

## A revision of the Caenozoic Pinnidae from Belgium (Mollusca, Bivalvia)

by Robert MARQUET

### Abstract

The taxonomy of the Pinnidae from the Belgian Caenozoic is revised. The species are described and their occurrence is discussed. The family Pinnidae comprises five species in the Belgian Caenozoic: *Atrina fragilis kalloensis* n. subsp. (Pliocene), *Atrina exanthema* (SPEYER, 1864) (Oligocene), *Atrina affinis* (SOWERBY, 1821) (Eocene), *Atrina propinqua* (E. VINCENT, 1894) (Paleocene) and *Pinna margaritacea* LAMARCK, 1805 (Eocene). Unidentifiable fragments were collected in the Grimmeringen Sand Member (Oligocene) and in the Antwerp Sand Member (Miocene). *Atrina fragilis kalloensis* n. subsp. is described; its ecology and epibionts are discussed.

**Key-words:** Pinnidae, Bivalvia, Mollusca - Caenozoic - Belgium.

### Résumé

La taxonomie des Pinnidés du Cénozoïque belge est révisée. Les espèces sont décrites et leur distribution est discutée. La famille des Pinnidae comprend cinq espèces dans le Cénozoïque belge: *Atrina fragilis kalloensis* n. subsp. (Pliocène), *Atrina exanthema* (SPEYER, 1864) (Oligocène), *Atrina affinis* (SOWERBY, 1821) (Eocène), *Atrina propinqua* (E. VINCENT, 1894) (Paléocène) et *Pinna margaritacea* LAMARCK, 1805 (Eocène). Des fragments jusqu'à présent non identifiables ont été trouvés dans les Sables de Grimmeringen (Oligocène) et dans les Sables d'Anvers (Miocène). *Atrina fragilis kalloensis* n. subsp. est décrite; son écologie et son épifaune sont discutées.

**Mots-clefs:** Pinnidae, Bivalvia, Mollusca - Cénozoïque - Belgique.

### Introduction

Shells of the family Pinnidae are generally large, thin and extremely fragile. Mostly, only unidentifiable fragments are collected. This makes their fossil record poor, although specimens can be very common in certain deposits. *Atrina* species have furthermore few characters and these are extremely variable. Recently, well preserved specimens of Pinnidae were collected in Eocene, Oligocene and Pliocene deposits in Belgium. A description of these discoveries is presented here.

*Pinna margaritacea* LAMARCK, 1805 is present in the Upper Eocene in Belgium, but complete specimens have not yet been recovered. In the Wemmel Sand Member, it coexists in smaller numbers with *Atrina affinis* (SOWERBY, 1821)

Part of the Oorderen Sand Member (Lillo Formation, Pliocene) is characterised by the abundant occurrence of an *Atrina* species. Pliocene Pinnidae from Belgium and the Netherlands were previously considered conspecific with the recent Atlantic-Mediterranean species, named *Atrina fragilis* (PENNANT, 1777) or (incorrectly) *Atrina pectinata* (LINNAEUS, 1758). Previous descriptions were generally based on very fragmentary material. During harbour construction works in Kallo (Oost-Vlaanderen), complete specimens were collected. They belong to an until now undescribed subspecies, *Atrina fragilis kalloensis* n. subsp.

A large and well preserved *Atrina* specimen was collected at Ruisbroek, Belgium; it is kept in the NNM. It has proved conspecific with a specimen from Söllingen, B.R.D. in the same museum. From the German locality, a *Pinna exanthema* was described by SPEYER (1864). R. JANSSEN (1979) considered this name as a *nomen dubium*, because of the very fragmentary state of SPEYER's type specimen. The specimen in the NNM from the type locality could however be used as topotype.

In the Belgian Eocene, two Pinnidae occur: *Atrina affinis* (SOWERBY, 1821) and *Pinna margaritacea* LAMARCK, 1805. Until now, both were united under the second name, as a consequence of an error made by DESHAYES (1837). The discovery of complete specimens of the first species in Egem allowed the separation of both species.

In the Paleocene Landen Formation, an *Atrina* species occurs, which, by its distinct sculpture, can be considered different from the Eocene species, although no reasonably complete specimens are known.

IRScNB: Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium.

NNM: Nationaal Natuurhistorisch Museum, Leiden, The Netherlands.

### Systematic part

Text-figure 1 gives outline drawings of eight specimens of the recent *Atrina fragilis fragilis* (PENNANT, 1777) from different localities, Text-figure 2 of six paratype

specimens of *Atrina fragilis kolloensis* n. subsp. From these figures, it is obvious that some characters show a high degree of intraspecific variability in *Atrina*:

- the umbonal angle, especially in the recent species;
- the curvature of the ventral margin;
- the number of ribs and their development.

Some features are more variable in the subspecies, *A. f. fragilis*:

- the presence of spines on the ribs;
- the presence of a notch in the dorsal margin.

The most constant characters seem to be the general outline of the shell and the angle between dorsal and posterior margin. Consequently, herein these features are given here precedence in the differentiation of the species.

#### Phylum Mollusca

Class Bivalvia LINNAEUS, 1758

Subclass Pteriomorphia BEURLIN, 1944

Order Mytiloidea FERUSSAC, 1821

Superfamily Pinnoidea LEACH, 1819

Family PINNIDAE LEACH, 1819

Genus *Pinna* LINNAEUS, 1758

Subgenus *Pinna* LINNAEUS, 1758

#### *Pinna margaritacea* LAMARCK, 1805

Pl. 2, Fig. 4.

- \* 1805 *Pinna margaritacea* - LAMARCK, p. 118.  
 1823 *Pinna margaritacea* - LAMARCK, pl. 15 fig. 8.  
 1861 *Pinna margaritacea*, LAMARCK - WOOD, p. 56, pl. 11 fig. 9.  
 1887 *P. margaritacea*, LAMK. - COSSMANN, p. 161.  
 1906 *Pinna margaritacea*, LAMK. - COSSMANN & PISSARRO, pl. 39 fig. 120.1.  
 pp v 1936 *Pinna (Pinna) vincenti* COSSMANN, 1903 - GLIBERT, p. 46, non pl. 1 fig. 14.  
 v 1975 *Pinna cf. margaritacea* LAMARCK, 1805 - GLIBERT, p. 23 - 24.

MATERIAL: Coll. Marquet: one steinkern from Balegem, Oost-Vlaanderen; Lede Fo., Lutetian, Upper Eocene. Coll. IRScNB: two steinkerns from Brussels (Centenaire), two steinkerns from Melsbroek, 4 steinkerns from Nederokkerzeel, one steinkern from Ukkel, one shell from Zellik, all Brabant; one steinkern from Ghent, Oost-Vlaanderen; all Lede Fo., Lutetian, Upper Eocene; one shell fragment from Wommel, one shell fragment from Neder-over-Heembeek, 8 shell fragments from Laeken, one shell fragment from Asse (Kautertavert); all Brabant; all Wommel Fo., Bartonian, Upper Eocene.

LOCUS TYPICUS: Grignon, Yvelines, France.

STRATUM TYPICUM: Lutetian, Upper Eocene.

DIAGNOSIS: A rather small *Pinna* species, with a narrow, elongated shell, divided into two lobes which form a clear angle; the shell is completely covered with ribs, which bear no spines or scales.

Text-fig. 1 — *Atrina fragilis fragilis* (PENNANT, 1777). Recent, 1: from Palamos, Costa Brava, Spain (coll. MARQUET), 2, 3, 5, 7: from Rosas, Spain (NNM), 4: from Manta Rota, Portugal (NNM), 6: from the North Sea (coll. MARQUET), 8: from 60 miles north of Scotland (NNM), not in life position.

The figures show different shell shapes and sculptures. X 0,25.



