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The Pliocene turrid Gastropods of Belgium

Part 2: Conidae (genera *Asthenotoma, Comarmondia, Cytharella, Mangelia, Lusitanops, Raphitoma* and *Philbertia*)

by Robert MARQUET

Abstract

Part of the Pliocene turrid gastropods of Belgium are revised. *"Asthenotoma" pliocenica* (VAN DER BURG, 1987), *Cytharella costatostriata* (WOOD *in* ETHERIDGE & BELL, 1898) and *Cytharella plicatella* (JAN *in* BELLARDI, 1847) are new for the Pliocene of Belgium. *Lusitanops gigasei* n. sp. is until now only known from the Pliocene of Belgium. *Raphitoma hystrix* auct., non *Pleurotoma hystrix* DE CRISTOFORI & JAN, 1832 is described as *R. (R.) antonjanseni* n. sp. , *Raphitoma leufroyi* auct., non *Pleurotoma leufroyi* MICHAUD, 1828 as *Philbertia pseudoleufroyi* n. sp. *Daphnella (Bellardiella) pseusohistrix* PEYROT, 1938 is renamed *Philbertia ferrierensis* nov. nom. The distribution and ecology of the turrid species are discussed.

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

Résumé

Des Gastéropodes turriformes pliocènes de la Belgique sont révisés. *"Asthenotoma" pliocenica* (VAN DER BURG, 1987), *Cytharella costatostriata* (WOOD *in* ETHERIDGE & BELL, 1898) et *Cytharella plicatella* (JAN *in* BELLARDI, 1847) sont nouveaux pour le Pliocène belge. *Lusitanops gigasei* n. sp. est connu pour le moment seulement du Pliocène belge. *Raphitoma hystrix* auct., non *Pleurotoma hystrix* DE CRISTOFORI & JAN, 1832 est décrit comme *R. (R.) antonjanseni* n. sp., *Raphitoma leufroyi* auct., non *Pleurotoma leufroyi* MICHAUD, 1828 comme *Philbertia pseudoleufroyi* n. sp. *Daphnella (Bellardiella) pseusohistrix* PEYROT, 1938 est nommé *Philbertia ferrierensis* nov. nom. La distribution et l'écologie des espèces turriformes sont discutées.

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

Introduction

This is the second paper about the Belgian turrid gastropods, now divided among three families, according to TAYLOR *et al.* (1993). Together with the paper of MARQUET (1997), it forms a revision of GLIBERT's (1960) work on this part of the Pliocene molluscan fauna of Belgium. Apart from GLIBERT's material, new specimens from Kallo (Oost-Vlaanderen) and from docks on the right Scheldt River in Antwerp have been studied. The localities are indicated on the map fig. 1 in MARQUET (1997). The locality numbers, cited in this text, correspond to that figure. de HEINZELIN (1950a, b, 1955 a, b) gave a geological description of the strata, observed in dock works on the right Scheldt bank in Antwerp. HOEDEMAKERS & MARQUET (1992) and MARQUET (1995) described the geology of the Kallo dock works. A review of the general Pliocene stratigraphy in Belgium can be found in MARQUET (1995). Material and methods are described by MARQUET (1997). It could be added that only selected references are cited in the synonymy lists: the original descriptions of the species, the publications about North Sea basin Neogene material and papers with clearly figured Recent and Neogene material from outside the North Sea basin. The material studied is kept in the following collections:

Coll. AJ: collection A. Janse, Brielle, The Netherlands; coll. AR: collection A. Ratinckx, Antwerp, Belgium; coll. IRScNB: collection Institut royal des Sciences naturelles de Belgique, Brussels, Belgium; coll. KP: collection K. Peeters, Kontich, Belgium; coll. RGM: collection Nationaal Natuurhistorisch Museum, Leiden, The Netherlands (formerly Rijksmuseum voor Geologie en Mineralogie); coll. RGH: collection Rijks Geologische Dienst, Haarlem, The Netherlands; coll. RM: collection R. Marquet, Antwerp, Belgium.

Taxonomy

Phylum Mollusca
Classis Gastropoda CUVIER, 1797
Superordo Caenogastropoda COX, 1960
Ordo Neogastropoda THIELE, 1929
Superfamilia Conoidea RAFINESQUE, 1815
Familia Conidae FLEMING, 1822
Subfamilia Clathurellinae H. & A. ADAMS, 1858
Genus *Asthenotoma* HARRIS & BURROWS, 1891 *sensu lato*
Type species *Asthenotoma meneghinii* (MAYER, 1868)

"Asthenotoma" pliocenica (VAN DER BURG, 1987)

Pl. 2, Fig. 2

v. 1987 – *Boreodrillia pliocenica* - VAN DER BURG, p. 121, fig. 1.

MATERIAL: (Table 1)

Table 1. — Material studied of *"Asthenotoma"* pliocenica (VAN DER BURG, 1987)

Collection	Locality	Member or Formation	Level	Collection number/Number of specimens
NNM	Macharen, Noord Brabant, The Netherlands	Formation of Oosterhout, Lower Pliocene	*Pseudamussium gerardi* range zone	Holotype RGM 229.313
NNM	same	same	same	Paratypes RGM 229.314, 229.315
NNM	Antwerp, 4e Havendok	Kattendijk Fm.	*Ditrupa*	RGM 396.396
NNM	same	same	same	2

DIMENSIONS:
Holotype - x: 7.5, H: 13.7 mm, D: 4.9 mm. Figured specimen RGM 396.396 - x: 8, H: 14.2 mm, D: 5.0 mm, S: 10.4 mm, A: 5.5 mm.

DESCRIPTION
Medium sized, slender fusiform shell with short siphonal canal and high spire. Protoconch (observed on holotype, not present or eroded on Belgian material) paucispiral (1 1/2 whorls), tumid, glossy, appearing smooth but with a microsculpture of granules. Protoconch and teleoconch separated by a sharp, opisthocline, slightly sinuous rib, with turning point on adapical upper third of last protoconch whorl. Teleoconch sculpture starting with vaguely delimited carina slightly abapical of half whorl height. On the second teleoconch whorl, tubercles appear on this carina. The tubercles are connected to the adapical suture by weak, not well delimited axial ribs. Against the adapical suture, a second spiral with tubercles starts. On the fourth teleoconch whorl, the oldest, abapical spiral splits. On the last whorl, 15 tubercles are present on the double abapical spiral; the adapical spiral becomes obsolete. Below both spirals, seven further spirals without tubercles are present. The siphonal fasciole consists of ten closely packed, weak ribs. Growth lines are conspicuous; their turning point is between the two spirals. The siphonal canal is short, the aperture relatively broad, oval, with a narrow callus and a deep, U-shaped sinus.

DISCUSSION
This species varies in the development of the tubercles, which can be smaller or larger; the splitting of the abapical spiral can start before the fourth teleoconch whorl. In some specimens, a third, adapical spiral is visible, but in others, the normal adapical spiral never becomes really pronounced and fades rapidly.

VAN DER BURG (1987) placed his new species in the genus *Boreodrillia*. The original diagnosis of this genus by SORGENFREI (1958, p. 271) reads "... small *Drillias* with a papillate paucispiral protoconch, a granulate protoconch shell surface and adult whorls with both spiral and collabral sculpture." Nothing in this diagnosis clearly separates *Boreodrillia* from other turrid genera, especially from *Asthenotoma*. A paucispiral protoconch which has solely a microsculpture consisting of granules is shared by *Boreodrillia* and *Asthenotoma*. This is clearly illustrated by GATTO (1990, fig. 5-6). The sharp separation of proto- and teleoconch by a slightly opisthocline ridge occurs in the type specimens of both genera, *B. toftludensis* SORGENFREI, 1958 and *A. meneghinii* (MAYER, 1868), as illustrated by SORGENFREI (1958, pl. 57, fig. 191) and GATTO (1990, fig. 5a). The presence of both spiral and axial teleoconch sculpture is a character shared by a large number of turrids. In the type species of *Boreodrillia* the number of teleoconch spirals is higher than in *Asthenotoma*; the spirals possess no tubercles and they are finer and more widely spaced than in *Asthenotoma*. This applies also to species, later referred to *Boreodrillia* by A.W. JANSSEN (1984). In VAN DER BURG's species, tubercles are always present on its spiral ribs, as in *Asthenotoma*. *"Asthenotoma" pliocenica* is quite similar to *"A." icenorum* (WOOD, 1872), which differs in being narrower, while the abapical spiral never splits, the adapical spiral is larger and remains strong till the last whorl and the protoconch is slightly larger. GATTO (1997, *in litt.*) however recommended to leave both species out of the genus *Asthenotoma* because of differences in the shell base. The generic attribution of both species therefore remains uncertain.

"Asthenotoma" pliocenica is very rare in the *Ditrupa* level of the Kattendijk Formation: only three specimens are known, in the collection Van Der Mark (now RGM).

Genus *Comarmondia* MONTEROSATO, 1884
Type species *Comarmondia gracilis* (MONTAGU, 1803)

Comarmondia gracilis (MONTAGU, 1803)

* 1803 – *Murex gracilis* - MONTAGU, p. 267, pl. 15, fig. 5.
v. 1878 – *Pleurotoma gracile*, Mont. - NYST, pl. 3, fig. 12.
v. 1881 – *Pleurotoma emarginata*, Donov. - NYST, p. 48 (non *Murex emarginatus* DONOVAN, 1805).

Table 2. — Material studied of *Comarmondia gracilis* (MONTAGU, 1803).

