BULLETIN DE L'INSTITUT ROYAL DES SCIENCES NATURELLES DE BELGIQUE
BULLETIN VAN HET KONINKLIJK BELGISCH INSTITUUT VOOR NATUURWETENSCHAPPEN
SCIENCES DE LA TERRE , 77: 107-116, 2007
AARDWETENSCHAPPEN, 77: 107-116, 2007

The cirripede *Cretiscalpellum paucistriatum* (Crustacea, Thoracica) in the lower Maastrichtian of NW Europe – is it stratigraphically useful?*

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JAGT, J.W.M. & VAN BAKEL, B.W.M., 2007 – The cirripede *Cretiscalpellum paucistriatum* (Crustacea, Thoracica) in the lower Maastrichtian of NW Europe – is it stratigraphically useful? *Bulletin de l'Institut royal des Sciences naturelles de Belgique, Sciences de la Terre*, **77**: 107-116, 1 fig., 2 pls, Brussels, October 15, 2007 – ISBN 0374-6291.

* Publication No. 16 of the Working Group 'Vijlen and Beutenaken members'

Abstract

New material of the calanticid cirripede *Cretiscalpellum paucistriatum* (WOODWARD, 1906) is recorded from the lower Maastrichtian (*obtusa* Zone) as exposed at the Saturn quarry, Kronsmoor (northern Germany); the carina is described for the first time. These specimens, together with material described previously in the literature, suggest *C. paucistriatum* to have been a short-lived offshoot of the *C. striatum* group, apparently confined to the interval from the lower *obtusa* to the lower *sumensis* zones of the lower Maastrichtian, with records to date from Norfolk (eastern England), southern Limburg (The Netherlands) and northern Germany. The species may thus be stratigraphically useful. To test this assumption, cirripede faunules from coeval strata in southern Belgium (Mons Basin; Ciply-Malogne Phosphatic Chalk Formation), eastern Denmark (Møn; white chalk facies), NE Germany (Rügen; white chalk facies) and even further afield (*e.g.*, central and eastern Poland; opoka and white chalk facies) need to be screened. Although the general view is that the correlative value of cirripede taxa is rather limited, a tendency may be noted in the scalpellomorph genera *Cretiscalpellum* and *Arcoscalpellum* to develop short-lived species during the Late Cretaceous (Campanian and Maastrichtian). Such taxa, considered in conjunction with co-occurring members of the main lineages, may prove useful in (supra-)regional correlation, and cirripede 'taxon range' and 'assemblage' zones could thus be established.

Keywords: Cirripedia, *Cretiscalpellum*, Maastrichtian, NW Europe, stratigraphy.

Résumé

De nouveaux fossiles du cirripède calanticidé *Cretiscalpellum paucistriatum* (WOODWARD, 1906) ont été découverts dans le Maastrichtien inférieur (Zone à *obtusa*) en affleurement dans la carrière Saturn à Kronsmoor (Allemagne septentrionale) ; la carène de ce taxon est décrite pour la première fois. Ces spécimens, ainsi que ceux décrits précédemment dans la littérature, suggèrent que *C. paucistriatum* est un rameau à courte extension stratigraphique du groupe *C. striatum*, apparemment confiné dans un intervalle s'étendant de la partie inférieure de la Zone à *obtusa* à la partie inférieure de la Zone à *sumensis* du Maastrichtien inférieur, avec, à ce jour, des découvertes dans le Norfolk (Angleterre orientale), au Limbourg méridional (Pays-Bas) et en Allemagne septentrionale. Cette espèce pourrait donc être utile d'un point de vue stratigraphique. Pour tester cette hypothèse, il faudrait tamiser des faunules à cirripèdes d'âge équivalent en Belgique (Bassin de Mons, Formation des Craies phosphatées de Ciply-Malognes), au Danemark oriental (Møn, faciès à calcaire blanc), en Allemagne du nord-est (Rügen, faciès à calcaire blanc) et même dans des gisements plus éloignés (notamment en Pologne centrale et orientale ; faciès à opoka et à calcaire blanc). Bien qu'on considère généralement que la valeur stratigraphique des cirripèdes est plutôt limitée, il existe une tendance chez les scalpellomorphes *Cretiscalpellum* et *Arcoscalpellum* à développer des espèces à durée de vie courte au cours du Crétacé supérieur (Campanien et Maastrichtien). De tels taxons, considérés conjointement avec d'autres membres des lignées principales présents dans les mêmes niveaux, pourraient s'avérer utiles dans le cadre de corrélations (supra-) régionales; de plus, des 'registres d'extension de taxons' et des 'zones d'assemblages' pourraient être établies sur base de cirripèdes.

