

PLIOCENE GASTROPOD FAUNAS FROM KALLO (OOST-VLAANDEREN, BELGIUM) — PART 2. CAENOGASTROPODA: POTAMIDIDAE TO TORNIDAE

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Elements of the caenogastropod fauna from Pliocene strata exposed at Kallo, province of Oost-Vlaanderen (Belgium), are described and illustrated, and their stratigraphical and geographical occurrence discussed. Ten species not recorded previously from the Pliocene of Belgium are described, viz. *Tenagodus obtusus* (Schumacher, 1817) s. lat., *Turritella (Haustator) vanderfeeni* Brakman, 1937, *Littorina (Melaraphe) gibbosa* Etheridge & Bell, 1893, *Onoba* aff. *milleti* (Etheridge & Bell, 1893), *Onoba semicostata* (Montagu, 1803), *Rissoa (Turboella) curticosata* Wood, 1848, *Obtusella intersecta* (Wood, 1856), *Skeneopsis planorbis* (Fabricius, 1780), *Caecum glabrum* (Montagu, 1803) and *Ceratia proxima* (Forbes & Hanley, 1850). *Alvania* (A.) *simonsi* and *Peringiella crassilabris* are described as new. Another species previously unknown from the Belgian Pliocene, *Alvania* (A.) *whitleyi* (Bell, 1898), is recorded from Antwerp-Oorderen.

Key words — Gastropoda, Caenogastropoda, Pliocene, North Sea Basin, taxonomy, stratigraphy, new species.

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SYSTEMATIC DESCRIPTIONS

Superorder	Caenogastropoda Cox, 1960
Order	Neotaenioglossa Haller, 1882
Suborder	Discopoda Fischer, 1886
Superfamily	Cerithioidea de Férussac, 1819
Family	Potamididae H. & A. Adams, 1854
Subfamily	Potamidinae H. & A. Adams, 1854
Genus	<i>Potamides</i> Brongniart, 1810
Subgenus	<i>Ptychopotamides</i> Sacco, 1895

INTRODUCTION

The harbour construction works at Kallo, and the stratigraphy of the Pliocene deposits exposed, have recently been described in detail by Marquet (1995). The present paper is part two of a series of papers devoted to a systematic revision of the Pliocene gastropod faunas from Kallo. Especially amongst the Rissoidae, a species-rich family, many taxa are here recorded for the first time from the Belgian Pliocene. These were mostly collected from the sediment infill of larger gastropods.

Potamides (Ptychopotamides) tricinctus (Brocchi, 1814) Pl. 1, Fig. 2

- 1814 *Murex tricinctus* Brocchi, p. 446, pl. 9, fig. 23.
- 1835 *Cerithium tricinctum* Br. — Nyst, p. 27.
- 1843 *Cerithium funiculatum* Sow. — Nyst, p. 539, pl. 42, fig. 8.
- 1848 *Cerithium tricinctum* ? Brocc. — Wood, p. 69, pl. 8, figs 1, 2.

- 1878 *Cerithium tricinctum*, Brocchi — Nyst, pl. 6, fig. 10.
 1881 *Cerithium tricinctum*, Brocchi — Nyst, p. 79.
 1918 *Potamides (Ptychopotamides) tricinctus* (Brocchi) — Harmer, p. 411, pl. 40, figs 22-25.
 1946 *Potamides (Ptychopotamides) tricinctus* (Brocchi, 1814) — Beets, p. 43.
 1958 *Potamides (Ptychopotamides) tricinctus* Brocchi, sp. 1814 — Glibert, p. 6.
 1965 *Potamides tricinctus* (Brocchi, 1814) — van Regteren Altena *et al.*, p. 17, pl. 6, fig. 59.
 1992 *Potamides (Ptychopotamides) tricinctus* (Brocchi, 1814) — Cavallo & Repetto, p. 48, fig. 60.
 1993 *Potamides tricinctus* (Brocchi, 1814) — Marquet, p. 90.

Dimensions — Height 16 mm, width 6 mm.

Description — Medium large, turreted shell lacking umbilicus, comprising ten recticonical whorls with shallow suture. The aperture lacks a siphonal canal, but is rarely preserved intact. Ornament consists of three spirals on the last whorl, crossed by radial ribs, giving rise to tubercles on the points of intersection of spirals and ribs.

Discussion — At Kallo, this species is rare in the Merksem Member, being found more commonly in the Austruweel Member near Antwerp, which probably corresponds with the *Angulus benedeni* level at Kallo. It does not occur at this level of the Oorderen Member at Kallo, representing deeper water deposition, nor is it known from the Kruisschans Member. Presumably, *P. tricinctus* was restricted to estuarine conditions, which explains its occurrence in the Austruweel Member. This nearshore deposit also yields many Ellobiidae and land snails. The species has also been recorded from the middle and late Pliocene of Italy and the North Sea Basin.

Family Siliquariidae Anton, 1838
 Genus *Tenagodus* Guettard, 1770

***Tenagodus obtusus* (Schumacher, 1817) s. lat.**
 Pl. 3, Fig. 4

- 1817 *Anguinaria obtusa* Schumacher, p. 262.
 1896 *Tenagodus anguineus* (Schumacher, 1817) — Sacco, p. 17, pl. 2, figs 14-18.
 1966 *Tenagodus* spec. cf. *terebellus* (Lamarck, 1818) — van Regteren Altena, p. 62, fig. 2.
 1992 *Tenagodus obtusus* (Schumacher, 1817) — Cavallo & Repetto, p. 48, fig. 063

Dimensions — Height 7 mm, width 5 mm.

Description — Medium-sized vermiform shell, with tubes in part loosely coiled and in part straight, not forming colonies. Aperture is rounded. A faint keel occurs on the upper part of the whorls. Next to this keel, closest to the suture, perforations occur. Ornament consists of very irregular radial ribs.

Discussion — This species is extremely rare in the *Petalococonchus* bed (Kattendijk Formation), the first specimen having been collected by Mr F. van Nieulande. In beach and dredged material from the Netherlands, the species had been recognised earlier (van Regteren Altena, 1966; Marquet and Keukelaar Collections). Pliocene specimens from Italy were illustrated by Cavallo & Repetto (1992), while material of Miocene age from the Loire Basin (France) was described as *Tenagodus terebellus* (Lamarck, 1818) and figured by Glibert (1949). Dutch material was assigned with a query to the latter species by van Regteren Altena (1966), the difference between the two taxa being mainly one of dimensions. The Miocene species is smaller than its Pliocene congener. This, however, is considered to be insufficient for separation at the specific level; a distinction at the subspecific level might be more appropriate. The Kallo specimen illustrated here is of the same size as shells from Touraine (France), but a fragment from Kallo and a complete specimen from dredged material dumped at Yerseke (The Netherlands) (Keukelaar Collection) are much larger. Not until more material is found, is a subspecific assignment of the North Sea Basin shells possible.

Family Turritellidae Lovén, 1847
 Subfamily Turritellinae Lovén, 1847
 Genus and subgenus *Turritella* Lamarck, 1799

Turritella (Turritella) tricarinata tricarinata
 (Brocchi, 1814)
 Pl. 1, Fig. 5

- 1814 *Turbo tricarinata* Brocchi, p. 374, pl. 6, fig. 21.
 1878 *Turritella incrassata* var. *triplicata* J. Sow. — Nyst, pl. 6, fig. 12.
 1912 *Turritella tricarinata* Br. sp. — Cerulli-Irelli, p. 158, pl. 26, figs 20-25.
 1912 *Turritella tricarinata* Br. sp. anom. *bicingulata* Cerulli-Irelli, p. 159, pl. 26, figs 26, 27.
 1912 *Turritella tricarinata* Br. sp. anom. *pluricingulata* Cerulli-Irelli, p. 159, pl. 26, figs 28, 29.
 1918 *Turritella tricarinata* (Brocchi) — Harmer, p. 438, pl. 44, figs 7-9.
 1958 *Turritella (Haustator) tricarinata* Brocchi, sp.

- 1814 — Glibert, p. 4, pl. 2, fig. 1.
 1965 *Turritella (Turritella) tricarinata* Brocchi, 1814 — van Regteren Altena *et al.*, p. 16, pl. 5, fig. 52a.
 1990 *Turritella tricarinata* (Brocchi) — Bernasconi, p. 32, pl. 1, figs 1-2.
 1992 *Turritella (Turritella) tricarinata* Brocchi, 1814 — Cavallo & Repetto, p. 50, fig. 64.

Dimensions — Height 30 mm, width 9 mm.

Description — Medium large, turreted shell lacking umbilicus, comprising about 13 whorls. Protoconch consists of two and a half tumid, smooth and glossy whorls, the boundary with the teleoconch being clearly delimited. The aperture is rounded quadrangular. The whorls are rather tumid and the suture deep. On each whorl two or three spirals occur, exceptionally with a secondary rib in between. The central spiral is usually developed best, but the relative strength of the spirals varies to some degree.

