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FOSSIL AND RECENT *LUTRARIA* (MOLLUSCA, BIVALVIA) IN EUROPE, WITH DESCRIPTIONS OF FOUR NEW SPECIES

by

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Miocene to Recent European *Lutraria* material in several Dutch collections was systematically revised. Ten species could be distinguished, viz. *Lutraria angustior* Philippi, 1844 (? Pliocene/? Early Pleistocene to Recent), *L. expansa* Dollfus, Berkeley Cotter & Gomes, 1903 (Miocene to ? Pliocene), *L. frangula* n. sp. (Miocene), *L. latissima* Deshayes, 1831 (Miocene), *L. lutraria* (Linné, 1758) (Pleistocene to Recent), *L. magna* (da Costa, 1778) (Miocene to Recent), *L. obliqua* n. sp. (age unknown, but probably Late Holocene), *L. procera* n. sp. (Pliocene), *L. scaldensis* n. sp. (Pliocene) and *L. vindobonensis* Sacco, 1901 (Miocene).

Six species (*angustior, frangula, lutraria, magna, obliqua* and *scaldensis*) are known from the Netherlands.

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Contents:

INTRODUCTION

The present paper is a revision of European *Lutraria* material at my disposal, mainly from the collections of the Rijksmuseum van Natuurlijke Historie, Leiden (RMNH), the Rijksmuseum van Geologie en Mineralogie, Leiden (RGM), the Rijks Geologische Dienst, Haarlem (RGD), the Natuurhistorisch Museum Rotterdam, Rotterdam (NMR) and the extensive material in the collection of Mr A.W. Lacourt, Leiden (Lac.), together with additional material from several other collections and from own samplings (U.).

Most of the palaeontological work in the past was carried out on a local scale. The present paper is an attempt towards a revision of a genus on a European scale and, as it is believed, one of the very few examples as such.

It is almost certain, that several additional fossil species occur in Europe, but this is only a revision of the material available for the moment.

With about 150 (!) names in the genus, it seems odd to describe four new species, but the literature has been worked through very carefully and no other solution could be found. Each case is discussed in detail under the respective species.

I am indebted to the following persons: Mr W.A.M. Devilé (RGM), Dr E. Gittenberger (RMNH), Mr R.E. Hamstra (NMR), Mr H. van Haren (Den Haag), Mr A.W. Janssen (RGM), Mr A.W. Lacourt (Leiden), Mr J.H. van Os (Leiden) and Mr L. van der Slik (Rotterdam). If their names and those of several others have not been mentioned in the text, I would like to express here my special thanks for their kind help in many and various ways.

SPECIES AND CHARACTERS

The species in the genus *Lutraria*, more especially those in *Lutraria* s.s., are of a similar general appearance, and may be confused easily.

The distinguishing characters are in general of a relative or quantitative nature rather than of an absolute value. As an exemple may serve the comparative breadth of the ligament-pit and the length of the cardinal teeth in the left valve. It should be noticed, that given measurements in such cases should be looked upon as tentative. Thus 'cardinal teeth reaching about 3/4 the distance to the lower margin of the hinge-plate' may be translated in something like: 2/3-3/4, but clearly longer than half the distance. The material (with the exception of the three recent species *L. lutraria, angustior* and *magna*) was too scarce or too fragmentary for biometrical researches, though *Lutraria* would certainly provide an excellent group for carrying out such work.

Despite the rather delicate nature of many features I found the species to be well-defined and well-separated by combinations of characters. It should be emphasized, that the illustrations form an indispensable element for the identification, since even the best or most elaborate description would fail to give an impression of e.g. general appearance and outline, still less of their differences in related species. The drawings, though schematical, are made as accurate as possible from a taxonomic point of view, but slight deviations in the measurements may occur as a result of the fact, that a convex shell had to be projected on two-dimensional paper.

The last numbers (28-33) of the identification key are given intentionally. They may provide at least some helpful additional characters, but should be tested further for their value and, for this reason, have not been included in the original descriptions.

NOTE ON THE LITERATURE

There is a wealth of names in the genus, at least some 150 for Europe alone! These names are partly connected again with non-European species, either from adjacent regions, or other parts of the world - from South Africa to Japan. Since these species are described insufficiently in many cases, and illustrated poorly, extensive study of type-material would be required to put at least some order in matters. Mayer (1867) for instance describes 12 new species in such inadequate terms and without giving any illustrations, that hardly one of his species can be properly recognized. And this is only one example.

Of course there are exceptions. In Hoernes (1870) the species are so marvellously illustrated - also from the inside! - that one could draw up an almost complete description from it. A recent example, both as to descriptions and figures, is the work of Holme (1959) with its perfect discrimination of *L. angustior* from *L. lutraria*.

It will be obvious, that in the list of references under the species described here, all such problematic cases as mentioned above were omitted.

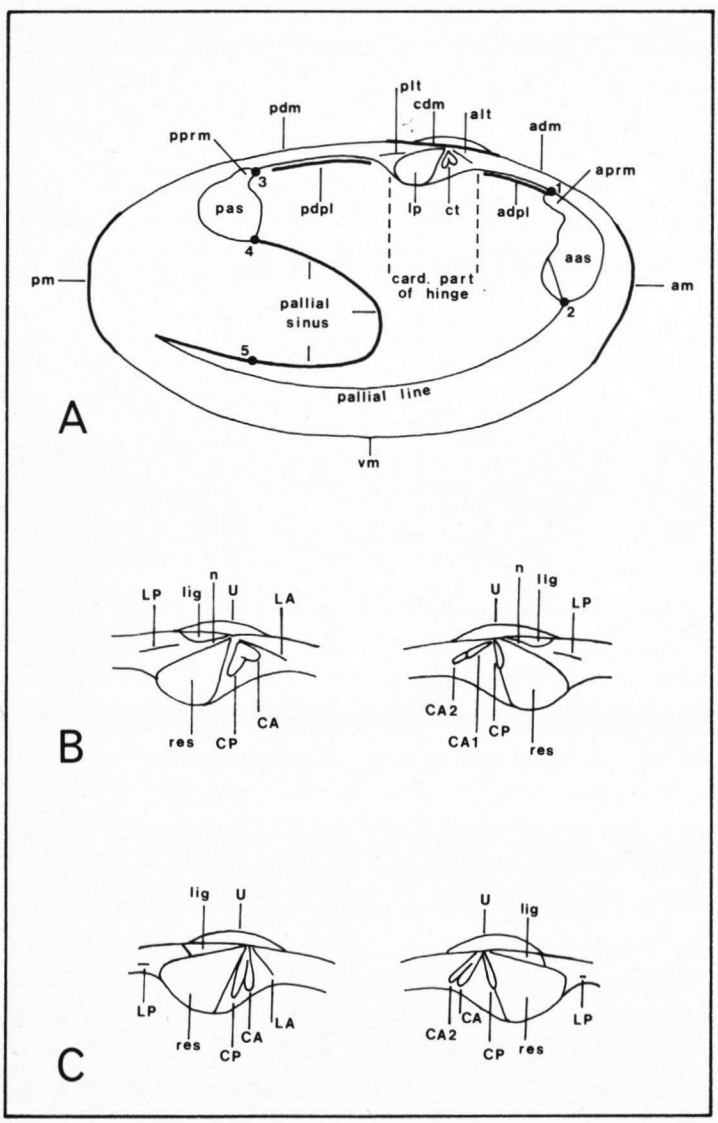


Fig. 1. Morphology of *Lutraria*.

A. Inner view of *L. lutraria*.

1-2 height of anterior adductor scar
3-4 height of posterior adductor scar;
4-5 height of pallial sinus.

aas - anterior adductor scar
adm - anterior dorsal margin
adpl - anterior dorsal pallial line
alt - anterior lateral tooth
am - anterior margin
aprm - anterior pedal retractor muscle
cdm - central dorsal margin
ct - cardinal tooth
lp - ligament-pit (= resilium)
pas - posterior adductor scar
pdm - posterior dorsal margin
pdpl - posterior dorsal pallial line
plt - posterior lateral tooth
pm - posterior margin
pprm - posterior pedal retractor muscle
vm - ventral margin

B. Hinge of *L. lutraria*.

C. Hinge of *L. magna*.

CA - anterior cardinal tooth
CP - posterior cardinal tooth
LA - anterior lateral tooth
lig - ligament
LP - posterior lateral tooth
n - nymph
res - resilium (= ligament-pit)

SUBDIVISION

The species described here comprise a heterogeneous group, which may be divided as follows:

1. *Lutraria* s.s.

In this group belong *L. lutraria, L. angustior, L. scaldensis, L. latissima* and *L. procera*), with the hinge-formula:

left valve: LP lig. n res. CP CC CA LA
right valve: LP lig. n res. CP CC CA –

The anterior cardinal tooth in the right valve (CA) gives rise to different interpretations. Holme (1959) writes that there are 'two imbricating teeth, one lying beyond the other, and both point in the same direction', or for short 'two imbricating teeth in line', considering both teeth as cardinals, the same as it is done here. Lamy (1917) is of the opinion, that the lower tooth actually represents the otherwise missing anterior lateral tooth. But the construction of two imbricating teeth also occurs in genera of the related family Mactridae with well-developed lateral teeth, and here the author writes about a 'lamelle accessoire' or 'accessory ridge'.

The posterior cardinal tooth in the left valve (CP) is defined by Holme (1959) as 'a thin, tongue-shaped tooth at the side of the cartilage pit, behind the second cardinal tooth. It is present in all three species - but is broken off in the majority of dead shells -.' In a few young specimens of *L. lutraria* I found this tooth to be clearly developed and about half the length of the adjacent cardinal tooth.

The nymph (n) in *L. lutraria* is low and inconspicuous. In fresh specimens it is covered by ligament and resilium and in older ones it is invariably broken off. As far as I can see it is also present in *L. angustior*, but as to the other, fossil species of the group this remains an open question.

The lateral teeth (LP, LA) in all species are low but well-marked, even in fossil material.