Mots-clefs: Cirripedia, *Cretiscalpellum*, Maastrichtien, Europe du nord-ouest, stratigraphie.

Introduction

In November-December 2003, within the framework of the 'Access to Belgian Collections (ABC)' grant scheme, one of us (JWMJ) started a revision of cirripede collections held at the Institut royal des Sciences naturelles de Belgique (IRScNB, Brussels). The aim was twofold: to redescribe type material from the extended type area of the Maastrichtian Stage, mainly that of BOSQUET (1854, 1857) and WITHERS (1935), and to determine in more detail its

stratigraphic provenance as based on preservational type, adhering matrix and personal fieldwork experience. Old collections generally suffer from a lack of stratigraphic data, but the fact that almost all localities from which BOSQUET (1854, 1857) described cirripede material are still accessible means that stratigraphic ranges of the various species may yet be refined by renewed collecting. In recent years, fieldwork has resulted in the discovery of new species (COLLINS & JAGT, 1999; JAGT & COLLINS, 1999) and copious material of species described by BOSQUET and by other authors is now available. The newly collected material will also enable a robust taxonomy to be worked out. Results of this study will be published in a series of brief notes (JAGT, 2004, in prep.) and, later, in a monograph in two parts, on scalpellomorphs and verrucomorphs/brachylepadomorphs, respectively.

A comparison of material collected (September 1988) at the Saturn quarry near Kronsmoor (northern Germany) with WITHERS's (1935) records of *Cretiscalpellum paucistriatum* from Trimingham (Norfolk, England) and Slenaken (southern Limburg, The Netherlands), has led us to reflect upon the possible stratigraphic value of that species. Although precise stratigraphic data are lacking for the Trimingham and Slenaken records, recent work on other macrofaunal groups (*e.g.*, belemnitellid coleoids, brachiopods) at these localities allows us to state that *C. paucistriatum* appears to be confined to a fairly narrow stratigraphic interval (lower *obtusa* to lower *sumensis* zones; *sensu* SCHULZ, 1979) within the lower Maastrichtian. In spite of the general view that cirripedes are of rather limited stratigraphic value, it may be that certain short-lived species (offshoots of the main lineage) can in fact be used for (supra-)regional correlations. In the literature, there are a few examples of such cirripede 'taxon range' and 'assemblage' zones (COLLINS & MELLEN, 1973; ZULLO, 1984; CANIS & ZULLO, 1986).

Of the scalpellomorphs *Cretiscalpellum* and *Arcoscalpellum*, most species are long-ranging and widely distributed (*e.g.*, *C. glabrum* (ROEMER, 1841), *A. maximum* (J. DE C. SOWERBY, 1829) and *A. fossula* (DARWIN, 1851)), but a handful of others (see *e.g.*, WITHERS, 1935; ALEKSEEV, 1974, 1979) have a more restricted stratigraphic range. Potentially, these may be used for correlations, but the type material of the various taxa needs to be restudied and its ranges refined and calibrated to modern biozonations, preferably based on belemnitellid coleoids and ammonites and inoceramid bivalves. In that way, also trans-Atlantic correlations become possible. On some occasions (COLLINS & MELLEN, 1973; JAGT & COLLINS, 1989, 1999) it has been demonstrated, or hinted at, that species from the Gulf Coast of the United States and NW Europe are obviously closely related and occur at comparable stratigraphic intervals.