DESCRIPTION: No complete specimens are known. The largest specimen in the IRScNB collection, from Zellik (Wommel Sand Member), measures 11 x 3,4 x 2,8 cm (bivalved). No specimen is complete enough to observe the outline. In the most complete specimens, the ventral as well as the dorsal margin are completely straight, forming a top angle of 25°. The posterior margin is never preserved in the material studied. The shell nacre is divided into two lobes, a division which is visible even in steinkerns. The ventral and dorsal lobes of the shell are each nearly flat, forming a wide angle at the division. Growth lines are inconspicuous. Ribs are present on both lobes of the shell and they continue far posteriorly. They never possess scales or spines. On the dorsal side, 10 ribs are present, on the ventral side 6, which are much weaker.

DISCUSSION: Although no complete specimens are available, this species differs clearly from *Atrina affinis* (SOWERBY, 1821), even in steinkern preservation, by the characters of its genus and by the much narrower shell. Also from LAMARCK's (1823) description, it is clear that the shell is divided into two lobes in this species.

— *Pinna multisulcata* MAYER-EYMAR, 1887 from the Alpine Bartonian, as figured in BOUSSAC (1911) pl. 7 fig. 30 (not fig. 22), under the name *P. helvetica* MAYER-EYMAR, 1861, comes very close to *P. margaritacea*; it is much better preserved than most Paris Basin specimens.

— *P. pyrenaica* ROUAULT, 1848 from the Cuisian of Gan, Pyrénées Atlantiques, as figured by COSSMANN (1921) pl. 10 fig. 1 - 3, seems however different, by the presence of much fewer, less clearly delimited ribs and by the broader, more flattened shell.

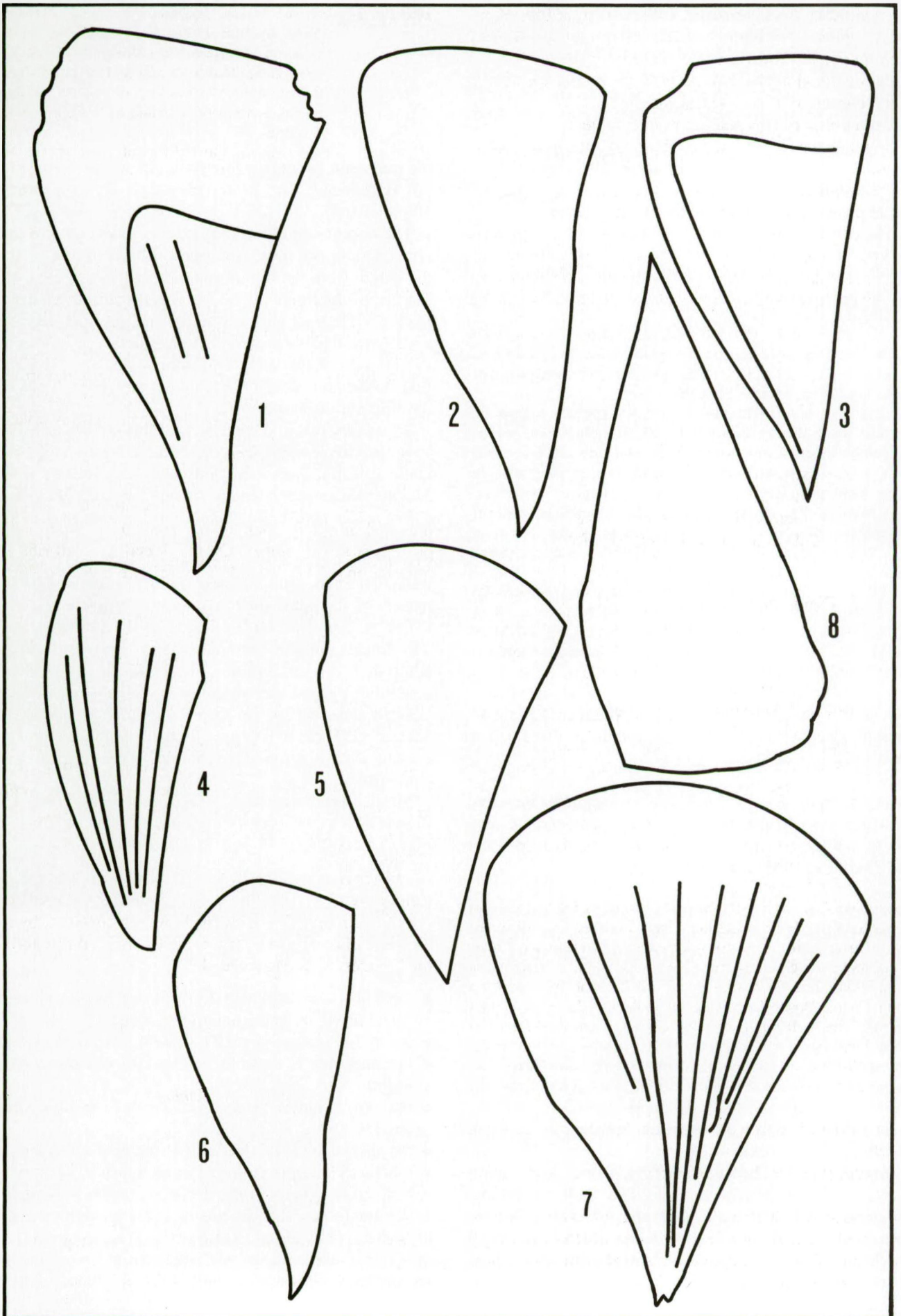
#### Genus *Atrina* GRAY, 1842

#### *Atrina fragilis kolloensis* n. subsp.

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Pl. 1, Fig. 2; Pl. 2, Fig. 5.

- v 1835 *Pinna margaritacea* ? - NYST, p. 17 (non LAMARCK)  
 ? 1840 *Pinna ingens* - S. WOOD, p. 252.  
 v pp 1843 *Pinna margaritacea* LAMK. - NYST, p. 274. (non LAMARCK)  
 - 1874 *Pinna pectinata* (?) LIN. - S. WOOD, p. 110.



- v 1881 *Pinna pectinata*, LINNE - NYST, p. 160-161.  
 v 1888 *Pinna pectinata*, LIN. - NYST, pl. 16, fig. 2.  
 v 1957 *Pinna pectinata* LINNE, 1767 - GLIBERT, p. 22.  
 - 1966 *Atrina fragilis* (PENNANT, 1777) - VAN REGTEREN ALTENA *et al.*, p. 57, pl. 6, fig. 2B.  
 - 1975 *Atrina fragilis* (PENNANT, 1777) - A.W. JANSSEN, p. 122.  
 v 1979 *Pinna pectinata* LINNE, 1767 - GEYS & MARQUET, p. 44, pl. 15, fig. 2.  
 v 1994 *Atrina* spec. nov. - VERVOENEN, p. 66, 68, fig. 118, 124.

DERIVATIO NOMINIS: After Kallo, the type locality.

#### MATERIAL:

— HOLOTYPE: coll. IRScNB, T.I. 6173 from the sea lock, Kallo, prov. Oost-Vlaanderen, Belgium; level no 3 of HOEDEMAKERS & MARQUET (1992) from the Oorderen Sand Member, Lillo Formation, Middle Pliocene.

— PARATYPES: coll. Marquet: 5 complete specimens from the harbour works, Kallo; same level; coll. A. Ratinckx (Antwerp): 10 complete specimens from the same locality and level; coll. D. Lauwers (Sint Niklaas): 8 complete specimens from the same locality and level; coll. F. Van Nieulande (Nieuw-en-Sint-Joosland, The Netherlands): 12 adult specimens, 4 juveniles and two prodissococonchs from the same locality and level; coll. NNM (figured by VERVOENEN, 1994): two specimens, same locality and level.

— OTHER MATERIAL: coll. IRScNB, Tertiary Invertebrates Types no 4133, figured by NYST (1888), from Wijnegem, "Scaldisien" (probably Oorderen Sand Member). Coll. NNM no RGM 393371: 1 specimen, Antwerp Dokkanaal, Oorderen Sand Member, Lillo Fo.

