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Molluscan Faunas and Biostratigraphy of the Marine Younger Miocene Formations in Denmark

Part II:

Palaeontology

By
Leif Banke Rasmussen

Dansk sammendrag:

De danske marine yngre miocæne formationers molluskfaunaer og biostratigrafi

Del II:

Palæontologi

I kommission hos
C. A. REITZELS FORLAG (JØRGEN SANDAL)
KØBENHAVN 1968

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With 27 plates

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PREFACE

This Part II is closely attached to Part I, published in 1966, and originally was intended to be published together with Part I. For economic reasons it proved impossible to carry out this plan.

After the manuscript of both parts had been written, H.-J. ANDERSON's great paper "Die miocäne Reinbek-Stufe in Nord- und Westdeutschland und ihre Mollusken-Fauna" was published. Most of the species of molluscs occurring in the Danish Hodde Formation have been described and pictured in this work. Unfortunately it has only to a limited extent been possible for me to consider ANDERSON's work, but I have inserted it in the lists of synonyms in question and have, with ANDERSON as my source at the mention of the distribution of the species in question, stated that they occur in the Reinbek-Stufe of Northern Germany.

In the preface to Part I an account has been given of the history of the investigations, and in the same place the persons are mentioned who have been of importance to the genesis of the work and the collaborators who in various ways have assisted me.

With special reference to Part II it should be pointed out that Mr. CHR. WESTERGAARD has taken the photos for the plates, Mrs. RIGMOR BORG has drawn the figures in the text, and Mrs. KIRSTEN SPERLING has typed the manuscript. The translation has been made by Cand. mag. NIELS HAISLUND, and at the proof-reading I have also in the case of this volume received valuable assistance from my wife, Mrs. INGER BANKE RASMUSSEN, Cand. mag. I take the opportunity once again to thank these helpers.

The Danish manuscript was finished in March 1965 and the English translation in May 1967.

Hellerup, 1st June 1967.

LEIF BANKE RASMUSSEN

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ABSTRACT

In this volume there are descriptions of 45 pelecypod species or subspecies, 5 scaphopod species, 107 gastropod species or subspecies, and 3 pteropod species from the marine Younger Miocene formations in Denmark. Most of the species have been pictured on a total of 27 plates.

The following four species have been described as new ones:
Solariella jutensis
Asthenotoma ravni
Diaphana moerchi
Spiratella gramensis

In Part I of the present work (published in 1966), furthermore, the following three species from the formations investigated were described as new ones: *Astarte* (*Goodallia*) *esbjergensis*, *Hinia slieswicia*, and *Neoguraleus sæthensis*. These three species and *Siphonodentalium cf. lobatum* (SOWERBY) are important species which on account of their importance for the biostratigraphical discussion had to be mentioned in Part I.

Apart from the species which are considered new ones, all the other molluscan species have been described before. However, many species have only been mentioned rather briefly in early palaeontological works. For uniformity's and documentation's sake the species have been described in great detail. Exceptions are some of the species mentioned previously (RASMUSSEN 1956). Some of the species pictured in the work of 1956 have not been pictured in the present work. In the case of some species, however, there seemed to be reason for offering a new and better picture.

ABBREVIATIONS USED IN THIS VOLUME

def.	= defective	(c)ompl.	= complete
sh.	= shell	f.	= figure
(fr)agm.	= fragment(s)	pl.	= plate
r	= right valve(s)	u.	= umbo(nal region)
l	= left valve(s)	d.	= double valve(s)

INTRODUCTION

The contents of molluscs in the Hodde Clay and the Gram Clay are comparatively high, and highest in the Gram Clay. Unfortunately nearly all the molluscs (especially the gastropods and the pelecypods with both valves intact) are full of pyrite, which will gradually spoil a large number of them.

Many of the shells were rather well preserved when found. In the drill samples there were, however, a majority of defective shells and fragments. An intimate knowledge of many years' standing as regards the morphology and variation of the species is necessary for pleading a certain proficiency in the identification of minor fragments.

By identification of species I here especially understand the one which can be established within the area of the Danish Miocene. Determination according to species which have been set up outside the North Sea Basin will often be uncertain, as it is sometimes necessary to know the variation within the populations of each basin. In this field there is still much work to be done.

In the present work, the final object of which is an elucidation of the variation of the molluscan faunas and their application for a bio-zonation in the Younger Miocene clay series within the Danish part of the North Sea Basin, no special importance has been attached to a statistical comparison with the populations of other basins. On the other hand, I have made a point of offering a description and a picture of each single species, even though the species in question has previously been described from other basins or from other formations in the North Sea Basin. This is first of all to be motivated by a demand for a certain uniformity in the treatment of the species for the sake of the general impression, but also in the fact that many of the species which have previously been described from the same formations, were only described in German or Danish. It has also been a contributory fact that to the user of the work it will be an advantage to find descriptions of all the species in one and the same book.

The pictures preferably comprise other species than those which were pictured in my work of 1956, but in several cases new pictures have been given of some of these species, i.a. because better specimens have been provided later.

The grouping of genera into subgenera often seems to be artificial or even rather unfounded, and considering the fact that even the genera often are

more relevant to an artificial labelling system than to a natural grouping determined by nature itself, I have preferred not to classify into subgenera in most cases.

Importance has especially been attached to the specific identification within the Danish part of the North Sea Basin and within the vertical series of Younger Miocene clay sediments. It must therefore be expected that there may be taxonomic deviations from the norm which perhaps might be discovered after a lengthy investigation into the research history of the groups of species.

As to the special problems within each group of molluscs, reference is made to the introductions of the section in question. Here I shall only add a few remarks on the sections in the descriptions of the species.

List of synonyms. In the lists of synonyms only the papers used by me have been adduced, and no attempt has been made at completeness. In the case of the species of which I have given a list of synonyms in my previous work (1956), a reference to this work is understood. In these cases there is in the present work only a short list of synonyms, beginning with a reference to my previous work and otherwise as a rule only containing later publications about the species in question.

After the name of each author his paper is cited with a highly abbreviated title, often only a single word. (This abbreviation may be found in parenthesis in the list of literature after the complete title.)

Original diagnosis. In general the original diagnosis is quoted only of the species which have not been mentioned in SORGENFREI 1958 and RASMUSSEN 1956, as it is considered unnecessary to repeat it in these cases. Some very old publications containing original diagnoses have not been available from Danish libraries.

Type material. Information about type material, locus typicus, stratum typicum, age, and depository has first of all been adduced in connexion with the new species, but also in the case of most species for which an original diagnosis has been adduced.

Material. In this section a complete list is given of the localities and levels from which material of the species in question is available. After each of these units the number of shells (or valves) and fragments is given, as well as a brief characterization of the condition of the shells.

Sometimes – e.g. in the case of all pelecypods and scaphopods – the number of individuals is indicated which the remnants in question are estimated to represent.

Description. In general a detailed description of each species is given. In cer-

tain cases, in which only very fragmentary material is available, however, reference is made to the descriptions in the literature cited.

Variations. In the case of certain species observations of their variations are communicated in a special section.

Remarks. Most comments on the species are given in the section "Remarks", which i.a. includes information about relations to other species, special information about circumstances of finding, corrections of previous views, etc.

Measurements. In the case of most species the dimensions of one or more shells are adduced, besides measurements of other morphological units. In the individual cases information about the dimensions, however, must be taken from the legend of the plate on which the species is pictured.

Distribution. The distribution of the species is indicated according to the basins of deposits, and within these according to (1) time intervals (Oligocene, Miocene, etc.), (2) countries, and (3) formations. The name of the author from which the information has been adduced, is then added in parenthesis.

DESCRIPTIONS OF SPECIES

PELECYPODA

The pelecypods are the group of molluscs represented by the largest number of individuals in the Hodde Clay as well as the Gram Clay. The number of species, however, is considerably lower than that of the gastropods.

The state of preservation is often good in all thick-shelled species, but the large number of thin-shelled forms are known almost only in a fragmentary state. Often the fragments of the latter shells are placed on a cast consisting of pyrite, so it is possible to receive a good impression of the exterior of the valve, but often one is prevented from studying the hinge and the interior.

As to the systematic arrangement, the one used by ANDERSON (1959 and 1964), GLIBERT (1945), and SORGENFREI (1958) has been followed. It corresponds mainly to the systematics in J. THIELE's "*Handbuch der systematischen Weichtierkunde*" (1935), but often other generic names have been used in the present work, mostly in conformity with the nomenclature used by ANDERSON (*loc. cit.*).

The morphological terms for parts of the shells are those ordinarily used.

ORDO: TAXODONTA NEUMAYR 1883

FAMILIA: NUCULIDAE D'ORBIGNY 1844

Genus: *Nucula* LAMARCK 1799

(Type: *Arca nucleus* LINNÉ 1758)

Nucula georgiana SEMPER in RAVN 1907

1956. *Nucula* (*Nucula*) *georgiana* SEMPER in RAVN – RASMUSSEN, South Jutland, p. 28, Pl. I, f. 1 a, b.

Material. In nearly all the localities with Gram Clay remnants of valves of *Nucula* were found. The great majority of these originate from very small individuals, which could not be determined to species. On the other hand, all remnants of large individuals can with certainty be identified with *N. georgiana* RAVN. Presumably the majority of the small individuals are young valves of this species.

In the following list of localities all remnants of Nuculidae have been considered. In the lists of analyses (see Part I, Tables 1–66) the great majority are entered as *Nucula* sp.

Gram Clay.

Skærum Mølle (clay pit), Lillelund (73.88), Lille Spåbæk (lignite pit), Muldbjerg (83.377), Kodal (84.763, 84.766), Fjaldene (84.238), Spjald (83.104, 83.127), Randbæk (83.591, 83.597, 83.602), Muldbjerg (83.1006), Kodal-Fjaldene (84.1749), Videbæk (84.1748, 84.313, 84.358, 84.417, 84.456, 84.492, 84.493, 84.525, 84.1727), Møltrup Brickworks (clay pit), Lille Torup (85.379), Gjellerup (85.380), Frølund (85.383), Gjødstrup (85.861), Snejbjerg (85.775), Bording (86.177), Brande Brickworks (clay pit), Drantum (104.1241), Nyholm (104.1166), Leding (93.155), Alkærsig (clay pit), Lønborg (102.55), Forsom Brickworks (clay pit), Odderup (clay pit), 103.150), Harkes (clay pit), Ålbæk Eng (102.59), Hesselho (113.121), Hauge (clay pit), Tønding (clay pit), Hoddemark (Karlsgårde Canal, section), Grøde (Karlsgårde Canal, section), Stenderup (113.36), Esbjerg (130.59, old clay pits and outcrop on the beach), Måde Brickworks (clay pits), Strandgård Brickworks (clay pit), Gørding (old clay pit), Brøstrup (141.224), Tiset (141.244), Holleskov (132.46 b), Ravning (clay pit), Hjortvad (141.178), Lintrup (132.140), Sønder Hygum (141.270, 141.260, 141.261, 141.273), Rødding (141.76, 141.242, 141.243), Vester Lindet (141.246), Gram (141.277), Spandetgård (clay pit), Spandet (150.184), Tønder (166.398), Brodersmark (166.351 b), Sæd (167.4, 167.445), Rends (167.236).

Description. The valves are often large and comparatively thick-shelled, but brittle, for which reason complete valves are rare. They are obliquely oval, lengthened anteriorly, and form an acute angle posteriorly. The anterior dorsal margin, is slightly convex and considerably longer than the posterior dorsal margin, which is directed steeply down towards the rear end of the ventral margin.

In the middle the dorsal margin forms a short, flat, convex curve. The ventral margin is regularly curved and, if anything, flatly convex.

The umbo is opisthogyrate. The prodissoconch is small and smooth. It was only preserved on a valve from Brodersmark (cf. the measurements). Area is almost heart-shaped, rather short and broad, bounded by a faint furrow and a faint edge. The lunula is narrowly lanceolate and rather indistinct.

The valves are rather highly convex, especially in the umbonal region.

The exterior is covered by numerous concentric furrows, which are rather indistinct, but demarcate more or less prominent, though mostly faint, concentric folds, which on many valves are irregular and abrupt. Furthermore, there are numerous very fine and thin radial striae, the number of which on the present valves, the quite small as well as the quite big ones, is about 56 to 67 (counted as the number of notches on the ventral margin).

The hinge consists of two rows of uniform, pointed, highly prominent teeth on both sides of the comparatively small, very obliquely placed, oblong triangular ligament pit below the umbo. The number of teeth increases by the age of the animal (cf. the table of measurements). The two rows of teeth form an obtuse angle to one another. It does not, however, seem to exceed 100°.

The interior is highly nacreous. The adductor impressions are deep and conspicuous. The anterior one is triangular, only the upper side, however, being straight and the lower one forming a highly convex curve. The posterior adductor impression is considerably smaller and narrower, but is of almost the same shape. The upper part of the valve shows several other small, irregular scars for muscular attachments. The pallial line is situated somewhat within and almost parallel to the ventral margin, which is provided with numerous small ridges. The interval between each two of these corresponds to the end of a radial rib.

Measurements. Only a small number of valves in the present material are so well preserved that it has been possible to measure them. The following measurements, however, give an impression of the dimensions of the large valves, which belong to the true *N. georgiana* sensu stricto, as well as the quite small shells, which can only tentatively be referred to this species.

Locality:	Length in mm.	Height in mm.	Thickness in mm.	Number of teeth in front of umbo	Number of teeth behind umbo	Number of radial ribs
Skærum Mølle						
Right valve	21.5	16.3	6.0	30	9	56
Esbjerg						
Right valve	16.6	12.4	4.9	26	?	64
Måde. Strandgård Brickworks						
Right valve	16.8	13.6	4.6	26	11	67
Ravning						
Right valve	21.5	16.3	6.0	30	9	56
–	14.8	11.6	4.0	22	9	58
–	16.5	13.3	5.1	28	11	56

Locality:	Length in mm.	Height in mm.	Thickness in mm.	Number of teeth in front of umbo	behind	Number of radial ribs
Left valve	20.8	16.0	5.6	23	?	53
–	14.8	11.4	4.2	?	?	56
Double valve	14.6	11.5	8.1			52
–	17.5	13.6	9.5			54
Gram Brickworks						
Left valve	20.3	16.1	5.9	31	12	54
–	17.2	13.3	4.9	?	?	57
–	17.5	14.2	5.3	25	11	59
Double valve	14.7	12.5	8.6			53
–	20.0	16.4	12.0			?
Brodersmark (166.351 b)						
24–25 m.						
Right valve	3.9	3.2	0.7	13	4	64
Hygum (141.261)						
13–19 m.						
Left valve	2.3	1.9	0.6	10	5	62
–	1.3	1.1	0.3	7	4	60
Right valve	1.9	1.4	0.4	9	4	54
–	1.1	0.8	0.3	5	2–3	?

Remarks. The importance of the number of radial ribs for the distinction of the various species of *Nucula* has been demonstrated by SORGENFREI 1958 (see especially fig. 5, p. 42 in that work). According to his examinations the number of radial ribs in *N. nucleus* (L.) is between 40 and 60, in *N. nitida* SOWERBY between 60 and 90, mainly, however, between 74 and 76, and in *N. cromata* SORGENFREI between 55 and 80.

In order to fully realize the identity of a *Nucula* population with or its relation to the three species mentioned above, as well as to *N. Jeffreysi* BELLARDI, it will be necessary to make countings of the radial striae (or ribs). The very small number of well-preserved valves of *N. georgiana* at my disposal has not been sufficient to clarify the relation of this species to those mentioned. The number of radial striae is, however, clearly higher than that on *N. nucleus*, and therefore it is improbable that *N. georgiana* should be a subspecies of this species, as has been suggested by HINSCH (cf. RASMUSSEN 1956, p. 28, where, as regards the relations between *N. georgiana* and *N. nucleus*, the statements have been inverted. By a regrettable oversight this was not corrected by me before the printing).

For the time being *N. georgiana* must be kept as an independent species. Among the small *Nucula* valves in the material from the Gram Clay there may be other species, which, however, it has not been possible to verify because of the state of preservation, which does not permit a determination to species of the fragments from the Hodde Clay, either.

Valves somewhat larger than the dimensions indicated above have been observed in situ in the Gram Clay in the eastern clay pit of Måde Brickworks.

Sometimes they lay rather close together in a fairly well-defined layer, but were so defective that they could not be removed.

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation. North Germany: Glimmerton at Morsum Kliff (RAVN), Breklum, Blunk,? Schmalfeld, Lieth, Langenfelde, Teufelsbrücke, Heiligengeistfeld, Elbtunnel, and Lüneburg (see RASMUSSEN 1956, p. 113).

FAMILIA: NUCULANIDAE H. & A. ADAMS 1858

Genus: *Nuculana* LAMARCK 1799

(Type: *Leda pernula* MÜLLER 1779)

Nuculana westendorpi (NYST in NYST & WESTENDORP 1839)

1839. *Trigonocoelia Westendorpii* – NYST & WESTENDORP, Nouv. rech. prov. Anvers, p. 405, Pl. 2, f. 17.
1907. *Leda Westendorpi* NYST sp. – RAVN, Jylland, p. 259 (55), Pl. I, f. 12.
1914. *Leda Westendorpii* NYST sp. – GRIPP, Itzehoe, p. 6.
1916. *Leda Westendorpi* NYST sp. – NØRREGAARD, Esbjerg, p. 11.
1925. *Leda (Ledina) Westendorpi* NYST – KAUTSKY, Hemmoor, p. 24, Pl. 2, f. 15, 16.
1942. *Leda (Ledina) westendorpi* (NYST) – ISPEERT, Mioz. Taxodonten, p. 28, Pl. 1, f. 6.
1942. *Leda (Ledina) westendorpi* (NYST) – HEERING, Oligoc. Taxodonten, p. 19, Pl. II, f. 12–14.
1945. *Leda westendorpi* NYST *sp.* – GLIBERT, Mioc. Belg. I, p. 26, Pl. I, f. 5a, b.
1958. *Leda (Ledina) Westendorpii* (NYST & WESTENDORP) – SORGENFREI, Middle Mioc., p. 54, Pl. 3, f. 9a–c.
1959. *Nuculana (Nuculana) westendorpi* (NYST in NYST & WESTENDORP) – ANDERSON, Untermiozän, p. 73, Pl. 13, f. 4a–c.
1964. *Nuculana (Nuculana) westendorpi* (NYST in NYST & WESTENDORP) – ANDERSON, Reinbek-Stufe, p. 127.

Material. Hodde Clay.

Leding	93.155	31 m.:	2 def. sh. and 2 fragm.	(2)
–	–	Unknown depth:	2 def. sh. and 2 fragm.	(4)
Lønborg	102.55	21.3 –22.3 m.:	1 fragm.	(1)
Odderup	103.150	24.8 –25.6 m.:	2 fragm.	(1)
Gram	141.277	32.30–32.70 m.:	1 def. sh.	(1)
–	–	33.05–33.40 m.:	4 fragm.	(1)
–	–	34.25–34.70 m.:	2 fragm.	(1)
–	–	34.70–35.00 m.:	1 def. sh. and 6 fragm.	(1)
–	–	35.00–35.30 m.:	5 fragm.	(1)
–	–	35.30–35.70 m.:	5 fragm.	(1)
Hajstrup		174′–194′ :	1 fragm.	(1)
–		194′–214′ :	5 fragm.	(1)
–		214′–234′ :	1 def. r., 1 def. l., 4 fragm.	(2)

Description. Very few fragmentary shells and small fragments of this characteristic species are available. The material corresponds completely to the

valves from Shell Bed I at Hoddemark and from the Arnum Formation, from which reference is made to SORGENFREI's description and picture (1958).

Distribution.

North Sea Basin. Oligocene. Holland: Upper (HEERING). – Miocene. Denmark: Arnum Formation (SORGENFREI). North Germany: Vierland-Stufe (GRIPP, ANDERSON), Hemmoor-Stufe (KAUTSKY, DITTMER), Reinbek-Stufe (ANDERSON). Holland: Middle (ISPEERT). Belgium: Horizon de Houthaelen, Anversien (GLIBERT).

Nuculana pygmaea (MÜNSTER in GOLDFUSS 1837)
Plate I, figs. 1–4

1956. *Leda* (*Jupiteria*) *pygmaea* (MÜNSTER) – RASMUSSEN, South Jutland, p. 29, Pl. I, f. 2a, b.
1958. *Leda* (*Jupiteria*) *pygmaea* (MÜNSTER) – SORGENFREI, Middle Mioc., p. 51, Pl. 2, f. 8a–b.
1959. *Nuculana* (*Jupiteria*) *pygmaea* (GRAF zu MÜNSTER) – ANDERSON, Untermiozän, p. 77, Pl. 13, f. 3a–c.
1964. *Nuculana* (*Jupiteria*) *pygmaea* (MÜNSTER) – ANDERSON, Reinbek-Stufe, p. 128.

Material. Hodde Clay.

Leding (93.155), Lønborg (102.55), Odderup (103.150), Måde Brickworks (Eastern clay pit), Gram (141.277), Hygum (141.215), and Hajstrup (167.235).

Gram Clay.

Skærum Mølle (clay pit), Aulum (74.321), Kodal (84.770), Randbæk (83.597, 83.602), Brejning Kro (83.197), Muldbjerg (83.1006), Kodal-Fjaldene (84.1749), Videbæk (84.1748, 84.358, 84.456, 84.483, 84.525, 84.1727), Møltrup Brickworks (clay pit), Lille Torup (85.379), Tværmose (85.381), Frølund (85.383), Gjødstrup (85.861), Snejbjerg (85.775), Bording (86.177), Brande Brickworks (clay pit), Drantum (104.1241), Nyholm (104.1166), Store Langkjær (104.1158), Hjortsballe (105.320), Skjerris gårde (104.1165), Leding (93.155), Alkærsig Brickworks (clay pit), Lønborg (102.55), Forsom Brickworks (clay pit), Odderup (103.150), Harkes (clay pit), Ålbæk Eng (102.59), Hesselho (113.121), Hauge (clay pit), Tønding (clay pit), Hodde (113.33a), Måde Brickworks (eastern clay pit), Sønderskovgård (132.34), Brøstrup (141.224), Rojbøl (141.194), Tiset (141.244), Holleskov (132.46b), Ravning (clay pit), Hjortvad (141.178), Lintrup (132.140), Sønder Hygum (141.170, 141.260, 141.261, 141.273), Rødding (141.75, 141.76, 141.241, 141.242, 141.243, 141.247), Vester Lindet (141.246), Gram (141.277), Spandetgård (clay pit), Tønder (166.398), Brodersmark (166.351b), Sæd (167.4, 167.445), and Rends (167.236).

Description. Valves small, more or less oval. The smallest valves short, the larger valves mostly somewhat protracted posteriorly.

The anterior dorsal margin slightly curved. The posterior dorsal margin often a little protracted into a short pointed proboscis. This character is most conspicuous on valves more than 2 mm. in length. The ventral margin regularly curved. The dorsal margin slightly curved.

The umbo nearly in centre position, opisthogyrate. No area or lunula.

The surface of the valves smooth and glossy. The growth lines are faintly visible as concentric lines.

The hinge is taxodont, consisting of a number of uniform, rather pointed, projecting teeth on both sides of the umbo. Under the umbo there is a deep ligament pit, the outline of which is shaped like an equilateral trapeze.

The interior of the valves is smooth. The pallial line is parallel to the ventral margin, often demarcating a deeper part of the valve, but is just as often indistinct. The adductor impressions are distinct. The anterior one is relatively large and rounded. The posterior one is small and oval.

The species has been thoroughly described in the quoted works by SORGENFREI and ANDERSON.

Remarks. In the younger horizons of the Gram Clay *N. pygmaea* is the dominant species. Its valves in these strata – and in the Gram Clay on the whole – are generally somewhat smaller than the valves from the Arnum Formation and the Lower Miocene boulders of Northern Germany (cf. the measurements published by SORGENFREI and ANDERSON, in relation to those below).

Thus only 2 out of 45 well-preserved valves from Spandetgård were more than 2 mm. in length. These two valves are also the only ones in the material which have a distinctly protracted posterior end. The other valves are comparatively short and have a more convex ventral margin than is generally seen in the material of the Arnum Formation.

The only specimen from Gram found in the collections of the Mineralogical Museum in Copenhagen when RAVN (1907, p. 261) examined the material of Tertiary molluscs of the museum, was of the short form, a fact which probably explains why the valve was referred to *Portlandia Philippiana* NYST sp. The determination (according to RAVN's remarks on the species) seems to be supported on material from the Upper Miocene Glimmerton (Mica Clay) of Langenfelde (Germany), which presumably by GOTTSCHE was labelled as *P. Philippiana.*

The oblong typical form is pictured on Plate I, figs. 1 and 3, while the short form is seen on the same plate, figs. 2 and 4.

Measurements. Five double valves from Spandetgård have the following measurements:

Length:	Height:	Thickness:
1.5 mm.	1.2 mm.	0.7 mm.
1.3 –	1.0 –	0.7 –
1.4 –	1.1 –	0.7 –
1.4 –	1.1 –	0.7 –
1.1 –	0.8 –	0.6 –

The largest of the valves from Spandetgård measures 3.0 mm. in length

and 2.3 mm. in height. The smallest one measures 1.1 mm. in length and 0.8 in height.

The average of measurements of 50 valves from the same locality shows a length of 1.5 mm. and a height of 1.2 mm.

These values seem to correspond very well to the dimensions of shells from the other Gram Clay localities, from which there are numerous valves of this species available.

Distribution.

North Sea Basin. Oligocene. Denmark: Upper (HARDER). North Germany: Middle (v. KOENEN 1867), Upper (SPEYER-v. KOENEN 1884). Holland: Upper (HEERING). – Miocene. Denmark: Klintinghoved Clay (SORGENFREI), Arnum Formation (SORGENFREI), Hodde Formation, Gram Formation. North Germany: Vierland-Stufe (GRIPP), Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON), Glimmerton (GOTTSCHE 1876: *P. Philippiana*). Holland: Middle (IJSPEERT). Belgium: Horizon de Houthaelen, Anversien (GLIBERT). – Plio-Pleistocene. England: Coralline Crag (WOOD). – The species is probably identical with *Leda tenuis* PHILIPPI, which occur in the Recent Atlantic Ocean, the seas around Great Britain and in the Mediterranean.

Genus: *Yoldia* MÖLLER 1842

(Type: *Leda hyperborea* (LOVÉN), TORELL 1859)

Yoldia glaberrima (MÜNSTER in GOLDFUSS 1837)

1956. *Yoldia* (*Yoldia*) *glaberrima* (MÜNSTER) – RASMUSSEN, South Jutland, p. 30.
1958. *Yoldia glaberrima* (MÜNSTER) – RASMUSSEN, Sæd, p. 7, Pl. I, f. 1a, b.
1958. *Yoldia glaberrima* (MÜNSTER) – SORGENFREI, Middle Mioc., p. 59, Pl. 4, f. 11a–b.
1959. *Yoldia* (*Yoldia*) *glaberrima* (Graf zu MÜNSTER) – ANDERSON, Untermiozän, p. 79, Pl. 13, f. 5a–c.
1964. *Yoldia* (*Yoldia*) *glaberrima* (MÜNSTER) – ANDERSON, Reinbek-Stufe, p. 129.

Material. Hodde Clay.

Leding (93.155), Lønborg (102.55), Hodde (113.33a), Gram (141.277).

Gram Clay.

Skærum Mølle (clay pit), Brejning Kro (83.197), Muldbjerg (83.1006), Kodal-Fjaldene (84.1749), Videbæk (84.1748), Lille Torup (85.379), Snejbjerg (85.775), Bording (86.177), Brande Brickworks (clay pit), Drantum (104.1241), Nyholm (104.1166), Odderup (103.150), Harkes (clay pit), Stenderup (113.36), Måde Brickworks (eastern clay pit), Tiset (141.244), Holleskov (132.46b), Ravning (clay pit), Hjortvad (141.178), Lintrup (132.140), Sønder Hygum (141.170, 141.260, 141.261, 141.273), Rødding (141.75, 141.76, 141.242, 141.247), Vester Lindet (141.246), Gram (141.277), Spandetgård (clay pit), Spandet (150.184), Tønder (166.398), Brodersmark (166.351b), Sæd (167.4, 167.445), and Rends (167.236).

Remarks. All the specimens available consist of fragments, with the exception of two defective valves found in a lump of clay collected in the clay pit of Brande Brickworks.

The appearance of the fragments shows that they belong to a smooth *Yoldia*, which can hardly be any other than the *Y. glaberrima* which is so frequent in the Miocene deposits of the North Sea Basin.

Reference is made to the thorough descriptions of the species in SORGENFREI (1958) and ANDERSON (1959).

Distribution.

North Sea Basin. Oligocene. Denmark: Upper (HARDER). North Germany: Upper (GÖRGES). Holland: Upper (HEERING). – Miocene. Denmark: Klintinghoved Clay (SORGENFREI), Arnum Formation (SORGENFREI), Hodde Formation, Gram Formation. North Germany: Vierland-Stufe (GRIPP), Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON), Glimmerton at Langenfelde (GOTTSCHE), Lüneburg (MÜLLER), Elbtunnel (HORN) and Morsum Kliff, Sylt (RAVN). Holland: Middle (IJSPEERT). Belgium: Horizon de Houthaelen, Anversien (GLIBERT). – Pliocene. Germany: Morsum Kliff, Limonitsandstein (GRIPP 1922), Bredstedt (H.-L. HECK).

FAMILIA: ARCIDAE GRAY 1840

Genus: *Bathyarca* KOBELT 1891

(Type: *Arca pectunculoides* SCACCHI 1834)

Bathyarca pectunculoides (SCACCHI 1834)

1856. *Arca pectunculoides* SCACCHI – S. V. WOOD, Crag Moll. II, p. 79, Pl. X, f. 3a–b.
1863. *Arca pectunculoides* SCACCHI – JEFFREYS, Brit. Conch. II, p. 171, V (1869), Pl. XXX, f. 3.
1867. *Arca pectunculoides* SCACCHI – WEINKAUFF, Conch. Mittelm. I, p. 201.
1892. *Arca pectunculoides* SCACCHI – LEHMANN, Dingden I, p. 211, Pl. IV, f. 4.
1898. *Arca pectunculoides* SCACCHI – BUCQUOY, DAUTZENBERG & DOLLFUS, Roussillon, II, p. 802.
1907. *Arca* (*Bathyarca*) *pectunculoides* SCACCHI – CERULLI-IRELLI, Fauna mal. mariana, p. 110, Pl. VII (V), f. 30.
1925. *Bathyarca pectunculoides* SCACCHI *var. minutissima* – KAUTSKY, Hemmoor, p. 18, Pl. 2, f. 1.
1934. *Arca* (*Bathyarca*) *pectunculoides* SCACCHI – JENSEN & SPÄRCK, Saltvandsmuslinger, p. 37, f. 25.
1945. *Arca* (*Bathyarca*) *pectunculoides* SCACCHI – GLIBERT, Mioc. Belg. II, p. 42, Pl. I, f. 11.
1957. *Bathyarca pectunculoides* SCACCHI sp. – GLIBERT, Pelecyp. I.R.S.N.B. Bull., T. XXXIII, no. 9, p. 18.
1958. *Bathyarca pectunculoides* (SCACCHI) – SORGENFREI, Middle Mioc., p. 65.
1964. *Bathyarca pectunculoides* (SCACCHI) – ANDERSON, Reinbek-Stufe, p. 130, Pl. 1, figs. 9a–b.

Material. Gram Clay.

Måde Brickworks		Eastern clay pit	1 defective left valve	(1)
Gram	141.277	18.00–18.50 m.:	1 def. valve	(1)
–	–	19.00–19.50 m.:	–	(1)
–	–	19.50–20.00 m.:	–	(1)

Description. Very few fragmentary valves are available.

The specimen from Måde consists of an incomplete left valve comprising the part around the umbo and the posterior hinge region as well as part of the shell ventrally to these areas. The remnant of the valve is seated on a lump of pyrite.

The umbo is prosogyrate. The surface of the valve is covered by numerous fine, filamentous, radial ribs, crossed by numerous fine, filamentous concentric ribs. At the intersections there are some very small knot-shaped elevations. The intervals between the ribs are equally rectangular except for the part of the shell below the margin of the hinge, where they are shaped as parallelograms.

The greater part of the hinge is covered by pyrite. Only the three strong posterior teeth are seen, parallel to the margin of the hinge.

The fragments from Gram are also seated on pyrite and comprise correspondingly smaller parts of the valve.

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Gram Formation. North Germany: Hemmoor-Stufe (KAUTSKY, DITTMER), Reinbek-Stufe (ANDERSON), Glimmerton at Langenfelde (GOTTSCHE 1876). Belgium: Anversien, Deurnien (GLIBERT). – Plio-Pleistocene. Belgium: Scaldisien (GLIBERT). England: Coralline Crag (WOOD). – Recent: Skagerak (300–700 m's depth acc. to JENSEN & SPÄRCK).