To illustrate what might be possible in this way, *C. paucistriatum* is briefly discussed here. Only screening of existing collections from, or renewed collecting at, Rügen, Møn, the Mons Basin and perhaps further afield (*e.g.*, central and eastern Poland) can demonstrate whether or not our claim that *C. paucistriatum* is stratigraphically useful, can

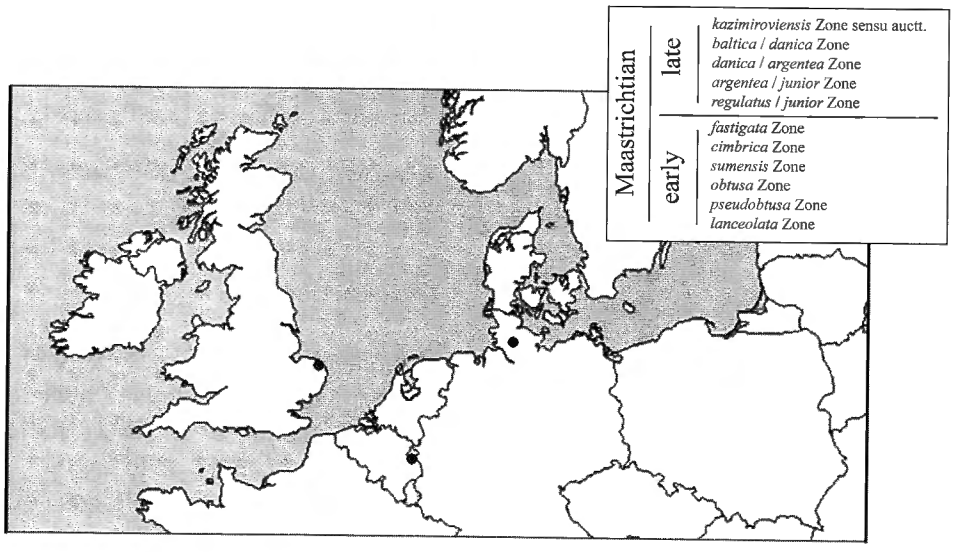

Fig. 1 — Map of northern Europe showing localities (dots) from which *Cretiscalpellum paucistriatum* has so far been recorded, and biozonation of the Maastrichtian Stage, based on the white chalk standard section of northern Germany (SCHULZ & SCHMID, 1983; SCHULZ *et al.*, 1984; SCHÖNFELD *et al.*, 1996; CHRISTENSEN *et al.*, 2004).

be upheld.

To denote the repositories of specimens referred to and/or illustrated here, the following abbreviations are used: IRScNB MI – Institut royal des Sciences naturelles de Belgique, Brussels [Mesozoic Invertebrates]; NHM – The Natural History Museum, Department of Palaeontology, London; NHMM – Natuurhistorisch Museum Maastricht (JJ = J.W.M. Jagt Colln).

Systematic palaeontology

Family Calanticidae ZEVINA, 1978
Genus *Cretiscalpellum* WITHERS, 1922

Type species: *Pollicipes unguis* J. DE C. SOWERBY, 1836, p. 335, pl. 11, fig. 5, by original designation.

Cretiscalpellum paucistriatum (WOODWARD, 1906)
Pl. 1; Pl. 2, Figs 1-3, 6-8

*1906 — (?)*Pollicipes striatus*, DARWIN, 1851, var. *paucistriatus*, H.W. – WOODWARD, p. 348, figs 31, 32.
1935 — *Cretiscalpellum paucistriatum* (H. WOODWARD) – WITHERS, p. 194, pl. 18, figs 8-11.

Type
WITHERS (1935, p. 195) designated lectotype a right tergum (NHM In.30157), the original of WOODWARD (1906, fig. 32); a right scutum (NHM In.30156), the original of WOODWARD (1906, fig. 31), is paralectotype.

Material
A left tergum (NHMM JJ 4471) and a fragmentary carina (NHMM JJ 4510), both from the lower Maastrichtian white chalk facies (lower *obtusa* Zone; around level G615) as exposed at the Saturn quarry (Kronsmoor, northern Germany), as well as three terga (one left, two right) and three right scuta (IRScNB MI 9370, 9371, 11025, 11026, 11029 and 11030) from Slenaken (southern Limburg, The Netherlands), listed and in part illustrated by WITHERS (1935). WITHERS (1935, p. 195) referred to the types from Trimingham, plus six additional terga (NHM and R.M. Brydone collections) from the same locality. He noted that there were four terga from Slenaken; one of these is now missing. As can be seen from the photographs (Pl. 2), these valves had been glued onto something (cardboard?) either by BOSQUET himself, or by someone else after his death (June 1880) when his collection was transferred to Brussels. For comparison, two left scuta (IRScNB MI 11027, 11028) in the same lot from Slenaken, here referred to *Cretiscalpellum striatum* (DARWIN, 1851), are illustrated (Pl. 2, Figs 4, 5).