STRATUM TYPICUM: Oorderen Sand Member, Lillo Formation, Middle Pliocene; level no 3 in the profile fig. 3 of HOEDEMAKERS & MARQUET (1992).

LOCUS TYPICUS: Sea lock in Kallo, municipality Beveren, province Oost Vlaanderen, Belgium, topographical map 7/5-6: x = 139.611,250, y = 219.504,250 (HOEDEMAKERS & MARQUET (1992) map fig. 1).

DIAGNOSIS: *Atrina* species with straight dorsal and ventral margins; dorsal and posterior margin with an angle of more than 90°; sculpture consisting only of about five weak dorsal ridges, without spines or scales.

#### DESCRIPTION: Size:

mean length: 21,9 cm (from 17,1 to 25,5 cm, n=24);  
 mean width: 10,5 cm (from 8,3 to 12,0 cm, n=24);  
 mean thickness: 2,9 cm (from 2,4 to 3,8 cm, n=24);  
 mean apical angle: 42° (from 38° to 45°, n=24).

The dimensions of the holotype are: length 25,3 cm, width 11,7 cm, thickness 2,4 cm.

Anteriorly, the shell is triangular. Dorsal and ventral margins are completely straight. The shell reaches its maximal width at about two thirds of the total length, measured from the top. From there onwards, the shell quickly narrows. The transition between dorsal and posterior margin makes an angle of more than 90°, whereas

Text-fig. 2 — *Atrina fragilis kalloensis* n. subsp. Oorderen Sand Member, Lillo Formation. Not in life position. All from Verrebroekdok, Kallo, Belgium (coll. MARQUET and RATINCKX). X 0,25.



the transition between ventral margin and posterior margin is rounded. The posterior margin forms a regular elliptical arch.

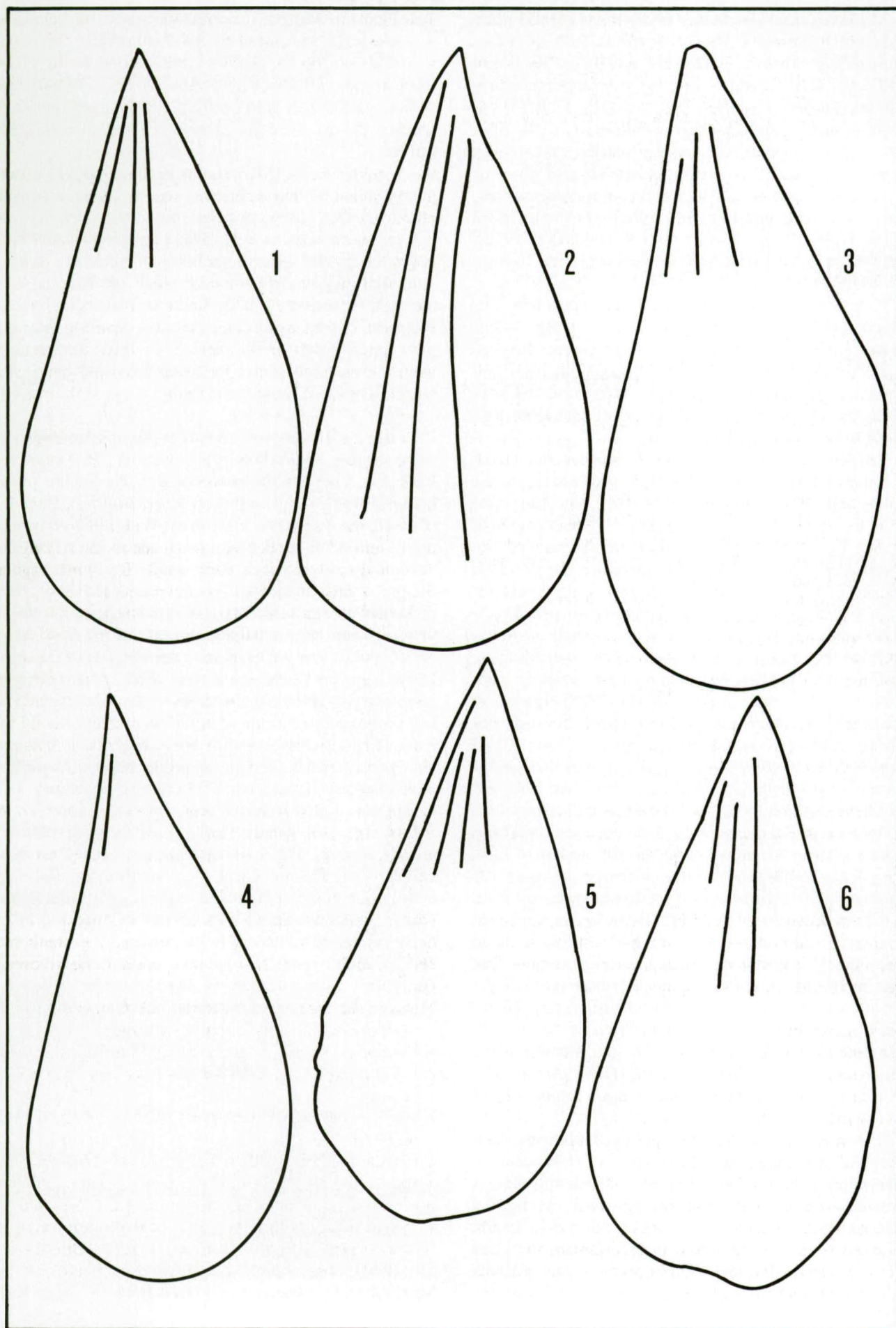
The largest part of the shell is smooth and growth lines are generally not seen. Anteriorly, till about one third of the length from the top onwards, very weak to clear ribs can occur, distributed from the dorsal margin to halfway the shell. Their number is variable and never exceeds six, with generally five present. Ribs are always absent on the ventral side of the shell. Spines or scales are never present. In the part closest to the umbo, the growth lines can develop into weak plicae.

Some very juvenile specimens of this species and some loose prodissococonchs were discovered by F. Van Nieulande at Kallo. They were compared with equally young Mediterranean specimens of *Atrina f. fragilis* (PENNANT, 1777) in the same collection. No differences in development were observed between fossil and recent *A. fragilis*. The prodissococonch is a very small (0,5 mm), regular triangular shell, with a clearly delimited umbo. The formation of the adult shell starts with the nacreous level, which is deposited on the inside of the prodissococonch. The animal turns 90° around when it starts to form the adult shell. In consequence, the umbo of the prodissococonch lies against the ventral or dorsal (this was impossible to ascertain on the material available) side of the adult shell. Three to five growth interruptions are present, causing the formation of parallel ridges near the top of the adult shell.

Similar prodissococonchs were figured by TURNER & ROSEWATER (1958) for *Pinna carnea* GMELIN, 1791, *P. rudis* LINNAEUS, 1758 and *Atrina seminuda* (LAMARCK, 1819).

DIFFERENTIATION: *Atrina* (A.) *f. fragilis* (PENNANT, 1777) occurs in the North Sea, the Atlantic and the Mediterranean. It differs from the new subspecies in the following features:

- the dorsal margin usually forms in *A. f. fragilis* an angle of about 90° with the anterior margin;
  - the dorsal margin is nearly straight instead of curved;
  - the sculpture is variable, with occasional presence of scales;
  - the ratio of antero-posterior diameter to width is smaller;
  - the shell is less flat than that of the new subspecies;
  - the ventral margin is mostly curved instead of straight;
  - frequently, a bend in the dorsal margin is present;
  - the maximal width lies nearer to the posterior margin.
- [JEFFREYS (1858), FORBES & HANLEY (1853), BUCQUOY *et al.* (1890), observed on specimens from Spain and the North Sea, coll. Marquet and NNM].