Discussion — This species ranges from the Kattendijk Formation to the Kruisschans Member, but is never common. In the former unit it occurs about 0,5 m above the *Petalococonchus* bed, where it replaces *T. vanderfeeni* (see below). It differs from its Kallo congeners in having a deep suture, tumid whorls and in lacking secondary ornament. The species is known from the Pliocene of the North Sea Basin and the Mediterranean area.

Subgenus *Haustator* de Montfort, 1810

***Turritella (Haustator) vanderfeeni* Brakman, 1937**
 Pl. 1, Fig. 1

- 1937 *Turritella (Haustator) vanderfeeni* Brakman, p. 62, pl. 3.
 1946 *Turritella incrassata* Sowerby, 1814 cum var. *triplicata* (Brocchi, 1814) — Beets, pp. 38, 39 (*partim*).
 1965 *Turritella (Haustator) triplicata* var. *vanderfeeni* Brakman, 1937 — van Regteren Altena *et al.*, p. 16, pl. 5, fig. 51e.
 1984 *Haustator incrassata* (Sowerby, 1814) — Marquet, p. 340.

Dimensions — Height 28 mm, width 10 mm; height 23 mm, width 8 mm.

Description — Rather large, turreted shell lacking umbilicus, comprising about 12 whorls. Shell shape is very regularly conical, the whorls are not tumid and the suture is very shallow. Ornament consists of a large

number of very fine spirals. Some specimens have a faint keel at whorl mid-height.

Discussion — At Kallo, this species is confined to the *Petalococonchus* bed of the Kattendijk Formation, this being the first record from Belgium. Most of the specimens known so far were collected from Dutch beach material (province of Zeeland). Most authors consider the present taxon to be but a variety of *T. incrassata*. However, the specific features displayed by *T. vanderfeeni* remain constant, and intermediates with *T. incrassata* are not found: it differs from the latter in having a relatively wider shell, an extremely shallow suture and in lacking stronger primary ribs. At Antwerp-Noordkasteel, typical *T. incrassata* is known from the *Ditrupea* bed of the Kattendijk Formation. It thus appears that these species possibly co-occurred, but final proof is still outstanding. The species is restricted to the early Pliocene of the North Sea Basin.

Turritella (Haustator) incrassata incrassata
 J. Sowerby, 1814
 Pl. 1, Fig. 3

- 1814 *Turritella incrassata* Sowerby, p. 111, pl. 51, fig. 4.
 1843 *Turritella triplicata* Br. — Nyst, p. 400, pl. 37, figs 7, 8.
 1848 *Turritella incrassata* J. Sow. — Wood, p. 75, pl. 9, fig. 7.
 1878 *Turritella incrassata*, J. Sow. — Nyst, pl. 6, fig. 12a, b.
 1878 *Turritella incrassata*, J. Sow. var. *planispira* Nyst, pl. 6, fig. 12c.
 1878 *Turritella incrassata*, J. Sow. var. *imbricataria* Nyst, pl. 6, fig. 12f.
 1878 *Turritella incrassata*, J. Sow. var. *bicatenata* Nyst, pl. 6, fig. 12g.
 1918 *Turritella (Haustator) incrassata* J. Sowerby — Harmer, p. 446, pl. 42, figs 1-3, 5-7; pl. 43, fig. 16.
 1918 *Turritella (Haustator) triplicata* (Brocchi) — Harmer, p. 448, pl. 42, figs 11, 13, 14.
 1918 *Turritella (Haustator) erthensis* Harmer, p. 451, pl. 42, fig. 4.
 1918 *Turritella (Haustator) biplicata* (Bronn) — Harmer, p. 455, pl. 43, figs 17, 18.
 1918 *Turritella (Zaria) subangulata* (Brocchi) — Harmer, p. 443, pl. 42, figs 15, 16.
 1918 *Turritella (Haustator) vermicularis* (Brocchi) — Harmer, p. 449, pl. 43, figs 2, 3, 5, 6.
 1918 *Turritella (Haustator) tornata* (Brocchi) — Harmer, p. 455, pl. 43, fig. 8.
 1946 *Turritella incrassata* Sowerby, 1814 cum var. *triplicata* (Brocchi, 1814) — Beets, p. 38 (*partim*).
 1946 *Turritella erthensis* Harmer, 1918 — Beets, p. 38,

- pl. 2, figs 23-29.
- 1946 *Turritella suttonensis* Beets, p. 40, pl. 2, figs 30-35.
- 1958 *Turritella (Haustator) incrassata* Sowerby, sp. 1814 — Glibert, pp. 2-4.
- 1965 *Turritella (Haustator) triplicata* (Brocchi, 1814) (+ var.) — van Regteren Altena *et al.*, p. 15, pl. 5, fig. 51a-d (non e).
- 1979 *Turritella incrassata* Sowerby, 1814 — Geys & Marquet, p. 68, pl. 27, fig. 4.

Dimensions — Height 53 mm, width 15 mm; height 51 mm, width 15 mm; height 54 mm, width 15 mm.

Description — Large, turreted shell, lacking umbilicus, comprising about 13 slightly tumid whorls, with distinct, but fairly shallow suture. Ornament consists of three to four strong primary spirals on each whorl in typical specimens, with about five weak, intercalated secondary ribs. Rib development varies, in rare extreme cases but a single primary rib remains.

Discussion — The ornament of this species varies to a large extent, which explains the plethora of specific and variety names introduced in the literature. The shape of the whorls as well as the presence of primary and secondary ornament is considered typical of the species, which is fairly common in the Oorderen Member, but less so in the Kruisschans Member. It is a North Sea Basin Pliocene species, also known from the 'Redonien' in France.

- Superfamily Littorinoidea Gray, 1847
 Family Littorinidae Gray, 1847
 Subfamily Littorininae Gray, 1847
 Genus *Littorina* Férussac, 1822
 Subgenus *Melaraphe* Mühlfeld in Menke, 1828

Littorina (Melaraphe) gibbosa

Etheridge & Bell, 1893

Pl. 1, Fig. 4

- 1923 *Littorina gibbosa* Etheridge & Bell — Harmer, p. 664, pl. 53, fig. 24.

Dimensions — Height 2,5 mm, width 2 mm.

Description — Small, solid, rather low-spined turbiniform shell lacking umbilicus, with deep suture. A small callus occurs on the columellar side of the aperture. With the exception of growth lines, ornament is absent. The shell periphery is faintly keeled below the upper margin of the aperture.

Discussion — This species, recorded previously from the St Erth Beds and the Red Crag (Great Britain),

differs from *L. (M.) suboperta* (J. Sowerby, 1814) in being smaller, in having a lower spire, sharper keel and deeper suture. It is here recorded from the Pliocene of Belgium for the first time, being extremely rare in the *Petalococonchus* bed (Kattendijk Formation). The species closely resembles *L. (M.) ariesiensis* (Fontannes, 1880) from the Italian and French Pliocene, which, however, appears to have faint spiral ribs (Sacco, 1895; Cavallo & Repello, 1992). *Littorina (M.) gibbosa* may be an Atlantic and North Sea Basin subspecies of the Mediterranean *L. (M.) ariesiensis*.

Littorina (Melaraphe) suboperta

(J. Sowerby, 1814)

Pl. 1, Fig. 7

- 1814 *Vivipara suboperta* Sowerby, p. 80, pl. 31, fig. 6.
 1843 *Littorina suboperta* Sow. — Nyst, p. 388, pl. 37, fig. 1.
 1848 *Littorina (?) suboperta* J. Sow. — Wood, p. 120, pl. 10, fig. 13.
 1872 *Lacuna suboperta* J. Sow. — Wood, p. 80.
 1878 *Littorina suboperta*, J. Sow. — Nyst, pl. 6, fig. 21.
 1881 *Littorina suboperta*, J. Sow. — Nyst, p. 93.
 1921 *Lacuna suboperta* (J. Sowerby) — Harmer, p. 669, pl. 53, figs 31, 32.
 1946 *Lacuna (Temanella) suboperta* (Sowerby, 1813) — Beets, p. 31, pl. 2, figs 1-6.
 1957 *Littorina (Melaraphe) suboperta* Sowerby, sp. 1813 — Glibert, p. 22, pl. 1, fig. 20.
 1965 *Lacuna suboperta* (J. Sowerby, 1813) — van Regteren Altena *et al.*, p. 11, pl. 3, fig. 27.

Dimensions — Height 12 mm, width 9 mm.

Description — Medium large, rather high-spined, near-rectilinear shell, with shallow suture. A large callus nearly covers the tiny umbilicus. An inconspicuous keel may be present on the periphery, near the upper end of the aperture. Most specimens preserve the colour pattern: white on the upper half of the whorls, red below. Ornament consists of growth lines only.

Discussion — In the Kruisschans and Merksem members this species is rare; it differs from the following species (see below) in having a wider shell and relatively higher ultimate whorl. It has so far been recorded from the North Sea Basin Pliocene and the St Erth Beds in Great Britain.