Description
Carina (Pl. 1, Figs 3-5): apical third broken, estimated length *c.* 25 mm, i.e. near-equalling 2.5 times width; slightly bowed inwards; tectum transversely strongly arched and lateral margins rounded, forming very weak parietes; parallel to this a weak ridge bordering a narrow, flat area; median keel narrow and low; basal margin obtusely angular (*c.* 115°); basi-lateral angles sharply rounded; outer surface apparently smooth, but under low-angle light there is a hint of a few very faint longitudinal ridges; inner surface deeply concave; apex apparently open to the top, indicating that little or none of the valve projected freely.

Tergum (Pl. 1, Figs 1, 2; Pl. 2, Figs 1-3): elongate, length between 2 and nearly 2.25 times breadth; apico-basal ridge sharp, either near-straight or bowed towards scutal side, situated closer to carinal margin; on each side of ridge, valve moderately to strongly bent downwards, valve thickness varying between 2 and 3 mm; carinal margin obtusely angular; occludent margin near-straight, near-equal to slightly longer than scutal margin, strongly raised forming a wide ridge; scutal angle rounded and slightly protuberant; inner surface moderately to deeply concave, with faint depression along line of apico-basal ridge; inner occludent edge rounded, and inner upper carinal edge slightly flattened.

Scutum (Pl. 2, Figs 6-8): outline trapezoidal, strongly convex transversely, much bowed towards tergum, with fairly strong, rounded apico-basal ridge, more conspicuous in apical part; similar, less wide, ridge extending from apex to near middle of basal margin; on both sides of this ridge, valve near-smooth; apical portions abraded but generally with longitudinal striations seemingly confined to that portion, especially on occludent side; basal and lateral margins near straight, forming right angle; tergo-lateral angle sharp; occludent margin strongly convex; along tergal side, valve abruptly bending inwards; inner surface deeply concave.

Remarks
WITHERS (1935, p. 196) noted that, 'This form [...] seems to have a good claim to be a distinct species, and evidently represents an offshoot from

C. striatum.' Like *C. striatum*, it has an elongate tergum, but that of *C. paucistriatum* is much less longitudinally striated, to near smooth, and shows a peculiar transverse convexity. The same can be seen in the scutum; it shares with *C. striatum* that the tergal side is abruptly inturned, but the longitudinal striation of the valves is much less marked. For comparison, two scuta with well-developed striations, present in the same lot from Slenaken, are here illustrated (Pl. 2, Figs 4, 5). These are here referred to *C. striatum* and compare closely with material illustrated by WITHERS (1935, pls. 21, 22). The carina of *C. paucistriatum*, unknown to WITHERS (1935), agrees with the tergum and scutum in being transversely convex. It lacks any conspicuous longitudinal striation, but shares with carinae of *C. striatum* rounded lateral margins which form very weak parietes.

With material of *C. paucistriatum* now available from three localities in NW Europe, we can substantiate WITHERS's (1935) claim that this is a distinct species, characterised by fairly thick, transversely convex capitular valves (tergum, scutum, carina) and a much subdued longitudinal striation (mainly on scuta). Other capitular valves and imbricating plates are unknown.

Discussion

WOODWARD (1906, p. 349) was of the opinion that the well-preserved scutum and tergum from Trimingham, collected by R.M. Brydone, that formed the basis for his var. *paucistriatus*, agreed 'very well with *P. striatus*. They are at most only a less striated variety which might be named *P. paucistriatus*.' Later, WITHERS (1935, p. 196) considered it to represent a distinct species; we concur.

With regard to the stratigraphic provenance of the types of *C. paucistriatum*, little is known, unfortunately. WOODWARD (1906) only noted that Brydone had collected the material at Trimmingham [*sic*], but failed to indicate precisely where. At Trimingham, just offshore, there are various glacially moved chalk masses from which this material may have come. PEAKE & HANCOCK (1970, fig. 9) are referred to for a detailed reconstruction of these chalk occurrences. Those authors distinguished four local units, of Maastrichtian age, in ascending order: '*Porosphaera* Beds and below', 'Sponge Beds', 'White Chalk without *Ostrea lunata* and White Chalk with *O. lunata*' and 'Grey Beds'. With regard to the third unit, they (p. 323) indicated that, ' [...] this Chalk has yielded by far the greatest number of specimens marked "Trimingham" in museum-collections, [...]'. For the time being, this is here accepted as the stratigraphic level for the type material of *C. paucistriatum*.