2. *Lutraria (Psammophila)*

The hinge differs from *Lutraria* s.s. by the absence of a nymph, the very weak and short posterior lateral tooth which almost or entirely disappears in full-grown specimens, and by the long cardinal teeth in both valves, lying close together. The only known representative, *L. magna*, usually has the posterior part of the shell curved upwards, but straight forms also occur. The hinge-formule is:

left valve: (LP) lig. res. CP CC CA LA
right valve: (LP) lig. res. CP CC VA –

It seems questionable, whether the differences with *Lutraria* s.s. are sufficient to justify a separate genus or even subgenus. If we do so the consequence will be, that the species under consideration here, have to be subdivided into five or six different genera or subgenera.

3. *Lutraria obliqua*

The hinge differs from that of the other species mentioned here by the deep groove running between the posterior dorsal shell margin and the posterior margin of the ligament pit, this groove stretching up quite to the umbo.

There seems to be a short but pronounced tooth bordering the posterior margin of the ligament pit near the top, but its interpretation has to be left open for the moment.

Otherwise the whole appearance of the shell is that of a *Lutraria* s.s.

4. *Lutraria expansa*

The hinge is built up in the same way as in *Lutraria* s.s. with the only difference that the teeth are high and markedly developed. The shell, however, has a quite different appearance on account of its strongly widened posterior part. Whether a nymph is present or absent could not be decided from the (fossil) material.

5. *Lutraria frangula*

The hinge differs from that of the other species mentioned here by the presence of two posterior lateral teeth in the right valve. Like in *L. expansa* the teeth are high and pronounced. A nymph may be present or absent.

6. *Lutraria vindobonensis*

The hinge in the left valve is marked by a strongly developed posterior cardinal tooth, situated on the anterior margin of the ligament pit, of the same length as the other cardinal teeth and hardly narrower. It seems likely, that the corresponding anterior cardinal tooth in the right valve is equally developed, but in the material at my disposal it is broken off.

Otherwise the hinge is built up in the same way as in *Lutraria* s.s. A nymph may be present or absent.

USE OF THE SYNOPTICAL KEY

For those, who are not familiar with the type of key presented here (a 'synoptical key'), one or two examples may be given to demonstrate its use.

Suppose we have an adult specimen of *L. expansa*; the identification in this case may run then as follows:

	1	2	3	4	5	6	7	8	9	10
There are ten species										
1a refers to species:	1						7	8		10
Species 2 3 4 5 6 9 are excluded!										
2b refers to species:								8		10
Species 1 and 7 are excluded.										
3-5 do not distinguish between the										
remaining species 8 and 10, but										
6a refers to species:								8		
which is *L. expansa*!										

We have started here with key number 1, but this is not necessary; actually it is possible to start from any point in the key and to follow any sequence.

For instance with *L. lutraria*

	1	2	3	4	5	6	7	8	9	10
10a refers to species:	1			4			7		9	
15a refers to species:	1						7			

Species 2 5 8, also mentioned under 15a were already excluded.

22a refers to: 1

Still shorter:

	1	2	3	4	5	6	7	8	9	10
22a refers to:	1									

= *L. lutraria*!

Once an identification has been made, one can get a complete description of the species by following its number throughout the key.

The differences between such related species as *L. lutraria* and *L. angustior* may be found in a similar way. Where the species numbers 1 and 2 are placed at a different level, the species differ in the corresponding characters. On the other hand, when the species numbers are placed at the same level, the species will agree in the mentioned character.

As has been stated before, the characters in *Lutraria* are often rather delicate. In case of doubt, for instance between 9b or c, it is advised to take both numbers into consideration, excluding 9a only.

It is obvious, that a reliable identification in a group like *Lutraria* can only be acquired by checking a number of different characters, even if a correct name may be found in certain cases by checking one key number only.

KEY FOR THE IDENTIFICATION OF *LUTRARIA* SPECIES

The numbers 1-10 refer to the following species of *Lutraria*:

	1	2	3	4	5	6	7	8	9	10
SHAPE AND DIMENSIONS (nrs. 1-14)										
(incl. thickness and dimensions)										
Adult shell (nrs. 1-2)										
1a thin and fragile	1						7	8		10
b moderately solid	1	2	3							
c thick and solid				4	5	6			9	

		1	2	3	4	5	6	7	8	9	10
2	approximate length of an adult specimen										
a	small (3.9 cm)							7			
b	medium-sized (resp. 6.5 and 8.7 cm)								8		10
c	large (10 cm or more)	1	2	3	4	5	6			9	
d	very large (up to ± 15 cm)	1			4						
Outline (nrs. 3-4)											
3a	oval, broadest near the umbo, or (species 4 and 8) at the posterior end	1			4	5		7	8	9	10
b	elliptical, of nearly equal breadth throughout		2		4		6				
c	slightly triangular			3							
4a	umbo rather pronounced			3	4	5		7	8	9	10
b	umbo in about one line with the dorsal margins	1	2				6		8		
Posterior part (nrs. 5-6)											
5a	straight	1	2	3	4	5	6	7	8	9	10
b	curved upwards				4						
6a	of about the same breadth as the anterior part	1	2	3	4	5	6	7		9	10
b	more or less broadened				4						
c	much broadened								8		
Margins (nrs. 7-14)											
7a	anterior margin rounded	1		3		5	6	7	8	9	10
b	often nearly straight in its centre		2		4						
8a	posterior margin rounded	1	2	3	(4)	5	6	7	8		10
b	truncate				4					9(?)	
9a	ventral margin straight or nearly straight in its central part		2	3			6				
b	rather strongly curved	1		3							10
c	strongly curved	1			4	5		7	8		
10a	anterior dorsal margin convex (strongly in species 4 and 9)	1			4			7		9	
b	straight		2	3		5	6		8		
c	slightly convex or (nearly) straight										10
11a	posterior dorsal margin convex	1									
b	straight		2	3	4	5	6	7	8	9	
c	concave				4						
d	slightly concave behind the umbo				(4)						10

		1	2	3	4	5	6	7	8	9	10
12a	anterior and posterior dorsal margins nearly in one line	1					6		8		
b	forming at the umbo a more or less pronounced angle		2		4	5		7	8	9	10
c	at the umbo nearly in one line, but before and behind the hinge at a more or less pronounced angle			3						9	10
13a	anterior dorsal margin at an angle of about 90°, or somewhat more, with the anterior margin		2				6		8		10
b	much more	1		3	4	5		7		9	
14a	posterior dorsal and posterior ventral margins nearly parallel		2				6				
b	diverging	1		3	4	5		7	8	9	10
c	markedly diverging			3	4	5		7	8		
HINGE (nrs. 15-21)											
Hinge-plate (nrs. 15-16)											
15a	before and behind the umbo of about equal breadth	1	2			5		7	8		
b	behind the umbo (markedly) narrowing towards the posterior adductor scar			3	4		6			9	10
Cardinal teeth (nrs. 16-17)											
16a	cardinal teeth in the left valve reach the lower margin of the hinge-plate				4		6?				
b	reach about halfway the distance	1	2			5		7	8		10
c	reach about 3/4 the distance			3			6			9	
17a	cardinal teeth in the left valve at an angle of about 90° or even more (in species 6)	1					6				
b	about 75°-90° (± 75°-80° in species 2)	1	2								
c	about 45°			3		5		7	8	9	10
d	close together				4		6?				
Ligament-pit (nrs. 18-20)											
18a	about 1/2 the breadth of the cardinal hinge-part	1		3		5		7	8		10
b	(slightly) broader		2				6			9	
c	about 2/3				4						
19a	anterior margin of ligament-pit perpendicular (at an angle of about 90°) to the lower margin of the hinge-plate									9	
b	oblique (at an angle of about 45°)	1			4	5	6	7			10
c	slightly oblique		2	3	4				8		

		1	2	3	4	5	6	7	8	9	10
20a	posterior margin of ligament-pit fused over its entire length with the posterior dorsal margin				4						
b	fused to about 3/4 of its length		2			5?	6				
c	to about 1/2	1		3		5?			8		10
d	separated over its entire length from the posterior dorsal margin									9	
Lateral teeth (nr. 21)											
21a	strongly developed and well-marked (in species 10: two posterial lateral teeth in the right valve)							7	8		10
b	medium developed, but clearly visible	1	2	3		5	6			9	
c	short and inconspicuous, if present				4						
MUSCLE SCARS (nrs. 22-33)											
Pallial sinus (nrs. 22-24)											
22a	ventral part of pallial sinus free from the pallial line throughout its length	1									
b	partly fused posteriorly with the pallial line		2	3		5	6	7			
c	fused with the pallial line throughout its length				4				8	9	10
23a	dorsal line of the pallial sinus nearly horizontal; the pallial sinus of about equal width throughout		2				6				
b	dorsal line directed downwards; the pallial sinus narrowing inwards	1		3	4	5		7	8	9	10
24a	width of the pallial sinus slightly exceeding the height of the posterior adductor scar		2		4						
b	± 1.5 x	1				5		7			
c	± 2 x	1		3			6		8	9	10
Pallial line (nrs. 25-26)											
25a	upper posterior pallial line distinctly diverging from the posterior shell margin	1		3	4	5					10
b	slightly diverging		2		4		6	7	8		
c	parallel with									9	
26a	upper posterior pallial line here straight or nearly straight		2	3	4		6		8	9	
b	convex	1	2			5	6	7			10
Anterior adductor scar (nrs. 27-31)											
27a	breadth/height ratio ± 1:1.5		2				6				
b	± 1:2	1		3	4	5			8	9	10
c	± 1:2.5							7			

		1	2	3	4	5	6	7	8	9	10
28a	height axis (in the left valve) directed vertically or nearly vertically	1		3	4	5		7			10
b	directed NE-SW									9	
c	directed NW-SE		2				6		8		
29a	horizontally connected with the pallial line	1	2	3			6				
b	obliquely						6		8		
c	at an angle of about 90°				4	5		7		9	10
30a	inner line deeply incised in, or just above, the middle	1		3	4						10
b	curved inwards at its upper part resp. near the top		2				6	7	8	9	
c	straight or nearly straight					5					
31a	ratio between its breadth and the length of the adjoining anterior dorsal pallial line ± 1 : 1.5							7		9	
b	± 1 : 1	1				5					
c	± 1.5 : 1			3					8		10
d	± 2 : 1		2		4		6				
Posterior adductor scar (nrs. 32-33)											
32a	breadth/height ratio ± 1 : 1.5									9	
b	± 1 : 1	1						7	8		10
c	breadth slightly exceeding the height		2			5					
d	± 1.5 : 1 (in species 3 excl. the footretractor scar)			3	4		6				
33a	ratio between its breadth and the length of the adjoining posterior dorsal pallial line ± 1 : 1 (or slightly more)		2				6		8		
b	± 1 : 1.5	1		3	4	5					10
c	± 1 : 2							7		9	

SYSTEMATICAL PART

Lutraria lutraria (Linné, 1758)
Text-fig. 2a

1758 *Mya lutraria* Linné, p. 670.
1801 *Lutraria elliptica* Lamarck, p. 120
1818 *Lutraria elliptica* Lamarck - Lamarck, p. 468 (excl. var. b).
1836 *Lutraria elliptica* Lamk. - Philippi, p. 9 (pro parte).
1844 *Lutraria elliptica* Lamk. var. *latior* Philippi, p. 7.
1848 *Lutraria elliptica* Lamarck - Forbes & Hanley, pl. 12, p. 370.