Genus *Eula* Kadolsky, 1973

***Eula terebellata* (Nyst, 1835)**

Pl. 1, Fig. 6

- 1835 *Melania terebellata* Nyst, p. 24, pl. 4, fig. 9.
 1843 *Melania terebellata* Nyst — Nyst, p. 38, fig. 12.
 1848 *Paludestrina (?) terebellata* Nyst — Wood, p. 109, pl. 12, fig. 7.
 1872 *Eulimene terebellata* Nyst — Wood, p. 65.
 1878 *Littorina terebellata*, Nyst — Nyst, pl. 6, fig. 22.
 1881 *Littorina terebellata*, Nyst — Nyst, p. 95.
 1921 *Eulimene terebellata* (Nyst) — Harmer, p. 594, pl. 50, fig. 23.
 1946 *Eulimene terebellata* (Nyst, 1835) — Beets, p. 33.
 1957 *Littorinopsis (Eulimene) terebellata* Nyst, sp. 1835 — Glibert, p. 22, pl. 1, fig. 21.
 1965 *Eulimene terebellata* (Nyst, 1835) — van Regteren Altena *et al.*, p. 12, pl. 3, fig. 31.

Dimensions — Height 12,5 mm, width 6,5 mm.

Description — Medium large, high-spined, rather narrow, near-rectilinear shell, with very shallow suture. A small callus is present, the umbilicus is closed. The periphery is slightly angular above the aperture, but not keeled. A colour pattern does never occur. Ornament consists of growth lines only.

Discussion — In the Kruisschans Member this species is common, but well-preserved shells are rare, the aperture mostly being broken off. An incomplete specimen from Kallo must have been at least twice the size of the specimen here illustrated. Kadolsky (1973) changed the preoccupied generic name *Eulimene* to *Eula* and tentatively assigned it to the Eulimidae. It is here considered to be a littorinid, on account of its shell surface, which is much less smooth and glossy than that which can be expected for a eulimid. This species has also been recorded from The Netherlands and from the Red Crag and St Erth Beds in Great Britain.

- Superfamily Rissoidea Gray, 1847
 Family Rissoidae Gray, 1847
 Subfamily Rissoinae Gray, 1847
 Genus *Cingula* H. & A. Adams, 1854

***Cingula inusitata* (Beets, 1946)**

Pl. 2, Fig. 1

- 1878 *Rissoa proxima*, S. Wood — Nyst, pl. 38, fig. 13.
 1881 *Rissoa proxima*, Alder — Nyst, p. 96.
 1946 *Hydrobia (Hydrobia ?) inusitata* Beets, p. 35, pl. 2, figs 8-16.
 1952 *Cingula (Cingula) koeneni* Glibert, p. 19, pl. 2, fig. 6.
 1957 *Cingula inusitata* Beets, sp. 1946 — Glibert, p. 23.
 1965 *Hydrobia inusitata* Beets, 1946 — van Regteren Altena *et al.*, p. 12, pl. 4, fig. 33.

Dimensions — Height 3,5 mm, width 1,5 mm.

Description — Small, elongated shell lacking umbilicus. The protoconch consists of about two smooth whorls, the adult shell comprising five to six, only slightly tumid whorls. The aperture is oval and pointed above and below. The inner lip is sharply delimited. Ornament consists of numerous very faint spiral lines, which are crossed by growth lines.

Discussion — This species, which cannot be confused with any other in the Kallo faunas, ranges from the Kattendijk Formation to the Kruisschans Member and is common; it appears to be restricted to the Pliocene of Belgium and The Netherlands.

Genus and subgenus *Alvania* Risso, 1826

***Alvania (Alvania) whitleyi* (Bell, 1898)**

Pl. 3, Fig. 1

- 1898 *Rissoa Whitleyi* Bell, p. 153.
 1925 *Alvania Whitleyi* (Bell) — Harmer, p. 606, pl. 50, fig. 40.

Dimensions — Height 4 mm, width 2 mm.

Description — Small, elongated shell with deep suture, comprising 7 angular whorls. The protoconch consists of three whorls, the first being smooth and globular, the other ones ornamented with 7 or 9 very fine spiral lines. The boundary with the teleoconch is clearly delimited. Teleoconch sculpture starting with two spiral ribs, the uppermost forming a keel. Axial sculpture starts half a whorl later. The spire occupies slightly more than half the total shell height, the aperture accounting for slightly more than a quarter. Teleoconch ornament consists of, at first, twelve narrow (about one third of the intercostal area), faintly delimited, radial ribs on the ultimate whorl. These ribs become obsolete near the adapical margin of the aperture; they are crossed by 10 narrow (about half the intercostal area), clearly delimited, spiral lines on the ultimate whorl. They are most pronounced where the radial ornament is absent, but become vaguer near the shell base. Spiral and radial ornament elements form rectangles, whose shortest side lies in top-base direction. Between the spirals fine growth lines are seen. The aperture is continuous, rounded, obtusely oval, being widest in the lower half. The outer lip is thickened, but there are no teeth. The umbilicus is nearly closed, only a small cleft remaining.

Discussion — In addition to the holotype from St Erth, only a single specimen of this species is known; it was collected from the base of the 'Scaldisien' (probably

Oorderen Member) at Antwerp (Oorderen, Kruisschans zeesluis). It is included here as it represents the first record from the Pliocene of Belgium.

***Alvania (Alvania) simonsi* n. sp.**

Pl. 3, Fig. 2

Diagnosis — A species of the subgenus *Alvania* (*Alvania*) with a smooth first protoconch whorl, second protoconch whorl with spiral lines, sub- and subsutural depressions on teleoconch whorls, 25 opisthocline radial ribs and 12 spiral ribs.

Dimensions — Height 1,8 mm, width 1 mm.

Type — Holotype, KBIN/IRScNB no. IST 5891; paratypes, 1 specimen (G.F. Simons Coll.), 1 specimen (F. van Nieulande Coll.), 4 specimens (A.C. Rijken Coll., dredged material from Yerseke), 1 specimen (G.F. Simons Coll.), 1 specimen (A.C. Rijken Coll., beach material from Ritthem), 2 specimens (A.C. Rijken Coll., beach material from de Kaloot-Vlissingen), 1 specimen (A.C. Rijken Coll., dredged material Westerschelde-Hooge Platen), 5 specimens (H.J. Raad Coll., beach material from Breskens), 2 specimens (H.J. Raad Coll., beach material from Nieuwe Sluis near Breskens, probably from Sluisse Hompels, Scheldt River), 2 specimens (H.J. Raad Coll., beach material from Zwarte Polder near Cadzand), 1 specimen (H.J. Raad Coll., beach material from Oostkapelle, possibly from Steenbanken, Scheldt River), 20 specimens (Rijks Geol. Dienst Coll., borehole Oosterhout), 2 specimens (author's coll., Kallo-Verrebroekdok, Oorderen Member, *Atrina* level and basal layer of *Cultellus* level), 2 specimens (A. Janse Coll., Antwerp-Kanaaldok B2, Luchtbal Member).

Locus typicus — Afrikadok, Antwerp (Belgium).

Stratum typicum — 'Scaldisien base', Luchtbal Member (Lillo Formation), middle Pliocene.

Derivatio nominis — Named after Mr G.F. Simons, who collected and recognised the first specimen of this species.

Description — Small, rather elongated shell with flat-sided whorls and deep suture, consisting of about 6 whorls. The spire occupies 3/8th of the total shell height, the aperture about a third. The protoconch comprises two whorls, the first of which is smooth, the second having about 7 very fine spiral lines, which are as broad as the intercostal spaces. Start of teleoconch sculpture unclear, because of erosion, in all specimens. Teleoconch ornament consists firstly of two narrow depressions, one subsutural, the other suprasutural. The adapical one may become more or less obsolete on the ultimate whorl. Secondly, about 25 opisthocline radial ribs occur on this whorl. Above the subsutural

depression they continue as a series of tubercles. They are clearly delimited and may be broader than or as broad as the intercostal spaces. These radial ribs efface before reaching the shell base. About 12 spiral ribs are present on the ultimate whorl, becoming more pronounced near the shell base and rather vague near the adapical side of the whorls. The aperture is oval, with a thickened outer lip, lacking teeth. The umbilicus is closed.

Discussion — In the Oorderen Member (*Pygocardia* level) at Kallo, this species is rare, and all specimens collected are worn and abraded. This is why an Antwerp shell is here designated holotype. The species was first recognised in the sediment fill of a dredged larger shell dumped at Yerseke; it is, however, never common. It is now known from the Oorderen and Luchtbal members, but has not yet been recorded from Great Britain. Harmer (1920, pl. 51) illustrated a number of species from St Erth (Cornwall), which also show the characteristic suprasutural depression and spiral protoconch ornament, viz. *Alvania densicostata* (Etheridge & Bell, 1898), *A. partimcancellata* (Wood in Kendall & Bell, 1886), *A. enysii* (Bell, 1898) and *A. dubiosa* Etheridge & Bell in Harmer, 1920. These, however, are consistently different from the present species. The first two are very similar and are best considered identical, using Wood's specific name. Material of this species is present in the IRScNB collections: it differs from *A. simonsi* in lacking a subsutural depression (so that the radial ribs are continuous on the adapical side, instead of being split into tubercles). The last two species are much larger than the present species (6 and 3,5 mm, respectively), having approximately the same number of whorls; they too lack the subsutural depression. However, it is evident that these 3 or 4 species together with the new taxon described here constitute a group of closely related species.

