

The Pliocene turrid Gastropods of Belgium

Part 1: Drilliidae, Turridae, Conidae (genus *Bela*)

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Abstract

The taxonomy and systematics of part of the Pliocene turrid gastropods of Belgium are revised. Three species are added to the Belgian fauna: *Asthenotoma icenorum* (WOOD, 1872), *A. ratinckxi* n. sp. and *Bela antwerpiensis* n. sp. The Belgian and part of the Dutch material, considered by GLIBERT (1960) to belong to *Bela neerlandica* (BEETS, 1946), is divided into four species: *B. neerlandica*, *B. antwerpiensis* n. sp., *B. consimilis* (HARMER, 1915) and *B. keepingi* (ETHERIDGE & BELL, 1898). *Bela nebula* auct. non MONTAGU, 1803 is described as *Bela gliberti* n. sp. *Haedropleura delheidi* (VINCENT, 1890) is united with *Bela tenuistriata* (BELL, 1871).

Key-words: turrid Gastropoda - taxonomy - Pliocene - North Sea.

Résumé

La taxinomie et la systématique d'une partie des Gastropodes turriiformes pliocènes de la Belgique sont révisées. Trois espèces sont ajoutées à la faune belge: *Asthenotoma icenorum* (WOOD, 1872), *Asthenotoma ratinckxi* n. sp. et *Bela antwerpiensis* n. sp. Le matériel belge et une partie du matériel néerlandais, considéré par GLIBERT (1960) comme *B. neerlandica* (BEETS, 1946), est divisé en quatre espèces: *B. neerlandica*, *B. antwerpiensis* n. sp., *B. consimilis* (HARMER, 1915) et *B. keepingi* (ETHERIDGE & BELL, 1898). *Bela nebula* auct. non MONTAGU, 1803 est décrit comme *Bela gliberti* n. sp. *Haedropleura delheidi* (VINCENT, 1890) est considéré comme synonyme de *Bela tenuistriata* (BELL, 1871).

Mots-clefs: Gastropoda turriiformes - taxinomie - Pliocène - Mer du Nord.

Introduction

BEETS (1946), GLIBERT (1960) and VAN REGTEREN AL-TENA *et al.* (1965) mentioned 19 Pliocene species of Turridae *sensu lato* for Belgium and 29 for the Netherlands, 17 of which were considered as common to both faunas. New fossil material from the Belgian Pliocene was collected during extensive dock works, executed between 1970 and 1994 in Kallo, Oost-Vlaanderen. This exposure yielded a large number of species, new for the Pliocene of Belgium. The location of the works and the stratigraphy are treated by HOEDEMAKERS & MARQUET (1992) and MARQUET (1995). Material in the Institut Royal des Sciences naturelles de Belgique, from dock

works in Antwerp, on the right Scheldt River bank, and not discussed in GLIBERT's (1957-1960) papers, is also studied here. The stratigraphy, observed during these works was described by DE HEINZELIN DE BRAUCOURT (1950a, b, 1955a, b). The material from Belgium was compared, when necessary, with Dutch specimens, present in the collections of the Nationaal Natuurhistorisch Museum, Leiden and the Rijks Geologische Dienst, Haarlem.

Material and methods

The material studied comprises 9142 specimens of turrid Gastropods. Only at Kallo, bulk samples were taken; these were picked from sieving residues on 5 and 1 mm mesh, most turrids originating from the finest fraction of the residues. From the *Petalococonchus* level (Kattendijk Formation), the *Atrina* and *Cultellus* levels (Oorderen Member) and from the Kruisschans Member, at least 50 kg of fine residue was picked. The basal crag of the Oorderen Member and the *Angulus benedeni* level of the same member are less well represented in the material studied. From most species SEM-photographs were made, illustrating protoconchs and microsculpture. Whenever sufficient material was available, four measurements were taken: total shell height (H), total shell diameter (D), height of the spira (S, from abapical suture above the aperture to top) and height of the aperture (A); the number of whorls (x) was counted.

Material from several localities around Antwerp was studied (see Fig. 1). The locality numbers, cited in the text, correspond to those in Fig. 1. Campine Pliocene deposits yield only steinkern material, if fossiliferous at all. Other localities in the provinces of Antwerp and Oost-Vlaanderen contain only derived Pliocene material, which is usually insufficiently preserved to study. The stratigraphic terms used are those of DE MEUTER & LAGA (1976). The Austruweel Member is here considered as a distinct sandy facies of the clayey *Angulus benedeni* level of the Oorderen Member.

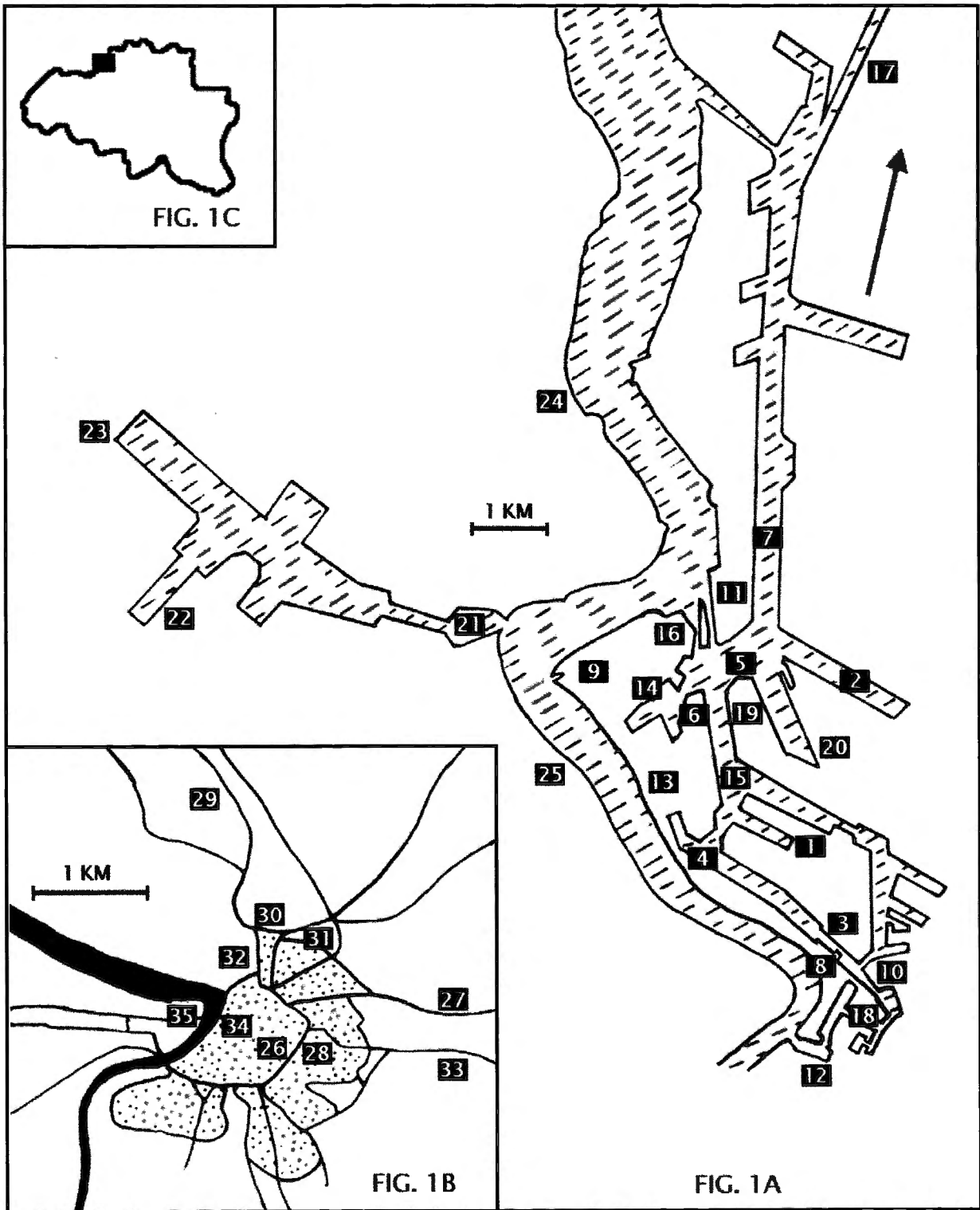


Fig. 1 — 1A. Localities in the Antwerp right Scheldt bank harbour: 1. Vierde Havendok, Kaai 271; 2. Oorderen Churchilldok; 3. Junction Amerikadok-Lefèbvredok (Noordkasteel); 4. Austruweel, bridge over Vijfde Havendok; 5. Stocatra; 6. Bridge over Petroleumdok; 7. Kanaaldok; 8. Amerikadok; 9. Wilmarsdonk; 10. Afrikadok = Lefèbvredok; 11. Boudewijnsluis; 12. Verbindingsdok; 13. Austruweel (with Van De Vin Dok); 14. Petroleumdok; 15. Mercantile; 16. Kruisschanssluis; 17. Berendrecht; 18. Kattendijkdok; 19. Hansadok; 20. Zesde Havendok. Localities on the left Scheldt Bank: Kallo, prov. Oost-Vlaanderen: 21. Verrebroekdok; 22. Zeesluis; 23. Vrasenedok. Doel, prov. Oost-Vlaanderen: 24. Doel, Plage orientale. Zwijndrecht, prov. Oost-Vlaanderen: 25. Plage orientale. Hatched areas: Scheldt River and docks.

1B. Localities around and in Antwerp city: 26. Kerkstraat; 27. Wijnegem, Het Sas; 28. Borgerhout, Stenenbrug; 29. Zoomseweg; 30. Ekeren, Schoonbroek; 31. Merksem; 32. Noorderlaan + Luchtbal (dredged); 33. Wommelgem, prov. Antwerp, Ternesselei; 34. Waaslandtunnel; 35. Sint Anna. Black: Scheldt River, stippled: city area, lines: main roads.

1C. Location of the study area (black) in Belgium.

Table 1. — Lithostratigraphic units of the Neogene of the vicinity of Antwerp.

Pliocene		
Formations	Members	Levels
Lillo Formation (= Scaldisien), upper and middle Pliocene	* Zandvliet Member * Merksem Member * Kruisschans Member * Austruweel Member = Oorderen Member * Oorderen Member	<i>Angulus benedeni</i> level <i>Cultellus</i> level <i>Atrina</i> level basal crag
Kattendijk Formation, lower Pliocene	* Luchtbal Member * Kattendijk Member	<i>Ditrupa</i> level <i>Petalocochus</i> level basal gravel
Miocene		
Formations	Members	Levels
Diest Fm., upper Miocene Berchem Fm., middle and lower Miocene (province of Antwerp) Bolderberg Fm. (province of Limburg)	* Deurne Member * Antwerp Member * Kiel Member * Edegem Member	

The material studied is kept in the following collections:

Coll. AJ: collection A. Janse, Brielle, The Netherlands; coll. AR: collection A. Ratincx, Antwerp, Belgium; coll. IRScNB: collection Institut royal des Sciences naturelles de Belgique, Brussels, Belgium; coll. KP: collection K. Peeters, Kontich, Belgium; coll. NNM: collection Nationaal Natuurhistorisch Museum, Leiden, The Netherlands; coll. RGH: collection Rijks Geologische Dienst, Haarlem, The Netherlands; coll. RM: collection R. Marquet, Antwerp, Belgium.

Systematic part

Phylum Mollusca
Class Gastropoda CUVIER, 1797
Superordo Caenogastropoda COX, 1960
Ordo Neogastropoda THIELE, 1929
Superfamilia Conoidea RAFINESQUE, 1815
Familia Drilliidae MORRISON, 1966
Genus *Cerodrillia* BARTSCH & REHDER, 1939
Subgenus *Elaeocyma* DALL, 1918

Cerodrillia (Elaeocyma) nysti (HARMER, 1915)
Pl. 2, Fig. 1

- 1872 - *Pleurotoma crassa* A. Bell - BELL in WOOD, p. 37, pl. 7, fig. 10 (non *Pleurotoma crassa* CONTI, 1864).
v. 1878 - *Pleurotoma incrassata*, Duj. - NYST, pl. 3, fig. 10

- (non *Pleurotoma incrassata* DUJARDIN, 1837).
v. 1881 - *Pleurotoma incrassata?* Duj. - NYST, p. 45 (non *Pleurotoma incrassata* DUJARDIN, 1837).
v. 1890 - *Pleurotoma crassa* Bell - VINCENT, p. 96, text-fig. (non *Pleurotoma crassa* CONTI, 1864).
· 1915 - *Drillia incrassata* var. *dertomagna*, Sacco - HARMER, p. 223, pl. 27, fig. 29 (non *Drillia incrassata* var. *dertomagna* SACCO, 1890).
· 1915 - *Drillia incrassata* var. *crassa* (A. Bell) - HARMER, p. 224, pl. 27, fig. 32.
· 1915 - *Drillia incrassata* var. *Nysti* nov. - HARMER, p. 224, pl. 27, fig. 31.
· 1915 - *Drillia incrassata* var. *miominor* (?) Sacco - HARMER, p. 223, pl. 27, fig. 30 (non *Drillia incrassata* var. *miominor* SACCO, 1890).
v. 1946 - *Clavus crassus* (Bell, 1871) - BEETS, p. 103.
v. 1954 - *Clavus (Elaeocyma) belli* nov. nom. - GLIBERT, p. 34, pl. 5, fig. 7, pl. 1 fig. 14.
v. 1960 - *Clavus (Elaeocyma) nysti* Harmer, sp. 1915 - GLIBERT, p. 10, pl. 4, fig. 8.
v. 1965 - *Clavus (Elaeocyma) belli* Glibert, 1954 - VAN REGTEREN ALTENA *et al.*, p. 38, pl. 16, fig. 155.

TYPE LOCALITY AND STRATUM: Little Oakley, East Anglia, United Kingdom; Red Crag, Pliocene.

MATERIAL: (Table 2).

DIMENSIONS:

Figured specimen Pl. 2, Fig. 1 - x: 11, H: 16.2 mm, D: 5.7 mm, S: 7.5 mm, A: 5.9 mm.

Table 2. — Material studied of *Cerodrillia (E.) nysti* (HARMER, 1915).

Types and figured specimens				
Collection	Locality	Member/Formation	Level	Coll. number
IRScNB	Antwerp	Scaldisien		IST 4376
Other material				
Collection	Locality	Member/Formation	Level	Number of spec.
IRScNB	Antwerp	Austruweel Mbr.		22
IRScNB	1	Scaldisien		10
IRScNB	1	Kattendijk Fm.		7
IRScNB	4	Oorderen Mbr.	1.3 m	1
IRScNB	4	Oorderen Mbr.	2.4 m	2
IRScNB	5	Austruweel Mbr.	basal crag	1
IRScNB	5	Oorderen Mbr.	11.2-11.5 m	1
IRScNB	6	Scaldisien	5.9-6.4 m	1
IRScNB	6	Luchtbal Mbr.	7.4 m	3
IRScNB	6	Luchtbal Mbr.	7.75 m	1
IRScNB	6	Luchtbal Mbr.	8.1 m	8
IRScNB	6	Luchtbal Mbr.	9 m	1
IRScNB	6	Kattendijk Fm.	9.35-9.6 m	4
IRScNB	6	Kattendijk Fm.	9.75 m	2
IRScNB	6	Not in situ		1
IRScNB	8	Austruweel Mbr.		10
IRScNB	8	Scaldisien		10
IRScNB	9	Scaldisien	basal crag	6
IRScNB	10	Scaldisien		2
IRScNB	11	Oorderen Mbr.	10-10.5 m	1
IRScNB	11	Oorderen Mbr.	10.5-11 m	2
IRScNB	11	Oorderen Mbr.	11-11.5 m	3
IRScNB	11	Oorderen Mbr.	11.5-12 m	2
IRScNB	11	Oorderen Mbr.	13.00-13.25 m	1
IRScNB	11	Oorderen Mbr.	13.25-13.50 m	4
IRScNB	11	Luchtbal Mbr.	13.5-13.75 m	2
IRScNB	13	Luchtbal Mbr.		15
IRScNB	13	Scaldisien		3
IRScNB	13	Austruweel Mbr.		6
IRScNB	16	Oorderen Mbr.		6
IRScNB	16	Scaldisien	basal crag	4
IRScNB	16	Scaldisien	<i>Glossus</i>	1
IRScNB	16	Kattendijk Fm.		1
IRScNB	24	Scaldisien		3
IRScNB	29	Scaldisien		10
NNM	1	Kattendijk Fm.	<i>Ditrupa</i>	1
NNM	3	Luchtbal Mbr.		2
RM	3	Kattendijk Fm.		1
RM	21	Oorderen Mbr.	<i>Cultellus</i>	11
RM	21	Oorderen Mbr.	<i>Atrina</i>	46
RM	23	Oorderen Mbr.	<i>Atrina</i>	35

DESCRIPTION

Medium sized, very slender fusiform shell, with shallow suture and very short siphonal canal. Teleoconch whorls

flat-sided, with very slight subsutural depression on last whorl. Protoconch consisting of 3 smooth whorls, not clearly separated from teleoconch. Nucleus globular, sub-

Table 3. — Statistics of 30 specimens of *Cerodrillia (E.) nysti* (HARMER, 1915 from Kallo, Verrebroekdok and Vrasenedok, Oorderen Member, *Atrina* level.