1853 *Lutraria elliptica* Lamarck - Forbes & Hanley, p. 370.
1854 *Lutraria elliptica* Lamarck - Reeve, pl. 1, fig. 3.
1863 *Lutraria elliptica* Lamarck - Jeffreys, p. 428 (excl. var. *alterutra*).
1869 *Lutraria elliptica* Lamarck - Jeffreys, pl. 44, fig. 1.
1896 *Lutraria lutraria* Linné - Bucquoy, Dautzenberg & Dollfus, p. 566, pl. 83, fig. 1-4 (excl. var. *angustior*).
1913 *Lutraria elliptica* Lamarck - Lamy, p. 344.
1917 *Lutraria lutraria* Linné - Lamy, p. 360 + fig. p. 360 (excl. var. *angustior*).
1937 *Lutraria lutraria* (Linné) - van Regteren Altena, p. 89 (pro parte).
1943 *Lutraria lutraria* (Linné) - van Benthem Jutting, p. 284, fig. 105.
1959 *Lutraria lutraria* (L.) - Holme, p. 560, fig. 1A, 2A, 3A, 4A, C; pl. 2, fig. 1-3, 6.
1965 *Lutraria lutraria* (L.) - Entrop, p. 124 (excl. fig. 75).
1966 *Lutraria lutraria* (Linnaeus) - Tebble, p. 133, fig. 69.
1969 *Lutraria (Lutraria) lutraria* (Linné) - Moore, p. N 604, fig. E 97, 5a-e.
1969 *Lutraria lutraria* (Linné) - Nordsieck, p. 143, pl. 20, fig. 81.60.
1975 *Lutraria (Lutraria) lutraria* (Linné) - Janssen, p. 127.
1976 *Lutraria (Lutraria) lutraria* (L). - Brambilla, p. 113 (pro parte).

Description: read key numbers, species 1.

Characteristic features:
- the pallial sinus, separated from the ventral pallial line over its entire length; this free pallial sinus is typical and not present in any of the other species mentioned here.
- the oval outline, in combination with
- the curved dorsal margins which are in one line, or almost in one line, before and behind the umbo.
- the rather narrow ligament pit occupying about half the central hinge-part, and in combination with this
- the oblique anterior margin of the ligament pit.
- the cardinal teeth in the left valve which form an angle of (nearly) 90°; in the other species (with the exception of *L. angustior* and *L. procera*) these teeth form an angle of no more than ± 45°-60°, and in *L. magna* even much less.

For differences with *L. angustior*, with which it is most likely to be confused, see also that species.

Geographical distribution: Norway - Mediterranean; also reported from West-Africa.

Mr J.A. Sneli (Trondheim, Norway) informs me, that the species is extremely common there (pers. comm.). At the same time this is the northernmost locality known to me, but in the literature (Nordsieck, 1964; Parenzan, 1976) the Lofoten are mentioned as such.

The great majority of specimens washed ashore along the Dutch coast has a more or less fossil appearance, being dark blue or brown, but part of the valves from the northern islands (especially in samples from the island of Terschelling) seems to be in a more fresh condition. In a recent paper (Doeksen, 1979) the author reports fresh material from the islands of Terschelling and Schiermonnik oog, altogether 44 specimens from 1976-1978. This in sharp contrast with his other records of fresh material from the Dutch coast: 8 specimens from Scheveningen, Zandvoort and Schiermonnikoog since 1940. In the same paper fresh material from dredgings is mentioned: Texelse stenen, lightship Texel, N. of Terschelling, off the Zeeland coast.

Holme (1959, 1961) gives records from the English Channel coast.

In France it is to be expected all along the coast where the habitat is suitable, together with the

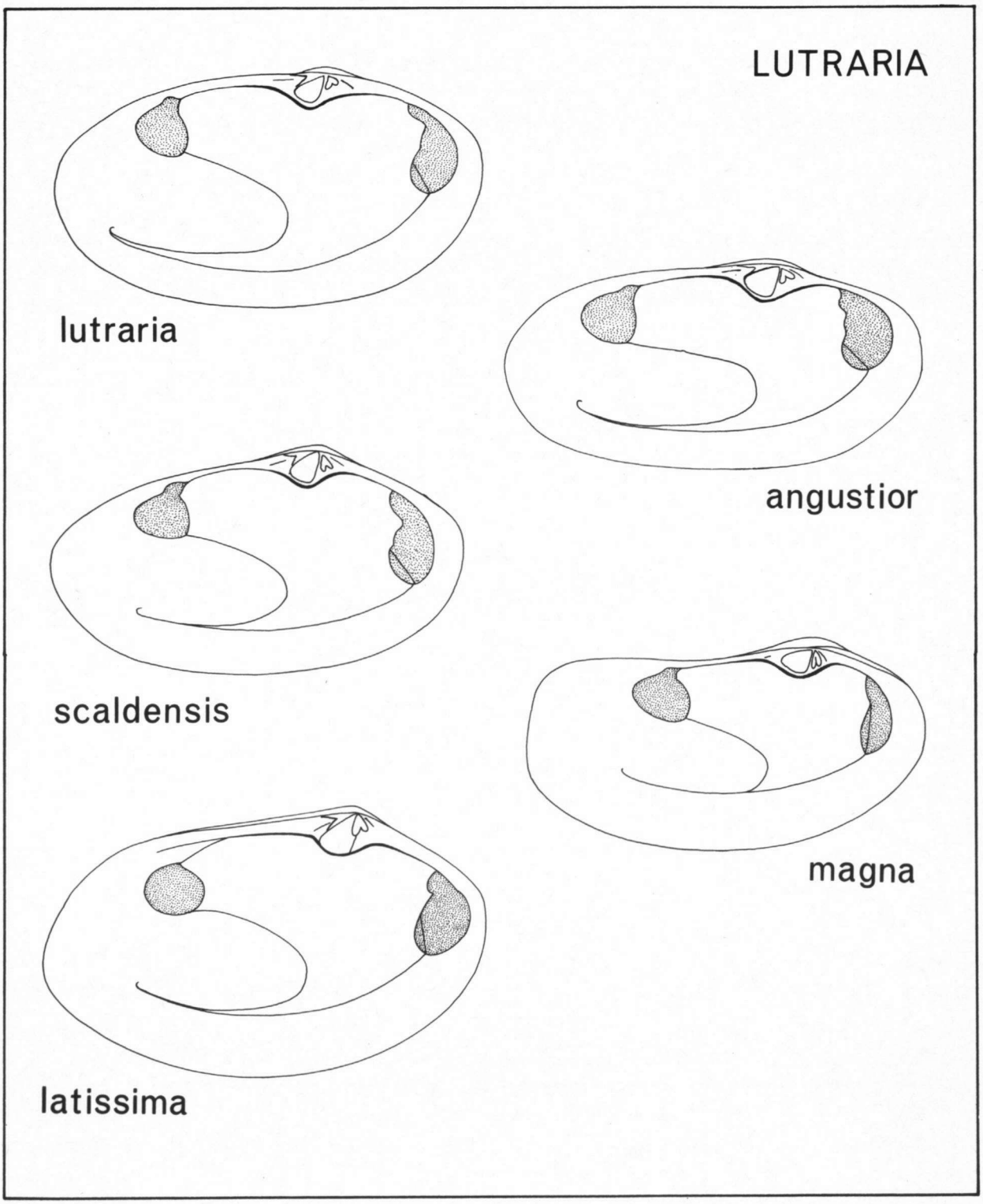
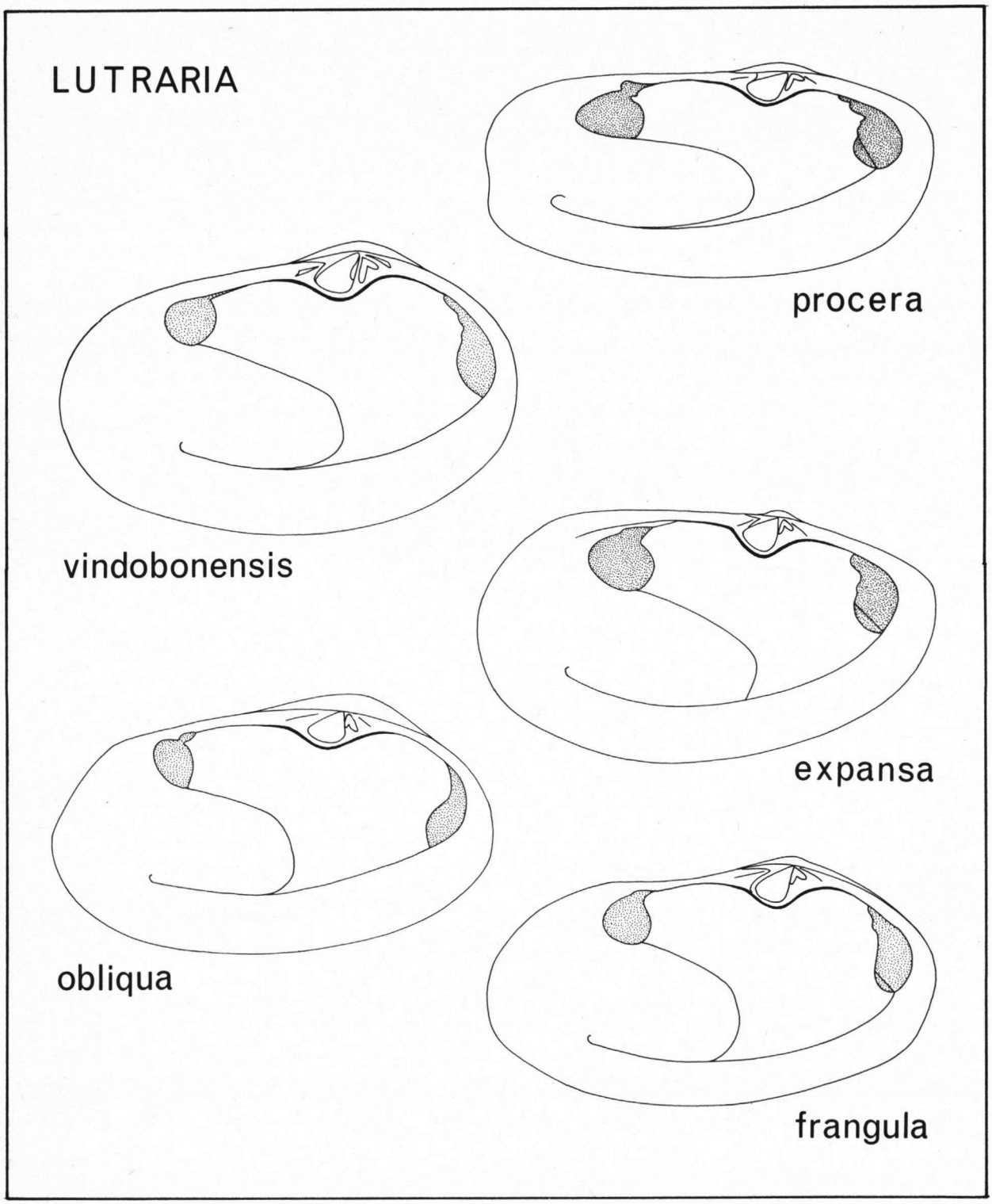