***Alvania (Alvania) beani* (Hanley in Thorpe, 1844)**

Pl. 2, Fig. 6

- 1920 *Alvania reticulata* (Montagu) — Harmer, p. 617, pl. 50, fig. 45.
1957 *Alvania (Turbona) beani* Thorpe, sp. 1844 — Glibert, pp. 23, 24, pl. 1, fig. 22.
1965 *Alvania (Alvania) beani* (Thorpe, 1844) — van Regteren Altena *et al.*, p. 13, pl. 4, fig. 38.
1978 *Alvania beani* (Hanley in Thorpe, 1844) — Fretter & Graham, pp. 173, 174, figs 148, 149.
1985 *Alvania (Alvania) beani* (Hanley) — Ponder, p. 136, fig. 87a-c.
1988 *Alvania beani* (Hanley in Thorpe, 1844) — Graham, p. 239, fig. 88.

1992 *Alvania (Alvania) beani* (Hanley in Thorpe, 1844)
— Cavallo & Repetto, p. 52, fig. 072.

Dimensions — Height 2 mm, width 1,5 mm.

Description — Shell small, higher than wide, lacking umbilicus. Three protoconch whorls lacking ornament and about four teleoconch whorls make up the shell. The suture is shallow. The aperture is oval, pointed at the apical side. The outer apertural lip is thickened and the inner lip clearly delimited. Ornament consists of about 9 spirals on the ultimate whorl, on the upper whorl portion crossed by slightly thinner radial ribs.

Discussion — In the *Petalococonchus* bed, this species is extremely rare. It may be distinguished from the other Kallo rissoids in having spiral as well as radial ribs, which cover the shell completely and reach nearly the same strength. Recent records of this species range from the Mediterranean and the Azores to off northern Norway (Graham, 1988). In Great Britain, it has been recorded from the St Erth Beds and the Red Crag.

Genus *Rissoa* Fréminville in Desmarest, 1814
Subgenus *Turboella* Gray, 1847

***Rissoa (Turboella) obsoleta* Wood, 1842**
Pl. 2, Fig. 2

- 1842 *Rissoa obsoleta* Wood, p. 533.
1848 *Rissoa obsoleta* S. Wood — Wood, p. 105, pl. 11, fig. 2.
1918 *Rissoa pentodonta* (S.V. Wood) — Harmer, p. 637, pl. 51, figs 34-36.
1925 *Rissoa obsoleta* S.V. Wood — Harmer, p. 859, pl. 65, figs 5, 6.
1946 *Rissoa obsoleta* Wood, 1848 — Beets, p. 36.
1957 *Rissoa (Turboella) obsoleta* Wood, sp. 1848 — Glibert, p. 24, pl. 1, figs 2, 3.
1965 *Rissoa (Turboella) obsoleta* S.V. Wood, 1848 — van Regteren Altena *et al.*, p. 13, pl. 4, fig. 40.

Dimensions — Height 3 mm, width 1,5 mm.

Description — Small, rather broad shell lacking umbilicus, comprising about six whorls, with proto-teleoconch boundary not well marked, and a shallow suture. The aperture is rounded, slightly pointed above, with very thick outer lip and clearly delimited inner lip. Poorly developed teeth may be seen on the inside of the outer lip in some specimens. Ornament is lacking in unworn specimens; at times, the outer shell peels off, and up to four faint radial ribs may be seen on the basal part of the shell. Such specimens also have a deeper

suture.

Discussion — This well-known species is not rare, ranging from the Kattendijk Formation to the Kruis-schans Member. In Great Britain, it is known from the Red and Coralline crags; Harmer (1918) illustrated a well-preserved shell under the name of *Rissoa pentodonta*, a species allegedly differing by the presence of apertural teeth. However, this character also occurs in the present species, as Glibert's (1957) illustrations show well. Harmer's (1925) illustration of *R. obsoleta* depicts a worn, decorticated specimen with damaged aperture.

***Rissoa (Turboella) curticosata* Wood, 1848**
Pl. 2, Fig. 4

- 1848 *Rissoa semicostata* Woodward — Wood, p. 102, pl. 11, fig. 10.
1848 *Rissoa curticosata* Wood, p. 102.
1925 *Rissoa semicostata* (S. Woodward) — Harmer, p. 634, pl. 51, fig. 16.
1965 *Rissoa (Turboella) curticosata* S. Wood, 1848 — van Regteren Altena *et al.*, p. 13, pl. 4, fig. 41.

Dimensions — Height 2 mm, width 1,5 mm.

Description — Small, rather broad shell lacking umbilicus, comprising about six whorls. Aperture is continuous, oval, pointed above, with a thickened outer lip. There are three smooth protoconch whorls, which are not clearly delimited from the teleoconch. The teleoconch has strong radial ornament which gradually appears after the protoconch. About 13 radial ribs occur on the ultimate whorl; they end at the periphery of this whorl. The lowest portion of the ultimate whorl shows about 8 very weak spirals, which may become obsolete.

Discussion — This is the first record of this species from the Pliocene of Belgium, having been previously recorded from Dutch beach material and from the Pleistocene at Bramerton (Great Britain). It is rare in the *Atrina* level (Oorderen Member); it differs from the other Kallo rissoid species by having strong radial ribs on the upper portion of the whorls only. Harmer's (1923, pl. 51, fig. 17) specimen from the Red Crag at Butley has much stronger radial ribs and is probably not conspecific.

Genus *Obtusella* Cossmann, 1921

***Obtusella intersecta* (Wood, 1856)**
Pl. 2, Fig. 3

- 1856 *Rissoa soluta* Philippi — Wood, p. 318, pl. 31, fig. 18 (?).
 1856 *Rissoa intersecta* Wood, p. 318.
 1914 *Rissoa (Cingulina) intersecta* Wood — Cerulli-Irelli, p. 197, pl. 15, figs 63-66.
 1923 *Cingula soluta* (Philippi) — Harmer, p. 863, pl. 65, fig. 12.
 1985 *Obtusella intersecta* (Wood) — Ponder, p. 167, fig. 118a-e.
 1988 *Obtusella intersecta* (Wood, 1848) — Graham, p. 260, fig. 102.
 1992 *Obtusella* cf. *intersecta* (Wood S.W., 1857) — Cavallo & Repetto, p. 54, fig. 081.
 1993 *Obtusella intersecta* (S.V. Wood, 1857) — Bouchet & Warén, p. 693, figs 1626, 1627, 1633.

Dimensions — Height 1 mm, width 1 mm.

Description — Minute, globose shell with very small umbilicus, comprising four to five tumid whorls. The aperture is rounded or squarish, the outer lip not thickened and the inner lip not clearly delimited. Ornament consists of numerous extremely fine radial and spiral lines, with the latter becoming more prominent around the umbilicus.

Discussion — This species is not rare in the *Atrina* level (Oorderen Member), having been collected especially from sediment fill of larger gastropod shells (e.g. *Scaphella*); this is the first record for the Belgian Pliocene. From The Netherlands no Pliocene records are known, and from the Coralline Crag and St Erth beds but few. The Coralline Crag specimens have a more elongated shell; Harmer's (1923) material corresponds more closely with the Kallo shells. This species has also been recorded from the Italian Pliocene, and at present, it occurs in depths from 20-800 m, from Spain to Norway (Graham, 1988; Bouchet & Warén, 1993).

Genus *Onoba* H. & A. Adams, 1854

Onoba aff. *millettii* (Etheridge & Bell, 1893)

Pl. 2, Fig. 5

- 1925 *Ceratia Millettii* (Etheridge & Bell) — Harmer, p. 864, pl. 65, fig. 13.

Dimensions — Height 3 mm, width 1,5 mm.

Description — Small, elongated shell, comprising about six rather tumid whorls and a rather deep suture and lacking an umbilicus. The apex is more or less blunt. The aperture is continuous and the outer lip not thickened. Ornament consists of a large number of very

fine spirals covering the entire shell, which are intersected by even finer radial striae.

Discussion — Being rather rare in the *Atrina* level (Oorderen Member), this species is here recorded for the first time from the Belgian Pliocene. A single specimen has been recorded from the St Erth Beds, and although the Kallo shells closely resemble Harmer's (1925) illustration, they differ from the English specimen in having faint radial striae. It also resembles the Recent Mediterranean *O. gianninii* (Nordsieck, 1974), as illustrated by Bouchet & Warén (1993, figs 1518-1521), whose micro-ornament approaches that of the Kallo shells, but heavier primary ribs are developed and the whorls are clearly more tumid.