Later, JOHANSEN & SURLYK (1990) studied brachiopods, in particular micromorphic species, from the Norfolk chalk sections and introduced a formal lithostratigraphic scheme. Their Trimingham Sponge Beds Member equates with the 'Sponge Beds' of PEAKE & HANCOCK (1970) and, for the most part, probably is of *obtusa* Zone age. Overlying, and corresponding to the 'White Chalk without *Ostrea lunata*' and 'White Chalk with *Ostrea lunata*', is their Little Marl Point Chalk Member, which on macrofossil evidence is correlatable with the *sumensis* Zone (see SCHULZ, 1979, 1985). Finally, the 'Grey Beds' are termed Beacon Hill Grey Chalk Member by JOHANSEN & SURLYK (1990), and are held to be of late *sumensis* Zone age.

A similar correlation was favoured by CHRISTENSEN (1995, fig. 3), who showed the largest portion of the Trimingham Sponge Beds Member to be of *obtusa* Zone age, with exception of the uppermost part, which he correlated with the lower *sumensis* Zone. Thus, the types of *C. paucistriatum*, if they were in fact collected from the unit now referred to as Little Marl Point Chalk Member, are of *sumensis* Zone age. However, since we cannot rule out that they actually came from a different (i.e., lower or higher) unit, an age assignment of upper *obtusa* Zone to lower *sumensis* Zone is favoured here.

Labels associated with the small lot of *C. paucistriatum* from Slenaken in the BOSQUET Collection (lot IRScNB I.G. 4285) read, 'Et. Sénonien Cp3 (Ass. de Nouvelles), Craie marneuse, Loc: Slenaken'. In modern terminology, this would now mean 'Nouvelles Chalk Formation', of late Campanian age (ROBASZYNSKI *et al.*, 2002), as recorded in the Mons Basin (southern Belgium). In fact, at Slenaken, the lowest chalk units resting on glauconitic sands of the Vaals Formation (lower Campanian) actually correspond to the lower part of the Vijlen Member in current terminology, although exact position with reference to interval zones of FELDER & BLESS (1994) is not yet clear (compare FELDER, 1997, 2001; KEUTGEN *et al.*, in press). This is the most likely source of BOSQUET's material, also when the moderate degree of abrasion of the valves (Pl. 2) is taken into consideration. This part of the sequence yields numerous remanié belemnitellid cephalopods which suggests correlation with the (middle) *obtusa* Zone, having yielded the nominal species in great abundance (SCHULZ, 1979; KEUTGEN & VAN DER TUUK, 1991; KEUTGEN, 1996). In this

respect, it should be noted that a biozonation of the Vijlen Member (and upper part of the underlying Beutenaken Member) based entirely on species of *Belemnella* proves to be extremely difficult, if not impossible, mainly because of frequent reworking and a general lack of population mean values (KEUTGEN, JAGT & P.J. FELDER, in press). Units 0, 1, 2 and 3 of FELDER & BLESS (1994) are now considered to be of general early Maastrichtian date; for a detailed discussion reference is made to KEUTGEN *et al.* (in press). For the time being, an *obtusa* (to lower *sumensis*) Zone age is accepted for Bosquet's original material.

The third lot (Pl. 1) from the Saturn quarry at Kronsmoor (Schleswig-Holstein, northern Germany) includes a single tergum from level G615 + *c.* 2-4 m, and a carina from around G615. As documented by SCHULZ (1978, 1979, 1985), SCHÖNFELD *et al.* (1996) and NIEBUHR (2003), level G615 is within the lower portion of the *obtusa* Zone.