Measurement	Number of specimens	Minimal value	Maximal value	Mean value	Standard deviation
Number of whorls	30	8	11	10	0.8
Height (mm)	30	9.8	17.5	13.4	2.3
Diameter (mm)	30	3.2	5.9	4.6	0.7
Spire (mm)	30	4.1	8.9	6.1	1.3
Aperture (mm)	30	3.5	6.4	5.0	0.8

sequent whorls less tumid. Adult shell with on average 7 whorls. Spire taking on average 45.5 % of total height, diameter 34.3 %, aperture 37.3 %. Aperture elongate oval, with narrow, U-shaped, but deep anal sinus. A narrow callus is present. On the parietal side of the aperture of adult specimens occurs a distinct tubercle, making up part of the adapical side of the anal sinus. Most specimens with 9 whorls are adult, but exceptionally specimens with 10 whorls without tubercle occur. Axial sculpture comprising 10 opisthocline ribs, which are vaguely delimited and become obsolete near the last whorl. They do not reach the suture, causing the formation of a shallow subsutural depression. Growth lines opisthocline, faint, slightly coarser in the subsutural depression, where the old anal sinuses can be seen. Spiral sculpture absent, except for 12 faint oblique striae on the siphonal canal.

DISCUSSION

The size and the relative diameter of *Cerodrillia nysti* (HARMER, 1915) are very variable: adult specimens range from 9.8 to 17.5 mm height. The nomenclature of this species was discussed by GLIBERT (1960). *Cerodrillia nysti* is common in the Oorderen Member of Kallo, especially in the *Atrina* level. A considerable number of specimens shows borings of *Terebripora ramosa* FISCHER, 1866. In other localities, it ranges from Luchtbal to Austruweel Member. It is a species typical of the North Sea basin Pliocene. In Great Britain it has been found in the Coralline as well as in the Red Crag.

Genus *Spirotropis* SARS, 1878

Spirotropis confusa confusa (SEGUENZA, 1880)

DISCUSSION: JANSSEN (1993) discussed the systematics and occurrence of this species in detail and figured the species. In Belgium, it is present in the Kattendijk Formation, but always rare. One specimen was collected in the Austruweel Sand in the Amerikadok, Antwerp, but its state of preservation shows that it could be derived from older strata.

Familia Turridae H. & A. ADAMS, 1853
Subfamilia Turrinae SWANSON, 1840
Genus *Gemmula* WEINKAUFF, 1875
Subgenus *Unedogemmula* Mac NEIL, 1960

Gemmula (Unedogemmula) stoffelsi (NYST, 1843) Pl. 1, Fig. 3

- v. 1843 - *Pleurotoma stoffelsi* Nob. - NYST, p. 521, pl. 44, fig. 1.
- v. 1878 - *Pleurotoma woodi*, Nyst - NYST, pl. 3, fig. 8.
- v. 1881 - *Pleurotoma woodi*, Nyst - NYST, p. 44.
- v. 1954 - *Gemmula (α-Gemmula) stoffelsi* Nyst, sp. 1843 - GLIBERT, p. 8, pl. 2, fig. 6.
- v. 1960 - *Gemmula (α-Gemmula) stoffelsi* Nyst, sp. 1843 - GLIBERT, p. 6.
- v. 1984 - ? *Unedogemmula stoffelsi* (NYST, 1843) - JANSSEN, p. 283, pl. 11, fig. 8, pl. 69, fig. 5-6.

TYPE LOCALITY AND STRATUM: Bolderberg, Limburg, Belgium; Bolderberg Formation, derived Miocene.

MATERIAL: (Table 4).

DIMENSIONS:

Lectotype - x: 9, H: 15.0 mm, D: 5.1 mm, S: 6.0 mm, A: 7.4 mm. Figured specimen Pl. 1, Fig. 3 - H: 15.1 mm, D: 4.9 mm (incomplete).

DESCRIPTION

Medium sized, very slender fusiform shell with shallow suture and long, straight siphonal canal. Protoconch multispiral, consisting of five whorls, teleoconch of eight whorls. The first three protoconch whorls are smooth, then axial ribs occur. A spiral can start on the last protoconch whorl. The spire is less than half the total height. The aperture is narrow, pointed above, with narrow, but clear callus. The spiral sculpture consists firstly of a carina above the periphery, which can be well or less developed. On the last whorl, between the aperture and the suture, three to four primary spirals are present; between them run as many weaker secondary spirals. These ribs continue on the siphonal canal, but the distinction between secondary and primary ones becomes less clear. The axial sculpture is weaker and consists of

Table 4. — Material studied of *Gemmula (U.) stoffelsi* (NYST, 1843).

Types and figured specimens				
Collection	Locality	Member/Formation	Level	Coll. number
IRScNB	Bolderberg	Bolderberg Fm.		Lectotype IST 4235
IRScNB	Antwerp	Kattendijk Fm.		IST 4374
IRScNB	Edegem	Edegem Member		IST 4446
Other material				
Collection	Locality	Member/Formation	Level	Number of spec.
RM	23	Kattendijk Fm.	<i>Petalococonchus</i>	1
RM	3	Kattendijk Fm.	<i>Ditrupa</i>	4
RM	26	Kattendijk Fm.	<i>Ditrupa</i>	1

growth lines, which can become coarse. The part of these growth lines marking the ancient anal sinuses can be seen on the carina as rectangular tubercles.

DISCUSSION: This species, which is common in the Miocene of the North Sea basin, extends into the Kattendijk Formation, but it is very rare in the Pliocene. In Kallo, a few badly preserved specimens were found in the *Petalococonchus* level. The species has until now been found neither in the Dutch, nor in the British Pliocene. The Pliocene material is too scant and too badly preserved to allow measurements or more detailed description.

Gemmula (Unedogemmula) antwerpiensis
(VINCENT, 1890)
Pl. 1, Fig. 2

- v. 1843 - *Pleurotoma turricula*, Brocchi - NYST, p. 520, pl. 41, fig. 5
- . 1848 - *Pleurotoma turricula* Broc. - WOOD, p. 53, pl. 6, fig. 1
- . 1872 - *Pleurotoma turrifera* Nyst - WOOD, p. 33 (non *Pleurotoma turrifera* NYST in D'OMALIUS D'HALLOY, 1853).
- v. 1879 - *Pleurotoma turrifera*, Nyst - NYST, pl. 3, fig. 6 (non *Pleurotoma turrifera* NYST in D'OMALIUS D'HALLOY, 1853).
- v. 1881 - *Pleurotoma turricula*, Brocchi - NYST, p. 42.
- v. 1890 - *Pleurotoma antwerpiensis* nov. sp. - VINCENT, p. 95, text-fig.
- . 1915 - *Pleurotoma turricula* Brocchi - HARMER, p. 203, pl. 26, fig. 1-2
- . 1915 - *Pleurotoma turricula* var. *antwerpiensis* E. Vincent - HARMER, p. 205, pl. 26, fig. 3-4.
- v. 1946 - *Turris (Gemmula) turricula* (Brocchi, 1814) - BEETS, p. 97.
- v. 1954 - *T. (α-Gemmula) antwerpiensis* - GLIBERT, p. 9, pl. 1, fig. 4.
- v. 1960 - *Gemmula (Alpha-Gemmula) antwerpiensis* Vincent, sp. 1890 - GLIBERT, p. 7.

- v. 1965 - *Turris (Gemmula) antwerpiensis* (Vincent, 1890) - VAN REGTEREN ALTENA *et al.*, p. 38, pl. 16, fig. 153.
- v. 1979 - *Gemmula antwerpiensis* (VINCENT, 1890) - GEYS & MARQUET, p. 76, pl. 31, fig. 1.

TYPE LOCALITY AND STRATUM: Kattendijkdok, Antwerp, Belgium; Kattendijk Formation, lower Pliocene.

MATERIAL: (Table 5).

DIMENSIONS:

Lectotype - x: 9 (protoconch lacks), H: 44.4 mm, D: 13.3 mm, S: 18.9 mm, A: 19.3 mm. Figured specimen Pl. 1, Fig. 2 - x: 11, H: 32.8 mm, D: 10.8 mm, S: 13.4 mm, A: 16.8 mm.

DESCRIPTION

Large, very slender fusiform shell with medium sized siphonal canal, adult shell consisting of 4 protoconch and 6, rarely 7 teleoconch whorls. Protoconch multispiral, relatively tumid; 3 1/2 first whorls smooth, markedly more tumid than teleoconch; then follows 1/4 whorl with more or less clear, flexuous, opisthocline axial ribs, which continue as weaker growth lines on the teleoconch. Protoconch and teleoconch not clearly delimited. Teleoconch sculpture starting with 4 spiral ribs, which are as broad as the intercostal areas; the adapical one, just below the suture is slightly stronger and darker coloured; only on the first teleoconch whorl, it forms a small depression. On the third teleoconch whorl a second coloured spiral starts. Teleoconch suture very shallow, whorls flat. Spire taking on average 44 % of total height, aperture 49 %, diameter 32 %. Aperture elongate oval, pointed adapically, with a narrow, unclear callus; sinus broad, deep, V-shaped. Spiral sculpture consisting of 2, rarely 3 rather broad primary ribs on the penultimate whorl, which have mostly conserved their orange colour. Between them, five to eight much weaker secondary spirals are present. Adapical spiral just below the suture darker coloured than

Table 5. — Material studied of *Gemmula (U.) antwerpiensis* (VINCENT, 1890).

Types and figured specimens				
Collection	Locality	Member/Formation	Level	Coll. number
IRScNB	Kattendijkdok	Kattendijk Fm.		Lectotype IST 5012
IRScNB	Antwerp	Scaldisien		IST 4398
IRScNB	Antwerp	Scaldisien		IST 4448
Other material				
Collection	Locality	Member/Formation	Level	Number of spec.
IRScNB	9	Scaldisien	basal crag	1
RM	3	Oorderen Mbr.		20
RM	3	Luchtbal Mbr.		4
RM	13	Austruweel Mbr.		8
RM	21	Oorderen Mbr.	<i>A. benedeni</i>	2
RM	21	Oorderen Mbr.	<i>Cultellus</i>	57
RM	21	Oorderen Mbr.	<i>Atrina</i>	32
RM	22	Oorderen Mbr.	basal crag	2
RM	30	Kruisschans Mbr.		1

second primary spiral, which is broader. Below this second spiral, 7 to 12 weaker, coloured spirals are present, always with 3 to 4 white spirals in between; together, they form a siphonal fasciole. Axial sculpture consisting only of often coarse growth lines, which can form weak scales on the second coloured spiral.

DISCUSSION

GLIBERT (1954, Pl. 1 Fig. 4) figured the protoconch of this species. JANSSEN (1984) observed granulous microsculpture on the protoconchs of related Miocene species; the conservation of our Pliocene material was however insufficient to observe microsculpture. *Gemmula antwerpiensis* (VINCENT, 1890) is common in Kallo in all parts of the Oorderen Member. It occurs from the Kattendijk Formation, where it is very rare to the Kruisschans Member, but it is most common in the Oorderen Member. The species occurs also in British and Dutch Pliocene deposits, but it is unknown outside the Pliocene North Sea

basin. Specimens in Kallo have often been inhabited by the boring bryozoan *Terebripora ramosa* FISCHER, 1866 and some show traces of being scraped by the Lantern of Aristotle of sea urchins: the trace fossil *Gnathichnus pentax* BROMLEY, 1975 (see MARQUET (1984)).

Genus *Fusiturris* THIELE, 1929

Fusiturris porrecta (WOOD, 1848)

- . 1848 - *Pleurotoma porrecta* - WOOD, p. 55, pl. 7, fig. 1.
- . 1872 - *Pleurotoma inermis* Partsch - WOOD, p. 33, pl. 3, fig. 2 (non *Pleurotoma inermis* PARTSCH in HÖRNES, 1856).
- v. 1878 - *Pleurotoma inermis*, Partsch - NYST, pl. 3, fig. 9 (non *Pleurotoma inermis* PARTSCH in HÖRNES, 1856).
- v. 1881 - *Pleurotoma inermis?* 1842, Partsch - NYST, p. 45

Table 6. — Statistics of 30 specimens of *Gemmula (U.) antwerpiensis* (VINCENT, 1890) from Kallo, Verrebroekdok, Oorderen Member, *Cultellus* level.

Measurement	Number of specimens	Minimal value	Maximal value	Mean value	Standard deviation
Number of whorls	30	9	12	10	0.61
Height (mm)	30	22.7	39.3	30.0	3.44
Diameter (mm)	30	7.2	19.5	9.5	2.13
Spire (mm)	30	10.0	17.8	13.3	1.70
Aperture (mm)	30	10.5	19.8	14.8	1.90

Table 7. — Material studied of *Fusiturris porrecta* (WOOD, 1848).

Types and figured specimens				
Collection	Locality	Member/Formation	Level	Coll. number
IRScNB	Antwerp 13	Luchtbal Mbr.		IST 5013
IRScNB	Antwerp	Scaldisien		IST 4375
Other material				
Collection	Locality	Member/Formation	Level	Number of spec.
IRScNB	Antwerp	Scaldisien		1
IRScNB	Antwerp	Kattendijk Fm.		7
IRScNB	Antwerp	Luchtbal Mbr.		2
IRScNB	13	Kattendijk Fm.		6
IRScNB	25	Kattendijk Fm.		1
IRScNB	31	Scaldisien		1
IRScNB	34	Kattendijk Fm.		1
RM	3	Kattendijk Fm.	<i>Ditrupa</i>	1
AJ	23	Kattendijk Fm.	<i>Petalocochnus</i>	1

(non *Pleurotoma inermis* PARTSCH in HÖRNES, 1856).

- . 1915 - *Pleurotoma inermis* Partsch - HARMER, p. 207, pl. 26, fig. 5, 6 (non *Pleurotoma inermis* PARTSCH in HÖRNES, 1856).
- v. 1946 - *Turris inermis* (Partsch, 1842) - BEETS, p. 95.
- v. 1960 - *Turris (Fusiturris) porrecta* Wood, sp. 1848 - GLIBERT, p. 8, pl. 4, fig. 6.

TYPE LOCALITY AND STRATUM: Gedgrave, East Anglia, United Kingdom; Coralline Crag, lower Pliocene.

MATERIAL: (Table 7).

DIMENSIONS:

Specimen IST 5013, figured by GLIBERT (1960) - x: 10, H: 17.2 mm, D: 5.5 mm, S: 6.7 mm, A: 8.3 mm.