Atlantic Region. Aquitanian Basin: Helvétien (COSSMANN & PEYROT: *B. polyfasciata* (SISM.). – Recent: Atlantic Ocean from Greenland (POSSELT) and Spitsbergen to the coasts of the British Isles (JEFFREYS), Morocco and the Mexican Gulf (JENSEN & SPÄRCK).

Mediterranean Basin. Miocene. Italy: Elveziano (SACCO). – Pliocene. Italy: Monte Mario (CERULLI-IRELLI). – Recent: The coast off Gibraltar, Naples, the Aegean Islands etc. (in deep water) (WEINKAUFF).

Poland: Miozän (FRIEDBERG: *Arca pectunculoides* SCACCHI *var. minutissima* KAUTSKY).

FAMILIA: LIMOPSIDAE DALL 1895

Genus: *Limopsis* SASSI 1827
(Type: *Arca aurita* BROCCHI 1814)

Limopsis aurita (BROCCHI 1814)
Plate I, figs. 5 and 6

1956. *Limopsis* (*Limopsis*) *aurita* (BROCCHI) – RASMUSSEN, South Jutland, p. 31, Pl. I, f. 3a, b.
1958. *Limopsis aurita* (BROCCHI) – SORGENFREI, Middle Mioc., p. 66.
1959. *Limopsis* (*Limopsis*) *aurita* (BROCCHI) – ANDERSON, Untermiozän, p. 87, Pl. 13, f. 8a-c.
1964. *Limopsis* (*Limopsis*) *aurita* (BROCCHI) – ANDERSON, Reinbek-Stufe, p. 132.

Material. Hodde Clay.

Leding (93.155), Odderup (103.150), Grøde (Karlsgårde Canal, Section), Måde Brickworks (northwestern clay pit, eastern clay pit), Gram (141.277), Hygum (141.215), Tønder (166.398), and Hajstrup (167.235).

Gram Clay.

Skærum Mølle (clay pit), Lillelund (73.88), Vinding (74.321), Lille Spåbæk (lignite pit), Spjald (83.127), Brejning Kro (83.197), Kodal-Fjaldene (84.1749), Videbæk (84.344, 84.1727), Møltrup Brickworks (clay pit), Gjødstrup (85.861), Vester Høgild (95.1510b), Drantum (104.1241), Nyholm (104.1166), Store Langkjær (104.1158), Hjortsballe (105.320), Leding (93.155), Alkærsig Brickworks (clay pit), Forsom Brickworks (clay pit), Odderup (103.150), Hesselho (113.121), Hauge (clay pit), Karlsgårde Canal (unknown locality), Hodde (113.33a), Esbjerg (130.59, clay pit and beach), Måde Brickworks (eastern clay pit), Strandgård Brickworks (clay pit), Lintrup (132.140), Sønder Hygum (141.170, 141.260), Rødding (141.75), Gram (141.277), Spandetgård (clay pit), Spandet (150.184), and Tønder (166.398).

Description. The valves are obliquely oval and become more oblique with age. The margin of the hinge is almost straight or slightly convex, on both sides of the umbo being protracted into mostly indistinct small auricles or ear-shaped extensions. The anterior margin of the valve is highly convex. The posterior margin of the older valves are lengthened downwards and are a little more flatly convex. Both margins are evenly merged into the highly convex ventral margin.

The umbo is small, conspicuous, situated a little in front of the axis of the valve. Area is clearly demarcated as a triangular depressed part, the surface of which is striated lengthwise. In the middle of area, immediately below the umbo, the small triangular, sharply defined ligament pit is found.

The hinge consists of a number of teeth (5–9) on each side of the ligament pit. It projects a little over the dorso-ventral plane, and the inmost ones are vertically placed, while the outmost ones are more oblique. The central ones are usually the largest, and mostly there is a tooth more in the posterior row of the hinge.

The valves are evenly convex.

The exterior is comparatively smooth, but is densely set with concentric growth lines, which, however, mostly demarcate numerous, more or less distinct thickenings of the surface of the valve. Besides, it is possible by magnification to see numerous radial striae, which, however, are only visible on the passage above the concentric thickenings, where a number of very small, mostly indistinct notches on these are often formed.

The interior is smooth. Mostly, however, there is a very indistinct and irregular radial striation. As a rule the adductor impressions are distinct. The anterior one is shaped like an oval cut lengthwise, the surface of which is deeply depressed in the middle. The straight line which constitutes the demarcation towards the middle of the valve, often forms a projecting edge. The posterior adductor impression is much larger and of the same form.

The ventral shell-margin is smooth.

Remarks. This species is very common in the Miocene of the North Sea Basin.

In Denmark it seems to have diasppeared before the end of Upper Miocene time.

In the Hodde and Gram Formations there are furthermore two *Limopsis* forms: *L. lamellata* in the Hodde Clay and *L. anomala* in the Gram Clay. Both of them are described below, but probably they are shells of *L. aurita* with an appearance deviating in the case of each type. *L. lamellata* is presumably only the juvenile form of *L. aurita* occurring in the Hodde Clay and *L. anomala* the corresponding stage in the Gram Clay. See the remarks under the two species.

Distribution.

North Sea Basin. Oligocene. Denmark: Upper (HARDER). Holland: Upper (HEERING). – Miocene. Denmark: Klintinghoved Clay, Arnum Formation (SORGENFREI), Hodde Formation, Gram Formation. North Germany: Vierland-Stufe (ANDERSON), Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON), Glimmerton at Lieth, Langenfelde, Teufelsbrücke (GOTTSCHE), Lüneburg (MÜLLER). Holland: Upper (IJSPEERT). Belgium: Anversien (GLIBERT). – Plio-Pleistocene. England: Coralline Crag (WOOD). – Recent living in the northern North Sea (JENSEN & SPÄRCK).

Atlantic Region. Aquitanian Basin: Tortonien (COSSMANN & PEYROT: *L. dumasi*). – Recent from the seas off Western Greenland to the Gulf of Mexico, the seas around the Bermudas and from the Shetlands to Gibraltar (JEFFREYS).

Mediterranean Basin. Italy: Elveziano, Tortoniano, Piacenziano (SACCO), Monte Mario (CERULLI-IRELLI). Spain: Plaisancien (GIGNOUX et FALLOT). Cyprus: Pliocène inférieur. Syria: Miocène superieur, Pliocène (DUBERTRET, VAUTRIN, KELLER, DAVID). Algeria: Plaisancien (DE LAMOTHE). – Recent (BUCQUOY, DAUTZENBERG & DOLLFUS).

Limopsis anomala (EICHWALD 1830)

Plate I, figs. 8 and 9

1830. *Pectunculus anomalus* – EICHWALD, Nat. Skizze, p. 211.
1870. *Limopsis anomala* EICHWALD – HÖRNES, Wienerbecken II, p. 312, Pl. XXXIX, f. 2–3.
1892. *Limopsis anomala* EICHWALD – LEHMANN, Dingden I, p. 214.
1898. *Pectunculina anomala* EICHWALD – SACCO, I Molluschi, XXVI, p. 41 (*var. minuta*, p. 41, Pl. X, f. 11–18).
1907. *Limopsis* (*Pectunculina*) *anomala* EICHW. sp. – CERULLI-IRELLI, Fauna mal. mariana, I, p. 122, Pl. XI (IX), f. 13–15. (*var. minuta* PHIL., p. 123, Pl. XI (IX), f. 16; *var. cancellata* MICH., p. 123, Pl. XI (IX), f. 17–18).
1912. *Limopsis* (*Pectunculina*) *minuta* (PHIL.). – COSSMANN & PEYROT, Conch. Néog. A.S.L.B. LXVI, 4 fasc. p. 321, Pl. VII, f. 9–12.
1913. *Limopsis anomala* EICHWALD sp. – DOLLFUS et DAUTZENBERG, Bassin Loire, p. 364, Pl. XXXIII, f. 1–10.
1914. *Limopsis anomala* EICHW. – GRIPP, Itzehoe, p. 7.
1925. *Limopsis* (*Pectunculina*) *minuta* PHIL. – KAUTSKY, Hemmoor, p. 20.
1942. *Limopsis anomala* (EICHWALD). – ISPEERT, Mioz. Taxodonten, p. 59, Pl. 4, f. 7–8.
1945. *Limopsis* (*Pectunculina*) *minuta* PHILIPPI sp. – GLIBERT, Mioc. Belg. I, p. 49, Pl. II, f. 3.
1958. *Limopsis anomala* (EICHWALD). – SORGENFREI, Middle Mioc., p. 69, Pl. 4, f. 16a–b.

1964. *Limopsis (Pectunculina) anomala* (EICHWALD) – ANDERSON, Reinbek-Stufe, p. 132, Pl. 1, f. 13a–b.

Material. Gram Clay.

Muldbjerg	83.1006	6.0 – 7.0	m.:	1 complete shell (1)
–	–	7.0 – 8.0	m.:	3 def. sh. (2)
–	–	8.0 – 9.0	m.:	3 complete sh., 3 def. sh. (3)
Videbæk	84.1748	22.95–23.95	m.:	11 complete sh. 10 def. sh. (11)
–	–	23.95–24.95	m.:	2 complete sh., 7 def. sh. (5)
–	84.358	7.2 –15.1	m.:	6 complete sh., 15 def. sh. (11)
–	84.417	2.2 –15.0	m.:	1 def. sh. (1)
–	84.456	2.2 –15.0	m.:	2 complete sh., 6 def. sh. (4)
–	84.483	2.0 –10.8	m.:	3 complete sh., 4 def. sh. (4)
–	84.492	5.1 –15.5	m.:	5 def. sh. (3)
–	84.525	6.2 – 9.0	m.:	1 complete sh., 11 def. sh., 8 fragm. (3)
Lille Torup	85.379	16.8 –20.0	m.:	24 complete sh., 47 def. sh., 1 fragm. (36)
Tværmose	85.381	21.0 –25.0	m.:	2 complete sh., 2 def. sh., 1 fragm. (2)
Frølund	85.383	9.2 –17.9	m.:	2 complete sh., 2 def. sh. (3)
Gjødstrup	85.861	54.0	m.:	2 complete sh., 2 def. sh. (3)
Snejbjerg	85.775	28.25–29.25	m.:	1 complete sh. (1)
–	–	29.25–30.25	m.:	1 def. sh. (1)
Brande Brickworks		Clay pit	:	1 small complete sh. (1)
Odderup	103.150	20.0 –21.0	m.:	1 complete sh., 7 def. sh., 1 fragm. (7)
Måde Brickworks		Eastern clay pit	:	1 def. sh. and 1 complete sh. (2)
Gram	141.277	14.60–15.10	m.:	1 def. sh. (1)
–	–	15.55–16.00	m.:	2 complete sh., 1 def. d, 1 fragm. (4)
–	–	16.00–16.50	m.:	1 complete sh., 9 def. sh., 2 fragm. (6)
–	–	16.50–17.00	m.:	7 complete sh., 12 def. sh. (10)
–	–	17.00–17.50	m.:	17 complete sh., 21 def. sh., 1 complete d., 5 fragm. (22)
–	–	17.50–18.00	m.:	1 complete sh., 1 def. sh. (2)

Description. The valves are almost circular, sometimes, however, slightly obliquely oval. The margin of the hinge is rectilinear, protracted into small, very short ears on both sides of the umbo. The anterior and posterior margins of the valves are approximately equally convex, the posterior one, however, sometimes being slightly less convex than the anterior one.

The umbo is small, situated approximately in the axis of the valve. Area is shaped as on the preceding species. The ligament pit which is situated in the middle of the area immediately below the umbo, is deep and shaped as a somewhat narrower and more pointed triangle than on the preceding species.

The hinge is clearly differently developed on each side of the ligament pit. The anterior row in the largest valves consists of two or three horizontal teeth, whereas the posterior row has three or four vertical teeth.

The valves are rather highly convex.

The exterior is covered with close-set, more or less prominent, conspicuous

and regular, concentric ribs intersected by numerous thin and fine, very distinct radial filaments. Mostly, however, the concentric ribs are highly dominant.

The interior is smooth. The adductor impressions are often indistinct, but show the same form and situation as those of the preceding species.

The inside of the ventral margin is crenulated. The upper part of the posterior margin is often also crenulated, but with fainter ridges than the ventral margin, and there is a short, smooth piece of shell-margin between the two rows of ridges.

Measurements.

			Length	Height	Thickness
Odderup	103.150	20.0 –21.0 m.:	2.8 mm.	3.1 mm.	0.9 mm.
Lille Torup	85.379	16.8 –20.0 m.:	2.3 –	2.4 –	0.9 –
–	–	–	2.4 –	2.6 –	0.9 –
–	–	–	1.5 –	1.5 –	0.4 –
–	–	–	2.0 –	2.0 –	0.8 –
Snejbjerg	85.775	28.25–29.25 m.:	2.1 –	2.2 –	0.9 –
Brande (brickworks pit)			2.1 –	2.1 –	0.6 –
Måde Brickworks (eastern clay pit)			3.0 –	3.1 –	1.2 –

(Plate I, figs. 8 and 9)

			Length	Height	Thickness	Number of teeth in front of umbo	Number of teeth behind
Gram	141.277	17.00–17.50 m.	0.8 mm.	0.8 mm.	0.2 mm.	1	1
–	–	–	0.9 –	0.9 –	0.2 –	1	1
–	–	–	1.0 –	1.0 –	0.3 –	1	2
–	–	–	1.2 –	1.3 –	0.3 –	1	2
–	–	–	1.4 –	1.5 –	0.4 –	2	3
–	–	–	1.7 –	1.8 –	0.6 –	2	3
–	–	–	2.1 –	2.1 –	0.9 –	2	3
–	–	–	2.1 –	2.2 –	0.8 –	2	3
–	–	–	2.5 –	2.6 –	0.9 –	3	4

Remarks. SORGENFREI (1958, p. 70) remarks that *L. anomala* may only be a variety of *L. aurita*, as the only difference between the two species seems to be that the ventral margin is crenulated in the former and smooth in the latter.

Observations from the *Limopsis* material of the Gram Formation confirm that there is a close connexion between the two forms. It is even probable that *L. anomala* should only be considered a juvenile form of *L. aurita*, as all small valves of *Limopsis* measuring less than 3 mm. in length and height, have the character of *L. anomala*, i.e. first of all the crenulated ventral margin, but also the close-set concentric folds and the radial striae.

All the *Limopsis* valves collected, with the exception of a few small specimens (from Brande and Måde), are large, typical *L. aurita* valves. In return the small *L. anomala* valves are dominant in the drilling samples. This seems to corroborate what has been said above, but it has not been possible to provide a clear proof.

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Gram Formation. North Germany: Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON). Holland: Middle (IJSPEERT). Belgium: Anversien (GLIBERT)

Atlantic Region. Loire Basin: Miocène Moyens (Faluns) (DOLLFUS & DAUTZENBERG). – Aquitanian Basin: Burdigalien, Helvétien (COSSMANN & PEYROT: *L. minuta*).

Mediterranean Basin. Italy: Elveziano, Piacenziano, Astiano (SACCO), Monte Mario (CERULLI-IRELLI).

Vienna Basin. Austria: Baden Tegel (HÖRNES).
Poland: Miozän (FRIEDBERG).

Limopsis lamellata LEHMANN 1885

Plate I, figs. 7 and 10

1892. *Limopsis lamellata* – LEHMANN, Dingden I, p. 216, Pl. IV, f. 5.
1925. *Limopsis (Pectunculina) lamellata* LEHM. – KAUTSKY, Hemmoor, p. 20, Pl. 2, f. 7a, b.
1964. *Limopsis (Pectunculina) lamellata* LEHMANN – ANDERSON, Reinbek-Stufe, p. 134, Pl. 1, f. 14a–b.

Original diagnosis: Not adduced. *Main features of the original description:* "Die Schale ist fast kreisrund, ziemlich stark gewölbt ----- die Oerschen stehen beiderseits sehr wenig vor ----- Die Oberfläche der Klappen trägt wenige, ziemlich weit von einander abstehende, starke, lamellenartig vorstehende, konzentrische Rippen, welche von zahlreichen feineren Radialrippen durchschnitten werden, so dass ein deutliches Gitter mit ziemlich grossen, länglich rechteckigen, in den Ecken mehr oder weniger knotigen Feldern entsteht. ----- Der Innenrand ist stets gekerbt und zwar meist vollständig und ziemlich tief." (LEHMANN 1892).

Type material. The holotype is the shell pictured by LEHMANN (*loc. cit.*). Locus typicus: Dingden. Stratum typicum: Mica Clay. Age: Middle Miocene (Reinbek-Stufe). Repository unknown.

Material. Hodde Clay.

Leding	93.155	27 –28 m.:	2 def. sh.	(2)
–	–	Unknown depth:	1 complete sh., 2 def. sh.	(3)
Lønborg	102.55	17.3 –18.3 m.:	1 fragm.	(1)
–	–	18.3 –19.3 m.:	1 complete sh.	(1)
Hodde	113.33a	18.5 –18.9 m.:	7 def. sh., 4 fragm.	(5)
Brøstrup	141.255	30.3 m.:	2 def. sh.	(2)
Rødding	141.243	30 m.:	6 complete sh.	(3)
Gram	141.277	27.50–28.00 m.:	1 complete sh., 14 def. sh., 17 fragm.	(8)
–	–	28.00–28.50 m.:	9 complete sh., 32 def. sh., 1 complete d, 15 fr.	(22)

Gram	141.277	28.50–29.00 m.:	4 complete sh., 6 def. sh., 8 fragm.	(5)
–	–	29.00–29.50 m.:	1 complete sh., 14 def. sh., 7 fragm.	(8)
–	–	29.50–30.00 m.:	2 complete sh., 8 def. sh., 4 fragm.	(5)
–	–	30.00–30.50 m.:	8 def. sh., 1 fragm.	(4)
–	–	30.95–31.35 m.:	2 def. sh., 1 fragm.	(1)
–	–	31.35–31.65 m.:	1 def. sh.	(1)
–	–	31.65–31.95 m.:	2 complete sh.	(1)
–	–	31.95–32.30 m.:	8 def. sh.	(4)
–	–	32.30–32.70 m.:	11 def. sh., 2 fragm.	(6)
–	–	32.70–33.05 m.:	3 def. sh., 1 fragm.	(3)
–	–	33.05–33.40 m.:	10 def. sh., 16 fragm.	(6)
–	–	33.40–33.80 m.:	2 def. sh., 2 fragm.	(2)
–	–	33.80–34.25 m.:	3 complete sh., 13 def. sh., 2 fragm.	(9)
–	–	34.25–34.70 m.:	28 def. sh., 11 fragm.	(15)
Hajstrup	167.235	174′–194′	2 complete sh., 14 def. sh., 1 fragm.	(9)
–	–	214′–234′	3 complete sh., 9 def. sh.	(6)

Description. The shells are circular when small and obliquely oval when larger.

Outline, hinge, and interior, for that matter, correspond to the appearance and conditions in *L. aurita.* Therefore reference is made to the description of this species and to the quotation of the original description.

The surface of the valve is on the exterior characterized by lamelliform concentric thickenings intersected by numerous fine radial striae. The lamellae as a rule are less prominent on the young parts of the larger valves, which thus become difficult to distinguish from *L. aurita.*

The ventral margin is crenulated on the small valves and smooth on the larger ones.

Measurements. The following measurements of representative valves will give the reader an impression of the dimensions of the material. The valves from Leding and Hoddemark are the largest complete valves in the material, but there are fragments of valves which were somewhat larger.

			Length	Height	Thickness	
Leding	93.155	Unknown depth	5.5 mm.	5.7 mm.	2.0 mm.	
Rødding	141.243	30 m.	1.1 –	1.1 –	0.3 –	
–	–	30 m.	1.2 –	1.0 –		(Plate I, fig. 7)
Gram	141.277	29.50–30 m.	1.0 –	1.0 –	0.3 –	
–	–	–	0.8 –	0.8 –	0.2 –	
Hoddemark	Shell Bed I		3.1 –	3.2 –		(Plate I, fig. 10)

Remarks. It is doubtful whether it will be possible to maintain *L. lamellata* as an independent species, as there seems to be even transitions to *L. aurita.*

The small valves from the Hodde Clay are clearly characterized by the lamelliform concentric thickenings, which are not found on the small *Limopsis* valves from the Gram Clay. The populations in the Hodde Clay thus can easily be distinguished from that in the Gram Clay on the basis of the small individuals (i.e. with a length and a height of less than 2 mm.), but the adult

valves (length and height of more than 6 mm.) from the two formations cannot be distinguished morphologically.

Therefore it is probable that *L. lamellata* should be considered a subspecies of *L. aurita*. As, however, it has not been possible to verify this view by means of the present material, *L. lamellata* is maintained as an independent species in the present paper.

Distribution.

North Sea Basin. Miocene. Denmark: Hodde Formation. North Germany: Hemmoor-Stufe (DITTMER), Reinbek-Stufe (ANDERSON).

Genus: *Modiolus* LAMARCK 1799

(Type: *Mytilus modiolus* LINNÉ 1758)

Modiolus phaseolinus (PHILIPPI 1844)

Plate V, fig. 1

1844. *Modiola phaseolina* – PHILIPPI, Enum. Moll. Siciliae II, p. 51, Pl. XV, f. 14.
1850. *Modiola phaseolina* PHILIPPI – S. V. WOOD, Crag. Moll. II, p. 59, Pl. VIII, f. 4.
1853. *Modiola phaseolina* PHILIPPI – FORBES & HANLEY, Brit. Moll. II, p. 186; IV, Pl. XLIV, f. 3.
1863. *Mytilus phaseolinus* PHILIPPI – JEFFREYS, Brit. Conch. II, p. 118, V. (1869), Pl. XXVII, f. 5.
1867. *Modiola phaseolina* PHILIPPI – WEINKAUFF, Conch. Mittelm. I, p. 218.
1878. *Modiola phaseolina* PHILIPPI – NYST, Conch. Terr. Tert., p. 164, Pl. XVII, f. 6a–d.
1934. *Modiola phaseolina* PHILIPPI – JENSEN & SPÄRCK, Saltvandsmuslinger, p. 76, f. 57.
1945. *Modiolus* (*Modiolula*) *phaseolinus* PHILIPPI – GLIBERT, Mioc. Belg. I, p. 53, Pl. II, f. 7.
1957. *Modiolus* (*Modiolula*) *phaseolina* PHILIPPI – GLIBERT, I.R.S.N.B., Bull., T. XXXIII, no. 9, p. 19.
1959. *Volsella* (*Modiolula*) *phaseolina* (PHILIPPI) – ANDERSON, Untermiozän, p. 91, Pl. 14, f. 2a, b.
1964. *Modiolus* (*Modiolula*) *phaseolinus* (PHILIPPI) – ANDERSON, Reinbek-Stufe, p. 135.

Original diagnosis. "M. testa ovato-oblonga, gibba, laevigata; margine ventrali recto subsinuato, dorsali postico eidem subparallelo; cardine denticulato." (PHILIPPI 1844).

Type material. The place where PHILIPPI's type is kept is unknown. Thus also its locus typicus and stratum typicum.

Material. Hodde Clay.

Gram	141.277	27.00–27.50 m.:	1 defective valve	(1)

Gram Clay.

Brande Brickworks	The clay pit	Sample:	1 defective right valve	(1)
Gram	141.277	17.00–17.50 m.:	1 double valve of a juvenile individual	(1)

Gram	141.277	17.50–18.00 m.:	1 fragment	(?1)
–	–	18.50–19.00 m.:	1 double valve of a juvenile individual	(1)
–	–	21.00–21.50 m.:	1 defective double valve	(1)

Description. The specimens available are all juvenile.

The valves are oblong, obliquely oval, and thin. The dorsal margin is unsymmetrically curved. The part situated in front of the umbo is short and slightly convex. It forms a rounded angle to the almost straight anterior margin of the valve. The part behind the umbo slopes steeply in an almost straight line down towards the posterior margin of the valve, which is also straight and seems to be parallel to the anterior margin. Below, both margins in an even curve pass into the highly convex ventral margin.

The umbo is slightly prosogyrate and situated near the anterior part of the dorsal margin, projecting a little beyond it.

The valves are evenly convex.

The surface is smooth. When highly magnified, it shows concentric, very faint growth lines.

The interior and the hinge region were only visible on a fragmentary right valve from Brande Brickworks, the other specimens being double valves on a cast of pyrite.

The valve from Brande shows the following features:

Below the umbo the dorsal margin is thickened and provided with about six fairly irregular elevations. The posterior dorsal margin is crenulated, being decomposed into at least eleven (+ a few more on the whole valve) parallelogram-shaped, flat ridges, the intervals of which are shaped as very narrow grooves. The ligament pit is groove-shaped and is found closely below the dorsal margin, between this margin and a list-shaped thickening issuing from the thickened dorsal margin under the umbo on both sides of it.

The anterior dorsal margin of the valve in question was broken off.

The adductor impressions and the ventral part of the valve were also inaccessible to examination.

Measurements. Hodde Clay.

			Length	Height
Gram	141.277	27.00–27.50 m.:	1.1 mm.	1.4 mm.
	Gram Clay.			
Gram	141.277	17.00–17.50 m.:	0.9 –	1.1 –
Brande Brickworks		The clay pit. Right valve	0.8 –	1.1 –

Remarks. It seems possible with certainty to refer the very small specimens to this species, although their shape is shorter and broader than that of the much larger valves pictured by GLIBERT and ANDERSON. All the other characters are in agreement with theirs.

Distribution.

North Sea Basin. Miocene. Denmark: Hodde Formation, Gram Formation. North Germany: Vierland-Stufe (ANDERSON), Hemmoor-Stufe (DITTMER), Reinbek-Stufe (ANDERSON). Belgium: Anversien, Deurnien (GLIBERT). – Plio-Pleistocene. Belgium: Scaldisien (GLIBERT). England: Coralline Crag (WOOD). – Recent (JENSEN & SPÄRCK).

Atlantic Region. Recent from the seas off northern Norway to the seas around Iceland and the western coasts of Europe (JENSEN & SPÄRCK).

Mediterranean Basin. Italy: ? Pliocene at Palermo and Messina (WEINKAUFF).

FAMILIA: PINNIDAE

Genus: *Pinna* LINNÉ 1758

(Type: *Pinna rudis* LINNÉ 1758)

? Pinna sp.

Material. Gram Clay.

Tønding		Clay pit	Fragments	(1)
Gram	141.277	6.90– 7.30 m.	–	(1)
–	–	8.05– 8.50 m.	–	(1)
–	–	8.50– 9.00 m.	–	(1)
–	–	9.00– 9.50 m.	–	(1)
–	–	9.50– 9.90 m.	–	(1)
–	–	15.55–16.00 m.	–	(1)

Description. There are numerous fragments of a fairly large, very thin-shelled and apparently quite flat-shelled pelecypod, the interior of which is nacreous. A few of the fragments originate from the region around the margin of the valve, which is seen to be slightly curved. Apart from very faint growth lines the surface of the valve is smooth, but there are suggestions of very slight folds parallel to the growth lines.

With some doubt the fragments are referred to the genus *Pinna.*

FAMILIA: PECTINIDAE LAMARCK 1801

Genus: *Amussium* (BOLTEN) RÖDING 1798

(Type: *Ostrea pleuronectes* LINNÉ 1758)

Amussium cf. woodi (NYST 1861)

1861. *Pecten Woodi* – NYST, Crag noir d'Edeghem, p. 196.
1892. *Pecten Gerardi* NYST – LEHMANN, Dingden I, p. 201.
1893. *Pecten Woodi* NYST – LEHMANN, Dingden II, p. 290 (under *P. Gerardi*).
1916. *Pecten (Amussium) n. sp.* – NØRREGAARD, Esbjerg, p. 9, f. 1.
1939. *Amussium Woodi* NYST – ROGER, Chlamys, p. 254 (under *A. Gerardi*).
1940. *Lissochlamys cfr. Gérardi* NYST – SORGENFREI, Klintinghoved, p. 14 (and 93), Pl. IV, f. 1.

1945. *Amusium woodi* NYST *sp.* – GLIBERT, Mioc. Belg. I, p. 88, Pl. V, f. 3a–c.
1950. *Pecten (Pseudamussium) corneus* SOWERBY – HEERING, Mioc. Pelec. p. 14, Pl. 1, f. 14, 18; Pl. 2, f. 22.
1958. *Pecten Gerardii* NYST – SORGENFREI, Middle Mioc., p. 78, Pl. 5, f. 24.
1959. *Amussium (Amussium) woodi* (NYST) – ANDERSON, Untermiozän, p. 102, Pl. 14, f. 10.
1964. *Amussium (Amussium) woodi* (NYST) – ANDERSON, Reinbek-Stufe, p. 137, text-fig. 9.

Material. Gram Clay.

Fragments from the clay pits of Lille Spåbæk, Hauge, and Måde (eastern pit) and from the bore-hole at Gram Brickworks (141.277), 14.60–15.10 m.

Description. There are few fragments of a large, smooth, very thin-shelled, and only very slightly convex *Amussium* species. Broken valves have been found a few times (the eastern clay pit of Måde Brickworks, Lille Spåbæk, and Hauge) in Gram Clay, with some of the fragments in situ, but it has never been possible to preserve so many fragments that it has been possible to reconstruct a whole valve.

On the surface of the fragments there are numerous very fine concentric growth lines, and by magnification innumerable, very faint, close-set, somewhat irregular radial striae are seen.

Remarks. The fragments probably belong to the species which by SORGENFREI has been termed *Pecten gerardii* and by ANDERSON *Amussium woodi*. The two names perhaps – as supposed by GLIBERT and ANDERSON cover one and the same species in the Miocene. GLIBERT (*loc. cit.*, p. 89, note 182), considers *A. gerardi* a Pliocene and *A. woodi* a Miocene species.

Here the name is preferred of the form in the Anversien of Belgium.

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation, Gram Formation. North Germany: Vierland-Stufe (ANDERSON), ? Hemmoor-Stufe (KAUTSKY: *Lissochlamys cf. Gérardi*), Reinbek-Stufe (ANDERSON), Glimmerton at Elbtunnel (E. HORN: *Pecten Gerardi*). Holland: "Miocene" (HEERING: *Pecten (Pseudamussium) corneus*). Belgium: Anversien (GLIBERT).

Genus: *Chlamys* (BOLTEN) RÖDING 1798

(Type: *Pecten islandicus* O. F. MÜLLER 1776)

Chlamys tigerina (MÜLLER 1776)

1776. *Pecten tigerinus* – MÜLLER, Zool. Dan. Prodomus, p. 248, nr. 2993.
1778. *Pecten tigerinus* – MÜLLER, Zool. Dan. II, p. 26, Pl. 60, f. 6–8.
1843. *Pecten tigrinus* MÜLLER – NYST, Coq. et Polyp., p. 303, Pl. XXIII, f. 4–10.
1850. *Pecten tigrinus* MÜLLER – WOOD, Crag Moll. II, p. 27, Pl. V, f. 2a–g.
1892. *Pecten Lamali var.* NYST – LEHMANN, Dingden I, p. 202.

1916. *Pecten cfr. tigerinus* MÜLLER – NØRREGAARD, Esbjerg, p. 8.
1925. *Flexopecten tigrinus* MÜLL. *var. praecedens* – KAUTSKY, Hemmoor, p. 13.
1934. *Pecten tigrinus* MÜLLER – JENSEN & SPÄRCK, Saltvandsmuslinger, p. 64, f. 45.
1939. *Chlamys tigrina* MÜLLER – ROGER, Chlamys, p. 196, Pl. 21, f. 11–21.
1945. *Pecten (Pallium) tigerinus* MÜLLER – GLIBERT, Mioc. Belg. I, p. 79, Pl. V, f. 2a–n.
1950. *Pecten (Flexopecten) tigerinus* MÜLLER – HEERING, Mioc. Pelec., p. 14, Pl. 1, f. 1–7, f. 10–12, 15, 16, 19, Pl. 2, f. 29, Pl. 8, f. 175–177. 191.
1957. *Chlamys (Camptonectes?) tigerinus* MÜLLER *sp.* – GLIBERT, I.R.S.N.B., Bull., T. XXXIII, no. 9, p. 29.
1958. *Pecten tigerinus* MÜLLER – SORGENFREI, Middle Mioc., p. 77, Pl. 8, f. 23.
1959. *Chlamys (Pallium) tigerina* (MÜLLER) – ANDERSON, Untermiozän, p. 99, Pl. 14, f. 7.
1964. *Chlamys (Pallium) tigerina* (O. F. MÜLLER) – ANDERSON, Reinbek-Stufe, p. 142.

Material. Gram Clay.

Sæd 167.445

91.00–91.50 m.:	2 posterior auricles of right valves and 17 small fragm.	(2)
91.50–91.75 m.:	1 posterior auricle of a right valve	
	1 posterior auricle of a left valve and 2 small fragm.	(1)
91.75–92.00 m.:	2 posterior auricles of right valves	
	1 anterior auricle of a right valve	
	1 anterior auricle of a left valve and 27 small fragm.	(3)
92.00–92.25 m.:	3 posterior auricles of right valves	
	1 anterior auricle of a left valve	
	2 anterior auricles of right valves and 31 small fragm.	(3)
92.25–92.70 m.:	1 posterior auricle of a left valve and 11 fragm.	(2)

Description. As only fragments are available, reference is made to the descriptions of the species in the literature quoted.