Collection	Locality	Member or Formation	Level	Collection number/Number of specimens
IRScNB	Antwerp	Austruweel M.		IST 4377
IRScNB	Antwerp	Luchtbal M.		IST 5084
IRScNB	Antwerp	Kattendijk Fm.		1
IRScNB	11	Oorderen M.	10.5-11 m	1
IRScNB	11	Luchtbal M.	13.5-14 m	1
IRScNB	13	Scaldisien		1
IRScNB	16	Scaldisien		1
IRScNB	24	Scaldisien		1
IRScNB	29	Scaldisien		2
RM	21	Oorderen M.	*Cultellus*	8
RM	29	Luchtbal M.	dredged	1
RM	32	Lillo Fm.	dredged	2

. 1915 – *Bellardiella gracilis* (Montagu) - HARMER, p. 241, pl. 28, fig. 34-35.
v. 1946 – *Raphitoma gracilis* (Montagu, 1803) - BEETS, p. 107.
v. 1960 – *Comarmondia gracilis* Montagu, sp. 1803 - GLIBERT, p. 17, pl. 4, fig. 17, pl. 5, fig. 5.
. 1963 – *Comarmondia gracilis* (Montagu) - VENZO & PELOSIO, p. 131, pl. 41, fig. 35.
v. 1965 – *Philbertia (Comarmondia) gracilis* (Montagu, 1803) - VAN REGTEREN ALTENA *et al.*, p. 42, pl. 18, fig. 172.
. 1988 – *Comarmondia gracilis* (Montagu, 1803) - GRAHAM, p. 452, fig. 189.
. 1992 – *Comarmondia gracilis* (Montagu, 1803) - CAVALLO & REPETTO, p. 146, fig. 406.

MATERIAL: (Table 2)

DIMENSIONS: (Table 3)
Figured specimen IST 5084 GLIBERT (1960, pl. 4, fig. 17) - x: 10, H: 15.4 mm, D: 3.3 mm (aperture damaged), S: 4.5 mm, A: 5.0 mm.

DESCRIPTION
Rather large, slender fusiform shell with long siphonal canal and deep suture. Protoconch figured by GLIBERT (1960, pl. 5, fig. 5). It is 1.2 mm high and multispiral (3 3/4 to 4 whorls). First 2 1/2 whorls smooth, glossy and tumid. Then one whorl with sculpture follows. A spiral carina appears halfway on the whorl and fine granulation starts. After 1/4 whorl, a second spiral appears very close to the abapical suture. Both spirals continue on the teleoconch, a third spiral then appears between both. On the spirals, tubercles appear, which develop into axial ribs. The adapical spiral remains always at the same distance from the adapical suture, forming a subsutural depression with a microsculpture of granules. Six tumid teleoconch whorls are present. Diameter on average 33 % of total height, spire 42 %. Aperture oval, on average 43 % of shell height, with a narrow callus which bears a tubercle on the columellar side near the anal sinus. In adult specimens, the outer lip is thickened and bears narrow teeth on the inside. Anal sinus very deep and U-shaped. Axial sculpture on last whorl consisting of 14 not well delimited ribs, which are as broad as the intercostal spaces and slightly opisthocline. They end below the subsutural depression. Four spiral ribs are present in the depression, 14 spirals run between and over the axial sculpture on the penultimate whorl. Spirals much narrower than axials, about as wide as intercostal spaces and very finely granulated in well preserved specimens.

Table 3. — Statistics of seven specimens of *Comarmondia gracilis* (MONTAGU, 1803) from Kallo, Oorderen Member (three sp.), Antwerp, Zoomseweg, dredged (one sp.), Merksem, Scaldisian (two sp.) and Antwerp, Austruweel, Scaldisien (one sp.).

Measurements	Minimal value	Maximal value	Mean value	Standard deviation
Number of whorls	9	11	10	0.53
Height (mm)	14.2	19.8	16.8	1.96
Diameter (mm)	6.6	4.7	5.5	0.69
Spire (mm)	5.6	8.4	7.0	1.09
Aperture (mm)	5.7	8.4	7.2	0.84

DISCUSSION

This species is easily recognisable among the Pliocene turrid gastropods of Belgium because of its long siphonal canal, tumid whorls, typical sculpture and protoconch. No better specimen than that figured by GLIBERT (1960) is available, so the species is not figured here. *Comarmondia gracilis* (MONTAGU, 1803) is rare in the Oorderen Member of Kallo, in other localities it occurs in the Kattendijk Formation, Luchtbal and Austruweel Members. The species is known from the British, Dutch and Italian Pliocene and according to VENZO & PELOSIO (1963) also from the Italian Miocene. As a Recent species, it occurs from the Mediterranean to the Azores and the British Isles, between 7 and 150 m (GRAHAM, 1988).

Subfamilia Mangeliinae FISCHER, 1883
Genus *Cytharella* MONTEROSATO, 1875
Type species *Cytharella costata* (DONOVAN, 1803)

Cytharella costatostriata (WOOD *in* ETHERIDGE & BELL, 1898)
Pl. 1, Figs. 1-2

v p. p. 1843 - *Pleurotoma mitrula* Sow.- NYST, p. 528, pl. 46, fig. 3 (non *Buccinum mitrula* J. de C. SOWERBY, 1822).
v p. p. 1878 - *Pleurotoma costata*, Da Costa - NYST, pl. 3, fig. 17 (non *Buccinum costatum* DA COSTA, 1778).
v p. p. 1881 - *Pleurotoma costata*, Da Costa - NYST, p. 52 (non *Buccinum costatum* DA COSTA, 1778).
. 1886 - *Pleurotoma costato-striata* - WOOD *in* KENDALL & BELL, p. 210.
* 1898 - *Pleurotoma costatostriata* nob. - WOOD *in* ETHERIDGE & BELL, p. 137.
. 1915 - *Mangilia costato-striata* (S.V. Wood MS, Kendall and R. Bell) - HARMER, p. 381, pl. 39, fig. 18-19.
v p. p. 1938 - *Mangelia altenai* nov. sp. - BRAKMAN, p. 47, text-fig. left, middle.
v p. p. 1946 - *Mangelia (Mangelia) altenai* (Brakman, 1938) - BEETS, p. 106.
v p. p. 1958 - *Mangelia (Smithiella) smithi* (Forbes) - GLIBERT, p. 18 (non *Pleurotoma Smithi* FORBES, 1840).
v 1960 - *Mangelia (Cytharella) altenai* Brakman, 1938 - GLIBERT, p. 13, pl. 5 fig. 1.
v . 1965 - *Mangelia (Mangelia) substriolata* (Harmer, 1918) - VAN REGTEREN ALTENA *et al.*, p. 40, pl. 17, fig. 161.
v . 1993 - *Cytharella* aff. *substriolata* (Harmer, 1918) - MARQUET, p. 93 (non *Raphitoma substriolata* HARMER, 1918).

TYPE LOCALITY AND STRATUM: St. Erth, Cornwall, United Kingdom; St. Erth Beds, upper Pliocene.

MATERIAL: (Table 4)

DIMENSIONS: (Table 5)
Figured specimen IST 6296 - x: 8, H: 7.1 mm, D: 2.8 mm, S: 2.6 mm, A: 3.4 mm. Figured specimen IST 6297 - x: 7, H: 3.6 mm, D: 1.8 mm, S: 1.1 mm, A: 2.0 mm.

Table 4. – Material studied of *Cytharella costatostriata* (WOOD *in* ETHERIDGE & BELL, 1898).

Collection	Locality	Member or Formation	Level	Collection number/Number of specimens
IRScNB	Antwerp 8	Kruisschans M.		IST 6296, 6297
IRScNB	Merksem 31	Kruisschans M.		IST 5015
IRScNB	Antwerp	Scaldisien		1
IRScNB	Antwerp	Austruweel M.?		7
IRScNB	4	Scaldisien	2 m	2
IRScNB	5	Kruisschans M.		8
IRScNB	5	Kruisschans M.	0-1 m	5
IRScNB	5	Kruisschans M.	1-2 m	19
IRScNB	5	Kruisschans M.	2-3 m	6
IRScNB	5	Kruisschans M.	3-3.5 m	4
IRScNB	6	Scaldisien	5.9-6.4 m	1?
IRScNB	11	Kruisschans M.	7-7.5 m	36
IRScNB	11	Kruisschans M.	7.5-8 m	3
IRScNB	19	Merxemian = ? Kruisschans M.	4 m	4
IRScNB	20	Kruisschans M.	5-5.5 m	23
IRScNB	20	Kruisschans M.	5.5-6 m	16
RM	21	Kruisschans M.		310
RM	30	Kruisschans M.		4

Table 5. – Statistics of 30 specimens of *Cytharella costatostriata* (WOOD *in* ETHERIDGE & BELL, 1898) from Kallo, Verrebroekdok, Kruisschans Member.

Measurements	Minimal value	Maximal value	Mean value	Standard deviation
Number of whorls	7	9	7.9	0.40
Height (mm)	7.8	13.0	9.2	0.93
Diameter (mm)	3.0	4.0	3.4	0.22
Spire (mm)	2.8	4.4	3.5	0.38
Aperture (mm)	3.8	5.3	4.4	0.32

DESCRIPTION
Small, slender fusiform shell with short siphonal canal and deep suture. Diameter on average 36 % of shell height. Protoconch with 3 whorls, 0.7 mm high. It consists of 2 1/2 smooth whorls, 1/4 of a whorl with one spiral rib on its abapical part, forming a carina and 1/4 of a whorl with a reticulate pattern. Then the first axial rib of the teleoconch appears. Teleoconch comprising five to six whorls, without subsutural depression. Spire 35 % of total height. Aperture elongate oval, 47 % of total height, rounded above, with narrow callus. Anal sinus medium deep and narrow. The outer lip can be thickened when coinciding with an axial rib. A tubercle, which notably narrows the aperture, is present on the inner side of the outer lip, just below the sinus. On the last whorl, about 10 strong, well delimited axial ribs occur, which are as broad or broader than the intercostal spaces. They start at the suture, where they are prosocline, and become opisthocline after a very short distance. They extend till the siphonal fasciole, which shows only about six ribs, running at an angle of 45° in respect to the shell axis. Between and on the axial ribs, 14 spiral ribs are clearly visible. They are broader than the very narrow intercostal spaces.

DISCUSSION
The authorship of this species is complicated. WOOD described it, but did not publish his description. KENDALL & BELL (1886) only mentioned the name in a list, so this was a *nomen nudum*. Only WOOD *in* ETHERIDGE & BELL (1898) gave a first description. This species differs from the next by its slightly less slender shell and especially by the much coarser spiral sculpture. A similar sculpture is not found in any related Recent species. BRAKMAN's *Mangelia altenai* seems to include this as well as the next species, judging by his figures. The species is known in Kallo from the Kruisschans Member, where it is very common, and from fragments in the Merksem Member. In the United Kingdom, it was only found in the St. Erth Beds, just as *Bela keepingi* (ETHERIDGE & BELL, 1897); this is further proof for a correlation between the St. Erth Beds and the Kruisschans Member. Dutch material from boreholes was not figured by BEETS (1946). Study of his material in the RGD collection proved the presence of this as well as the next species.