DESCRIPTION

Large, very slender fusiform shell with long siphonal canal, composed of 10 flat, but mostly keeled whorls, with a shallow suture and a broad, shallow subsutural depression. The spire takes 39 % of the total height, the aperture 48 %. The protoconch is paucispiral, with 1 1/4 smooth, tumid, glossy whorl; the last part of the protoconch is broader than the start of the teleoconch. On the second teleoconch whorl, a first axial rib appears. On the last whorl, 8 axial ribs are present; these become obsolete near the aperture. They are sinuous and opisthocline; the turning point is just below the subsutural depression; in the depression, the axials are very weak. At the turning point, tubercles are formed by old anal sinuses, but in some specimens these tubercles are lacking. Spiral sculp-

ture starts on the fourth teleoconch whorl with 5 very broad ribs; the intercostal areas form narrow grooves between the spirals. On the last whorl, 5 narrow spirals are present in the subsutural depression. Two broader ones occur on the tubercles, 7 very broad spirals, with very shallow intercostal incisions are present between subsutural depression and siphonal canal, 11 narrower spirals form a siphonal fasciole. The aperture is narrow, elongate, with a deep and broad, V-shaped anal sinus.

DISCUSSION

This is a species restricted to the Kattendijk and Luchtbal Members in Belgium and to the Coralline Crag in Great Britain. No better material than that figured by GLIBERT (1960) was studied, so the species is not figured. In the Miocene of Belgium, two species of the genus *Fusiturris* are present: *Fusiturris aquensis* (GRATELOUP, 1832) and *Fusiturris duchasteli flexiplicata* (KAUTSKY, 1925). *F. aquensis* (GRATELOUP, 1832) resembles *Fusiturris porrecta* (WOOD, 1848), especially the specimens without tubercles from the latter species, which are rare in the Belgian Pliocene. Both could form an evolutionary lineage. *Fusiturris aquensis* (GRATELOUP, 1832) has however a multispiral protoconch with 4 1/2 to 5 whorls and the axial sculpture is less pronounced or absent. The spiral ribs of *F. aquensis* (GRATELOUP, 1832) have the same broad shape with very narrow intercostal areas as in *F. porrecta* (WOOD, 1848), but their number is lower. *Fusiturris duchasteli flexiplicata* (KAUTSKY, 1925) differs strongly from *F. porrecta* (WOOD, 1848) by the presence of 4 1/2 to 5 1/4 protoconch whorls, the absence of a carina on the teleoconch, the weak axial sculpture and the much coarser and numerous spirals.

Familia Conidae FLEMING, 1822
Subfamilia Clathurellinae H. & A. ADAMS, 1953
Genus *Acamptogenotia* ROVERETO, 1899

Acamptogenotia intorta nysti GLIBERT, 1954
Pl. 1, Fig. 1

The higher systematic units adopted here are those of TAYLOR *et al.* (1993). Their system is however based foremost on anatomical characters, especially of the foregut. This poses a problem for a number of exclusively fossil genera, like *Acamptogenotia*, especially because the parts of the diagnoses of the subfamilies in TAYLOR *et al.* (1993), based on shell characters, are rather vague. The genus *Acamptogenotia* is here only tentatively included in the Clathurellinae, as in PACAUD & LE RENARD (1995).

- v. 1843 - *Pleurotoma intorta* Brocchi - NYST, p. 509, pl. 41, fig. 2.
 . 1848 - *Pleurotoma intorta* Broc. - WOOD, p. 53, pl. 6, fig. 4.
 v. 1878 - *Pleurotoma intorta*, Brocc. - NYST, pl. 3, fig. 11.
 v. 1881 - *Pleurotoma intorta*, Brocc. - NYST, p. 47.
 . 1915 - *Pseudotoma intorta* (Brocchi) - HARMER, p. 212, pl. 26, fig. 11-12 (not 13, 14).
 v. 1946 - *Surculites (Pseudotoma) intortus* (Brocchi, 1814) - BEETS, p. 94.
 v. 1954 - *A. intorta f. nysti* n. f. - GLIBERT, p. 24.
 v. 1960 - *Acamptogenotia intorta* Brocchi, sp. 1814 f. *nysti* Glibert, 1954 - GLIBERT, p. 9.

Table 8. — Material studied of *Acamptogenotia intorta nysti* GLIBERT, 1954.

Types and figured specimens				
Collection	Locality	Member/Formation	Level	Coll. number
IRScNB	Stuyvenberg, Antwerp	Kattendijk Fm.?		Lectotype IST 4238
Other material				
Collection	Locality	Member/Formation	Level	Number of spec.
IRScNB	Antwerp	Kattendijk Fm.		8
IRScNB	Antwerp	Luchtbal Mbr.		11
IRScNB	Antwerp	Scaldisien		15
IRScNB	Helder (??)	Scaldisien		1
IRScNB	4	Luchtbal Mbr.	7.5 m	1
IRScNB	4	Kattendijk Fm.	9-9.5 m	2
IRScNB	4	Kattendijk Fm.	9.75 m	8
IRScNB	5	Luchtbal Mbr.	11.2-11.5 m	1
IRScNB	6	Luchtbal Mbr.	9.25-9.6 m	1
IRScNB	6	Luchtbal Mbr.	9-9.5 m	1
IRScNB	9	Scaldisien		1
IRScNB	10	Luchtbal Mbr.		11
IRScNB	10	Scaldisien		11
IRScNB	13	Luchtbal Mbr.		33
IRScNB	13	Scaldisien		18
IRScNB	18	Scaldisien		2
IRScNB	18	Kattendijk Fm.		1
IRScNB	25	Kattendijk Fm.		4
IRScNB	31	Scaldisien		4
IRScNB	34	Scaldisien		3
IRScNB	35	Kattendijk Fm.		4
KP	23	Kattendijk Fm.		1
RM	Antwerp	Luchtbal Mbr.		2
RM	3	Luchtbal Mbr.		10
RM	3	Kattendijk Fm.		4
RM	23	Kattendijk Fm.		1
RM	28	reworked		1
RM	28	Kattendijk Fm.		1
RM	29	Luchtbal Mbr.		1

Table 9. — Statistics of 30 specimens of *Acamptogenotia intorta nysti* GLIBERT, 1954 from Antwerp (Afrikadok and Kattendijk-dok), Luchtbal Member (8 sp.), Antwerp (Austruweel), Luchtbal Member (17 sp.) and Antwerp (new docks 1928), Luchtbal Member (5 sp.).

Measurement	Number of specimens	Minimal value	Maximal value	Mean value	Standard deviation
Number of whorls	30	8	9	8.5	0.5
Height (mm)	30	40.8	73.2	51.7	8.5
Diameter (mm)	30	16.4	27.3	21.7	3.4
Spire (mm)	30	12.0	23.0	15.7	2.9
Aperture (mm)	30	22.7	35.8	27.6	3.8

v. 1965 - *Acamptogenotia intorta nysti* Glibert, 1954 - VAN REGTEREN ALTENA *et al.*, p. 38, pl. 16, fig. 154.

v. 1979 - *Genota intorta nysti* (GLIBERT, 1954) - GEYS & MARQUET, p. 76, pl. 31, fig. 2.

TYPE LOCALITY AND STRATUM: Stuyvenberg, Antwerp, Belgium; Scaldisien, Pliocene, probably Kattendijk formation.

MATERIAL: (Table 8).

DIMENSIONS:

Lectotype - x: 9, H: 63.8 mm, D: 30.9 mm, S: 22.4 mm, A: 30.9 mm. Figured specimen Pl. 1, Fig. 1a - x: 9, H: 58.7 mm, D: 24.4 mm, S: 18.8 mm, A: 30.9 mm. Figured specimen Pl. 1, Fig 1b with *Hydractinia* sp. - H: 98 mm, D: 49 mm.

DESCRIPTION

Large, broad fusiform shell, with deep suture and extremely short siphonal canal. Protoconch consisting of 3 1/2 whorls, which are relatively less slender than teleoconch whorls. Last protoconch whorl with 5 faint, equally strong spiral ribs, which are slightly narrower than the intercostal areas. Start of teleoconch sculpture marked by gradual strengthening of spiral sculpture over 1/4 whorl. Halfway on the second teleoconch whorl, a keel appears gradually, marking a subsutural depression. At the start of the third teleoconch whorl, tubercles appear below the depression. The teleoconch consists maximally of 6 whorls. The spire is relatively low, it takes on average 30 % of the total shell height; the diameter takes 42 %. The aperture is elongate triangular, on average 53 % of total shell length, with the broadest side adapically. The anal sinus is rounded, shallow, but wide. An apertural callus is present. The spiral sculpture consists of 30 very fine ribs on the penultimate whorl, 50 ribs on the body whorl. The ribs are very fine in the subsutural depression and become coarser to the siphonal canal, where they form a siphonal fasciole. The axial sculpture consists of 20 unclearly delimited, very slightly opisthocline ribs, which extend on the last whorl from halfway to a deep subsutural depression,

where they end in obliquely placed tubercles. Growth lines are not very conspicuous. The marks of previous positions of the sinus can be seen in the subsutural depression.

DISCUSSION

This species is very rare in Kallo, where only a few badly preserved specimens were found in the Kattendijk Formation, above the *Petalococonchus* level. One of them is completely covered with *Hydractinia* sp. and shows a wear mark, caused by the dragging along of the shell by a hermit crab. The species is rare in the Kattendijk Formation and common in the Luchtbal Member; no material was seen from the Oorden or the Austruweel Members, although GLIBERT (1960) mentioned records from both strata. The subspecies is very variable in diameter: very slender specimens occur, but rarely. It is the North Sea basin representative of the Mediterranean *Acamptogenotia intorta intorta* (BROCCHI, 1814), from which it differs by its larger size, less distinct carina, less oblique tubercles, higher spire, broader and more rounded last whorl and less distinct spiral sculpture. The protoconch of the Italian subspecies has the same structure as that of the North Sea basin shells, but seems to be slightly smaller, with only 3 whorls (see MALATESTA (1979, fig. 33)).

Genus *Asthenotoma* HARRIS & BURROWS,
1891 *s. lat.*

Asthenotoma bipunctula (WOOD, 1872) and *Asthenotoma icenorum* (WOOD, 1872) are with little doubt referable to the genus *Asthenotoma*, as restricted by GATTO (1990), because of their shell shape, paucispiral protoconch with large nucleus and with microgranulation, spiral teleoconch sculpture, shallow, V-shaped anal sinus and aperture characteristics. *Asthenotoma ratinckxi* n. sp. however has also a granulated protoconch, but its teleoconch characters partly differ (see description of that species). Hence the *s. lat.*

Table 10. — Material studied of *Asthenotoma bipunctula* (WOOD, 1872).

Types and figured specimens				
Collection	Locality	Member/Formation	Level	Coll. number
IRScNB	Kallo 21	Oorderen Mbr.	<i>Cultellus</i>	IST 6306
Other material				
Collection	Locality	Member/Formation	Level	Number of spec.
IRScNB	Antwerp	Kattendijk Fm.		1
IRScNB	Antwerp	Austruweel Mbr.		1
IRScNB	Antwerp	Scaldisien		15
IRScNB	Ekeren	Scaldisien		20
IRScNB	4	Luchtbal Mbr.	8-8.5 m	1
IRScNB	5	Oorderen Mbr.	10.9-11.1 m	1
IRScNB	5	Oorderen Mbr.	11.2-11.5 m	1
IRScNB	6	Oorderen Mbr.	6.25 m	5
IRScNB	6	Luchtbal Mbr.	7.4 m	25
IRScNB	6	Luchtbal Mbr.	7.75-8.1 m	138
IRScNB	6	Luchtbal Mbr.	9 m	4
IRScNB	6	Luchtbal Mbr.	9-9.5 m	5
IRScNB	6	Luchtbal Mbr.	basal crag	6
IRScNB	6	not in situ		8
IRScNB	7	Scaldisien		2
IRScNB	7	Austruweel Mbr.		12
IRScNB	8	Austruweel Mbr.		6
IRScNB	9	Scaldisien		4
IRScNB	10	Scaldisien		17
IRScNB	11	Oorderen Mbr.	10-10.5 m	3
IRScNB	11	Oorderen Mbr.	10.5-11 m	6
IRScNB	11	Oorderen Mbr.	11-11.5 m	3
IRScNB	11	Oorderen Mbr.	12-12.25 m	2
IRScNB	11	Oorderen Mbr.	13-13.25 m	3
IRScNB	11	Luchtbal Mbr.	13.25-13.5 m	5
IRScNB	11	Luchtbal Mbr.	13.5-14 m	1
IRScNB	11	Luchtbal Mbr.	14.5-14.6 m	1
IRScNB	13	Scaldisien		48
IRScNB	13	Luchtbal Mbr.		1
IRScNB	15	Luchtbal Mbr.	7.6-8 m	1
IRScNB	16	Scaldisien	11-15 m	6
IRScNB	16	Scaldisien	16 m	2
IRScNB	16	Kattendijk Fm.	18-19 m	6
IRScNB	24	Scaldisien		7
IRScNB	25	Kattendijk Fm.		1
IRScNB	31	Scaldisien		3
RM	21	Oorderen Mbr.	<i>A. benedeni</i>	1
RM	21	Oorderen Mbr.	<i>Cultellus</i>	166
RM	21	Oorderen Mbr.	<i>Atrina</i>	30
RM	22	Oorderen Mbr.	<i>Atrina</i>	22
RM	23	Oorderen Mbr.	<i>Atrina</i>	53
RM	27	Austruweel Mbr.		1
RM	30	Kruisschans Mbr.		2
NNM	1	Kattendijk Fm.	Ditrupa	6

Asthenotoma bipunctula (WOOD, 1872)

Pl. 1, Fig. 4

- . p.p. 1848 - *Pleurotoma semicolon* (?) J. Sow. - WOOD, p. 54, pl. 6, fig. 3b (non *Pleurotoma semicolon* J. SOWERBY, 1816).
- . 1872 - *Pleurotoma bipunctula* - S. Wood, p. 36.
- v. 1878 - *Pleurotoma granulina*, Nyst - NYST, pl. 3, fig. 7.
- v. 1881 - *Pleurotoma granulina*, Nyst - NYST, p. 43.
- v. 1890 - *Oligotoma festiva* Hörnes - VINCENT, p. 93.
- . 1915 - *Oligotoma ornata* (Defrance) - HARMER, p. 216, pl. 27, fig. 2 (not 1).
- ? 1915 - *Oligotoma decorata* (A. Bell, MS), n. sp. - HARMER, p. 217, pl. 27, fig. 3-4.
- ? 1915 - *Oligotoma pannus* (Basterot) - HARMER, p. 215, pl. 27 fig. 9, 11 (not 8, 10).
- . 1915 - *Oligotoma bipunctula* (S.V. Wood) - HARMER, p. 218, pl. 27, fig. 12-15, pl. 28 fig. 5-8.
- . 1915 - *Oligotoma bipunctula* var. *proxima* nov. - HARMER, p. 219, pl. 28, fig. 3-4.
- v. 1946 - *Asthenotoma (Asthenotoma) bipunctula* (Wood, 1872) - BEETS, p. 101, pl. 6, fig. 2-4.
- v p.p. 1954 - *Asthenotoma (Asthenotoma) ornata* Defrance, sp. 1826 - GLIBERT, p. 35, pl. 5, fig. 8 c, d, e.
- v. 1960 - *Asthenotoma (Asthenotoma) ornata* Defrance, sp. 1826 - GLIBERT, p. 11.
- v. 1965 - *Asthenotoma bipunctula* (S.V. Wood, 1872) - VAN REGTEREN ALTENA *et al.*, p. 39, pl. 16, fig. 157.

TYPE LOCALITY AND STRATUM: Little Oakley, East Anglia, United Kingdom; Red Crag, Pliocene.

MATERIAL: (Table 10).

DIMENSIONS:

Figured specimen Pl. 1, Fig. 4a - x: 9, H: 15.6 mm, D: 5.5 mm, S: 6.5 mm, A: 7.0 mm. Pl. 1, Fig. 1b, c - x: 9, H: 15.0 mm, D: 5.7 mm, S: 6.2 mm, A: 7.7 mm.