Among the fragments nearly all parts of the valves are represented: anterior and posterior auricle, parts of the ventral margin and the rest of the surface of the valve.

The fragments are from small, rather young individuals, which on the whole have rather a faint sculpture. The anterior auricles have pronounced radial folds. The posterior auricles are small, and posteriorly form an obtuse angle. The surface of the valve is covered by innumerable filamentous radial striae, which are intersected by numerous growth lines. Parts of the ventral margin show many regular folds, which are striated longitudinally like their intervals.

Remarks. A comparison with recent valves from the Kattegat show so close a similarity that there is no reason to make reservations as regards the determination of the species.

Distribution.

North Sea Basin. Oligocene. Holland: Upper (HEERING). – Miocene. Denmark: Arnum Formation (SORGENFREI), Gram Formation. North Germany: Untermiozän (ANDERSON), Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON), Glimmerton at Lüneburg (MÜLLER). Holland: "Miocene" (HEERING). Belgium: Horizon de Houthaelen, Anversien

(GLIBERT). – Plio-Pleistocene. Holland (TESCH). Belgium: Scaldisien (GLIBERT). England: Coralline Crag, Red Crag (WOOD).

Atlantic Region. Recent off the coasts of western Europe from Finmarken (Norway) to Portugal (JEFFREYS).

Mediterranean Basin. Italy: Piacenziano (SACCO).

Chlamys clavata (POLI 1795)

1956. *Chlamys* (*Peplum*) *clavata* (POLI) – RASMUSSEN, South Jutland, p. 32, Pl. I, f. 5a, b.
1957. *Chlamys* (*Peplum*) *clavatum* POLI sp. – GLIBERT, I.R.S.N.B. Bull., T. XXXIII, no. 9, p. 28, Pl. I, f. 11a, b.

Material. Gram Clay.

Skærum Mølle (clay pit), Videbæk (84.1748), Brande Brickworks (clay pit), Drantum (104.1241), Alkærsig Brickworks (clay pit), Forsom Brickworks (clay pit), Hesselho (113.121), Hauge (Gram Clay and Glauconite Clay), Tønding (clay pit), Hoddemark (Karlsgårde Canal), Esbjerg (clay pit and beach), Måde Brickworks (eastern clay pit), Strandgård Brickworks (clay pits), Gørding (probably clay pit), Holleskov (132.46b), Ravning (clay pit), Sønder Hygum (141.260, 141.261), Gram (141.277), Spandetgård (clay pit), Brodersmark (166.351b), Sæd (167.445), and Rends (167.236).

Description. Shells almost circular. Apical angle 96°–108°. Hinge margin straight. Pallial line regularly semicircular. The umbo projects slightly beyond the hinge margin. The right valve is highly convex. The left valve is flat or slightly concave. The margins of the valves are sometimes somewhat introflexed.

The auricles (only observed on left valves) are straight along the hinge margin. The posterior one is slightly shorter than the anterior one and has a concave margin. The anterior auricle has a straight margin at right angles to the hinge margin. Both auricles are provided with narrow, distinctly set off radial ribs which are intersected by numerous growth lines parallel to the margins. The radial ribs are most distinct on the anterior auricle, their number mostly being eight. The anterior auricle of the right valve according to the literature has a deep byssal incision.

The sculpture of the valves consists of 5–6 large, broad, radial folds, which increase in breadth towards the valve margin, in the proximity of which they sometimes divide. In the intervals somewhat smaller, secondary folds are often formed. The folds as well as the intervals between them are furrowed longitudinally by numerous striae, which stand out more or less distinctly. In a broad zone along the pallial line there are often a large number of radial ribs of the third order, so that the valve suddenly gets a pleated appearance.

The growth lines are visible as concentric, more or less prominent and irregular lines.

The interior of the valves is nacreous, and the radial folds of the exterior stand out very much in a negative view. The adductor impressions are not visible on the specimens available.

Remarks. The greater part of the material from the Gram Clay consists of very small fragments, thus in the case of the part originating from the drillings.

Peculiarly enough the species has not yet been shown to occur in the Pliocene deposits in the North Sea Basin. It is fairly common in the Mediterranean Pliocene deposits and is recent in the Atlantic as well as the Mediterranean. Its occurrence in the Sables de Deurne and the Sables de Diest of Belgium has by GLIBERT & DE HEINZELIN (1955) and GLIBERT (1962) been interpreted as an argument in favour of the view that these deposits were contemporaneous with the Upper Miocene Glimmerton. The species does not occur in older strata of the North Sea Basin.

EAMES & COX (1956, p. 58) place *Chlamys* (*Peplum*) *elongata* (POLI) sensu ROGER 1939, p. 208 (with pictures belonging here) as a synonym of *C.* (*Peplum*) *inflexa* (LAMARCK 1819). No particular grounds for this have been given.

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation. North Germany: Glimmerton at Breklum (STRUCK 1908), Langenfelde (*Pecten pes lutrae* L. by GOTTSCHE 1876), Elbtunnel (HORN 1912) and Nordlohne (*Pecten septemradiatus* by GRIPP 1940a). – Mio-Pliocene. Holland: Upper Miocene in the Peel district (SPAINK). Belgium: Sables de Deurne and Sables de Diest at Berchem (GLIBERT).

Atlantic Region. Morocco: Pliocene (LECOINTRE). – Recent from the coasts of Portugal to the Shetlands (ROGER).

Mediterranean Basin. Italy: Piacenziano, Astiano, Calabriano (SACCO, GIGNOUX). Syria: Pliocene de Mandjila (ROGER). Algeria: Plaisancien (DE LAMOTHE). – Recent (BUCQUOY, DAUTZENBERG & DOLLFUS).

FAMILIA: LIMIDAE D'ORBIGNY 1847

Genus: *Lima* (CHEMNITZ 1784) BRUGUIÈRE 1792

Subgenus: *Limatula* S. WOOD 1839

(Type: *Pecten subauriculata* MONTAGU 1808)

Lima (Limatula) subauriculata (MONTAGU 1808)

Plate V, fig. 4

1808. *Pecten subauriculata* – MONTAGU, Test. Brit. Suppl., p. 63, Pl. 29, f. 2.
1849. *Lima subauriculata* – FORBES & HANLEY, Brit. Moll. II, p. 263, Pl. LIII, f. 4–5.
1850. *Lima subauriculata* MONTAGU – WOOD, Crag Moll. II, p. 47, Pl. VII, f. 3a–c.
1863. *Lima subauriculata* MONTAGU – JEFFREYS, Brit. Conch. II, p. 82, Pl. XXV, f. 3.
1870. *Lima subauriculata* MONT. – HÖRNES, Wienerbecken I, p. 389, Pl. LIV, f. 6a–b.
1881. *Lima subauriculata*, MONTAGU – NYST, Conch. Terr. Tert, p. 158, Pl. XVII, f. 3a–d.
1898. *Limatulata cf. subauriculata* – SACCO, I Molluschi XXV, p. 17, Pl. V, f. 10.

1914. *Lima (Limatula) subauriculata* (MONTAGU) – COSSMANN & PEYROT, Conch. Néog. A.S.L.B. LXVIII, 2 fasc., p. 157, Pl. XXI, f. 20–21.
1934. *Lima (Limatula) subauriculata* MONTAGU – JENSEN & SPÄRCK, Saltvandsmuslinger, p. 69, f. 51.
1945. *Lima (Limatula) subauriculata* MONTAGU sp. – GLIBERT, Mioc. Belg. I, p. 90, Pl. II, f. 11.
1950. *Lima (Limatula) subauriculata* (MONTAGU) – HEERING, Mioc. Pelec., p. 16, Pl. 6, f. 143–144.
1957. *Limatula subauriculata* MONTAGU sp. – GLIBERT, I.R.S.N.B., Bull., T. XXXIII, no. 9, p. 31.
1964. *Lima (Limatula) subauriculata* (MONTAGU) – ANDERSON, Reinbek-Stufe, p. 143.

Material. Gram Clay.

Måde Brickworks.		Eastern clay pit.	Upper part of a shell
Gram	141.277	17.50–18.00 m.:	1 very defective double valve and the upper part of another shell
–	–	19.00–19.50 m.:	The upper part of a shell

Description. The material is too fragmentary for a complete description. A complete description may be found in the literature cited. As to the Miocene valves, reference is made to GLIBERT's description (1945).

From the Gram Clay only the upper parts of three valves are available, showing the umbonal region, the hinge margin, the two auricles, which are of the same size, but comparatively small, and the upper part of the convex valve itself, with rather faint radial striae.

These parts are also seen on the defective double valve from Gram, which furthermore gives a good impression of the slender shape of the shells and situation of the axis at right angles to the rectilinear hinge margin. There are also distinct traces of the large number of comparatively strong and broad radial ribs on the ventral part of the valves. Otherwise the specimen mainly consists of a cast of pyrite with remnants of the valves here and there. The height is 7.5 mm. and the length 4.1 mm.

The shape and sculpture of the valves are in complete agreement with the descriptions and the pictures of *L. subauriculata.*

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation. North Germany: Vierland-Stufe (ANDERSON), Reinbek-Stufe (ANDERSON). Holland: Middle Miocene (HEERING). Belgium: Anversien (GLIBERT). – Plio-Pleistocene. Holland (HEERING). Belgium: Scaldisien (GLIBERT). England: Coralline Crag (WOOD). – Recent (JEFFREYS).

Atlantic Region. Aquitanian Basin: Helvetien, Tortonien, (COSSMANN & PEYROT). – Recent from the coasts off Norway, Iceland, and the Canarian Islands, from the west coast of Greenland and Florida (JENSEN & SPÄRCK).

Mediterranean Basin. Italy:? (SACCO). – Recent (JEFFREYS).

Vienna Basin. Austria: Steinabrunn, Grund (HOERNES).
Poland: Miozän (FRIEDBERG).

ORDO: EULAMELLIBRANCHIATA

SUBORDO: HETERODONTA

FAMILIA: ASTARTIDAE GRAY 1840

Genus: *Astarte* J. SOWERBY 1816

(Type: *Pectunculus sulcatus* DA COSTA 1778)

Astarte gracilis v. MÜNSTER in GOLDFUSS 1837

Plate III, figs. 1–6.

1837. *Astarte gracilis* MÜNSTER – GOLDFUSS, Petrefac. Germ. II, p. 194, Pl. CXXXV, f. 4a–c.
1837. *Astarte concentrica* – GOLDFUSS, ibid., p. 195, Pl. CXXXV, f. 7a, b.
1892. *Astarte concentrica* (s.a.) – LEHMANN, Dingden I, p. 226.
1907. *Astarte concentrica* GOLDFUSS – RAVN, Jylland, p. 268 (64), Pl. I, f. 23.
1914. *Astarte concentrica* GOLDF. – GRIPP, Itzehoe, p. 7, Pl. I, f. 1–2.
1916. *Astarte cfr. concentrica* GOLDF. – NØRREGAARD, Esbjerg, p. 13.
1925. *Astarte concentrica* GOLDF. & *var. gracilis* MÜNST. – KAUTSKY, Hemmoor, p. 25, Pl. 2, f. 17–18.
1940. *Astarte concentrica* GOLDF. – SORGENFREI, Klintinghoved, p. 20, Pl. IV, f. 8.
1944. *Astarte concentrica* GOLDF. – HEERING, Oberolig. Bivalv., p. 22, Pl. 8, f. 1–24, Pl. 9, f. 1–2.
1944. *Astarte gracilis* GOLDFUSS – HEERING, ibid., p. 23, Pl. 9, f. 3–12.
1945. *Astarte* (*Astarte*) *concentrica* GOLDFUSS – GLIBERT, Mioc. Belg. I, p. 97, Pl. VI, f. 2a–c.
1945. *Astarte* (*Astarte*) *gracilis* MÜNSTER – GLIBERT, ibid. I, p. 99, Pl. VI, f. 6a, b.
1950. *Astarte concentrica* GOLDFUSS – HEERING, Mioc. Pelec., p. 19, Pl. 3, f. 50, 51, 55, 59–66; Pl. 8, f. 194.
1950. *Astarte gracilis* MÜNSTER – HEERING, ibid., p. 20.
1957. *Astarte gracilis* (MÜNSTER) GOLDFUSS – GLIBERT, Rupél., Chattien, p. 22, Pl. II, f. 3a–n.
1957. *Astarte goldfussi* HINSCH & *praecursor n. s. sp.* – GLIBERT, ibid., p. 24, Pl. I, f. 17; Pl. III, f. 1a, b.
1957. *Astarte* (*Astarte*) *goldfussi* HINSCH – GLIBERT, I.R.S.N.B., Bull., T. XXXIII, no. 47, p. 5.
1958. *Astarte cf. concentrica* GOLDFUSS – SORGENFREI, Middle Mioc., p. 83.
1959. *Astarte* (*Astarte*) *gracilis* MÜNSTER – ANDERSON, Untermiozän, p. 106–111, Pl. 15, f. 2a–c and 3a–e.

Original diagnosis: "Astarte testa convexa, ovato suborbiculari, umbonius medianis prominulis, lunula late lanceolata, costulis crebis convexis, interstitiis aequalibus planis, margine interno integro vel crenulato" (GRAF zu MÜNSTER 1835).

Material. Hodde Clay.

The shells of this species have been referred to the specific name of *goldfussi* HINSCH in the tables in Part I.

Leding	93.155	31	m.:	1 def. l.	(1)
Odderup	103.150	24.8 –25.6	m.:	4. def. 1, 4 fr.	(4)
Grøde. Karlsgårde Canal			:	1 def. sh.	(1)

Hodde	113.33a	18.5 –18.9	m.:	1 def. l, 2 fr. (2)
Måde Brickworks.	Northwestern pit		:	3 complete l (3)
–	Eastern pit		:	8 complete r, 9 complete l, 7 def. r, 13 def. l (25)
Rødding	141.241	28.0 –33.0	m.:	1 small fragm. (?1)
–	141.243	30.0	m.:	1 def. shell (1)
Grønnebæk	141.205	20.0	m.:	1 def. r, 1 def. l, 1 fragm. (?1)
Gram	141.277	26.00–26.50	m.:	1 fragm. (1)
–	–	26.50–27.00	m.:	1 def. l, 4 fragm. (1)
–	–	27.00–27.50	m.:	1 def. r, 1 def. l, 6 fragm. (2)
–	–	27.50–28.00	m.:	3 def. r, 1 def. l, 13 fragm. (3)
–	–	28.00–28.50	m.:	3 def. l, 3 def. r, 2 complete r, 2 complete l, 23 fragm. (5)
–	–	28.50–29.00	m.:	1 small r, 5 def. l, 2 def. r, 16 fragm. (5)
–	–	29.00–29.50	m.:	5 def. r, 4 def. l, 9 fragm. (5)
–	–	29.50–30.00	m.:	2 def. r, 3 def. l, 11 fragm. (3)
–	–	30.00–30.50	m.:	6 def. r, 2 def. l, 6 fragm. (6)
–	–	30.50–30.95	m.:	2 def. r, 3 def. l, 2 fragm. (3)
–	–	30.95–31.35	m.:	1 def. l, 2 fragm. (1)
–	–	31.35–31.65	m.:	1 def. r, 1 def. l, 3 fragm. (1)
–	–	31.65–31.95	m.:	1 def. r, 1 fragm. (1)
–	–	31.95–32.30	m.:	2 def. l, 8 fragm. (2)
–	–	32.30–32.70	m.:	1 def. r, 1 def. l, 15 fragm. (1)
–	–	32.70–33.05	m.:	2 fragm. (1)
–	–	33.05–33.40	m.:	2 def. r, 3 def. l, 9 fragm. (3)
–	–	33.40–33.80	m.:	1 def. shell (1)
–	–	33.80–34.25	m.:	2 def. l, 30 fragm. (3)
–	–	34.25–34.70	m.:	4 def. r, 6 def. l, 2 def. shells, 9 fragm. (7)
–	–	34.70–35.00	m.:	1 def. l, 2 fragm. (1)
–	–	35.00–35.30	m.:	1 small compl. l, 2 def. r, 1 def. l, 21 fragm. (3)
–	–	35.30–35.70	m.:	1 small complete r, 2 def. r, 2 def. l, 3 fragm. (3)
Sønder Hygum	141.215	26.2 –32.8	m.:	Fragments (?)
Tønder	166.398	76	m.:	1 fragm. (?1)
Hajstrup	167.235	174′–194′	:	5 fragm. (2)

Description. (Mainly on the basis of material from Måde Brickworks.)

Valves comparatively small, of varying form, often more or less oval-triangular.

The anterior end is convex and often (Måde) only insignificantly or not at all protracted. It passes evenly into the slightly concave anterior dorsal margin. The posterior dorsal margin is slightly convex and by an even, more highly convex curve passes into the likewise convex ventral margin.

The umbo is small, prosogyrate, situated somewhat in front of the middle of the longitudinal axis.

The convexity of the valves is varying. The population from Gram has

rather flat valves, whereas that from Måde has rather pronouncedly convex valves.

The lunula is more or less depressed and bounded by a rounded margin. Area is lanceolate and indistinctly bounded. Both the lunula and the area are without any sculpture, apart from growth lines.

The hinge of the right valve is dominated by a large triangular cardinal tooth (3b), which projects somewhat beyond the dorso-ventral plane. On each side of this tooth there are two deep, triangular pits. In front of the foremost one there is a long, narrow, and sharp-edged lateral tooth (AI) parallel to the dorsal margin, from which it is separated by a narrow, deep groove. Behind the posterior pit a distinctly oblique elevation is seen, which constitutes a third tooth (5b). Behind this there is another long, narrow lateral tooth, which constitutes the posterior dorsal margin and is difficult to distinguish from this.

On the left valve two strong, slender, projecting cardinal teeth on each side of a deep triangular pit. The posterior one (2a) is a little fainter and smaller than the anterior one (4b), which is also somewhat more pointed. In front of this, there is a narrow pit and then there is a long sharp-edged anterior lateral tooth, which is close to the dorsal margin. Within the posterior margin, from which it is separated by a narrow groove, there is another slender lateral tooth (P II).

The exterior is covered by many (20–28 on the valves from Måde) strong, regular, concentric ribs, the breadth of which corresponds more or less to the intervals between them. On the largest of the valves (8 mm. in length) they are 0.2 mm. broad.

The interior is smooth and has distinct adductor impressions, which are more or less deep and, if anything, oval. They are of nearly equal size. The pallial line is distinct and situated far within and parallel to the ventral margin. This margin is either smooth or crenulated with up to thirty odd round ridges.

Measurements. The material from Måde Brickworks is the only one containing well-preserved valves which can be measured.

The largest of these valves (a right valve) measures in length: 8.9 mm., height: 7.6 mm., and thickness: 3.1 mm. For the smallest valve (a left valve) the corresponding measurements are respectively: 5.0 mm., 4.3 mm., and 1.3 mm. In 12 valves the indexof convexity is 31. 69 (i.e. $\frac{\text{thickness of valve}}{\text{length}} \cdot 100$). The index of ribs (i.e. $\frac{\text{number of ribs}}{\text{length}} \cdot 100$) could only be calculated in the case of 6 valves, in which it was 34.84.

Remarks. This species belongs to a group of closely related Astartidae, which have often been united under the specific name of *A. concentrica* GOLDFUSS, with which *A. gracilis* MÜNSTER has often been considered synonymous.

HEERING and GLIBERT consider them to be two different species, and KAUTSKY is of opinion that *A. gracilis* is a subspecies of *A. concentrica*. GLIBERT (1945, p. 99) considers valves with few, coarse ribs to belong to *A. concentrica* and valves with many fine ribs to belong to *A. gracilis*. Cf. the same writer's views of the Belgian Oligocene forms (GLIBERT 1957a).

HINSCH (1952, p. 157) calls attention to the fact that the specific name of *concentrica* GOLDFUSS 1837 is invalid, as it was pre-occupied by CONRAD 1834. Instead he suggests that the specific name should be changed into *goldfussi*.

Latest ANDERSON (1959, pp. 106–109) has thoroughly investigated this form cycle and on the basis of variational statistics from investigations of material from the Upper Oligocene (Chattien) at Kapellen, the Lower Miocene (Vierland-Stufe, "Holsteiner Gestein") in Schleswig-Holstein, and the Middle Miocene (Reinbek-Stufe) at Twistringen (Germany) divided the species *A. gracilis* MÜNSTER 1835 (= *A. concentrica* 1837 = *A. goldfussi* HINSCH 1952) into the following subspecies according to the characters adduced:

(1) *Astarte gracilis gracilis* GRAF ZU MÜNSTER 1835.
Characters: Index of convexity below 25. Index of ribs between 30 and 35.
Occurrence: Chattien (Upper Oligocene) in Germany, Holland, and Belgium.
(2) *Astarte gracilis convexior* ANDERSON 1959. (Plate III, figs. 5–6).
Characters: Index of convexity between 25 and 30. Index of ribs between 25 and 30.
Occurrence: Vierland-Stufe and Reinbek-Stufe in Germany.
(3) *Astarte gracilis ventrosa* ANDERSON 1959.
Characters: Index of convexity above 30.
Occurrence: Anversien in Belgium and Hemmoor-Stufe in Germany.
(4) *Astarte gracilis goldfussi* HINSCH 1952.
Characters: Index of convexity between 25 and 30. Index of ribs below 25.

It has not been proved that these subspecies are not actually ecologically conditioned.

According to this principle of classification the material from Måde should be attached to the subspecies *ventrosa* as regards index of convexity, but to *gracilis* as regards index of ribs.

The valves from Gram seem to have been a little flatter than the valves from Måde. Because of their fragmentary condition they cannot be measured. It has, however, been possible to reconstruct a single valve so much that it can be established that at any rate this specimen cannot be referred to the subspecies *convexior*, of which I have collected many specimens at Twistringen in Northern Germany. A valve has been pictured on Plate III, figs. 5 and 6. This subspecies often has a completely rectilinear posterior dorsal margin, a deeply depressed lunula, and a pointed umbonal region. The valve from Gram

has a slightly convex posterior dorsal margin, a slightly depressed lunula, and an obtuse umbonal region. Through these characters it shows close agreement with the material from Måde. A defective right valve from a depth of 27.00–27.50 m. has an almost rectilinear posterior dorsal margin, but an only slightly depressed lunula. A fragment of a right valve from the depth of 34.25–34.70 m. has a completely rectilinear posterior dorsal margin, and two fragments of a left valve and a right valve, respectively, have each a rather pointed umbonal region, though not so pointed as on the shells from Twistringen.

The form from Måde may be a special subspecies. So far, however, there only seems to be reasons to refer the material from all the Hodde Clay to the very variable species *gracilis*, the main character of which according to ANDERSON (1959a, p. 109) can be epitomized in the following diagnosis:

"Eine Art der Untergattung *A.* (*Astarte*) mit deutlich erhobenen konzentrischen Rippen, mit durchschnittlichen Rippenindexwerten unter 40, Konvexsitätsindices zwischen 20 und 35."

Distribution (of the species *gracilis* in sensu ANDERSON).

North Sea Basin. Oligocene. Denmark: Upper (RAVN). North Germany: Chattien (ANDERSON). Holland: Upper (HEERING). Belgium: Chattien (GLIBERT). – Miocene. Denmark: Klintinghoved Clay, Arnum Formation (SORGENFREI), Hodde Formation. North Germany: Vierland-Stufe (ANDERSON), Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON). Holland: Middle (HEERING). Belgium: Houthaléen, Anversien, Deurnien (GLIBERT).

Astarte vetula PHILIPPI 1846

For lists of synonyms see the various subspecies.

Description. The valves comparatively large, obliquely triangular, slightly lengthened anteriorly and truncated posteriorly. The anterior dorsal margin slightly concave. The posterior dorsal margin slightly convex and forming an obtuse angle with the posterior margin of the valve, which for rather a short distance is almost at right angles to the ventral margin. This is more or less convex, but may be rectilinear. The anterior margin of the valve forms a highly convex curve and passes evenly into the anterior dorsal margin.

The umbo is prosogyrate, situated a little in front of the middle of the longitudinal axis of the valve. The lunula is more or less heart-shaped, rather deeply depressed, well-defined by a round edge. Area is lanceolate and also distinctly bounded by an edge. Both lunula and area are without any sculpture apart from growth lines.

The valves are more or less convex. The umbonal region can be considerably convex.

The hinge of the right valve has a large, oblique, slender, triangular cardinal tooth, which projects somewhat beyond the dorsoventral plane. At right angles to this plane there are on the anterior side of the tooth 4–5 parallel, equidistant,

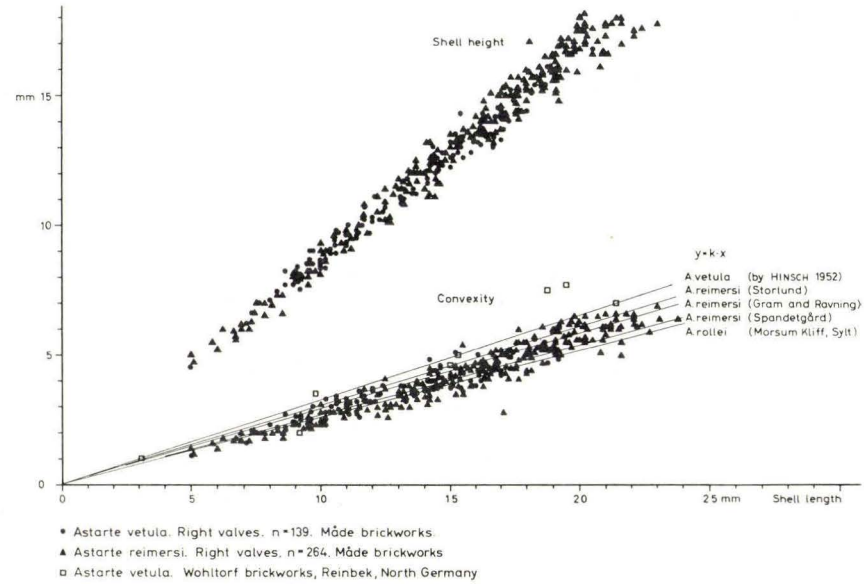


Fig. 1.

equally prominent lists. The pits on the side of the tooth are deep and triangular. The anterior one is smaller than the posterior one, which is placed very obliquely. In front there is a long lateral tooth, which may be a little curved. It is placed parallelly to the shell margin and separated from this margin by rather a deep groove. Behind the posterior triangular pit there is an oblique region of the valve which downward rises into a small ridge. At a short distance behind this ridge there is a posterior lateral tooth which is almost merged with the posterior dorsal margin.

On the left valve the two cardinal teeth are of the same shape as the corresponding pits on the right valve. The anterior lateral tooth is merged with the dorsal margin and the posterior lateral tooth is separated from the dorsal margin by a marked groove.

The exterior of the valve is covered by a greater or smaller number of concentric ribs. An obtuse carina passes from the umbo to the posterior corner of the valve.

The interior shows distinct, often rather conspicuous impressions of the adductors. The anterior one is reniform and highly depressed towards the middle of the valve. The posterior one is more oval and slightly less depressed. Both impressions are connected by a distinct pallial line, which runs parallelly to the ventral margin, which is either crenulated or smooth.

Remarks. To the form cycle of this species are attached two forms which have previously been considered independent species, viz. *A. reimersi* SEMPER in

RAVN 1907 and *A. rollei* SEMPER in RAVN 1907. It is, however, only through HINSCH's investigations on the basis of variational statistics (1952) that it has been possible to characterize the various forms in more detail. HINSCH did not, however, at that time know about the occurrence at Måde Brickworks, where the *Astarte* population seems to take up a position intermediate between the typical population of *A. vetula* from Wohltorf in Northern Germany and the population of *A. reimersi* from Gram. Later (1958) HINSCH has made good this deficiency and described the populations from Måde and given prominence to the conditions mentioned (on the basis of 36 valves, 16 of which could be measured).

Fig. 1 shows the results of measurements of 139 valves of the *Astarte vetula* population and 264 valves of the *A. reimersi* population, both from the eastern clay pit of Måde Brickworks. The ratios between length and height of the valves as well as between length of valve and convexity (= thickness) are so closely alike in the two populations that it is not possible to see any difference between them in these relations. In 1952 it was demonstrated by HINSCH that the index of convexity of the valves was increased from the somewhat convex *A. vetula* by way of the moderately convex *A. reimersi* to the rather flat *A. rollei*. The average values for the measurements in HINSCH (1952) and RASMUSSEN (1956) are sketched in as the line $y = k. x$ for each of the "species" in fig. 1. All lines are within the area of distribution of the two *Astarte* populations of Måde.

The concentric ribs on the *A. vetula* population from Måde Brickworks vary so much in number and strength that this otherwise very conspicuous character on many valves cannot be distinguished from the rib sculptures on the *A. reimersi* population. On the background of this fact it is, in my opinion, no longer possible to maintain *A. vetula*, *A. reimersi*, and *A. rollei* as independent species, for which reason I describe them as three subspecies of *A. vetula* PHILIPPI.

Astarte vetula vetula PHILIPPI 1846

1845. *Astarte vetula* PHILIPPI – VOLGER, De agri Luneburgici, p. 35.
1846. *Astarte vetula* PHILIPPI – PHILIPPI, Verzeichniss, p. 48, Pl. VIII, f. 3.
1847. *Astarte vetula* PHILIPPI – ZIMMERMANN, Reinbeck, p. 243.
1952. *Astarte* (*Carinastarte*) *vetula* PHILIPPI – HINSCH, Leit. Moll., p. 149, Pl. A, f. 1–2.
1956. *Astarte* (*Carinastarte*) *vetula* PHILIPPI – RASMUSSEN, South Jutland, Pl. II, f. 4a, b.
1956. *Astarte* (*Carinastarte*) *vetula* PHILIPPI – HINSCH, Maade, p. 468.

Original diagnosis. "A. testa solida, inflata, ovato-triangulari, subaequilatera; rugis concentricis regularibus exarata; interstitiis paullo latioribus, quam rugae; lunula magna ovata, profundata; margine ventrali parum arcuato. Long 7‴; alt. 6‴; crass. $5\frac{1}{2}$‴ (PHILIPPI in VOLGER 1845)."

New diagnosis by HINSCH 1952: "Eine *Carinastarte* mit ziemlich grosser

Längserstreckung. Die Aussenseite trägt regelmässige, kräftige Rippen mit weiten Abständen. Die Konvexität ist gross und der Ventralrand etwas gekrümmt. Lunula und Area sind deutlich asymmetrisch und ziemlich vertieft."

Type material: PHILIPPI's holotype has presumably been lost. HINSCH's neotype is kept in the Geologisches Institut der Universität in Kiel. Locus typicus: Lüneburg (Ziegelberg), North Germany. HINSCH's neotype originates from the clay pit of Wohltorf Brickworks near Reinbek, east of Hamburg. Stratum typicum: Glimmerton. Age: Upper Miocene (Langenfelde-Stufe).

The population in the "Lüneburg-Stufe"

Description. The valves of this population are characterized by the conditions mentioned in HINSCH's diagnosis: Strong, regular, concentric ribs. Great convexity. Deep lunula. This type has not so far been recorded from Denmark.

Distribution.

North Sea Basin. Miocene. North Germany: Glimmerton at Wohltorf and Lüneburg.

The population in the eastern clay pit of Måde Brickworks

Plate II, figs. 6 and 7

Material. 257 complete right, 51 defective right valves, 250 complete left, 33 defective left valves, 41 complete double valves, 5 defective double valves, 61 right valves, 88 left valves, 12 double valves, 1 fragment (471).

Other finding-places in Denmark appear from the analysis tables (see Part I). The features deciding the reference of the material to the same form as that found at Måde were exclusively the coarse ribs of the fragments and the signs of a curved ventral margin.

Description. The population from the older beds of Gram Clay at Måde Brickworks contains valves of very varying characters: The rib sculpture is mainly rather coarse, consisting of relatively few, rather broad ribs as in *A. vetula* sensu stricto. The convexity is slight. Most valves are very flat and considerably flatter than those of *A. vetula* sensu stricto from Wohltorf as well as *A. vetula reimersi.* The ventral margin is mostly convex, rarely rectilinear. Lunula not particularly deep.

Remarks. See under the remarks to the main species.

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation.

Astarte vetula reimersi SEMPER in RAVN 1907

1956. *Astarte* (*Carinastarte*) *reimersi* SEMPER in RAVN – RASMUSSEN, South Jutland, p. 34, Pl. II, f. 1a, b.

1958. *Astarte* (*Carinastarte*) *trigonata reimersi* SEMPER in RAVN – HINSCH, Maade, p. 469.

Material. Gram Clay.