Onoba semicostata (Montagu, 1803)

Pl. 3, Fig. 5

- 1848 *Rissoa striata* Mont. — Wood, p. 101, pl. 11, fig. 1.
 1923 *Rissoa striata* (J. Adams) — Harmer, p. 641, pl. 51, fig. 42.
 1965 *Cingula (Cingula) semicostata semicostata* (Montagu, 1803) — van Regteren Altena *et al.*, p. 12, pl. 4, fig. 35b.
 1978 *Onoba semicostata* (Montagu, 1803) — Fretter & Graham, pp. 163, 164, figs 139, 140.
 1988 *Onoba semicostata* (Montagu, 1803) — Graham, p. 256, fig. 100.

Dimensions — Height 1,5 mm, width 1 mm.

Description — Minute, elongated, slender shell with deep suture but lacking umbilicus, comprising five to seven tumid whorls. Protoconch mostly eroded, but preserved part showing microsculpture of irregular spiral striae. The aperture is oval, continuous, the outer lip not thickened. Ornament consists of about 18 distinct spirals on the ultimate whorl, which are intersected by radial costae on the adapical portion of each whorl. Microsculpture of spiral striae and pits present.

Discussion — Being new for the Belgian Pliocene as well, this species is rare in the Kattendijk Formation (c. 2 m below the Oorderen Member basal crag) and in the *Atrina* level (Kruisschans Member, F. van Nieulande and H. Keukelaar Collections). Previous records include Dutch beach material and specimens from the Coralline Crag and St Erth Beds. The species is nowadays found on rocky shores from the Mediterranean to off southern Norway.

Genus *Peringiella* Ponder, 1985

Peringiella crassilabris n. sp.
Pl. 3, Fig. 3

Diagnosis — A species of *Peringiella* with a rather stout shell and very thick varix on the outer apertural lip.

Dimensions — Height 2 mm, width 0,5 mm.

Type — Holotype, KBIN/IRScNB no. IST 5893.

Locus typicus — Kallo-Verrebroekdok, municipality of Beveren, province of Oost-Vlaanderen, co-ordinates 140,850/216,700.

Stratum typicum — Oorderen Member (Lillo Formation), middle Pliocene, *Cultellus* level (base with *Pygocardia*).

Derivatio nominis — in allusion to the strongly thickened outer apertural lip.

Generic attribution — Ponder (1985) presented a detailed description of the genus *Peringiella* and illustrated its type species, *P. denticulata* Ponder, 1985. The Kallo species is assigned here on account of its smooth proto- and teleoconch, paucispiral protoconch, apertural shape and the presence of a varix. It differs from congeners in being less elongate. The subgenus *Ovirissoa* Hedley, 1916, which occurs in Australia, New Zealand and Antarctica, is very similar, but has a larger protoconch (1½ whorls) than the present species.

Description — Minute, rather broad, more or less globular shell, comprising five whorls separated by a deep suture. The protoconch is smooth and consists of half a whorl, the boundary with the teleoconch being sharp. The aperture is continuous, more or less oval, rounded abapically and pointed adapically, with a straight adapical margin. The outer lip is straight and possesses a strongly thickened varix over a considerable distance. On the earliest teleoconch whorls widely separated, very fine spirals can just be made out; on younger whorls only growth lines are seen.

Discussion — Amongst the Kallo rissoids, *Obtusella intersecta* is the only one which superficially resembles the present species, but this has a less globular, more elongated shape, with a strongly thickened outer apertural lip. *Peringiella crassilabris* is extremely rare in the *Cultellus* level (Oorderen Member). So far, only four Recent species of the genus from the Mediterranean were known, viz. *P. denticulata* Ponder, 1985, *P. elegans* (Locard, 1892), *P. epidaurica* (Brusina, 1886) and *P. eburnea* (Monterosato, 1878), and a single species from the Canaries, *P. balteata* (Manzoni, 1868) (see Nordsieck, 1968; Sabelli *et al.*, 1990). These species all differ from the present taxon in having a much more slender, elongated shell, while the varix, if at all present, never reaches the same dimensions as that in *P. crassilabris*.

Family Skeneopsidae Iredale, 1915
Genus *Skeneopsis* Iredale, 1915

Skeneopsis planorbis (Fabricius, 1780)
Pl. 3, Fig. 6

1780 *Helix planorbis* Fabricius, p. 394.

1978 *Skeneopsis planorbis* (Fabricius, 1780) — Fretter & Graham, pp. 225, 226, figs 188, 189.

1983 *Skeneopsis planorbis* (Fabricius, 1780) — van Aartsen *et al.*, p. 16, fig. 58.

1988 *Skeneopsis planorbis* (Fabricius, 1780) — Graham, p. 278, fig. 112.

Dimensions — Height 1,5 mm, width 0,8 mm.

Description — Minute, depressed turbiniform shell, comprising about four whorls, with deep, wide open umbilicus. Whorls are swollen, and the suture deep. The aperture is continuous and nearly circular. Ornament is absent, with the exception of growth lines.

Discussion — Amongst the Kallo gastropod species, the only taxon to resemble the present species closely is *Dikoleps pusilla* (Jeffreys, 1847), which, however, has a much smaller umbilicus. The present record, the first from the Belgian Pliocene, is based on a single specimen from the Oorderen Member by Mrs Y. Butaye. In Recent faunas, it is widely distributed occurring from the Mediterranean and the Azores to the Arctic, and from Canada to Florida.

Family Adeorbidae Monterosato, 1884
Subfamily Adeorbinae Monterosato, 1884
Genus *Circulus* Jeffreys, 1865

Circulus supranitidus (Wood, 1842)
Pl. 4, Fig. 1

1842 *Adeorbis supra-nitidus* Wood, p. 530.

1848 *Adeorbis supra-nitidus* S. Wood — Wood, p. 137, pl. 15, fig. 5.

1923 *Adeorbis supranitidus* S.V. Wood — Harmer, p. 757, pl. 60, fig. 22.

1957 *Circulus supranitidus* Wood, sp. 1842 — Glibert, p. 21, pl. 1, fig. 19.

Dimensions — Height 1 mm, width 2,5 mm.

Description — Small, planorboid, strongly depressed shell with very large umbilicus. Ornament consists of a single strong keel slightly below the periphery and three to four weaker spirals inside the umbilicus. There is no ornament above the keel.

Discussion — This species is extremely rare, only a single specimen having been collected from the *Atrina* level. It closely resembles the Miocene *C. praecedens*

(von Koenen, 1872), and particularly its var. *gliberti* Janssen, 1967, which lacks one of the keels typical of that species. The present species is confined to the North Sea Basin Pliocene, but there are still no Dutch records. Harmer's (1923) record for modern faunas has not been substantiated in subsequent literature.

Circulus striatus (Philippi, 1836)

Pl. 4, Fig. 2

- 1836 *Valvata striata* Philippi, p. 147, pl. 9, fig. 3.
- 1848 *Adeorbis striatus* S. Wood — Wood, p. 137, pl. 15, fig. 7.
- 1923 *Circulus striatus* (Philippi) — Harmer, p. 759, pl. 60, fig. 25.
- 1957 *Circulus striatus* Philippi, sp. 1836 — Glibert, p. 21, pl. 1, fig. 18.
- 1965 *Circulus striatus* (Philippi, 1836) — van Regteren Altena *et al.*, p. 11, pl. 3, fig. 25.
- 1978 *Circulus striatus* (Philippi, 1836) — Fretter & Graham, pp. 227, 228, fig. 190.
- 1988 *Circulus striatus* (Philippi, 1836) — Graham, p. 286, fig. 115.
- 1992 *Circulus striatus* (Philippi, 1836) — Cavallo & Repetto, p. 54, fig. 087.

Dimensions — Height 1 mm, width 2 mm.

Description — Small, extremely depressed, nearly planorboid shell, with apex only slightly raised above the ultimate whorl, and a very large umbilicus. Ornament consists of spiral ribs on the basal as well as the adapical side of the ultimate whorl. The ribs near the suture are weaker than the lower ones, but a genuine keel never develops.

Discussion — This species is easily distinguished from its co-occurring congener by having ribs above the periphery. It is extremely rare in the *Petalococonchus* bed. In Recent faunas, it is known from the Mediterranean to the coasts of Ireland (Fretter & Graham, 1978).

- Family Caecidae Gray, 1850
- Subfamily Caecinae Gray, 1850
- Genus *Caecum* Fleming, 1813

Caecum mammillatum Wood, 1842

Pl. 4, Fig. 3

- 1842 *Caecum mammillatum* Wood, p. 459.
- 1848 *Caecum mammillatum* S. Wood — Wood, p. 116, pl. 20, fig. 4.
- 1923 *Caecum mammillatum* S.V. Wood — Harmer, p. 847, pl. 64, fig. 31.
- 1958 *Caecum mammillatum* Wood, sp. 1842 — Glibert, pp. 5, 6.