Cytharella substriolata (HARMER, 1915)
Pl. 1, Fig. 5

v p. p. 1843 – *Pleurotoma mitrula* Sow. - NYST, p. 528, pl. 46, fig. 3 (non *Buccinum mitrula* J. de C. SOWERBY, 1822).
v p. p. 1878 – *Pleurotoma costata*, Da Costa - NYST, pl. 3, fig. 17 (non *Buccinum costatum* DA COSTA, 1778).
v p. p. 1881 – *Pleurotoma costata*, Da Costa - NYST, p. 52 (non *Buccinum costatum* DA COSTA, 1778).
* 1915 – *Raphitoma substriolata* n. sp. - HARMER, p. 385, pl. 39, fig. 14-15.
v p. p. 1938 – *Mangelia altenai* nov. sp. - BRAKMAN, p. 47, text-fig. right.
v p. p. 1946 – *Mangelia (Mangelia) altenai* (Brakman, 1938) - BEETS, p. 106.
v p. p. 1958 – *Mangelia (Smithiella) smithi* (Forbes) - GLIBERT, p. 18 (non *Pleurotoma smithi* FORBES, 1840).
v p. p. 1960 – *Mangelia (Cytharella) altenai* Brakman, 1938 - GLIBERT, p. 13.
v. 1965 – *Mangelia (Mangelia) costulata smithi* (Forbes, 1840) - VAN REGTEREN ALTENA *et al.*, p. 40, pl. 17, fig. 160 (non *Pleurotoma smithi* FORBES, 1840).

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

MATERIAL: (Table 6)

DIMENSIONS: (Table 7)
Figured specimen IST 6316 - x: 8, H: 8.5 mm, D: 2.9 mm, S: 3.3 mm, A: 2.9 mm.

DESCRIPTION
Small, slender fusiform shell with short siphonal canal and deep suture. Diameter on average 35 % of total height. Protoconch 0.6 mm high, consisting of 2 1/2 smooth whorls and ½ sculptured whorl. First appear two, shortly later more spiral ribs. The abapical one, on the lowest third of the whorl, is stronger than the others and forms a weak carina. The three adapical spirals are as broad as the intercostal areas. Then axial sculpture appears: nine sinuous, strongly opisthocline ribs occur over ¼ of a whorl. At the start of the teleoconch, five new spirals appear, distributed over the whole whorl height;

Table 6. — Material studied of *Cytharella substriolata* (HARMER, 1915).

Collection	Locality	Member or Formation	Level	Collection number/Number of specimens
IRScNB	Kallo 21	Oorderen M.	*Atrina*	IST 6316
IRScNB	Antwerp 10	Luchtbal M.		IST 5016, 5017
IRScNB	Antwerp	Scaldisien		20
IRScNB	4	Oorderen M.?	1.3 m	4
IRScNB	4	Oorderen M.	1.5 m	1
IRScNB	4	Oorderen M.	2.25 m	1
IRScNB	4	Oorderen M.	2.4 m	4
IRScNB	4	Oorderen M.	3.6 m	12
IRScNB	4	Luchtbal M.	6.75 m	38
IRScNB	4	Luchtbal M.	7.5 m	5
IRScNB	5	Austruweel M.		5
IRScNB	5	Oorderen M.	8.8 m	3
IRScNB	5	Oorderen M.	9.5 m, *Atrina*	5
IRScNB	5	Luchtbal M.?	10.9-11.1 m	4
IRScNB	5	Luchtbal M.?	11.2-11.5 m	2
IRScNB	6	Oorderen M.?	9.85-10 m	1
IRScNB	6	Luchtbal M.?	7.4 m	1
IRScNB	7	Scaldisien		6
IRScNB	11	Oorderen M.	11-11.5 m	5
IRScNB	11	Oorderen M.	11.5-12 m	2
IRScNB	11	Oorderen M.	12-12.5 m	12
IRScNB	11	Oorderen M.	12.25-13 m	1
IRScNB	11	Oorderen M.	13-13.25 m *Atrina*	16
IRScNB	11	Luchtbal M.	13.25-13.5 m	24
IRScNB	11	Luchtbal M.	13.5-13.75 m	3
IRScNB	13	Scaldisien		1
IRScNB	13	Luchtbal M.		3
IRScNB	15	Luchtbal M.	7.6-8 m	54
IRScNB	15	Luchtbal M.	8.5-8.1 m	12
IRScNB	19	Merksem M.?	4 m	7
RM	Antwerp	Lillo Fm.		10
RM	2	Oorderen M.		6
RM	3	Oorderen M.		2
RM	3	Luchtbal M.		8
RM	13	Oorderen M.		6
RM	21	Oorderen M.	*A. benedeni*	7
RM	21	Oorderen M.	*Cultellus*	255
RM	21	Oorderen M.	*Atrina*	87
RM	22	Oorderen M.	*Atrina*	7
RM	23	Oorderen M.	*Atrina*	291
RM	23	Kattendijk Fm.	*Petaloconchus*	1
RM	27	Austruweel M.		2
RM	29	Lillo Fm.	dredged	3

they are broader than the intercostal areas. The protoconch axials are replaced by less sinuous, less opisthocline, heavier, more widely spaced ribs. Teleoconch comprising five to rarely seven whorls, without subsutural depression. Last whorl on average 60 % of total height. Aperture on average 47 % of shell height, elongate oval, rounded above, with narrow callus. Anal sinus medium deep and narrow. Outer apertural lip thickened when it coincides with an axial rib. A tubercle, which strongly narrows the aperture, is present on the outer lip, just below the sinus. On the last whorl, eight to (mostly) ten strong, well delimited axial ribs are present, which are narrower than the intercostal spaces. They start at the suture and are opisthocline. The axials extend nearly till the end of the siphonal canal, which bears no fasciole. Spiral sculpture can only be observed in the best pre-

Table 7. — Statistics of 30 specimens of *Cytharella substriolata* (HARMER, 1915) from Kallo, Vrasenedok, Oorderen Member, *Atrina* level.

Measurements	Minimal value	Maximal value	Mean value	Standard deviation
Number of whorls	8	10	8	0.48
Height (mm)	7.7	15.1	9.0	1.40
Diameter (mm)	2.6	5.1	3.1	0.43
Spire (mm)	2.7	5.8	3.6	0.60
Aperture (mm)	3.6	6.8	4.2	0.62

served specimens. They show 40 extremely fine spiral striae on the penultimate whorl.

DISCUSSION

The shell size of this species is very variable, as can be seen in Tab. 7. One specimen is nearly twice as high as average ones (15.1 mm, with 10 whorls). Shell shape, sculpture and protoconch of this specimen are however the same as that of average shells. SABELLI *et al.* (1992) consider *Mangelia altenai* BRAKMAN, 1938 and *Raphitoma substriolata* HARMER, 1915 as synonyms of *Mangelia costulata* (DE BLAINVILLE, 1829). This Recent species has however one or two axial ribs less than *Cytharella substriolata*. Another similar Recent species is *Cy. smithi* (FORBES, 1840), figured in GRAHAM (1988, p. 446, fig. 186), but GLIBERT (1960) mentioned differences in the protoconchs. *Cy. costata* (DONOVAN, 1803), a Pliocene to Recent species which occurs in the British Crags, has a similar protoconch and spiral sculpture as *Cy. substriolata*, but fewer and much more widely spaced axial ribs (eight), which are less opisthocline. It is clear from HARMER's (1915) figures of *Cy. substriolata* that his species is intended for specimens with much finer spiral sculpture than *Cy. costatostriata* (WOOD *in* ETHERIDGE & BELL, 1898). In Kallo, *Cy. substriolata* is very common in the Oorderen Member; one fragment was found in the *Petaloconchus* level. In other localities, the species was recorded abundantly in the Luchtbal and Oorderen Members, more rarely in the Austruweel Member, while doubtful records originate from the Merksem Member. Specimens were also collected in the United Kingdom and The Netherlands.

Cytharella vandewouweri (GLIBERT, 1960)

Pl. 1, Fig. 3

v * 1960 – *Mangelia (Cytharella) vandewouweri* n. sp. - GLIBERT, p. 14, pl. 4, fig. 9, pl. 5, fig. 2

TYPE LOCALITY AND STRATUM: Antwerp (Wilmarsdonk), Belgium; Luchtbal Member, Lillo Formation, Pliocene.

MATERIAL: (Table 8)

Table 8. — Material studied of *Cytharella vandewouweri* (GLIBERT, 1960).

Collection	Locality	Member or Formation	Level	Collection number/Number of specimens
IRScNB	Antwerp Wilmarsdonk	Luchtbal M.		Holotype IST 5079
IRScNB	Antwerp Wilmarsdonk	Luchtbal M.		Paratype IST 5080
IRScNB	Antwerp Wilmarsdonk	Luchtbal M.		IST 6298
IRScNB	Antwerp	Luchtbal M.		6
IRScNB	4	Luchtbal M.	6.75 m	2
IRScNB	6	Scaldisien	7.25 m	1
IRScNB	7	Luchtbal M.		1
IRScNB	9	Luchtbal M.		5
IRScNB	11	Luchtbal M.	13.25-13.5 m	1
IRScNB	13	Luchtbal M.		2
IRScNB	15	Luchtbal M.	7.6-8 m	3
RM	21	Oorderen M.	*Atrina*	1
RM	22	Oorderen M.	*Atrina*	1

Table 9. — Statistics of ten specimens of *Cytharella vandewouweri* (GLIBERT, 1960) from Antwerp, Luchtbal Member (two sp.), Wilmarsdonk, Luchtbal Member (four sp., including the holotype), Austruweel, Luchtbal Member (one sp.), Kallo, Oorderen Member (one sp.), Antwerp Van de Vin Dock, Luchtbal Member (one sp.).

Measurements	Minimal value	Maximal value	Mean value	Standard deviation
Number of whorls	7	9	8	0.54
Height (mm)	5.7	8.8	7.7	0.86
Diameter (mm)	2.0	2.7	2.3	0.27
Spire (mm)	2.0	3.5	2.7	0.58
Aperture (mm)	2.0	3.7	3.1	0.47

DIMENSIONS: (Table 9)
Holotype - x: 9, H: 8.3 mm, D: 2.4 mm, S: 3.3 mm, A: 3.4 mm. Figured specimen IST 6298 - x: 7, H: 6.0 mm, D: 2.0 mm, S: 2.2 mm, A: 2.8 mm.