Fig. 2a-b. Schematical drawings of *Lutraria* species. The drawings are made as accurate as possible from a taxonomical point of view, but do not represent single specimens. They are of uniform size to facilitate comparison; approximate length of adult specimens is given between brackets, 10 cm to be read as 10-12 cm or perhaps somewhat more, but at least ± 10 cm.
1. *L. lutraria* (10 cm), 2. *L. angustior* (10 cm), 3. *L. scaldensis* (10 cm), 4. *L. magna* (15 cm), 5. *L. latissima* (10 cm).



6. *L. procera* (10 cm), 7. *L. vindobonensis* (3.5-4 cm), 8. *L. expansa* (6.5 cm), 9. *L. obliqua* (10 cm), 10. *L. frangula* (8.5 cm).

other two recent species *L. angustior* and *L. magna,* as may be concluded from the extensive material Mr A.W. Lacourt kindly put at my disposal.

In S.W. Spain near Huelva I found the three recent species washed ashore in great quantities; they may be especially common there near the estuaries.

Mediterranean records of *L. lutraria* go at least as far East as Sicily (Philippi, 1844!) but its eastern Mediterranean range is uncertain and the same is true for its southern range in the Atlantic.

Stratigraphical distribution: I was surprised to find, that fossil material of *L. lutraria* is so utterly scarce, the only sample that could be dated being from the Eemian.

The *Lutraria*'s washed ashore along the Dutch coast with a few exceptions perhaps must be of still younger age, since typical Eemian material is scarce or very scarce along the greater part of the beach. It should be remarked, that such Eemian fossils are relatively more frequent on the island of Terschelling - this just being the place where *Lutraria*'s of a comparatively fresh condition have been found!

Material from the province of Zeeland may have a more worn appearance and a more progressed recrystallisation, resulting in completely opaque shells, thus suggesting a late Pleistocene or Pliocene origin, but its real age is unknown. Only this much is certain, that in the material from localities as Domburg, Westerschelde, De Kaloot etc. *L. lutraria* is very scarce (I saw only a few worn specimens resp. fragments which may be ascribed to this species) and probably less represented than either *L. angustior, L. magna* or *L. scaldensis*.

In European palaeontological literature all records of *L. lutraria* should be distrusted, since, as far as can be decided from the illustrations, they always refer to some other species, *L. angustior* in the first place.

Material

Pleistocene: Amsterdam (Netherlands), building site with sand from Slotermeer, Eemian, 1/2 juv. and many fr., RGD.

Recent: **Norway**: Trondheimfjord, Hambaara, 1/2, RMNH; **Denmark**: Kandestederne, 1/2, Lac.; Aalbaek, 1/2, Lac.; **Great Britain**: Scotland: Inverness, 1/2, RMNH; Aberlady, near Edinburgh, 8/2, RMNH; Wales: Anglesey, Red Wharf Bay, 2/2, Lac.; Tenby, near Pembroke, 1/1, RMNH; England: no locality, 1, RMNH; Plymouth, Eddystone, 1 1/2, RMNH; Dawlish, Co. Devon, 3/2, Lac.; **Ireland**: Galway Bay, 1/2, U.; Dingle Bay, Co. Kerry, 1/2, Lac.; Droghede, N. of Dublin, 1/2, Lac.; Dublin, 1/2, RMNH; **North Sea**: German Bight, 2/2, Lac.; 'De Diepte' ('The Depth'), 53° 33' N, 4° 02' E, 1, RMNH; 20 miles NNW of lightship Texel, 2, Lac.; **Netherlands**: Schiermonnikoog, 10/2 (in 2 samples), RMNH, Lac.; Ameland, 11/2 (in 3 samples), RMNH, Lac.; Terschelling, 45/2 (in 5 samples), RMNH; Texel, 1/2, RMNH; Zandvoort, 12/2, RMNH, Lac.; Noordwijk, 1/2, RMNH; Katwijk, 13/2 (in 5 samples), RMNH, Lac.; De Beer (Rozenburg) - Katwijk, 48/2, RMNH; Wassenaar, 1/2, RMNH; Scheveningen, 48/2 (in 9 samples), RMNH, Lac.; Scheveningen - Hoek van Holland, 9/2 (in 5 samples), RMNH, Lac.; Hoek van Holland, 3/2 (in 2 samples), RMNH; Schouwen, 2/2, RMNH; Domburg, 1/2, Lac.; **France**: Brittany, Finistère, 1/2, RMNH; St. Jacut, near Dinard, 9/2, Lac.; Roscoff, 1/2, RMNH; Pont l'Abbé, 2/2, RMNH; Concarneau, 1 4/2 (in 3 samples), RMNH, Iles de Glenan, S. of Concarneau, RGD; Port Aven, E. of Concarneau, 1/2, N. Dekker; Lacquemeau, 1/2, RMNH; Penthièvre, near Quiberon, 2/2, N. Dekker; South West: Ile de Noirmoutier, 1/2, Lac.; Ile de Ré, 1/2, Lac.; Arcachon, 19/2 (in 10 samples), Lac.; Mediterranean: Agde, near Cette, 1/2, RMNH; Palavas, near Montpellier, 3/2, RMNH, **Portugal**: Estremadura, Concha de São Martinho do Porto, 1, RMNH; Algarve, Culatra, 4/2, RMNH; **Spain**: Atlantic: El Portil - El Rompido, near Huelva, 1 1/2, RMNH; Punta Umbria, near Huelva, 1 5/2, RMNH; Valldelagrana, bay of Cádiz, 31/2 (in 2 samples), RMNH; Mediterranean: Benalmadena, near Málaga, 1/2, RMNH; Barcelona, 1/2, RMNH.

Lutraria angustior Philippi, 1844
Text-fig. 2a

1818 *Lutraria elliptica* Lamk. var. b - Lamarck, p. 469.
1835 *Lutraria elliptica* Lamk. var. b - Lamarck, p. 90.
1836 *Lutraria elliptica* Lamk. - Philippi, p. 9 (pro parte).
1844 *Lutraria elliptica* Lamk. var. *angustior* Philippi, p. 7.
1863 *Lutraria elliptica* Lamk. var. *alterutra* Jeffreys, p. 429, ? pl. 8, fig. 3 (as *Lutraria*), especially the valve on the right.
1896 *Lutraria lutraria* Linné var. *angustior* Philippi - Bucquoy, Dautzenberg & Dollfus, p. 571, pl. 83, fig. 5-6.
?1909 *Lutraria angusta* Desh. - Cossmann & Peyrot, p. 190, fig. 21, pl. 5, fig. 10-11.
1917 *Lutraria lutraria* Linné var. *angustior* Philippi - Lamy, p. 365.
1937 *Lutraria lutraria* (L.) - van Regteren Altena, p. 89 (pro parte).
1959 *Lutraria angustior* Philippi - Holme, p. 557, fig. 1B, 2B, 3B, 4B, pl. 1, fig. 1-3, pl. 2, fig. 4-5.
1965 *Lutraria lutraria* (L.) - Entrop, fig. 75 (excl. description).
1966 *Lutraria angustior* Philippi - Tebble, p. 135, fig. 71-72.
1969 *Lutraria angustior* Philippi - Nordsieck, p. 143, pl. 20, fig. 81.61.
1975 *Lutraria (Lutraria) angustior* Philippi - Janssen, p. 127.
1976 *Lutraria (Lutraria) lutraria* (L.) var. *angustior* Phil. - Brambilla, p. 113.
1976 *Lutraria (L.) lutraria* (l.) - Brambilla, pl. 28, fig. 19-20.

Description: read key numbers, species 2.