DESCRIPTION

Medium sized, very slender fusiform shell, with medium sized siphonal canal and shallow suture. Protoconch paucispiral, 0.8 mm high, with one and a half tumid, smooth whorl. Teleoconch sculpture starting with opisthocline growth lines on $\frac{1}{4}$ whorl, then 4 spirals start, which are not clearly delimited and broader than the intercostal

areas. Abapical spiral strongest, forming a carina just above the suture. Teleoconch consisting of seven whorls. Spire taking on average 42 % of the total height, aperture 44 %, diameter 35 %. Aperture long, narrow, with a wide, shallow anal sinus and narrow callus. Sculpture, especially axial, most clear on the oldest whorls and becoming obsolete near the aperture. Spiral sculpture consisting on the older whorls of one or two stronger ribs, which can form a carina on the lower part of the whorl, and of three weaker ribs adapically, which are unequal in strength. Axial sculpture comprising growth lines, which are especially strong on the older whorls, where they form tubercles on the intersection with the larger spirals. Deepest incision of anal sinus slightly above carina.

DISCUSSION

The species is very variable in regard to size (see measurements) and sculpture: some specimens have one stronger spiral rib, others two, while the carina can be absent on the youngest whorls. This prompted HARMER (1915) to recognise in his material a large number of mainly Miocene species. As JANSSEN (1984) observed, the protoconch of the North Sea basin Pliocene *Asthenotoma* differs from that of the Miocene *Asthenotoma ornata* (DEFRANCE, 1826), with which they were associated by GLIBERT (1960) in having fewer whorls. *Asthenotoma bipunctula* (WOOD, 1872) is in Kallo very common in the Oorderen Member, especially in the *Cultellus* level. Few specimens show borings of *Terebripora ramosa* FISCHER, 1866. In other localities, *Asthenotoma bipunctula* (WOOD, 1872) is present from the Kattendijk Formation to the Kruisschans Member, but always rarer than in the Oorderen Member.

Asthenotoma icenorum (WOOD, 1872)

Pl. 1, Fig. 6

- . p.p. 1848 - *Pleurotoma semicolon* (?) J. Sow. - WOOD, p. 54, pl. 5, fig. 3a (non *Pleurotoma semicolon* J. SOWERBY, 1816).
- . 1872 - *Pleurotoma Icenorum* - S. WOOD, p. 35.
- . 1879 - *Pleurotoma Icenorum*, S. WOOD - WOOD, p. 19, pl. 3, fig. 8.

Table 11. — Statistics of 30 specimens of *Asthenotoma bipunctula* (WOOD, 1872) from Kallo, Verrebroekdok, Oorderen Member, *Cultellus* level.

Measurement	Number of specimens	Minimal value	Maximal value	Mean value	Standard deviation
Number of whorls	30	8	10	9	0.66
Height (mm)	30	10.9	17.4	14.0	1.67
Diameter (mm)	30	4.0	5.8	4.9	0.53
Spire (mm)	30	4.2	8.6	5.9	1.09
Aperture (mm)	30	5.0	8.1	6.2	0.74

Table 12. — Material studied of *Asthenotoma icenorum* (WOOD, 1872).

Types and figured specimens				
Collection	Locality	Member/Formation	Level	Coll. number
IRScNB	Antwerp 7	Kattendijk Fm.		IST 6293
Other material				
Collection	Locality	Member/Formation	Level	Number of spec.
IRScNB	7	Kattendijk Fm.		1
RGD	Emmeloor, Holland, The Netherlands	450 m		2

1915 - *Drillia icenorum* (S. V. WOOD) - HARMER, p. 220, pl. 27, fig. 16-17.

1915 - *Drillia icenorum* (S. V. WOOD) var. *elongata* nov. - HARMER, p. 221, pl. 27, fig. 18.

1915 - *Drillia icenorum* (S. V. WOOD) var. *speciosa* nov. - HARMER, p. 222, pl. 27, fig. 19.

TYPE LOCALITY AND STRATUM: Orford, East Anglia, United Kingdom; Coralline Crag, lower Pliocene.

MATERIAL: (Table 12).

DIMENSIONS:

Figured specimen Pl. 1 Fig. 6 - x: 8, H: 11.9 mm, D: 4.4 mm, S: 5.0 mm, A: 5.0 mm.

DESCRIPTION

Medium sized, slender, fusiform shell, with long, straight siphonal canal. Shell composed of 8 whorls, which are only slightly tumid, keeled, with shallow suture. Aperture and spire taking 41 % of total shell height. Protoconch paucispiral, with 1½ whorls, smooth, brilliant; nucleus flat, second whorl tumid, with a microsculpture of small granules. Start of teleoconch unclear. Teleoconch sculpture consisting of 2 broad spiral ribs on the spire, 2 broader plus 8 much weaker ribs on the body whorl and the siphonal canal. Spirals broader than intercostal spaces, adapical one very close to suture and weaker than second spiral. On the last whorl, 12 tubercles present on two adapical spiral ribs; the tubercles of upper and second spiral alternate. Axial sculpture consisting of very conspicuous growth lines, which continue on the tubercles. They are strongly curved: prosocline between the suture and the intercostal space, where they turn into opisthocline. Anal sinus narrow, U-shaped.

DISCUSSION

This species is very rare, occurring only in the Kattendijk Formation. It was already known from the

British Crag, not from the Netherlands or Belgium, although HARMER (1915) mentioned specimens from Antwerp.

Asthenotoma ratinckxi n. sp.
Pl. 1, Fig. 5

Diagnosis

Asthenotoma species with extremely large, paucispiral protoconch, with adult sculpture consisting of strong spiral and weaker axial ribs, with a deep subsutural depression and deep, V-shaped anal sinus.

Generic attribution

The species is included with doubt in the genus *Asthenotoma*. Its very large protoconch is peculiar and it could be necessary to introduce a new genus, when more and possible Recent material with radula becomes known. The teleoconch of the new species differs of that of *Asthenotoma* as redefined by GATTO (1990) in being not claviform, while the suture is distinct. Its protoconch and its teleoconch sculpture resemble that of *Boreodrillia*, but the protoconch of that genus is always sharply separated from the teleoconch (SORGENFREI (1958), JANSSEN (1984, pl. 12 fig. 8,9). The protoconch of the new species comes closer to that of *Splendrillia*, as figured in JANSSEN (1984, pl. 12 fig. 14b), but it is relatively larger and the adult sculpture is completely different. The teleoconch of the new species is furthermore not claviform and the suture is distinct.

LOCUS TYPICUS: Vrasenedok, Kallo, municipality of Beveren, province of Oost-Vlaanderen, Belgium; x = 140,850, y = 216, 700 (see map in HOEDEMAKERS & MARQUET, 1992).

STRATUM TYPICUM: Oorderen Member, Lillo Formation, middle Pliocene; *Atrina* level.

Table 13. — Material studied of *Asthenotoma ratinckxi* n. sp.

Types and figured specimens				
Collection	Locality	Member/Formation	Level	Coll. number
IRScNB	Kallo 23	Oorderen Mbr.	<i>Atrina</i>	Holotype IST 6301

DERIVATION NOMINIS: After Mr. A. Ratinckx, who collected the holotype.

MATERIAL: (Table 13).

DIMENSIONS:

Figured specimen Pl. 1, Fig. 5 (holotype) - x: 7 1/4, H: 6.6 mm, D: 1.9 mm, S: 3.6 mm, A: 2.2 mm.

DESCRIPTION

Small, very slender, turriculate shell with deep suture and medium long siphonal canal. Protoconch consisting of 1 1/4 whorl, 0.7 mm high, appearing smooth, but with a microsculpture of small granules, very tumid and broader than first teleoconch whorl. Proto- and teleoconch not clearly separated. Teleoconch consisting of six tumid whorls, with deep subsutural depression. Spire taking 54 % of total shell height. Aperture elongate oval, relatively low (33 % of total height), pointed above, with a narrow callus, without teeth or tubercles. Anal sinus of last whorl not preserved; old anal sinuses deep and V-shaped; they turn in the lower part of the subsutural depression. Adult sculpture starting with three axial ribs. Spirals appear a quarter of a whorl later. On the penultimate whorl, three strong, clearly delimited spirals present below the depression; one further spiral is weaker and lies just above the suture. Last whorl bearing 16 spirals, two of which are stronger developed. In the depression, three spirals are present; the middle one is the weakest. Strongest spirals below the depression bearing 15 unclear tubercles, which form an opisthocline row. In the depression, sharply marked prosocline old sinuses can be observed, developing into small squarish tubercles on the points of intersection with the spirals.

DISCUSSION

Asthenotoma bipunctula (WOOD, 1872) and *Asthenotoma icenorum* (WOOD, 1872) are, when having the same number of whorls, much larger than *Asthenotoma ratinckxi* n. sp., while their sculpture is completely different; their protoconch and spire are relatively smaller. *Asthenotoma bipunctula* (WOOD, 1872) has furthermore much less tumid whorls and a shallow suture. *Asthenotoma icenorum* (WOOD, 1872) is easily recognisable by its coarse tubercles on both adapical spirals. The other known *Asthenotoma* species all have a relatively smaller protoconch nucleus, a claviform teleoconch and a shallow suture.

Subfamilia Mangeliinae FISCHER, 1884 Genus *Bela* GRAY, 1847

The subfamily Mangeliinae comprises a number of species in the Belgian and Dutch Pliocene, which are characterised by the absence of a labial varix, thick, but rather irregular, fading axial ribs, fusoid shells, conspicuous spiral sculpture, relatively short siphonal canal and shallow sinus. Consequently, they belong to the genus *Bela* as defined by NORDSIECK (1972) and POWELL (1966). Related species make up part of *Mangelia* in the sense of GRAHAM (1988).

Bela gliberti n. sp.

Pl. 2, Fig. 3

- ? 1872 - *Pleurotoma nebula* Mont. - WOOD, p. 45, pl. 7, fig. 7.
- ? p.p. 1915 - *Raphitoma nebula* (Montagu) - HARMER, p. 272 pl. 30, fig. 15, 17, 19, 21.
- ? 1915 - *Raphitoma nebula* var. *delicatula* nov. - HARMER, p. 274, pl. 30, fig. 26.
- v. 1960 - *Bela nebula* Montagu, sp. 1803 - GLIBERT, p. 15, pl. 4, fig. 12.
- v. 1965 - *Mangelia (Bela) nebula* (Montagu, 1803) - VAN REGTEREN ALTENA *et al.*, p. 41, pl. 18, fig. 168.

DIAGNOSIS

Relatively large *Bela* species with nearly biconical shell shape, short spire, orthocline axial ribs, unequal, finely granulated spiral ribs, the fifth of which is darker; protoconch with 3 1/2 whorls, the last of which shows first abapical spirals, while weak opisthocline axial sculpture appears later.

GENERIC ATTRIBUTION

The new species belongs clearly to the genus *Bela* as described above, because of its sculpture, aperture and anal sinus characters. Biconical *Bela* species were united by some authors (PAVIA (1976), NORDSIECK (1977), CAVALLO & REPETTO (1992)) in a subgenus *Ischnula* CLARK in GRAY, 1847 (also written as *Ich-nusa*). According to POWELL (1966), this is however a *nomen nudum*. Furthermore, most of the *Ischnula* species, which were all described by FORBES in REEVE (1843), are *nomina dubia* (VAN AARTSEN (1988), SABELLI *et al.* (1991)). Therefore, this name is not

Table 14. — Material studied of *Bela nebula* (MONTAGU, 1803).

Types and figured specimens			
Collection	Locality	Member/Formation	Coll. number
IRScNB	Torrevieja, S. of Alicante, Spain	Recent	IST 6295
Other material			
Collection	Locality	Member/Formation	Number of spec.
RM	Torrevieja, S. of Alicante, Spain	Recent	10

used here and the genus *Bela* is not divided into subgenera.

LOCUS TYPICUS: Verrebroekdok, Kallo, municipality of Beveren, province of Oost-Vlaanderen, Belgium; x = 140,850, y = 216,700 (see map in HOEDEMAKERS & MARQUET, 1992).

STRATUM TYPICUM: Oorderen Member, Lillo Formation, middle Pliocene; *Cultellus* level.

DERIVATIO NOMINIS: After Dr. M. Glibert.

MATERIAL: (Table 14, 15).

DIMENSIONS:

Bela nebula (MONTAGU, 1803): specimen IST 6295 figured herein Pl. 2, fig. 2 - x: 8, H: 6.7 mm, D: 2.3 mm, S: 2.8 mm, A: 2.8 mm. *Bela gliberti* n. sp.: Holotype Pl. 2, Fig. 3a, b - x: 8, H: 9.6 mm, D: 4.7 mm, S: 3.6 mm, A: 4.5 mm. IST 6317 Pl. 2, Fig. 3c - x: 8, H: 8.3 mm, D: 3.4 mm, S: 2.8 mm, A: 4.3 mm.

DESCRIPTION

Medium large, slender fusiform, regularly biconical shell, with medium long siphonal canal and deep suture. The protoconch is 0.6 mm high and consists of 3½ tumid whorls. First 2½ whorls smooth. Then follows ½ whorl with 2 spiral ribs on the lower half, the adapical one being

Table 15. — Material studied of *Bela gliberti* n. sp.

Types and figured specimens					
Collection	Locality	Member/Formation	Level	Coll. number	
IRScNB	Kallo 21	Oorderen Mbr.	<i>Cultellus</i> 7-8 m	Holotype IST 6300	
IRScNB	Antwerp 15	Luchtbal Mbr.		IST 6317	
IRScNB	Antwerp	Luchtbal Mbr.		IST 5021	
Other material					
Collection	Locality	Member/Formation	Level	Number of spec.	
IRScNB	Antwerp	Scaldisien	11.2-11.5 m	1	
IRScNB	Antwerp	Luchtbal Mbr.		1	
IRScNB	5	Scaldisien		1	
IRScNB	8	Austruweel Mbr.		1	
IRScNB	11	Luchtbal Mbr.		13.75-14 m	1
IRScNB	15	Luchtbal Mbr.		7.6-8 m	1
IRScNB	24	Scaldisien		1	
RM	32	Lillo Fm.		dredged	1

stronger. On the next $\frac{3}{4}$ whorl appear opisthocline axial ribs, which are especially clear on the abapical part of the whorl. The number of spirals increases to 5, also on the adapical part of the whorl, but the 2 original abapical spirals remain stronger than the others. At the start of the teleoconch, the spirals continue, but they are then equally strong. The sinuous axial ribs are replaced by broader, nearly orthocline ribs. Teleoconch comprises 5 tumid to flat-sided whorls. The spire takes on average 40 % of total shell height. Aperture elongate oval, taking on average 50 % of the shell height and pointed above. The anal sinus is broad but shallow. A siphonal fasciole is present. Teleoconch ornament composed of 10 axial ribs on the last whorl. They are orthocline, well defined and cover the penultimate whorl completely; on the last, they stop halfway the apertural height. Between and over them run 45 spiral ribs on the last whorl; each fifth one is stronger and darker coloured. The spirals are broader than the very narrow intercostal areas. They are unequal in strength and very finely granulated.

