

The Campanian-Maastrichtian ammonite sequence in the environs of Maastricht (Limburg, the Netherlands), Limburg and Liège provinces (Belgium)

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with 10 figures

Abstract. The Campanian and Maastrichtian ammonites from the environs of Maastricht, Limburg, The Netherlands and Limburg and Liège Provinces, Belgium are revised on the basis of the collections of the Museum für Naturkunde, Berlin (the BINKHORST Collection), Institut Royal des Sciences Naturelles de Belgique (Brussels) and Naturhistorisch Museum, Maastricht. The Vaals Formation yields a Lower Campanian assemblage at most localities, but there is an unexpected record of the Upper Maastrichtian *H. marroti* (COQUAND 1859) from Vijlen, near Cottessen. Important Upper Campanian records from the Zeven-Wegen Chalk are *Hoplitoplacenticeras coesfeldiense* (SCHLÜTER 1867) and *Trachyscaphites spiniger* (SCHLÜTER 1872) from Vijlenerbosch. Diagnostic Lower Maastrichtian ammonites are few, with only poorly localised specimens of *Acanthoscaphites tridens* (KNER 1848). *Hoploscaphites tenuistriatus* (KNER 1848), a species which spans the Lower-Upper Maastrichtian boundary elsewhere in Europe, occurs in the Vijlen Chalk at Mesch.

The celebrated Upper Maastrichtian fauna of the Calcaire de Kunraed is equivalent to that present in the Nekum and Lower Meerssen Chalk. The Upper part of the Meerssen Chalk yield *crassus* forms of *Hoploscaphites constrictus* (J. SOWERBY 1817) and most (but not all) of the *Sphenodiscus binkhorsti* BÖHM, 1898 recorded from the area. The types of *Pachydiscus colligatus* of BINKHORST (1861) are shown to cover four species of *Pachydiscus* with true *colligatus* a Campanian species unknown in the environs of Maastricht.

1 Introduction

The town of Maastricht in Limburg Province, The Netherlands (Text-figs. 1, 2), lends its name to the highest, Maastrichtian stage of the Cretaceous, while the generally accepted stratotype of the stage is in the quarry at St. Pietersberg, below Lichtenberg Farm (DUMONT 1849, MOURLON 1878, ROMEIN 1962 provides the most readily accessible account). Ammonites from this area and adjacent parts of Limburg and Liège Provinces in Belgium are of great importance for our understanding of Maastrichtian stratigraphy and palaeontology. Among early descriptions are those of FAUJAS-SAINT-FOND (1799), LAMARCK (1801, 1822), DEFRANCE (1816) and BLAINVILLE (1825). BOSQUET listed the ammonites of the Cretaceous of Limburg

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Province in 1860, but the first comprehensive account is that of J. T. BINKHORST (1861) who described some thirteen species. Some of these were reviewed by de GROSSOUVRE (1908), while HOLZAPFEL (1887–1888) and VAN DER WEIJDEN (1943) noted Campanian species. There is no recent work other than brief notes by VAN DER TUUK & ZILJSTRA (1979) and FELDER (1968), while I recently summarised ammonite distributions in the area, largely gleaned from published sources (KENNEDY 1984).

In 1982 my colleague Dr. A. V. DHONDT of the Institut Royal des Sciences Naturelles de Belgique invited me to study the ammonites of the Maastricht area, Limburg and Liège Provinces housed in that Institute. I subsequently visited the collections of the Naturhistorisch Museum, Maastricht, through the courtesy of Dr. A. W. F. MEIJER and Mr. P. J. FELDER, and studied the BINKHORST Collection, now in the Museum für Naturkunde, Berlin, through the courtesy Dr. H. JAEGER. These collections form the basis for a taxonomic revision of the Maastrichtian ammonites of the area, to be published elsewhere (KENNEDY, in press).

I here summarise in brief form the stratigraphic distribution of these faunas.

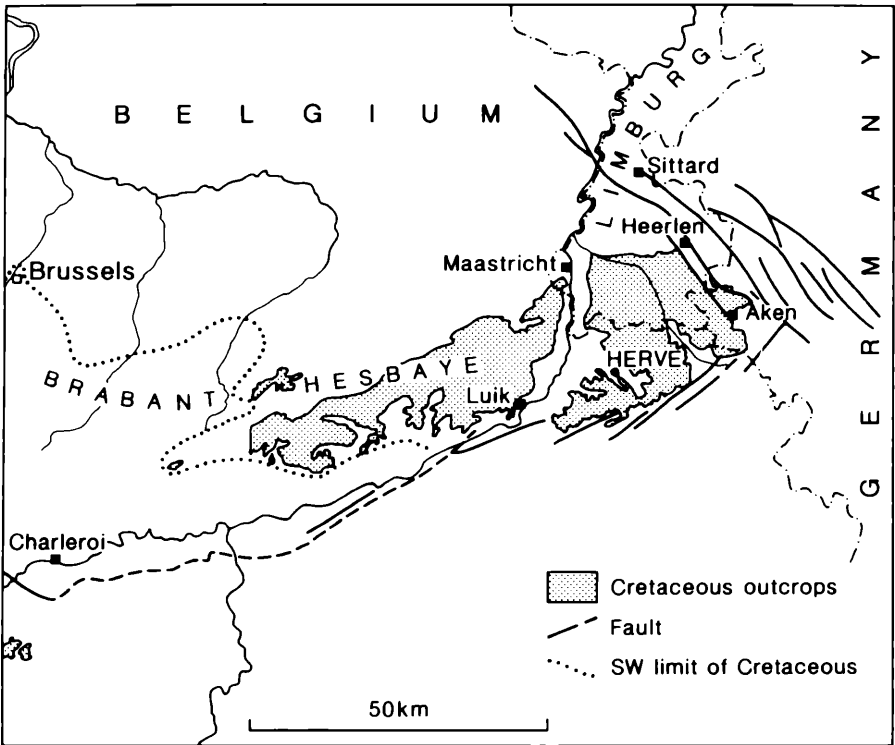


Fig. 1. Simplified geological map of south Limburg and Liège showing the distribution of Cretaceous sediments (modified after DEROO 1966).