DESCRIPTION
Small, very slender fusiform shell (diameter on average 30 % of shell height) with shallow suture and very short siphonal canal. Protoconch multispiral, 3 1/2 first whorls smooth. Then follows 1/2 whorl with reticulate sculpture. On this half whorl fine, sinuous opisthocline axial ribs appear first; they are as wide as the intercostal areas. Three spirals start slightly later. At the end of the protoconch, seven spiral ribs are present, which are slightly broader than the intercostal spaces. The axial ribs are more widely spaced than at the onset, with intercostal spaces four times as wide as the ribs. At the start of the teleoconch, the spiral ribs continue and the axials become less sinuous. Teleoconch with five whorls, which are not tumid. Subsutural depression absent. Spire on average 35 % of total height. Aperture elongate oval, on average 40 % of shell height, rounded above, with thickened outer lip when coinciding with an axial rib. Adapical part narrowed by a small tubercle just below the anal sinus. Sinus narrow and moderately deep. Axial ornament comprising eight ribs on the last whorl, which start at the suture and run opisthoclinally. They do not reach the end of the siphonal canal. A fasciole is absent. Ribs clearly delimited and about half as wide as intercostal spaces. Between and on them, a large number of extremely fine spiral striae can be observed in well preserved specimens.

DISCUSSION
Cytharella vandewouweri (GLIBERT, 1960) has a similarly fine spiral sculpture as *Cy. substriolata* (HARMER, 1915), but is more slender (diameter only 30 % of shell height) while the axials are narrower and more widely spaced. *Cy. costatostriata* (WOOD *in* ETHERIDGE & BELL, 1898) is much less slender and has more axial ribs, which lie more closely together; the number of spirals is much lower and these are broader. *Cy. vandewouweri* has been found until now exclusively in the Luchtbal Member. In Kallo, it occurs very rarely in the *Atrina* level of the Oorderen Member.

Cytharella beetsi (GLIBERT, 1960)
Pl. 1 Fig. 4

1915 – *Raphitoma megastoma* (Brugnone) - HARMER, p. 267, pl. 29, fig. 37 (non *Pleurotoma megastoma* BRUGNONE, 1862).

v. 1946 – *Mangelia (Mangelia)* cf. *megastoma* (Brugnone, 1862) - BEETS, p. 105, pl. 6, fig. 9-16 (non *Pleurotoma megastoma* BRUGNONE, 1862).

v* 1960 – *Haedropleura beetsi* n. sp. - GLIBERT, p. 12, pl. 4, fig. 11

TYPE LOCALITY AND STRATUM: Antwerp, "Nouveaux Bassins 1903", Belgium; Austruweel Member, Lillo Formation, middle Pliocene.

MATERIAL: (Table 10)

Table 10. — Material studied of *Cytharella beetsi* (GLIBERT, 1960).

Collection	Locality	Member or Formation	Level	Collection number/Number of specimens
IRScNB	Antwerp	Austruweel M.		Holotype IST 5019
IRScNB	Antwerp	Scaldisien		IST 6310
IRScNB	Antwerp	Scaldisien		8
IRScNB	Antwerp	Luchtbal M.	*P. gerardi*	1
IRScNB	8	Scaldisien		10

DIMENSIONS:
Holotype - x: 8, H: 11.2 mm, D: 4.4 mm, S: 3.3 mm, A: 5.7 mm. Figured specimen IST 6310 - x: 8, H: 10.6 mm, D: 3.8 mm, S: 3.1 mm, A: 5.4 mm.

DESCRIPTION
Small, fusiform, relatively broad shell, consisting of eight tumid, strongly broadening whorls with deep suture and medium long siphonal canal. Aperture 45 % of total shell height, spire as well as diameter 40 %. Protoconch with two whorls, sculpture never preserved. Axial teleoconch sculpture consisting of 9 to 11 nearly orthocline axial ribs, which are clearly delimited and narrower than the intercostal areas. They run from suture to suture and do not become obsolete near the aperture. On successive whorls the axials lie above each other. Spiral sculpture absent. Aperture elongate oval, with shallow anal sinus.

DISCUSSION
In Belgium this species is very rare and its distribution seems limited to the Austruweel Member. No specimen is well enough preserved to study its protoconch.

Cytharella cf. ***plicatella*** (JAN *in* BELLARDI, 1847)
Pl. 2, Fig. 5

? 1847 – *Raphitoma plicatella* Jan - BELLARDI, p. 92, pl. 4, fig. 18
? 1877 – *Raphitoma plicatella* (JAN) - BELLARDI, p. 307, pl. 3, fig. 19.
? 1910 – *Raphitoma plicatella* Jan, sp. - CERULLI-IRELLI, p. 65, pl. 6, fig. 15.
. 1915 – *Raphitoma plicatella*, Bellardi - HARMER, p. 258, pl. 30, fig. 7.
v. 1965 – *Mangelia (Mangelia) plicatella* (Jan *in* L. Bellardi, 1848) - VAN REGTEREN ALTENA *et al.*, p. 40, pl. 17, fig. 164.

TYPE LOCALITY AND STRATUM: Albenga, Italy; Piacenzian, Pliocene.

MATERIAL: (Table 11)

DIMENSIONS:
Figured specimen IST 6320 - x: 9, H: 15.3 mm, D: 4.2 mm, S: 5.4 mm, A: 7.7 mm.

DESCRIPTION
Large, fusiform, broad shell with short siphonal canal. Adapical whorls tumid, younger ones more flattened; suture shallow, subsutural depression absent. Aperture about 50 % of total height, spire slightly more than 30 %. Seven teleoconch whorls, protoconch absent in the specimens examined. Teleoconch with ten axial ribs on the last whorl; they are broad, not clearly delimited, nearly straight and opisthocline. They become obsolete near the aperture, reaching neither suture nor siphonal canal. The axial ribs are crossed by many very regular, narrow spiral ribs; these are broader than the intercostal spaces, which form very narrow incisions. The spirals consist of series of rectangles, with the largest side in the axial direction. Aperture elongate oval, rather narrow.

DISCUSSION
This species is much larger than all other Belgian Pliocene species of its genus. It is very rare in the Kattendijk Formation, where only badly preserved specimens are found. *Cytharella plicatella* (JAN *in* BELLARDI, 1847) occurs in the Italian Pliocene, in the British Pliocene and in Dutch beach material. The Dutch specimens

Table 11. — Material studied of *Cytharella* cf. *plicatella* (JAN *in* BELLARDI, 1847).

Collection	Locality	Member or Formation	Level	Collection number/Number of specimens
IRScNB	Yerseke, The Netherlands	Kattendijk Fm.?	dredged	IST 6320
IRScNB	Antwerp	Kattendijk Fm.		4
IRScNB	4	Kattendijk Fm.	8.5-9 m	1
IRScNB	18	Kattendijk Fm.		1
RM	Yerseke, The Netherlands	Kattendijk Fm.?	dredged	1
NNM	Ellewoutsdijk, The Netherlands	Pliocene	dredged	13
NNM	Zuidsloe, The Netherlands	Pliocene	on beach	12 + 1?
NNM	Ritthem, The Netherlands	Pliocene	on beach	5
NNM	De Kaloot, The Netherlands	Pliocene	on beach	10

Table 12. — Material studied of *Mangelia gracilior* (BELL, 1871).

Collection	Locality	Member or Formation	Level	Collection number/Number of specimens
IRScNB	Antwerp	Scaldisien		IST 4380
	Antwerp 2	Luchtbal M.		IST 5020, 5020 bis
IRScNB	Antwerp 9	Scaldisien	basal crag	IST 6318
IRScNB	Kallo 21	Oorderen M.	*Cultellus*	IST 6319
IRScNB	Antwerp	Scaldisien		6
IRScNB	4	Luchtbal M.	6.75 m	8
IRScNB	6	Luchtbal M.	9.75 m	1
IRScNB	7	Scaldisien		28
IRScNB	9	Scaldisien	basal crag	22
IRScNB	10	Scaldisien	basal crag	2
IRScNB	13	Scaldisien	basal crag	12
IRScNB	15	Luchtbal M.	7.6-8 m	8
IRScNB	24	Scaldisien		2
RM	13	Oorderen M.		5
RM	21	Oorderen M.	*Cultellus*	4

studied are better preserved than those of the Kattendijk Formation and they are used here in the description. Their sculpture is identical with that of the Belgian specimens.

Genus *Mangelia* RISSO, 1826
Type species *Mangelia attenuata* (MONTAGU, 1803)

Mangelia gracilior (BELL, 1871)
Pl. 2, Figs. 3-4

* 1871 – *Pleurotoma gracilior* Nob. - BELL, p. 357.
v. 1878 – *Pleurotoma subulata*, Nyst - NYST, pl. 3, fig. 16.
v. 1881 – *Pleurotoma subulata* Nob. - NYST, p. 51.
. 1915 – *Raphitoma attenuata* Montagu var. *tenuicosta* (Brugnone) - HARMER, p. 257, pl. 30, fig. 10-11 (non *Pleurotoma attenuata* var. *tenuicosta* BRUGNONE, 1862).
. 1915 – *Raphitoma attenuata* Montagu var. *gracilior* (A. Bell) - HARMER, p. 257, pl. 30, fig. 12.
v. 1946 – *Mangelia attenuata* var. *tenuicosta* (Brugnone, 1862) - BEETS, p. 107 (non *Pleurotoma attenuata* var. *tenuicosta* BRUGNONE, 1862).
v. 1958 – *Scobinella? nysti* nov. nom. - GLIBERT, p. 18.
v. 1960 – *Mangelia nysti* Glibert, sp. 1958 - GLIBERT, p. 15, pl. 4, fig. 15.
v? 1965 – *Mangelia (Bela) notata* (A. Bell, 1871) - VAN REGTEREN ALTENA *et al.*, p. 41, pl. 18, fig. 169.