Characteristic features, especially in comparison with *L. lutraria* are:
- the pallial sinus, which is fused to the ventral pallial line for half its length or more.
- the more elliptical outline, instead of oval, in combination with
- the straight dorsal margins, together forming a more or less pronounced angle before and behind the top,
- the broader ligament pit, occupying somewhat more than half the central hinge-part, and in combination with this
- the more perpendicular anterior margin of the ligament pit,
- the cardinal teeth in the left valve at an angle of less than 90°.

Furthermore:
- the dorsal margin of the pallial sinus being nearly horizontal (in *L. lutraria* directed downwards), and
- the posterior dorsal and posterior ventral margins which are nearly parallel (in *L. lutraria* clearly diverging).

Otherwise those key numbers should be compared, where species 1 and 2 are placed at different levels. Holme (1959) describes the two species in detail, being the first who recognized Philippi's *L. elliptica* var. *angustior* as a valid and well-defined species.

Actually *L. angustior* is more likely to be confused with *L. procera*, or with *L. scaldensis*; further details are given under those species.

Material

Fossil (age unknown): Netherlands, washed ashore: Schouwen, 1/2, RMNH; Domburg, 2/2, 2 fr., RMNH; Domburg, 8/2 (3 def.), NMR1935; Domburg, 2/2 (1 def.), U.; Walcheren, 1/2 juv., RMNH.

Recent: **Great-Britain**: Wales: Llandudno, Co. Carnaervon, 1/2, Lac.; **Ireland**: Dingle Bay, Co. Kerry, 1/2, Lac.;

Galway Bay, 1/1, 4/2, U.; Kilmore Quay, Co. Wexford, 1/2, U.; **Netherlands:** Texelse Stenen, off Texel, 1/2, RMNH; Scheveningen, washed ashore, 1/2 juv., RMNH; **France:** Brittany: Ile Grande, E. of Roscoff, 1/2, coll. N. Dekker; Concarneau, 2/2, RMNH; Locmariaquer, near Quiberon, 3/1 (in 2 samples); 1 slightly curved upwards, coll. N. Dekker; Penthièvre, near Quiberon, 2/2 (in 2 samples), coll. N. Dekker; South West: Ile d'Yeu, Plage des Conches!, 1/2, Lac.; Arcachon, 45/2 (in 11 samples), Lac.; Mimizan-les-Bains, 2/2, RMNH, U.; **Spain:** El Portil - El Rompido, near Huelva, 2/2, RMNH; Mazagón, near Huelva, 1/2, RMNH; Fuengirola, W. of Málaga, 1/2, RMNH.

Lutraria scaldensis n. sp.
Plate 1, fig. 1a-d, text-fig. 2a

1845 *Lutraria elliptica?* Lamarck - Nyst, p. 75.
1857 *Lutraria elliptica* Lamarck - Wood, p. 251, pl. 24, fig. 1a, b.
1878 *Lutraria elliptica* Lamarck - Nyst, pl. 24, fig. 5.
1881 *Lutraria elliptica* Lamarck - Nyst, p. 219.

Locus typicus - Antwerp (Belgium), 5th harbour dock.
Stratum typicum - Pliocene, Scaldisian, Kattendijk Sands.
Derivatio nominis - named after the river Scheldt.
Holotype - pl. 1, fig. 1a-d, 1/1, RGM 224 400 (leg. H. van Haren).

Description - Read key numbers, species 3.

Shell moderately solid, large (length of the holotype 10.4 cm), more or less triangular in outline with rather pronounced top.

Margins: anterior dorsal and posterior dorsal margins straight, at the umbo nearly in one line, but before and behind forming a pronounced angle, ventral margin rather strongly curved, posterior dorsal and posterior ventral margins diverging.

Hinge: hinge-plate behind the umbo markedly narrowing towards the posterior adductor scar, cardinal teeth in the left valve reaching about 3/4 of the distance to the lower margin of the hinge-plate, at an angle of ± 45°, ligament-pit about half the breadth of the cardinal hinge-part, its anterior margin slightly oblique and thus at an angle of somewhat less than 90° with the lower margin of the hinge-plate, its posterior margin fused to about half its length with the posterior dorsal shell margin, lateral teeth well-developed.

Muscle scars: pallial sinus posteriorly partly fused with the pallial line, its dorsal part sloping downwards, the pallial sinus narrowing inwards, anterior adductor scar (incl. the anterior footretractor scar): breadth/height ratio ± 1 : 2, its inner line markedly curved inwards above the middle.

Characteristic features: *L. scaldensis* may in general be recognized by its rather pronounced umbonal angle, giving the shell a more or less triangular outline, and in combination with this, by the straight dorsal margins.

It differs from *L. angustior*, with which it is most likely to be confused, by:
- the more pronounced umbo,
- the longer cardinal teeth in the left valve, reaching ± 3/4 the distance to the lower margin of the hinge-plate (in *L. angustior* ± 1/2),
- the cardinal teeth in the left valve forming an angle of ± 45° (distinctly more in *L. angustior*),
- the narrower ligament-pit, occupying ± 1/2 of the central hinge-part (more than 1/2 in *L. angustior*),
- the hinge-plate, which is narrowed posteriorly (in *L. angustior* of equal breadth before and behind the hinge),

- the dorsal line of the pallial sinus, which is directed downwards (nearly horizontal in *L. angustior*).

Also the deeply incurved inner line of the anterior adductor scar may provide a useful character.

Lutraria scaldensis in the Netherlands - The fossil material under consideration consists of the following seven samples from the province of Zeeland, containing 55 fragments alltogether: Westerschelde, near Ellewoutsdijk, 4 fr., NMR 1933; do., 9 fr., RGM 224 078; do., 3 fr., RGM 224 079; Westerschelde, 6 fr., nr. 1651, RMNH; do., 11 fr., nr. 1654, RMNH; do., 14 fr., nr. 1655, RMNH; De Kaloot, 8 fr., nr. 1653, RMNH. They are, with a few exceptions, all hinge-fragments. *L. lutraria* was not present in these samples, while *L. angustior* had already been selected out, mainly on account of its broad ligament-pit and the relatively short cardinal teeth in the left valve, forming an angle of slightly less than 90°. This was done, of course, by carefully comparing with adequate material, for even the most experienced eye would not like to do without such.

Before having seen the beautiful specimen of *L. obliqua* I considered all the remaining fragments as belonging to *L. scaldensis*. A careful re-examination makes me sure, that part of them belongs to *L. scaldensis*, a smaller part probably or likely to *L. obliqua*, while some fragments were too small or damaged for identification. The differences, to be found in the relative position of the hinge-teeth, are constant as far as I can see.

However, with only one left valve of *L. obliqua* at hand for comparison it seems better to draw the conclusions not too firm for the moment: *L. scaldensis* fragments are present in the material - though their exact number is uncertain - but the occurrence of *L. obliqua* needs further confirmation.

Material

Pliocene: Antwerp (Belgium), construction-pit, quay nr. 319, Scaldisian, Kattendijk Sands, 1/1, def., RGM 224 073; 1/2, def., RGM 224 075; construction-pit, quay nr. 271, Scaldisian, Kattendijk Sands, 1/2, def., RGM 224 074; 5th harbour dock, stratigraphic level unknown, 1/2, hinge defect, RGM 224 976; (Antwerp), without further indication of locality, 1/1, def., RGM 91 397.

Lutraria magna (da Costa, 1778)
Text-fig. 2a.

1778 *Chama magna* da Costa, pl. 17, fig. 4.
1801 *Lutraria solenoides* Lamarck, p. 120.
1818 *Lutraria solenoides* Lamk. - Lamarck, p. 468.
1836 *Lutraria solenoides* Lamk. - Philippi, p. 10 (sub *L. Cottardi*).
1844 *Lutraria solenoides* Lamk. - Philippi, p. 7.
1848 *Lutraria oblonga* Chemnitz - Forbes & Hanley, pl. 12, fig. 1.
1853 *Lutraria oblonga* Chemnitz - Forbes & Hanley, p. 374.
1854 *Lutraria oblonga* (*Mya*) Gmelin - Reeve, pl. 2, fig. 7.
1863 *Lutraria oblonga* Chemnitz - Jeffreys, p. 430.
1869 *Lutraria oblonga* - Jeffreys, pl. 44, fig. 2.
1896 *Lutraria oblonga* (Chemnitz) Gmelin - Bucquoy, Dautzenberg & Dollfus, p. 572, pl. 84, fig. 1-7.
1901 *Psammophila oblonga* (Chmntz.) - Sacco, p. 30.
1902 *Lutraria oblonga* (Chemnitz) Gmelin - Dollfus & Dautzenberg, pl. 5, fig. 1-2 (non fig. 4, 6 and doubtful fig. 3, 5); straight, elongate form.
?1909 *Lutraria lutraria* L. var. *Jeffreysi* De Greg. - Cerulli-Irelli, p. 143, pl. 15, fig. 9a, b.
1913 *Lutraria solenoides* Lamarck - Lamy, p. 344.

1917 *Lutraria oblonga* Chemnitz - Lamy, p. 370, p. 360.
1917 *Lutraria (Psammophila) oblonga* Chemn. - Lamy, fig. p. 361.
1937 *Lutraria magna* (Da Costa) - van Regeteren Altena, p. 90.
1959 *Lutraria magna* (da Costa) - Holme, p. 562, fig. 1C, 2C, 3C.
1965 *Lutraria magna* (Da Costa) - Entrop, p. 125, fig. 76.
1966 *Lutraria magna* (da Costa) - Tebble, p. 134, fig. 70.
1969 *Lutraria (Psammophila) oblonga* (Gmelin) - Moore, p. N604, fig. E97, 9a, b.
1969 *Psammophila magna* (Da Costa) - Nordsieck, p. 144, pl. 31, fig. 81.70.
1975 *Lutraria (Psammophila) magna* (Da Costa) - Janssen, p. 127.
1976 *Lutraria (Psammophila) oblonga* (Chemn.) - Brambilla, p. 113, pl. 28, fig. 21, 22.

Description: read key numbers, species 4.