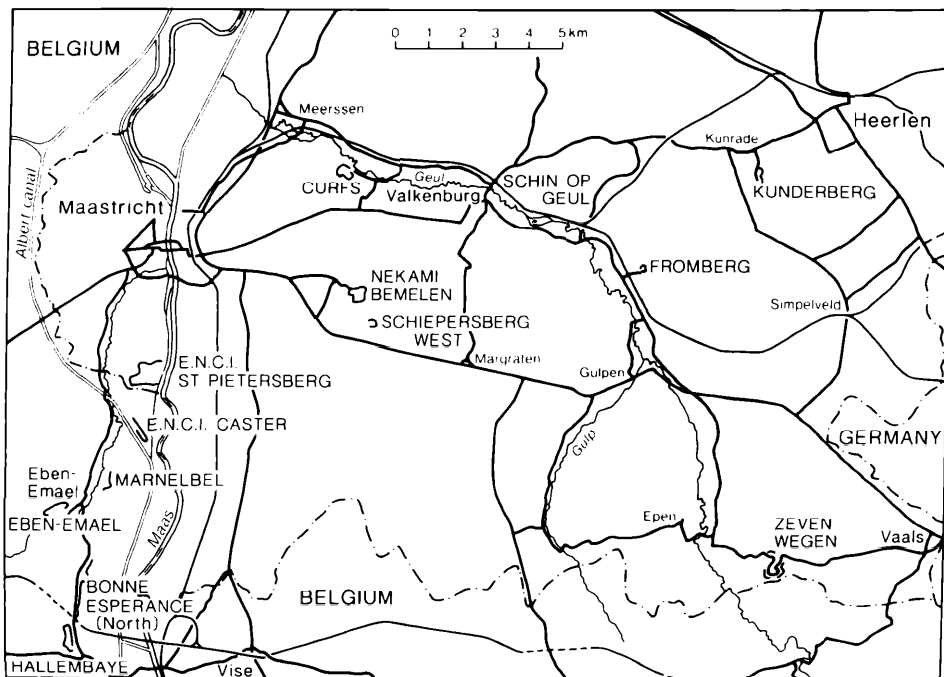


Fig. 2. Locality map for south Limburg and Liège, showing some of the more important localities.

2 Stratigraphy

The transgressive Cretaceous sequence of South Limburg and Liège Provinces (Fig. 3) rests unconformably on the Palaeozoic rocks of the Ardennes massif and includes clays, quartzose and glauconite sands, chalks and calcarenites (for a review of the very extensive literature on the sequence see bibliographies in the excursion report of the joint Paläontologische Gesellschaft and Palaeontological Association visit to the area (1978), also W. M. FELDER (1975a, b) VILLAIN (1977) and ROBASYNSKI, BLESS, FELDER, FOUCHER, LEGOUX, MANIVIT, MEESEN & VAN DER TUUK (1985a). Three formations that span the Campanian and Maastrichtian are recognised across the area: the predominantly terrigenous-clastic Vaals Formation at the base, succeeded by chalks and bioclastic carbonates of the Gulpen and Maastricht Formations (VAN DER HEIDE 1954, W. M. FELDER 1975a). These are in turn subdivided according to number or letter systems (UHLENBROECK 1912, HOFKER 1966) or into a series of members separated by distinctive lithological horizons, often, in the carbonates at least, discontinuity surfaces of various sorts (W. M. FELDER 1975a, b). Fig. 3 shows the correlation between the various divisions proposed in the literature; the nomenclature of W. M. FELDER is used in the following account.

Lithostratigraphic subdivisions of the Campanian, Maastrichtian and lower Tertiary in South Limburg and adjacent areas						Uhlenbroek 1912	Hofker 1966	
		East West of the Maas						
DANO-MONTIAN	Houthem Fmn.		Geleen Chalk	Vc		Lutterade Horizon		
			Bunde Chalk	Vb		Geleen Horizon	R	
			Geulhem Chalk	Va	Xlw	Bunde Horizon	Q	
MAASTRICHTIAN	Maastricht Fmn.	Upper	Meerssen Chalk	IVf	Xw	Vroenhoven Horizon	Md	N M L
			Nekum Chalk	IVe	IXw	Caster Horizon	Mc	K
			Emael Chalk	IVd		Laumont Horizon		
		Lower	Schiepersberg Chalk	IVc	VIIIw	Romontbos Horizon		I
			Gronsveld Chalk	IVb		Schiepersberg Horizon	Mb	J
			Valkenburg Chalk	IVa		St. Pieter Horizon		H
	Gulpen Fmn.	Upper	Lanaye Chalk	IIIg	VIIw	Lichtenberg Horizon	Cr4	F
			Lixhe Chalk 3	IIIf	VIw	Nivelle Horizon		
			Lixhe Chalk 2	IIIe	Vw	Boirs Horizon	Cr3c	E
		Lower	Lixhe Chalk 1	III d	IVw	Hallembaye Horizon 1	Cr3y	
			Vijlen Chalk	IIIc	IIIw	Wahlwiller Horizon		D C
			Beutenaken Chalk	IIIb		Bovenste Bos Horizon	Cr3b	B
CAMPANIAN	Vaals Fmn.	Upper	Zeven wegen Chalk	IIIa	IIw	Slenaken Horizon	Cr3a	A
			Terstraeten Sand	II f	Iw	Zeven Wegen Horizon		
			Beusdal Sand	II e		Terstraeten Horizon		
		Lower	Vaalsbroek Sand	II d		Beusdal Horizon		
			Gemmenich Sand	II c		Overgeul Horizon	Cr2	A'
			Cottessen Sand	II b		Gemmenich Horizon		
	Raren Sand	II a	Cottessen Horizon					
				Raren Horizon				