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

MATERIAL: (Table 12)

DIMENSIONS: (Table 13)
Figured specimen IST 6319 - x: 9, H: 15.0 mm, D: 4.2 mm, S: 5.7 mm, A: 7.2 mm. Figured specimen IST 6318 - x: 8, H: 10.0 mm, D: 3.2 mm, S: 3.2 mm, A: 5.0 mm.

DESCRIPTION
Medium large, very slender fusiform shell (diameter on average 28 % of shell height) with shallow suture and short siphonal canal. Protoconch multispiral, consisting

Table 13. — Statistics of 25 specimens of *Mangelia gracilior* (BELL, 1871) from Austruweel, dredged (three sp.), Kallo, Verrebroekdok, Oorderen Member (two sp.), Austruweel, Scaldisien (four sp.), Antwerp, Kanaaldok, Scaldisien (nine sp.)), Antwerp Wilmarsdonk, Scaldisien (five sp.) and Antwerp, Scaldisien (two sp.).

Measurements	Minimal value	Maximal value	Mean value	Standard deviation
Number of whorls	7.5	10	9	0.62
Height (mm)	10.4	18.7	13.1	1.72
Diameter (mm)	3.1	4.8	3.7	0.44
Spire (mm)	3.4	7.2	4.6	0.78
Aperture (mm)	5.1	8.1	6.4	0.77

of 2 1/2 smooth whorls and 1/2 whorl with very fine axial ribs. Six teleoconch whorls are present, which are only very slightly tumid. Spire on average 35 % of total height. Aperture elongate oval, on average 49 % of shell height, pointed above, without thickened outer lip and without tubercle. Anal sinus shallow and broadly V-shaped. Axial sculpture consisting of 12 opisthocline ribs on the last whorl, which are not very clearly delimited, irregularly spaced and always much narrower than the intercostal spaces. They become obsolete near the suture and do not reach the end of the siphonal canal. Spiral sculpture composed of numerous extremely fine striae, which are often eroded. Many specimens have part of their colour pattern preserved, which consists of two brown spiral lines on the early whorls.

DISCUSSION

This species can be easily recognised by its relatively large size, very slender shell and characteristic faint sculpture. The lack of a varix on the outer apertural lip and the relatively weak axial ribs demonstrate that this species belongs to *Mangelia* instead of to *Cytharella*. The type species of both genera were figured by POWELL (1966, pl. 15, figs. 7 and 21). *Mangelia gracilior* (BELL, 1871) is related to the Recent type species of its genus, *Ma. attenuata* (MONTAGU, 1803), figured by GRAHAM (1988, p. 444, fig. 185) but is larger, with a much shallower suture. *Ma. tenuicosta* (BRUGNONE, 1862) is a synonym of *Ma. attenuata* (Montagu, 1803) and not a variety of *Ma. gracilior* (BELL, 1871), as supposed by HARMER (1915) and BEETS (1946). *Ma. attenuata* var. *notata* (BELL, 1871), figured in HARMER (1915, pl. 30, fig. 13) is possibly different, but the figured specimen is too badly preserved to allow an identification. The type specimen of *Ma. gracilior* as figured by HARMER, 1915 is far from perfect, but it is recognisable as identical with GLIBERT's *Ma. nysti*. WOOD's (1872, p. 4, pl. 1, fig. 5) "*Pleurotoma gracilior*" could, however, represent a different species, because of the absence of axial and spiral macrosculpture, while the aperture is lower but broader than in *Mangelia gracilior* (HARMER, 1915). *Ma. gracilior* is rare in the *Cultellus* level of the Oorderen Member; previously it was known in Belgium only from the Luchtbal Member. In England, it occurs in the Coralline as well as in the Red Crag.

Subfamilia Daphnelliinae DESHAYES, 1863
Genus *Lusitanops* NORDSIECK, 1968
Type species *Lusitanops lusitanica* (SYKES, 1906)

Lusitanops gigasei n. sp.
Pl. 2, Fig. 1

DIAGNOSIS:

Lusitanops species with multispiral protoconch, consisting of two and a quarter whorls with reticulate sculpture, with a slender teleoconch, with a subsutural depression and a very shallow anal sinus.

GENERIC ATTRIBUTION:

No genus fits the new species completely. The genus *Lusitanops* is here interpreted as in BOUCHET & WARÉN (1980), including turrid gastropods without distinct sinus, with reticulate sculpture, large last whorl and short siphonal canal. The genus comprises species with rather different protoconchs. The anal sinus is larger in *Lu. gigasei* n. sp. than in the other *Lusitanops* species. *Lu. gigasei* is included in the genus *Lusitanops* because of its general teleoconch similarity to *Lu. expansa* (SARS, 1878). Also the protoconch is much alike, but the protoconch axial ribs of *Lu. expansa* are opisthocline instead of nearly orthocline and the sculpture is less regular. Some other deep-water genera have a general shape similar to that of the new species. The species of the genus *Gymnobela* VERRILL, 1884 are shorter and broader than *Lusitanops gigasei*. Especially the species *Gymnobela lamyi* (DAUTZENBERG, 1925) is similar to the new species, but it was only tentatively assigned to the genus *Gymnobela* by BOUCHET & WARÉN (1980). All *Gymnobela* species have a reticulate protoconch sculpture, but this sculpture stands obliquely in relation to the shell axis, in contrast to the nearly orthocline axials of *Lusitanops gigasei*. *Tetha* CLARKE, 1959 and *Bathybela* KOBELT, 1905 also have a similar shell shape, but the adapical postlarval whorls always have a carina in these genera, while the shell is much larger (40 to 60 mm). The protoconchs of some species of these genera, as in the new species, often have reticulate sculpture with discontinuous axial ribs, with axials always at least partially oblique. *Oenopota* MÖRCH, 1852 has a completely different paucispiral protoconch, without sculpture or with spirals only. *Thesbia* JEFFREYS, 1867 has a paucispiral protoconch and the teleoconch spirals consist of punctuate lines. *Xanthodaphne* POWELL, 1942 could be an alternative for *Lusitanops* for accommodating the new taxon. The protoconchs in this genus have obliquely reticulate or mainly axial sculpture. *Xanthodaphne* species have a shallow anal sinus, as in the new species, but most possess a notably longer siphonal canal. *Lusitanops gigasei* consequently has a combination of *Xanthodaphne* and *Lusitanops* characters and could be an intermediate species.

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.

MATERIAL: (Table 14)

DERIVATIO NOMINIS: After Dr. P. Gigase, who collected the specimen, designed as holotype.

DIMENSIONS:

Holotype: x: 5 3/4, H: 6.1 mm, D: 1.9 mm, S: 2.1 mm, A: 3.0 mm.

Table 14. — Material studied of *Lusitanops gigasei* n. sp.

Collection	Locality	Member or Formation	Level	Collection number/Number of specimens
IRScNB	Kallo, Vrasenedok	Oorderen M.	*Atrina*	Holotype IST 6307
AR	23	Oorderen M.	*Atrina*	1
IRScNB	Antwerp	Scaldisien		Paratype

DESCRIPTION

Small, slender fusiform shell, with very short siphonal canal, tumid whorls with narrow subsutural depression and deep suture. Protoconch multispiral, consisting of 2 1/4 whorls. These are tumid, glossy and clearly separated from the teleoconch. Fine reticulate sculpture is present, with the shortest side of the rectangles in axial direction. Axial protoconch ribs discontinuous, interrupted slightly lower than halfway; nearly orthocline on the upper part of the whorls, slightly prosocline abapically. On the last protoconch whorl, 15 equally strong, spiral ribs are present. Teleoconch comprising 3 1/2 whorls. Spire 34 % of total shell height. Aperture elongate oval, 50 % of total height, rounded above and detached from the last whorl on its adapical part. Outer lip not thickened, callus absent. Very shallow anal sinus present. Teleoconch sculpture consisting of 16 clearly delimited spiral ribs on the penultimate whorl, which are as broad as the intercostal spaces. On the last whorl and the siphonal canal, 27 spirals are present; the adapical ones are broad, with a narrow central groove; the abapical ribs are narrower. Between the spirals, a large number of much finer axial ribs can be observed.

DISCUSSION

The most closely resembling species is the Recent *Lusitanops expansa* (SARS, 1878), figured by BOUCHET & WARÉN (1980, fig. 172, 184). The Pliocene species, however, is more slender, with a more pronounced subsutural depression, and especially a different protoconch (see generic attribution). All other *Lusitanops* species have a more tumid, buccinid-like shell, with a relatively larger last whorl in relation to total length and a relatively wider aperture. *Daphnella romanii* (LIBASSI, 1859) from the Italian Pliocene, figured by LIBASSI (1859, pl. 1, fig. 30), CERULLI-IRELLI (1910, pl. 36, fig. 48-49) and CIPOLLA (1914, pl. 13, fig. 20) is somewhat similar, but is larger and less slender, its aperture more rounded and pointed above. Recent *Lusitanops* species are rare and they seem to occur mostly in very deep water (1300 - 5000 m); the only species found at lesser depths is the Norwegian *Lu. expansa* (220 and 280 m for the two specimens known, see BOUCHET & WARÉN (1980, p. 83). Consequently it is surprising to discover a *Lusitanops* species in the Oorderen Member, which was deposited in shallow water. The genus was unknown previously from the Pliocene.

Genus and subgenus *Raphitoma* BELLARDI, 1847
Type species *Raphitoma (R.) hystrix* DE CRISTOFORI & JAN, 1832

Raphitoma (Raphitoma) antonjanseni n. sp.
Pl. 3, Fig. 1

. 1872 – *Pleurotoma hystrix* Jan - WOOD, p. 41, pl. 6, fig. 3 (non *Raphitoma histrix* JAN *in* BELLARDI, 1847).
v. 1878 – *Pleurotoma histrix*, Jan - NYST, pl. 3, fig. 13 (non *Raphitoma histrix* JAN *in* BELLARDI, 1847).
v. 1881 – *Pleurotoma histrix*, Jan - NYST, p. 46 (non *Raphitoma histrix* JAN *in* BELLARDI, 1847).
. 1915 – *Clathurella hystrix* (Jan) - HARMER, p. 240, pl. 28, fig. 24-25 (non *Raphitoma histrix* JAN *in* BELLARDI, 1847).
v. 1946 – *Raphitoma histrix* (Jan, 1832) - BEETS, p. 107 (non *Raphitoma histrix* JAN *in* BELLARDI, 1847).
v. 1960 – *Raphitoma histrix* Jan, sp. 1832 - GLIBERT, p. 17, pl. 4, fig. 18 (non *Raphitoma histrix* JAN *in* BELLARDI, 1847).
v. 1965 – *Raphitoma hystrix* (Cristofori & Jan, 1832) - VAN REGTEREN ALTENA *et al.*, p. 42, pl. 18, fig. 171 (non *Raphitoma histrix* JAN *in* BELLARDI, 1847).