Complete valves and fragments were found in the following localities (see Part I, Tables 15–66):

Skærum Mølle (clay pit), Lillelund (73.88), Vinding (74.329), Aulum (74.321), Lille Spåbæk (lignite pit), Grønbjerg (clay pit), Kjærgårde (83.210), Muldbjerg (83.377, 83.1006), Kodal (84.763, 84.770), Fjaldene (84.233, 84.238), Spjald (83.104, 83.127), Randbæk (83.591, 83.597, 83.602), Brejning Kro (83.197), Kodal-Fjaldene (84.1749), Videbæk (84.1748, 84.288, 84.313, 84.344, 84.358, 84.417, 84.456, 84.483, 84.492, 84.493, 84.525, 84.1727), Møltrup Brickworks (clay pit), Timring (84.22), Lille Torup (85.379), Gjellerup (85.380, 85.382), Frølund (85.383), Gjødstrup (85.861), Snejbjerg (85.775), Bording (86.177), Vester Høgild (95.1510b), Fasterholt Plantage (95.849), Sandfeldbjerg (clay pit), Brande Brickworks (clay pit), Drantum (104.1241), Nyholm (104.1166), Store Langkjær (104.1158), Hjortsballe (105.320), Skjerris gårde (104.1165), Leding (93.155), Alkærsig Brickworks (clay pit, 93.101), Lønborg (102.55), Forsom (clay pit), Odderup (103.150), Oddum (lignite pit), Harkes (clay pit), Østbæk (103.152), Stenderup (113.36), Ålbæk Eng (102.59), Hesselho (113.121), Hauge (clay pit), Tønding (clay pit), Hodde (Karlsgårde Canal), Grøde (Karlsgårde Canal), Esbjerg (130.159, clay pit, beach), Måde Brickworks (eastern clay pit), Strandgård Brickworks (clay pit), Gørding (? clay pit), Tobøl (132.37), Hjerting (141.238), Brøstrup (141.224), Rojbøl (141.194), Tiset (141.244), Arnum (150.25b), Hønning (150.197), Holleskov (132.46b), Ravning (clay pit), Hjortvad (141.178), Lintrup (132.140), Sønder Hygum (141.260, 141.261, 141.273), Rødding (141.75, 141.76, 141.243), Vester Lindet (141.246), Gram (141.277), Spandetgård (clay pit), Spandet (150.184), Tønder (166.227, 166.398), Brodersmark (166.351b), Heds (167.234b), Sæd (167.4, 167.445), and Rends (167.236).

Description. The valves of this subspecies are characterized by the following facts: there are numerous, rather fine, concentric ribs, which may sometimes be a little blurred. There is a greater or smaller convexity. Mostly a less deep lunula.

Remarks. There seems to be a certain difference between the *Astarte* populations from the beds of the Gram Clay which at Måde are deposited immediately above the beds with the above-mentioned *A. vetula*, and the populations in the Gram Clay in the clay pit of Gram Brickworks. The former population was previously found also in the old clay pits on the southeastern outskirts of the town of Esbjerg and on the beach off Esbjerg Brickworks. It is characterized by the valves constantly being provided with numerous fine, irregular, concentric ribs, just as the size of the valves seems to be greater than that of the valves from Gram Brickworks. The latter population is characterized by having valves with many more or less fine concentric ribs, which are often rather irregular and sometimes almost completely indistinct. There has not

been any opportunity of examining the two, slightly different populations in one and the same section.

A. vetula reimersi is very closely related to *A. trigonata* NYST (see RASMUSSEN 1956, p. 34, Table II, figs. 2a, b) from the Deurnien of Belgium and Holland. This species has later been discussed again by GLIBERT (1957, I.R.S.N.B. XXXIII, No. 47, p. 1 and picture ibid. Plate II, fig. 1). HINSCH (1958, p. 469) even goes so far as to consider *reimersi* a subspecies of *trigonata*. I prefer to await the finding and examination of a whole *trigonata* population before taking a decision on the particular relation of this Dutch-Belgian form to *reimersi*. There is a possibility that the two forms are quite identical subspecies, if so of *A. vetula*. The name of *reimersi* then must be discarded in favour of the older *trigonata*.

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation. North Germany: Glimmerton at Morsum Kliff (RAVN), Ütersen (HINSCH 1952), Fresenmoor (Hinsch 1952, Hohenwörden (HINSCH 1955), Aschendorf (HINSCH in GRIPP 1961), Wielen Z1 (HINSCH in ELLERMANN 1963), North Sea oil test well "Nordsee B2", Westdorf 2A, Jemgum 2, Bunde 2, Holthusen 1, Wahn 101, Neusüstrum 1, Fehndorf 2T, and Adorf (HINSCH 1965). Holland: Sand at Oploo, Bakel and Beers (SPAINK).

Astarte vetula rollei SEMPER in RAVN 1907

1907. *Astarte Rollei* SEMPER Ms. – RAVN, Jylland, p. 270 (66), Pl. II, f. 1.
1952. *Astarte (Carinastarte) rollei* SEMPER in RAVN – HINSCH, Leit. Moll., p. 151, Pl. A, f. 7a, b.
1958. *Astarte cfr. reimersi* SEMPER – RASMUSSEN, Sæd, p. 7, Pl. I, f. 2a, b.

Original diagnosis. Not given. Diagnosis by HINSCH (1952): "Eine *Carinastarte* von geringer Konvexität und grosser Längserstreckung. Die Aussenseite ist dicht und unregelmässig berippt. Der Ventralrand ist schwach gekrümmt. Der Abfall der Aussenseite hinter dem Kiel ist nicht sehr steil."

Type material. The holotype is the left valve pictured by RAVN, Pl. II, fig. 1. Locus typicus: Morsum Kliff. Stratum typicum: Mica Clay. Age: Upper Miocene (Sylt-Stufe). Repository: The Mineralogical Museum of the University of Copenhagen.

Material. Only the following remnants of valves from Sæd may, though not with certainty, be referred to this subspecies.

Gram Clay.

Sæd	167.4a	about 70 m.:	1 compl. r and 1 fragm.	(2)
–	167.445	90.30–91.00 m.:	1 def. r, 1 def. l, 7 fragm.	(2)
–	–	91.00–91.50 m.:	12 def. r, 9 def. l, 10 fragm.	(12)

Sæd	167.445	91.50–91.75 m.:	1 def. r, 1 def. l	(2)
–	–	91.75–92.00 m.:	3 fragm.	(2)
–	–	92.00–92.25 m.:	10 def. r, 3 def. l, 10 fragm.	(10)
–	–	92.25–92.70 m.:	16 def. r, 17 def. l, 24 fragm.	(17)
–	–	92.70–93.00 m.:	4 def. r, 4 def. l, 7 fragm.	(6)

Description. This subspecies is, as adduced in HINSCH's diagnosis, characterized by its slight convexity and its slightly curved ventral margin.

The valve from the early drilling at Sæd (167.4a) described by RASMUSSEN 1958 perhaps, because of its slight convexity, should be considered to belong here. The same applies to the *Astarte* fragments from the later drilling (167.445) at a depth of 90.30–93.00 m. It is evidently a case of flat valves, but it has not been possible to make a sure determination.

Remarks. The population in the Mica Clay in Morsum Kliff contains many valves which cannot possibly be distinguished from *A. vetula reimersi*, as they have all the characters found in this subspecies.

Side by side with these valves there are various others with varying characters: curved ventral margin, slight convexity, more or less oblique forms, slightly developed carina, etc. (Cf. pictures in HINSCH, *loc. cit.*, and in RASMUSSEN 1956, Pl. II, fig. 3a, b). The population as a whole, however, has a deviating appearance in relation to the *A. reimersi* populations in the Gram Clay in Denmark.

The other *Astarte* found in Morsum Kliff, *A. syltensis* RAVN, differs from *A. rollei* by having a more rounded-off outline and by being comparatively longer (see picture on Pl. II, figs. 1 and 2 in the present work). HINSCH (1952, p. 157) considers this species to be identical with the form from the Scaldisien near Antwerp mentioned as *Astarte sulcata* MONT. by NYST (1843, p. 155, Pl. 9, fig. 5).

Distribution.

North Sea Basin. Miocene. Denmark: ? Gram Formation. North Germany: Glimmerton in Morsum Kliff (RAVN, HINSCH).

Astarte radiata NYST & WESTENDORP 1839
Plate II, figs. 8 and 9

1839. *Astarte radiata* – NYST & WESTENDORP, Nouv. rech. coq. foss. prov. d'Anvers, p. 8, Pl. II, f. 8.
1843. *Astarte radiata* NYST & WESTENDORP – NYST, Coq. et polyp., p. 162, Pl. IX, f. 8a, b.
1925. *Astarte radiata* NYST & WESTENDORP – KAUTSKY, Hemmoor, p. 25, Pl. 2, f. 19, 20, 21.
1945. *Astarte* (*Astarte*) *radiata* NYST & WESTENDORP – GLIBERT, Mioc. Belg. I, p. 102, Pl. VI, f. 3a–e.

1950. *Astarte radiata* NYST & WESTENDORP – HEERING, Mioc. Pelec., p. 20, Pl. 3, f. 45, 46.
1958. *Astarte* (β-*Nicania*) *radiata* NYST & WESTENDORP – HINSCH, Maade, p. 470.
1964. *Astarte* (*Astarte*) *radiata* NYST & WESTENDORP – ANDERSON, Reinbek-Stufe, p. 149, Pl. 3, f. 35a–c.

Diagnosis. NYST & WESTENDORP's paper from 1839 has not been accessible to me. NYST's diagnosis 1843 (p. 162): "A. testa trigono-orbiculata, transversim striata; longitudinaliter radiata, natibus subacutis; lunula ovata, profunda, laevigata; marginibus crenulatis."

Material. Gram Clay.

Måde Brickworks. Eastern clay pit:			47 compl. r, 3 def. r, 57 compl. l, 4 def. l, 7 compl. d, 3 def. d	(86)
Måde. Strandgård Brickworks. Clay pit:			1 compl. r, 2 def. l, 1 def. d	(4)
Gram	141.277	18.00–18.50 m.:	1 small compl. r, 1 def. r, 1 def. l	(2)
–	–	20.00–20.50 m.:	1 small, compl. r, 1 greater def. l	(4)

Description. Valves comparatively small, rounded-triangular, little longer than high. The form often varies a little as regards the ratio between length and height. The anterior dorsal margin is very slightly concave and passes steeply down towards the little protracted, short and highly convex anterior end. The posterior dorsal margin is convex and curves into the likewise convex ventral margin.

The umbo is prosogyrate, situated a little in front of the middle of the longitudinal axis of the valve.

The lunula is oval and bounded by a distinct edge. The area is narrow, lanceolate, and indistinctly delimited.

The valves are highly convex.

The hinge has the same appearance as those of the *Astarte* species described above.

The exterior is covered by numerous (about 40–50) fine, close-set, concentric ribs.

On the interior two adductor impressions are clearly seen. The anterior one is, if anything, reniform, the posterior one is more oval. The pallial line is parallel to the ventral margin, which is either smooth or crenulated (with about 40–50 ridges).

Measurements. The largest valve (left valve) from Måde measures: Length: 11.8 mm. Height: 10.3 mm. Thickness (convexity): 3.3 mm.

The smallest one (right valve) from the same locality: Length: 2.9 mm. Height: 2.6 mm. Thickness: 0.9 mm.

A valve from Gram (141.277, 20.00–20.50 m.) shows the following dimensions:

Length: 7.8 mm. Height: 7.5 mm. Thickness: 2.6 mm.

For comparison reference may be made to the largest (a left valve) of the valves which I have had at my disposal from Langenfelde (North Germany):

Length: 14.0 mm. Height: 11.8 mm. Thickness: 4.1 mm.

The material from Måde on the whole consists of much smaller shells than those available from Langenfelde.

Remarks. The radial bands or zones which are so characteristic of this species and from which it is named, have not been observed in any of the valves available. This also applies to the material which I have borrowed from the Mineralogical Museum (Copenhagen) and which originates from Langenfelde near Hamburg.

These shells, for that matter, are in complete agreement with the shells from Måde, so that there can be no doubt that they belong to the same species. Cf. furthermore HINSCH's measurements and remarks (1958).

Distribution.

North Sea Basin. Miocene. Denmark: Albækhoved, unknown formation (RAVN), Gram Formation. North Germany: Hemmoor-Stufe (KAUTSKY, DITTMER), Reinbek-Stufe (ANDERSON), Glimmerton at Breklum, Lieth, Langenfelde, Teufelsbrücke, Elbtunnel, Reinbek and Lüneburg. Holland: Middle (HEERING). Belgium: Bolderien, Houthaleen, Anversien (GLIBERT).

Subgenus: *Goodallia* TURTON 1822
(Type: *Mactra triangularis* MONTAGU 1803)

Astarte (Goodallia) angulata LEHMANN 1885
Plate II, figs. 3–4

1892. *Astarte angulata* – LEHMANN, Dingden I, p. 230, Pl. IV, f. 8.
1964. *Astarte (Laevastarte) angulata* LEHMANN – ANDERSON, Reinbek-Stufe, p. 150, Pl. 3, f. 36a–c.

Original diagnosis. Not adduced. Main features of the original description (LEHMANN, op. cit.): "Die Schale ist dickwandig, dreiseitig, in den Ecken gerundet, mehr oder weniger schwach gewölbt, ungleichseitig ... Der Vorderrand ist bei beiden Klappen etwas nach innen ausgeschweift, so dass die vordere Ecke etwas weiter ausgezogen erscheint als die hintere; der Hinterrand ist geradlinig oder nur sehr wenig nach aussen gebogen; der Ventralrand bildet einen sehr flachen, gleichförmigen Bogen. Die Aussenfläche der Klappen ist bald in ihrer ganzen Ausdehnung glatt und nur mit sehr feinen Zuwachsstreifen versehen ... Die Muskeleindrücke und die Mantellinie sind deutlich ausgeprägt; der vordere Muskeleindruk ist nierenförmig, der hintere oval ..."

Type material. The right valve pictured by LEHMANN, *op. cit.*, Pl. IV, fig. 8,

is the holotype. Depository: unknown. Locus typicus: Dingden. Stratum typicum: Micaceous, silty clay. Age: Middle Miocene, Reinbek-Stufe.

Material. Hodde Clay.

Leding	93.155	Unknown depth:	1 defective left valve
Lønborg	102.55	17.3 –18.3 m.:	1 fragment of 1 right valve
Gram	141.277	29.50–30.00 m.:	1 fragment of 1 right valve
Hajstrup	167.235	174′–194′ :	1 small fragment
Måde Brickworks. Eastern clay pit:			1 compl. right valve and 1 compl. left valve

Description. The shell is small, rounded-off, subtriangular. The two available valves from Måde, however, are of the same length and height. Because of a comparatively high hinge area the valves have rather a subtriangular appearance. The same applies to a left valve from Leding. The rest of the material is too fragmentary to give any information about the form of the shell.

The ventral margin is convex, but is a very little less rounded-off than the following form, *G. esbjergensis*, which mostly is semicircular. Anteriorly and posteriorly the dorsal margins form a slightly acuter angle with the ventral margin than in *G. esbjergensis*. The posterior dorsal margin is slightly convex and the anterior one is almost straight.

The umbo is small, prosogyrate.

The shell is moderately convex.

The lunula and the area are oblong lanceolate.

The exterior is smooth, that of the present valves somewhat corroded.

The hinge of the right as well as the left valve corresponds to that of the next species, to the description of which the reader is referred (Part I, p. 181).

The interior is smooth. The adductor impressions are oval or reniform, situated closely below the lower part of the hinge and connected with a distinct pallial line parallel to the ventral margin. On the inside the ventral margin is provided with 28–30 ridges.

Remarks. The present valves seem to be in between *G. triangularis* and *G. esbjergensis*, having a comparatively more rounded-off form than the former and being slightly more triangular than the latter. Perhaps both of them belong to two subspecies of the same species.

Provisionally the valves from the Hodde Clay are referred to the species from Dingden set up by LEHMANN, which is undoubtedly identical with the species in the Hodde Clay.

Measurements. The two valves from Måde measure:

Length: 2.8 mm., height: 2.8 mm., and thickness: 0.1 mm.

Distribution.

North Sea Basin. Miocene. Denmark: Hodde Formation. North Germany: Reinbek-Stufe (ANDERSON).

Astarte (Goodallia) esbjergensis RASMUSSEN 1966
Plate III, figs. 7, 8, and 9

1966. *Goodallia esbjergensis nov. sp.* – RASMUSSEN, Molluscan Faunas I, p. 181, fig. 96a–c.

Reference is made to the description in RASMUSSEN 1966.

A shell of the subspecies *pseudo-ovata*, only known from a bore-hole at Sæd (167.445) is pictured on Plate V, figs. 2–3, in the present paper.

FAMILIA: CARDITIDAE FERUSSAC 1821

Genus: *Cardita* BRUGUIÈRE 1792
(Type: *Chama calcyculata* LINNÉ 1758)

Cardita orbicularis (SOWERBY 1825)
Plate IV, figs. 1–4

1956. *Cardita (Cyclocardia) orbicularis* (SOWERBY) – RASMUSSEN, South Jutland, p. 40.
1959. *Cardita (Cyclocardia) orbicularis* (SOWERBY) – ANDERSON, Untermiozän, p. 116, Pl. 15, f. 9a–d.

Occurrence. Gram Clay.

Skærum Mølle (clay pit), Lillelund (73.88), Aulum (74.321), Kodal (84.770), Randbæk (83.597, 83.602), Brejning Kro (83.197), Muldbjerg (83.1006), Kodal-Fjaldene (84.1749), Videbæk (84.1748, 84.344, 84.358, 84.417, 84.456, 84.483, 84.525, 84.1727), Møltrup Brickworks (clay pit), Lille Torup (85.379), Tværmose (85.381), Frølund (85.383), Gjødstrup (85.861), Bording (86.177, 86.215), Vester Høgild (95.1510b), Drantum (104.1241), Nyholm (104.1166), Hjortsballe (105.320), Skjerris gårde (104.1165), Leding (93.155), Alkærsig Brickworks (clay pit, 93.101), Lønborg (102.55), Forsom Brickworks (clay pit), Odderup (103.150), Østbæk (103.152), Ålbæk Eng (102.59), Hauge (clay pit), Tønding (clay pit), Hodde (Karlsgårde Canal, 113.33a), Esbjerg (130.59, clay pit), Måde Brickworks (eastern clay pit), Strandgård Brickworks (clay pit), Holleskov (132.46b), Hjortvad (141.178), Sønder Hygum (141.260), Rødding (141.76), Gram (141.277), Spandetgård (clay pit), Spandet (150.184), Tønder (166.398), and Brodersmark (166.351b).

Description. The shells comparatively small. Outline almost circular. Anterior dorsal margin short, slightly concave. Posterior dorsal margin relatively long, slightly convex. The convex anterior and posterior margins pass imperceptibly into the highly convex ventral margin.

The umbo is small, prosogyrate, situated approximately in the middle of the longitudinal axis of the valve. Lunula is short, nearly heart-shaped, depressed, poorly demarcated. Area is very small, lanceolate, clearly demarcated by a rib.

The hinge of the right valve is dominated by a large, pointed, highly tilted, triangular cardinal tooth (3b). On both sides of this there are narrow, deep, triangular pits, the posterior one of which is considerably longer than the anterior one. A small tooth is found immediately in front of the anterior pit.

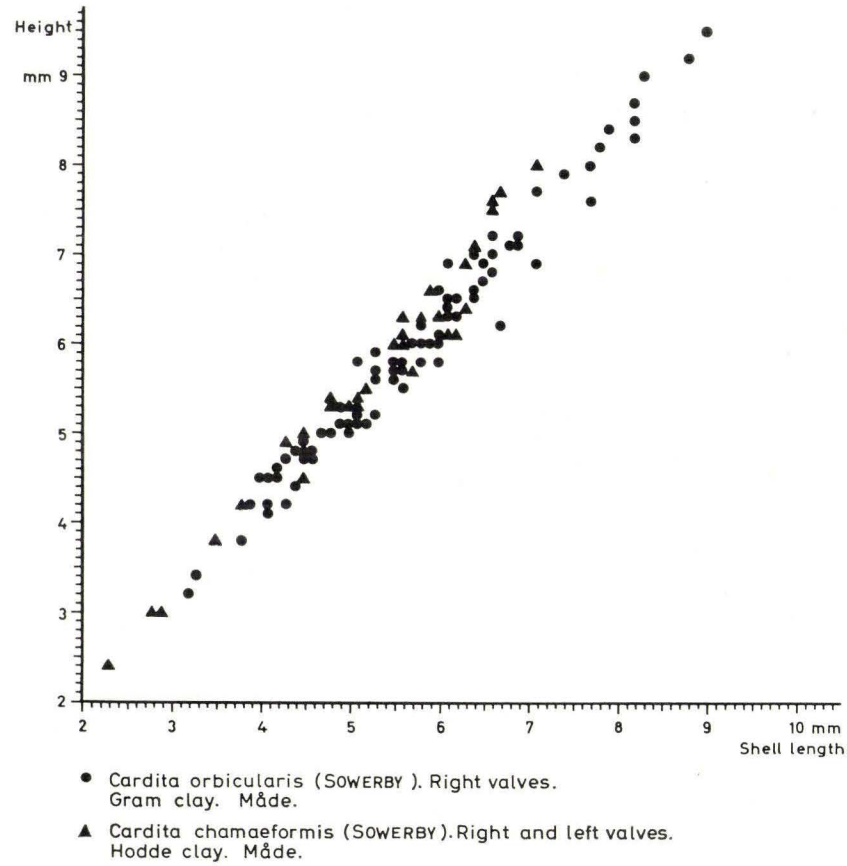
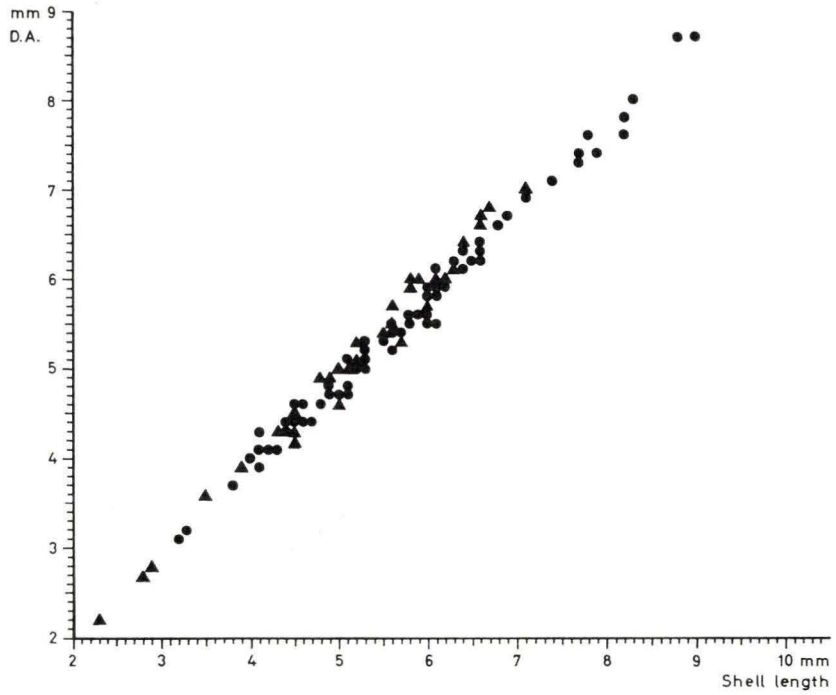


Fig. 2.

Inside the anterior dorsal margin and parallel to it there is a nodular, very short, narrow lateral tooth (AI), separated from the margin by a groove. The posterior lateral tooth (PIII) forms a short, narrow elevation on the dorsal margin.

On the left valve there is vertically below the umbo a narrow, triangular, pointed tooth (2a), which projects a little beyond the dorso-ventral plane. It is separated from the anterior dorsal margin by rather a deep groove. Behind the tooth there is a deep, triangular pit, which is situated in front of a long, narrow, highly tilted, list-shaped tooth (4b), which is almost parallel to the posterior dorsal margin, from which it is separated by a narrow furrow. The anterior lateral tooth (AII) is short, situated on the dorsal margin at some distance in front of 2a. The posterior lateral tooth (PII) is longer, narrow, parallel to the dorsal margin, from which it is separated by a furrow. It forms a continuation of 4b.

The exterior is covered by radial ribs to the number of 16–20. They increase



● Cardita orbicularis (SOWERBY). Right valves.
Gram clay: Måde.

▲ Cardita chamaeformis (SOWERBY). Right and left valves.
Hodde clay. Måde.

Fig. 3.

regularly in breadth towards the ventral margin and are at the constriction divided up into numerous rounded-off rectangular tubercles. The intervals between the ribs are considerably narrower than the ribs and often numerous growth lines are seen in these intervals.

The interior is smooth. The anterior adductor impression is reniform and a little larger than the oval posterior one.

The ventral margin is crenulated with ridges corresponding to the ribs.

Measurements. The result of measurements of 100 right valves from the eastern clay pit of Måde Brickworks has been shown in the diagrams figs. 2, 3, and 4.

	Length (L)	Height (H)	Convexity (T)
The largest of these valves measures	9.0 mm.	9.5 mm.	3.6 mm.
The smallest of these valves measures	3.2 –	3.2 –	1.0 –

Remarks. C. tuberculata (v. MÜNSTER), which occurs in the Oligocene strata, is now considered a subspecies of *C. orbicularis*. The *Cardita* material from

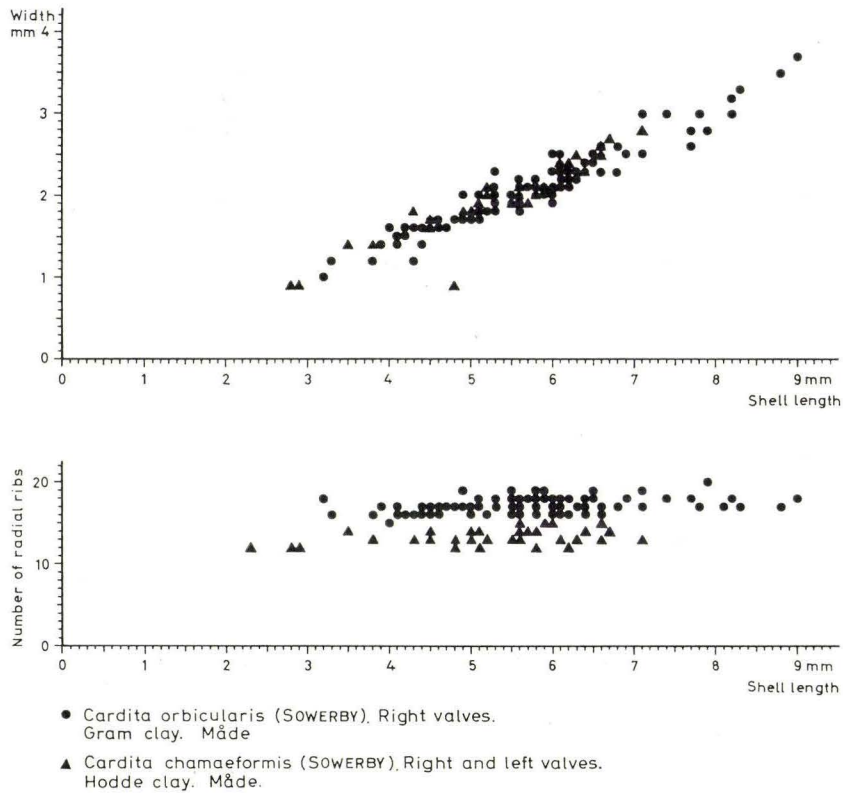


Fig. 4.

Vierland-Stufe (ANDERSON) in North Germany and Houthaléen in Belgium (GLIBERT) is also referred to this subspecies.

GLIBERT characterizes the subspecies *tuberculata* as follows: slighter convexity, less orbicular contour, broader intercostal space, and less prominent tubercles. – The diameter index of 100 valves was $\left(\frac{H}{L} \cdot 100\right) = 102.093$ and their index of convexity $\left(\frac{T}{L} \cdot 100\right) = 32.743$.

The typical *orbicularis* in the Anversien of Belgium is characterized by GLIBERT as having: greater convexity, more orbicular contour, narrower intercostal space, and more prominent tubercles. – The diameter index of 100 valves was 100.683 and the index of convexity was 36.212.

The valves of the population of Måde are less orbicular than those of *C. tuberculata* and just as much or more convex than those of *C. orbicularis* from the Anversien. The diameter index of 50 valves was found to be 104.415 and their index of convexity was found to be 37.198.

From these figures it appears that the three populations are slightly different, but hardly so much that they can be characterized as well-defined subspecies.

No variations were found among the valves from the Gram Clay. SEMPER in an unprinted manuscript has named the form in the Upper Miocene Glimmerton of North Germany *C. bella*, and under this name RAVN (1907, p. 267, Pl. I, fig. 20) described and pictured a valve from Esbjerg. Some valves from Langenfelde (Hamburg) in the Geological Museum of the University of Copenhagen are labelled *C. bella* (from GOTTSCHE). In every respect they correspond to the valves from Måde.

Distribution.

North Sea Basin. Oligocene. Denmark: Upper (RAVN: *C. tuberculata* (MÜNST.)). North Germany: Middle (v. KOENEN: *C. tuberculata*), Upper (GÖRGES). Holland: Upper (HEERING). – Miocene. Denmark: Arnum Formation (SORGENFREI), Gram Formation. North Germany: Vierland-Stufe (ANDERSON), Hemmoor-Stufe (KAUTSKY), Glimmerton (GOTTSCHE). Holland: Middle (HEERING). Belgium: Houthaléen, Anversien (GLIBERT). – Plio-Pleistocene. Holland: Diestien superieur, Scaldisien (TESCH, HEERING). Belgium: Scaldisien (GLIBERT). England: Coralline Crag, Red Crag (S. V. WOOD).

Cardita chamaeformis (SOWERBY 1825)

Plate IV, figs. 5–8

1825. *Venericardia chamaeformis* – SOWERBY, Min. Conch., V, p. 145, Pl. CCCCXC, f. 1.
1843. *Cardita chamaeformis* SOW. – NYST, Coq. et polyp., p. 211, Pl. XVI, f. 7a, b, d.
1853. *Cardita chamaeformis* LEATHES' Ms. – S. V. WOOD, Crag Moll. II, p. 167, Pl. XV, f. 3a–b.
1881. *Cardita chamaeformis* SOW. – NYST, Conch. Terr. Tert., p. 205, Pl. XXII, f. 7a, b.
1892. *Cardita chamaeformis* SOW. – LEHMANN, Dingden I, p. 225.
1925. *Pteromeris chamaeformis* SOW. – KAUTSKY, Hemmoor, p. 28, Pl. 3, f. 7a, b, 8a, b.
1945. *Cardita (Cyclocardia) chamaeformis* SOWERBY *sp.* – GLIBERT, Mioc. Belg. I, p. 128, Pl. VI, f. 15a, b.
1964. *Cardita (Cyclocardia) chamaeformis* (SOWERBY) – ANDERSON, Reinbek-Stufe, p. 153, Pl. 4, f. 39a–c.

Original diagnosis. "Convex, orbicular, with rather produced beaks; ribs rugged, distant, about 14, hinge large" (SOWERBY 1825).

Material. Hodde Clay.

Leding	93.155	19	–27	m.:	2 def. l	(2)
–	–		31	m.:	1 def. r, 1 def. l	(2)
–	–	28	–32	m.:	1 def. r, 1 fragm.	(1)
–	–	Unknown depth:			1 def. r	(1)
Lønborg	102.55	18.3	–19.3	m.:	?1 fragm.	(?1)
Odderup	103.150	24.8	–25.6	m.:	3 def. r, 4 def. l, 1 small, compl. d, 11 fragm.	(5)
Grøde. Karlsgårde Canal:					1 sh.	(1)
Måde Brickworks. Northwestern pit:					3 sh.	(3)

Måde Brickworks	Eastern pit:		13 compl. r, 18 def. r, 21 compl. l, 6 def. l, 1 compl. d (30)
Rødding	141.243	34.5 m.:	?1 fragm. (?1)
Grønnebæk	141.205	20 m.:	?3 fragm. (1)
Enderupskov	141.196	35 m.:	?1 fragm. (1)
Gram	141.277	25.50–26.00 m.:	?1 def. l (?1)
–	–	26.50–27.50 m.:	?1 def. l, 1 fragm. (?1)
–	–	27.50–28.00 m.:	1 small r, 3 fragm. (1)
–	–	28.00–28.50 m.:	2 compl. r, 9 def. r, 2 compl. l, 10 def. l, 2 compl. d, 32 fragm. (14)
–	–	28.50–29.00 m.:	3 def. r, 1 def. l, 5 fragm. (3)
–	–	29.00–29.50 m.:	1 compl. r, 4 def. r, 1 compl. l, 6 def. l, 24 fragm. (7)
–	–	29.50–30.00 m.:	2 compl. r, 9 def. r, 2 compl. l, 4 def. l, 60 fr. (11)
–	–	30.00–30.50 m.:	1 compl. r, 11 def. r, 2 compl. l, 5 def. l, 22 fr. (12)
–	–	30.50–30.95 m.:	2 def. r, 1 small, compl. l, 3 def. l, 3 fragm. (4)
–	–	30.95–31.35 m.:	1 small, compl. r, 1 small, compl. l, 1 def. l, 3 fragm. (2)
–	–	31.35–31.65 m.:	1 def. r (1)
–	–	31.65–31.95 m.:	1 small, juvenile r (1)
–	–	32.30–32.70 m.:	3 def. r, 2 def. l, 15 fragm. (3)
–	–	33.05–33.40 m.:	10 small def. sh., 4 fragm. (5)
–	–	33.40–33.80 m.:	1 def. r, 2 fragm. (1)
–	–	33.80–34.25 m.:	1 def. l, 4 fragm. (1)
–	–	34.25–34.70 m.:	1 def. r, 1 compl., small l, 15 fragm. (3)
–	–	34.70–35.00 m.:	1 def. r, 2 def. l, 7 fragm. (2)
–	–	35.00–35.30 m.:	1 def. r, 1 compl. d, 1 fragm. (2)
–	–	35.30–35.70 m.:	2 def. sh. (2)
Sønder Hygum	141.215	26.2 –32.8 m.:	1 shell (1)
Tønder	166.398	85 m.:	?1 fragm. (?1)
Hajstrup	167.235	174′–194′ :	1 compl. r, 6 def. r, 1 big, compl. l, 3 def. l, 9 fragm. (8)
–	–	194′–214′ :	1 def. r, 1 small, def. r (2)

Description. In most conditions this species corresponds to the preceding one, but differs from it in the following facts:

The valves are apparently higher in relation to the length, which is due to the hinge region in the present species being more prolonged in the direction towards the umbo.