— *A. (Servatrina) pectinata* (LINNAEUS, 1758) is often used as a name for European fossil as well as recent specimens. It however occurs exclusively in the Indian and Pacific Oceans and belongs to a different subgenus than the European species (FISCHER-PIETTE, 1974). *A. pectinata* differs from *A. fragilis kalloensis* by the right angle between dorsal and anterior margin, the smaller anterior angle and by the sculpture, consisting of ribs over 9/10 of the shell width, from the dorsal margin onward, with occasional presence of spines (FISCHER-PIETTE (1974), HABE (1953), SPRINGSTEEN & LEOBRERA (1986), ROSEWATER (1961); observed on specimen from Taiwan, coll. Marquet).

— A lower Pliocene (Coralline Crag) specimen, described and figured by WOOD (1870, pl. 9, fig. 11) as *Pinna rudis* seems conspecific with the recent *Atrina f. fragilis* (PENNANT, 1777), because of its angular transition between dorsal and anterior margin. Well preserved lower Pliocene (Kattendijk Formation) specimens from Belgium were not collected until now.

— "*A. brocchii* (d'ORBIGNY, 1852)" was described from the Italian Pliocene. d'ORBIGNY (1852) did not figure the species and referred to BROCCHI (1814), who had mentioned the species as "*Pinna nobilis* L.". BROCCHI (1814) did not figure his material either, but mentioned the existence of a complete shell; furthermore, the presence of scales is mentioned, but it is not clear if this character was observed on recent or on fossil specimens. SACCO (1898) considered *Atrina brocchii* as a variety of *Pinna pectinata* (L.) and mentioned specimens from Miocene and Pliocene localities, together with a number of other varieties of the same species. SACCO (1898) figured no identifiable specimens and the same applies for the work of MALATESTA (1974). GLIBERT & VAN DE POEL (1965) considered *Atrina brocchii* as a valid species and used it as a name for all Italian Pliocene *Atrina* taxa. The best specimens, figured by SACCO (1898) as the variety *ventrosoplicata* of *Pinna pectinata*, form between dorsal and anterior margin an angle of about 90° and they have strong folds parallel to the anterior margin. CAVALLI & REPETTO (1990) figured a well preserved specimen from the Lower Pliocene of Monteu Roero, under the name *Atrina pectinata* (LINNAEUS, 1767). It also shows an angle of about 90° between dorsal and anterior margin. The same applies for complete specimens, observed by me at Corbara, near Orvieto (Astian, Middle Pliocene). Therefore, it seems probable that Italian Pliocene *Atrina* taxa described so far, belong to the recent Mediterranean subspecies, *A. f. fragilis* (PENNANT, 1777). *A. brocchii* (d'ORBIGNY, 1852) is herein considered a junior subjective synonym.

— *A. brocchii* has also been mentioned from the Austrian Miocene (Badenian) by HOERNES (1870) and by SIEBER (1955, here as a subspecies of *A. pectinata*). A specimen with partially preserved posterior part, figured by HOERNES (1870, pl. 50) shows a rounded transition between dorsal and posterior margin and its shell has neither spines nor ridges. This specimen has a much thicker shell than the Kallo specimens. It is not impos-

sible that the Austrian material will prove to belong to *A. radwanskii* JAKUBOWSKY, 1977, of which specimens n° RGM 393366 to 393369, were studied in the NNM from its type locality Chomentov (Kielce, Poland), Badenian. The Polish taxon differs clearly from the Kallo species by its strongly curved ventral margin (see further).

— *A. subpectinata* (MICHELOTTI in SACCO, 1898) occurs in the Italian Miocene. Eocene specimens were considered by SACCO (1898) as belonging to the same species, but as a var. *eotransiens*. These specimens are very fragmentary and belong probably to another species. Although no complete Miocene shells are known, fragments differ clearly from the Kallo *Atrina* species by their sculpture, consisting of numerous ribs, covering the complete anterior part of the shell. They differ furthermore from the new subspecies in possessing a 90° angle between dorsal and posterior margin.

ECOLOGY: All paratypes of *Atrina fragilis kalloensis* n. subsp. in the "Verrebroekdok" locality were collected lying flat. They are the most conspicuous feature of the fauna in level 3. According to YONGE (1953), Pinnidae (*Pinna carnea* GMELIN, 1791 in his study) live vertically, partly buried in sand. Specimens, which have been uncovered by a storm, seem to be unable to get erect again. So the "Verrebroekdok" specimens could have been dislodged by storm activity, but without being displaced far from their natural habitat, because of the small number of broken specimens of this extremely fragile species. In the exposure of the sea lock at Kallo, where the type specimen was collected, the shells were observed erect, in life position. Three kinds of epibionts were found on the Kallo *Atrina* shells: serpulids on 11 specimens, balanids (*Verruca* sp.) on 6 specimens and the bivalve *Heteranomia squamula* (LINNAEUS, 1758) on one specimen. Epibionts were found from the posterior end to about 1/3 or 1/2 of the shell length. Near the umbo, epibionts are always absent. The epifauna always occurs on both valves, so it did not develop on shells lying flat. The distribution of the epibionts strongly suggests that *Atrina fragilis kalloensis* lived with its top and lower third to half of the shell buried, in the same way as the recent species of its genus. Completely epifaunal or infaunal specimens, as mentioned by BOEKSCHOTEN (1967) for Miocene *Atrina* species, were not observed at Kallo.

#### *Atrina* sp.

- v 1945 *Pinna (Atrina) pectinata* LINNE, 1767 - GLIBERT, p. 56 - 57.
- v 1984 *Atrina pectinata* (PENNANT, 1777) - A. W. JANSSEN, p. 50 - 51, pl. 23 fig. 5.
- v 1984 Bivalvia ? non det. - A. W. JANSSEN, p. 114, pl. 1 fig. 12.
- v 1984 *Atrina pectinata* (PENNANT, 1777) - A. W. JANSSEN & MÜLLER, p. 6.

MATERIAL: Coll Marquet: 4 fragments from the Kleine Ring,

Borgerhout, Antwerp; two fragments from Metrostation Schijnpoort, Antwerp; all Antwerp Sand Member, Berchem Formation, Middle Miocene; two incomplete steinkerns, claypit Hermans, Ramsel, province Antwerp; unnamed basal gravel above Rupel Clay; three fragments from Zonderschot, Heist-Op-Den-Berg, province Antwerp; Zonderschot Sand member, Berchem Fo., Middle Miocene. Coll. IRScNB : 6 fragments from Edegem prov. Antwerp, Edegem Sand Member and Antwerp, Antwerp Sand Member. Coll. NNM : 8 fragments from Ramsel.

**DESCRIPTION :** The very fragmentary nature of the material available justifies no specific identification. The most complete specimens known (from Borgerhout, Ring, coll. Marquet) differ however from the Pliocene *Atrina fragilis kalloensis* in the following features. They seem to be higher, compared with the extremely flattened Pliocene shells. Furthermore, their sculpture seems, as GLIBERT (1945) also observed, more pronounced, by the presence of a number of ridges, parallel to the dorsal margin, and weaker plicae, running from the ridges obliquely to the ventral margin.

**DISCUSSION :** Several names are available for Miocene Pinnidae.

— For Austrian specimens, the name *Atrina brocchii* has been used (see above). French specimens, from the Aquitaine, have received the names *A. ferelaevius* (COSSMANN & PEYROT, 1914) and *A. basteroti* (COSSMANN & PEYROT, 1914). The incomplete type specimens of these taxa makes them probably nomina dubia. Their differentiating characteristics are furthermore not convincing, as already GLIBERT (1945) remarked. Fragments from Salles (Moulin Ruiné), Aquitaine, France, Sallomacien, in the coll. Van Nieulande, are smooth and very large, with a rather strongly curved ventral margin. BOEKSCHOTEN (1967) figured a well preserved specimen from the Miocene of Istres (Bouches-du-Rhône) as *Pinna* cf. *ferelaevius*. It is a large *Atrina*, without ribs or spines and with an angle, slightly larger than 90° between posterior and dorsal margin; the ventral margin is not complete, but it is not strongly curved.