DISCUSSION

This species is extremely rare in the Oorderen Member of Kallø. In other localities, it is known from Luchtbøl to Austruweel Member. It occurs in Great Britain in the Coralline and Red Craggs. *Bela gliberti* n. sp. differs from the other Pliocene *Bela* species from Belgium by its larger size (except from *B. belgica* VAN REGTEREN ALTEANA, 1959 and from some specimens of *Bela tenuistriata* (A. BELL, 1871)), deep suture, broader, biconical shell and characteristic sculpture. Recent *Bela nebula* (MONTAGU, 1803) occurs, according to GRAHAM (1988) and NORDSIECK (1972), from the Mediterranean to Norway; fossil specimens have been found in the Spanish lower Pliocene (coll. RM) and in the Italian Pliocene (CAVALLO & REPETTO, 1992). Recent specimens, as figured here Pl. 2, Fig. 2 and by GRAHAM (1988, fig. 182) and VAN AARTSEN *et al.* (1984, fig. 215) differ quite clearly from *Bela gliberti*. Their protoconch is smaller (0.25 mm high) and possesses 1 whorl less. It is more tumid, the number of axial ribs is lower and the spiral ribs are discontinuous, being composed of separated squares. The adult shell is not biconical and relatively narrower than the new species. The teleoconch sculpture comprises 28 ribs on the last whorl, which are narrower than the intercostal spaces, but higher and more clearly delimited than in the new species. *Bela gliberti* n. sp. differs by the same characteristics from the Mediterranean *Bela fuscata* (DESHAYES, 1834) (= *Bela ginnania* auct. non RISSO), as figured by NORDSIECK (1972, pl. 10 fig. 75), which BUCQOY *et al.* (1886), VAN AARTSEN *et al.* (1984) and SABELLI *et al.* (1991) united with *Bela nebula* (MONTAGU, 1803), possibly as a Mediterranean subspecies with a more slender shell. HARMER's (1915, pl. 30 fig. 25-26) *Raphitoma nebula*, var. *Ginnaniana* (RISSO) from Little Oakley looks much too slender to belong to the new species, but the specimens seem to be too badly preserved for certain identification. Apart from *Bela nebula*, SABELLI *et al.* (1991) distinguished 9 species in the Mediterranean: *Bela*

laevigata (PHILIPPI, 1836), *Bela menkhorsti* VAN AARTSEN, 1988, *Bela cycladensis* REEVE, 1844, *Bela oceanica* (LOCARD, 1897), *Bela ornata* (LOCARD, 1897), *Bela septenvillei* (MONTEROSATO in DAUTZENBERG & DUROUCHOUX, 1913), *Bela turgida turgida* (FORBES in REEVE, 1844), *Bela zonata* (LOCARD, 1892) and *Bela brachystoma* (PHILIPPI, 1844). The last species reaches according to GRAHAM (1988) to the British Isles. Both first occurred, according to HARMER (1915) in the British Pliocene. *B. septenvillei* was described from the French Atlantic coast. *B. ornata* occurs to Ria de Vigo, northern Spain (ROLAN MOSQUERA, 1983) and resembles *B. gliberti* slightly, but it is more slender, with a lower aperture and a higher spire. *B. turgida turgida* (FORBES in REEVE, 1844) occurs recent in the Mediterranean, as a fossil in the Mediterranean Pliocene (CAVALLO & REPETTO (1992)), in the Atlantic Spanish Pliocene (coll. RM) and in the French Redonien (BREBION (1964)). Some authors, like VAN AARTSEN (1988) and SABELLI *et al.* (1991) consider it however as a *nomen dubium*. It is the only species with a similar biconical shell shape as *B. gliberti*. It differs however by its broader shell and by its stronger and clearly opisthocline axial sculpture. None of the other Mediterranean *Bela* species has a darker and stronger fifth spiral, their shape is not biconical and their spire is higher than in *B. gliberti*. *Bela powisiana* (RECLUZ in DAUTZENBERG, 1887) is found from the Bay of Biscay to Norway (GRAHAM, 1988); it is more slender, with a higher spire than the new species, while the axial sculpture on the last whorl is weaker. Five further *Bela* species occur in the Mediterranean Pliocene. *B. brachystoma* (PHILIPPI, 1844) has a higher spire and fewer and stronger spirals. *B. bucciniformis* (BELLARDI, 1847) is characterised by its very shallow suture and flat-sided whorls. *B. nitida* PAVIA, 1976 is smaller, with angular whorls and a lower aperture. *B. scalariformis* (BRUGNONE, 1862) has a smaller aperture and heavier spirals. *B. submarginata* (BONELLI in BELLARDI, 1847), which occurs also in the Redonien, is very slender, with stronger axial ribs and a longer siphonal canal. The British Pliocene *Bela valida* (HARMER, 1915) is slender, not biconical, while the axial ribs are weak and opisthocline. *Bela* species are absent from the North Sea basin and Touraine (France) Miocene. Several *Bela* species occur in the Aquitaine (France) and Paratethys Miocene. From none have the protoconch or the teleoconch microsculpture been figured. Their generic attribution and relations therefore remain obscure. At least two *Bela* species are found in the Aquitaine Miocene: *B. minuta* PEYROT, 1931 (pl. 9 fig. 1) and *B. aquensis* PEYROT, 1931 (pl. 9 fig. 22, 69). Both are very slender instead of biconical. In the Paratethys Miocene, one biconical *Bela* species is found: *B. turgida subturgida* (BOETTGER, 1906, p. 80), figured in ZILCH (1934, pl. 19 fig. 56). It differs from *B. gliberti* in being relatively broader and in axial sculpture. Other *Bela* species from the Paratethys are *B. pseudoturgida* (STRAUSZ, 1954, pl. 5 fig. 10), *B. sparsa* (BOETTGER, 1901, p. 74), figured by ZILCH (1934, pl. 19 fig. 58), *B. perpulchra* (FRIEDBERG, 1912, pl. 14 fig. 13), *B. subcylindrica* (BOETTGER, 1901,

p. 75), figured by ZILCH (1934, pl. 19 fig. 61). These species have all a completely different shell shape.

Bela neerlandica (BEETS, 1946)
Pl. 2, Fig. 4

v p.p. 1946 - *Moniliopsis neerlandica* n. sp. - BEETS, p. 101, pl. 6, fig. 24-36 (not 26).

TYPE LOCALITY AND STRATUM: Biggekerke, Zeeland, The Netherlands; 33.70-35.70 m, Pliocene.

MATERIAL: (Table 16).

DIMENSIONS:

Holotype - H: 11.4 mm, D: 2.7 mm. Figured specimen Pl. 2, Fig. 4 - x: 8, H: 7.1 mm, D: 2.4 mm, S: 2.7 mm, A: 3.4 mm.

DESCRIPTION

Small, slender fusiform shell with short siphonal canal. Whorls flat, suture shallow, marked by very deep sub-sutural depression. Protoconch flat-sided, consisting of 2½ whorls, without sculpture. Teleoconch with 5 to 6 whorls, not clearly separated from protoconch. Spire takes 38 % of total shell height. Teleoconch sculpture starts with spiral lines. On the last whorl, 15 spirals are present, including those on the siphonal canal, which form a siphonal fasciole. They are much broader than the intercostal spaces, which form narrow grooves between the spirals. Axial sculpture consists of 11 to 18 narrow, sharply delimited ribs on the last whorl; they become more or less obsolete near the aperture and they do not reach the end of the siphonal canal. They are clearly opisthocline and sinuous. Aperture elongate oval, 48 % of total height. Anal sinus broad, V-shaped.

DISCUSSION

This species occurs only rarely in Holland and Belgium;

most records in GLIBERT (1960) belong to the next species, as well as part of BEETS' material, while GLIBERT's (1958) records, under the name *Bela neerlandica* (BEETS, 1946), from the *Angulus benedeni* level and from the Kruisschans Member belong to *Bela keepingi* (ETHERIDGE & BELL, 1898). *Bela neerlandica* and *Bela antwerpiensis* differ clearly in the absence of granulous microsculpture, the much more sharply delimited axial ribs and the lower number of spiral ribs, which are broader than the intercostal areas, in *Bela neerlandica* (BEETS, 1946).

Bela antwerpiensis n. sp.

Pl. 2, Fig. 5

v p.p. 1878 - *Pleurotoma brachystoma*, Phil - NYST, pl. 3, fig. 18 (non *Pleurotoma brachystoma* PHILIPPI, 1844).

v p.p. 1881 - *Pleurotoma brachystoma*, Phil - NYST, p. 53 (non *Pleurotoma brachystoma* PHILIPPI, 1844)

v p.p. 1946 - *Moniliopsis neerlandica* n. sp. - BEETS, p. 101, pl. 6, fig. 26.

v p.p. 1960 - *Bela neerlandica* Beets, sp. 1946 - GLIBERT, p. 16, pl. 4, fig. 13, pl. 5, fig. 3.

v p.p. 1965 - *Mangelia (Mangelia) keepingi* (Etheridge & A. Bell, 1898) forma *consimilis* (Harmer) - VAN REGTEREN ALTENA *et al.*, p. 41, pl. 18, fig. 166b.

DIAGNOSIS

Bela species with rounded whorls, unclear subsutural depression, low spire, 30 to 35 finely granulated spiral ribs, which are broader than the intercostal spaces and 15 low, narrow axial ribs on the last whorl; protoconch with 2 smooth whorls and ¾ sculptured whorl; first start 3 rows of tubercles, which later become spiral ribs with very narrow intercostal areas; axial protoconch sculpture starts later.

GENERIC ATTRIBUTION

It is clear from its general shape and sculpture that this species belongs to *Bela*, as defined by NORDSIECK (1977) and POWELL (1966).

Table 16. — Material studied of *Bela neerlandica* (BEETS, 1946).

Types and figured specimens				
Collection	Locality	Member/Formation	Level	Coll. number
RGD	Biggekerke, The Netherlands	Pliocene	33.7-35.7 m	Holotype and paratype
IRScNB	Antwerp	Austruweel Mbr.	<i>Lentidium complanatum</i>	IST 6299
Other material				
Collection	Locality	Member/Formation	Level	Number of spec.
IRScNB	Antwerp	Austruweel Mbr.	<i>Lentidium complanatum</i>	1

Table 17. — Material studied of *Bela antwerpiensis* n. sp.

Types and figured specimens				
Collection	Locality	Member/Formation	Level	Coll. number
IRScNB	Antwerp 8	Luchtbal Mbr.		Holotype IST 6305
IRScNB	Antwerp 11	Oorderen Mbr.	13-13.25 m	IST 6314
IRScNB	Antwerp 13	Luchtbal Mbr.		IST 5022, 5022 bis
IRScNB	Kallo 23	Oorderen Mbr.	<i>Atrina</i>	IST 6315
Other material				
Collection	Locality	Member/Formation	Level	Number of spec.
IRScNB	Antwerp	Kattendijk Fm.		1
IRScNB	Antwerp	Austruweel Mbr.		4
IRScNB	Antwerp	Scaldisien		22
IRScNB	4	Oorderen Mbr.	1.3 m	1
IRScNB	4	Oorderen Mbr.	2.25 m	1
IRScNB	4	Oorderen Mbr.	3.6 m	1
IRScNB	4	Luchtbal Mbr.	6.75 m	2
IRScNB	4	Luchtbal Mbr.	7.5 m	1
IRScNB	5	Austruweel Mbr.		1
IRScNB	5	Oorderen Mbr.	10.9-11 m	2
IRScNB	5	Oorderen Mbr.	11.2-11.5 m	1
IRScNB	6	Oorderen Mbr.	4.5 m	1
IRScNB	6	Oorderen Mbr.	7.25 m	1
IRScNB	6	Oorderen Mbr.	7.4 m	33
IRScNB	6	Oorderen Mbr.	8.1 m	63
IRScNB	6	Luchtbal Mbr.	9-9.5 m	2
IRScNB	7	Scaldisien		18
IRScNB	8	Scaldisien		52
IRScNB	8	Scaldisien		9
IRScNB	9	Luchtbal Mbr.		4
IRScNB	9	Scaldisien	basal crag	9
IRScNB	10	Scaldisien		15
IRScNB	11	Oorderen Mbr.	10.0-10.5 m	1
IRScNB	11	Oorderen Mbr.	10.5-11.0 m	1
IRScNB	11	Oorderen Mbr.	11.0-11.5 m	3
IRScNB	11	Oorderen Mbr.	11.5-12.0 m	5
IRScNB	11	Oorderen Mbr.	12.0-12.25 m	2
IRScNB	11	Oorderen Mbr.	13.0-13.25 m	2
IRScNB	11	Luchtbal Mbr.	13.25-13.5 m	7
IRScNB	11	Luchtbal Mbr.	13.5-13.75 m	1
IRScNB	12	Scaldisien		1
IRScNB	13	Luchtbal Mbr.		5
IRScNB	13	Scaldisien		18
IRScNB	15	Luchtbal Mbr.	7.6-8 m	4
IRScNB	16	Scaldisien	11-15 m	2
IRScNB	16	Scaldisien	base 16 m	2
RM	2	Oorderen Mbr.		2
RM	3	Luchtbal Mbr.		2
RM	20	Oorderen Mbr.	<i>Atrina</i>	12
RM	21	Oorderen Mbr.	<i>Atrina</i>	54
RM	21	Oorderen Mbr.	<i>Cultellus</i>	71
RM	23	Oorderen Mbr.	<i>Atrina</i>	87
RM	27	Austruweel M		3

LOCUS TYPICUS: Antwerp, Belgium (Amerikadok).

STRATUM TYPICUM: Luchtbal Member, Lillo Formation, middle Pliocene.

DERIVATIO NOMINIS: After the type locality.

MATERIAL: (Table 17).

DIMENSIONS:

Holotype - x: 8, H: 5.5 mm, D: 2.2 mm, S: 2.0 mm, A: 2.5 mm. Figured specimen Pl. 2, Fig. 5f (IST 6315) - x: 7, H: 6.2 mm, D: 2.2 mm, S: 2.0 mm, A: 2.9 mm. Figured specimen Pl. 2, Fig. 5g (IST 6314) - x: 8, H: 6.0 mm, D: 2.7 mm, S: 2.2 mm, A: 2.7 mm.

DESCRIPTION

Small, slender fusiform shell with short siphonal canal and shallow suture. The whorls are not tumid, the subsutural depression is shallow and narrow. Spire on average 41 % of total height, diameter 35 %. Protoconch 0.8 mm high, consisting of 2 smooth, glossy and globular whorls. Transition to teleoconch over $\frac{3}{4}$ whorl, starting with 3 spiral rows of tubercles; the adapical row is the strongest. The rows of tubercles become spiral ribs, which are broader than the teleoconch spirals; the intercostal areas are very narrow. The first opisthocline axial ribs start half a whorl later, together with a fourth abapical spiral; the axial ribs reach to the abapical spiral. Teleoconch sculpture starts $\frac{1}{4}$ whorl later with broader, more widely spaced axial sculpture and 8 finer spiral ribs. Teleoconch with 5 slightly tumid whorls. Aperture on average 43 % of total height, elongate oval and pointed above; the largest specimens (with 9 whorls) have a relatively lower aperture: 40 to 41 %. Very narrow callus present. Anal sinus deep, broad, V-shaped. On the penultimate whorl, 18 spiral ribs are present, on the last 33 to 35. They are wider than the very narrow intercostal spaces and they bear small granules in perfect specimens. There are 15 stronger axial ribs present on the last whorl, which are not very clearly delimited. They become obsolete near the aperture and near the suture in most specimens, but in some the axials remain strong on the last whorl. The ribs are sinuous and slightly opisthocline. They turn on the abapical edge of the subsutural depres-

sion and become there much clearer. Between and on the spirals, a granulous microsculpture is present.

DISCUSSION

The species is common in the Oorderen Member of Kallo. In other localities, it occurs from the Luchtbal Member onward. The species is variable in height, with specimens which can become 25 % larger than the average height, in relative height of the aperture, which diminishes in the oldest specimens and in axial sculpture, which can become more or less obsolete on the last whorl. The differences between *Bela antwerpiensis* and the three other, strongly resembling species from the Belgian and Dutch Pliocene, are summarised in table 19. *Bela bucciniformis* (BELLARDI, 1847) differs by having less and narrower axial ribs and coarser spirals, while a subsutural depression is nearly absent and the whorls are strongly flattened. *Bela brachystoma* (PHILIPPI, 1844) has much heavier, but less spirals. *Bela nebula* (MONTAGU, 1803) is characterised by coarser sculpture, broader axials, less spirals and a higher aperture. *Bela nitida* PAVIA, 1976 differs in having angular whorls, while it is smaller and relatively broader than the new species. *Bela scalariformis* (BRUGNONE, 1862) has heavier spirals as well as axials, the aperture is relatively lower. *Bela submarginata* (BONELLI in BELLARDI, 1847) is much larger, more slender, with a longer siphonal canal and angular whorls. *Bela turgida turgida* (FORBES in REEVE, 1844) is larger, biconical and relatively broader than the new species. *Bela valida* (HARMER, 1915) differs in being much larger and relatively more slender, while the aperture is higher. *Bela laevigata* (PHILIPPI, 1836) and *Bela zonata* (LOCARD, 1892) are relatively narrower, flat-sided, with heavier axials. *Bela cycladensis* (REEVE, 1845) has stronger, but less spirals and tumid whorls. *Bela oceanica* (LOCARD, 1897) has more sinuous axials and slightly angular whorls, but this species resembles *Bela antwerpiensis* n. sp. most among their European Pliocene to Recent congeners. *Bela ornata* (LOCARD, 1897) is larger, with angular whorls, relatively lower aperture and stronger axials. *Bela powisiana* (RECLUZ in DAUTZENBERG, 1887) is much larger and slender, with stronger axials. Seven European Miocene species belong probably to the genus *Bela*. *Bela minuta* PEYROT, 1931 (Aquitaine) is much smaller than the new species, with a relatively broader aperture. *Bela*

Table 18. — Statistics of 30 specimens of *Bela antwerpiensis* n. sp. from Kallo, Vrasenedok (22 specimens) and Verrebroekdok (8 specimens), both Oorderen Member, *Atrina* level.