Taken together, these data suggest that *C. paucistriatum* may be a short-ranging species, restricted to the *obtusa* and (lower) *sumensis* zones of the lower Maastrichtian. To test this claim, cirripede collections from coeval strata elsewhere in Europe need to be screened for this species. In the Ciply area (Mons Basin, southern Belgium), and at the Vandamme quarry in particular, the 'Craie phosphatée de Ciply' (now referred to as the Ciply-Malogne Phosphatic Chalk Formation) also yields belemnitellids typical of the *obtusa* Zone (CHRISTENSEN, 1999), as well as baculitid ammonoid species which allowing a direct trans-Atlantic correlation with the *Baculites baculus* Zone of the Western Interior (KENNEDY, 1993; ROBASZYNSKI *et al.*, 2002; JAGT, 2005). The IRScNB collections contain a few samples from the Ciply area, but in none of these we have so far been able to detect *C. paucistriatum*. We have only just begun screening macrofossil collections from correlative strata at Rügen (WITHERS, 1923; REICH & FRENZEL, 2002; JWMJ pers. obs.), Møn (Denmark) and central Poland (WALASZCZYK, 2004), but have not yet recognised material assignable to *C. paucistriatum*. However, it should be noted that collections currently available rarely contain any cirripede material, which is an expression of collection failure rather than of actual absence. Additional sampling is therefore called for.

Finally, *C. paucistriatum* appears close to *C. harnedi* COLLINS *in* COLLINS & MELLEN, 1973 (p. 357, pl. 1, figs 10-12; holotype is NHM In. 64421), mainly in carina and scutum. This species is from the middle Ripley Formation of Oktibbeha County (Mississippi), of mid-Maastrichtian age.

In short, *C. paucistriatum* ranks amongst other short-lived species of *Cretiscalpellum* and *Arcoscalpellum* from the Campanian and Maastrichtian of NW Europe, such as *Cretiscalpellum filosum* (WITHERS, 1911) (see WITHERS, 1935, p. 179, pl. 19, figs 7-10), *C. semiporcatum* (DARWIN, 1851) (see WITHERS, 1935, p. 196, pl. 20, fig. 6), *A. bellulum* WITHERS, 1935 (p. 266, pl. 35, fig. 2), *A. perarcuatum* WITHERS, 1935 (p. 267, pl. 35, fig. 1), *A. depressum* (MARSSON, 1880) (see WITHERS, 1935, p. 269, pl. 34, figs 1-9) and *A. pulchellum* (BOSQUET, 1854) (see WITHERS, 1935, p. 274, pl. 35, figs 4-6), in addition to some species described by ALEKSEEV (1979, *nomina nuda*). The type material of these taxa needs to be revised; moreover, their stratigraphic ranges are to be determined in more detail, preferably on the basis of newly collected material (wherever possible) and calibrated to zonations based on belemnitellid coleoid and ammonoid cephalopods and inoceramid bivalves. Thus, these species may be shown to be of stratigraphic value, in contrast to widely distributed and long-ranging taxa such as *C. glabrum*, *A. maximum* and *A. fossula*.

Acknowledgements

We thank A.S. Alekseev (Moscow State University) for supplying items of literature, J. Wördemann (Halstenbek) and K. Esser (Ellerau) for guidance at Kronsmoor quarry (1988) and M. Kutscher (Sassnitz-Lancken) for allowing us to study cirripede material from Rügen in his collection. JWMJ acknowledges the support of the European Community-Access to Research Infrastructure action of the Improving Human Research Potential Programme (ABC grant), which allowed him to visit the IRScNB in November-December 2003, where Isabella Van de Velde, Annie V. Dhondt (deceased), D. Anne and W. Miseur were extremely helpful. The journal reviewers, J.S. Buckeridge (RMIT University, Melbourne) and J.-P. Carriol (Muséum national d'Histoire naturelle, Paris), made helpful comments on an earlier typescript, for which we are grateful.

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Typescript submitted: August 28, 2006
Revised typescript received: March 5, 2007

Explanation of the plates

PLATE 1

Cretiscalpellum paucistriatum (WOODWARD, 1906) from the lower Maastrichtian (*obtusa* Zone) of Saturn quarry (Kronsmoor).

Figs 1-2 — Left tergum (NHMM JJ 4471), level G615 + *c.* 2-4 m.
Figs 3-5 — Carina (NHMM JJ 4510), around level G615.

PLATE 2

Scalpellomorph cirripedes from the lowermost Vijlen Member (Gulpen Formation, probably Interval 0, [partially] equivalent to *obtusa* Zone) at Slenaken, southern Limburg (The Netherlands).