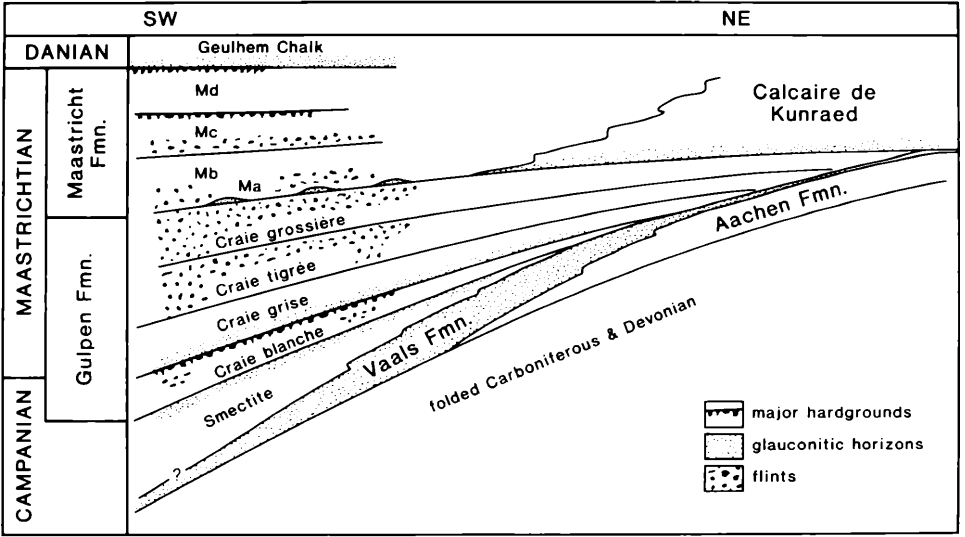


Fig. 4. Generalised section across south Limburg showing the distribution of the main stratigraphic units (modified after POLLOCK 1974).

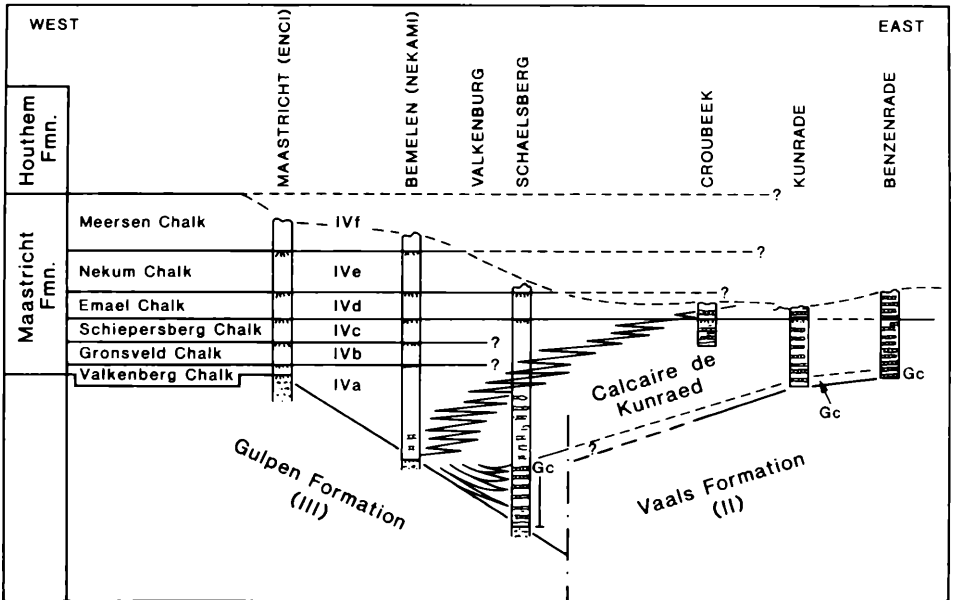


Fig. 5. Lateral changes in the Maastricht Formation between Maastricht and Heerlen (Benzerade) (modified after W. M. FELDER 1976).

Fig. 3. Lithostratigraphic divisions of the Campanian to Danian in south Limburg and Liège showing the correlation of the schemes of UHLENBROECK (1912), HOFKER (1966) and W. M. FELDER (1975a, b) (modified after W. M. FELDER 1976).

It should be stressed that the succession in the study area is frequently very incomplete and that units thin, or are cut out by intra-Cretaceous unconformities, especially in the Gulpen and Maastricht Formations (see details in UHLENBROECK 1912, W. M. FELDER 1975a, b, POLLOCK 1974 etc.), as summarised in Fig. 4 (modified after POLLOCK 1974). Note also that there are major facies changes across the area, especially in the Maastricht Formation. This is replaced to the north-east of Maastricht by the more terrigenous, glauconite-rich Calcaire de Kunraed (Kunrade), as shown in Text-fig. 4.

Biostratigraphic work on this succession has been concentrated on the microfauna and flora (VAN VEEN 1928, DEROO 1966, HOFKER 1966, VANGEROW & SCHLOEMER 1967, WILSON 1971, VILLAIN 1977, ROBASZYNSKI et al. 1985a, b, NEUMANN & ROBASZYNSKI 1985).

Maastricht Fmn.	Upper	Meerssen Chalk	<i>casimirovensis</i> Zone	
		Nekum Chalk		
	Lower	Emael Chalk		<i>junior</i> Zone
		Schiepersberg Chalk		
		Gronsveld Chalk		
		Valkenburg Chalk		
Gulpen Fmn.	Upper	Lanaye Chalk	<i>cimbrica</i> Zone	
		Lixhe Chalk 3		
		Lixhe Chalk 2		
		Lixhe Chalk 1		
	Lower	Vijlen Chalk		<i>obtusa</i> Zone
		Beutenaken Chalk		
		Zeven wegen Chalk		<i>mucronata</i> Zone

Fig. 6. Belemnite zonation of the uppermost Campanian and Maastrichtian in south Limburg, based on results in SCHULZ & SCHMID (1983).