Measurement	Number of specimens	Minimal value	Maximal value	Mean value	Standard deviation
Number of whorls	30	7	9	8	0.4
Height (mm)	30	6.2	10.9	8.0	1.0
Diameter (mm)	30	2.2	3.5	2.8	0.3
Spire (mm)	30	2.0	4.7	3.2	0.6
Aperture (mm)	30	2.8	4.5	3.5	0.3

Table 19. — Comparison of some diagnostic characters of *Bela* species.

Character	<i>B. consimilis</i>	<i>B. antwerpiensis</i>	<i>B. neerlandica</i>	<i>B. keepingi</i>
Spiral sculpture	Ribs equal, as broad as intercostals, 20	Ribs equal, broader than intercostals, 30 to 35	Ribs equal, much broader than intercostals, 15	Primary and secondary ribs, narrow, 15 primary
Axial ribs	Broad, conspicuous	Narrow, unclear, can be absent on last whorl	Narrow, clearly delimited	Broad, conspicuous
Whorls	Angular	Rounded	Rounded	Rounded
Subsutural depression	Deep	Shallow	Very deep	Deep
Spire	40 % of height	1 % of height	38 % of height	41 % of height
Size (height)	Average 5.6 mm	Average 8.0 mm	To 11.4 mm	Average 9.9 mm

aquensis PEYROT, 1931 shows some resemblance to the new species, but is relatively broader, with a higher aperture. The Paratethys species *Bela subcylindrica* (BOETTGER, 1901) and *Bela pseudoturgida* (STRAUSZ, 1954) have a much deeper suture, a higher spire and a lower aperture. *Bela turgida subturgida* (BOETTGER, 1906) is biconical. *Bela sparsa* (BOETTGER, 1901) is relatively broader, with a deeper suture and a lower spire. *Bela perpulchra* (FRIEDBERG, 1912) has much stronger, but fewer axial ribs and a deeper suture.

Bela consimilis (HARMER, 1915)

Pl. 2, Fig. 6, Pl. 1, fig. 7

- v p.p. 1878 - *Pleurotoma brachystoma*, Phil - NYST, pl. 3, fig. 18 (non *Pleurotoma brachystoma* PHILIPPI, 1844)
- v p.p. 1881 - *Pleurotoma brachystoma*, Phil - NYST, p. 53 (non *Pleurotoma brachystoma* PHILIPPI, 1844)
- . 1915 - *Raphitoma brachystoma* (Philippi) - HARMER, p. 261, pl. 30, fig. 30-31.
- . 1915 - *Raphitoma consimilis* nov. - HARMER, p. 387, pl. 39 fig. 9.
- v p.p. 1960 - *Bela neerlandica* Beets, sp. 1946 - GLIBERT, p. 16, pl. 4, fig. 13, pl. 5, fig. 3.
- v p.p. 1965 - *Mangelia (Mangelia) keepingi* (Etheridge & A. Bell, 1898) forma *consimilis* (Harmer) - VAN REGTEREN ALTENA *et al.*, p. 41, pl. 18, fig. 166b.

TYPE LOCALITY AND STRATUM: Gedgrave, East Anglia, United Kingdom; Coralline Crag, lower Pliocene.

MATERIAL: (Table 20).

DIMENSIONS:

Figured specimens Pl. 2, Fig. 6a - c (IST 6303) - x: 7, H:

4.9 mm, D: 2.0 mm, S: 1.6 mm, A: 2.3 mm. Pl. 2, Fig. 6d (IST 6304) - x: 8, H: 6.6 mm, D: 2.2 mm, S: 2.9 mm, A: 2.6 mm. Pl. 2, Fig 6e, Pl. 1 Fig. 7 (IST 6312) - x: 8, H: 5.3 mm, D: 1.9 mm, S: 2.0 mm, A: 2.4 mm.

DESCRIPTION

Small, slender fusiform shell with short siphonal canal and deep suture. Clear subsutural depression, whorls tumid and angular at the depression. Spire takes 40 % of total shell height, aperture 42 %, diameter 37 %. Protoconch 0.7 mm high, with about 2½ smooth, glossy, globular whorls and one sculptured whorl at the transition to the teleoconch. The sculpture on this whorl starts with 2 spirals on the adapical part, an abapical spiral starts ¼ whorl later. The spirals are as broad as the intercostal areas. Slightly later than the abapical spiral, opisthocline rows of tubercles start on the spirals; they do not reach below the abapical spiral. The teleoconch sculpture starts with the appearance of one additional abapical spiral. The protoconch spirals continue, but become more widely spaced. Axial ribs take the place of the lines of tubercles. Teleoconch with 5 whorls. Spiral sculpture starts first, axial ribs later. Spiral sculpture consisting of 10 ribs on the penultimate whorl and 20 ribs on the last whorl. The spirals are of equal size or alternatively higher and lower, and they are as broad as the intercostal spaces. A micro-sculpture of granules is present on and between the ribs. Especially in the subsutural depression, tubercles may be present on the spiral ribs. Ten broad, opisthocline, conspicuous, rather irregular axial ribs are present on the last whorl. Aperture relatively low but broad, rounded oval, pointed above, with a narrow callus. Anal sinus shallow and broadly V-shaped.

DISCUSSION

Bela consimilis seems to occur in Belgium only in the Luchtbal Member, where it is rare and coexists with the

Table 20. — Material studied of *Bela consimilis* (HARMER, 1915).

Types and figured specimens				
Collection	Locality	Member/Formation	Level	Coll. number
IRScNB	Gedgrave, U.K.	Coralline Crag		IST 6303
IRScNB	Antwerp 15	Luchtbal Mbr.		IST 6304, 6312
Other material				
Collection	Locality	Member/Formation	Level	Number of spec.
IRScNB	Gedgrave, U.K.	Coralline Crag		153
IRScNB	Antwerp	Scaldisien		12
IRScNB	4	Luchtbal Mbr.	6.75 m	3
IRScNB	4	Luchtbal Mbr.	7.5 m	1
IRScNB	7	Scaldisien		10
IRScNB	8	Scaldisien		16
IRScNB	9	Scaldisien	basal crag	30
IRScNB	11	Luchtbal Mbr.	13.25-13.5 m	1
IRScNB	11	Luchtbal Mbr.	13.5-13.75 m	1
IRScNB	15	Luchtbal Mbr.	7.6-8 m	15
RM	3	Luchtbal Mbr.		1

previous species. British material originates mostly from the Coralline Crag; specimens from the type locality are present in the IRScNB collection. British material seems to be smaller than that from Belgium, but with identical sculpture pattern. Contrary to VAN REGTEREN ALTENA *et al.* (1965), *Bela keepingi* (ETHERIDGE & BELL, 1898) and *Bela consimilis* (HARMER, 1915) are considered here as distinct species. *Bela consimilis* differs from *Bela keepingi* by its more numerous and equal spiral ribs, by its smaller protoconch and by the shorter siphonal canal. In his original description, HARMER (1915) mentioned the finer spiral sculpture of this species as an important diagnostic feature. *Pleurotoma compacta* ETHERIDGE & BELL, 1898 and HARMER's (1915, pl. 39 fig. 8) *Raphitoma Hörnesii* (MAYER) (non *Pleurotoma Hörnesii* MAYER, 1858), both from St. Erth, Cornwall

and probably representing the same species, seem to differ only slightly from *Bela consimilis* (HARMER, 1915), which is however slightly larger, with less conspicuous spiral sculpture and less angular whorls. Several Mediterranean species are rather similar. *Bela consimilis* (HARMER, 1915) has often been referred to *Bela brachystoma* (PHILIPPI, 1844), which has however a lower aperture, higher spire, less, but stronger axial ribs and much broader spirals, as can be seen in PHILIPPI (1844, pl. 26 fig. 10), CAVALLO & REPETTO (1992, p. 139, fig. 374) and PAVIA (1976, pl. 8 fig. 14-15). *Bela (s.l.)* sp. 3. in CAVALLO & REPETTO (1992, p. 140, fig. 382) might be conspecific with *Bela consimilis* (HARMER, 1915). *Bela (B.) scalariformis* (BRUGNONE, 1862), figured by BRUGNONE (1862, pl. 1 fig. 16), CAVALLO & REPETTO (1992, p. 140, fig. 378) and

Table 21. — Statistics of 25 specimens of *Bela consimilis* (HARMER, 1915), from Antwerp Mercantile (3 sp.), Luchtbal Member, Antwerp Amerikadok, Luchtbal Member (6 sp.), Antwerp Wilmarndonk, Scaldisien (12 sp.) and Antwerp, Scaldisien (4 sp.).

Measurement	Number of specimens	Minimal value	Maximal value	Mean value	Standard deviation
Number of whorls	25	7	9	8	0.5
Height (mm)	25	4.8	7.5	5.6	0.6
Diameter (mm)	25	1.7	2.4	2.0	0.2
Spire (mm)	25	1.7	3.7	2.2	0.4
Aperture (mm)	25	1.9	2.8	2.3	0.2

PAVIA (1976, pl. 8 fig. 16) is also similar, especially regarding sculpture, but the shell shape is different: the spire is lower, the last whorl is relatively broader. In *Bela (B.) nitida* PAVIA, 1976 (pl. 8 fig. 17-20), the subsutural depression is nearly smooth and the number of spirals is lower.

Bela keepingi (ETHERIDGE & BELL, 1898)
Pl. 3, Fig. 2, Pl. 1, Fig. 8

- . 1898 - *Pleurotoma Keepingi* - ETHERIDGE & BELL, p. 138.
- . 1915 - *Raphitoma Keepingi* (Etheridge and Bell) - HARMER, p. 388, pl. 39, fig. 17.
- v. 1946 - *Raphitoma keepingi* (Etheridge & Bell, 1898) - BEETS, p. 108, pl. 6, fig. 17-23.
- v p.p. 1960 - *Bela neerlandica* Beets, sp. 1946 - GLIBERT, p. 16.
- v. 1965 - *Mangelia (Mangelia) keepingi* (Etheridge & A. Bell, 1898) forma *keepingi* (Eth. & Bell) - VAN REGTEREN ALTENA *et al.*, p. 41, pl. 18, fig. 166a.
- v. 1993 - *Mangelia keepingi* (Etheridge & Bell, 1898) - MARQUET, p. 93, pl. 4, fig. 5, 6.

TYPE LOCALITY AND LEVEL: St. Erth, Cornwall, United Kingdom; St. Erth Beds, Upper Pliocene.

MATERIAL: (Table 22).

DIMENSIONS:

Figured specimen Pl. 1, Fig. 8, Pl. 3 Fig. 1 - x: 8, H: 7.4 mm, D: 2.7 mm, S: 3.1 mm, A: 3.3 mm.

DESCRIPTION

Small, slender fusiform shell with short siphonal canal and shallow suture. Protoconch 0.7 mm high, consisting of 2 smooth, tumid whorls, nucleus small, globular. A whorl with reticulate sculpture makes the transition to the teleoconch. First, a very slight carina appears halfway. Then 4 spiral ribs start, which are as broad as the intercostal areas. After $\frac{1}{4}$ of a whorl, opisthocline axial ribs start, which are as strong as the spirals. At the start of the teleoconch sculpture, the spiral ribs continue, but the axials become much coarser and more widely separated. Teleoconch comprises about seven whorls, which are not tumid. Shallow to rather deep subsutural depression present. Diameter taking on average 35.5 % of total shell height, spire 41 %, aperture 41 %. Aperture elongate oval, pointed above, with very narrow callus and shallow, broadly V-shaped anal sinus. Ornament consists of 8 to 9 slightly opisthocline axial ribs on each whorl. They are not clearly delimited and become obsolete near the aperture. They end mostly on the subsutural depression and they are slightly narrower than the intercostal areas. On

Table 22. — Material studied of *Bela keepingi* (ETHERIDGE & BELL, 1898).

Types and figured specimens				
Collection	Locality	Member/Formation	Level	Coll. number
IRScNB	Antwerp 11	Kruisschans Mbr.	7.8-8 m	IST 6311
IRScNB	Kallo 21	Kruisschans Mbr.		IST 6127
Other material				
Collection	Locality	Member/Formation	Level	Number of spec.
IRScNB	5	Kruisschans Mbr.		20
IRScNB	5	Kruisschans Mbr.	0-1 m	8
IRScNB	5	Kruisschans Mbr.	1-2 m	53
IRScNB	5	Kruisschans Mbr.	2-3 m	33
IRScNB	5	Kruisschans Mbr.	3-3.25 m	3
IRScNB	11	Kruisschans Mbr.	7-7.5 m	65
IRScNB	11	Kruisschans Mbr.	7.5-8 m	6
IRScNB	14	Merksem Mbr.	1 m	1
IRScNB	19	Kruisschans Mbr.?	4 m	2
IRScNB	20	Kruisschans Mbr.	5-5.5 m	10
IRScNB	20	Kruisschans Mbr.	5.5-6 m	35
IRScNB	24	Scaldisien		27
RM	21	Oorderen Mbr.	<i>A. benedeni</i>	2
RM	21	Kruisschans Mbr.		4998
RM	30	Kruisschans Mbr.		2

Table 23. — Statistics of 30 specimens of *Bela keepingi* (ETHERIDGE & BELL, 1898) from Kallo, Verrebroekdok, Kruisschans Member.

Measurement	Number of specimens	Minimal value	Maximal value	Mean value	Standard deviation
Number of whorls	30	8	9	9	0.4
Height (mm)	30	8.2	11.3	9.9	0.9
Diameter (mm)	30	2.9	4.1	3.5	0.3
Spire (mm)	30	3.3	4.7	4.1	0.4
Aperture (mm)	30	3.3	4.6	4.1	0.3

the last whorl, 12 to 15 primary spirals occur. Between them, two to four weaker secondary spirals present, in total 20 ribs. The spirals may form the only ornament on the subsutural depression, but some specimens show there a regular lattice sculpture, formed by old anal sinuses and spirals. On and between ribs, fine granules are present in well preserved specimens.

DISCUSSION

This species is rarely found in the *Angulus benedeni* level of the Oorderen Member, in the Kruisschans Member, where it is one of the commonest gastropod species and rarely in the Merksem Member. It is known from Dutch boreholes and beach material. The British specimens were found in the St. Erth Beds, which seem consequently to be of the same age as the Kruisschans-Merksem Members. This is in accordance with the results of JENKINS & HOUGHTON (1987), who determined the age of the St. Erth Beds, with the aid of planctonic foraminifera and nannofossils, as Upper Pliocene (1.9 - 2.1 million years).

Bela belgica (VAN REGTEREN ALTENA, 1959) Pl. 3, Fig. 2

- . 1878 - *Pleurotoma hispidula* Jan - WOOD, p. 42, pl. 3, fig. 3 (non *Pleurotoma hispidula* DE CRISTOFORI & JAN, 1832).
- v. 1878 - *Pleurotoma similis*, Nyst - NYST, pl. 3, fig. 19 (non *Pleurotoma similis* BIVONA, 1832).
- v. 1881 - *Pleurotoma similis*, Nyst - NYST, p. 55 (non *Pleurotoma similis* BIVONA, 1832).
- . 1915 - *Raphitoma similis* (Nyst) - HARMER, p. 259-260, pl. 29, fig. 28-29 (non *Pleurotoma similis* BIVONA, 1832).
- v. 1946 - *Lora* cf. *garlandi* (Harmer, 1915) - BEETS, p. 97, pl. 5, fig. 7-8.
- v. 1946 - *Lora similis*??? - BEETS, p. 98.
- v. 1959 - *Mangelia (Bela) belgica* n. sp. - VAN REGTEREN ALTENA, p. 32.
- v. 1960 - *Bela belgica* Regteren-Altena, sp. 1959 - GLIBERT, p. 16, pl. 4, fig. 14, pl. 5, fig. 4.
- v. 1965 - *Mangelia (Bela) belgica* Van Regteren Altena, 1954 - VAN REGTEREN ALTENA *et al.*, p. 41, pl. 17, fig. 167.