- 1965 *Caecum mammillatum* S.V. Wood, 1842 — van Regteren Altena *et al.*, p. 17, pl. 6, fig. 56.

Dimensions — Length 2 mm, diameter 0,5 mm.

Description — Small, curved tubiform shell, open at one end. At the posterior end closed by a calcareous plate, from which a point projects internally in intact specimens. Ornament is absent, with the exception of a few faint rings near the anterior end. A keel occurs on part of the calcareous plate.

Discussion — The Kallo specimens are not really typical of any of the three species described previously from the North Sea Basin Pliocene. They generally lack the pointed projection of typical *C. mammillatum*, and their calcareous plates more closely resemble those of *C. imperforatum* (Kanmacher, 1798), but this species has rings on most of the shell, which the Kallo shells have not. Specimens of *C. mammillatum* from the Coralline Crag at Sutton Park Pit, however, also occasionally lack this projection. In the form of the calcareous plate and in the presence of indistinct ribs, the Kallo material displays a certain resemblance to *C. armoricum* de Folin, 1869, but it lacks the longitudinal micro-ornament of that species, as illustrated by Hoeksema & Segers (1993). Scanning electron micrographs of the Kallo material showed a pitting pattern; larger pits in part may explain the lack of obvious rings on the shell, and are undoubtedly the result of boring. Smaller pits occur as well, and penetrate the shell matter; it could not be determined whether these were trace fossils or not. At Kallo, *C. mammillatum* is rather rare in the *Atrina* level.

Caecum glabrum (Montagu, 1803)

Pl. 4, Fig. 4

- 1803 *Dentalium glabrum* Montagu, p. 197.
- 1848 *Caecum glabrum* Mont. — Wood, p. 117, pl. 20, fig. 6.
- 1912 *Caecum glabrum* Mont. sp. — Cerulli-Irelli, p. 168, pl. 25, figs 28, 29.
- 1923 *Caecum glabrum* (Montagu) — Harmer, p. 848, pl. 64, fig. 33.
- 1965 *Caecum glabrum* (Montagu, 1803) — van Regteren Altena *et al.*, p. 17, pl. 6, fig. 57.
- 1978 *Caecum glabrum* (Montagu, 1803) — Fretter & Graham, pp. 234, 235, fig. 195.
- 1988 *Caecum glabrum* (Montagu, 1803) — Graham, p. 290, fig. 117.

Dimensions — Length 1 mm, diameter 0,2 mm.

Description — Minute, curved, smooth, tubiform shell, open at the anterior end. The posterior end is closed by a rounded calcareous plate.

Discussion — This form differs from its congener in

being smaller and having a rounded calcareous plate. It has previously been recorded from Great Britain and Dutch beach material; the present record is the first from the Belgian Pliocene. The species is extremely rare in the

Atrina level (Oorderen Member). In Recent faunas it is known from Scandinavia to the Medi-terranean (Graham, 1988).

SPECIES	K	Kb	KP	O	Ob	Oat	OC	Oan	Kr	M
<i>Potamides (Ptychopotamides) tricinctus</i>										x
<i>Bittium rubanocinctum</i>										
<i>Bittium robustum</i>										
<i>Tenagodus obtusus</i>				x						
<i>Turritella (T.) tricarinata tricarinata</i>				x	x		x		x	
<i>Turritella (Haustator) vanderfeeni</i>				x						
<i>Turritella (Haustator) incrassata incrassata</i>					x	x	x	x	x	
<i>Littorina (Melaraphe) gibbosa</i>				x						
<i>Littorina (Melaraphe) suboperta</i>									x	x
<i>Eula terebellata</i>									x	
<i>Cingula inusitata</i>				x	x	x	x		x	
<i>Alvania (Alvania) simonsi</i>						x	x			
<i>Alvania (Alvania) beani</i>				x		x				
<i>Rissoa (Turboella) obsoleta</i>				x		x	x		x	
<i>Rissoa (Turboella) curticosata</i>						x				
<i>Obtusella intersecta</i>					x	x				
<i>Onoba aff. millettii</i>						x				
<i>Onoba semicosata</i>						x				
<i>Peringiella crassilabris</i>							x			
<i>Skeneopsis planorbis</i>						x				
<i>Circulus supranitidus</i>						x				
<i>Circulus striatus</i>				x						
<i>Caecum mammillatum</i>						x				
<i>Caecum glabrum</i>						x				
<i>Ceratia proxima</i>				x		x	x			
<i>Tornus belgicus</i>					x	x	x		x	

Table 1. Stratigraphical distribution of caenogastropod species from the Belgian Pliocene (Kallo sections) known to date (see also Marquet, 1995).

Abbreviations: **K** - Kattendijk Formation (unspecified); **Kb** - Kattendijk Formation base; **KP** - Kattendijk Formation, *Petaloconchus* bed; **O** - Oorderen Member (unspecified); **Ob** - Oorderen Member base; **Oat** - Oorderen Member, *Atrina* bed; **OC** - Oorderen Member, *Cultellus* bed; **Oan** - Oorderen Member, *Angulus benedeni* bed; **Kr** - Kruisschans Member; **M** - Merksem Member.

Family Iravadiidae Thiele, 1928
Genus *Ceratia* H. & A. Adams, 1854

Ceratia proxima (Forbes & Hanley, 1850)
Pl. 4, Fig. 5

1850 *Rissoa proxima* Forbes & Hanley, p. 127, pl. 75, figs 7, 8.

1872 *Rissoa proxima* Forbes & Hanley — Wood, p. 71, pl. 4, fig. 17.

1914 *Rissoa (Ceratia) proxima* Alder — Cerulli-Irelli, p. 196, pl. 15, figs 58-62.

- 1923 *Ceratia proxima* (Forbes & Hanley) — Harmer, p. 644, pl. 51, fig. 41.
1978 *Ceratia proxima* (Forbes & Hanley) — Fretter & Graham, pp. 166, 167, figs 141, 142.
1984 *Ceratia proxima* (Forbes & Hanley, 1850) — Janssen, p. 135, pl. 46, fig. 7.
1988 *Ceratia proxima* (Forbes & Hanley, 1850) — Graham, p. 208, fig. 79.

Dimensions — Height 3 mm, width 1 mm.

Description — Minute, slender shell with tumid whorls and deep suture, lacking an umbilicus. The spire accounts for less than half of the shell height, the apex is blunt. The aperture is rounded oval, small (less than half the last whorl) and continuous, without thickened outer lip. Ornament consists of numerous fine spiral ribs.

Discussion — This is the first record of this species from the Belgian Pliocene; Nyst's (1881) record of '*Rissoa proxima*' in reality refers to *Cingula inusitata*. The species is extremely rare in the *Petalococonchus*, *Atrina* and *Cultellus* levels. It might be confused with *Onoba semicostata*, but it differs from that species in having a blunt apex and in lacking radial ribs. It has previously been recorded from the North Sea Basin Miocene, from the Coralline Crag and Pleistocene of Great Britain and the Pliocene of Italy. In Recent faunas, it is a southerly sublittoral element, which ranges from the Mediterranean to Great Britain.

Family Tornidae Sacco, 1894
Genus *Tornus* Turton & Kingston, 1830

***Tornus belgicus* (Glibert, 1949)**
Pl. 4, Fig. 6

- 1843 *Trochus trigonostomus* Bast. — Nyst, p. 385, pl. 35, fig. 25.
1878 *Adeorbis subcarinatus*, Mont. — Nyst, pl. 7, fig. 6.
1881 *Adeorbis subcarinatus*, Mont. — Nyst, p. 110.
1946 *Tornus subcarinatus* (Montagu, 1803) — Beets, pp. 37, 38, pl. 2, figs 19-22.
1949 *Adeorbis belgicus* Glibert, p. 113, pl. 6, fig. 14.
1958 *Tornus belgicus* Glibert, sp. 1949 — Glibert, p. 1.
1965 *Tornus belgicus* (Glibert, 1949) — van Regteren Altena *et al.*, p. 14, pl. 4, fig. 45.

Dimensions — Height 1,5 mm, width 2 mm.

Description — Minute, low-spined, strongly depressed, turbiniform shell with wide open umbilicus. Two weak keels occur on the ultimate whorl, the upper one at the base of the whorl, the other on the basal portion of the shell. A subsutural depression is present. Ornament

consists of growth lines only, which may become very prominent on the shell base.

Discussion — This species is common in the Oorderen and Kruisschans members; it has previously been recorded from the Pliocene of Belgium and The Netherlands.