— *A. subpectinata* (MICHELOTTI in SACCO, 1898) is also based on very fragmentary, mostly nacreous material and it corresponds closely in sculpture with fragments, collected in the Antwerp Sand Member. Further material is needed to make a definite identification. *A. subpectinata* is the oldest name available for European Miocene *Atrina* species.

— A specimen from the Helvetian of St. Gallen, Switzerland (NNM no RGM 221614) shows a right angle between dorsal and posterior margin; it agrees rather well with the recent *A. f. fragilis* (PENNYANT, 1777).

— From Poland, *A. radwanskii* JAKUBOWSKI, 1977 was recently described. It differs from other Miocene, Pliocene and recent shells of this genus mainly by its very strongly curved ventral margin, which makes Polish specimens look very similar to the Oligocene *A. exanthema* (SPEYER, 1864).

— A.W. JANSSEN (1984) figured unidentified shells, which seem to correspond to prodissococonchs of *Atrina* sp. Similar shells were found in the Pliocene Oorderen Sand Member of Kallo and are described above.

### *Atrina exanthema* (SPEYER, 1864)

Pl. 1, Figs. 1, 3.

- \* 1864 *Pinna exanthema* nov. sp. - SPEYER, p. 65 - 66, pl. 3 fig. 1 - 3.
- 1868 *Pinna exanthema* SPEYER - von KOENEN, p. 88.
- 1912 *Pinna Hassiaca* sp. nov. - STEUER, p. 44 - 45, pl. 5 fig. 1, pl. 6 fig. 3.
- 1912 *Pinna Moenana* sp. nov. - STEUER, p. 48 - 50, pl. 4 fig. 1, pl. 6 fig. 2.
- 1973 *Pinna (Pinna) hassiaca hassiaca* STEUER, 1912 - NEUFFER, p. 26.
- 1979 *Atrina* sp. ex aff. *pectinata* (LINNAEUS 1767) - R. JANSSEN, p. 44 - 45.

**MATERIAL:** Coll. NNM: 1 specimen no RGM 393370 from Söllingen, Niedersachsen, B.R.D., Chattian A, Asterigerina Horizon, Upper Oligocene; 1 nearly complete specimen no RGM 393148 and 10 fragments no RGM 393142 to 393147 and 393149 from Ruisbroek, province Antwerp, Belgium (Rupel Tunnel works), Bassevelde Sand Member, Rupel Fo., Middle Oligocene. Coll. Marquet : 2 fragments from the same Belgian locality.

**Type specimen:** SPEYER's (1864) specimen is too incomplete to warrant a description as the lectotype. Therefore, the specimen no. RGM 393370, NNM (Leiden, The Netherlands) is used as a topotype.

**LOCUS TYPICUS:** Söllingen, Niedersachsen, Germany, railroad cut r = 44.26620, h = 57.72450.

**STRATUM TYPICUM:** Chattian A, Upper Oligocene.

**DIAGNOSIS:** A large *Atrina* species, without spines, scales or ribs, with an angular postero-dorsal margin, partly straight posterior margin and an extremely convex ventral margin.

**DESCRIPTION:** The Söllingen specimen measures 16,2 x 11,7 cm, the most complete Ruisbroek specimen 21,7 x 17,9 cm. The shell is more or less rounded trigonal in outline. The dorsal margin is nearly straight, without notch. The posterior margin is elliptical and makes an angle of 90° or larger with the dorsal margin. The posterior margin in the most complete specimen is partly straight at the dorsal side, while it curves towards the ventral side. The ventral margin is strongly convex, and this more so in larger, older specimens. This seems the result of an allometric growth pattern. In younger individuals, growth is more pronounced in antero-posterior than in dorso-ventral direction. Gradually, the dorso-ventral growth component increases in comparison with antero-posterior accretion. This increase in dorso-ventral

growth occurs only on the ventral side, the dorsal margin remaining straight. This results in a stronger curving ventral side in older specimens. While the relatively young Söllingen specimen is rather flattened, the larger Ruisbroek specimens become very tumid.

Neither ribs, scales, nor spines are present in this species. The sculpture consists only of growth lines, which can develop along the ventral margin into strong plicae. The sculpture of the nacreous layer, figured by SPEYER (1864) is not a specific character, but it is present in most species of the genus investigated.

DISCUSSION: The Söllingen and Ruisbroek specimens belong clearly to the same species. The latter are larger, but the shape of the younger stages, as observed on the growth lines of the best preserved Ruisbroek specimen, are very much alike.

— *Atrina radwanskii* JAKUBOWSKI (1977), from the Polish Miocene, strongly resembles this species and in particular the Ruisbroek specimens. It could simply be a subspecies of *A. exanthema* (SPEYER, 1864).

— From the European Middle and Upper Oligocene, several further species of Pinnidae have been described. *Pinna deshayesi* MAYER, 1864, from the French Middle Oligocene (Stampien) is clearly different, though the known specimens are fragmentary, because of its nacre, which is divided into two lobes. *Atrina mayeri* COSSMANN, 1921 from the Stampien of Gaas, dept. Landes, France and from Cassinelle, province Alessandria, Italy and *Atrina sandbergeri* (MAYER-EYMAR, 1864) from the Rupelian of the Mainz Basin, Germany, could be conspecific with *A. exanthema* (SPEYER, 1864) as interpreted above. *A. mayeri* would then become a junior subjective synonym. The name *A. sandbergeri* was given by MAYER-EYMAR (1864) to figure 3 pl. 31 in SANDBERGER (1863), representing a fragment, which SANDBERGER did not consider worth naming. From neither of these taxa, sufficient material has been collected until now to make them more than nomina dubia. Their only difference, namely the number of ribs on the nacreous layer, is absolutely insignificant, due to the high variability of this character in *Atrina*. Two species, described by STEUER (1912) from the Mainz basin Oligocene, *Pinna Hassiaca* and *P. Moenana*, belong to the genus *Atrina*. They are probably conspecific with *A. exanthema*. Both are large and especially the second taxon of which a rather complete specimen is known (pl. 4 fig. 1 in STEUER (1912)), clearly shows the strongly curving ventral margin, typical of *A. exanthema*. *Pinna Hassiaca* was described on the basis of less well preserved material, consisting only of a top fragment. No other specimens were collected later and even the holotype has been lost (NEUFFER (1973)). The fragment, figured by STEUER (1912) shows however also a part of the ventral margin, very similar to that of *Atrina exanthema*.

— The species *A. fragilis* (PENNANT, 1777) and *A. pectinata* (LINNAEUS, 1758) clearly differ from the Oligocene species: the ventral side never curves as strongly as in *A. exanthema* (SPEYER, 1864), they have ribs, occasionally

developing into scales and a notch on the dorsal margin is often present in the first species.

*Atrina* sp. “*semiradiata*” (von KOENEN, 1893)

Pl. 1, Fig. 4.

- v 1836 *P. margaritacea* ? - NYST, p. 14-15 (non LAMARCK).
- v 1843 *Pinna affinis* SOW. ? - NYST, p. 275-276 (non SOWERBY).
- 1886 *Pinna dumonti* - G. VINCENT, p. 13 (*nomen nudum*).
- \* 1893 *Pinna semiradiata* v. KOENEN - VON KOENEN, p. 1062-1063, pl. 69 fig. 12.
- 1943 *Pinna semiradiata* VON KOENEN ? - ALBRECHT & VALK, p. 115 - 116, pl. 124 fig. 437.
- v 1954 *Pinna semiradiata* KOENEN, 1868 - GLIBERT & de HEINZELIN, p. 323.

MATERIAL: Coll. IRScNB: 15 fragments from Hoeselt, Lanaken (Smeermaas), Engelmanshoven, Velm, Bilzen and Vliermaal (Grimmertingen) (province Limburg, Belgium); Grimmertingen Sand Member, Lattorfian, Lower Oligocene.