DIAGNOSIS:

Raphitoma (R.) species with deep subsutural depression, elongate shell shape, widely spaced teleoconch sculpture and with three spirals appearing closely together at the end of the protoconch.

GENERIC ATTRIBUTION:

The species belongs clearly to *Raphitoma (R.)*, as restricted by VAN AARTSEN *et al.* (1984), because of its multispiral, keeled protoconch with reticulate sculpture.

LOCUS TYPICUS: Antwerp, Belgium, B2 Havendok.

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

DERIVATIO NOMINIS: After Mr. A. Janse, who collected the specimen designated as holotype.

MATERIAL: (Table 15)

whorls; nucleus appearing smooth, globular, oblique in relation to shell axis. After 1/2 whorl 11 spiral ribs start, which are slightly broader than the very narrow intercostal areas. Teleoconch sharply delimited by the end of the protoconch spirals and the appearance of four new spiral ribs; the adapical one lies at 1/3 of the whorl height below the suture; they are as broad as half of the intercostal area. After 1/8 whorl, the axial sculpture starts with ribs which are twice as broad as the spirals and as 1/4 of their intercostal distance. The upper spiral comes closer to the adapical suture during one revolution. The axial ribs end on the primary adapical spiral, leaving a narrow subsutural depression. Teleoconch composed of six tumid whorls, with only very narrow subsutural depression. Spire 30 % of total height, aperture 50 %. Aperture elongate oval, pointed above; outer lip thickened and with plicae on the inside in adult specimens. Anal sinus U-shaped, shallow and narrow. Axial sculpture consisting of 18 ribs, which are not clearly delimited and as wide as the intercostal spaces. They do not reach the end of the siphonal canal. There are one to five very fine spirals present in the subsutural depression. Also in the depression, conspicuous markings of old anal sinuses can be seen. On the penultimate whorl five to seven spiral ribs are present, which are alternating stronger and weaker. On the last whorl, one to five spirals in the depression and 25 to 28 alternating spirals are present.

DISCUSSION

The holotype of this species is the specimen figured by GLIBERT (1960, pl. 5, fig. 7) as *Raphitoma (Leufroyia) leufroyi* (MICHAUD, 1828). The number of complete specimens of *Philbertia pseudoleufroyi* is too low to give statistics of the shell dimensions. This species strongly resembles, in general shape and sculpture, the Recent Atlantic *R. (Leufroyia) boothii* (SMITH, 1839), as figured under the name *R. leufroyi* (MICHAUD, 1828) in GRAHAM (1988, p. 461, fig. 193). However, as remarked by VAN AARTSEN *et al.* (1984), the protoconch of the fossil species is paucispiral as in *Philbertia,* while that of the genus *Raphitoma* is multispiral and keeled. The shell ratios of *Ph. pseudoleufroyi* differ markedly from the Mediterranean *Raphitoma (L.) leufroyi* (MICHAUD, 1828), as figured by VAN AARTSEN *et al.* (1984) and NORDSIECK (1977): both the spire and the aperture of the Recent species measure somewhat less than half of the total height. *Raphitoma (L.) concinna* (SCACCHI, 1836), a Recent and Italian Pliocene species, figured by CIPOLLA (1914) and CERULLI-IRELLI (1914) has more or less the same outline as *Philbertia pseudoleufroyi* but the shell is smaller, shorter, with less tumid whorls and the protoconch is multispiral and keeled. The Recent *Philbertia* species listed by VAN AARTSEN *et al.* (1984) - *Ph. pseudohystrix* (SYKES, 1906), *Ph. pallaryi* NORDSIECK, 1977, *Ph. horrida* (MONTEROSATO, 1884), *Ph. philberti* (MICHAUD, 1829) - often have spines on the points of intersection of spiral and axial ribs. All these species have a relatively higher spire (40 to 50 % of total height) and a lower aperture than *Ph. pseudoleufroyi*, while in none of them the spirals are alternatively stronger and weaker. GLIBERT (1954, pl. 7, fig. 8) figured *Leufroyia leufroyi* f. *praecedens* (DOLLFUS & DAUTZENBERG in PEYROT, 1938) from the Touraine (France) Miocene. Well preserved specimens from Ferrière Larçon, Touraine (Pontilevien) in coll. RM have a paucispiral protoconch; so they are not related to *Raphitoma (Leufroyia) leufroyi* (MICHAUD, 1828) and their correct name is *Philbertia praecedens* (DOLLFUS & DAUTZENBERG *in* PEYROT, 1938). They differ from the new species in reaching only half of its size and in possessing slightly angular whorls, which cause the formation of a narrow subsutural depression; in the depression, very conspicuous markings of old sinuses are present. In the Touraine Miocene also occurs *Daphnella (Bellardiella) pseusohistrix* PEYROT (1938, p. 300, pl. 5, fig. 1, 8), corrected by GLIBERT (1960) to *pseudohistrix*. It belongs, as is proven by its paucispiral protoconch, to the genus *Philbertia*. Its correct name should be *Ph. pseudohystrix* (PEYROT, 1938). GLIBERT figured a broader specimen, with more tumid whorls than that of PEYROT; GLIBERT's specimen is however more adult, with a thickened outer apertural lip. The species differs from the Recent *Ph. pseudohystrix* (SYKES, 1906) in possessing no spines and in having a much finer reticulate teleoconch sculpture. Because the name *Ph. pseudohystrix* (PEYROT, 1939) is a junior secondary homonym of *Ph. pseudohystrix* (SYKES, 1906), while " *pseudohistrix*" or " *pseusohistrix*" are incorrect spellings, the Touraine species is renamed here *Ph. ferrierensis* nov. nom., after its type locality. *Ph. pseudoleufroyi* is much larger, the last whorl is relatively higher and the number of spiral, as well as axial ribs, is much lower.

Ph. pseudoleufroyi n. sp. is very rare in the Oorderen Member of Kallo. It also occurs in Belgium in the Luchtbal Member and in Dutch Pliocene deposits. The nature of the British Pliocene material needs to be confirmed.

Stratigraphic and geographic distribution of the Pliocene turrid gastropods of Belgium

As reviewed in this paper and in MARQUET (1997), 28 taxa of turrid gastropods were present in the Pliocene of Belgium; they are listed in Table 20. The number of species of the different turrid families and subfamilies in each of the Belgian Pliocene Formations and Members is given in Table 21. Two among the 16 Kattendijk species were already present during the Miocene: *Gemmula stoffelsi* (NYST, 1843) and "*Asthenotoma*" *ornata* (DEFRANCE, 1826) = "*Asthenotoma*" *bipunctula* (WOOD, 1872) according to GATTO (1997). *Acamptogenotia intorta nysti* GLIBERT, 1945, *Fusiturris porrecta* (WOOD, 1848), *Spirotropis confusa confusa* (SEGUENZA, 1880) and *Raphitoma antonjanseni* n. sp. could respectively have been related to the following North Sea basin Miocene species: *Acamptogenotia escheri* (MAYER, 1861), *Fusiturris aquensis* (GRATELOUP, 1832), *Spirotropis gramensis* R. JANSSEN, 1993 and *Raphitoma praehispida* (BOETTGER, 1906). Species of the genus *Bela* lacked in

Table 20. — Stratigraphic distribution of the Pliocene Drilliidae, Turridae and Conidae in Belgium. K.F. = Kattendijk Formation, L.M. = Luchtbal Member, O.M. = Oorderen Member, A.M. = Austruweel Member, K.M. = Kruisschans Member, M.M. = Merksem Member. VR = very rare, less than 10 specimens; R = rare, 10 to 100 specimens; C = common, more than 100 specimens; ? = presence doubtful.

Species	K.F.	L.M.	O.M.	A.M.	K.M.	M.M.
Cerodrillia nysti (HARMER, 1915)	R	R	C	R		
Spirotropis confusa confusa (SEGUENZA, 1880)	R			?		
Gemmula stoffelsi (NYST, 1843)	VR					
Gemmula antwerpiensis (VINCENT, 1890)	R	R	C	R	VR	
Fusiturris porrecta (WOOD, 1848)	R					
Acamptogenotia intorta nysti GLIBERT, 1954	R	C		?		
"Asthenotoma" ornata (DEFRANCE, 1826)	R	R	C	R	VR	
"Asthenotoma" icenorum (WOOD, 1872)	VR					
"Asthenotoma" ratinckxi MARQUET, 1997			VR			
"Asthenotoma" pliocenica (VAN DER BURG, 1987)	VR					
Comarmondia gracilis (MONTAGU, 1803)	R	R	R			
Bela gliberti MARQUET, 1997		VR	VR	VR		
Bela neerlandica (BEETS, 1946)				VR		
Bela antwerpiensis MARQUET, 1997	VR	R	C	R		
Bela consimilis (HARMER, 1915)		R				
Bela keepingi (ETHERIDGE & BELL, 1898)				R	C	R
Bela belgica (VAN REGTEREN ALTENA, 1959)		C	VR			
Bela tenuistriata (BELL, 1871)	VR	R	R	R	R	R
Cytharella substriolata (HARMER, 1915)	VR	C	C	R		
Cytharella costatostriata (WOOD *in* ETHERIDGE & BELL, 1898)				?	C	
Cytharella vandewouweri (GLIBERT, 1960)		R	R			
Cytharella beetsi (GLIBERT, 1960)		R		R		
Cytharella plicatella (JAN *in* BELLARDI, 1847)	VR					
Mangelia gracilior (BELL, 1871)		R	R			
Lusitanops gigasei n. sp.			VR			
Raphitoma antonjanseni n. sp.	VR	R	R		VR	
Raphitoma perpulchra (WOOD, 1848)	VR	C	C	R		
Philbertia pseudoleufroyi n. sp.		R	R			

Table 21. — Number of species of Drilliidae, Turridae and Conidae in the Formations and Members of the Pliocene of Belgium. K.F. = Kattendijk Formation, L.M. = Luchtbal Member, O.M. = Oorderen Member, A.M. = Austruweel Member, K.M. = Kruisschans Member, M.M. = Merksem Member.