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PLATE 1

- Fig. 1. *Turritella (Haustator) vanderfeeni* Brakman, 1937, Kallo (Vrasenedok), Kattendijk Formation (*Petalocochnus* bed), x 1,9 (a) and x 2,3 (b). Marquet Collection.
- Fig. 2. *Potamides (Ptychopotamides) tricinctus* (Brocchi, 1814), Kallo (zeesluis), Lillo Formation (Merksem Member), x 3,6. Marquet Collection.
- Fig. 3. *Turritella (Haustator) incrassata incrassata* J. Sowerby, 1814, Kallo (Verrebroekdok), Lillo Formation (Oorderen Member, *Atrina* level), x 1 (a, c) and x 1,1 (b). Marquet Collection.
- Fig. 4. *Littorina (Melaraphe) gibbosa* Etheridge & Bell, 1893, Kallo (Vrasenedok), Kattendijk Formation (*Petalocochnus* bed), x 31,6. KBIN collections, no. IRScNB IST 5884.
- Fig. 5. *Turritella (T.) tricarinata tricarinata* (Brocchi, 1814), Kallo (Verrebroekdok), Lillo Formation (Oorderen Member, *Cultellus* level), x 2,9 (a), Marquet Collection; x 50 (b) and x 80 (c), KBIN collections, no. IRScNB IST 6239. b,c SEM photographs.
- Fig. 6. *Eula terebellata* (Nyst, 1835), Kallo (Verrebroekdok), Lillo Formation (Kruisschans Member), x 5,2. Marquet Collection.
- Fig. 7. *Littorina (Melaraphe) suboperta* (J. Sowerby, 1814), Kallo (Verrebroekdok), Lillo Formation (Kruisschans Member), x 4,6. Marquet Collection.

PLATE 1

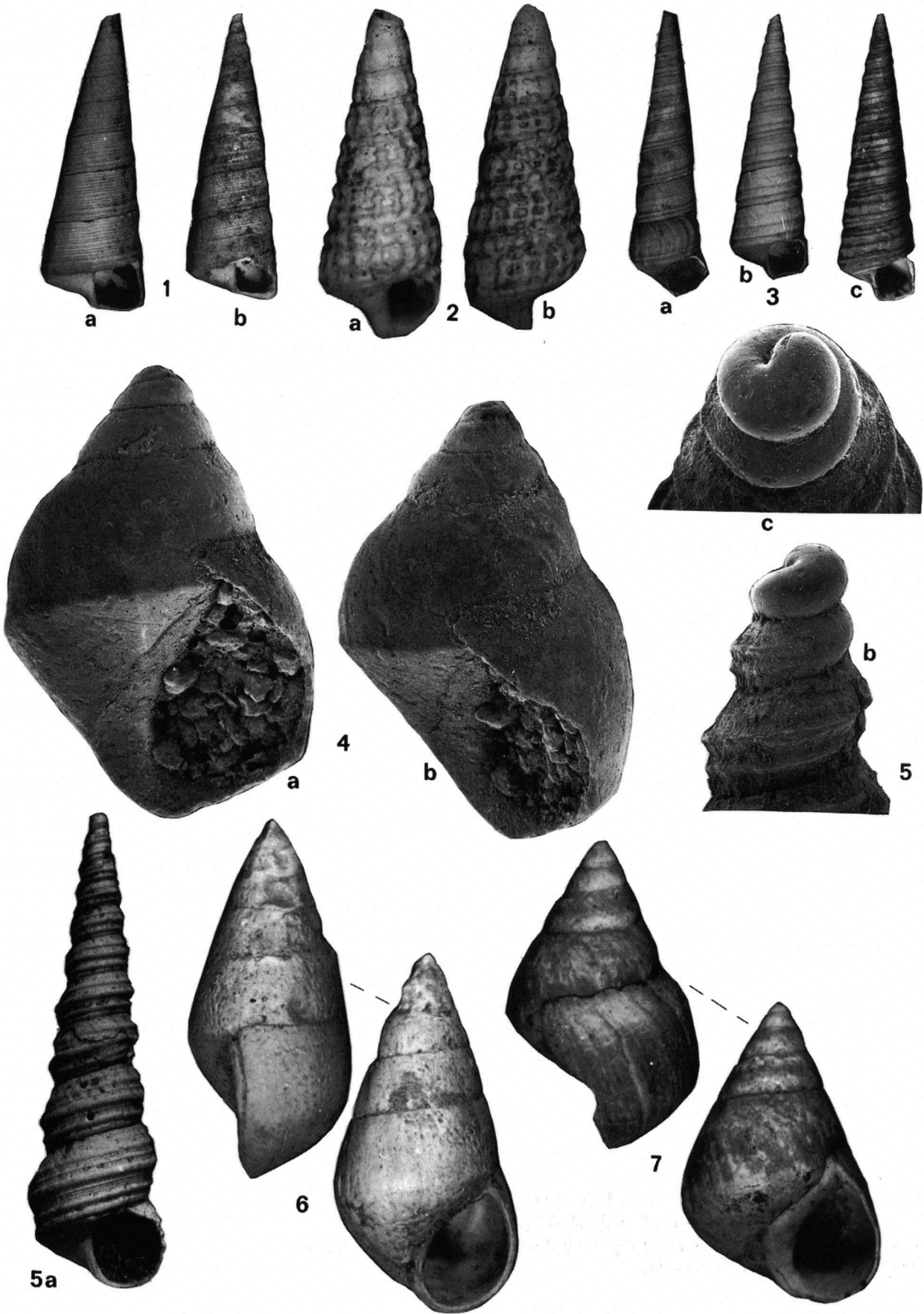


PLATE 2

- Fig. 1. *Cingula inusitata* (Beets, 1946), Kallo (Verrebroekdok), Lillo Formation (Oorderen Member, *Cultellus* level), x 23 (a, b) and x 180 (c). KBIN collections, no. IRScNB IST 5885. (SEM)
- Fig. 2. *Rissoa (Turboella) obsoleta* Wood, 1842, Kallo (Verrebroekdok), Lillo Formation (Oorderen Member, *Atrina* level), x 26. KBIN collections, no. IRScNB IST 5886. (SEM)
- Fig. 3. *Obtusella intersecta* (Wood, 1856), Kallo (Vrasenedok), Lillo Formation (Oorderen Member, *Atrina* level), x 50. KBIN collections, no. IRScNB IST 5889. (SEM)
- Fig. 4. *Rissoa (Turboella) curticosata* Wood, 1848, Kallo (Verrebroekdok), Lillo Formation (Oorderen Member, *Atrina* level), x 21. KBIN collections, no. IRScNB IST 5887. (SEM)
- Fig. 5. *Onoba* aff. *milletti* (Etheridge & Bell, 1893), Kallo (Vrasenedok), Lillo Formation (Oorderen Member, *Atrina* level), x 20 (a, b) and x 180 (c). KBIN collections, no. IRScNB IST 5878. (SEM)
- Fig. 6. *Alvania (A.) beani* (Hanley in Thorpe, 1844), Kallo (Vrasenedok), Kattendijk Formation (*Petalococonchus* bed), x 40. KBIN collections, no. IRScNB IST 5889. (SEM)