Characteristic features: *L. magna* usually is recognized at once by the upwards curvature of its shell, but straight specimens also occur. Further diagnostic features are the long cardinal teeth lying close together and reaching the lower margin of the hinge-plate, the very broad ligament-pit, the strongly curved anterior dorsal margin in combination with the concave or straight posterior dorsal margin, the hinge-plate which is broad before the umbo but almost or completely disappearing posteriorly, the strongly declining dorsal line of the pallial sinus, of which the ventral part is fused with the ventral pallial line throughout its length, the absence of a well-developed posterior lateral tooth, etc.

Remarks: Straight specimens are not uncommon and found throughout the material; in the list they have been indicated with r. I have intentionally avoided to write here about a 'straight form' - which might suggest a certain taxonomical quality - since every gradation between straight and strongly curved may be found.

In the introduction it has been pointed out already, that the (sub) genus *Psammophila* for this species was not founded on a very firm base. The curvature of the shell alone cannot serve since straight specimens also occur, the absence of a posterior lateral tooth cannot be used as such, since this tooth is certainly present in the species, though underdeveloped and (often) disappearing in larger specimens. Whether or not the absence of a nymph provides a reason for a subgeneric distinction may be another question. Even in *L. lutraria* (and *L. angustior*) the nymph is very low and poorly developed, while we can only guess about it in the fossil species. Remain the long cardinal teeth lying close together, a construction which is different indeed from that of the other species.

It is true, that the combination of these single features readily distinguishes *L. magna* from the species of *Lutraria* s.s., which in their turn comprise a quite homogeneous group. So for practical reasons it may be useful to denote it as *Lutraria (Psammophila)* until new evidence is provided by more elaborate taxonomical researches in this and allied genera.

Material

Miocene: Amberre near Mirebeau (France, Vienne). Faluns de Touraine, upper coarse sand, 3/2 + 8 fr. (r.), RGM 224 072.

Pliocene: Castell'Arquato (Italy, Emilia), probably Piacentian (judging from the sediment), 1/1 def., RGM 49 547; do., probably Astian (judging from the sediment), 1/2, RGM 16 525; Asti (Italy, Emilia), Astian, 1/1, RGM 49 552-3.

Pliocene/Pleistocene: Monte Mario (Italy, Rome), stratigraphic level unknown, 2/2, RGM 49 548.

Age unknown: Netherlands, washed ashore: Schiermonnikoog, 2/2 (1r), photographs sent to me by Mr H. P. Boerse, but no further details available; Terschelling, 1/2 juv. (r.), RMNH; Domburg, 5/2, 1 fr., 2/2 (±r.), RMNH; do.,

2/2, Lac.; do., 1/2, (r.), Lac.; do., 1/2, (±r.), U.; Domburg-Westkapelle, 1 fr., (r.), RMNH; Walcheren, 3/2 (one r., one ±r.), RGD; Westerschelde, 2 fr., RMNH; Cadzand-Zwin, 2 fr., (r.), RMNH.

Recent: **Great-Britain:** Wales: Uandudno, 1, RMNH; Dawlish, Co. Devon, 1/2, RMNH; Channel Islands: Guernsy, 1, RMNH; Jersey, 1, RGD; **France:** Brittany: Dinard, 1/2, Lac.; St. Jacut near Dinard, 9/2 (in 1 sample), 1/2 r.; Quiberon 2/2 (in 1 sample), Lac.; South West: Ile de Noirmoutier, 4/2 (in 1 sample), 1/2 r., Lac.; Ile de Ré, 11/2 (in 4 samples), 5/2 r., Lac.; Ile d' Oléron, 1/2, Lac.; Soulac near Arcachon, 1/2, Lac.; Arcachon 40/2 (in 11 samples), 4/2 r., Lac.; **Portugal:** Algarve, Mar Santo E. of Faro, 1/2, RMNH; **Spain:** Atlantic: El Portil - El Rompido, near Huelva, 1/2, r., RMNH; Punta Umbria near Huelva, 3/2, RMNH; Chipiona, N.W. of Cádiz, 1/2, RMNH; Valldelagrana, bay of Cádiz, 4/2, RMNH; Barbate, S.E. of Cádiz, 2/2, RMNH; Mediterranean: Fuengirola near Málaga, resp. S.W. of -, 1 11/2 (in 6 samples), 3/2 r., RMNH.

Lutraria latissima Deshayes, 1831
Text-fig. 2a.

1901 *Lutraria* cf. *latissima* Desh. - Sacco, p. 29, pl. 8, fig. 4a, b.
1909 *Lutraria latissima* Desh. - Cossman & Peyrot, p. 192, pl. 6, fig. 28, 29, pl. 7, fig. 5.
non:
1870 *Lutraria latissima* Desh. - Hoernes, pl. 6, fig. 1a, b (= *L. pseudosanna* Sacco, 1901, p. 29).
1964 *Lutraria* cf. *latissima* Desh. - Anderson, p. 184, fig. 10 (= *L. frangula* in this paper).

Description: read key numbers, species 5.

My concept of this species is based on the description and illustrations in Cossmann & Peyrot, with which the specimen from Bordeaux mentioned below agrees very well.

Characteristic features are:
- the quite oval outline, especially caused by the strongly curved ventral margin;
- the straight dorsal margins forming a pronounced angle at the top;
- the (very) short anterior dorsal margin;
- the partly free ventral line of the pallial sinus;
- the relatively narrow ligament-pit;
- the broad hinge-plate, which is not narrowed posteriorly.

The young specimen from Cabannes shows the same features, its top being even more pronounced and its anterior margin still shorter. The cardinal teeth in the left valve of this specimen are rather short, reaching about halfway the lower margin of the hinge-plate, and diverging at an angle of approximately 45°.

A table comparing *L. frangula* with (young) *L. latissima*, and with *L. expansa* is given under the first mentioned species.

Material

Miocene: Bordeaux (France), stratigraphic level unknown, probably Burdigalian, 1/1, RGM 49 550; Cabannes (France, dép. Lot-et-Garonne), Faluns jaunes de Dax, 1/1 juv., RGM 221 477.

Lutraria procera n. sp.
Plate 2, fig. 1a-d, text-fig. 2b.

Locus typicus - Castell'Arquato (Italy, Emilia).

Stratum typicum - Pliocene, Astian (judging from the sediment).
Derivatio nominis - *procerus* (Lat.) = unusually high or long.
Holotype - pl. 2, fig. 1a-d. 1/1, RGM 224 080 (ex RGM 49 553).

Description: read key numbers, species 6.

Shell (rather) thick and solid, large (length of holotype 10.7 cm), elliptical, of nearly equal breadth throughout, posterior part markedly elongate, about twice the length of the anterior part.

Margins: anterior and posterior dorsal margins straight, at the umbo nearly in one line, anterior dorsal margin at an angle of about 90° with the anterior margin, ventral margin nearly straight in its central part, posterior dorsal and posterior ventral margins nearly parallel.

Hinge: hinge-plate narrowing towards the posterior adductor scar, about half the breadth of the anterior hinge-plate, cardinal teeth damaged in the type-specimen, but in other specimens from Castell'Arquato, Italy (RGM 49 553) at an angle of c. 90° or even somewhat more, the posterior tooth being longer than the anterior one and reaching about 2/3 of the distance to the lower margin of the hinge-plate (the indication in text-fig. 2b, representing the holotype, is tentative), ligament-pit exceeding half the breadth of the cardinal hinge-part, up to about 2/3, its anterior margin slightly oblique, forming an angle of less than 90° with the lower margin of the hinge-plate, its posterior margin fused to about 3/4 of its length with the posterior dorsal shell-margin, lateral teeth well-developed.

Muscle scars: pallial sinus posteriorly partly fused with the pallial line, its dorsal line nearly horizontal, the pallial sinus of about equal breadth throughout, anterior adductor scar (incl. anterior footretractor scar): breadth/height ratio ± 1:1.5, its inner margin deeply incised far above the middle.

Remarks: Though *L. procera* has a quite remarkable appearance, it shows resemblance to *L. angustior* in many respects. The following characters may serve to distinguish it from that species:
- the more elongate form (length/breadth ratio ± 1:2 1/4, in *L. angustior* ± 1:2) and in addition,
- the much longer posterior part (about 2 times the anterior part, in *L. angustior* somewhat over 1 1/2); it is this latter character which primarily causes the strongly elongate appearance;
- the hinge-plate, which is narrowed posteriorly, whereas it is of the same breadth before and behind in *L. angustior*.
- the cardinal teeth in the left valve, which form an angle of ± 80° or even more (in *L. angustior* distinctly less than 90°), while the deeply incised inner margin of the anterior adductor scar may provide a useful character.

There seem to be other differences as to the details, but more extensive material of *L. procera* would be required to confirm them.

Though it approaches *L. angustior* in many details, one can hardly imagine, that the species escaped attention up to now. Still, no description is to be found in the literature mentioned, nor any special name and also there is hardly any illustration of it. The only one, which can be applied to it more or less satisfactorily, is given by Sacco (mentioned above) sub nomine *L. lutraria* var. *angustior* Phil. Mayer-Eymar (1889) describes and illustrates two elongate forms (*L. Paeteli* and *L. Graeffei*, resp. p. 204, pl. 2. fig. 7 & p. 203, pl. 5, fig. 4), obviously referring to other forms than *L. procera*, while finally the identify of '*L. praelonga* Sismonda in schedis' mentioned by Sacco (p. 29) is too uncertain for any conclusions.

It is true, that young elongate forms - under various names and probably referring to different species - are also mentioned by several authors, e.g.:

1902 *L. lutraria* Linné - Dollfus & Dautzenberg, pl. 5, fig. 7-9.
1902 *L. oblonga* (Chemnitz) Gmelin - Dollfus & Dautzenberg, pl. 5, fig. 3-6.
1939 *L. angusta* Desh. var. *praecedens* nov. var. - Venzo, p. 79, pl. 4, fig. 18.
1962 *L. praeangusta* nov. spec. - Hölzl, p. 102, pl. 6, fig.2.

There are probably others, but these exemples may give an idea of the problems involved. The few small elongate specimens at my disposal in combination with such citations as mentioned above, did not give me any further indication as to the identity of such material.