LOCUS TYPICUS: Lattorf, near Bernburg, Germany.

STRATUM TYPICUM: Lattorfian, Lower Oligocene.

DESCRIPTION: The fragments, preserved in the IRScNB collection, consist only of parts of the nacreous layer of the shells, on which neither shell shape nor sculpture can be ascertained. They are not divided into two lobes. Some are rather flat, others more tumid. This could, as in *Atrina exanthema* (SPEYER, 1864), be due to age difference.

DISCUSSION: *Pinna dumonti* VINCENT (1886) was presented in a list and never described nor figured, so it is a *nomen nudum*. von KOENEN's name was first used in 1893. In his earlier work (1868) on the German Middle Oligocene, von KOENEN used the name *Pinna exanthema* SPEYER, but changed it to *P. semiradiata* in 1893. von KOENEN's (1893) type specimen is however too incomplete to define a species and the name should be considered a *nomen dubium*. Pending the discovery of better preserved material, the possible identity of *Atrina semiradiata* with *A. exanthema* should remain undecided.

*Atrina affinis* (SOWERBY, 1821)

Pl. 2, Figs. 1, 2, 3; Pl. 3, Fig. 1.

- \* 1821 *Pinna affinis* - J. SOWERBY, p. 55 - 56, pl. 10 fig. 1.
- 1824 *Pinna margaritacea* LAMK. - DESHAYES, p. 280-281 (non LAMARCK).
- v 1836 *Pinna margaritacea* LAMK. - NYST, p. 17.
- 1837 *Pinna margaritacea* LAMK. - DESHAYES, pl. 41 fig. 15 (non LAMARCK).
- v pp 1843 *Pinna margaritacea* LAM. - NYST, p. 274-275, pl. 20 fig. 9 (non LAMARCK).
- 1861 *Pinna affinis* J. SOWERBY - WOOD, p. 55, pl. 10 fig. 1.

- ? 1868 *Pinna fragilis* - WATELET, p. 148. (non PENNANT)
- ? 1887 *Pinna fragilis* WATELET - COSSMANN, p. 161, pl. 7 fig. 1.
- v 1894 *Pinna margaritacea* LMK. - E. VINCENT, p. 73-74, textfig. 1. (non LAMARCK).
- v 1894 *Pinna consobrina* nov. sp. - E. VINCENT, p. 74-75, textfig. 2.
- ? 1906 *Pinna fragilis* WATELET - COSSMANN & PISSARRO, pl. 39 fig 120.2.
- v 1907 *Pinna vincenti* nobis - COSSMANN, p. 202.
- ? v 1933 *Pinna margaritacea* LAMARCK, 1805 - GLIBERT, p. 129-130, pl. 7 fig. 19 (non LAMARCK).
- v pp 1936 *Pinna (Pinna) vincenti* COSSMANN, 1907 - GLIBERT, p. 46-47, pl. 1 fig. 14.
- v 1983 *Pinna margaritacea* LAMARCK, 1805 - GEYS & MARQUET, p. 70, pl. 26 fig. 1 (non LAMARCK).
- v 1983 *Pinna vincenti* COSSMANN, 1907 - GEYS & MARQUET, p. 72, pl. 27 fig. 2.
- v 1985 *Pinna* cf. *margaritacea* LAMARCK, 1805 - GLIBERT, p. 274-275 (non LAMARCK).

MATERIAL: Coll. Marquet: one specimen in shell conservation from Egem (Ampe Quarry), province West-Vlaanderen, Belgium; Egem Sand Member, Ypresian, Lower Eocene. Coll. Lauwers (St. Niklaas): one specimen, same locality.

Coll. IRScNB: one specimen of the same locality and layer. two steinkerns from Torhout, province West-Vlaanderen; 13 steinkerns from Ronse, 7 steinkerns from the Muziekberg, Ronse, one steinkern from Ten Abeele, Ronse, one steinkern from Geraardsbergen, 5 steinkerns from Erwetegem, 13 steinkerns from Sint Antelinks, all province Oost-Vlaanderen; 7 steinkerns from Anderlecht, one steinkern from Ukkel, 6 steinkerns from the Isberg, Schepdaal, 8 steinkerns from Vlasendaal, Anderlecht, three steinkerns from Dilbeek, three steinkerns from Neerpede, Anderlecht, all province Brabant; 12 steinkerns from Beaufaux, Ellezelles, 88 steinkerns from the Mont Panisel, Mons, 13 steinkerns from Frasnes-lez-Buissenal, 11 steinkerns from Ellezelles, two steinkerns from Pâturages, all province Hainaut; all Panisel Fo., Y2, Ypresian, Lower Eocene.

Fragments from Oedelem, West-Vlaanderen; Oedelem Sand Member, Knesselare Fo., Lutetian. two fragments from Aalter and one from Ghent, both province Oost-Vlaanderen; Aalter Sand Member, Knesselare Fo., Lutetian, Middle Eocene.

One steinkern from Oudergem, 8 steinkerns from Melsbroek, three steinkerns from Ukkel, one steinkern from Brussels, 6 shell fragments from Nederokkerzeel, two shell fragments from Oudergem, all province Brabant; Brussels Fo., Lutetian, Middle Eocene.

14 steinkerns from St. Gillis, province Brabant; Laeken Sand Member, Lede Fo., Lutetian. 13 shell fragments from Neder-Over-Heembeek (including the lectotype no 49 of *Atrina vincenti* (COSSMANN, 1907), two shell fragments from Laken, 10 shell fragments from Wemmel, one shell fragment from Jette, all province Brabant; all Wemmel Fo., Bartonian, Upper Eocene.

LOCUS TYPICUS: Bognor Regis, Hampshire, U.K.

STRATUM TYPICUM: London Clay, Lower Eocene.

DIAGNOSIS: A small *Atrina* species, with dorsal and posterior margin forming an angle of more than 90°, slightly

curved posterior and ventral margins and about 8 ribs on the dorsal side, which never develop spines nor scales.

DESCRIPTION: This is mainly based on the Egem specimens, with shell conservation. The most complete specimens measure 8 x 4,2 x 1,7 cm (bivalved specimen) and 8,9 x 4,7 x 0,9 cm (one valve). The steinkerns studied are all of the same size range. The species is consequently rather small. The dorsal margin is straight. It forms with the posterior margin a clear angle of 93° and 100° in the two best specimens. In the steinkerns, the angle is also always larger than 90°. The posterior margin is nearly straight and slightly rounded where it meets the ventral margin. The ventral margin is also nearly straight and forms a very slightly concave arc near the posterior margin. The top angle is 40°.

The best specimens possess 7 and 10 ribs on the dorsal shell part, till about 1/4 or 3/4 of the distance to the ventral margin. The number and development of the ribs is consequently strongly variable. The ribs are most pronounced in the area, closest to the umbo, to about half the shell length. They diminish then quickly. No spines or scales are present. Growth lines are visible, but they never develop into plicae.

DISCUSSION: The Egem specimens agree very well with WOOD's (1861) figure pl. 10 fig. 1, which shows a slightly larger shell with strong ribs. DESHAYES (1837) figured a very similar shell, under the name *Pinna margaritacea*. *P. margaritacea* LAMARCK, 1805, however, belongs to the genus *Pinna* instead of *Atrina*. The interpretation of DESHAYES (1824) for the Paris Basin *Atrina* species was subsequently adopted by NYST (1843), who simply copied on his pl. 20 fig 9 DESHAYES (1824) figure. Later Belgian authors: GLIBERT, VINCENT and GEYS & MARQUET used the name *Pinna margaritacea* sensu DESHAYES.

— The name *Pinna fragilis* WATELET, 1868 for shells from the Cuisian of the Paris Basin is preoccupied by *P. fragilis* PENNANT, 1777. It is not certain what exactly WATELET (1868) intended with this name, because he gave no figure and only a rather vague description. The specimen, on which his description was based, seems to have been lost, because COSSMANN (1887) and COSSMANN & PISSARRO (1906) only figured small fragments, however undoubtedly belonging to the genus *Atrina*.