Families and subfamilies	K.F.	L.M.	O.M.	A.M.	K.M.	M.M.
Drilliidae	2	1	1	1-2?	–	–
Turridae	3	1	1	1	1	–
Conidae: Clathurellinae	5	3	3	1-2?	1	–
Mangeliinae	4	9	7	7-8?	3	2
Daphnellinae	2	3	4	1	1	–
Total number of species	16	17	16	11-14	6	2

the North Sea basin Miocene, they were rare in the Atlantic Miocene (two species in the Aquitaine), while several species were present in the Paratethys. This genus spread in the Atlantic Upper Miocene of France (Redonian) and arrived during the Lower Pliocene in the North Sea basin. During the deposition of the Luchtbal Member the turrids reached a high diversity, with 17 species. An important turnover occurred among the turrid gastropods of the North Sea basin. The number of species belonging to Drilliidae, Turridae and Clathurellinae diminished. They were replaced mostly by Mangeliinae. Most turrid species remained rare, with only *Bela belgica* (VAN REGTEREN ALTENA, 1959) and *Cytharella substriolata* (HARMER, 1915) as exceptions. The Oorderen Member deposits were characterised by 16 turrid species. Mangeliinae represented the predominant element among the turrids,

Table 22. — Number of species of Pliocene Drilliidae, Turridae and Conidae from Belgium with the same stratigraphic and geographic range.

Stratigraphic range	Number and name of species
Miocene and Pliocene	2: *G. stoffelsi, A. ornata*
Pliocene and Recent	2: *S. confusa confusa, C. gracilis*
Pliocene only	24: all other species
Geographic range	**Number and name of species**
North Sea basin and eastern Atlantic	3: *B. consimilis, B. keepingi, C. costatostriata*
North Sea basin, eastern Atlantic and Mediterranean	3: *C. plicatella, C. gracilis, S. confusa confusa*
North sea basin only	22: all other species

with seven species. During this period, turrids belonged to the most common elements of the molluscan fauna, especially *Gemmula antwerpiensis* (VINCENT, 1890), *"Asthenotoma" ornata* (DEFRANCE, 1826), *Bela antwerpiensis* MARQUET, 1997 and *Cytharella substriolata* (HARMER, 1915), while *C. nysti* and *Raphitoma perpulchra* (WOOD, 1848) were relatively less common. During the deposition of the Austruweel Member, turrids began to decline: 11 species were certainly present. The occurrence of three further species is doubtful. This decline might be explained by the fact that the Austruweel Member was deposited in less holomarine conditions than the previous Members, as shown by the occurrence of *Potamides, Ellobium* and the land snail *Cepaea*. During the deposition of the Kruisschans Member, the turrid fauna showed a major decline: only five species were present. While the diversity of the turrid gastropods was low, the number of specimens was however at its peak. *Bela keepingi* (ETHERIDGE & BELL, 1898) was probably the most common gastropod species present. The impoverishment involved not only turrid gastropods, but the complete molluscan fauna. It could have been correlated with a cooling of the climate: cold water species began to occur (see MARQUET, 1993). A decline in species diversity at the end of the middle Pliocene occurred also in the Mediterranean, according to RAFFI & MARASTI (1982). In the Merksem Member only 2 turrid species were found which became extinct at the end of the deposition of this Member.

The Mangeliinae species formed very characteristic associations, which had a short stratigraphic range. They could be used as stratigraphic marker species for the North Sea basin: *Bela antwerpiensis* Marquet, 1997 - *Bela consimilis* (HARMER, 1915) - *Cytharella substriolata* (HARMER, 1915) in the Luchtbal Member, *Bela antwerpiensis* - *Cytharella substriolata* in the Oorderen Member, *Bela keepingi* (ETHERIDGE & BELL, 1898) - *Cytharella costatostriata* (WOOD *in* ETHERIDGE & BELL, 1898) in the Kruisschans Member.

Table 22 summarises the stratigraphic and geographic distribution of the Pliocene turrid species of Belgium. Twenty-two taxa occurred exclusively in the North Sea basin. The North Sea basin Pliocene turrid gastropods were consequently for a large part endemic. The present day North Sea basin and Channel have all 22 species of turrid gastropods in common with the Atlantic, Arctic and Mediterranean, while none is endemic. The endemic Pliocene species represented in most cases the end point of their evolutionary lineage. During the cold stages of the Pleistocene this fauna became extinct and the North Sea basin was later repopulated by northern as well as southern species with an extensive geographical range. Similar results were obtained by MARQUET (1996) for the family Triphoridae: a large number of endemic species now extinct was present in the North Sea basin Pliocene.

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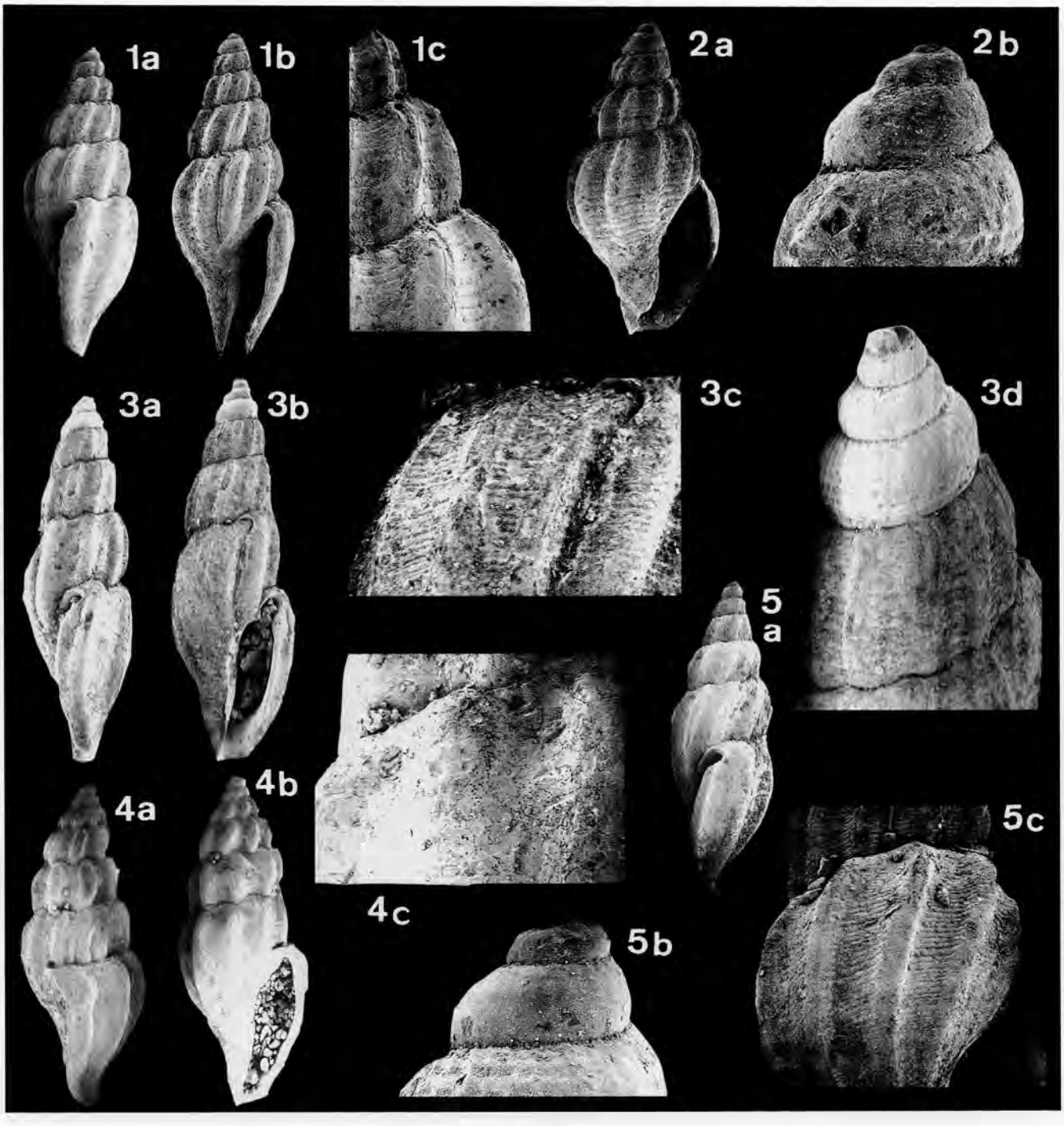

PLATE 1

Fig. 1 – *Cytharella costatostriata* (WOOD *in* ETHERIDGE & BELL, 1898). Amerikadok, Antwerp, Kruisschans Member, Lillo Formation, upper Pliocene; Coll. IRScNB IST 6296. a X 7.8, b X 8, c teleoconch microsculpture X 25; all SEM photographs.

Fig. 2 – *Cytharella costatostriata* (WOOD *in* ETHERIDGE & BELL, 1898). Amerikadok, Antwerp, Kruisschans Member, Lillo Formation, upper Pliocene; Coll. IRScNB IST 6297. a X 14, b protoconch X 56; all SEM photographs.

Fig. 3 – *Cytharella vandewouweri* (GLIBERT, 1960). Wilmarsdonk, Antwerp, Luchtbal Member, Lillo Formation, middle Pliocene; Coll. IRScNB IST 6298. a X 10, b X 11, c teleoconch microsculpture X 30; d protoconch X 33; all SEM photographs.

Fig. 4 – *Cytharella beetsi* (GLIBERT, 1960). New docks 1904, Antwerp, Scaldisien, Pliocene; Coll. IRScNB IST 6310. a, b X 6, c teleoconch microsculpture X 27; all SEM photographs.

Fig. 5 – *Cytharella substriolata* (HARMER, 1915). Vrasenedok, Kallo, prov. Oost-Vlaanderen, *Atrina* level, Oorderen Member, Lillo Formation, middle Pliocene; Coll. IRScNB IST 6316. a X 6, b protoconch X 16, c teleoconch microsculpture X 54; all SEM photographs.