Material

Pliocene: Castell'Arquato (Italy, Emilia), Piacentian (judging from the sediment), 2/1 def., RGM 49 553; Astian (judging from the sediment, 1/1, RGM 16 526; Astian (judging from the sediment), 1/1, RGM 49 549; Asti (Italy, Emilia), Astian (judging from the sediment), 2/1 def., RGM 49 551.

Lutraria obliqua n. sp.
Plate 1, fig. 2a-b, text-fig. 2b.

Locus typicus - De Kaloot (Netherlands, province of Zeeland), washed ashore.
Stratum typicum - unknown. Recrystallization is not yet complete. the shell is still somewhat translucent and remnants of the periostracum are still present; all these characters suggest an age of Late Holocene at the most.
Derivatio nominis - *obliqua*, from *obliquus* (Lat.) = oblique, referring to the different position of the two adductor scars, which are not placed on the same level.
Holotype - pl. 1, fig. 2a-b, 1/2, RGM 224 102 (leg. L. van der Slik).

Description: read key numbers, species 9.

Shell thick and solid, strongly convex, large (length of holotype 10.6 cm), oval, the posterior part clearly higher than the anterior part, umbo broad and pronounced.

Margins: anterior margin rounded, but posterior margin truncate (though this may be a casual feature), the anterior and posterior dorsal margins at the umbo nearly in one line, ventral margin rather strongly curved, posterior dorsal and posterior ventral margins diverging.

Hinge: hinge-plate behind the umbo narrowing towards the posterior adductor scar, but hinge-plate and -groove still clearly visible, cardinal teeth in the left valve probably rather long, the anterior tooth reaching about 3/4 of the distance to the lower margin of the hinge-plate, the teeth at an angle of about 45°, ligament-pit exceeding half the breadth of the cardinal hinge-part, its porterior margin separated over its entire length from the posterior dorsal shell margin, lateral teeth well-developed.

Muscle scars: the ventral line of the pallial sinus is fused with the pallial line throughout its length, its dorsal part is directed downwards, the pallial sinus narrowing inwards, anterior adductor scar narrow, its height (incl. the anterior footretractor scar) exceeding the breadth more than 2 times, its inner line deeply incised above the middle.

Remarks: Though *L. obliqua* has the general appearance of a *Lutraria* s.s., its characters are so different from any other species I have seen, or which is illustrated in the literature that it seems justified to distinguish it as a new species, even if only one valve is at hand. Characteristic features are:

- the strongly curved anterior dorsal margin in combination with
- the straight, or almost straight, posterior dorsal margin;
- the pallial sinus, which is fused with the ventral pallial line,
- the posterior margin of the ligament-pit, which is separated all over its length from the posterior dorsal shell-margin; it is the only species in which I found this character.

Whether or nor the truncate posterior end, the shape of the anterior adductor scar and the markedly developed umbo are typical, cannot be decided from this single specimen.

The combination of characters makes it impossible to include the specimen in any of the species discussed in this paper. Thus the strongly curved anterior dorsal margin combined with a straight posterior dorsal margin is only found in *L. magna* and *L. vindobonensis*; the dorsal margins do not form a marked angle at the umbo like in *L. scaldensis* and *L. latissima*; the rather broad ligament-pit excludes *L. lutraria* and other species, the broad hinge-plate posteriorly *L. scaldensis* and *L. frangula*, the fused pallial sinus *L. latissima*, etc.

Material

The holotype is the only available specimen up to now. Fragments of this species may be present among the Dutch material of *L. scaldensis*, mentioned above.

Lutraria frangula n. sp.
Plate 2, fig. 2a-b, text-fig. 2b.

1964 *Lutraria* sp. cf. *latissima* Deshayes - Anderson, p. 184, fig. 10.
1975 *Lutraria* cf. *latissima* Deshayes - van den Bosch, Cadée & Janssen, pl. 13, fig. 1.

Locus typicus - Antwerp (Belgium), construction pit of E3 motorway 'Kleine Ring'.
Stratum typicum - Miocene, Anversian, Antwerp Sands.
Derivatio nominis - from *frangere* (Lat.), to break; *frangula* = brittle.
Holotype - pl. 2, fig. 2a-b, 1/2, RGM 224 098 (leg. D. van der Mark).

Description: read key numbers, species 10.

Shell thin and fragile, medium-sized (length of holotype 8.7 cm), oval, top rather pronounced.

Margins: anterior dorsal margin slightly convex or (nearly) straight, posterior dorsal margin slightly concave behind the umbo, the margins nearly in one line at the umbo. but before and behind forming a more or less pronounced angle, ventral margin rather strongly curved, posterior dorsal and posterior ventral margins nearly parallel.

Hinge: hinge-plate behind the top markedly narrowing towards the posterior adductor scar, cardinal teeth at an angle of ± 45° in the left valve reaching about halfway the lower margin of the hinge-plate, ligament-pit about half the breadth of the cardinal hinge-part, its anterior margin oblique, at an angle of about 45° with the lower margin of the hinge-plate, its posterior margin fused to about half its length with the posterior dorsal shell margin, lateral teeth markedly developed, in the right valve two posterior laterals.

Muscle scars: the ventral line of the pallial sinus is fused with the pallial line throughout its length, its dorsal line directed downwards, the pallial sinus narrowing inwards, the breadth/height ratio of the anterior adductor scar (incl. the anterior footretractor scar) is ± 1:2, its inner line slightly irregular or nearly straight, but not deeply incised.

Characteristic features: typical for *L. frangula* are
- the posterior dorsal margin, which is slightly concave behind the umbo (*L. magna* is the only other species with concave posterior dorsal margin), and in combination
- the (moderately) curved anterior dorsal margin, and
- the hinge-plate, which is narrowed posteriorly.

Additional characters are:
- the rather narrow ligament-pit,
- the fused pallial sinus,
- the dorsal margins which are in one line, just before and behind the umbo, and
- the high and pronounced lateral teeth (like in *L. expansa* and *L. vindobonensis*).

Besides the two lateral teeth in the right valve (not to be met in any of the other species) may be characteristic.

The species may resemble young *L. latissima* to some extent, but there is no need for confusion, once the real characters are understood. In table 1 differences are given between *L. frangula*, young *L. latissima*, and *L. expansa*, applied to specimens of some 5-7 cm length.

	L. frangula	*L. latissima*	*L. expansa*
posterior shell part	± as wide as the anterior part	± as wide or slightly narrower	much widened
anterior dorsal margin	(moderately) curved	straight	straight
posterior dorsal margin	slightly concave	straight	straight
dorsal margins at the umbo	nearly in one line	forming a pronounced angle	nearly in one line or forming a small angle
ventral line of the pallial sinus	fused with the pallial line	free for half its length or more	fused with the pallial line
hinge-plate	narrowed posteriorly	not narrowed	not narrowed
cardinal teeth of the left valve	at an angle of ± 45° reaching halfway the lower margin of hinge-plate	± 45° ± 2/3	clearly more ± 1/2
lateral teeth	markedly developed and high	well visible but low and less marked	markedly developed and high
number of posterior lateral teeth in the right valve	2	1	1
anterior lateral tooth in the left valve	exceeding length of anterior cardinal tooth	of about equal length	—
posterior lateral tooth in the left valve	between dorsal shell margin and ligament-pit	close to (posterior margin of) ligament-pit	almost fused with posterior margin of ligament-pit

Table 1. Comparison between *L. frangula*, *L. latissima* and *L. expansa* (for specimens with a length of 5-7 cm).

Remarks: The extensive material from Winterswijk-Miste contains specimens with a slightly different outlook of which the hinge cannot be checked. Thus one specimen (RGM 224 734) shows some resemblance with *L. latissima* Desh. in Hoernes (1870, pl. 6, fig. 1a, b = *L. pseudosanna* Sacco 1901, p. 29, non *L. latissima* Desh.), while other specimens (RGM 224 093) more or less approach *L. latissima* Desh. resp. *L. expansa* (Dollfus, Berkeley Cotter & Gomes) in outline, or rather something between. For the moment I consider this material as belonging to *L. frangula*.

A few right valve fragments possess one posterior lateral tooth only, instead of the normal two in this species. The second tooth may be broken off, but it is interesting to quote here a passage of Beu (1966) on *L. solida* Hutton, a tertiary New Zealand species resembling *L. expansa*: '— there are two posterior laterals in the right valve of some specimens. The dorsal one of these is absent in other specimens'.

Material from Eger, Hungary, Late-Oligocene - Egerian (RGM 224 104, 1/1 + 2/2 specimens) agrees with *L. frangula* in general outline, especially as to the slight upwards curvature of the posterior dorsal margin and the presence of two posterior lateral teeth in the right valve. This form or species is mentioned in literature by Báldi (1973, p. 218, pl. 19, fig. 5) as *L. oblonga soror* Mayer, 1867 (= nomen dubium, see: Note on the literature, p. 237).

Material

Miocene: Winterswijk-Miste (Netherlands, prov. of Gelderland), Aalten Member, Miste Bed, many fr., RGM 224 083-8; do., 3/1 + 9/2, all more or less damaged, RGM 224 092; do., 1/2 (ill. in van den Bosch, Cadée & Janssen, 1975), RGM 184 724; Maasbree (Netherlands, prov. of Limburg), deep-boring 13, depth unknown, Breda Formation, 2 fr., RGD, Baarlo (Netherlands, prov. of Limburg), deep-boring 9, 100-160 m, Breda Formation, 1 fr., RGD; Dingden (F.R.G., Westfalen), Reinbekstufe, Dingdener Feinsand, resp. 8 fr., 6 fr. and many fr., RGM 224 089-91.

Lutraria expansa Dollfus, Berkeley Cotter & Gomes, 1903
Text-fig. 2b.

1903-1904 *Lutraria oblonga* Chemnitz var. *expansa* D.C.G. - Dollfus, Berkeley Cotter & Gomes, p. 30, pl. 4, fig. 3.

Description: read key numbers, species 8.

Characteristic features: This species can be recognized at once by its strongly widening posterior part; besides the medium-sized shell (± 6.5 cm being the largest specimen I have seen) is thin and fragile. It is so utterly different from *L. magna* (= *L. oblonga*), that there can be no hesitation to give it the specific name mentioned above.