— *Pinna consobrina* VINCENT, 1894 was renamed *P. vincenti* by COSSMANN (1907), because the name was preemployed. No complete specimens of this taxon exist. The fragments, present in the IRScNB collection, are of an *Atrina* specimens of the same size as those from Egem, with a comparable shape, as far as can be ascertained. The high rib number, which was considered by VINCENT (1894) as an important differentiating character, is too variable in the genus *Atrina* to justify a species separation.

— *A. affinis* differs clearly from the Alpine Bartonian species *Atrina helvetica* (MAYER-EYMAR, 1861), which possesses no ribs and is much larger, broader and has a

rounded posterior margin. It was figured by BOUSSAC (1911), pl. 7 fig. 22, not fig. 30.

— From the British Eocene, two further *Atrina* taxa were described, *A. arcuata* (SOWERBY, 1821) and *A. pyriformis* (WOOD, 1861); both were figured by WOOD (1861) pl. 11 fig 8 and 10 respectively. Both differ from *A. affinis* (SOWERBY, 1821) by their tumid shells, which have a strongly convex, instead of nearly straight, ventral margin. Herein, they somewhat resemble the Oligocene species *A. exanthema* (SPEYER, 1864).

**OCCURRENCE:** *Atrina affinis* seems to have a long time range, occurring from Ypresian to Bartonian strata. Its geographic distribution includes the Hampshire Basin, the Paris Basin and the Belgian Eocene outcrops.

In Egem, the species is found in the sandy middle part of the Egem Sand Member, not in the top "falun" level with *Megacardita planicosta lerichei* (GLIBERT & VAN DE POEL, 1970). It is also absent from the overlying sandstone beds. The specimens were found in widely separated small clusters of 3 to 5 individuals. In the Mont Panisel sandstone in Mons, the species occurs more frequently, forming also clusters of 5 to 10 individuals.

The fragments from Oedelem, Ghent and Aalter, mentioned in GLIBERT (1958) are very small and nearly unidentifiable. They might belong to *Atrina*.

*Atrina propinqua* (E. VINCENT, 1894)  
Pl. 3, Figs. 2, 3.

v\* 1894 *Pinna propinqua* nov. sp. - E. VINCENT, p. 75-76, textfig. 3.

**MATERIAL:** Coll. IRScNB: 21 steinkerns from Saint-Jean-Geest, 12 steinkerns from Angre, 5 steinkerns from Chercq, one steinkern from Bouffioulx, one steinkern from Calonne, all province Hainaut; 10 steinkerns from Tournoy, Hingeon, province Namur; three steinkerns from Wansin, province Liège; all Landen Formation, Thanetian, Upper Paleocene.

**TYPE MATERIAL:** VINCENT (1894) did not designate a type and his textfig. 3 is a composition of different fragments. Therefore, the specimen no 6172 TCTI in

the IRScNB is herein formally designated as the lectotype of *Pinna propinqua* VINCENT.

**LOCUS TYPICUS:** St. Jean Geest, SW of Tienen, Brabant, Belgium.

**STRATUM TYPICUM:** Landen Formation, Thanetian, Upper Paleocene.

**DIAGNOSIS:** A rather small *Atrina* species, with convex dorsal margin and with sculpture consisting of ribs on the complete shell surface, crossed by nearly equally strong concentric lines.

**DESCRIPTION:** The lectotype, an incomplete steinkern, measures 9,5 x 4,9 x 4,2 cm. The top angle is 25°. No even nearly complete specimen is known. The dorsal margin is straight. The posterior margin is in none of the specimens studied present. The ventral margin is slightly curved, so that the postero-ventral part is rather convex. The shell is rather tumid. The sculpture consists of ribs, covering the complete shell surface (9 ribs on 1 cm), crossed by concentric lines (8 on 1 cm), which are only slightly less well pronounced than the ribs. The distance between the ribs and the concentric lines is small and the same for both sculpture elements.

**DISCUSSION:** *Atrina propinqua* differs clearly from the Eocene *A. affinis* (SOWERBY, 1821) by its tumid shell, curved ventral margin and characteristic sculpture. Its shape comes closer to that of both other British Eocene *Atrina* taxa: *A. arcuata* (SOWERBY, 1821) and *A. pyriformis* (WOOD, 1861), but these taxa both lack the characteristic sculpture of the Paleocene species.

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## Explanation of Plates

## PLATE 1

- Fig. 1a — *Atrina exanthema* (SPEYER, 1864). Left valve. Ruisbroek, province Antwerp, Belgium; Bassevelde Sand Member, Rupel Formation, Middle Oligocene. NNM RGM 393148. X 0,48.
- Fig. 1b — Same specimen, right valve. X 0,54.
- Fig. 2 — *Atrina fragilis kalloensis* n. subsp. Holotype IRScNB-IST n° 6173. Left valve. Kallo, province Oost Vlaanderen; Oorderen Sand Member, Lillo Formation, Middle Pliocene. X 0,45.
- Fig. 3 — *Atrina exanthema* (SPEYER, 1864). Topotype NNM RGM 393370. Right valve. Söllingen, Niedersachsen, Germany; Chattian A, Upper Oligocene. NNM RGM 393370. X 0,60.
- Fig. 4 — *Atrina "semiradiata"* (von KOENEN, 1864). Fragment of left valve. Hoeselt, province Limburg; Grimmeringen Sand Member, Lattorfian, Lower Oligocene. IRScNB-IST n° 6236. X 1,47.

## PLATE 2

- Fig. 1 — *Atrina affinis* (SOWERBY, 1821). Steinkern of left valve. Muziekberg, Ronse, province Oost Vlaanderen; Panisel Formation, Ypresian, Lower Eocene. IRScNB-IST n° 6231. X 1,86.
- Fig. 2 — *Atrina affinis* (SOWERBY, 1821). Steinkern of right valve. Oudergem, Brussels, province Brabant; Laeken Sand Member, Lede Formation, Middle Eocene. IRScNB-IST n° 6232. X 1,57.
- Fig. 3 — *Atrina affinis* (SOWERBY, 1821). Left valve. Egem, province West Vlaanderen; Egem Sand Member, Ypresian, Lower Eocene. IRScNB-IST n° 6233. X 1,27.
- Fig. 4 — *Pinna margaritacea* LAMARCK, 1805. Side view of bivalved specimen. Zellik, province Brabant; Wemmel Formation, Bartonian, Upper Eocene. IRScNB-IST n° 6234. X 1,07.
- Fig. 5a — *Atrina fragilis kalloensis* n. subsp. Fragment with outside view of prodissoconch. Kallo, province Oost Vlaanderen; Oorderen Sand Member, Lillo Formation, Middle Pliocene. IRScNB-IST n° 6235. X 38.
- Fig. 5b — Same specimen, inside view.

## PLATE 3

- Fig. 1 — *Atrina affinis* (SOWERBY, 1821). Holotype of *Pinna vincenti* COSSMANN, 1907. IRScNB-IST n° 49. Neder-over-Heembeek, province Brabant; Wemmel Formation, Bartonian, Upper Eocene. X 1,46.
- Fig. 2a — *Atrina propinqua* (E. VINCENT, 1894). Lectotype. IRScNB-IST n° 6172. Side view of steinkern. Saint-Jean-Geest, province Brabant; Landen Formation, Thanetian, Upper Paleocene. X 1,23.
- Fig. 2b — Same specimen. Negative, showing the sculpture. X 1,63.
- Fig. 2c — Same specimen. Left valve of steinkern. X 1,21.
- Fig. 3a — *Atrina propinqua* (E. VINCENT, 1894). Side view of steinkern. Saint-Jean-Geest, province Brabant; Landen Formation, Thanetian, Upper Paleocene. IRScNB-IST n° 6230. X 1,21.
- Fig. 3b — Same specimen, negative, showing the sculpture. X 2,08.