TYPE LOCALITY AND STRATUM: Antwerp, Belgium; "Scaldisien" (Lillo Formation), Pliocene.

MATERIAL: (Table 24).

DIMENSIONS:

Holotype - x: 8, H: 13.0 mm, D: 4.6 mm, S: 3.8 mm, A: 7.9 mm. Figured specimen Pl. 3, Fig. 2 - x: 8, H: 11.1 mm, D: 4.0 mm, S: 3.4 mm, A: 6.8 mm.

DESCRIPTION

Medium sized, moderately broad, fusiform shell with deep suture and short siphonal canal. Protoconch (see GLIBERT (1960, pl. 5 fig. 4)) consists of 2 glossy, smooth whorls and one with reticulate pattern. Nucleus flattened, next protoconch whorl tumid, often slightly keeled; third whorl less tumid. Protoconch sculpture starts with 2 narrow spiral ribs, halfway on the whorl. Regular, prosocline, sinuous axial ribs start slightly later; these ribs are narrower than the intercostal areas and they end apically in a small spine. Half a whorl later, 4 spirals are present. Start teleoconch clear; the regular axial ribs disappear. Ten spirals are then present. The upper ones are weaker and lie farther from each other than the abapical ones. After 1/2 whorl, new axial ribs appear, which are less regular, coarser and farther separated from each other than the original ones. Teleoconch consists of about 7 tumid whorls. Spire relatively low, taking on average 33 % of total height, aperture 53 %, diameter 36 %. Aperture elongate oval, pointed above, not thickened, with an unclear and narrow callus. Anal sinus shallow and broadly V-shaped. Axial sculpture comprises 20 to 25 weak, unclear ribs, which are narrower than the intercostal spaces. Axial ribs opisthocline, weaker near the suture, heavier after the turning point; they become obsolete before the end of the siphonal canal. Spiral sculpture is composed of 15 to 20 striae on the penultimate whorl. They bear a microsculpture of fine granules in perfect specimens. Last whorl with 8 spiral striae above the turning point of the axial ribs, 30 heavier spirals abapically; between the heavier spirals, 1 to 3 weaker spirals are present.

Table 24. — Material studied of *Bela belgica* (VAN REGTEREN ALTENA, 1959).

Types and figured specimens				
Collection	Locality	Member/Formation	Level	Coll. number
IRScNB	Antwerp	Scaldisien		Holotype IST 4383
IRScNB	Antwerp 13	Luchtbal Mbr.		IST 5082
Other material				
Collection	Locality	Member/Formation	Level	Number of spec.
IRScNB	Antwerp	Scaldisien		47
IRScNB	4	Luchtbal Mbr.	6.75 m	3
IRScNB	4	Luchtbal Mbr.	7.5 m	1
IRScNB	5	Scaldisien	10.9-11.1 m	1
IRScNB	6	Luchtbal Mbr.	9.75 m, base	7
IRScNB	7	Scaldisien		28
IRScNB	10	Scaldisien		4
IRScNB	11	Oorderen Mbr.	13-13.25 m	1
IRScNB	11	Luchtbal Mbr.	13.5-13.75 m	2
IRScNB	11	Luchtbal Mbr.	14-14.25 m	2
IRScNB	13	Luchtbal Mbr.		1
IRScNB	13	Scaldisien		39
IRScNB	15	Luchtbal Mbr.	7.6-8 m	4
IRScNB	25	Scaldisien		1
IRScNB	29	Scaldisien		2
RM	Antwerp	Luchtbal Mbr.		3
RM	3	Luchtbal Mbr.		4
RM	21	Oorderen Mbr.	<i>Atrina</i>	1
RM	29	Lillo Fm.	dredged	2

DISCUSSION

This species is much larger and relatively broader, with a deeper suture than *B. neerlandica* (BEETS, 1946), *B. antwerpiensis* n. sp., *B. consimilis* (HARMER, 1915) and *B. keepingi* (ETHERIDGE & BELL, 1898). It is very rare in the *Atrina* level of the Oorderen Member, more common

in the Luchtbal Member. In Great Britain, it occurs in the Coralline and Red Crags. *Raphitoma Garlandi* HARMER, 1915 is larger and more slender. *Bela belgica* (VAN REGTEREN ALTENA, 1959) is possibly a junior synonym of HARMER's name, but this cannot be ascertained without study of the type material.

Table 25. — Statistics of 30 specimens of *Bela belgica* (VAN REGTEREN ALTENA, 1959) from Antwerp, Luchtbal Member (15 sp.), Antwerp Van de Vin Dock, Luchtbal Member (7 sp.), Antwerp Wilmarsdonk, Scaldisien (7 sp.) and the holotype.

Measurement	Number of specimens	Minimal value	Maximal value	Mean value	Standard deviation
Number of whorls	30	8	9	8.6	0.5
Height (mm)	30	12.1	16.9	14.5	1.2
Diameter (mm)	30	4.5	6.1	5.2	0.4
Spire (mm)	30	3.8	5.8	4.8	0.5
Aperture (mm)	30	6.0	9.3	7.6	0.7

Bela tenuistriata (A. BELL, 1871)
Pl. 3, Fig. 3

v. 1965 - *Mangelia (Bela) tenuistriata* (A. BELL, 1871) -
VAN REGTEREN ALTENA *et al.*, p. 42, pl. 18,
fig. 170.

- . 1848 - *Clavatula laevigata* Phil.(?) - WOOD, p. 62, pl. 7,
fig. 12.
- . 1871 - *Pleurotoma tenuistriata* NoB. - BELL, p. 357.
- . 1872 - *Pleurotoma tenuistriata* Bell - WOOD, p. 41.
- v. 1890 - *Haedropleura delheidi* nov. sp. - VINCENT, p. 97,
text-fig.
- . 1915 - *Raphitoma tenuistriata* (A. Bell) - HARMER, p. 263,
pl. 29, fig. 31, 32.
- . 1915 - *Raphitoma tenuistriata* var. *carinata*, nov. - HAR-
MER, p. 264, pl. 29, fig. 33.
- v. 1946 - "*Mangelia*" *tenuistriata* (Bell, 1871) - BEETS,
p. 104, pl. 5, fig. 28-37.
- v. 1960 - *Haedropleura delheidi* Vincent, 1890 - GLIBERT,
p. 12, pl. 4, fig. 16.

TYPE LOCALITY AND STRATUM: Sutton, East Anglia, United
Kingdom; Coralline Crag, lower Pliocene.

MATERIAL: (Table 26).

DIMENSIONS:

Holotype of *H. delheidi* - x: 9, H: 15.6 mm, D: 5.2 mm,
S: 6.4 mm, A: 6.8 mm. Figured specimen Pl. 3, Fig. 3a
(IST 6294) - x: 7, H: 6.0 mm, D: 2.2 mm, S: 2.3 mm,
A: 2.6 mm. Figured specimen Pl. 3, Fig. 3b (IST 6302) -
e - x: 8, H: 11.3 mm, D: 3.8 mm, S: 4.9 mm, A: 4.5
mm.

Table 26. — Material studied of *Bela tenuistriata* (A. BELL, 1871).

Types and figured specimens				
Collection	Locality	Member/Formation	Level	Coll. number
IRScNB	Antwerp 4	Luchtbal Mbr.	7-8 m	IST 6294 IST 6302 Holotype of <i>H. delheidi</i> IST 5018 8 paratypes of <i>H. delheidi</i>
IRScNB	Antwerp 15	Luchtbal Mbr.		
IRScNB	Antwerp 8	Merksem Mbr.		
IRScNB	Antwerp 8	Merksem Mbr.		
Other material				
Collection	Locality	Member/Formation	Level	Number of spec.
IRScNB	Boyton, U.K.	Coralline Crag		7
IRScNB	Orford Castle, U.K.	Coralline Crag		5
IRScNB	Little Oakley, U.K.	Red Crag		1
IRScNB	Antwerp	Scaldisien		19
IRScNB	4	Oorderen Mbr.	3.10 m	1
IRScNB	4	Oorderen Mbr.	3.10-3.75 m	4
IRScNB	4	Luchtbal Mbr.	6.75 m	3
IRScNB	4	Luchtbal Mbr.	7.50 m	1
IRScNB	5	Merksem Mbr.		1
IRScNB	6	Oorderen Mbr.?	7.4 m	12
IRScNB	6	Luchtbal Mbr.	7.75 m	3
IRScNB	10	Scaldisien		5
IRScNB	11	Oorderen Mbr.	11.5-12 m	1
IRScNB	11	Oorderen Mbr.	13.25-13.5 m	2
IRScNB	11	Luchtbal Mbr.	13.5-13.75 m	5
IRScNB	11	Luchtbal Mbr.	14.5-14.6 m	2
IRScNB	13	Austruweel Mbr.		4
IRScNB	13	Kattendijk Fm.		1
IRScNB	15	Luchtbal Mbr.	7.6-8 m	1
RM	23	Oorderen Mbr.	<i>Atrina</i>	3
RM	21	Kruisschans Mbr.		2
RM	23	Lillo Fm.	dredged	1
RM	32	Lillo Fm.	dredged	2

Table 27. — Statistics of 30 specimens of *Bela tenuistriata* (A. BELL, 1871) from Antwerp, Mercantiledok (1 sp.), Antwerp Vijfde Havendok (2 sp.), Antwerp Boudewijnsluis (2 sp.), Antwerp Petroleumdok (6 sp.), Antwerp Afrikadok (1 sp.), all Luchtbal Member, Antwerp, Amerikadok, Kruisschans Member (IST 5018), Kallo, Verrebroekdok, Oorderen Member (3 sp.), Kallo Verrebroekdok, Kruisschans Member (1 sp.), Antwerp, Scaldisien (2 sp.), Boyton, U.K., Coralline Crag (5 sp.), Orford Castle, U.K., Coralline Crag (6 sp.).

Measurement	Number of specimens	Minimal value	Maximal value	Mean value	Standard deviation
Number of whorls	30	7	9	8	0.7
Height (mm)	30	6.0	16.6	11.0	2.8
Diameter (mm)	30	2.0	5.2	3.6	0.8
Spire (mm)	30	2.2	7.6	4.6	1.4
Aperture (mm)	30	2.6	6.8	4.5	1.0

DESCRIPTION

Small, slender shell with 8 whorls. Shape biconical, adapical cone much larger than basal one. Protoconch consists of 2 $\frac{3}{4}$ smooth, glossy, tumid whorls; nucleus very small, next whorl relatively broad. Then follows $\frac{1}{4}$ whorl with 6 strongly curved, opisthocline axial ribs, which lie closely together. Spiral sculpture starts at the beginning of the teleoconch with 4 ribs; the teleoconch axial ribs are less curved and more widely spaced than the protoconch axials. Whorls of adult shell flattened, with shallow or slightly incised suture. The spire takes on average 43 % of total height, aperture 42 %, diameter 34 %. Aperture elongate oval, pointed adapically. Siphonal canal very short, with narrow, but clearly delimited callus and very shallow sinus. On the last whorl, 50 spiral lines are present; they are broader than the intercostal areas, which form very narrow depressions. In these intercostal depressions, a microsculpture of punctate lines is present. In some specimens, 5 slightly more conspicuous, darker colored spirals occur, regularly distributed between the others. Near the siphonal canal, the spirals are much more pronounced. No axial sculpture present in most specimens, others have 8 to 10 broad plicae, which are not clearly delimited.

DISCUSSION

This species is quite variable in general shape. Typical specimens (Pl. 3 Fig. 3a) are slender, with flat-sided whorls, but some are much more tumid (Pl. 3 Fig. 3b, c, d). Also the size at the same number of whorls is very variable. Axial sculpture can be completely absent to well developed. The holotype of *Haedropleura delheidi* VINCENT, 1890 differs from typical *Bela tenuistriata* in being larger in size than average specimens and by the presence of conspicuous axial sculpture. The characteristic spiral sculpture of both types is however undistinguishable and most of the paratypes of *Haedropleura delheidi* VINCENT, 1890 are smaller than the holotype and lack axial ribs. Therefore, both types are united here, although extreme specimens differ. *Bela tenuistriata* (A. BELL, 1871) re-

sembles *Cerodrillia nysti* (HARMER, 1915), which has more tumid whorls and a completely different aperture, while spiral sculpture lacks. In sculpture, there is some resemblance with *Bela gliberti* n. sp., but the spirals of that species are granulated, the shell is very regular biconical and the aperture is relatively higher. The protoconch of *Bela tenuistriata* (A. BELL, 1871) is broader than that of *Bela gliberti* n. sp., while axial sculpture is always present in that species. *Bela tenuistriata* (A. BELL, 1871) is new for the Pliocene of Belgium; it was known until now from the British Coralline and Red Craggs and from Dutch boring and beach material. *Raphitoma valida* n. sp. of HARMER (1915, pl. 30 fig. 22-23) has the same shell form as *B. tenuistriata* (A. BELL, 1871), but nothing is mentioned in the original description about the presence of spiral sculpture. The species is present in the whole Belgian Pliocene, from Kattendijk Formation to Merksem Member, but it is nowhere really common, although most specimens are found in the Luchtbal Member. *Bela tenuistriata* (A. BELL, 1871) is very rare in Kallo, where specimens were found in the *Atrina* level of the Oorderen Member and in the Kruisschans Member. DAUTZENBERG & DUROUCHOUX (1913, pl. 1 fig. 4-5) figured Recent specimens from Saint-Malo, France, under the name *Bela rufa* var. *semicostata* JEFFREYS, which have much in common with *Bela tenuistriata* (A. BELL, 1871). Their figures and descriptions do however not allow to recognise the sculpture of this type of shells. JEFFREYS (1867) name is furthermore a *nomen nudum*.

Acknowledgements

I wish to thank A. V. Dhondt, A. W. Janssen, T. Meyer and K. Wouters for the use of the research facilities of the IRScNB and for the opportunity to study the IRScNB, RGD and NNM collections. A. Janse, K. Peeters, A. Ratinckx and F. A. D. Van Nieulande allowed me to study their private collections. Photographs were made by L. Cillis (SEM) and M. Wagenaar. P. Marquet helped with Fig. 1. J. J. Van Aartsen helped with remarks about some species. K. Hoedemakers improved the English manuscript.

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Typescript submitted 15.5.1996.

Revised typescript submitted 6.11.1996.

PLATE 1

- Fig. 1 — *Acamptogenotia intorta nysti* GLIBERT, 1954. a, b Noordkasteel, Antwerp Luchtbal Member, Lillo Formation, middle Pliocene; Coll. RM. c. specimen, covered with *Hydractinia* sp.; Vrasenedok, Kallo, province Oost-Vlaanderen; Kattendijk Formation, lower Pliocene; Coll. RM. a, b X 1, c X 0.7.
- Fig. 2 — *Gemmula (Unedogemmula) antwerpiensis* (VINCENT, 1890). Verrebroekdok, Kallo, province Oost-Vlaanderen, *Cultellus* level, Oorderen Member, Lillo Formation, middle Pliocene; Coll. RM. a, b X 1,7.
- Fig. 3 — *Gemmula (Unedogemmula) stoffelsi* (NYST, 1843). Vrasenedok, Kallo, *Petalocochus* level, Kattendijk Formation, lower Pliocene; Coll. RM. a, b X 3.
- Fig. 4 — *Asthenotoma bipunctula* (WOOD, 1872). Verrebroekdok, Kallo, province Oost-Vlaanderen, *Cultellus* level, Oorderen Member, Lillo Formation, middle Pliocene; a Coll. RM, b, c Coll. IRScNB IST 6306. a X 3.5, b x 7, c x 25; b, c: SEM photographs.
- Fig. 5 — *Asthenotoma ratinckxi* n. sp. Holotype IRScNB IST 6301, Vrasenedok, Kallo, Oost-Vlaanderen, *Atrina* level, Oorderen Member, Lillo Formation, middle Pliocene; a X 7, b X 20, c X 80, d X 120; c, d protoconch microsculpture, all SEM photographs.
- Fig. 6 — *Asthenotoma icenorum* (WOOD, 1872). Kanaaldok (1926), Antwerp, "Diestien" = Kattendijk Formation, lower Pliocene; Coll. IRScNB IST 6293. a X 4.4, b X 20, c X 120; c protoconch microsculpture, all SEM photographs.
- Fig. 7 — *Bela consimilis* (HARMER, 1915). Mercantile Dok, Antwerp, Luchtbal Member, Lillo Fm., middle Pliocene; a, b. Coll. IRScNB IST 6312. a X 25, b X 300; a, b teleoconch microsculpture, all SEM photographs.
- Fig. 8 — *Bela keepingi* (ETHERIDGE & BELL, 1898). Boudewijnsluis, Antwerp, Kruisschans Member, Lillo Formation, upper Pliocene; Coll. IRScNB IST 6311. X 300; teleoconch microsculpture, SEM photograph.