Variability is to be found in the more or less sloping anterior dorsal margin (Dollfus, Berkeley Cotter & Gomes illustrate a specimen with rather pronounced umbonal angle), and in the degree of the posterior widening. Both characters fall within the normal range of variation and do not allow any further discrimination.

Beu (1966, p. 68, fig. 1) gives an illustration of the tertiary New Zealand species *L. solida* Hutton, which almost completely agrees with the specimen of *L. expansa* represented here in text-fig. 2b. It is true, that in *L. solida* the cardinal teeth in the left valve seem to be at a narrower angle, while the ventral shell margin is almost straight, but apart from such details the resemblance is striking. I may confine myself by just mentioning the curious fact, having no material of *L. solida* at my disposal.

Forms which, to a more or less extent, bear resemblance with *L. expansa*, are illustrated at several places in the literature. Sacco (1901, pl. 7, fig. 5a, b, pl. 8, fig. 1b and, to a less extent, pl. 8, fig. 1a; as *L. lutraria*) illustrates specimens which indeed largely correspond with the *L. expansa* in this paper and which may be identical with it. In other cases (such as Dollfus, Berkeley Cotter & Gomes, 1903, pl. 4, fig. 3, as *L. oblonga* var. *expansa*; Hölzl, 1962, pl. 6, fig. 3, as *L. sanna*; Venzo, 1939, pl. 4, fig. 17, as *L. latissima* var. *minor*) I feel too much doubt for any conclusions.

Material

Miocene: Cacela Velha (Portugal, Algarve), Tortonian, 8/1 + 3/2, RGM 224 094, 224 099; Miocene or Pliocene, locality unknown, label indicates two locality names, Bordeaux (= Miocene) and Castell'Arquato (= Pliocene), different types of sediment are present in the two valves, 2/2 RGM 49 546.

Lutraria vindobonensis Sacco, 1901
Text-fig. 2b.

1870 *Lutraria sanna* Bast. - Hoernes, p. 56, pl. 5, fig. a-c.
1901 *Lutraria sanna* Bast. (in Hörnes) var. *vindobonensis* Sacco, p. 31.
1902 *Lutraria sanna* Basterot - Dollfus & Dautzenberg, p. 105, pl. 5, fig. 12-15.
1909 *Lutraria sanna* Basterot - Cossmann & Peyrot, p. 196, fig. 22, pl. 7, fig. 6-9 (? fig. 10-12).
1917 *Lutraria ovalis* Bell, p. 420 (proposed for the species of Hoernes, pl. 5, fig. 5a-c; preoccupied by: *L. ovalis* Sowerby, 1819; Münster in Goldfuss, 1849; Mayer, 1867 and Tokunaga, 1906).

A related or perhaps identical, truncate form (see below):

1867 *Lutraria Hoernesi* May. - Mayer, p. 52 (applied to Hoernes, pl. 5, fig. 6a-c).
1870 *Lutraria oblonga* Chemnitz - Hoernes, pl. 5, fig. 6a-c.
1902 *Lutraria sanna* Basterot - Dollfus & Dautzenberg, pl. 5, fig. 10-11.
1903 *Lutraria sanna* Bast. - Dollfus, Berkeley Cotter & Gomes, pl. 4, fig. 4b, d.

non:

1825 *Lutraria sanna* Basterot, p. 94, pl. 7, fig. 13.
Lutraria sanna (Bast.) auct. pro max. parte.

Description: read key numbers, species 7.

Characteristic features: This small species is easily recognized by its strongly curved anterior dorsal margin and almost straight posterior dorsal margin, a combination also present in *L. obliqua* and *L. magna*. The strongly developed posterior cardinal tooth, if not broken off, may give another useful indication.

The largest specimen I have seen has a length of 3.9 cm and this may be an average. Schaffer (1910) mentions a (*L. sanna*) var. *major*, but is seems doubtful whether or not his form belongs to *L. vindobonensis* and also other records need confirmation in this respect.

Remarks: The *Lutraria sanna* Bast. figured in Hoernes (1870) is so different from the original illustration of Basterot (1825), that it can hardly belong to the same species. Sacco (1901) already points out this fact and proposes the name *L. sanna* Bast. var. *vindobonensis*, which has been given specific rank in this paper.

The material mentioned and illustrated here quite agrees with the species illustrated by Hoernes, except in the form of the pallial sinus. It should be noted, however, that the pallial sinus in all the

(otherwise beautiful) illustrations of Hoernes is drawn in a similar and rather artistic fashion, which does not permit its comparing with nature.

A form with truncate posterior end closely approaches *L. vindobonensis* and may belong to the same species.

Material

Miocene: Saucats (France, Gironde), Burdigalian, Faluns de Leognan, 1/1, RGM 221 590; Bordeaux (France), stratigraphic level unknown, probably Burdigalian, 1/1, RGM 49 544.

Furthermore a truncate form, which may belong to the same species (see above) from Nawodzice (Poland, vojv. Tarnobrzeg), Badenian, 1/2, RGM 224 095.

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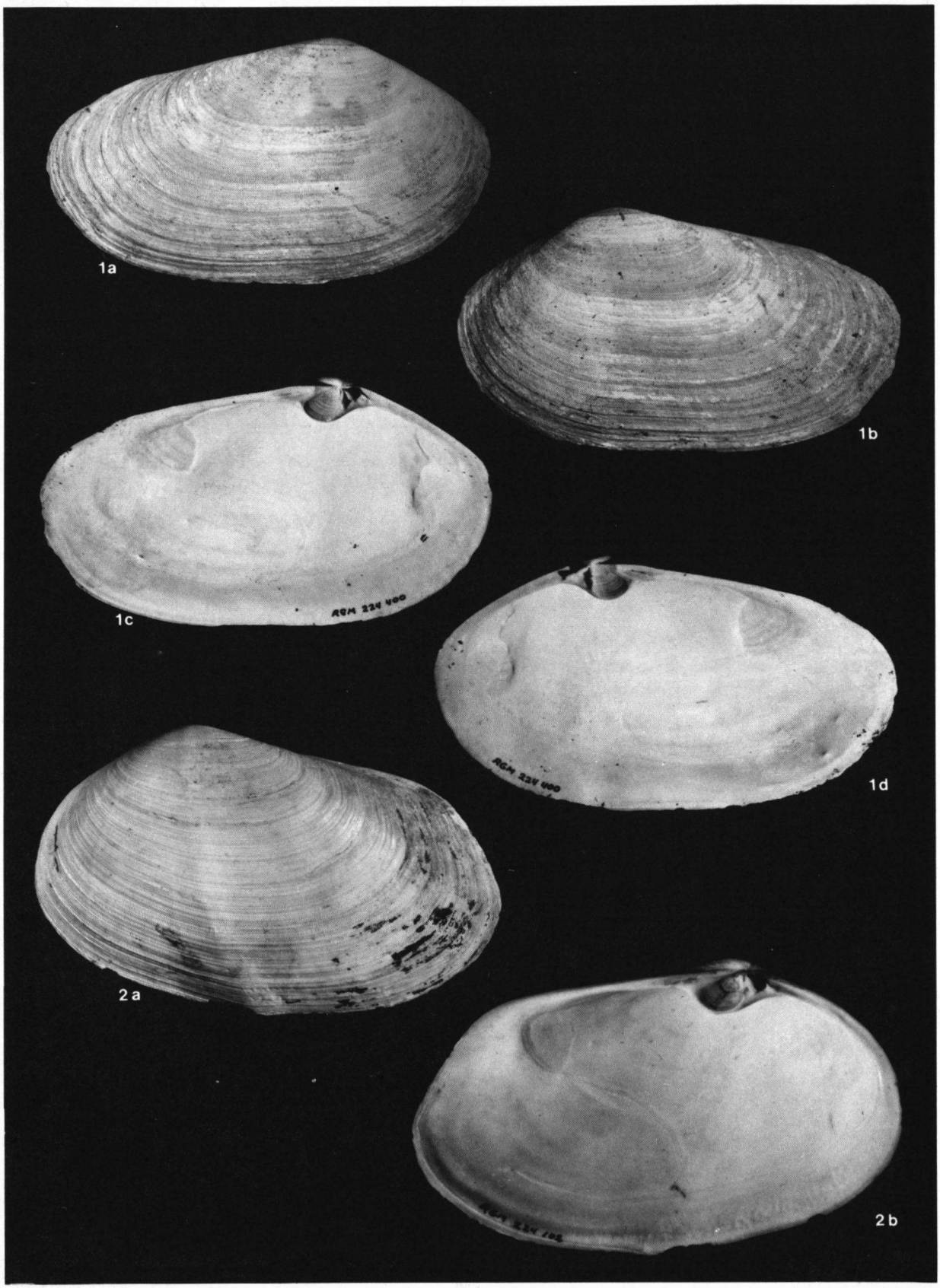
EXPLANATION OF PLATE 1

Fig. 1a-d. *Lutraria scaldensis* n. sp., holotype.
Antwerp (Belgium), 5th harbour dock.
Pliocene, Scaldisian, Kattendijk Sands.
Length 10.4 cm, RGM 224 400 (leg. H. van Haren).

Fig. 2a-b. *Lutraria obliqua* n. sp., holotype.
De Kaloot (Netherlands, province of Zeeland), washed ashore.
? Late Holocene.
Length 10.6 cm, RGM 224 102 (leg. L. van der Slik).


1a
1b
1c
1d
2a
2b

EXPLANATION OF PLATE 2

Fig. 1a-d. *Lutraria procera* n. sp., holotype.
Castell'Arquato (Italy, Emilia).
Pliocene, Astian (judging from the sediment).
Length 10.7 cm, RGM 224 080 (ex RGM 49 553).

Fig. 2a-b. *Lutraria frangula* n. sp., holotype.
Antwerp (Belgium), construction-pit for E3 motorway 'Kleine Ring'.
Miocene, Anversian, Antwerp Sands.
Length 8.7 cm, RGM 224 098 (leg. D. van der Mark).


1a
1b
1c
1d
2a
2b

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