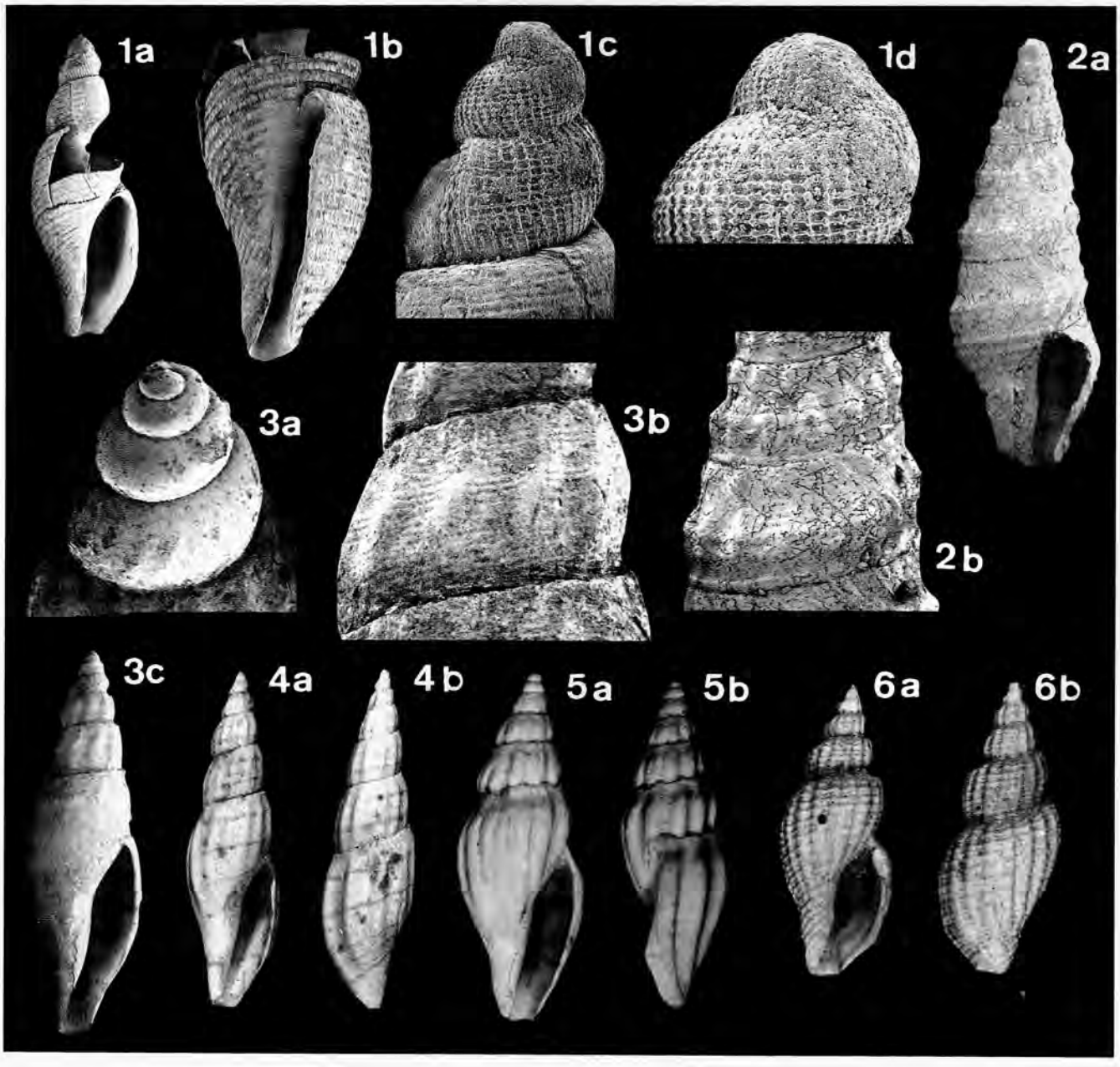

PLATE 2

Fig. 1 – *Lusitanops gigasei* n. sp. Holotype IRScNB IST 6307, Vrasenedok, Kallo, province Oost-Vlaanderen, *Atrina* level, Oorderen Member, Lillo Formation, middle Pliocene. a X 9, b aperture X 14, c protoconch X 14, d protoconch microsculpture X 33; all SEM photographs.

Fig. 2 – *''Asthenotoma'' pliocenica* (VAN DER BURG, 1987). Kaai 271, Antwerp Harbour, Kattendijk Formation, lower Pliocene; Coll. RGM 396.396. a X 5.3, b teleoconch sculpture X 11; all SEM photographs.

Fig. 3 – *Mangelia gracilior* (BELL, 1871). Wilmarsdonk, Antwerp, ''Scaldisien base'' (= Luchtbal Member), Lillo Formation, middle Pliocene; Coll. IRScNB IST 6318. a protoconch X 27, b teleoconch sculpture X 26, c juvenile specimen X 6; all SEM photographs.

Fig. 4 – *Mangelia gracilior* (BELL, 1871). Verrebroekdok, Kallo, province Oost-Vlaanderen, *Cultellus* level, Oorderen Member, Lillo Formation, middle Pliocene; Coll. IRScNB IST 6319. a, b X 3.3.

Fig. 5 – *Cytharella* cfr. *plicatella* (JAN *in* BELLARDI, 1847). Dredged from Westerschelde, put ashore at Yerseke, Zeeland, The Netherlands, Pliocene (Kattendijk Formation?); Coll. IRScNB IST 6320. a X 3.5, b X 3.4.

Fig. 6 – *Philbertia pseudoleufroyi* n. sp. Vrasenedok, Kallo, province Oost-Vlaanderen, *Atrina* level, Oorderen Member, Lillo Formation, middle Pliocene; Coll. IRScNB IST 6321. a, b x 3.5.

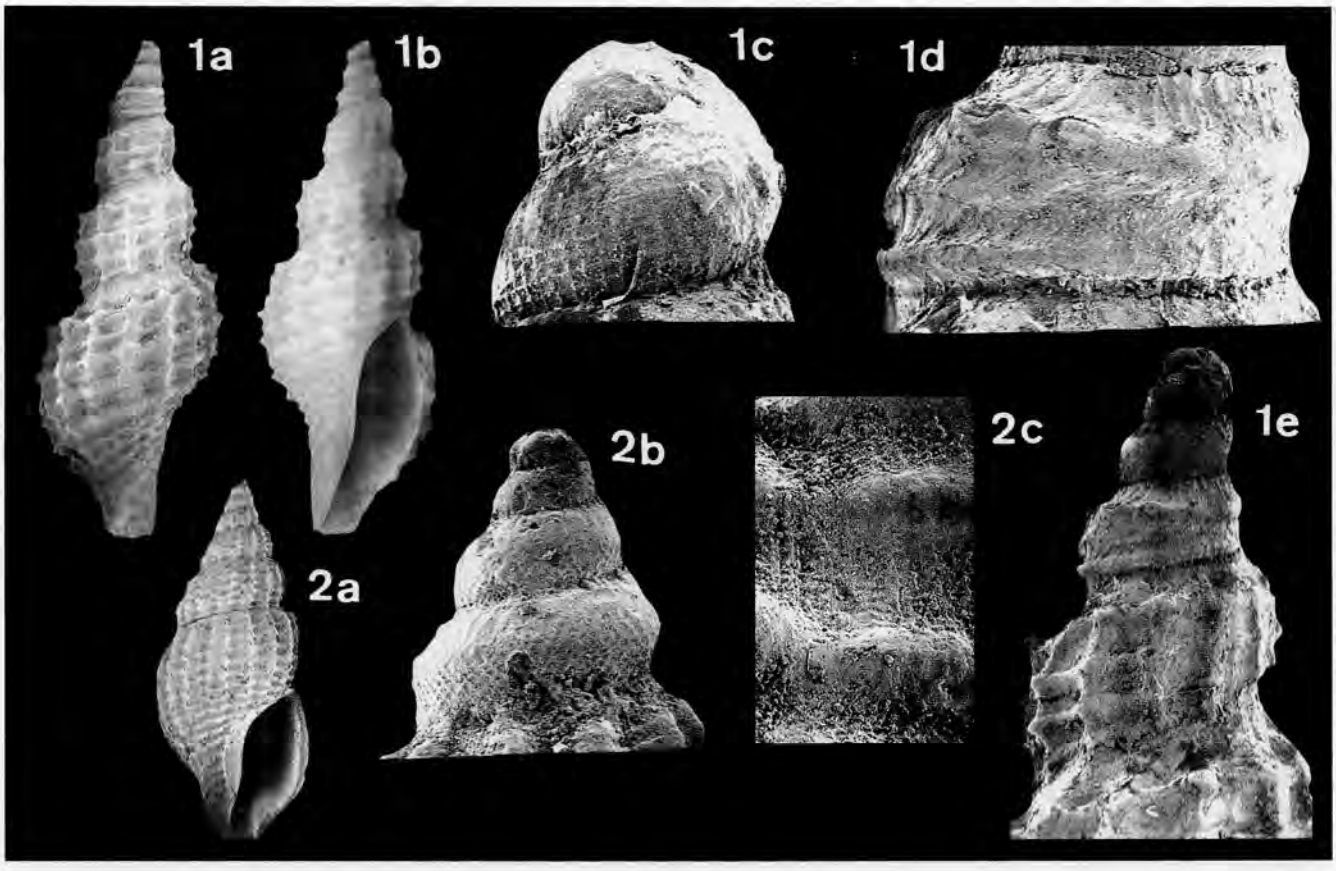

PLATE 3

Fig. 1 – *Raphitoma (R.) antonjanseni* n. sp. Holotype IRScNB IST 6313. Havendok B2, Antwerp, Luchtbal Member, Lillo Formation, middle Pliocene. a, b X 13, c protoconch top X 130, d protoconch-teleoconch transition X 110, e end of protoconch and early teleoconch whorls X 40; all SEM photographs.

Fig. 2 – *Raphitoma (R.) perpulchra* (WOOD, 1848). Vrasenedok, Kallo, province Oost-Vlaanderen, *Atrina* level, Oorderen Member, Lillo Formation, middle Pliocene; a Coll. IRScNB IST 6308, b, c Coll. IRScNB IST 6309. a X 6, b protoconch X 53, c teleoconch microsculpture x 100; all SEM photographs.