The number of the radial ribs is only 12–15, and the distances between them are a little greater.

Measurements. In figs. 2, 3, and 4 the results of some measurements on the material from Måde are shown.

The largest valve (left valve) from this locality measures in length: 6.7 mm., in height: 7.7 mm., and thickness (convexity): 2.7 mm.

Correspondingly the smallest valve (left valve) measures: 2.8 mm., 3.0 mm., and 0.9 mm.

Remarks. As appears from fig. 4, this species is clearly distinct from *C. orbicularis* by having only 12–15 ribs. As to the other characters there is little difference between them.

GLIBERT (1945, p. 129) maintains that *C. orbicularis* and *C. chamaeformis* are often difficult to distinguish in the Miocene formations, as there are even transitions between them as regards the intervals between the ribs, whereas the differences between the two species are distinct in the Pliocene formations. According to GLIBERT these differences consist in the valves of *C. chamaeformis* being slightly convex, the distances between the ribs being a little greater, and the valves being a little more protracted in height. Otherwise, reference is made to the detailed discussion of the species in GLIBERT.

Distribution.

North Sea Basin. Miocene. Denmark: Hodde Formation. North Germany: Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON). Holland: ? Middle (HEERING). Belgium: Houthaléen, Anversien (GLIBERT). – Plio-Pleistocene. Belgium: Scaldisien (GLIBERT). England: Coralline Crag, Red Crag (WOOD).

FAMILIA: KELLYELLIDAE

Genus: *Kellyella* M. SARS 1870 (*Kelliella*)
(Type: *Venus*? *miliaris* PHILIPPI 1844)

Kellyella rotunda SORGENFREI 1958
Plate II, fig. 5

1956. *Kellyella* (*Kellyella*) *sp.* – RASMUSSEN, South Jutland, p. 41.
1958. *Kellyella* (*Lutetia*) *rotunda nov. sp.* – SORGENFREI, Middle Mioc., p. 86, Pl. 10, f. 32a–e.

Material. Gram Clay.

Gram	141.277	19.00–19.50 m.:	1 def. l	(1)
–	–	21.50–22.00 m.:	1 compl. d	(1)
Tønder	166.398	58.85–59.00 m.:	2 def. d	(2)
Rends	167.236	140′–160′ :	1 def. r	(1)
Sæd	167.4a	about 70 m.:	1 def. r	(1)

Description. As no complete valves are available, reference is made to SORGENFREI's detailed description of shells from the Arnum Formation and to my previous mention of material from the clay pit of Gram Brickworks.

The specimen pictured in Plate II, fig. 5, has later been broken.

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Gram Formation.

FAMILIA: ISOCARDIIDAE GRAY 1840

Genus: *Isocardia* (KLEIN) LAMARCK 1799

(Type: *Cardium humanum* LINNÉ 1758)

Isocardia forchhammeri BECK in RAVN 1907

1956. *Isocardia (Isocardia) forchhammeri* BECK in RAVN – RASMUSSEN, South Jutland, p. 41, Pl. III, f. 1 a, b.

Material. Gram Clay.

Skærum Mølle	Clay pit:			Remnants of 5 r, 2 l, 2 d, 11 fr. (9)
Lille Spåbæk	Lignite pit:			19 fragm. (3)
Grønbjerg	Clay pit:			Remnants of 1 r, 1 l, 8 fr. (2)
Randbæk	83.597	2.1 –15.0	m.:	26 fr. (1)
Muldbjerg	83.1006	8.0 – 9.0	m.:	1 fr. (1)
Kodal-Fjaldene	84.1749	14.55–15.55	m.:	1 fr. (1)
–	–	20.55–21.55	m.:	3 fr. (1)
–	–	21.55–22.55	m.:	2 fr. (1)
Videbæk	84.1748	23.95–24.95	m.:	2 fr. (1)
–	84.417	2.2 –15.0	m.:	14 fr. (1)
–	84.483	2.0 –10.8	m.:	1 fr. (1)
–	84.492	5.1 –15.5	m.:	1 fr. (1)
–	84.493	7.7 –15.0	m.:	1 fr. (1)
–	84.525	6.2 – 9.0	m.:	1 fr. (1)
Møltrup Brickworks.	Clay pit:			Remnants of 1 r, 12 fr. (2)
Lille Torup	85.379	16.8 –20.0	m.:	2 fr. (1)
Gjellerup	85.380	13 –20	m.:	6 fr. (1)
Tværmose	85.381	21.0 –25.0	m.:	2 fr. (1)
Frølund	85.383	9.2 –17.9	m.:	4 fr. (1)
Snejbjerg	85.775	23.25–24.25	m.:	1 u. of 1 r (1)
Bording	86.177	3.2 – 9.8	m.:	3 fr. (1)
–	86.215	about 10	m.:	4 fr. (1)
Fasterholt Plantage	95.849	4.1 –14.0	m.:	11 fr. (1)
Brande Brickworks.	Clay pit:			U. of 5 r, 9 l, 26 fr. (10)
Drantum	104.1241	36.0 –40.0	m.:	U. of 1 r, 1 l, 2 fr. (2)
–	–	40.0 –44.0	m.:	1 compl. small d, u. of 2 r, 3 l (4)
–	–	51.4 –51.8	m.:	1 fr. (1)
Skjerris gårde	104.1165	8.5 – 9.5	m.:	12 fr. (1)
Leding	93.155	10 –12	m.:	1 fr. (1)
Alkærsig Brickworks.	Clay pit:			Remnants of 3 r, 3 l, 23 fr. (6)
Lønborg	102.55	9.3 –10.3	m.:	2 fr. (1)
Forsom Brickworks	Clay pit:			Remnants of 2 r, 9 fr. (4)
Harkes	Clay pit:			1 cast of 1 d, 1 fr. (1)
Hesselho	113.121	44.0 –50.0	m.:	Remnants of 1 r (1)
Hauge	Clay pit:			Remnants of 10 r, 8 l, 87 fr. (18)
Tønding	Clay pit:			Remnants of 2 r, 2 l, 21 fr. (2)
Hoddemark. Karlsgårde Canal:				14 fr. (2)
Grøde. Karlsgårde Canal:				Remnants of 1 r, 1 fr. (1)
Esbjerg	130.59	72.0	m.:	2 fr. (1)
–	–	72.5	m.:	1 fr. (1)
–	–	76.5 –77.5	m.:	3 fr. (1)

Esbjerg	130.59	78 m.:	1 fr. (1)
–	–	78.5 m.:	2 fr. (1)
–	Clay pit and beach:		U. of 7 r, 3 l, 26 fr. (7)
Måde Brickworks.	Northwestern pit:		1 fr. (1)
–	Eastern pit:		U. of 10 r, 16 l, 82 fr. (33)
Måde. Strandgård Brickworks.	Clay pit:		1 compl., big d, u of 6 l, 29 fr. (9)
Holleskov	132.46b	4.9 –11.2 m.:	U. of 1 l, 2 fr. (1)
Ravning. Clay pit:			1 fr. (1)
Sønder Hygum	141.260	12 –40 m.:	4 fr. (2)
–	141.261	13 –19 m.:	3 fr. (2)
Gram	141.277	5.30– 5.70 m.:	4 fr. (1)
–	–	6.10– 6.40 m.:	Remnants of 2 r (2)
–	–	7.30– 7.65 m.:	2 fr. (1)
–	–	8.05– 8.50 m.:	?3 fr. (?1)
–	–	8.50– 9.00 m.:	?6 fr. (?1)
–	–	9.50– 9.90 m.:	1 small, def. r (1)
–	–	9.90–10.30 m.:	U. of 1 l, 3 fr. (1)
–	–	12.10–12.60 m.:	1 fr. (1)
–	–	14.00–14.60 m.:	3 fr. of u. of 1 l (1)
–	–	14.60–15.10 m.:	7 fr. (1)
–	–	15.55–16.00 m.:	2 fr. (1)
–	–	16.00–16.50 m.:	6 fr. (1)
–	–	16.50–17.00 m.:	1 fr. (1)
–	–	17.00–17.50 m.:	1 small, def. d, u. of 1 l (2)
–	–	17.50–18.00 m.:	U. of 1 l, 5 fr. (1)
–	–	18.50–19.00 m.:	1 fr. (1)
–	–	19.00–19.50 m.:	3 fr. (1)
–	–	21.00–21.50 m.:	1 small pyrite cast (1)
–	–	22.00–22.50 m.:	?1 fr. (?1)
Spandetgård. Clay pit:			U. of 13 r, 16 l, 1 sh., 33 fr. (25)
Brodersmark	166.351 b	28 –29 m.:	1 fr. (1)
Sæd	167.4a	about 70 m.:	1 fr. (1)
–	167.445	91.00–91.50 m.:	5 fr. (1)
–	–	93.00–93.70 m.:	2 fr. (1)
–	–	93.70–94.10 m.:	5 fr. (1)
–	–	94.10–94.75 m.:	3 fr. (1)
–	–	95.50–95.90 m.:	Remnants of 1 l (1)
–	–	97.40–97.90 m.:	10 fr. (1)
–	–	94.00–94.70 m.:	(Special sample): U. of 1 l, 3 fr. (1)
–	–	97.90–98.60 m.:	7 fr. (1)
–	–	99.55–100.10 m.:	U. of 1 l (1)
Rends	167.236	140′–160′ :	U. of 1 r, 3 fr. (1)

Description. The valves are thick-shelled, oblong heart-shaped, somewhat protracted posteriorly. Anteriorly the valve forms a short, very convex arch, which passes evenly into the slightly curved and almost rectilinear ventral margin. Posteriorly the ventral margin forms an obtuse angle with the almost vertically rising posterior end, which by an indistinct other angle passes into the evenly rising, long, posterior dorsal margin.

The umbones are prosogyrate, fairly highly involute, placed far anteriorly.

No lunula is observed. Area is lanceolate, bordered by a slight, but distinct edge, which continues along the margin of the valve right to the umbo.

The hinge is not complete on any of the available shell fragments. It was described by RAVN (1907, p. 274 (70)) as follows:

"In the left valve there are two horizontal cardinal teeth, the anterior (lower) one of which is oblong, rather thick, and provided with a deep pit on the middle of the lower side, whereas the posterior (upper) one is long and lamelliform. Furthermore there is a lamelliform lateral tooth far posteriorly. Such a tooth is also found on the right valve, which likewise has two horizontal cardinal teeth, the anterior one of which is rather short and thin and by a deep pit is separated from the posterior, lamelliform one."

The surface of the shell is smooth, but with distinct concentric growth lines. When magnified, at oblique light, some extremely faint, but decidedly demonstrable radial striae, which are equidistant, can be seen here and there.

Remarks. The material consists almost exclusively of fragments of this characteristic *Isocardia*, which perhaps is a forerunner of the Pliocene and recent *I. humana.*

ANDERSON (1959, pp. 120–121) in some remarks on the Lower Miocene *I. lunulata* NYST advanced the view that this species is the forerunner of *I. forchhammeri.* In his opinion (*loc. cit.*) this specific name should be cancelled in favour of the earlier name *olearii* given by SEMPER (1861), as this author, who did not himself picture the species, referred to a copper engraving of it in OLEARIUS, "*Gottorfische Kunstkammer*" from 1676. It does not seem to me that there are cogent reasons to reject the specific name validated by RAVN (1907), which has later been that most commonly used, for which reason I prefer to maintain the name of *forchhammeri.*

The large number of remnants of *Isocardia* found in the Hodde Clay have proved indeterminable. They seem to derivate from a form with a more protracted umbonal part, but otherwise the fragments very much resemble *I. forchhammeri.*

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation. North Germany: Glimmerton (GOTTSCHE, HINSCH).

FAMILIA: CYPRINIDAE PICTET 1855

Genus: *Pygocardia* MUNIER-CHALMAS 1887

(Type: *Venus rustica* SOWERBY 1818)

Pygocardia rustica (SOWERBY 1818)

Plate VI, figs. 1–2

1818. *Venus rustica* – SOWERBY, Min. Conch., p. 196.

1843. *Cyprina tumida* NYST – NYST, Coq. et Polyp., p. 148, Pl. VIII, f. 2–3; Pl. X, f. 1a, a′, b, e.

1853. *Cyprina rustica* I. SOWERBY – WOOD, Crag. Moll. II, p. 197, Pl. XVIII, f. 1a–e.
1881. *Cyprina rustica* SOW. – NYST, Conch. Terr. Tert., p. 191, Pl. XX, f. 1a–f.
1907. *Cyprina tumida* NYST – RAVN, Jylland, p. 278(74), Pl. II, f. 8.
1945. *Pygocardia rustica* SOWERBY sp. – GLIBERT, Mioc. Belg. I, p. 143, Pl. VIII, f. 8a–b.
1957. *Pygocardia rustica* SOWERBY sp. – GLIBERT, I.R.S.N.B., Bull., T. XXXIII, no. 47, p. 17.

Material. Gram Clay.

Sandfeldbjerg. Old clay pit: 2 valves (Mineralogical Museum).
Gørding. Unknown locality: 1 well-preserved double valve.

Description. The double valve from Gørding is complete, and it is the only specimen that has been available to me for examination.

It is of a slightly oblong form. The anterior end is evenly convex. The posterior end is considerably more obtuse. The posterior dorsal margin slopes relatively little in a posterior direction and forms an obtuse angle with the posterior end, which again at an obtuse angle passes into the convex ventral margin.

The umbones are prosogyrate, placed anteriorly. The valves are evenly convex.

The surface is almost completely smooth. There are, however, numerous, more or less regular growth lines. On the posterior part of the valve these lines are crossed by numerous faint, almost completely effaced radial striae.

The interior of the valves and the hinge have not been accessible for examination.

Remarks. According to figures in the literature, especially in WOOD, the appearance, first of all the outline of this species, is rather variable, which has given occasion for the setting up of subspecies.

It has not been possible to refer the small material from the Gram Clay to any definite one of these subspecies.

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation. Belgium: Anversien (GLIBERT). – Plio-Pleistocene. Holland (HEERING). Belgium: Scaldisien (GLIBERT). England: Coralline Crag, Red Crag (WOOD).

FAMILIA: THYASIRIDAE DALL 1901

Genus: *Thyasira* (LEACH) LAMARCK 1818

(Type: *Tellina flexuosa* MONTAGU 1803)

Thyasira flexuosa (MONTAGU 1803)

Plate V, figs. 7–9

1803. *Tellina flexuosa* – MONTAGU, Test. Brit., p. 72.
1853. *Lucina flexuosa* MONTAGU – FORBES & HANLEY, Brit. Moll. II, p. 54, Pl. XXXV, f. 4.

1863. *Axinus flexuosus* MONTAGU – JEFFREYS, Brit. Conch. II, p. 247, V (1869), Pl. XXXIII, f. 1.
1867. *Axinus flexuosus* MONTAGU – WEINKAUFF, Conch. Mittelm. p. 170.
1909. *Thyasira flexuosa* MONTAGU sp. – CERULLI – IRELLI, Fauna mal. mariana, p. 155, Pl. XVIII (XXVIII), f. 29.
?1925. *Cryptodon hanseatus* – KAUTSKY, Hemmoor, p. 30, Pl. 3, f. 12a, b, 13a, b.
1934. *Thyasira flexuosa* (MONTAGU) – JENSEN & SPÄRCK, Saltvandsmuslinger, p. 92, f. 74.
1945. *Thyasira flexuosa* MONTAGU sp. – GLIBERT, Mioc. Belg. I, p. 153, Pl. VI, f. 5.
1956. *Thyasira (Thyasira) sp.* – RASMUSSEN, South Jutland, p. 43, Pl. I, f. 7.

Material. Gram Clay.

Remnants of *Thyasira* are known from the following localities: Kodal-Fjaldene (84.1749), Videbæk (84.1748), Møltrup Brickworks (clay pit), Frølund (85.383), Gjødstrup (85.861), Brande Brickworks (clay pit), Drantum (104.1241), Nyholm (104.1166), Alkærsig Brickworks (clay pit), Odderup (103.150), Hesselho (113.121), Tønding (clay pit), Måde Brickworks (eastern clay pit), Holleskov (132.46b), Sønder Hygum (141.260, 141.261), Gram (141.277), Spandetgård (clay pit), Brodersmark (166.351b), Sæd (167.4a, 167.445), and Rends (167.236).

Description. The greatest part of the available material by far is so defective that it has not been possible to receive an impression of the adult valves. Among these the defective double valve previously described from Gram Brickworks (RASMUSSEN 1956) is the specimen best preserved.

In the material from the bore-holes there are a few whole, juvenile valves, thus from Gram (141.277), from where two valves are pictured in Plate V (figs. 7 and 8).

The outline of these valves shows a slightly convex anterior dorsal margin, which, forming an angle, passes into the convex ventral margin. Only a short carina from the umbo along the posterior dorsal margin is seen.

A third valve from the same bore-hole at Gram, pictured in Plate V (fig. 9) has a considerably greater hinge angle. This valve has no other characteristics than a smooth exterior surface. It is apparently without any carinae.

Remarks. The two juvenile valves from Gram must be supposed to be juvenile forms of *T. flexuosa.* As a large number of the fragments available have two carinae from the umbo to the posterior part of the valve, there is hardly any reason to suppose that any other species than that known from the other Miocene formations, from the Pliocene, and from recent times, *T. flexuosa,* should be represented in the material from the Gram Clay.

The valve from Gram with the large hinge angle is in the lists of analysis (Part I, Table 59, p. 269) denoted as *Thyasira sp.,* but it cannot be precluded that it, too, belongs to the species mentioned (see picture on Plate V, fig. 9).

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation, (SORGENFREI), Gram Formation. North Germany: ? Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON), ? Glim-

merton at Langenfelde (GOTTSCHE 1876: *Cryptodon sinuosus* DON.). Belgium: Anversien (GLIBERT). – Pleistocene: Denmark: Postglacial deposits in North Jutland (NORDMANN & A. JESSEN 1905, p. 135).

Mediterranean Basin. Italy: Pliocene at Monte Mario (CERULLI – IRELLI). Recent.

In the present time the species according to JENSEN & SPÄRCK is extremely widely distributed from the North Atlantic (from Northeast Greenland to the Canary Islands) into the Mediterranean, and furthermore it is recorded from the seas around New Zealand and Australia, as well as the Bering Sea.

According to JENSEN & SPÄRCK the species is very common on clayey bottom in the Danish waters from a depth of about 20 m. to a depth of about 100 m. In the Atlantic, too, it is typical of clayey bottom.

FAMILIA: LUCINIDAE FLEMING 1828

Genus: *Phacoides* BLAINVILLE 1825

(Type: *Lucina pectinata* GMELIN 1789)

Phacoides sp.

From a few bore-holes there are fragments, which may belong to the genus *Phacoides*. Because of the state of preservation they are indeterminable to species.

The fragments originate from the following localities of Gram Clay:

Hygum	141.261	13 –19 m.:	U. of 5 l, 20 fr.	(5)
Gram	141.277	12.10–12.60 m.:	2 fr.	(1)
–	–	17.00–17.50 m.:	2 fr.	(1)
Rends	167.236	140′–160′ :	5 fr.	(2)

Genus: *Codakia* SCOPOLI 1777

(Type: *Venus orbicularis* LINNÉ 1758)

Codakia jutensis SORGENFREI 1958

Plate V, fig. 5

1958. *Codokia jutensis nov. sp.* – SORGENFREI, Middle Mioc., p. 93, Pl. 13, f. 40a–b.
1964. *Codakia jutensis* SORGENFREI – ANDERSON, Reinbek-Stufe, p. 160, Pl. 5, f. 46a–b.

Material. Gram Clay.

Sæd	167.445	94.00–94.70 m.:	1 fr. of 1 l

Description. The fragment consists of the whole of the hinge region and adjoining parts of a left valve.

The hinge as well as the shape of the margin of the valve and the concentric lamallae on the exterior of the valve correspond completely to the picture in SORGENFREI of shells from the Middle Miocene beds at Toftlund.

The size of the valve from Sæd at least correspond to the dimensions of the left valve pictured by SORGENFREI.

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Gram Formation. North Germany: Reinbek-Stufe (ANDERSON).

FAMILIA: ERYCINIDAE DESHAYES 1857

Genus: *Erycina* LAMARCK 1805
(Type: *Erycina pellucida* LAMARCK 1805)

? Erycina sp.

From the Gram Clay at Gram (144.277. 14.60–15.10 m. and 15.10–15.55 m.) and Brodersmark (166.351 b. 29–30 m.) there are a few fragments which with reservations are referred to this species.

FAMILIA: MONTACUTIDAE THIELE 1934

Genus: *Montacuta* TURTON 1819
(Type: *Ligula substriata* MONTAGU 1808)

? Montacuta sp.

In the Gram Clay at Harkes Brickworks H. ØDUM in 1919 collected a defective valve of a pelecypod, probably a *Montacuta* (? *M. bidentata* (MONTAGU). A sure determination is not possible. See further *Pelecypoda non det.* on p. 77.

FAMILIA: CARDIIDAE LAMARCK 1801

Genus: *Laevicardium* SWAINSON 1840
(Type: *Cardium oblongum* GMELIN 1789)

Laevicardium sp.

Material. Hodde Clay.

Leding	93.155	27 –28 m.:	1 def. r, 1 def. l, 1 fr.	(1)
–	–	31 m.:	4 def. r, 3 def. l	(4)
–	–	28 –32 m.:	1 def. l	(1)
–	–	Unknown depth:	2 def. r, 2 def. l	(2)
Lønborg	102.55	21.3 –22.3 m.:	1 def. r	(3)
Gram	141.277	33.05–33.40 m.:	16 fr. of l (?) sh.	(1)
–	–	33.40–33.80 m.:	2 fragm.	(1)
Tønder	166.398	90 m.:	1 fragm.	(1)
	Gram Clay.			
Odderup	103.150	20.0 –21.0 m.:	1 fragm.	(?1)

Description and remarks. In the Hodde Clay some fragmentary shells and fragments of a *Laevicardium* have been found, which proved too defective to

be determined as to species. Presumably it is a case of remnants of *L. cyprium* (BROCCHI) or *L. subturgidum* D'ORBIGNY.

In the Gram Clay at Odderup a fragment was found which seems to have belonged to a species of the genus *Laevicardium*. If so, this much corroded fragment is the only one found in the Gram Clay.

Genus: *Cardium* LINNÉ 1758

(Type: *Cardium costatum* LINNÉ 1758)

Cardium papillosum (POLI 1791)

1956. *Corculum* (*Papillicardium*) *papillosum* (POLI) – RASMUSSEN, South Jutland, p. 43, Pl. I, f. 6a, b.

1958. *Corculum* (*Parvicardium*) *papillosum* (POLI) – HÖLZL, Oberbayer. Burdigal, p. 106.

Material. Shell material is available from the following localities (see Part I, Tables 15–66):

Gram Clay.

Skærum Mølle (clay pit), Spjald (83.127), Randbæk (83.597), Brejning Kro (83.197), Muldbjerg (83.1006), Kodal-Fjaldene (84.1749), Videbæk (84.1748, 84.358, 84.1727), Møltrup Brickworks (clay pit), Lille Torup (85.379), Gjellerup (85.380), Tværmose (85.381), Frølund (85.383), Gjødstrup (85.861), Snejbjerg (85.775), Bording (86.177, 86.215), Brande Brickworks (clay pit), Drantum (104.1241), Nyholm (104.1166), Store Langkjær (104.1158), Skjerris gårde (104.1165), Alkærsig (93.101), Odderup (103.150), Ålbæk Eng (102.59), Hesselho (113.121), Hauge (clay pit), Tønding (clay pit), Hodde (113.33a), Måde Brickworks (eastern clay pit), Holleskov (132.46b), Ravning (clay pit), Hjortvad (141.178), Lintrup (132.140), Sønder Hygum (141.260, 141.261, 141.273), Rødding (141.75, 141.242, 141.243), Vester Lindet (141.246), Gram (141.277), Spandetgård (clay pit), Tønder (166.398), Brodersmark (166.351b), Sæd (167.4a, 167.445), and Rends (167.236).

Description. Besides numerous fragments and defective valves, there are some well-preserved, but rather small valves available.

The species was described by me in 1956 on the basis of valves from Gram Brickworks. Therefore reference is made to this description.

Remarks. It has not been possible to provide a sufficient number of well-preserved shells of a population from one of the localities so that a variation statistical investigation could be made.

Therefore it is uncertain whether the populations from the Gram Clay are most closely connected with the species *C. straeleni* (see the comments on this species, p. 65) or with the recent *C. papillosum*. SORGENFREI inclines to the assumption that the valves from the Arnum Formation ought to be grouped with *C. straeleni*.

I also refer the *Cardium* from Shell Bed I at Hoddemark, pictured in Plate V, fig. 6, to *C. straeleni*, as this valve also, i.a., has a convex posterior dorsal

margin as distinct from the valves of *C. papillosum*, in which this margin is rectilinear. The valves from Hoddemark, for that matter, are considerably less oblique in outline than the valves from the Gram Clay.

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation. North Germany: Glimmerton (STAESCHE). Holland: Middle (HEERING). – Plio-Pleistocene. Denmark: Eem (NORDMANN 1928). Holland (HEERING).

Atlantic Region. Loire Basin: Miocène Moyen (Faluns) (DOLLFUS & DAUTZENBERG). Aquitanian Basin: Burdigalien, Helvétien, Tortonien (COSSMANN & PEYROT). Morocco: Pliocene, Quaternaire (LECOINTRE). – Recent from the coast off South England to the coasts off Morocco, the Canaries, and the Azores (WEINKAUFF).

Mediterranean Basin. Spain: Pleistocene (DOUVILLÉ). Italy: Elveziano, Tortoniano, Piacenziano, Astiano (SACCO). France (Rhone valley and Roussillon): Pliocène (FONTANNES). Cyprus: Pliocène inferieur (DUBERTRET, VAUTRIN, KELLER & DAVID). Syria and Liban: Pliocène ancien (DUBERTRET, VAUTRIN et KELLER). Egypt: Miozän (BLANKENHORN). Algeria: Plaisancien (DE LAMOTHE). – Recent (WEINKAUFF).

Vienna Basin. Austria: Grunder Schichten, 2. Mediterran-Stufe (KAUTSKY).
South Germany (Bavaria): Burdigal (HÖLZL).
Poland: Miozän (FRIEDBERG).

Cardium straeleni GLIBERT 1945

Plate V, fig. 6

1945. *Cardium (Parvicardium) straeleni* – GLIBERT, Mioc. Belg. I, p. 174, Pl. XI, f. 1a–c.
1964. *Cardium (Parvicardium) straeleni* GLIBERT – ANDERSON, Reinbek-Stufe, p. 168, Pl. 7, f. 57a–d.

Material. Hodde Clay.

Leding	93.155	31 m.:	1 def. r, 2 def. l, 2 fr.	(2)
Gram	141.277	27.00–27.50 m.:	1 def. l	(1)
–	–	28.00–28.50 m.:	1 def. r, 1 fr.	(1)
–	–	28.50–29.00 m.:	1 def. l	(1)
–	–	29.00–29.50 m.:	1 def. r	(1)
–	–	29.50–30.00 m.:	1 fr.	(1)
–	–	30.00–30.50 m.:	2 def. r	(2)
–	–	30.95–31.35 m.:	1 fr.	(1)
–	–	31.35–31.65 m.:	1 def. r	(1)
–	–	31.95–32.30 m.:	1 def. r	(1)
–	–	33.05–33.40 m.:	4 fr.	(1)
–	–	33.80–34.25 m.:	7 def. r, 6 def. l, 8 fr.	(8)
–	–	34.25–34.70 m.:	4 def. r, 2 def. l, 8 fr.	(4)
–	–	34.70–35.00 m.:	2 def. l, 6 fr.	(2)
–	–	35.30–35.70 m.:	1 def. r, 3 def. l, 3 fr.	(3)
Hajstrup	167.235	214′–234′	1 def. l	(1)

Description. As there is only a fragmentary material from the Hodde Clay available, reference is made to the descriptions in GLIBERT and ANDERSON.

Remarks. It is only with great reservations that the material is referred to this species. The morphology of the fragments available shows with certainty that they have belonged to a species which is closely related to *C. straeleni* and *C. papillosum*. Provisionally they are considered to have belonged to valves with the same form and characters as the valves of this group from Shell Bed I at Hoddemark. I refer these shells to *C. straeleni* (see remarks sub *C. papillosum*).

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Hodde Formation. North Germany: Hemmoor-Stufe (DITTMER), Reinbek-Stufe (ANDERSON).

FAMILIA: VENERIDAE LEACH 1819

Genus: *Venus* LINNÉ 1758

(Type: *Venus verrucosa* LINNÉ 1758)

Venus multilamella (LAMARCK 1818)

1818. *Cytheria multilamella* – LAMARCK, Hist. Nat., V. p. 581.
1870. *Venus multilamella* LAM. – HÖRNES, Wienerbecken II, p. 130, Pl. 15, f. 2–3.
1893. *Venus rugosa* – LEHMANN, Dingden, II, p. 274.
1900. *Ventricola rugosa* LAM. – SACCO, I Molluschi, XXVIII, p. 30, Pl. VIII, f. 1–8.
1908. *Venus* (*Ventricola*) *multilamella* LK. sp. – CERULLI – IRELLI, Fauna mal. mariana, p. 52, Pl. X (XX), f. 10–18, Pl. XI (XXI), f. 1–7.
1910. *Chione* (*Ventricoloidea*) *multilamella* (LAMK.) – COSSMANN & PEYROT, Conch. Néog. A.S.L.B., LXIV, 5 fasc., p. 373, Pl. XIII, f. 26–28.
1925. *Chione* (*Ventricoloidea*) *multilamella* LAMK. – KAUTSKY, Hemmoor, p. 39.
1945. *Venus* (*Dosina*) *multilamella* LAMARCK *sp.* – GLIBERT, Mioc. Belg. I, p. 186, Pl. XI, f. 5a–c.
1958. *Venus* (*Ventricola*) *multilamella* (LAMARCK) – SORGENFREI, Middle Mioc., p. III, Pl. 18, f. 55a–d.
1958. *Venus* (*Ventricola*) *multilamella* (LAMARCK) – HÖLZL, Oberbayer. Burdigal, p. 124.
1959. ?*Venus* (*Dosina*) *multilamella* (LAMARCK) – ANDERSON, Untermiozän, p. 139, Pl. 17, f. 3a, b.
1964. *Venus* (*Dosina*) *multilamella* (LAMARCK) – ANDERSON, Reinbek-Stufe, p. 169, Pl. 8, f. 58a–b.

Material. Hodde Clay.

Grøde. Karlsgårde Canal:			1 fragm.	(?1)
Gram	141.277	35.00–35.30 m.:	3 fragm.	(1)

Remarks. The material only includes four fragments with the laminated surface characteristic of this species.

It is probably *V. multilamella*, which is common in the clayey, micaceous beds at Dingden in Germany (Reinbek-Stufe).

As for description of the species reference may especially be made to GLIBERT, *op. cit.*

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Hodde Formation. North Germany: Vierland-Stufe (ANDERSON), Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON), Glimmerton at Lieth, Langenfelde, Teufelsbrücke, and Elbtunnel (GOTTSCHE, HORN). Holland: Middle (HEERING). Belgium: Bolderien, Houthaléen, Anversien (GLIBERT).

Atlantic Region. Aquitanian Basin: Burdigalien, Helvétien (COSSMANN & PEYROT).