Figs 1-3, 6-8 — *Cretiscalpellum paucistriatum* (WOODWARD, 1906); 1. left tergum, IRScNB MI 11025 (*ex* Bosquet Colln); 2. right tergum, IRScNB MI 9371 (*ex* Bosquet Colln), illustrated previously by WITHERS (1935, pl. 18, fig. 11); 3. right tergum, IRScNB MI 11026 (*ex* Bosquet Colln); 6. right scutum, IRScNB MI 9370 (*ex* Bosquet Colln), illustrated previously by WITHERS (1935, pl. 18, fig. 10); 7. right scutum, IRScNB MI 11029; 8. right scutum, IRScNB MI 11030.
Figs 4-5 — *Cretiscalpellum striatum* (DARWIN, 1851); 4. left scutum, IRScNB MI 11027 (*ex* Bosquet Colln); 5. left scutum, IRScNB MI 11028 (*ex* Bosquet Colln).

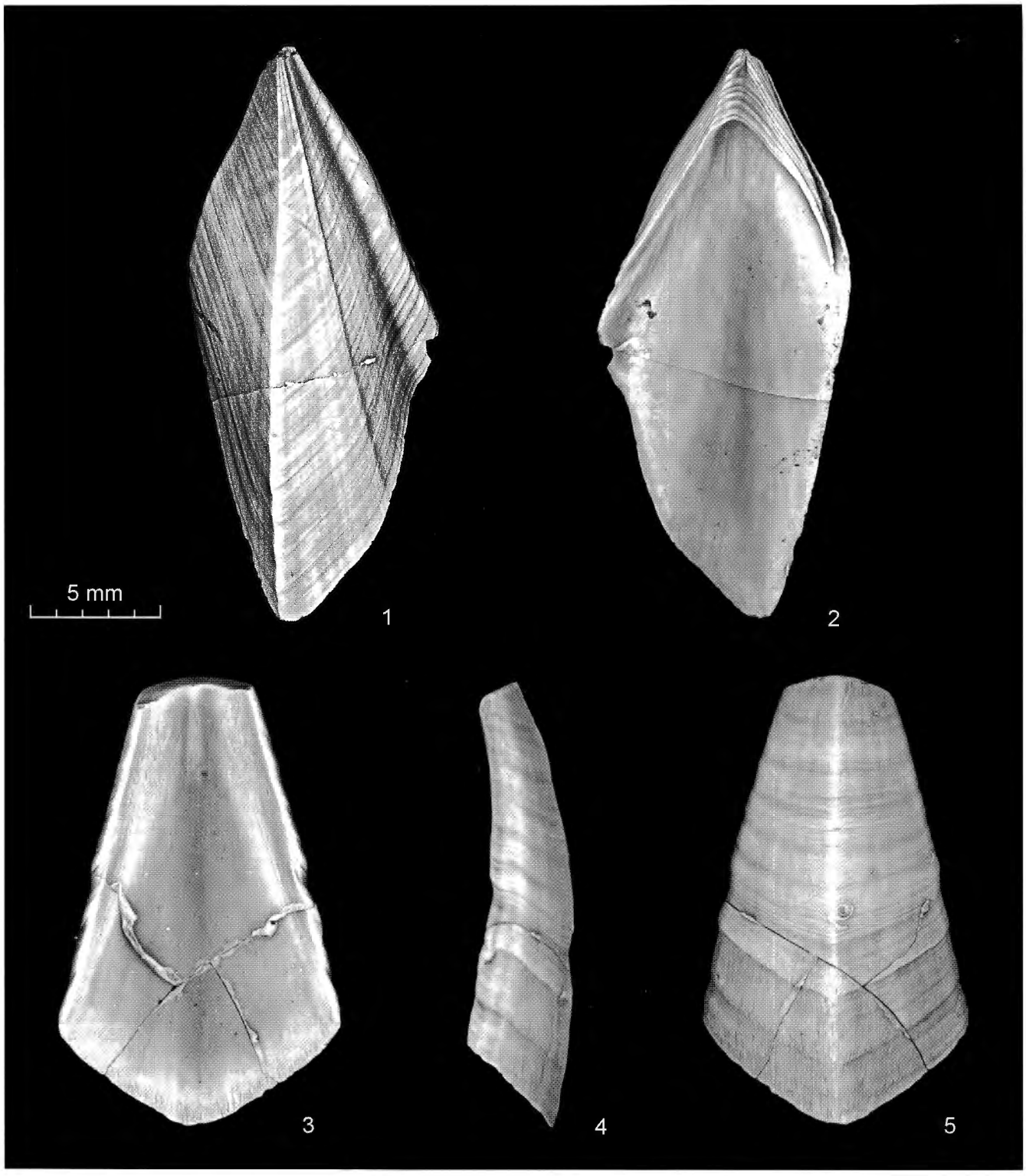

PLATE 1

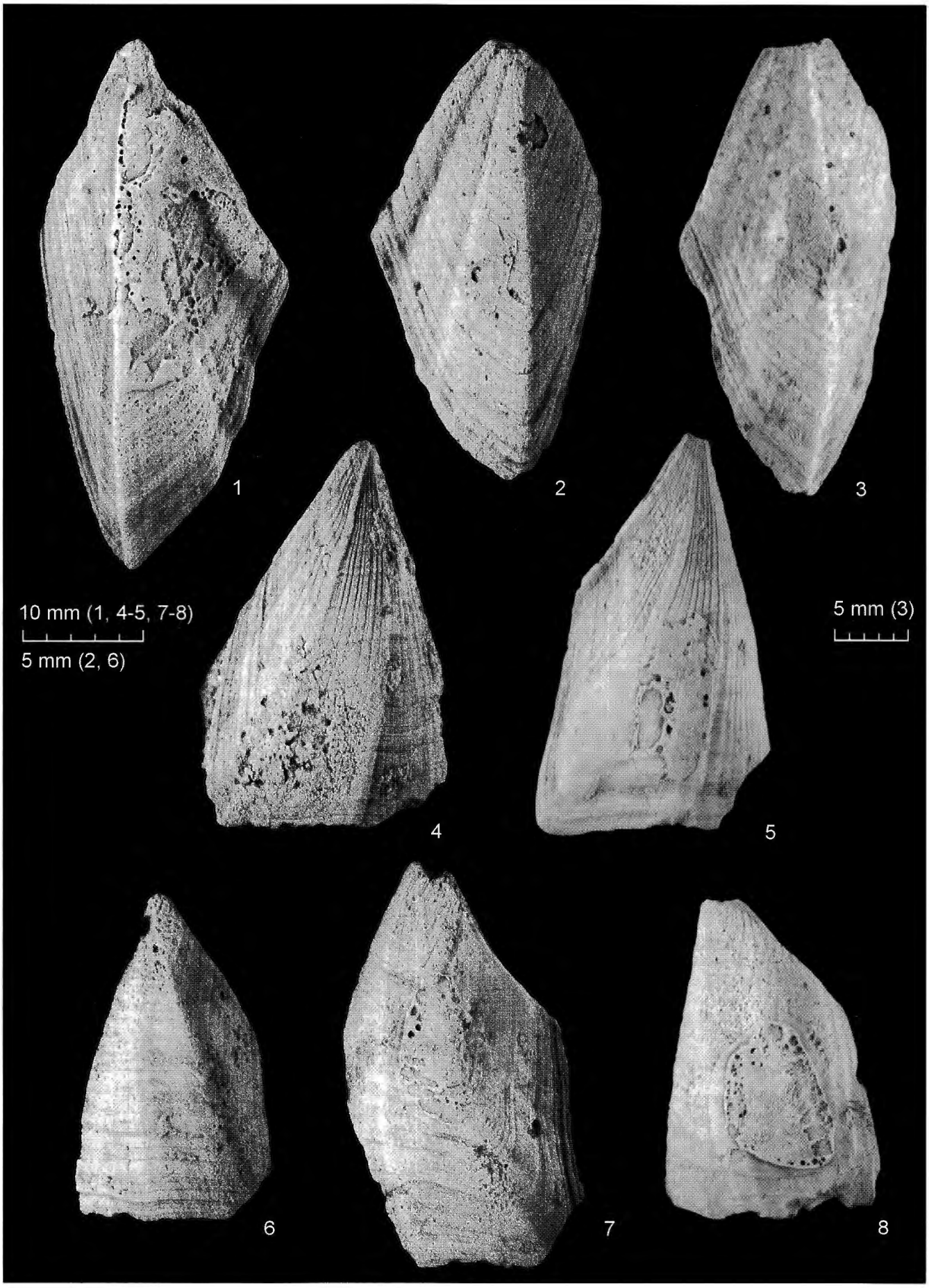

PLATE 2