PLATE 2

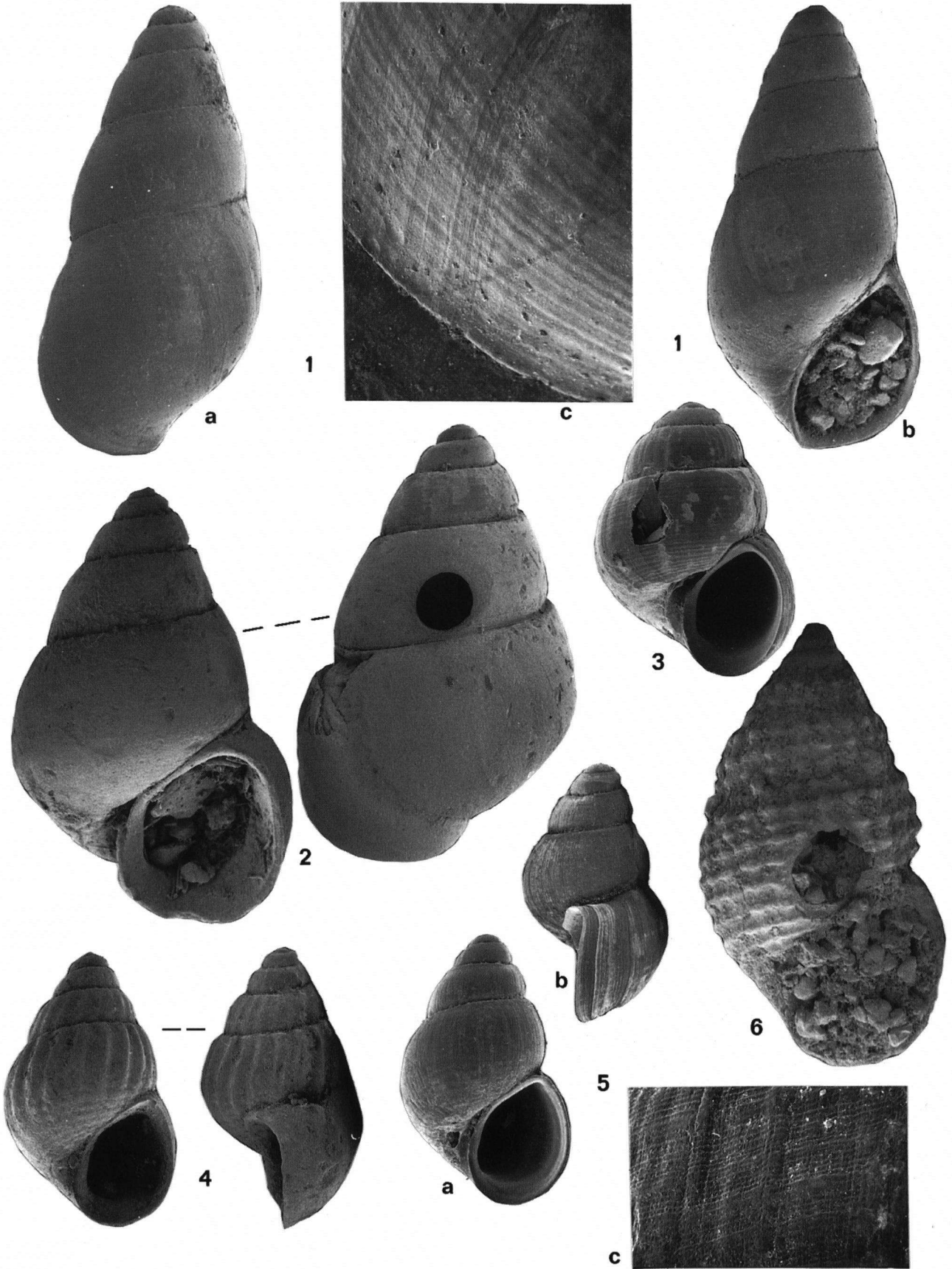


PLATE 3

- Fig. 1. *Alvania* (*A.*) *whitleyi* (Bell, 1898), Antwerp (Kruisschans zeesluis, Oorderen), Lillo Formation (base 'Scaldisien', probably Oorderen Member), x 15 (a, d), x 50 (b) and x 120 (c). KBIN collections, no. IRScNB IST 5890. (SEM)
- Fig. 2. *Alvania* (*A.*) *simonsi* n. sp., Antwerp (Afrikadok), Lillo Formation ('Scaldisien base', probably Luchtbal Member), x 60 (a), x 28 (b, c) and x 120 (d). KBIN collections, no. IRScNB IST 5891 (**holotype**). (SEM)
- Fig. 3. *Peringiella crassilabris* n. sp., Kallo (Verrebroekdok), Lillo Formation (Oorderen Member, *Cultellus* level), x 33 (a, d), x 90 (b) and x 88 (c). KBIN collections, no. IRScNB IST 5893 (**holotype**). (SEM)
- Fig. 4. *Tenagodus obtusus* (Schumacher, 1817) s. lat., Kallo (Vrasenedok), Kattendijk Formation (*Petalococonchus* bed), x 8,8. Van Nieulande Collection.
- Fig. 5. *Onoba semicostata* (Montagu, 1803), Kallo (Vrasenedok), Kattendijk Formation (2 m below base Oorderen Member), x 34. KBIN collections, no. IRScNB IST 5892. (SEM)
- Fig. 6. *Skeneopsis planorbis* (Fabricius, 1780), Kallo (Verrebroekdok), Lillo Formation (Oorderen Member, *Atrina* level), x 34. KBIN collections, no. IRScNB IST 5894. (SEM)

PLATE 3

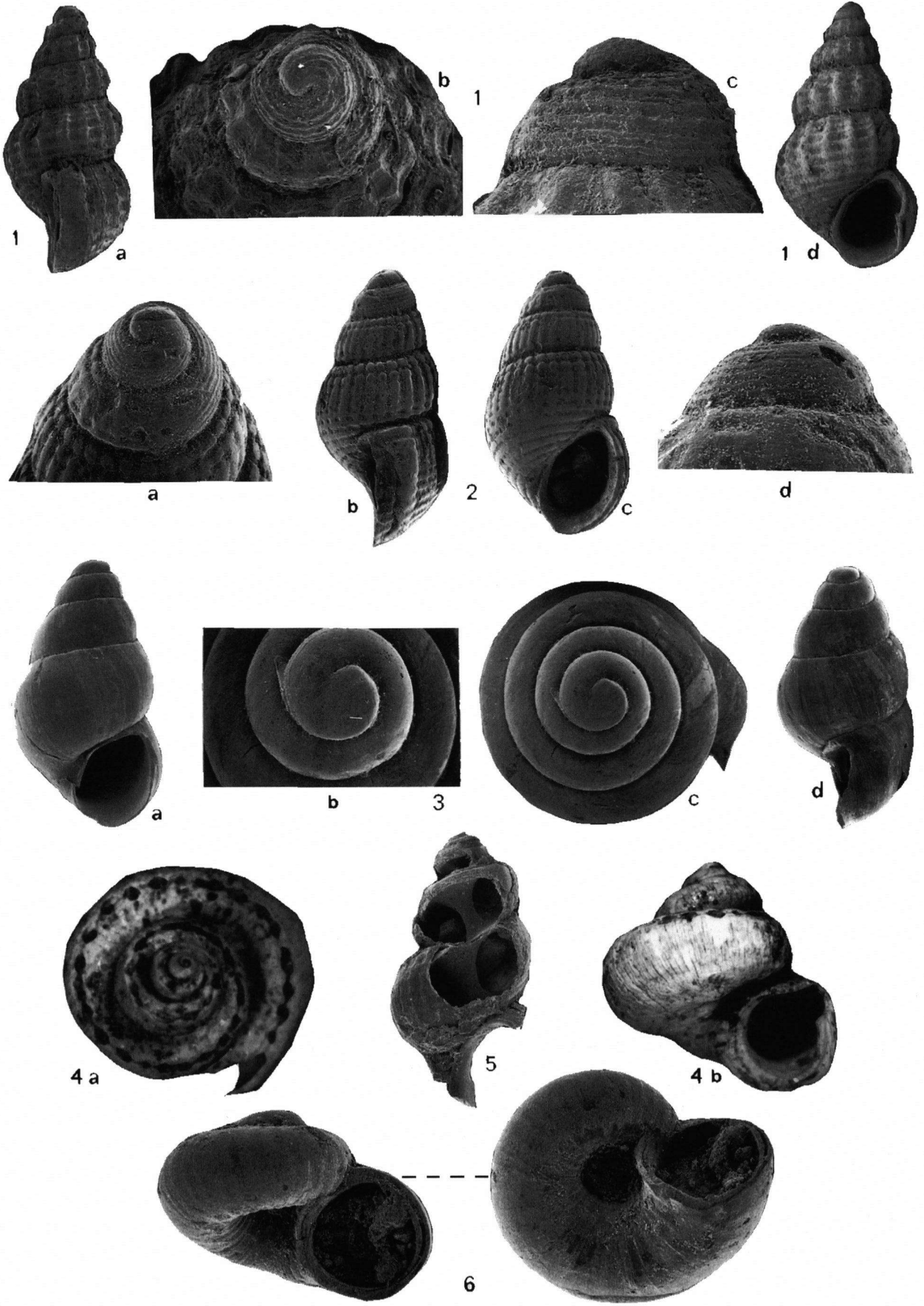


PLATE 4

- Fig. 1. *Circulus supranitidus* (Wood, 1842), Kallo (Verrebroekdok), Lillo Formation (Oorderen Member, *Atrina* level), x 20. KBIN collections, no. IRScNB IST 5895. (SEM)
- Fig. 2. *Circulus striatus* (Philippi, 1836), Kallo (Vrasenedok), Kattendijk Formation (*Petalococonchus* bed), x 9. KBIN collections, no. IRScNB IST 5896. (SEM)
- Fig. 3. *Caecum mammillatum* Wood, 1842, Kallo (Verrebroekdok), Lillo Formation (Oorderen Member, *Atrina* level), x 20 (a) and x 70 (b, c). KBIN collections, no. IRScNB IST 5897. (SEM)
- Fig. 4. *Caecum glabrum* (Montagu, 1803), Kallo (Vrasenedok), Lillo Formation (Oorderen Member, *Atrina* level), x 50 (a) and x 140 (b). KBIN collections, no. IRScNB IST 5898. (SEM)
- Fig. 5. *Ceratia proxima* (Forbes & Hanley, 1850), Kallo (Vrasenedok), Lillo Formation (Oorderen Member, *Cultellus* level), x 27. KBIN collections, no. IRScNB IST 6237. (SEM)
- Fig. 6. *Tornus belgicus* (Glibert, 1949), Kallo (Vrasenedok), Lillo Formation (Oorderen Member, *Atrina* level), x 40. KBIN collections, no. IRScNB IST 6238. (SEM)

PLATE 4