Mediterranean Basin. France (Rhône valley): Pliocène (FONTANNES). Italy: Tortoniano, Piacenziano, Astiano (SACCO), Monte Mario (CERULLI – IRELLI).

Vienna Basin. Austria (HOERNES).
South Germany (Bavaria): Burdigal (HÖLZL).
Poland: Miozän (FRIEDBERG).

FAMILIA: MACTRIDAE FLEMING 1828

Genus: *Spisula* GRAY 1837

(Type: *Cardium solidum* LINNÉ 1758)

Spisula subtruncata (DA COSTA 1778)

1956. *Spisula* (*Spisula*) *subtruncata* (DA COSTA) *var. triangula* (RENIERI) – RASMUSSEN, South Jutland, p. 45, Pl. II, f. 6a–b.

1958. *Spisula subtruncata* (DA COSTA) var. – SORGENFREI, Middle Mioc., p. 114, Pl. 19, f. 57a–e.

1964. *Spisula subtruncata triangula* ((RENIER 1804) BROCCHI 1814) – ANDERSON, Reinbek-Stufe, p. 182, Pl. 10, f. 70a–b.

Material. Hodde Clay.

Leding	93.155	19 –27 m.:	2 def. sh.	(2)
–	–	27 –28 m.:	1 def. l	(1)
–	–	31 m.:	1 def. r, 1 def. l, 1 def. sh.	(2)
–	–	Unknown depth:	2 def. l	(2)
Lønborg	102.55	21.3 –22.3 m.:	fragm. of 4 sh., 5 frag.	(5)
Odderup	103.150	24.8 –25.6 m.:	?1 fragm.	(?1)
Hodde	113.33a	18.5 –18.9 m.:	1 def. l	(1)
Hajstrup	167.235	214′–234′ :	1 fragm.	(1)
Gram Clay.				
Brejning Kro	83.197	42 –45 m.:	1 def. sh.	(1)
Brande Brickworks. Clay pit:			1 def. r	(1)
Drantum	104.1241	36.0 –40.0 m.:	3 def. sh.	(3)
–	–	40.0 –44.0 m.:	2 def. l	(2)
Store Langkjær	104.1158	13.1 –14.1 m.:	1 def. sh.	(1)
Hauge. Clay pit:			3 fragm.	(1)
Lintrup	132.140	3.25– 3.75 m.:	1 def. r	(1)
–	141.261	13 –19 m.:	2 def. r	(2)
–	–	20 m.:	4 def. l	(4)
Gram	141.277	10.80–11.25 m.:	1 def. r	(1)
–	–	11.65–12.10 m.:	1 def. r	(1)
Sæd	167.445	91.00–91.50 m.:	1 fragm.	(1)
–	–	92.00–92.25 m.:	7 fragm.	(1)
–	–	92.25–92.70 m.:	2 def. r, 1 def. l, 3 fragm.	(3)
Rends	167.236	140′–160′ :	3 def. r, 4 def. l	(4)

Description. All the available remnants of this species consist of fragmentary shells and fragments. A complete right valve from the clay pit of Gram Brickworks was pictured and mentioned in 1956 (RASMUSSEN, *loc. cit.*). This valve as well as all the others from the Hodde Clay and the Gram Clay is of the triangular shape, which mostly is considered characteristic of the subspecies *triangula* RENIERI 1804.

As for a description of the species reference is made to the literature quoted.

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Hodde Formation, Gram Formation. North Germany: Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON: *triangula*), Glimmerton at Morsum Kliff, Sylt (RAVN). Holland: Middle (HEERING). Belgium: Bolderien, Houthaléen, Anversien (GLIBERT). – Plio-Pleistocene. Holland: Scaldisien, Diestien supérieur (TESCH, HEERING). – Recent in the North Sea and in the Kattegat (JENSEN & SPÄRCK).

Atlantic Region. Loire Basin: Miocène Moyen (Faluns) (DOLLFUS & DAUTZENBERG: *triangula*). Aquitanian Basin: Helvetien (COSSMANN & PEYROT). Morocco: Miocène (LECOINTRE). – Recent from the seas off the westcoast of Europe from Finmarken (northern Norway) to Spain and Morocco and the Canarian Islands (JEFFREYS).

Mediterranean Basin. France (Rhône valley): Pliocène (*Mactra triangula*, FONTANNES). Italy: Elveziano, Tortoniano, Piacenziano, Astiano (SACCO). – Recent (WEINKAUFF).

Vienna Basin. Austria: Grunder Schichten (KAUTSKY).
South Germany (Bavaria): Burdigal (HÖLZL: *Mactra subtruncata bavarica*).
Poland: Miozän (FRIEDBERG: *Mactra subtruncata triangula*).

FAMILIA: SCROBICULARIIDAE H. & A. ADAMS 1858

Genus: *Abra* (LEACH) LAMARCK 1818

Type: *Ligula tenuis* MONTAGU 1808)

Abra cf. prismatica (MONTAGU 1808)

1956. *Abra* (*Abra*) *prismatica* (MONTAGU) – RASMUSSEN, South Jutland, p. 46, Pl. I, f. 4.
1958. *Abra prismatica* (MONTAGU) *var.* – SORGENFREI, Middle Mioc., p. 119, Pl. 19, f. 60.

Material. Only fragments are available. The list includes all localities from where rests of the genus *Abra* are kept.

Hodde Clay.

Leding (93.155), Lønborg (102.55), Måde Brickworks (eastern clay pit), Gram (141.277), and Hajstrup (167.235).

Gram Clay.

Randbæk (83.597), Brejning Kro (83.197), Muldbjerg (83.1006), Kodal-Fjaldene (84.1749), Videbæk (84.1748, 84.1727), Møltrup Brickworks (clay pit), Lille Torup (85.379), Gjødstrup (85.861), Snejbjerg (85.775), Brande Brickworks (clay pit), Drantum (104.1241), Nyholm (104.1166), Skjerris gårde (104.1165), Leding (93.155), Alkærsig (93.101), Løn-

borg (102.55), Odderup (103.150), Ålbæk Eng (102.59), Hauge (clay pit), Tønding (clay pit), Esbjerg (clay pit and beach), Måde Brickworks (eastern clay pit), Holleskov (132.46b), Ravning (clay pit), Hjortvad (141.178), Sønder Hygum (141.260, 141.261), Gram (141.277), Spandetgård (clay pit), Spandet (150.184), Tønder (166.398), Brodersmark (166.351b), Sæd (167.4a, 167.445), and Rends (167.236).

Description. Nearly the whole of the available material of remnants of *Abra* specimens from the Hodde Clay and the Gram Clay consists of fragments of the umbonal part of the valves with the ligament pit.

The character of the fragments is in agreement with conditions in the recent *A. prismatica*, but the determination can of course only be uncertain.

Distribution.

North Sea Basin. Miocene. Denmark: Klintinghoved Clay, Arnum Formation (SORGENFREI), Hodde Formation, Gram Formation. North Germany: Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (HINSCH), Glimmerton on the island of Sylt (STAESCHE). Holland: Middle (HEERING). – Plio-Pleistocene. Denmark: Eem (NORDMANN 1928). Holland: Scaldisien (TESCH, HEERING). Belgium: Scaldisien (GLIBERT). England: Coralline Crag, Clyde Beds (S. V. WOOD). – Recent: North Sea, Skagerak and the Kattegat (Jensen & SPÄRCK).

Atlantic Region. Morocco: Pliocène (LECOINTRE). – Recent from the Norwegian Sea and the seas around Iceland to the sea off Portugal (WEINKAUFF).

Mediterranean Basin. Italy: Tortoniano, Piacenziano, Astiano (SACCO), Calabria, Sicily (GIGNOUX). – Recent (WEINKAUFF).

FAMILIA: TELLINIDAE BLAINVILLE 1814

Genus: *Angulus* MEGERLE VON MÜHLFELD 1811

(Type: *Tellina lanceolata* GMELIN 1790)

Angulus cf. fallax (BEYRICH 1868)

1868. *Tellina fallax* BEYRICH – BEYRICH in v. KOENEN, Mittelolig., p. 113 (nomen nudum).
1893. *Tellina fallax* BEYRICH – LEHMANN, Dingden, II, p. 277.
1907. *Tellina fallax* BEYRICH – RAVN, Jylland, p. 280 (76).
1914. *Tellina fallax* BEYRICH – GRIPP, Itzehoe, p. 9.
1916. *Tellina Benedenii* NYST & WESTENDORP – NØRREGAARD, Esbjerg, p. 16.
1925. *Tellina fallax* BEYRICH – KAUTSKY, Hemmoor, p. 42.
1940. *Tellina fallax* BEYRICH – SORGENFREI, Klintinghoved, p. 23, Pl. IV, f. 11–12.
1945. *Angulus* (*Angulus*) *fallax* BEYRICH *sp.* – GLIBERT, Mioc. Belg. I, p. 207, Pl. XII, f. 4.
1950. *Tellina fallax* BEYRICH – HEERING, Mioc. Pelec., p. 42, Pl. VIII, f. 188.
1958. *Tellina cf. fallax* BEYRICH – SORGENFREI, Middle Mioc., p. 122.
1959. *Angulus* (*Angulus*) *fallax* (LEHMANN) – ANDERSON, Untermiozän, p. 145.
1964. *Angulus* (*Angulus*) *fallax* LEHMANN – ANDERSON, Reinbek-Stufe, p. 175.

Material. Hodde Clay.

Leding	93.155	31 m.:	4 fr. with hinge	(3)
Måde Brickworks. Eastern clay pit:			1 def. l	(1)
Hajstrup	167.235	214′–234′:	1 fr. of 1 r and of 1 l	(1)

Description. The fragments consist of the region around the umbo with the hinge. These remnants show with certainty that this is a case of an *Angulus*.

Most probably this species is *A. fallax*, but the determination of the *Angulus* species is also due to the shape of the valves, for which reason an only fairly certain determination as to species is out of the question in the present case.

Distribution of *A. fallax*.

North Sea Basin. Miocene. Denmark: Klintinghoved Clay, Arnum Formation (SORGENFREI), Hodde Formation. North Germany: Vierland-Stufe (ANDERSON), Hemmoor-Stufe (DITTMER), Reinbek-Stufe (ANDERSON). Holland: Middle (HEERING). Belgium: Bolderien, Houthaléen, Anversien (GLIBERT).

ORDO: DESMODONTA NEUMAYR 1883

FAMILIA: CORBULIDAE FLEMING 1828

Genus: *Varicorbula* GRANT & GALE 1931

(Type: *Tellina gibba* OLIVI 1792)

Varicorbula gibba (OLIVI 1792)

Plate VI, figs. 3–6

1792. *Tellina gibba* – OLIVI, Zoologia Adriatica, p. 101.
1853. *Corbula nucleus* LAMARCK. – FORBES & HANLEY, Brit. Moll. I, p. 180, Pl. IX, f. 7–12, Pl. G, f. 3.
1861. *Corbula striata* WALKER & BOYS – WOOD, Crag Moll. II, p. 274, Pl. XXX, f. 3.
1865. *Corbula gibba* OLIVI – JEFFREYS, Brit. Conch. III, p. 56; V (1869), Pl. XLIX, f. 6.
1867. *Corbula gibba* OLIVI – WEINKAUFF, Conch. Mittelm., p. 25.
1867. *Corbula gibba* OLIVI – v. KOENEN, Mittelolig., p. 116.
1870. *Corbula gibba* OLIVI – HÖRNES, Wienerbecken II, p. 34, Pl. III, f. 7a–g.
1878. *Corbula gibba* OLIVI – SARS, Moll. Arct. Norveg., p. 91.
1892. *Corbula gibba* OLIVI – LOCARD, Côtes d. France, p. 257, f. 235.
1893. *Corbula gibba* OLIVI – LEHMANN, Dingden II, p. 288.
1896. *Corbula gibba* OLIVI *sp.* – BUCQUOY, DAUTZENBERG & DOLLFUS, Roussillon, II, p. 578, Pl. LXXXV, f. 1–23.
1901. *Corbula gibba* OLIVI – SACCO, I Molluschi XXIX, p. 34, Pl. IX, f. 1–11.
1902. *Corbula (Agina) gibba* OLIVI *sp.* – DOLLFUS et DAUTZENBERG, Bassin Loire, p. 82, Pl. III, f. 43–46.
1907. *Corbula gibba* OLIVI *sp.* – RAVN, Jylland, p. 285.
1909. *Corbula gibba* OLIVI *sp.* – CERULLI – IRELLI, Fauna mal. mariana, p. 148, Pl. XVI (XXVI), f. 15–19.
1909. *Corbula (Agina) gibba* OLIVI – COSSMANN & PEYROT, Conch. Néog., A.S.L.B., LXIII, p. 176, Pl. II, f. 98–101; Pl. V, f. 22.
1913. *Corbula gibba* OLIVI *sp.* – HARDER, Aarhus, p. 62, Pl. IV, f. 27.
1916. *Corbula gibba* OLIVI *sp.* – NØRREGAARD, Esbjerg, p. 18, Pl. 2, f. 3.
1925. *Corbula gibba* OLIVI *sp.* – KAUTSKY, Hemmoor, p. 51.
1934. *Corbula gibba* OLIVI – JENSEN & SPÄRCK, Saltvandsmuslinger, p. 171, f. 156.
1944. *Aloidis (A.) gibba* OLIVI – HEERING, Oberolig. Bivalv., p. 45, Pl. 6, f. 16–17, Pl. 7, f. 22–28, Pl. 10, f. 9, 10, 15.

1945. *Aloidis* (*Varicorbula*) *gibba* OLIVI *sp.* – GLIBERT, Mioc. Belg. I, p. 215, Pl. III, f. 10a–c.
1950. *Aloidis* (*A.*) *gibba* OLIVI – HEERING, Plioc. a. old. Pleist., p. 191.
1950. *Aloidis gibba* OLIVI – HEERING, Mioc. Pelec., p. 45, Pl. 5, f. 101, 102, 109.
1957. *Corbula* (*Varicorbula*) *gibba* OLIVI *sp.* – GLIBERT, Rupél., Chattien, p. 46.
1958. *Varicorbula gibba* (OLIVI) – SORGENFREI, Middle Mioc., p. 129, Pl. 23, f. 69a–g.
1958. *Aloidis* (*Varicorbula*) *gibba* (OLIVI) – HÖLZL, Oberbayer, Burdigal, p. 163.
1959. *Varicorbula gibba* (OLIVI) – ANDERSON, Untermiozän, p. 154, Pl. 18, f. 6a–c.
1964. *Varicorbula gibba* (OLIVI) – ANDERSON, Reinbek-Stufe, p. 187.

Material. Hodde Clay.

Leding	93.155	31 m.:	1 def. r	(1)
Lønborg	102.55	19.3 –20.3 m.:	4 fragm.	(1)
Gram	141.277	28.50–29.00 m.:	1 def. l and 3 fragm.	(1)
–	–	31.35–31.65 m.:	2 fragm.	(1)
Hajstrup	167.235	214′–234′ :	1 def. l	(1)

Gram Clay.

Muldbjerg	83.1006	8.0 – 9.0 m.:	1 fragm.	(1)
Drantum	104.1241	46.0 –50.0 m.:	1 def. r	(1)
Hauge. Clay pit:			1 def. l	(1)
Esbjerg	130.59	72.0 m.:	1 compl. r	(1)
Måde Brickworks. Eastern clay pit:			1 compl. d, 3 compl. r	(4)
Gram	141.277	14.60–15.10 m.:	1 compl. r, 1 def. r, 1 compl. l, 3 def. l, 3 fr. of 1 r	(4)
–	–	15.10–15.55 m.:	1 def. r	(1)
–	–	21.50–22.00 m.:	3 fragm.	(1)

Description. This species has been described so often that it is unnecessary to repeat the descriptions here.

The shells from the Hodde Clay as well as the Gram Clay are in complete agreement with the recent as well as the fossil shells.

The marginal pore on the right valve mentioned by SORGENFREI (1958) is also seen on the valves from the Gram Clay.

Distribution.

North Sea Basin. Oligocene. Denmark: Upper (HARDER). North Germany: Middle (v. KOENEN), Upper (GÖRGES). Holland: Upper (HEERING). Belgium: Tongrien, Rupélien, Chattien (GLIBERT). – Miocene. Denmark: Arnum Formation (SORGENFREI), Hodde Formation, Gram Formation. North Germany: Vierland-Stufe (ANDERSON), Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON), Glimmerton at Langenfelde and Teufelsbrücke (GOTTSCHE 1876). Holland: Middle (HEERING). Belgium: Boldérien, Houthaléen, Anversien (GLIBERT). – Plio-Pleistocene. Holland (HEERING). Belgium: Scaldisien (GLIBERT). England: Coralline Crag and Red Crag (S. V. WOOD). – Recent (JENSEN & SPÄRCK).

Atlantic Region. Loire Basin: Miocène Moyen (Faluns) (DOLLFUS & DAUTZENBERG). Aquitanian Basin: Burdigalien, Helvétien (COSSMANN & PEYROT). – Recent from coasts off West-Finmarken (Norway) to the Canary Islands (JENSEN & SPÄRCK).

Mediterranean Basin: France (Rhône valley: Pliocène (FONTANNES). Italy: Astiano, Piacenziano (SACCO), Pliocene at Monte Mario (CERULLI – IRELLI). – Recent (JENSEN & SPÄRCK).

Vienna Basin. Austria: Eggenburg, Grund, Baden, etc. (HOERNES).
South Germany (Bavaria): Burdigal (HÖLZL).
Poland: Miozän (FRIEDBERG).

FAMILIA: TEREDINIDAE FLEMING 1828

Genus: *Teredo* LINNÉ 1758
(Type: *Teredo navalis* LINNÉ 1758)

Teredo sp.

1956. *Teredo sp.* – RASMUSSEN, South Jutland, p. 48, Pl. III, f. 2.
1958. *Teredo cf. saucatsensis* BENOIST – SORGENFREI, Middle Mioc., p. 137, Pl. 26, f. 75a–c.

Material. Gram Clay.

Videbæk	84.1727	9.4 –10.4 m.:	1 def. pyrite cast	(1)
Alkærsig Brickworks. Clay pit:			Fragments, def. shells and other remnants in fossil wood	(1)
Tønding. Clay pit:			2 fragm.	(1)

Remarks. The material from the Gram Clay is very defective. However, there seems to be a close agreement with the species (from Gram Brickworks) mentioned and pictured in a previous work (RASMUSSEN 1956). This species seems to be identical with the form which SORGENFREI described from the Arnum Formation under the name of *T. cf. saucatsensis* BENOIST 1876.

There are fairly often rests of driftwood bored by *Teredo* in the Gram Clay.

FAMILIA: THRACIIDAE DALL 1903

Genus: *Thracia* (LEACH) BLAINVILLE 1824
(Type: *Mya pubescens* PULTENEY 1799)

Thracia ventricosa PHILIPPI 1844

1956. *Thracia (Thracia) cf. ventricosa* PHILIPPI – RASMUSSEN, South Jutland, p. 48, Pl. II, f. 7.
1956. *Cochlodesma sp.* – RASMUSSEN, South Jutland, p. 49.
1958. *Thracia (Cyathodonta) ventricosa* PHILIPPI – HÖLZL, Oberbayer. Burdigal, p. 170, Pl. 16, f. 7.
1959. *Thracia (Thracia) ventricosa* PHILIPPI – ANDERSON, Untermiozän, p. 158, Pl. 18, f. 9.
1964. *Thracia ventricosa* PHILIPPI – ANDERSON, Reinbek-Stufe, p. 189.

Material. Hodde Clay.

Gram (141.277).

Gram Clay.

Kodal (84.770), Spjald (83.104, 83.127), Muldbjerg (83.1006), Kodal-Fjaldene (84.1749), Videbæk (84.1748, 84.358, 84.1727), Møltrup Brickworks (clay pit), Lille Torup (85.379), Gjødstrup (85.861), Brande Brickworks (clay pit), Drantum (104.1241), Nyholm (104.1166), Store Langkjær (104.1158), Odderup (103.150), Hesselho (113.121), Hauge (clay pit), Tønding (clay pit), Esbjerg (130.59), Rojbøl (141.194), Holleskov (132.46b), Ravning (clay pit), Hjortvad (141.178), Sønder Hygum (141.261), Rødding (141.76), Gram (141.277), Spandetgård (clay pit), Spandet (150.184), Tønder (166.398), Brodersmark (166.351b), Sæd (167.445), and Rends (167.236).

Description. This species is thin-shelled and therefore has been found only as small fragments. There is, however, a rather complete left valve available, the greater part of which is found covered by clay in a lump of Gram Clay. The specimen was collected by P. HOUGAARD in the clay pit of Brande Brickworks in 1964. Furthermore, there are also a few casts from concretions.

The defective state of preservation of the whole material thus does not permit any proper description of the species, as has previously been given by M. HÖRNES (1870, p. 48) in German and by RAVN (1907, p. 283) in Danish.

A single cast of a shell from Måde, collected by K. DREYER JØRGENSEN, from an unknown level, clearly shows the shape characteristic of the species: the convex anterior and the rather concave posterior ventral margin. The anterior corner of the valves is rounded-off. The posterior, anal region is broken off in the case of the cast from Måde, but there is on it a triangular region which is delimited anteriorly by a well marked, somewhat rounded-off carina from the umbo to the posterior corner of the ventral margin. The valves have been rather highly convex anteriorly, but depressed on the region in front of the carina.

For a close study of the sculpture on the surface of the valve I have had 18 double valves from Klintinghoved (Lower Miocene) at my disposal. Nearly all these specimens have preserved both valves, although always with minor parts broken off. The exterior surfaces of these valves are irregularly concentrically striated, furrowed, or slightly folded. Besides there are numerous very small, scattered granulae on nearly the whole surface of the valve. On the anal region behind the carina these granulae are considerably larger and cover the whole surface of the valve. As distinct from the granulation on the rest of the surface of the valve, these granulae are visible to the naked eye. They are so characteristic that it is easy to recognize fragments of this part of the valve.

The only partly visible valve from Brande Brickworks shows the posterior part of the valve, the surface of which is studded with granulae, and the carina from the umbo to the posterior corner is exposed, too.

Many of the pelecypod fragments found in the samples from the localities investigated show just those sculptural features which characterize *T. ventricosa*, so it is hardly wrong to refer them to this species.

Remarks. The six fragments from Gram with a large, oval ligament plate which were described by the present writer in 1956 under the name of *Cochlodesma* sp. (see RASMUSSEN 1956, p. 49) in appearance correspond to numerous similar fragments from many other localities (see the section "Material" above). These umbonal parts of valves I now consider remnants of *T. ventricosa*, as *Thracia*, as is well-known, has rather a large, oval ligament plate. It does not seem possible to demonstrate the occurrence of *Cochlodesma* in the present shell material from the Gram Clay.

Distribution.

North Sea Basin. Miocene. Denmark: Klintinghoved Clay (SORGENFREI), Hodde Formation, Gram Formation. North Germany: Vierland-Stufe (ANDERSON), Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON), Glimmerton (STAESCHE). Belgium: Anversien (GLIBERT). – Plio-Pleistocene. Holland: ? (HEERING). England: Coralline Crag (S. V. WOOD).

Mediterranean Basin. Italy: Tortoniano, Piacenziano, Astiano (SACCO).

Vienna Basin. Austria: "2. Mediterranstufe" (KAUTSKY).
South Germany (Bavaria): Burdigal (HÖLZL).
Poland: Miozän (FRIEDBERG).

FAMILIA: CUSPIDARIIDAE DALL 1886

Genus: *Cuspidaria* NARDO 1840
(Type: *Tellina cuspidata* OLIVI 1792)

Cuspidaria cuspidata (OLIVI 1792)
Plate VI, fig. 8

1792. *Tellina cuspidata* – OLIVI, Zool. Adriat., p. 101, Pl. 4, f. 3.
1814. *Tellina cuspidata* OLIVI – BROCCHI, Conch. subapp., p. 515.
1853. *Neaera cuspidata* OLIVI – FORBES & HANLEY, Brit. Moll. I, p. 195, Pl. VII, f. 4–6, Pl. G, f. 4–7.
1861. *Neaera cuspidata* OLIVI – WOOD, Crag. Moll. II, p. 273, Pl. XXX, f. 6.
1865. *Neaera cuspidata* OLIVI – JEFFREYS, Brit. Conch. III, p. 53; V (1869), Pl. XLIX, f. 5.
1867. *Neaera cuspidata* OLIVI – WEINKAUFF, Conch. Mittelm., p. 27.
1870. *Neaera cuspidata* OLIVI – HÖRNES, Wienerbecken II, p. 42, Pl. V, f. 1–2.
1892. *Cuspidaria cuspidata* OLIVI – LOCARD, Côtes d. France, p. 259, f. 238.
1901. *Cuspidaria cuspidata* OLIVI – SACCO, I Molluschi XXIX, p. 123, Pl. XXVI, f. 31–34.
1909. *Cuspidaria cuspidata* OLIVI – CERULLI – IRELLI, Fauna mal. mariana, p. 180, Pl. XXI (XXXI), f. 37–41.
1914. *Neaera* (*Cuspidaria*) *cuspidata* OL. *sp.* – GRIPP, Itzehoe, p. 10.
1916. *Neaera cuspidata* OLIVI – NØRREGAARD, Esbjerg, p. 19, Pl. II, f. 2.
1925. *Cuspidaria cuspidata* OLIVI – KAUTSKY, Hemmoor, p. 51.
1934. *Cuspidaria cuspidata* OLIVI – JENSEN & SPÄRCK, Saltvandsmuslinger, p. 193, f. 175.
1945. *Cuspidaria* (*Cuspidaria*) *cf. cuspidata* OLIVI *sp.* – GLIBERT, Mioc. Belg. I, p. 220, Pl. IV, f. 4.
1950. *Cuspidaria* (*C.*) *cuspidata* (OLIVI). – HEERING, Mioc. Pelec., p. 47, Pl. 5, f. 114–117.
1958. *Cuspidaria cf. cuspidata* (OLIVI) – SORGENFREI, Middle Mioc., p. 140.
1958. *Cuspidaria cuspidata* (OLIVI) – HÖLZL, Oberbayer. Burdigal, p. 171, Pl. 16, f. 8.

1959. *Cuspidaria* (*Cuspidaria*) *cuspidata* (OLIVI) – ANDERSON, Untermiozän, p. 160, Pl. 18, f. 10.

1964. *Cuspidaria cuspidata* (OLIVI) – ANDERSON, Reinbek-Stufe, p. 192.

Material. Hodde Clay.

Leding	93.155	31 m.:	4 def. rostra	(3)
–	–	28 –32 m.:	1 def. rostrum	(1)
–	–	Unknown depth:	2 def. rostra	(2)
Lønborg	102.55	21.3 –22.3 m.:	1 u. and 1 fr.	(1)
Odderup	103.150	24.8 –25.6 m.:	2 fragm. rostra	(1)
Gram	141.277	25.50–26.00 m.:	1 fragm. rostrum	(1)
–	–	30.00–30.50 m.:	1 def. sh., 1 fr.	(1)
–	–	35.30–35.70 m.:	6 fr.	(1)

Gram Clay.

Brande Brickworks. Clay pit:			cast of 1 d, 1 rostr., 1 fragm.	(1)
Drantum	104.1241	36.0 –40.0 m.:	1 fragm.	(1)
–	–	40.0 –44.0 m.:	1 fragm.	(1)
Måde Brickworks. Eastern clay pit:			1 def. d, 2 rostra, 2 u., 1 fragm. l	(3)
Holleskov	132.46b	4.9 –11.2 m.:	1 fragm. rostrum	(1)
Sønder Hygum	141.260	12 –40 m.:	2 casts of d, 1 rostrum	(3)
–	141.261	13 –19 m.:	1 u of r, 1 l, rostra of 4 r, 2 l, 8 fragm.	(7)
Rødding	141.75	10.80–16.75 m.:	1 rostrum	(1)
Vester Lindet	141.246	30.9 m.:	1 def. rostrum of 1 l	(1)
Gram	141.277	5.30– 5.70 m.:	4 def. rostr. of r, 5 def. rostr. of l	(5)
–	–	5.70– 6.10 m.:	4 rostr. of 3 r, and 1 l, 1 fr.	(3)
–	–	6.10– 6.40 m.:	3 fr. of rostra of r	(2)
–	–	7.30– 7.65 m.:	1 fr. of rostrum	(1)
–	–	8.50– 9.00 m.:	2 fr. of rostra	(1)
–	–	9.00– 9.50 m.:	1 u.	(?1)
–	–	9.50– 9.90 m.:	2 fr. of 2 sh.	(?2)
–	–	10.80–11.25 m.:	2 fr.	(?1)
–	–	12.10–12.60 m.:	1 rostrum of 1 l	(1)
–	–	13.10–13.50 m.:	1 rostrum of 1 r, 1 def. d	(2)
–	–	13.50–14.00 m.:	1 rostr. of 1 l	(1)
–	–	14.60–15.10 m.:	1 u. of 1 l	(?1)
–	–	15.10–15.55 m.:	1 rostr. of 1 sh.	(1)
–	–	16.00–16.50 m.:	1 def. rostr. of 1 l, 1 rostr. of 1 sh.	(2)
–	–	16.50–17.00 m.:	1 def. rostr. of 1 l	(1)
–	–	17.00–17.50 m.:	1 def. d, 2 def. rostra of 2 sh.	(3)
–	–	17.50–18.00 m.:	1 def. d	(1)
–	–	18.50–19.00 m.:	1 fr. of 1 rostrum	(1)
–	–	20.50–21.00 m.:	2 fr.	(1)
Spandetgård. Clay pit:			1 u. and 1 rostr.	(2)
Sæd	167.445	90.30–91.00 m.:	2 fr.	(1)
–		91.00–91.50 m.:	9 fr.	(3)
–	–	91.50–91.75 m.:	Rostra of 5 r, 1 l	(2)
–	–	91.75–92.00 m.:	4 fr.	(2)
–	–	92.00–92.25 m.:	Rostra of 3 r, 2 l, 10 fr.	(4)
–	–	92.25–92.70 m.:	Rostra of 7 r, 4 l, u. of 1 r, 4 fr.	(7)
–	–	93.70–94.10 m.:	1 def. r	(1)
–	–	94.75–95.50 m.:	1 fr. of 1 rostrum	(1)

Sæd	167.445	96.20–96.75 m.:	1 fr. of 1 rostrum	(1)
–	–	94.00–97.70 m.:	1 fr.	(1)
–	–	98.60–99.05 m.:	2 fr. of rostra	(1)
–	–	99.05–99.55 m.:	1 rostrum of 1 r	(1)
Rends	167.236	140′–160′ :	U. of 1 l, 1 fr.	(1)

Description. The material is very defective. Most remnants consist of broken-off rostra or fragments of rostra. Besides, casts of double valves with parts of the shell have been found in a few exposures. Such findings have been made at Måde and Brande. The best specimen so far is that pictured in Plate VI, fig. 8. It originates from the eastern clay pit of Måde Brickworks and was collected in a nonidentified horizon. It may be described as follows:

Double valve on cast of clay containing much pyrite. The right valve has disappeared and in its place the cast of clay is worn down and flattened. The left valve is partly preserved, but broken by numerous crevices. Large parts of the preserved part of the valve is rust-coloured because of incipient limonitizing. On the lower, anterior part of the valve a number of the numerous pieces of the valves bounded by crevices had dropped off. The outline of the valve has in the main been preserved. Only the outermost part of the rostrum is broken, so that only about half of it is gone.

The sculpture on the exterior of the valve consists of fine concentric striae, which are parallel and apparently regular. When magnified (some 20 times) they also prove to be irregular. On the dorsal part of the rostrum they are bent at right angles up towards the hinge margin.

The valve is highly convex and very thin. The posterior hinge margin is rectilinear. The anterior hinge margin is highly curved and passes evenly into the highly curved, convex anterior part. The umbones are rather large and retrorse. The rostrum is greatly hollowed out interiorly. The interior of the valve has not been accessible to examination.

A cast of clay-ironstone concretion from Brande Brickworks is of a similar shape as the specimen from Måde, but still less of the shells has been preserved.

A juvenile, fairly well-preserved double valve from Gram (Bore-hole 141.277) has a so far little developed short rostrum, which, however, is in part broken off.

Remarks. C. cuspidata according to GRIPP (1915) differs from the similar species *C. rostrata* SPENGLER 1793, by having a shorter rostrum and a higher valve. These characters seem to be present in the greater part of the material from the Hodde Clay and the Gram Clay. It cannot, however, be precluded that some of the available fragments ought to be referred to *C. rostrata* instead.

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Hodde Formation. North Germany: Vierland-Stufe (GRIPP), Hemmoor-Stufe (KAUTSKY), Reinbek-

Stufe (ANDERSON). Holland: Middle (HEERING). Belgium: Anversien (GLIBERT). – Plio-Pleistocene. England: Coralline Crag (WOOD). – Recent: North Sea and Kattegat (JENSEN & SPÄRCK).

Atlantic Region. Recent from the coasts of Spitsbergen and South Greenland to Tenerifa (JEFFREYS).