The standard zonal indices for the uppermost Cretaceous of north-west Europe are, however, belemnites. These have been studied in the present area by SCHMID (1959, 1967), POLLOCK (1974), VAN DER TUUK & BOR (1980), SCHULZ & SCHMID (1983) and VAN DER TUUK (in ROBASYNSKI et al. 1985a). So far as the general north-west European sequence is concerned, the standard zonation for the Maastrichtian is as follows (see CHRISTENSEN 1979 for discussion):

Upper Maastrichtian	{	<i>Belemnella casimirovensis</i>
		<i>Belemnitella junior</i>
Lower Maastrichtian	{	<i>Belemnella occidentalis</i>
		<i>Belemnella lanceolata</i>

SCHULZ (1979), working in the White Chalk of north Germany further divided the Lower Maastrichtian into six *Belemnella* Zones:

<i>Belemnella fastigata</i>	}	<i>Belemnella occidentalis</i>
<i>Belemnella cimbrica</i>		
<i>Belemnella sumensis</i>		
<i>Belemnella obtusa</i>	}	<i>Belemnella lanceolata</i>
<i>Belemnella pseudobtusa</i>		
<i>Belemnella lanceolata</i>		

In the present study area there are marked differences in interpretation of the belemnite faunas. I follow the work of SCHULZ & SCHMID (1983) and this, together with additional information from Messrs. W. G. SCHULZ & W. K. CHRISTENSEN provides the subdivision shown in Fig. 6; further details are given below.

3 The Ammonite sequence

3.1 Vaals Formation

The top of the Vaals Formation at Hallembaye yields Lower Campanian belemnites including *Belemnitella mucronata senior* NOWAK 1913 and *Goniotenthis quadrata* (BLAINVILLE 1827). This accords well with published ammonite records and my own observations on material in the Brussels and Maastricht collections. In addition to *Baculites* and diplomoceratid species these include *Pachydiscus duelmensis* (SCHLÜTER 1872) (p. 52, pl. 16, figs. 1, 2) known from the Lower Campanian at Dülmen in the German Federal Republic and the lower part of Assise P¹ of ARNAUD (1887) at Le Maine-Bardon and Chardurie, Charmant, Charente, France (DE GROSSOUVRE 1894, p. 199, pl. 20, fig. 1) and *Scaphites* identified by COBBAN (1969 p. 21) as *S. hippocrepis* (DEKAY, 1828) form III (e.g. HOLZAPFEL 1888, p. 61, pl. 5, fig. 2 (as *S. aquisgranensis* SCHLÜTER, 1872: Fig. 7D–F); p. 62, pl. 5, fig. 3 (as *S. hippocrepis*: Fig. 7 G, H). This same form occurs in the Lower Campanian elsewhere in Europe, and is well-dated in the Aquitaine Basin, occurring in Assise P¹ of ARNAUD (DE GROSSOUVRE 1894, pl. 31, figs. 3, 4; pl. 32, figs. 2, 3).

There is also a specimen of *Hoplitoplacenticerias marroti* (COQUAND 1859) in the FELDER Collection (Naturhistorisch Museum Maastricht no. VG 1312: Fig. 7 I, J), from near Vijlen, Cottessen, on the Belgian/Dutch border. This species is unequivocally lower Upper Campanian, and suggests a significantly younger age for the Vaals Formation at this locality, if correctly horizoned.

VAN DER TUUK (in ROBASYNSKI et al. 1985a, p. 23) cites a number of other species from this unit, but to judge from the literature and museum specimens these are errors and misidentifications. The *Euhomaloceras incurvatus* (DUJARDIN 1837) of authors do not belong to this Coniacian-Santonian species, while *Sciponoceras bohemicum* (FRITSCH 1872) is a Turoonian species (Fide WRIGHT 1979). Records of *Placenticerias meeki* BÖHM, 1898 I cannot comment on.

3.2 Gulpen Formation

3.2.1 Zeven Wegen Chalk

This yields what Dr. M. G. SCHULZ believes to be reworked Lower Campanian *Goniotenthis quadrata* at the base (Craie Glauconifère), while Upper Campanian *Belemnitella* of the *B. mucronata* (LINK 1807) group (including *B. minor* JELETZKY 1951) occur throughout. *Baculites* occur at a number of localities and although poorly-preserved (Fig. 10A, B), are characterised by crescentic flank ribs in some cases. In the present state of our knowledge of European Upper Campanian *Baculites* they are best left in open nomenclature. Of more value is a record of *Hoplitoplacenticerias* cf. *coesfeldiense* (SCHLÜTER 1867) (Fig. 7A) from this unit at Vijlenerbosch (FELDER Collection, Naturhistorisch Museum, Maastricht, no. GK 840). The careful records of GIERS (1964 p.275) show this to be an Upper Campanian species, also known from European Russia and Soviet Central Asia (MICHAILOV 1951, NAIDIN & SHIMANSKIY 1959, ATABEKIAN & KHAKIMOV 1976). Two scaphitids in the same collection (NMM GK 965, 1116) and from Vijlenerbosch (Fig. 8F) are *Trachyscaphites spiniger* (SCHLÜTER 1872) (see revisions by COBBAN & SCOTT 1964, SCHMID & ERNST 1975) an Upper Campanian marker in Germany, France, the USSR, the U.S. western interior and Gulf Coast. These records show the Zeven Wegen Chalk to be equivalent to the upper Upper Campanian *Bostrychoceras polyplocum* Zone. VAN DER TUUK (in ROBASZYNSKI et al. 1985a, fig. 12) shows *Acanthoscaphites tridens* (KNER 1848) occurring in the Zeven Wegen Chalk, but this is a Maastrichtian species and presumably an error.

3.2.2 Beutenaken Chalk

This yields an assemblage dominated by *Belemnella obtusa* SCHULZ, 1979 (SCHULZ & SCHMID 1983 p.34) and is thus upper Lower Maastrichtian. At localities such as Hallembaye it is missing. In have seen no ammonites from this unit.

Fig. 7. A. *Hoplitoplacenticerias coesfeldiense* (SCHLÜTER 1867) from the Upper Campanian Zeven-Wegen Chalk at Vijlenerbosch, Limburg, the Netherlands (NMM GK 840).

B, C. *Acanthoscaphites tridens* (KNER 1848) from the "Mucronaten-Schichten von Vaals bei Aachen", the original of SCHLÜTER 1872, pl. 28, fig. 3 (GPIB unregistered).

D, E, F. *Scaphites* corresponding to *Scaphites aquisgranensis* SCHLÜTER, 1872, regarded as a synonym of *S. hippocrepis* (DEKAY 1828) III by COBBAN (1969) (IRSNB unregistered) from the Lower Campanian Vaals Formation of Vaals, The Netherlands.

G, H. *Scaphites hippocrepis* (DEKAY 1828) (GPIB unregistered), from the Lower Campanian 'Hervian' of Battice, Belgium.

