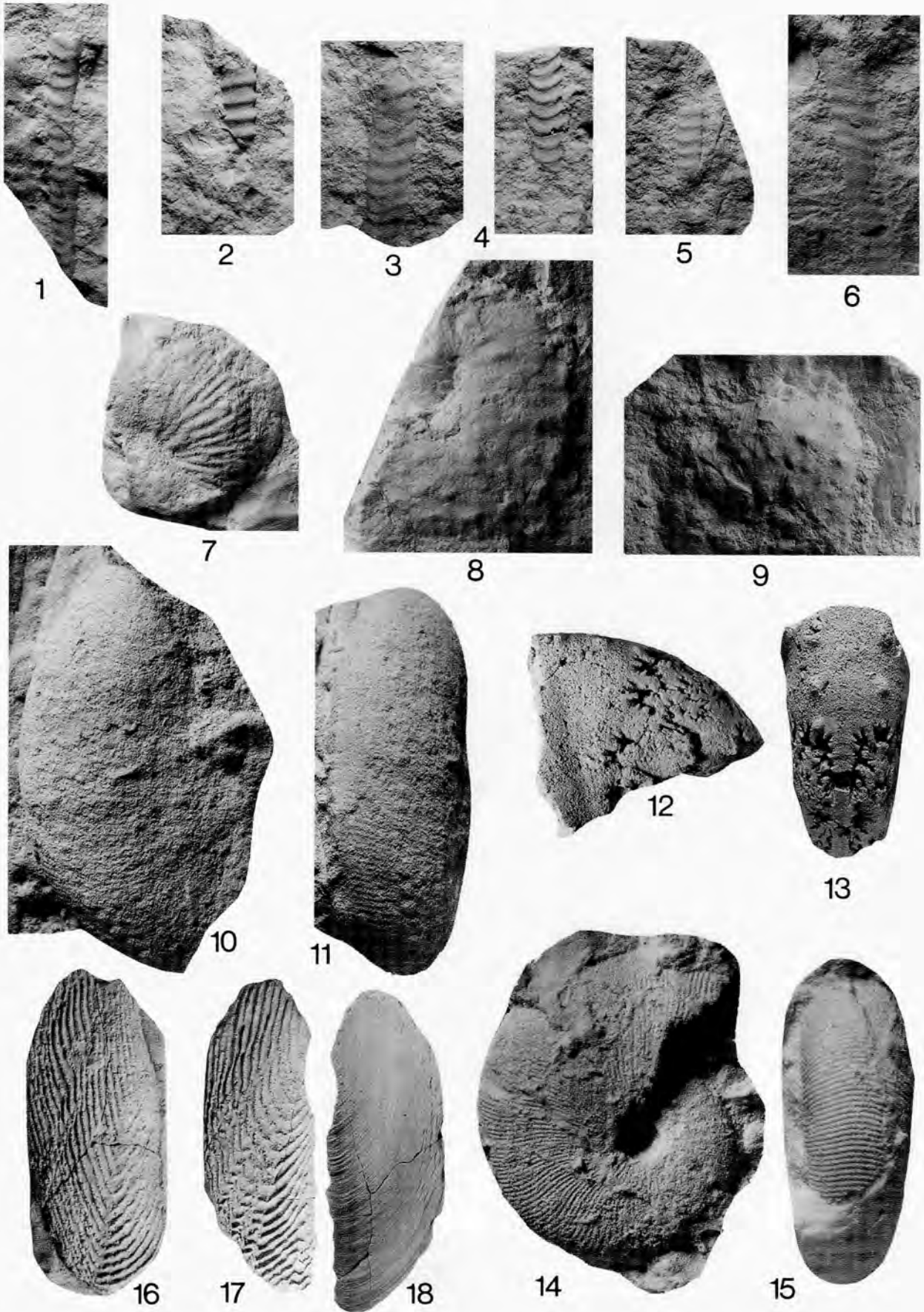




PLATE 3



3



2



1

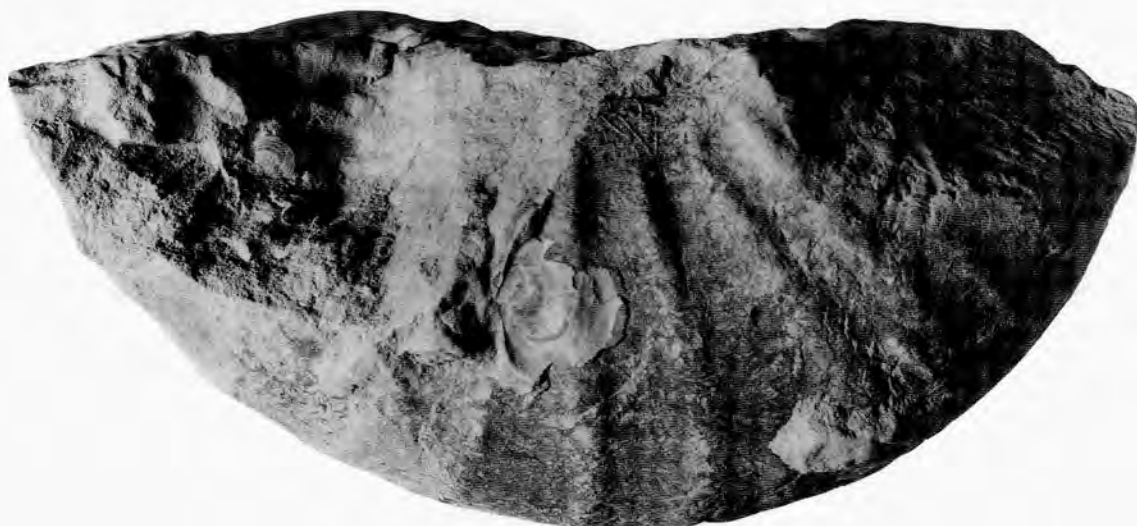
PLATE 4



3



2



1

PLATE 5



3



2



1

PLATE 6