Mediterranean Basin. Italy: Elveziano, Piacenziano, Astiano (SACCO), Upper Pliocene at Monte Mario (CERULLI – IRELLI). – Recent (WEINKAUFF).

Vienna Basin. Austria: Baden, Grund (M. HOERNES).
South Germany (Bavaria): Burdigal (HÖLZL).

Cuspidaria costellata (DESHAYES 1832)

1832. *Corbula costellata* – DESHAYES, Exped. scientif. Morée III, p. 86, Pl. XXIV, f. 1–3.
1853. *Neaera costellata* DESHAYES – FORBES & HANLEY, Brit. Moll. I, p. 199, Pl. VII, f. 8–9, Pl. G, f. 8–9.
1865. *Neaera costellata* DESHAYES – JEFFREYS, Brit. Conch. III, p. 99; V (1869), Pl. XLIX, f. 3.
1867. *Neaera costellata* DESHAYES – WEINKAUF, Conch. Mittelm., p. 29.
1892. *Cuspidaria costellata* DESHAYES – LOCARD, Côtes d. France, p. 259.
1901. *Cardiomya costellata* DESHAYES – SACCO, I Molluschi, XXIX, p. 127, Pl. XXVI, f. 62–63.
1908. *Cuspidaria* (*Cardiomya*) *costellata* DESH. sp. – CERULLI – IRELLI, Fauna mal. mariana, p. 181, Pl. XXI (XXXI), f. 45.
1909. *Cuspidaria* (*Cardiomya*) *cf. costellata* (DESH.) – COSSMANN & PEYROT, Conch. Néog. LXIII, p. 108.
1932. *Cuspidaria costellata* DESHAYES – JENSEN & SPÄRCK, Saltvandsmuslinger, p. 194.
1940. *Cuspidaria* (*Cardiomya*) *costellata* DESHAYES – SORGENFREI, Klintinghoved, p. 27, Pl. IV, f. 17.
1945. *Cuspidaria* (*Cardiomya*) *costellata* DESH. *sp.* – GLIBERT, Mioc. Belg. I, p. 221, Pl. IV, f. 5; Pl. XI, f. 10.
1950. *Cuspidaria* (*Cardiomya*) *costellata* DESHAYES – HEERING, Mioc. Pelec., p. 47.
1958. *Cuspidaria cf. costellata* (DESHAYES) – SORGENFREI, Middle Mioc., p. 142.
1959. *Cuspidaria* (*Cardiomya*) *costellata* (DESHAYES) – ANDERSON, Untermiozän, p. 161, Pl. 18, f. 11 a, b.
1964. *Cuspidaria costellata* (DESHAYES) – ANDERSON, Reinbek-Stufe, p. 142.

Material. Hodde Clay.

Hajstrup	167.235	194′–214′ :	1 def. rostrum	(1)

Gram Clay.

Aulum	74.321	11.40–12.40 m.:	8 fr.	(1)
Brejning Kro	83.197	40.5 m.:	1 def. rostrum of 1 r	(1)
Muldbjerg	83.1006	6.0 – 7.0 m.:	1 def. rostrum of 1 l	(1)
Gjødstrup	85.861	54.0 m.:	2 fr. of rostrum of 1 r	(1)
Gram	141.277	5.30– 5.70 m.:	1 def. rostrum of 1 l	(1)
–	–	6.10– 6.40 m.:	2 fr.	(1)
–	–	15.10–15.55 m.:	12 fr. of 1 r, 4 fr. of rostra of 2 shells	(2)
–	–	18.50–19.00 m.:	1 fr. of rostra of 1 r	(1)
–	–	20.50–21.00 m.:	1 def. rostra of 1 shell	(1)

Description. Only fragments of this species are available. They are provided with narrow, prominent, spread radial ribs. It has not been possible to observe other characters on the fragments, but a reference to any other species than *C. costellata* is out of the question, so the material has without reservations been referred to that species.

Distribution.

North Sea Basin. Miocene. Denmark: Klintinghoved Clay, Arnum Formation (SORGENFREI), Hodde Formation, Gram Formation. North Germany: Vierland-Stufe (ANDERSON), Reinbek-Stufe (ANDERSON). Holland: Middle (HEERING). Belgium: Anversien (GLIBERT). – Recent: Skagerak and Northern Kattegat (JENSEN & SPÄRCK).

Atlantic Region. Aquitanian Basin: Burdigalien (COSSMANN & PEYROT). – Recent from the coasts of Western Norway to the Canarian Islands and from there to New England and the Mexican Gulf (JENSEN & SPÄRCK).

Mediterranean Basin. Italy: Astiano (SACCO). Upper Pliocene at Monte Mario (CERULLI – IRELLI). – Recent (WEINKAUFF).

Poland: Miozän (FRIEDBERG: *C. costellata var. zaleścensis*).

Pelecypoda non det.

Plate VI, fig. 7

Material. Gram Clay.

Brodersmark	166.351 b	28–29 m.:	1 almost compl. double valve

The present, almost complete double valve is very thin-shelled, rather highly convex, and without sculpture. The shape is oblong oval. The umbones are found rather far posteriorly. The anterior dorsal margin is long and almost parallel to the ventral margin.

No attempt has been made at making the hinge stand out, as the specimen in this way would be spoiled.

I have not succeeded in identifying the shell, neither as to genus nor as to species. It seems to me to be most similar to *Montacuta*, especially *M. ferruginosa* (MONTAGU).

SCAPHOPODA

FAMILIA: DENTALIIDAE GRAY 1834

Genus: *Dentalium* LINNÉ 1758

(Type: *D. elephantinum* MONTFORT 1810)

Dentalium badense PARTSCH in HOERNES 1856

Plate VII, figs. 2 and 4

1856. *Dentalium badense* PARTSCH – M. HOERNES, Wienerbecken I, p. 652, Pl. 50, f. 31.
1882. *Dentalium badense* PARTSCH – v. KOENEN, Mioc. Nordd. II, p. 323.
1897. *Entalis badensis* PARTSCH – SACCO, I Molluschi, XXII, p. 107, Pl. 9, f. 17–20.
1907. *Dentalium badense* PARTSCH – RAVN, Jylland, p. 288, Pl. III, f. 3.

1916. *Entalis badensis* (PARTSCH) – COSSMANN & PEYROT, Conch. Néog. A.S.L.B. LXIX, 3, p. 175, Pl. I, f. 12–13, 16.
1925. *Dentalium (Entalis) badense* PARTSCH *var. borealis* – KAUTSKY, Hemmoor, p. 53, Pl. 5, f. 12.
1940. *Dentalium (Entalis) badense* PARTSCH – SORGENFREI, Klintinghoved, p. 29.
1958. *Dentalium cf. badensis* PARTSCH – SORGENFREI, Middle Mioc., p. 146.
1959. *Dentalium badense* PARTSCH in HOERNES – SEIFERT, Die Scaphopoden, p. 27, Pl. 1, f. 1–3.
1964. *Dentalium (Dentalium) badense* PARTSCH in HOERNES – ANDERSON, Reinbek-Stufe, p. 194.

Original diagnosis. D. testa maxima, parum arcuata, basi valde dilatata, versus apicem duodecim costata, versus aperturam multistriata, fissura postica, magna. (HOERNES 1856).

Type material. The holotype is the shell pictured by HÖRNES, 1856, Pl. 50, fig. 11. Locus typicus: Baden. Stratum typicum: "Unter Tegel und Sand." Depository: Naturhistorisches Museum, Vienna.

Material. Gram Clay.

Tværmose	85.391	21.0 –25.0 m.:	?1 fragment	(1)
Hauge. Clay pit:			9 fragmentary shells	(9)
Hoddemark. Karlsgårde Canal:			2 fragmentary shells	(2)
Hoddemark. Locality unknown:			1 fragm. shell	(1)
Esbjerg. (leg. P. HARDER):			1 fragm. shell	(1)
Måde Brickworks. Eastern clay pit:			111 fragm. shells	(111)
Gram	141.277	16.50–17.00 m.:	2 fragm. shells	(2)
–	–	17.00–17.50 m.:	2 fragm. shells	(2)
–	–	17.50–18.00 m.:	1 fragm. shell	(1)
–	–	20.00–20.50 m.:	2 fragm. shells	(2)
–	–	20.50–21.00 m.:	4 fragm. shells	(4)
–	–	21.50–22.00 m.:	?1 fragm. shell	(?1)

Description. The shell is large and sturdy, rather slightly curved, with a circular transverse section. The young shells have a longitudinal sculpture consisting of 14–16 narrow, prominent ribs, separated by comparatively broad intervals. On older shells these ribs become flatter and as a rule furrowed, so that they are disintegrated into two, three, or more rarely, more narrower ribs. As furthermore there is one or more thin secondary ribs in the intervals between the actual main spirals, the surface of the older shell is nearly always covered by numerous close-set, flat ribs characterized by unequal breadths. In this very variable arrangement of ribs, however, the original 14–16 main ribs or sets of ribs are usually recognized. On the younger parts of the old shells and on young shells the various ribs and their intervals are often longitudinally striated. The growth lines, which are at right angles to these striae, often form a fine network with them.

No slit has been observed on the shells available.

Remarks. SEIFERT (1959) has observed that the number of ribs on an average is 14 on the shells in the Hemmoor- and the Langenfelde-Stufe, but only 12 in the Sylt-Stufe. In the Danish material there is good agreement with the shells of the former stages. The number of ribs on the Sylt shells corresponds to that stated by HOERNES for the specimens from the Vienna Basin.

In the eastern clay pit of Måde Brickworks it has repeatedly been possible to observe that shells of this species mainly were found in close proximity of one of the concretion beds in the old part of the Gram Clay. At Hauge the shells were also found together with large pieces of a concretion bed, and in the bore-hole at Gram (141.277), too, it has been possible to demonstrate a connection between findings of this species and the lower one of the two concretion beds. Thus there is an obvious connection with a concretion bed, without, however, it being possible to elucidate the cause of this.

Measurements. The dimensions of the shell from Måde Brickworks pictured in Plate VII, figs. 2 and 4:
Length: 60.1 mm.
Interior diameter: apically: 3 mm., aperturally: 9 mm.
Exterior – : – : 8 – – : 13 –

The largest interior diameter on the present shells is 10 mm., and the longest shell is the one pictured from Måde. In the material there are, however, fragments of somewhat longer shells.

Distribution.

North Sea Basin. Miocene. Denmark: Klintinghoved Clay, (SORGENFREI), ? Arnum Formation, Gram Formation. North Germany: Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON), Glimmerton at Langenfelde, Lüneburg, Lieth, Teufelsbrücke, Muggesfelde, Reinbek, Gühlitz (v. KOENEN).

Atlantic Region. Aquitanian Basin: Burdigalien (COSSMANN & PEYROT).

Mediterranean Basin. Italy: Aquitaniano, Langhiano, Elveziano, and Astiano (SACCO).

Vienna Basin. Austria: Baden Tegel at Baden, Möllersdorf, Vöslau and Forchtenau; "Tegel und Sand des Leythakalkes" at Gainfahren and Steinabrunn (HOERNES).
Poland: Miozän (FRIEDBERG).

Dentalium dollfusi v. KOENEN 1882
Plate VII, figs. 1 and 3

1882. *Dentalium Dollfusi* – v. KOENEN, Mioc. Nordd. II, p. 326.
1907. *Dentalium Dollfusi* v. KOENEN – RAVN, Jylland, p. 288 (84).
1925. *Dentalium (Entalis) Dollfusi* v. KOENEN – KAUTSKY, Hemmoor, p. 54, Pl. 5, f. 13.
1959. *Dentalium dollfusi* v. KOENEN – SEIFERT, Die Scaphopoden, p. 27, Pl. 2, f. 9.
1964. *Dentalium dollfusi* KOENEN – ANDERSON, Reinbek-Stufe, p. 193.

Material. Hodde Clay.

Leding	93.155	27	–28	m.:	1 fragment	(1)
–	–		31	m.:	19 fragments	(6)

Leding	93.155	28 –32 m.:	10 small fragments	(3)
–	–	Unknown depth:	11 fragments	(3)
Lønborg	102.55	18.3 –19.3 m.:	2 small fragments	(1)
–	–	21.3 –22.3 m.:	4 small fragments	(2)
Odderup	103.150	24.8 –25.6 m.:	50 small fragments	(11)
Grøde. Karlsgårde Canal:			8 fragments	(2)
Måde Brickworks. Northwestern clay pit:			3 fragments	(3)
–	Eastern clay pit:		67 fragments	(17)
Gram	141.277	25.50–26.00 m.:	8 fragments	(1)
–	–	26.00–26.50 m.:	25 fragments	(1)
–	–	26.50–27.00 m.:	22 fragments	(4)
–	–	27.00–27.50 m.:	7 fragments	(2)
–	–	27.50–28.00 m.:	11 fragments	(2)
–	–	28.00–28.50 m.:	16 fragments	(3)
–	–	28.50–29.00 m.:	1 fragment	(1)
–	–	29.00–29.50 m.:	28 fragments	(7)
–	–	29.50–30.00 m.:	24 fragments	(4)
–	–	30.00–30.50 m.:	37 fragments	(7)
–	–	30.50–30.95 m.:	10 fragments	(2)
–	–	30.95–31.35 m.:	?1 fragment	(?1)
–	–	31.35–31.65 m.:	17 fragments	(4)
–	–	31.65–31.95 m.:	12 fragments	(1)
–	–	31.95–32.30 m.:	2 fragments	(1)
–	–	32.30–32.70 m.:	6 fragments	(2)
–	–	32.70–33.05 m.:	1 fragment	(1)
–	–	33.05–33.40 m.:	15 fragments	(3)
–	–	33.40–33.80 m.:	1 fragment	(1)
–	–	33.80–34.25 m.:	24 fragments	(5)
–	–	34.25–34.70 m.:	16 fragments	(3)
–	–	34.70–35.00 m.:	5 fragments	(2)
–	–	35.30–35.70 m.:	1 fragment	(1)
Sønder Hygum	141.215	21.2 –32.8 m.:	6 fragments	(2)
Tønder	166.398	85.5 m.:	1 fragment	(1)
Hajstrup	167.235	174′–194′ :	5 fragments	(3)

Description. Only fragments are available.

The shell is only slightly curved. The transverse section is circular. The surface is usually provided with 10–11 sharp-edged ribs. Sometimes, however, there are shells with 8–9 or 12–14 ribs. In the samples from a depth of about 30 m.–35 m. in the bore-hole at Gram (141.277) the number of ribs is mostly 12–14. Between these actual main ribs there are often some weaker ribs. In rare cases these secondary ribs almost have the same strength as the main ribs. The intervals between the ribs are smooth. No slit has been observed on any of the fragments.

Remarks. The fragments from the Hodde Clay have all been referred to *D. dollfusi* because of the number and shape of the ribs, as this species has more ribs than the species *D. novemcostatum mutabile* DODERLEIN in HÖRNES

1856, which is otherwise very similar and which as a rule has only 8–9 ribs. Besides, the two species (including subspecies) seem to resemble each other so much that only a thorough examination can decide whether they ought not actually to be united. In this place I prefer to retain the name of *D. dollfusi* as a designation of the shells from the Hodde Clay, as there can hardly be any doubt of their identity with the species occurring at Twistringen in Northern Germany. From the latter locality I have numerous shells which all bear great resemblance to the shells from the Hodde Clay. The material from Twistringen is without reservations referred to *D. dollfusi* by HINSCH (1962, p. 297).

In the lower part of the Hodde Clay in the Gram drilling the shells seem to have more ribs than in the upper part of the clay.

Distribution.

North Sea Basin. Miocene. Denmark: Hodde Formation. North Germany: Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON).

Dentalium cf. michelotti HÖRNES 1856

1856. *Dentalium Michelottii* – HÖRNES, Wienerbecken I, p. 654, Pl. 50, f. 33.
1897. *Dentalium Michelotti* HÖRNES – SACCO, I Molluschi, XXII, p. 96, Pl. VII, f. 84–86. *var. costulatior*, ibid., p. 97, Pl. VII, f. 93–94.
1910. *Dentalium Michelottii* HÖRN. – CERULLI – IRELLI, Fauna mal. mariana, parte 4, p. 23, Pl. III (XXXIV), f. 1–2.
1925. *Dentalium Michelotti* HÖRN. *var. costulatior* SACCO – KAUTSKY, Hemmoor, p. 52, Pl. 5, f. 11.
1958. *Dentalium cf. Michelottii* HÖRNES *var. costulatissima* SACCO – SORGENFREI, Middle Mioc., p. 144.
1959. *Dentalium cf. michelottii* HOERNES – SEIFERT, Die Scaphopoden, p. 31, Pl. 2, f. 5.

Material. Gram Clay.

Skærum Mølle. Clay pit:			7 fragments	(1)
Tværmose	85.381	21.0–25.0 m.:	1 fragment	(1)
Ålbæk Eng	102.59	19.8–20.8 m.:	1 fragment	(1)
Gram	141.277	14.6–15.1 m.:	1 fragment	(1)

Description. Only fragments are available. On two fragments from Skærum Mølle, one fragment from Ålbæk Eng, and one fragment from Gram 16(–17) minute longitudinal ribs are clearly seen at a fairly great distance from each other. On a single one of the fragments (from Ålbæk Eng) furthermore some finer secondary ribs were seen in the intervals.

From Skærum Mølle there are, besides, five fragments, four of which must have originated from the broad, younger, more apertural part of the shell. The longitudinal ribs here can only be suspected to occur in certain places. Otherwise the surface is smooth.

On the basis of this fragmentary material, which obviously belonged to one

and the same species, it may be concluded that this was a form with some 16 minute, only slightly elevated longitudinal ribs on the apical part and with almost completely obliterated longitudinal ribs or a completely smooth surface on the apertural part. The curvature of the shell is only slightly indicated on the fragments. The transverse section is circular.

Remarks. The imperfect state of preservation of the material prevents a close determination of the species.

It seems that the shell fragments can best be referred to *D. michelotti*, perhaps more exactly to *var. costulatior* SACCO, which according to its suture has 14–16 ribs. At any rate the shells from the Gram Clay correspond completely to the form in the Arnum Formation and in the Hemmoor-Stufe.

For that matter, the specific definitions of *Dentalium* shells with a slightly ribbed apical end and a smooth apertural end seem to be rather vague.

Distribution. D. michelotti is recorded from the following areas:

North Sea Basin. Miocene. Denmark: ? Arnum Formation. (SORGENFREI), ? Gram Formation. North Germany: Hemmoor-Stufe (KAUTSKY).

Mediterranean Basin. Italy: Elveziano, Tortoniano, Piacenziano, Astiano (SACCO), Monte Mario (CERULLI – IRELLI). France (Rhône Valley): Pliocène (FONTANNES). Spain (Cataluna): Placenciense (ALMERA Y BOFILL).

Vienna Basin. Austria: Baden (HÖRNES).
Poland: Miozän (FRIEDBERG).

Dentalium entale LINNÉ 1758

1758. *Dentalium entalis* – LINNAEUS, Systema naturae, edit. X, p. 785.
1843. *Dentalium entalis* – NYST, Coq. et polyp., p. 345, Pl. XXXV, f. 3.
1848. *Dentalium entale* – WOOD, Crag Moll. I, p. 189, Pl. XX, f. 2.
1853. *Dentalium entalis* LINN. – FORBES & HANLEY, Brit. Moll., II, p. 449, Pl. LVII, f. 11.
1856. *Dentalium entalis* LINN. – HÖRNES, Wienerbecken I, p. 658, Pl. 50, f. 38a, b.
1865. *Dentalium entalis* LINNÉ – JEFFREYS, Brit. Conch. III, p. 191.
1882. *Dentalium entale* L. – v. KOENEN, Mioc. Nordd. II, p. 327.
1916. *Dentalium entale* L. – NØRREGAARD, Esbjerg, p. 20.
1925. *Dentalium (Antale) vitreum* SCHROT. – KAUTSKY, Hemmoor, p. 52.
1959. *Dentalium entale* LINNÉ – SEIFERT, Die Scaphopoden, p. 30, Pl. 2, f. 3–4.
1959. *Dentalium entale* LINNÉ – MUUS, Skallus, Søtænder, Blæksprutter, p. 66, f. 42 (p. 69).
1964. *Dentalium (Antalis) entale* LINNÉ – ANDERSON, Reinbek-Stufe, p. 194.

Original diagnosis. D. testa tereti subarcuata continua laevi (GMELIN in LINNAEUS Syst. naturae 1790).

Material. Hodde Clay.

Leding	93.155	19	–27	m.:	1 fragment	(1)
–	–	27	–28	m.:	19 small fragments	(4)
–	–		31	m.:	15 small fragments	(5)

Leding	93.155	28 –32 m.:	11 small fragments	(3)
–	–	Unknown depth:	9 small fragments	(3)
Lønborg	102.55	21.3 –22.3 m.:	2 small fragments	(1)
Odderup	103.150	24.8 –25.6 m.:	1 fragment	(1)
Hodde	113.33a	18.5 –18.9 m.:	3 fragments	(2)
Måde Brickworks. Eastern clay pit. Northwall:			2 fragments	(2)
Gram	141.277	28.00–28.50 m.:	6 very small fragm.	(2)
–	–	29.00–29.50 m.:	4 fragments	(2)
–	–	29.50–30.00 m.:	1 fragment	(2)
–	–	30.00–30.50 m.:	4 fragments	(1)
–	–	30.50–30.95 m.:	1 small fragment	(1)
Gram Clay.				
Spandetgård. Clay pit:			1 fragment	(1)

Description. Only fragments are available.

The transverse section is circular or more oval. Often the tube even has two distinct edges. This is seen in fragments from Odderup, Måde, and Gram. In the case of a fragment from Leding the thickness of the shell is considerably greater in one side of the shell, so that the aperture is eccentric. Some fragments have a long, thin slit at the apical end. The surface of the shell in every case is smooth and glossy.

The largest fragment (1 cm. long) originates from the Gram Clay at Spandetgård. The transverse section of the very slightly curved shell is circular and the surface is smooth and glossy. The growth lines are fairly distinct.

Remarks. For comparison with the present material I have had numerous fragments and shells from Shell Bed I at Hoddemark. Many of these have a long and narrow slit at the apical end, and several of the fragments have two well-defined edges at one side of the shell. Thus there is a close agreement with the material from the Hodde Clay.

From the Miocene beds of Northern Germany SEIFERT has observed shells with similar characters as those mentioned. KAUTSKY like SACCO considered all the Miocene shells referred to *D. entalis* as belonging to *Antale vitreum*, as he had not observed any slit on the material available to him. SEIFERT found shells with a slit in the Miocene of Northern Germany and showed that both species are present there.

All the shells found in the Hodde Clay and the Gram Clay are so clearly homogenous that they most probably belong to *D. entale*.

Distribution.

North Sea Basin. Miocene. Denmark: ? Arnum Formation (NØRREGAARD), Hodde Formation, Gram Formation. North Germany: Hemmoor-Stufe (SEIFERT), Reinbek-Stufe (ANDERSON).

Mediterranean Basin. France (Rhône Valley): Pliocène (FONTANNES). Spain (Cataluna): Placenciense (ALMERA Y BOFILL).

FAMILIA: SIPHONODENTALIIDAE

Genus: *Siphonodentalium* M. SARS 1859
(Type: *Dentalium vitreum* M. SARS 1851
(non GMELIN 1791 = *D. lobatum* SOWERBY 1860))

Siphonodentalium cf. lobatum (SOWERBY 1860)

1966. *Siphonodentalium cf. lobatum* (SOWERBY) – RASMUSSEN, Molluscan Faunas I, p. 186.

The shell material referred to the genus *Siphonodentalium* was described and discussed in Part I, p. 186.

GASTROPODA

The systematic arrangement of the gastropods is on the whole the same as that used in WENZ's handbook (1938–44), but with some alterations. Furthermore, S. THIELE's handbook (1931–35) and Part I (Mollusca 1) of the *Treatise on Invertebrate Paleontology* has been used. The morphological terms of the handbook last mentioned have been used to a great extent, for which reason reference is made to its description of "Morphology of hard Parts", pp. 105–129 and to the section on pp. 129–135, "Morphological Terms Applied to Gastropod Shells." It should be added that the direction-terminology for the growth lines is also used for the description of the collabral sculpture in the present work. During the description the gastropod shells have been oriented with the apex directed upward. Therefore, in the cases in which the direction "upwards" is mentioned, this means "adapically".

SUBCLASSIS: PROSOBRANCHIA

ORDO: ARCHÆOGASTROPODA

FAMILIA: TROCHIDAE D'ORBIGNY

Genus: *Solariella* S. WOOD 1842
(Type: *Solariella maculata* S. WOOD 1847)

Solariella jutensis nov. sp.
Plate VII, figs. 11 and 14, and Plate X, fig. 2

Diagnosis. A *Solariella* with a convex, smooth periphery. Adapically there is an indistinct keel. Between the keel and the adapical suture and between the umbilicus and the smooth periphery there is rather a strong spiral sculpture, which is crossed by collabral (radial) ribs or threads.

Type material. The shell pictured in Plate VII, fig. 11, has been selected as holotype. Depository: Danmarks Geologiske Undersøgelse, Charlottenlund.

Type locality: The easternmost clay pit of Måde Brickworks, the south wall. Stratum typicum: Gram Clay.

Derivatio nominis. jutensis, Lat. = Jutlandish.

Material. Gram Clay.

Muldbjerg	83.1006	6.0 – 7.0 m.:	1 shell
Måde. Eastern clay pit:			1 shell (leg. 1962)
Gram	141.277	14.00–14.60 m.:	1 shell
Brodersmark	166.351 b	29 –30 m.:	1 shell (with a somewhat corroded apex)

Description. The shell is very small, trochiform, considerably broader than high.

The protoconch is small, paucispiral, comprising only 1–1¼ whorl, which is smooth. The initial whorl is comparatively large, vesicular, orthostrophic or slightly heterostrophic.

The teleoconch, only one whorl of which is present in the material available, comprises one whorl (on older shells probably more) fast increasing in diameter, the adapical part of which gradually becomes quite flat, at right angles to the axis and demarcated abaxially by a keel on which there is a narrow spiral rib.

A slight spiral thread is seen on the shell from Gram half-way between the keel and the deep-set adapical suture. The keel is especially conspicious on the shell from Måde.

Abapically to the keel there is first one, then soon after two, and then again three spiral ribs of approximately the same strength as the one on the keel. On the shell from Gram there are 5–6 such spiral ribs. In the middle of the whorl, from a point adapically to the periphery to a point abapically to it, there is a smooth, convex zone. Abapically it is demarcated by another series of spiral ribs which encircle a deep, circular umbilicus. Closest to the periphery there are 4–5 close-set spiral ribs. These are followed by a stronger spiral rib, which disappears spirally into the umbilicus, after which there are a further 3 rather strong spiral ribs, which behave like the preceding one. The distance between these spiral ribs first is twice as great as the breadth of the ribs, but then decreases.

At the same time as the spiral ornamentation a collabral sculpture starts. It consists of flat ribs which take a radial course on the adapical part of the whorl as well as on the base. They are never so strong as the spiral ribs, and they number about 17 on the present shells. On the shell from Brodersmark it is seen that the collabral ribs are densest towards the umbilicus and are of nearly the same strength as the spiral ribs, which at the passage are disintegrated into a number of small tubercles.

The aperture is almost circular. Labrum is broken on all the shells. Labium is also defective, but on the shells from Brodersmark and Gram is seen to have spread widely over the umbilicus as a callus.

Measurements.

Locality:	Length Axis	Length Aperture	Diameter Shell	Diameter Protoconch
Måde	0.7 mm.	0.4 mm.	0.8 mm.	0.3 mm.
Gram	0.7 –	0.4 –	0.9 –	0.3 –
Brodersmark	0.8 –	0.4 –	0.9 –	0.3 –

Remarks. It has not been possible to identify the present material with any of the *Solariella* species described so far.

The shells from the Gram Clay differ from the Oligocene *S. suturalis* (PHILIPPI 1843) and the closely related Miocene form *S. miosuturalis* (KAUTSKY 1925) by not having the two strong spiral ribs in the middle of the whorls of the teleoconch and by having a highly deviating sculpture (as to the two species see the description in ANDERSON 1959).

S. straeleni GLIBERT 1952 from the Anversien of Belgium differs from the species in the Gram Clay by having its four very weak spiral ribs on the adapical part of the whorls of the teleoconch and by its faint sculpture in general, but in the other characters there is so great a similarity between the two forms that they are probably closely related. Both species have a smooth ramp without spiral ornamentation and an indistinct adapical margin.

In this connection it should be emphasized that the material of *S. jutensis* consists of juvenile shells only. Perhaps the finding of older specimens will show that this species should be united with *S. straeleni*. So far there is not, however, a sufficient basis for identifying the shells from the Gram Clay with the latter species, for which reason they must for the time being be considered as belonging to a new species.

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation.

Genus: *Calliostoma* SWAINSON 1840

(Typus: *Trochus conulus* LINNÉ 1758)

Calliostoma sp.

Plate VII, figs. 9, 10, 12, and 13

Material. Gram Clay.

Måde. Eastern clay pit, younger section: 1 shell missing the upper part (leg. 2.8. 1950).

Description. Only a single, fragmentary specimen has been recorded.

The upper part of the apex has been broken off. The younger part of the shell, with the base, a whorl and a half in all, is present. Only parts of the abapical half of the next youngest whorl are present.

The shell must have been markedly conical with an almost flat base. The

available part of the teleoconch has convex whorls. The ornamentation can only be studied on the youngest whorl, where there are four spiral bands in all. Band 1 is placed closely below the adapical suture and is of the third order. Band 2, which is of the fourth order, is found in the deepest part of the convexity and, if anything, is to be considered a spiral thread. Band 3 is of the second order and Band 4 is of the first order. The last-mentioned spiral band forms the periphery of the whorl and seem to have developed from two, originally independent, but gradually merged spiral bands. Spiral Band 3 is closely adapical to Band 4. These two close-set spiral bands are the only ones preserved on the next youngest whorl of the available specimen.

All the spiral bands are disintegrated into small tubercles with short, collabrally placed longitudinal axes. On the youngest whorl about 40 tubercles were counted on Band 3 and about 42 on Band 4.

The base of the shell is provided with eight rather broad spiral bands. The intervals between the four bands closest to the periphery are broader than the spiral bands, whereas the four innermost ones in relation to the centre of the base are denser. The spiral band closest to the periphery is found closely below the peripheral, nodose spiral band (No. 4).

The aperture is trapezoid. The labrum has been broken off.

A few remnants of Trochidae have been found in the Hodde Clay. From Gram (141.277. 27.50–28.00 m.) there is a protoconch available which has belonged to a representative of the family Trochidae, but which it has not been possible to determine as to genus or species.

From Sønder Hygum (141.215. 5.00–33.00 m.) we have some fragments of a shell the interior of which is covered with mother of pearl and the exterior surface of which is covered with spiral ribs. The fragments undoubtedly originate from a trochid, most probably a *Calliostoma*. It is not possible to determine them as to species, but from the existing possibilities it seems that *C. laureatum* (MAYER) should, if anything, be considered.

FAMILIA: VITRINELLIDAE

Genus: *Teinostoma* H. & A. ADAMS 1853

(Type: *Teinostoma politum* A. ADAMS 1853)

Teinostoma pulchralis (WOOD 1848)

Plate VII, figs. 5–8

1848. *Adeorbis pulchralis* – S. WOOD, Crag Moll. I, p. 139. Pl. XV, fig. 4.
1923. *Adeorbis pulchralis* WOOD – HARMER, Plioc. Moll. II, 3, p. 758, Pl. LX, f. 23.

Original diagnosis. Testa minuta tenui, pellucida (?), depressa, suborbiculari, heliciformi; anfractibus tribus, superne convexis, subtus planiusculis, trans-

versim tenuissima striatis; apertura patente, obtuse angulato; umbilico magno, profundo; peritrema acuta, superne incurva prominente, intus et infra valde sinuata (S. WOOD 1848).

Material. Gram Clay.

Hauge. Clay pit:			1 shell
Hodde	113.33a	9 –10 m.:	1 shell
Hjortvad	141.178	28.1 –33.1 m.:	1 shell
Gram	141.277	20.00–20.50 m.:	1 shell

Description. The shell is small, trochiform, somewhat broader than high, with a low spire. The diameter of the whorls is increasing highly by the age of the animal. The umbilicus is relatively large, deep, and has a circular outline.

The protoconch is smooth, consisting of 1–2 whorls. Faint traces of spiral ornamentation on the adapical part of the whorls. The growth lines are prosocyrt, distinct at 12.5 × magnification. The base is slightly convex, but mainly flat, densely set with spiral bands about 0.01 mm. broad. The specimen from Hauge has some 20 of these spirals, the intervals between which are considerably narrower than the bands themselves. They are found all over the base from the periphery to the margin of the umbilicus. Both of the specimens present consist of three whorls.

The shell from Hodde is limonitized on the surface and has a defective aperture. The latter is also the case on the shell from Hauge.

Measurements.