Plate 1.

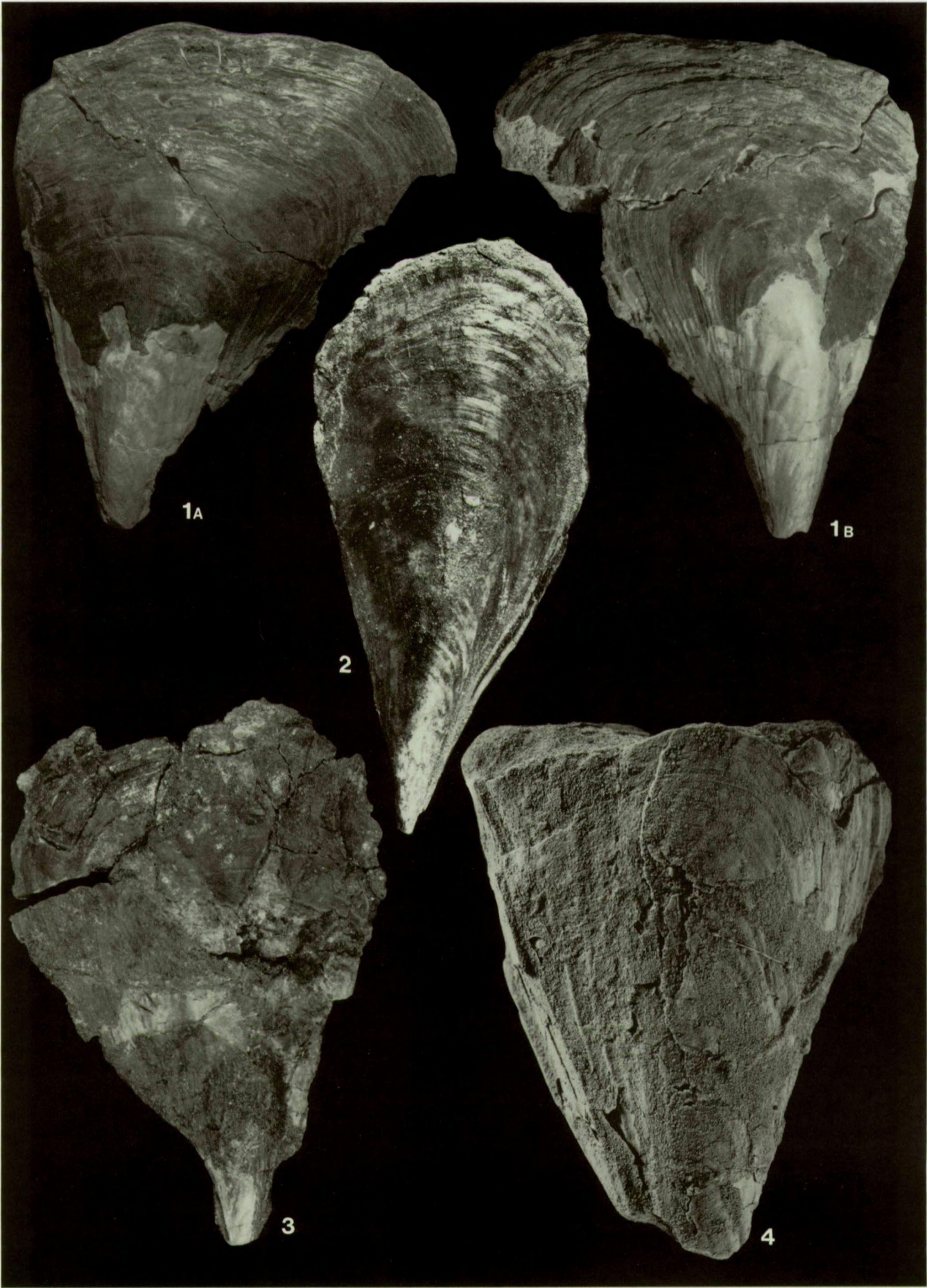


Plate 2.

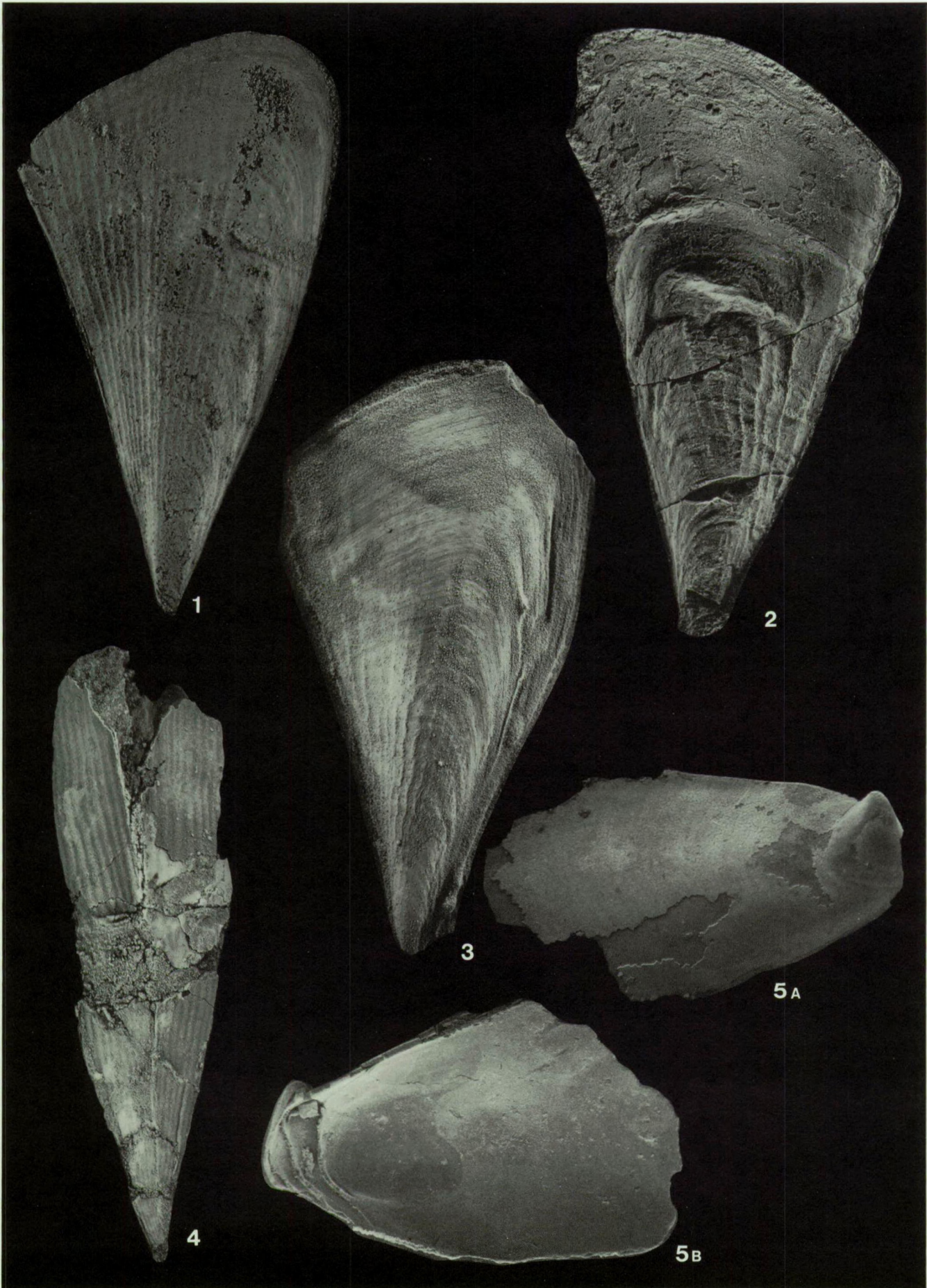


Plate 3.