I, J. *Hoplitoplacenticerias marroti* (COQUAND 1859) said to be from the Vaals Formation by marker stone 7 at Vijlen, Cottessen, on the Dutch/Belgian border (NMM VG 1312). All figures are natural size.

NMM = Naturhistorisches Museum Maastricht.

GPIB = Collections of the Geological and Palaeontological Institute, Bonn University.

IRSNB = Institut Royal des Sciences Naturelles de Belgique.

MNB = Museum für Naturkunde, Berlin.



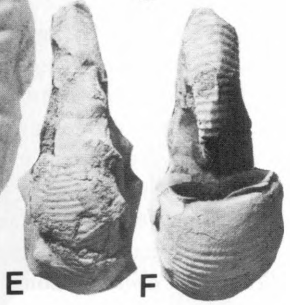
A



B



D

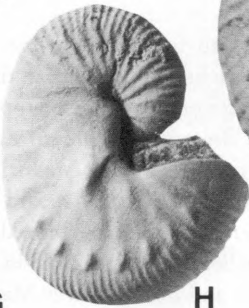


E

F



G



H



I



J



C

3.2.3 Vijlen Chalk

Where the Beutenaken Chalk is missing, the Vijlen Chalk rests on Zeven Wegen Chalk and yields a mixed fauna including elements derived from the Beutenaken Chalk according to SCHULZ & SCHMID (1983). These same authors record only a single *Belemnella* ex gr. *junior* NOWAK, 1913 and a specimen tentatively identified as *Belemnella cimbrica* BIRKELUND, 1957, suggesting, perhaps, upper Lower Maastrichtian. In Liège, SCHULZ & SCHMID note that the Craie Grise at Hallembaye and Boirs (equivalent to the Vijlen Chalk according to ALBERS & FELDER 1979) is said to yield exclusively *Belemnella* ex gr. *junior* and thus be Upper Maastrichtian. They present new evidence that shows it to be upper Lower Maastrichtian (*B. cimbrica* and *B. fastigata* Zones). VAN DER TUUK (in ROBASZYSKI et al. 1985a, fig. 13) shows the Vijlen Chalk as Upper Maastrichtian, *B. junior* Zone, yet records the exclusively Lower Maastrichtian *Acanthoscaphites tridens* from this unit.

I have seen phosphatised and unphosphatised *Baculites* from the Vijlen Chalk at a number of localities, but they give little indication of age within the Maastrichtian. More important are unequivocal specimens of *Hoploscaphites tenuistriatus* (KNER 1848) at Mesch (fig. 10F, P). I interpret this species in the sense of BIRKELUND (1982) as lacking ventral tubercles at any stage. This form has a fairly precisely determined range in the White Chalk sequence of North Germany and Denmark, where it is known in situ from the *Belemnella fastigata/Belemnella cimbrica* Zone boundary in the Lower Maastrichtian (e. g. high in the *Belemnella occidentalis* Zone of authors) to low in the *Belemnella junior* Zone of the Upper Maastrichtian, with some evidence that it extends down into the *Belemnella sumensis* Zone. The unit also yields *H. constrictus* (J. SOWERBY 1817), indicating no more than a Maastrichtian date.

The present ammonite evidence is equivocal. If VAN DER TUUK's record of *Acanthoscaphites tridens* is confirmed, the unit is certainly Lower Maastrichtian. Indeed, BIRKELUND (1979) show it occurring only at the top of the *Belemnella lanceolata* Zone in Denmark; it occurs in the same zone in Poland (BLASZKIEWICZ 1980) and in the Lower Maastrichtian of Rügen, the environs of Lvov in the Ukraine, the Donbass and elsewhere in the southern part of European Russia. SCHLÜTER (1872 p. 94, pl. 28, fig. 3) illustrates a specimen of the species from "Vaals bei Aachen" (Fig. 7B, C); HOLZAPFEL (1888 p. 63, pl. 5, fig. 1) a specimen from the "Mucronaten-Mergeln des Schneeberges" and there is a third specimen labelled: "Craie Glauconifère, Schneeberg" in the Institut Royal des Sciences Naturelles in Brussels. I previously and erroneously recorded these specimens as from the Zeven-Wegen Chalk (1984). Their matrix is a yellowish-weathering glauconitic chalk suggesting that they are actually from an imprecise horizon in the Gulpen Formation.

Fig. 8. A. *Hoploscaphites* sp. nov. from the Upper Maastrichtian Calcaire de Kunraed of Kunrade, the Netherlands (IRSNB 10294); the original of DE GROSSOUVRE 1908, pl. 10, fig. 1.
 B, C. *Pachydiscus (Pachydiscus) gollevillensis* (D'ORBIGNY 1850) horizon and locality as for A (IRSNB 9477); the original of DE GROSSOUVRE, 1908, pl. 9, fig. 2.
 D, E. *Anapachydiscus fresvillensis* (SEUNES 1890) horizon and locality as for A (IRSNB 9473, 9472); the original of DE GROSSOUVRE, 1908, pl. 11, figs. 1, 2.
 F. *Trachyscaphites spiniger* (SCHLÜTER 1872) from the Upper Campanian Zeven-Wegen Chalk of Vijlenbosch, The Netherlands (NMM GK965).
 All figures are natural size.



A



B



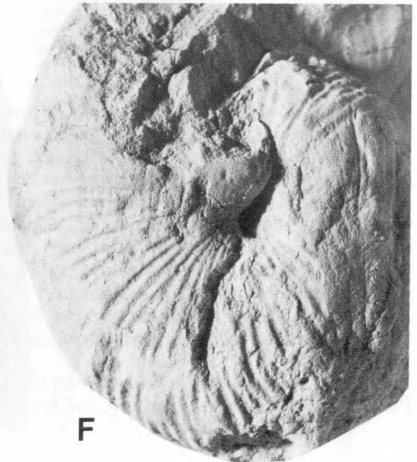
C



D



E



F

3.2.4 Lixhe and Lanaye Chalk

These are Upper Maastrichtian, *Belemnella junior* Zone. I have seen no ammonites from these units.