PLATE 2

- Fig. 1 — *Cerodrillia (Elaeocyma) nysti* (HARMER, 1915). Vrasenedok, Kallo, province Oost-Vlaanderen, *Atrina* level, Oorderen Member, Lillo Formation, lower Pliocene; Coll. RM. a, b X 2,5.
- Fig. 2 — *Bela nebula* (MONTAGU, 1803). Torrevieja, 50 km S. of Alicante, Spain, Recent; Coll. IRScNB IST 6295. a X 8, b X 70, c X 180, d X 13; c teleoconch microsculpture, all SEM photographs.
- Fig. 3 — *Bela gliberti* n. sp. a, b Holotype IRScNB IST 6300; Verrebroekdok, Kallo, Oost-Vlaanderen, *Cultellus* level, Oorderen Member, Lillo Formation, middle Pliocene. c Mercantile Dok, Antwerp, Luchtbal Member, Lillo Formation, middle Pliocene; Coll. IRScNB IST 6317. a X 5, b x 15, c x 25; c teleoconch microsculpture, all SEM photographs.
- Fig. 4 — *Bela neerlandica* (BEETS, 1946). Antwerp, Scaldisien à *Lentidium complanatum* (Austruweel Member?), Lillo Formation, middle Pliocene; Coll. IRScNB IST 6299. a X 9, b X 21; a teleoconch microsculpture, all SEM photographs.
- Fig. 5 — *Bela antwerpiensis* n. sp. a, b, c, d, e Holotype IRScNB IST 6305; Amerikadok, Antwerp, Luchtbal Member, Lillo Formation, middle Pliocene. f Slender specimen. Vrasenedok, Kallo, Oost-Vlaanderen, *Atrina* level, Oorderen Member, Lillo Formation, middle Pliocene; IRScNB IST 6315. g Specimen with weak axial sculpture; Boudewijnsluis, Antwerp, Oorderen Member, Lillo Formation, middle Pliocene; IRScNB 6314. a, b X 10, c X 34, d X 43, e X 360, f X 7, g X 9; d, e teleoconch microsculpture, all SEM photographs.
- Fig. 6 — *Bela consimilis* (HARMER, 1915). a, b, c Gedgrave, Great Britain, Coralline Crag, lower middle Pliocene; Coll. IRScNB IST 6303. d, e Mercantile Dok, Antwerp, Luchtbal Member, Lillo Fm., middle Pliocene; d Coll. IRScNB IST 6304, e Coll. IRScNB IST 6312. a X 15, b X 43, c X 50, d, e X 10; c teleoconch microsculpture; all SEM photographs.

Plate 1

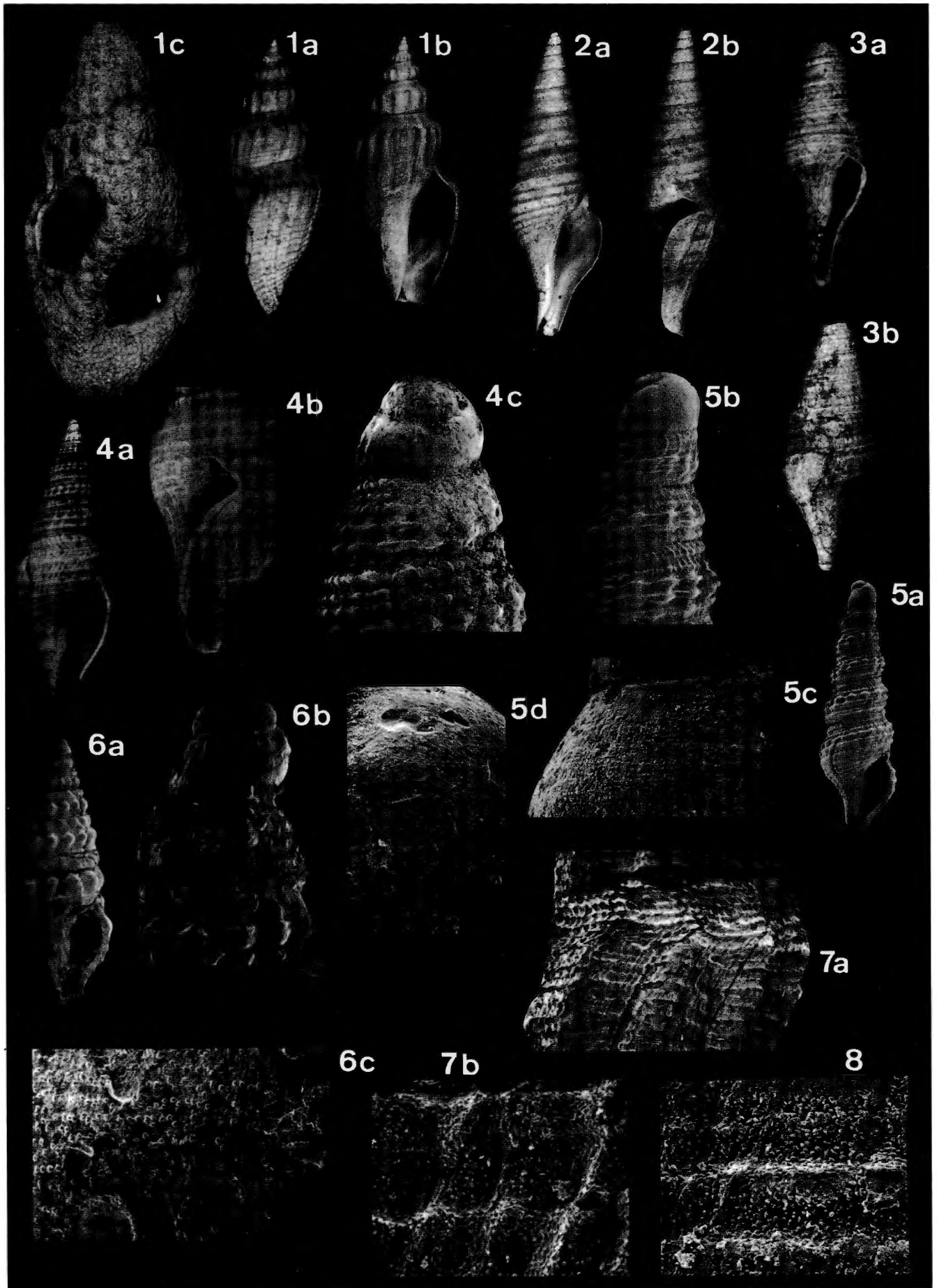


Plate 2

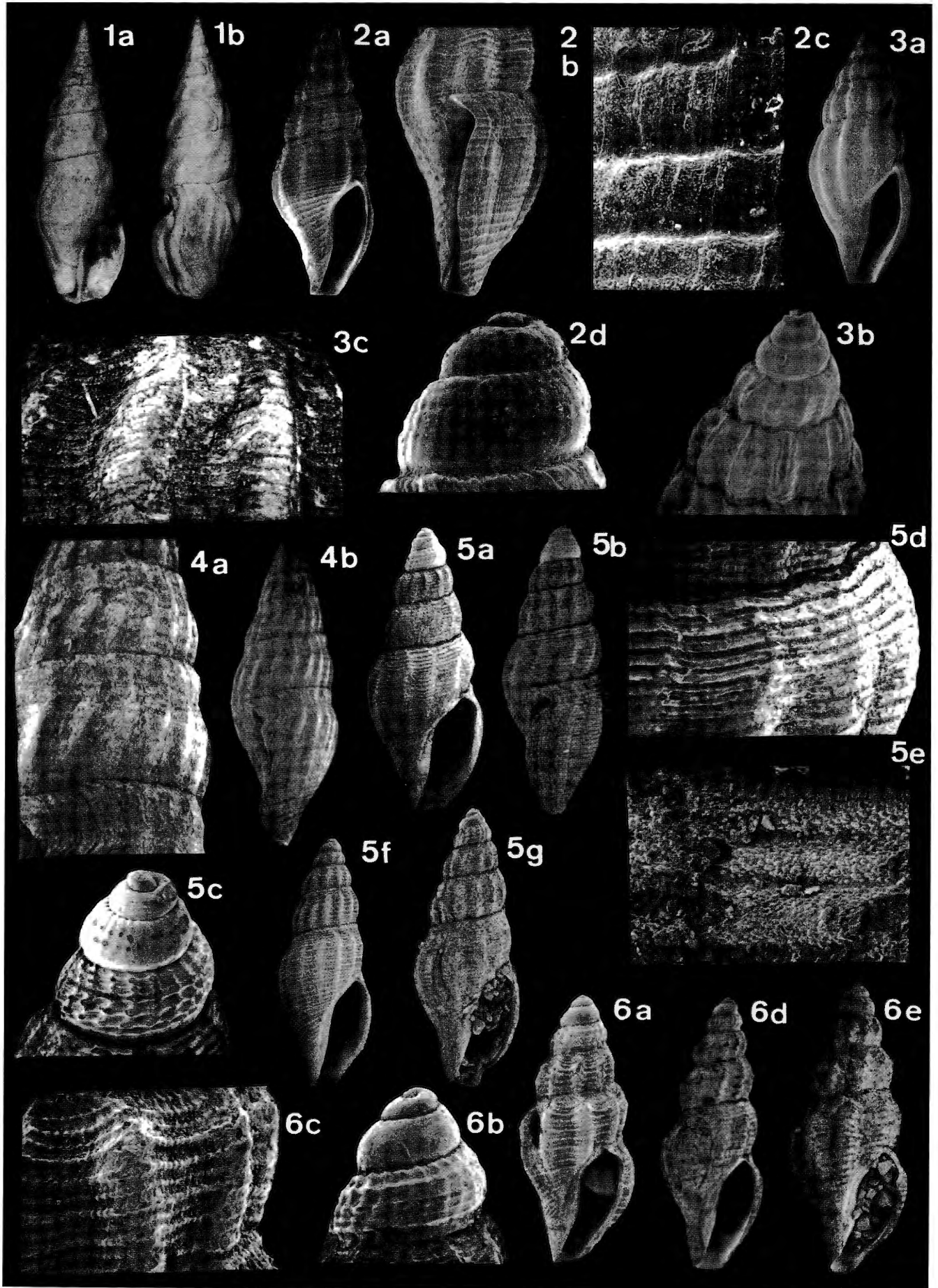


Plate 3

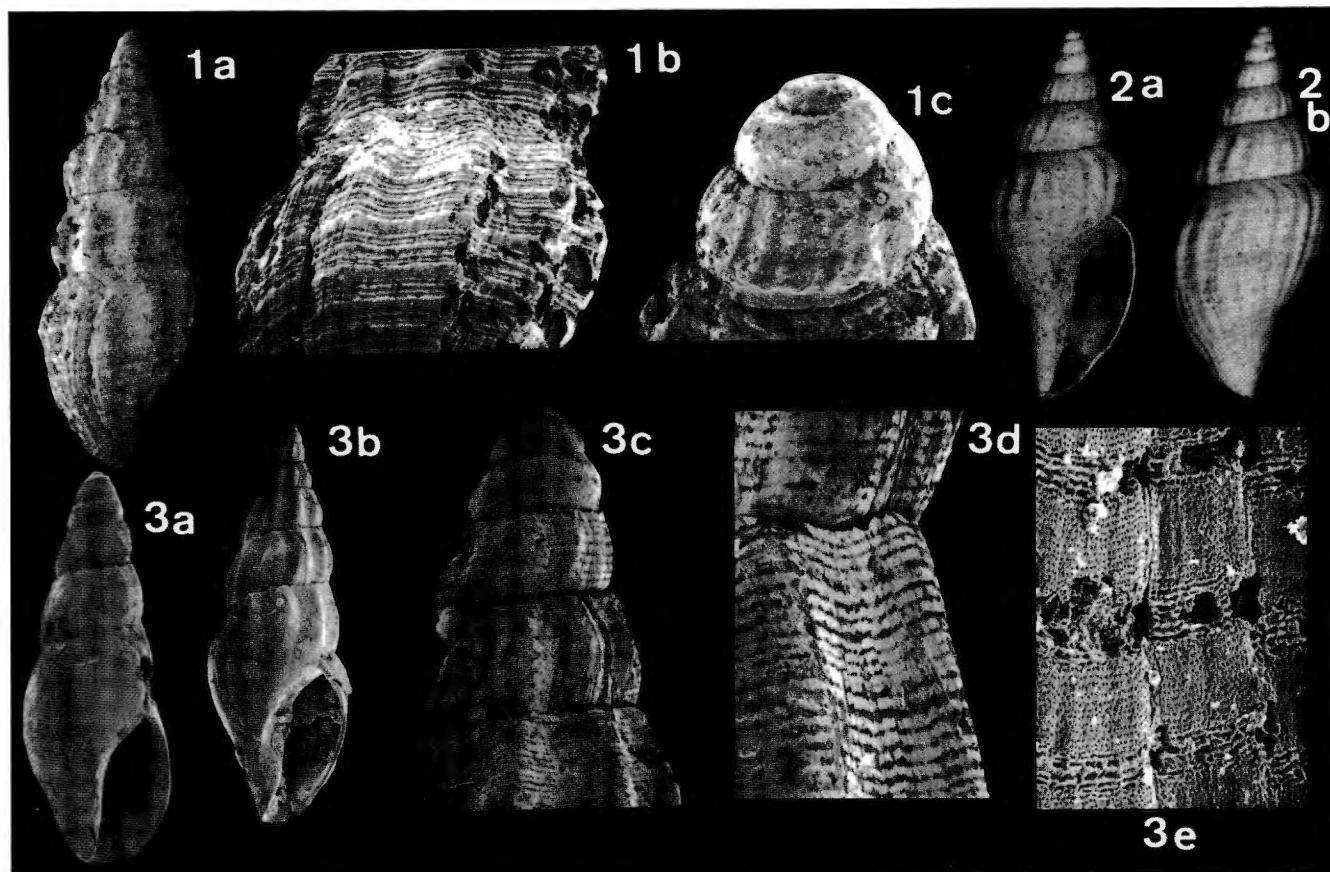


PLATE 3

- Fig. 1 — *Bela keepingi* (ETHERIDGE & BELL, 1898). Boudewijnsluit, Antwerp, Kruisschans Member, Lillo Formation, upper Pliocene; Coll. IRScNB IST 6311. a X 8, b X 47, c X 18; b teleoconch microsculpture, all SEM photographs.
- Fig. 2 — *Bela belgica* (VAN REGTEREN ALTENA, 1959). Verrebroekdok, Kallo, province Oost-Vlaanderen, *Atrina* level, Oorderen Member, Lillo Formation; Coll. RM. a, b X 4.
- Fig. 3 — *Bela tenuistriata* (A. BELL, 1871). a Vijfde Havendok, Austruweel, Antwerp, Luchtbal Sand; Coll. IRScNB IST 6294. b, c, d, e. Mercantile Dok, Antwerp, Luchtbal Sand. a X 9, b X 5, c X 24, d X 42, e X 380; d, e teleoconch microsculpture, all SEM photographs.