3.3 Maastricht Formation

3.3.1 Valkenburg Chalk

This unit is still within the Upper Maastrichtian *B. junior* Zone. The only ammonites seen are phosphatised *Baculites*, including *B. anceps*, LAMARCK, 1822. The careful records of BIRKELUND (1979, p. 53 as *B. valognesis* BÖHM, a synonym) show this species to be restricted to the Upper Maastrichtian in the White Chalk facies in Denmark; it is Upper Maastrichtian at the type locality in Normandy, France (fide KENNEDY 1986). Campanian records are based on dubious material.

3.3.2 Gronsveld, Schiepersberg and Emael Chalks

These are Upper Maastrichtian *B. junior* Zone. No ammonites are known.

3.3.3 Nekum Chalk

This yields exclusively Upper Maastrichtian *B. junior* Zone belemnites. Ammonites, chiefly from the Maastricht area are *Anapachydiscus fresvillensis* (SEUNES 1890) *Diplomoceras cylindraceum* (DEFRANCE 1816), *Baculites vertebralis* LAMARCK, 1801, *B. anceps* LAMARCK, 1822, and *Hoploscaphites constrictus* (J. SOWERBY 1817). This assemblage matches closely the fauna of the Upper Maastrichtian Calcaire à *Baculites* of the Cotentin Peninsula, Manche, France, and all the species cited are fully revised by KENNEDY (1986). FELDER (1968) records a single specimen of *Sphenodiscus binkhorsti* BÖHM, 1898 from the Upper part of the Nekum (loc. cit. pp. 84–85).

Fig. 9. A. *B. Pachydiscus (Pachydiscus) jacquoti* (SEUNES, 1890) from the Upper Maastrichtian Calcaire de Kunraed of Kunraed, Limburg, the Netherlands (MNB unregistered ex BINKHORST Collection); this may be the original of BINKHORST, 1861, pl. 7, figs. 2a, 2b.

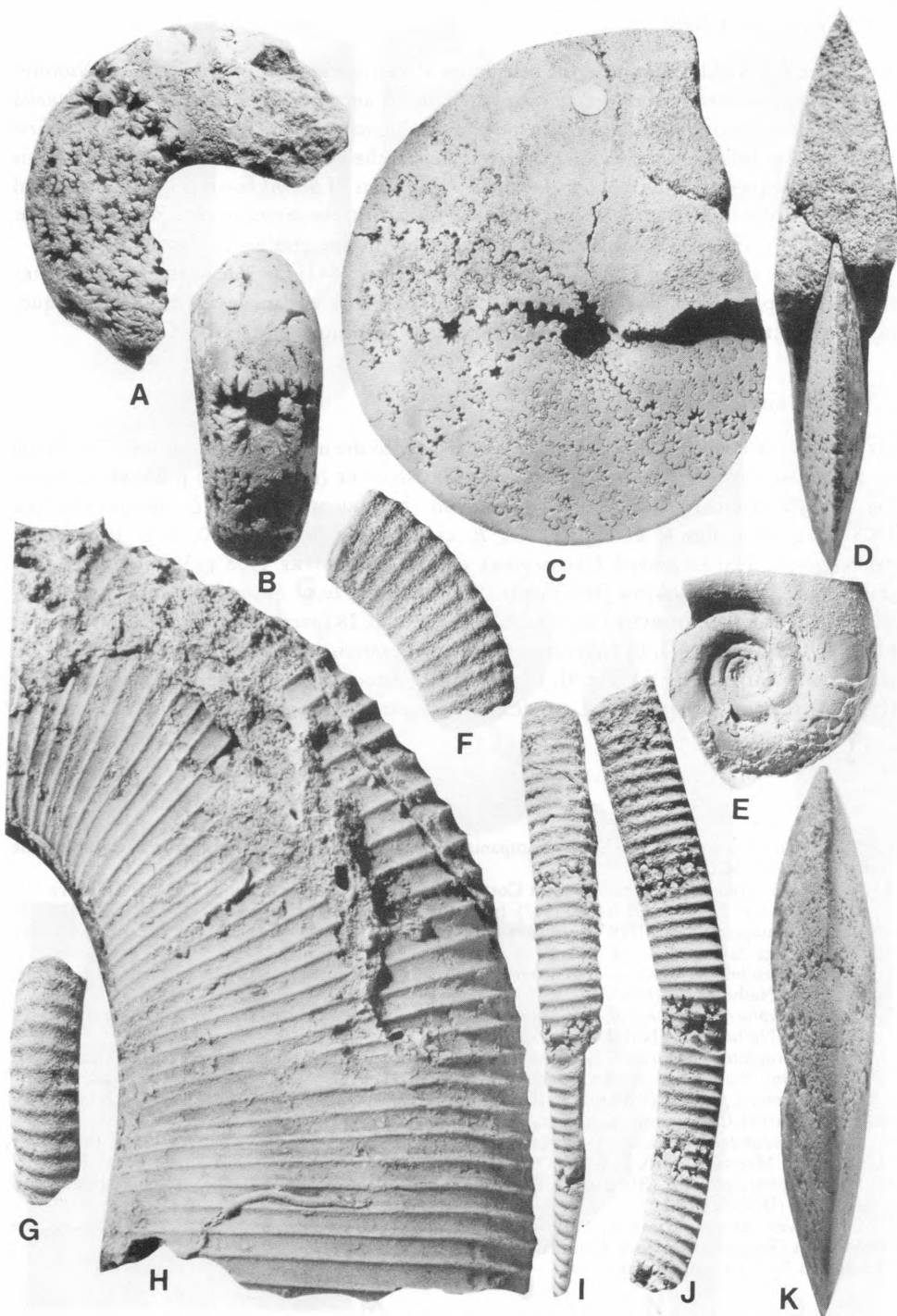
C, D, K. *Sphenodiscus binkhorsti* BÖHM, 1898 from the Upper Maastrichtian (Meerssen Chalk inferred) of Geulhem, Limburg, the Netherlands (MNB unregistered, ex BINKHORST collection); the original of BINKHORST, 1861, pl. 5d, figs. 5a, 5b, ? 5c and DE GROSSOUVRE, 1908, pl. 2, figs. 2a, 2b; pl. 3.

E. *Saghalinites* sp. nov. from the Upper Maastrichtian Calcaire de Kunraed of Kunraed, Limburg, the Netherlands (IRSNB 9482); the original of DE GROSSOUVRE, 1908, pl. 10, fig. 5.

F, G. *Glyptoxoceras* cf. *subcompressum* (FORBES, 1846) from the same horizon and locality as E (MNB ex BINKHORST Collection); the original of BINKHORST, 1861, pl. 5b, figs. 4a, 4b.

H. *Diplomoceras cylindraceum* (DEFRANCE, 1816) from the same horizon and locality as E (IRSNB 10290).

I, J. *Glyptoxoceras* cf. *circulare* SHIMIZU, 1935 from the Upper Maastrichtian? Nekum Chalk of St Pietersberg, Maastricht, Limburg, the Netherlands (NMM 1083).



3.3.4 Meerssen Chalk

The lower part yields *B. junior* Zone belemnites alone together with the ammonites *Nostoceras* sp., *Diplomoceras cylindraceum*, *B. vertebralis*, *B. anceps* and *H. constrictus*. *Belemnella casimirovensis* (SKOLOZDROWNA 1932), index of the highest Maastrichtian belemnite zone first appears 5–7 m below the top of the Meerssen Chalk at the ENCI quarry near Maastricht ; this part of the sequence yields most of the known specimens of *S. binkhorsti* (Fig. 9C, D, K) and the *crassus* form of *H. constrictus* (Fig. 10K, L), an exclusively *casimirovensis* Zone ammonite (see KENNEDY 1986 p. 73) occur at this level, notably in the terminal hardground.

The single specimen of *Eubaculites lyelli* (D'ORBIGNY 1847) (= *Baculites anceps* of BINKHORST 1861 pl. 5d, figs. 3a–d; Fig. 10C, D) from “St Pierre et dans les environs de Fauquemont” (BINKHORST 1861 p. 43) is from either the Nekum or the Meerssen Chalk.

3.3.5 Calcaire de Kunraed

Mr. P. J. FELDER tells me that ammonites occur only in the upper part of this unit. The fauna is: *Saghalinites* sp. (= *Gaudryceras* cf. *kayei* GROSSOUVRE (non FORBES) p. 34, pl. 10, fig. 5: Fig. 9E), *Pachydiscus* (*Pachydiscus*) *gollevillensis* (D'ORBIGNY 1850) (e.g. DE GROSSOUVRE 1908 p. 32, pl. 9, figs. 1, 2: Fig. 8B, C), *P.* cf. *jacquoti* (SEUNES 1890) (e.g. *Pachydiscus neubergicus* v. HAUER emend GROSSOUVRE of DE GROSSOUVRE 1908 p. 30, pl. 9, figs. 3, 4) (Fig. 9A, B), *Anapachydiscus fresvillensis* (SEUNES, 1890) (e.g. *Pachydiscus colligatus* BINKHORST VAN DER BINKHORST of DE GROSSOUVRE 1908 p. 28 (pars), pl. 4, figs. 1–3; pl. 5, fig. 1; pl. 6, fig. 1 only) (Fig. 8D, E) *Glyptoxoceras* cf. *subcompressum* (FORBES 1846) (Fig. 9F, G), *G.* cf. *circularis* (SHIMIZU 1935) (Fig. 9I, J), *G.* sp., *Diplomoceras cylindraceum* (DEFrance 1816) (Fig. 9H), *Baculites vertebralis* LAMARCK, 1801 (common) (Fig. 10E), *B. anceps* LAMARCK,

Fig. 10. A. *Baculites* sp. from the Upper Campanian Zeven-Wegen chalk of Vijlenerbosch, Limburg, the Netherlands (NMM GK662).

B. *Baculites* sp. from the same unit as A at Cottessen, Limburg, the Netherlands (NMM GK1101).

C, D. *Eubaculites lyelli* (D'ORBIGNY 1847) from the Upper Maastrichtian of “St-Pierre et dans les environs de Fauquemont” (MNB unregistered, ex BINKHORST Collection); the original of BINKHORST 1861, pl. 5d, figs. 3a–d.

E. *Baculites vertebralis* LAMARCK, 1801 from the Upper Maastrichtian Calcaire de Kunraed of Kunrade, Limburg, the Netherlands. (IRSNB 10284).

F, P. *Hoploscaphites tenuistriatus* (KNER 1848) from the Lower Maastrichtian Vijlen Chalk of Mesch, Limburg, the Netherlands (NMM 0006545b).

G, H. *Hoploscaphites constrictus* (J. SOWERBY 1817) a microconch from the same horizon and locality as E (IRSNB 10296), the original of DE GROSSOUVRE 1908, pl. 11, fig. 7.

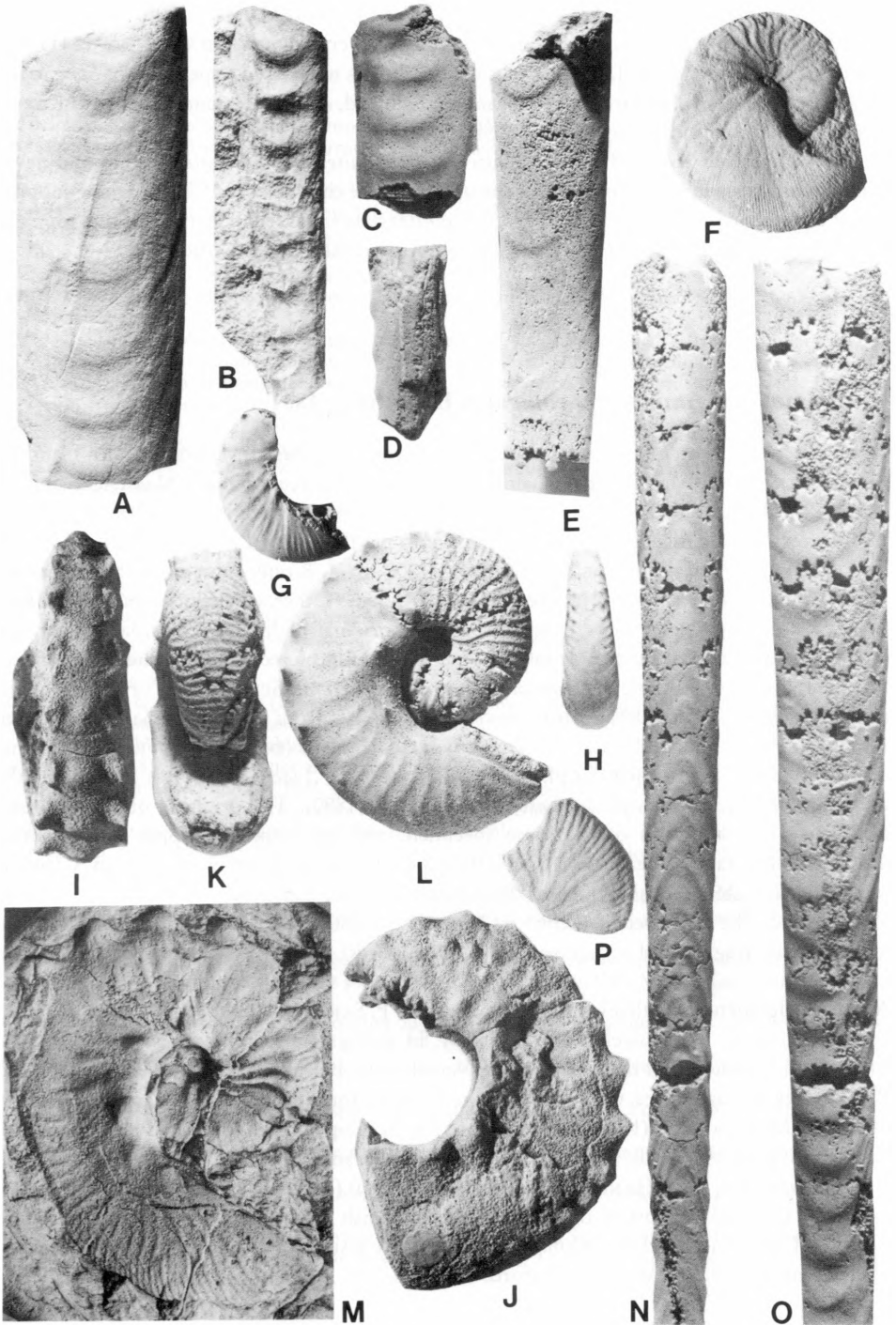
I, J. *Hoploscaphites pungens* (BINKHORST 1861) from the same horizon and locality as E (MNB unregistered ex BINKHORST Collection); the original BINKHORST, 1861, pl. 5a, 3, figs. 1a–1e.

K, L. *Hoploscaphites constrictus* (J. SOWERBY 1827) a macroconch from the upper part of the Upper Maastrichtian Meerssen Chalk as Curfs Quarry, Geulhem, Limburg, the Netherlands (NMM 2874).

M. *Hoploscaphites pungens* (BINKHORST 1861) cast taken of natural mould from the same horizon and locality as E (IRSNB 9492).

N, O. *Baculites anceps* LAMARCK, 1822 from the Upper Maastrichtian of “Maastricht”, Limburg, the Netherlands (Sedgwick Museum, Cambridge, no. F2822).

The figures 7–10 are natural size.



1822, *Hoploscaphites constrictus* (J. SOWERBY 1817) (Fig. 10G, H), *H. sp. nov.*, *H. pungens* (BINKHORST 1816) (Fig. 10I, J, M), *Acanthoscaphites verneuilianus* (D'ORBIGNY 1841) and *Acanthoscaphites sp.* Mr. P. J. FELDER tells me that he has never seen a specimen of *Sphenodiscus binkhorsti* BÖHM, 1898 from the Calcaire de Kunraed, and that specimens labelled Kunraed (or Kunrade) in old collections are mislabelled.

The Calcaire de Kunraed yields exclusively *Belemnitella* of the *junior* group and never *B. casimirovensis* and is thus older than the upper part of the Meerssen Chalk, a view supported by the absence of *crassus* forms of *Hoploscaphites constrictus* (characteristic of the *casimirovensis* Zone) at Kunraed, and in accordance with the results of VILLAIN (1977).

4 A note on *Ammonites colligatus* BINKHORST, 1861

It will be noted that I nowhere record *Pachydiscus colligatus* BINKHORST, 1861 from the Maastrichtian of the Maastricht area, although it is generally recorded as a Maastrichtian form (e. g. BLASZKIEWICZ 1980). A full revision of the species will be published elsewhere (KENNEDY in press). It is sufficient to state that the lectotype, the original of BINKHORST 1861 pl. 8, figured photographically by DE GROSSOUVRE (1908 pls. 7, 8 only, non pls. 4, 5, 6) is a low Upper Campanian form from Jauche, Brabant Belgium. Other specimens figured by BINKHORST belong to at least three other species: the original of his pl. 6, figs. 3a–3f from the Upper Maastrichtian of Benzerade near Kunrade could not be recognised in the Berlin collections, but is either a juvenile *Pachydiscus* (*Pachydiscus*) *jacquoti* SEUNES, 1890 or *Anapachydiscus fresvillensis* (SEUNES 1890). BINKHORST's pl. 7, fig. 1 is from the Campanian of Slenaken, Limburg, The Netherlands, and is a *Eupachydiscus cf. levyi* (DE GROSSOUVRE 1894). What may be the basis of BINKHORST's pl. 7, figs. 2a, 2b, are *P. (P.) jacquoti* SEUNES 1890, as are the figures; pl. 7, fig. 2c is an *A. cf. fresvillensis* (SEUNES 1890). The originals of BINKHORST's pl. 8a, figs. 1, 2 are parts of the same specimen, and are from the Upper Maastrichtian Calcaire de Kunraed of Benzerade, the Netherlands; the original survives, and is an *A. fresvillensis* (SEUNES 1890). The original of BINKHORST's pl. 8a, figs. 3a–e is a *P. (P.) cf. jacquoti* SEUNES 1890. The final specimen cited by BINKHORST (1861 p. 29), from Folx-les-Caves, is an indeterminate fragment of a Campanian *P. (Pachydiscus)*.

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