	The shell from Hauge	The shell from Hodde
Diameter of whorl 1 (protoconch)	0.4 mm.	0.3 mm.
– – – 2	0.9 –	0.8 –
– – – 3	2.3 –	1.9 –
– – the umbilicus	0.4 –	0.3 –
Length of the axis of the shell	1.8 –	1.4 –
Height of the youngest whorl preserved	1.7 –	1.2 –

Remarks. This species seems to correspond completely to the shells from Sutton (Coralline Crag) and Little Oakley (Waltonian) described by WOOD and HARMER.

GLIBERT (1952, p. 9, Plate I, fig. 6) describes and pictures a closely related form from Edeghem: *Teinostoma* (*Solariorbis*) *antwerpiense* GLIBERT and discusses the difference between this species and *T. pulchralis*. The most important characters by which the latter form differs from GLIBERT's species are the following: large umbilicus, through the opening of which it is possible to see far towards the apex. Base almost plane, completely covered by spiral ornamentation. The small umbilicus and the abrupt basal spiral ornamentation of *T. antwerpiense* are clearly seen in ANDERSON (1959, Plate 3, fig. 3a–c).

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation. – Plio-Pleistocene. England: Coralline Crag, Waltonian (HARMER).

Mediterranean Basin. Italy: Livorno (SEQUENZA).

FAMILIA: CYCLOSTREMATIDAE

Genus: *Circulus* JEFFREYS 1865
(Type: *Valvata striata* PHILIPPI 1836)

Circulus praecedens (v. KOENEN 1882)
Plate IX, figs. 11–13

1882. *Adeorbis praecedens* v. KOENEN – v. KOENEN, Mioc. Nordd. II, p. 312, Pl. V (IV), f. 15a–d.
1925. *Adeorbis praecedens* v. KOEN. – KAUTSKY, Hemmoor, p. 60.
1952. *Circulus præcedens* VON KOENEN sp. – GLIBERT, Mioc. Belg. II, p. 12, Pl. II, f. 1.
1958. *Adeorbis planorbillus* (DUJARDIN) – SORGENFREI, Middle Mioc., p. 159, Pl. 28, f. 97a–c.
1959. *Circulus praecedens* (v. KOENEN) – ANDERSON, Die Gastropoden, 1, p. 62, Pl. 3, f. 6a–b.
1964. *Circulus praecedens* (KOENEN) – ANDERSON, Reinbek-Stufe, p. 199.

Material. Hodde Clay.

Gram	141.277	35.30–35.70 m.:	1 small, somewhat defective shell

Description. The present shell is very small and has a corroded surface.

The protoconch comprises about $2\frac{1}{2}$ smooth whorls.

Only about one whorl of the teleoconch is available, as the younger part of the shell has been broken off. On the whorl there are three carinae, the uppermost one of which is about halfway between the abapical suture and the periphery. The middle carina, which is the least prominent, is on the periphery, while the lowest one is on the base of the shell, halfway between the periphery and the umbilicus. Apart from the three carinae no sculpture is seen on the shell.

The umbilicus is big, deep, and circular.

A more detailed description of the species is found in the cited works by GLIBERT, SORGENFREI, and ANDERSON.

Measurements.

The shell from Gram measures 0.7 mm. in height and 1.2 mm. in diameter.

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI: *Adeorbis planorbillus*), Hodde Formation. North Germany: Vierland-Stufe, Hemmoor-Stufe, Reinbek-Stufe (ANDERSON), Glimmerton (Langenfelde-Stufe at Mürwik near Flensburg (ANDERSON)).

Circulus hennei GLIBERT 1952

1952. *Circulus hennei* – GLIBERT, Mioc. Belg. II, p. 11, Pl. I, f. 7.
1956. *Adeorbis carinatus* (PHILIPPI) – RASMUSSEN, South Jutland, p. 51, Pl. III, f. 4a–c.
1959. *Circulus hennei* GLIBERT – ANDERSON, Die Gastropoden, 1, p. 63, Pl. 3, f. 7a–c.
1964. *Circulus hennei* GLIBERT – ANDERSON, Reinbek-Stufe, p. 199.

Material. Gram Clay.

Brande Brickworks. Clay pit:			1 fragm. shell and 1 def. juvenile shell
Drantum	104.1241	36.0 –40.0 m.:	1 fragm.
–	–	40.0 –44.0 m.:	1 small, defective shell
Hauge. Clay pit. Gram Clay:			1 def. shell
Sønder Hygum	141.260	12 –40 m.:	1 fragm.
Gram	141.277	5.30– 5.70 m.:	1 fragm.
–	–	7.30– 7.65 m.:	1 fragm. shell
–	–	12.10–12.60 m.:	1 juvenile shell
Spandetgård. Clay pit:			1 compl. shell and 1 def. shell
Brodersmark	166.351 b	27 –28 m.:	1 juvenile shell
Sæd	167.445	97.90–98.60 m.:	1 def., juvenile shell

Description. I have no additions to my description of 1956.

The juvenile shells are often entirely without sculpture in conformity with what can be observed on the oldest parts of adult shells.

Remarks. C. carinatus (PHILIPPI) differs from *C. hennei* by having spiral striae between the middle carina on the base and the umbilicus. It was only found in the Upper Oligocene formations.

ANDERSON (1959) is of the opinion that *C. hennei* originates from the Lower Miocene *C. praecedens* (v. KOENEN), the original form of which is supposed to be *C. carinatus*. The difference between these species is demonstrable, but not particularly obvious.

The shells from Gram, however, should evidently be referred to the *hennei* type.

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation. North Germany: Hemmoor-Stufe, Reinbek-Stufe (ANDERSON), Langenfelde-Stufe at Mürwik near Flensburg (ANDERSON). Holland: Peel. Belgium: Anversien (GLIBERT).

ORDO: MESOGASTROPODA

FAMILIA: RISSOIDAE

Genus: *Putilla* A. ADAMS 1867

(Type: *Putilla lucida* A. ADAMS 1867)

Putilla gottscheana (V. KOENEN 1882)

Plate VIII, figs. 3–5. Plate IX, figs. 5–6.

1882. *Assiminea Gottscheana* – V. KOENEN, Mioc. Nordd. II, p. 319.
1958. *Rissoa Ravni* – SORGENFREI, Middle Mioc., p. 154, Pl. 30, f. 92.
1960. *Putilla (Ovirissoa) gottscheana* (KOENEN) – ANDERSON, Die Gastropoden, 2, 1, p. 19, Pl. 2, f. 4.
1964. *Putilla (Ovirissoa) gottscheana* (KOENEN) – ANDERSON, Reinbek-Stufe, p. 200.

Original diagnosis. Not adduced.

Type material. One of the shells among v. KOENEN's material has by ANDERSON been selected as lectotype. Depository: Coll. KOENEN, Geol. Institut der Universität Göttingen. Orig. No. 67. Locus typicus: Langenfelde bei Altona. Stratum typicum: Glimmerton (Langenfeld-Stufe, Miocene).

Material. Shell material is available from the following localities (see Part I, Tables 4–66):

Hodde Clay.

Gram (141.277), Hajstrup (167.235).

Gram Clay.

Aulum (74.321), Muldbjerg (83.1006), Videbæk (84.1748, 84.1727), Møltrup Brickworks (clay pit), Gjødstrup (85.861), Brande Brickworks (clay pit), Drantum (104.1241), Store Langkjær (104.1158), Leding (93.155), Ålbæk Eng (102.59), Hauge (clay pit), Tønding (clay pit), Måde Brickworks (eastern clay pit, new section 1962), Holleskov (132.46b), Ravning (clay pit), Hjortvad (141.178), Lintrup (132.140), Sønder Hygum (141.260, 141.261, 141.273), Brøstrup (141.224), Rødding (141.75, 141.243), Vester Lindet (141.246), Gram (141.277), Spandetgård (clay pit), Spandet (150.184), Tønder (166.398), Brodersmark (166.351b), Sæd (167.445), and Rends (167.236).

Description. The shell is very small, ovoid. The biggest shell recorded (from Gram) has four whorls. Most of the others have three, only. The protoconch is conical, with a flattened apex, paucispiral, slightly heterostrophic.

The initial whorl rises little above the following whorl on some specimens. On others this is, however, less pronounced.

The transition to the teleoconch is quite even and difficult to determine. The whorls of this part of the shell are highly convex and separated by deep-set sutures. The convexity of the whorls seems to increase by the age of the animal. Certain shells already on whorl no. 2 have the weak sculptural features which otherwise only seem to make their appearance on whorl no. 3 (cf. a shell from Rødding. 141.75. 10.80–16.75 m. pictured in Plate VIII, figs. 3 and 4). On

the otherwise smooth and glossy surface of the shell partly some very weak and extremely fine spiral striae, partly some more or less conspicuous faint collabral folds are seen which are orthocline and conformal with that of the growth lines. The spiral striae on certain shells can only be seen on the youngest whorls. The distance between the striae is comparatively great and is the same all over the whorl. Often the collabral folds can only be seen at obliquely incident light. They are more or less close-set and often disappear on the abapical part of the whorl.

Often there is on the youngest whorl a distinct keel issuing from the adapical corner of the aperture. It looks like a spiral thread and is also frequently seen on the older whorls as a spiral thread immediately above the abapical suture. The youngest whorl forms rather a sharp boundary between the apex and the base.

The base is convex. The aperture is roundly oval, encircled by rather a sharp connected apertural margin, which sometimes has an adaxial curve on the adapical part of the inner lip as it there closely joins the curvature of the whorl. The inner lip is abapically more or less prominent with a sharp or slightly bent edge. On the base there is often a more or less narrow umbilicus.

Variations. The species varies somewhat as regards the sculptural features mentioned and as regards the presence or absence of an abapical spiral thread.

Remarks. Because of its small size this species has been considered rare. The opposite, however, has proved to be the case. In the wash residues, the fractions below 0.1 mm., the species is the commonest in the Gram Clay.

As the species was not pictured by v. KOENEN, it was impossible to verify it before ANDERSON examined v. KOENEN's type material.

Rissoa ravni SORGENFREI is perhaps – as assumed by ANDERSON – identical with *P. gottscheana.*

Measurements. The largest specimen available is the shell (from Gram) pictured in Plate IX, figs. 5 and 6. It measures

Length of axis: 1.3 mm. Maximum diameter: 0.9 mm. The longest axis of the aperture: 0.5 mm.

A shell from Rødding (141.75. 10.80–16.75 m.), the apex of which is pictured in Plate VIII, fig. 3, measures

Length of the axis: 1.0 mm. Maximum diameter: 0.8 mm. The longest axis of the aperture: 0.4 mm.

Most of the numerous shells group around the measures of the shell from Rødding.

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (*Rissoa ravni* SORGENFREI), Hodde Formation, Gram Formation. North Germany: Hemmoor-Stufe (DITTMER,

ANDERSON), Reinbek-Stufe (ANDERSON), Glimmerton at Langenfelde (v. KOENEN, ANDERSON) and the Elbtunnel (HORN).

Genus: *Cingula* FLEMING 1828

(Type: *Turbo cingillus* MONTAGU 1815)

Cingula proxima laevigata (v. KOENEN 1882)

Plate IX, figs. 9–10

1882. *Rissoa laevigata* – v. KOENEN, Mioc. Nordd. II, p. 318, Pl. VII (VI), f. 3a, b.
1952. *Cingula (Ceratia) proxima f. laevigata* v. KOENEN sp. – GLIBERT, Mioc. Belg. II, p. 17, Pl. II, f. 5.
1960. *Cingula (Ceratia) proxima laevigata* (KOENEN) – ANDERSON, Die Gastropoden 2, 1, p. 21, Pl. 2, f. 6.
1964. *Cingula (Ceratia) proxima laevigata* (KOENEN) – ANDERSON, Reinbek-Stufe, p. 201.

Material. Gram Clay.

Sønder Hygum	141.261	13–19 m.:	1 defective shell

Description. Only the basal part of a shell is available, comprising the youngest whorl and a well-preserved aperture. As to the relation of the whorls of the protoconch and the oldest part of the teleoconch reference is made to the works cited.

The whorls of the teleoconch are smooth, convex. No spiral ornamentation visible. The growth lines are not curved, but have a slightly prosocline inclination. The sutures are deep-set.

The aperture is oval, tapering adapically, evenly rounded-off abapically, with the greatest breadth on the abapical part. The labrum is regular, smooth and rather sharp-edged. The inner lip is smooth, rather sharp-edged, separated from the body whorl by a narrow, deep groove issuing from the suture and only ending at the outmost abapical part of the shell. The labrum and the inner lip are merged without a break, so that the margin of the aperture constitutes a continuous whole.

Measurements. Diameter of the shell: 1.2 mm.
Longest axis of the shell: 2.3 mm.
Shortest – – – – : 0.9 mm.

Remarks. This subspecies is by GLIBERT considered a subspecies of *C. proxima* (FORBES & HANLEY), the surface of the shell of which is covered by numerous spiral striae (see further GLIBERT's discussion, *loc. cit.* pp. 18–19).

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation. North Germany: Hemmoor-Stufe (ANDERSON), Reinbek-Stufe (ANDERSON). Belgium: Anversien at Edeghem (VON KOENEN, GLIBERT).

Cingula inusitata (BEETS 1946)

Plate IX, figs. 7–8

1878–81. *Rissoa proxima* FORBES & HANLEY sp. – NYST, Conch. terr. tert., p. 96, Pl. XXVIII, f. 13a, b.

1946. *Hydrobia* (*Hydrobia*?) *inusitata* – BEETS, Plioc. a. Lower Pleistoc. Gastr. p. 35, Pl. 2, f. 8–16.

1952. *Cingula* (*Cingula*) *koeneni* – GLIBERT, Mioc. Belg. II, p. 19, Pl. II, f. 6.

1957. *Cingula inusitata* BEETS sp. – GLIBERT, I.R.S.N.B., Bull., T. XXXIII, no. 36, p. 23.

1960. *Cingula* (*Cingula*) *inusitata* (BEETS) – ANDERSON, Die Gastropoden, 2, 1, p. 21, Pl. 2, f. 7.

Material. Gram Clay.

Lille Torup	85.379	16.8 –20.0 m.:	1 def. shell
Hauge. Clay pit:			1 def. shell
Gram	141.277	17.50–18.00 m.:	1 def. shell
–	–	18.00–18.50 m.:	1 def. shell
–	–	18.50–19.00 m.:	1 def. shell

Description. The shell is small, oblong egg-shaped.

The protoconch is damaged or missing from the specimens available. According to BEETS and ANDERSON it is short and flat, obviously consisting of only one whorl. The initial whorl is small and introflexed.

The teleoconch includes at least 3–4 whorls, which are only slightly convex. The surface of the shell is covered by numerous very fine spiral striae, which can only be seen when highly magnified. They are crossed by more or less faintly visible growth lines, which are slightly prosocline. The adapical part seems a little depressed on the young whorls, as also appears from BEET's pictures. The sutures are oblique and only moderately depressed. Closely abapically to the suture there is on the young whorls of the largest shell from Gram a very narrow, dark-coloured spiral band.

The aperture is oval, tapering adapically and rounded-off abapically. The labrum is broken off the shells available. Labium is smooth and spreads but little over the body whorl. It is merged with the labrum adapically and without a break.

Variations. On the largest of the shells from Gram the spiral ornamentation is clearly visible when magnified; on the other shell from the same locality the spiral threads are so weak that they can only be dimly seen at illumination at a special angle. In all other respects the shells are identical.

Measurements. Gram 141.277.

18.00–18.50 m. Length of the axis: 2.9 mm. Diameter of the shell: 1.4 mm.
18.50–19.00 m. – : 2.3 mm. – : 1.3 mm.

Remarks. The rather flat whorls and the form of the aperture as well as the

relatively small apical angle make it easy to distinguish this species from *C. proxima* and its subspecies.

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation. North Germany: Hemmoor-Stufe (ANDERSON). – Pliocene. Holland (BEETS). Belgium: Scaldisien (GLIBERT).

FAMILIA: TURRITELLIDAE CLARCK 1851

Genus: *Archimediella* SACCO 1895
(Type: *Turritella cochlias* BAYAN 1873)

Archimediella cochlias (BAYAN 1873)
Plate X, fig. 1

1956. *Turritella* (*Archimediella*) *archimedis* BRONGNIART – RASMUSSEN, South Jutland, p. 53, Pl. IV, f. 2.
1960. *Archimediella* (*Archimediella*) *cochlias* (BAYAN) – ANDERSON, Die Gastropoden, 2, 1, p. 36, Pl. 5, f. 4a, b; Pl. 6, f. 3.

Material. Gram Clay.

Mostly defective shells from the following localities (as to number of shells, see Part I, Tables 15–66):

Skærum Mølle (clay pit), Lille Spåbæk (clay pit), Grønbjerg (clay pit), Spjald (83.104), Randbæk (83.591, 83.597, 83.602), Muldbjerg (83.1006), Kodal-Fjaldene (84.1749), Videbæk (84.417, 84.456, 84.492, 84.525, 84.1727), Møltrup Brickworks (clay pit), Gjellerup (85.380), Gjødstrup (85.861), Brande Brickworks (clay pit), Drantum (104.1241), Nyholm (104.1166), Skjerris gårde (104.1165), Leding (93.155), Alkærsig (clay pit, 93.101), Forsom (clay pit), Odderup (103.150), Oddum (lignite pit), Hesselho (113.121), Hauge (clay pit), Tønding (clay pit), Hoddemark (Karlsgårde Canal), Grøde (Karlsgårde Canal), Esbjerg (clay pit, 130.59), Måde Brickworks (eastern clay pit), Strandgård Brickworks (clay pit), Holleskov (132.46b), and Gram (141.277).

Description. The shell is slender, turriculate. The protoconch is paucispiral, comprising $1\frac{1}{2}$ smooth and convex whorls. The initial whorl is comparatively large, vesicular, slightly heterostrophic.

The whorls of the teleoconch are rather flat, with two strong spiral carinae; one approximately in the middle and another situated a short distance above the abapical suture. A varying number of weak spiral threads are seen both adapically on the whorl and between the two carinae. The growth lines are opisthocyrt, with their vertex on the adapical carina. They bend sharply on to the base, which is covered by a number of weak spiral bands.

The aperture is oval. Labrum is broken off the specimens available. Labium is smooth.

Remarks. Shells of the type mentioned here have previously been described

under the name of *Turritella archimedis* BRONGNIART. The specific name had, however, been preoccupied by DILLWYN in 1817 for another *Turritella* species.

Shells of *A. cochlias* in an adult state are clearly slenderer and more solid than those of the other Turritellidae in the Gram Clay.

Good pictures of this species are found in ANDERSON, *op. cit.*, where the conditions of the growth lines are illustrated by drawings of material from Gram Brickworks.

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation. North Germany: Gram-Stufe, Sylt-Stufe (ANDERSON). – Plio-Pleistocene. England: Waltonian (HARMER: *Archimediella bicarinata*).

Atlantic Region. Aquitanian Basin (COSSMANN & PEYROT: *T. cochlias mut. Thetis* D'ORB.).

Mediterranean Basin. Italy: Tongriano, Elveziano, Piacenziano (SACCO). – Algeria: Miocène (BRIVES), Plaisancien (DE LAMOTHE).

Archimediella subangulata (BROCCHI 1814)

Plate VIII, figs. 7–8

1814. *Turbo spiratus* – BROCCHI, Conch. subapp. II, p. 369, Pl. VI, f. 19 (1843 edit. p. 152).
1814. *Turbo subangulatus* – BROCCHI, Conch. subapp. II, p. 374, Pl. VI, f. 16 (1843 edit. p. 158).
1882. *Turritella subangulata* BROCC. – v. KOENEN, Mioc. Nordd. II, p. 287.
1907. *Turritella subangulata* BROCCHI sp. – RAVN, Jylland, p. 296.
1922. *Turritella* (*Zaria*) *subangulata* BROCCHI *var. spirata* BROCCHI – COSSMANN & PEYROT, Conch. Néog., A.S.L.B., LXXIII, p. 17, Pl. II, f. 12–13.
1925. *Turritella* (*Zaria*) *subangulata* BROCC. – KAUTSKY, Hemmoor, p. 79.
1944. *Turritella* (*Zaria*) *subangulata* (BROCCHI) – v. VOORTUYSEN, Mioz. Gastrop., p. 22, Pl. 1, f. 13–23, Pl. 2, f. 1–3.
1949. *Turritella* (*Zaria*) *subangulata* BROCCHI *sp.* – GLIBERT, Gastr. Loire, p. 117, Pl. VII, f. 1a, b.
1952. *Turritella* (*Zaria*) *subangulata* BROCCHI *sp.* – GLIBERT, Mioc. Belg. II, p. 25, Pl. II, f. 12.
1955. *Turritella* (*Zaria*) *subangulata* (BROCCHI) – ROSSI RONCHETTI, I tipi, p. 114, f. 53.
1955. *Turritella* (*Zaria*) *spirata* (BROCCHI) – ROSSI RONCHETTI, I tipi, p. 116, f. 54.
1958. *Turritella subangulata* (BROCCHI) – SORGENFREI, Middle Mioc., p. 161, Pl. 30, f. 99a–b.
1960. *Archimediella* (*Torculoidella*) *subangulata* (BROCCHI) – ANDERSON, Die Gastropoden, 2, 1, p. 37, Pl. 5, f. 3a, b, Pl. 6, f. 4a, b.
1964. *Archimediella* (*Torculoidella*) *subangulata* (BROCCHI) – ANDERSON, Reinbek-Stufe, p. 206.

Original diagnosis. T. spiratus: Testa subulata, turrita, anfractubus superne angustatis, carina unica acutissima, striis transversis subtilissimis oculo nudo inconspicuis. (BROCCHI 1814.)

T. subangulatus: Testa turrita, subulata, anfractubus tumidiusculis subcarinatis, striis confertis inaequalibus undique cincta (BROCCHI 1814).

Type material. The holotypes of *A. spiratus* and *A. subangulata*, respectively, are the specimens pictured by BROCCHI and again in 1955 by ROSSI RONCHETTI, which are kept in the Museo Civico di Storia Naturale di Milano. Type locality: Crete Senesi (Terziario).

Material. Gram Clay.

Drantum	104.1241	46.0 –50.0 m.:	8 fragmentary shells
Esbjerg. Clay pit:			1 defective shell
Måde Brickworks. Eastern clay pit:			8 def. shells
Strandgård Brickworks. Clay pit:			1 def. shell
Gram	141.277	19.50–20.00 m.:	2 small, fragm. shells and 1 fragm.
–	–	20.00–20.50 m.:	1 def. shell

Description. The shell is turriculate, more or less slender. The protoconch is paucispiral, comprising $1\frac{1}{2}$–$2\frac{1}{2}$ smooth, convex whorls. The initial whorl is small, slightly heterostrophic.

The whorls of the teleoconch are angular, with a strong, central, more or less sharp-edged carina and several very weak spiral bands or threads (type *spiratus*) or, more rarely, moderately or slightly convex, covered by numerous weak spiral bands (type *subangulatus*). Of the latter type only one specimen is available from the Gram Clay (from the easternmost clay pit of Måde Brickworks).

The growth lines form a flat sinus in the middle of the whorls. The base with the apertural region is damaged on the shells available.

A thorough description of the species is found in ANDERSON (1960).

Remarks. The material from the Danish Gram Clay has not consistently 2–$2\frac{1}{2}$ protoconch whorls, as stated by ANDERSON for the shells from Northern Germany. For that matter, the species is rare in the Gram Clay, where it only seems to belong in the lower (early) layers.

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Gram Formation. North Germany: Hemmoor-Stufe, Reinbek-Stufe, Langenfelde-Stufe (ANDERSON). Holland: Middle Miocene (VOORTHUYSEN). Belgium: Bolderien, Anversien (GLIBERT).

Atlantic Region. Aquitanian Basin: Burdigalien, Helvétien (COSSMANN & PEYROT). Portugal: Tortonien (DOLLFUS, COTTER & GOMES). Spain (Cataluna): Placenciense, Astiense (ALMERA Y BOFILL).

Mediterranean Basin. Italy: Elveziano, Tortoniano, Piacenziano, Astiano (SACCO). France: Rhône Valley: Pliocène (FONTANNES).

Vienna Basin. Baden (HOERNES). Hungary: "Miozän-Mediterran" (STRAUSZ). Poland: Miozän (FRIEDBERG).

Genus: *Turritella* LAMARCK 1799
(Type: *Turbo terebra* LINNÉ 1758)

Turritella tricarinata (BROCCHI 1814)

1956. *Turritella* (*Turritella*) *tricarinata* (BROCCHI) – RASMUSSEN, South Jutland, p. 52, Pl. IV, f. 1a, b.
1960. *Turritella* (*Turritella*) *tricarinata* (BROCCHI) – ANDERSON, Die Gastropoden, 2, 1, p. 38, Pl. 5, f. 5a, b; Pl. 6, f. 5.

Material. Gram Clay.

Fragments of shells and a few almost complete shells (as to number of individuals, see Part 1, Tables 15–66) are known from the following localities:

Skærum Mølle (clay pit), Lillelund (73.88), Kodal (84.763), Spjald (83.127), Randbæk (83.602), Brejning Kro (83.197), Muldbjerg (83.1006), Kodal-Fjaldene (84.1749), Videbæk (84.1748, 84.344, 84.358, 84.417, 84.456, 84.483), Møltrup Brickworks (84.1509), Lille Torup (85.379), Tværmose (85.381), Frølund (85.383), Gjødstrup (85.861), Snejbjerg (85.775), Bording (86.177), Vester Høgild (95.1510b), Sandfeldbjerg (clay pit), Brande Brickworks (clay pit), Drantum (104.1241), Hjortsballe (105.320), Leding (93.155), Alkærsig (clay pit), Lønborg (102.55), Forsom (clay pit), Odderup (103.150), Harkes (clay pit), Stenderup (113.36), Ålbæk Eng (102.59), Hesselho (113.121), Hauge (clay pit), Karlsgårde Canal (unknown loc.), Hodde (113.33a), Esbjerg (clay pit and beach, 130.59), Måde Brickworks (eastern clay pit), Strandgård Brickworks (clay pit), Holleskov (132.46b), Ravning (clay pit), Hjortvad (141.178), Sønder Hygum (141.260, 141.261, 141.273), Rødding (141.75, 141.243), Gram (141.277), Spandetgård (clay pit), Tønder (166.398), Brodersmark (166.351b), Sæd (167.4, 167,445), and Rends (167.236).

Description. The shell is rather small, slender, turriculate.

The protoconch is small, paucispiral, comprising $1\frac{1}{2}$ smooth whorls. The initial whorl is comparatively large, orthostrophic or slightly heterostrophic, smooth.

The teleoconch whorls have a central carina on whorl no. 1 and already on whorl no. 2 two carinae more: one half-way between the adapical suture and the middle carina and one halfway between this and the abapical suture. The middle carina often continues to be the strongest, but otherwise there is little difference between their strengths. The adapical one of the two others is generally the weakest and the abapical one the next strongest. Weak, often almost quite obliterated spiral threads frequently appear between the three carinae and between these and the sutures.

The growth lines are opisthocyrt with the sinus closely adapical to the middle carina. On the base they are very slightly curved. The base is slightly convex and covered by weak spiral bands. Neither the labrum nor the labium has been preserved on the shells available. The aperture is rounded-off trapeziform.

For further details see ANDERSON's description (1960).

Remarks. This species is sometimes stated to have been founded in the Middle

Miocene formations of the North Sea Basin: Hemmoor-Stufe (KAUTSKY) and Arnum Formation (SORGENFREI). VAN VOORTHUYSEN (1944), GLIBERT (1952), and finally ANDERSON (1960), however, have pointed out that the shells from these formations belong to *Haustator eryna* (D'ORBIGNY). The sculptures of the two species may be almost identical, but the directions of the growth lines according to ANDERSON (*loc. cit.*) are different. The difference is said to be the fact that the line connecting the intersection points with the two sutures of the whorl are almost perpendicular to those in *T. tricarinata*, whereas in *H. eryna* they are oblique in relation to the sutures. It may, however, be very difficult to establish this fact, and as the directions of the growth lines are otherwise almost identical in the two species, it is often impossible to make a clear distinction between the two species on this basis. Cf. further the pictures in ANDERSON (1960, Plate 5, figs. 2a, b, and 5a, b, and Plate 6, figs. 2 and 5). On the other hand, the protoconch of *H. eryna* seems to comprise a whorl more than that of *T. tricarinata*, but as the protoconchs are mostly broken off the shells available, a sure determination as to species may be difficult or impossible. For that matter, it is doubtful whether a larger or smaller protoconch is a sufficient basis of a differentiation of species.

Because of the still unclarified relation between *T. tricarinata* and respectively *H. eryna* and *T. communis* (RISSO) it is not possible to indicate the conditions of distribution of *T. tricarinata* with certainty. The information below therefore is undoubtedly insufficient.

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation. North Germany: Langenfelde-Stufe, Gram-Stufe, and Sylt-Stufe (ANDERSON). – Plio-Pleistocene: Belgium: Merxemien (GLIBERT).

Mediterranean Basin. Pliocene (and Miocene?) formations (BROCCHI, SACCO).

FAMILIA: CERITHIIDAE

Genus: *Bittium* LEACH in GRAY 1847

(Type: *Strombiformis reticulatum* DA COSTA 1778)

Bittium tenuispina SORGENFREI 1958

Plate VIII, fig. 9

1958. *Bittium tenuispina nov. sp.;* SORGENFREI, Middle Mioc., p. 167, Pl. 31, f. 104.
1964. *Bittium tenuispina* SORGENFREI – ANDERSON, Reinbek-Stufe, p. 209.

Original diagnosis. Bittium with protoconch consisting of $2\frac{1}{2}$ to 3 whorls of which the last half to whole whorl has 1 to 2 spiral riblets. Adult shell stage with 3 to 5 spiral ribs. Initial whorl with 11 to 15 collabral ribs. Number of collabral ribs increases with about 1 rib per whorl (SORGENFREI 1958).

Material. Gram Clay.

Brodersmark		22.6 –24.0 m.:	1 shell
Gram	141.277	17.50–18.00 m.:	1 fragment (?)

Description. The present specimen is quite small and consists of $6\frac{1}{2}$ whorls. It may be described as follows:

The shell is slender, turriculate. The protoconch consists of $2\frac{1}{2}$ whorls, which are smooth and highly convex. At 50 × magnification no sculpture is seen. The anlage of two spiral threads can only be suspected on the youngest whorl. The boundary between protoconch and teleoconch is fairly distinct at the magnification mentioned. It is marked by a slightly elevated sigmoidal opisthocline sinus line.

The teleoconch consists of four sculptured whorls. The sculpture consists of a strong spiral ornamentation and a somewhat weaker collabral sculpture. On the oldest adult whorl two strong spiral threads immediately appear, which like carinae stand out from the abapical half of the whorl, one close below the middle, the other close above the abapical suture. Already on the following whorl a weaker spiral thread of the secondary order appears close below the adapical suture. On the fourth whorl between this spiral thread and the first of the strong carina-like spiral threads, there appears a new spiral thread, of the tertiary order, so that a total of four spiral threads are seen.

The spiral sculpture is intersected by collabral folds or ribs, which pass in an opisthocyrt curve from suture to suture and form small granules at the intersection with the spiral elements. On the oldest adult whorl there are 10, on the youngest 13–14 collabral ribs. Adapically to the ramp of the base, there are two rather conspicious spiral threads immediately below the suture.

The aperture is oval. Labrum has been broken off. The collumellar lip is smooth.

Measurements. Length of shell: 1.6 mm. Maximum diameter: 0.7 mm.

Remarks. The specimen corresponds best to the species *B. tenuispina* defined by SORGENFREI, especially as regards the protoconch. A third spiral rib only appears on the second to third whorl on the shell from Brodersmark, just as a fourth spiral rib cannot be seen until the fourth whorl. In these characters the specimen differs a little from the greater part of the material from the South Jutland Middle Miocene, in which the species is very numerous in certain layers.

B. spina (PARTSCH), which in many features resembles the present species, as well as *B. tenuispina*, has been thoroughly described by SORGENFREI, to whose descriptions (*loc. cit.* pp. 165–170) and material of figures (Plate 31, figs. 103–104) reference is made.

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Gram Formation). North Germany: Reinbek-Stufe (ANDERSON). Holland: Middle (SORGENFREI).

FAMILIA: TRIPHORIDAE

Genus: *Triphora* BLAINVILLE 1828
(Type: *Trochus perversus* LINNÉ 1758)

Triphora fritschi (v. KOENEN 1882)
Plate VIII, fig. 10

1882. *Cerithium Fritschi* – v. KOENEN, Mioc. Nordd. II, p. 271, Pl. VI (V), f. 19.
1925. *Triphora Fritschi* v. KOENEN – KAUTSKY, Hemmoor, p. 84, Pl. 7, f. 7.
1944. *Triphora (Triphora) Fritschi* (v. KOENEN) – VOORTHUYSEN, Mioz. Gastrop., p. 30, Pl. 12, f. 16–19.
1960. *Triphora (Triphora) Fritschi* (KOENEN) – ANDERSON, Die Gastropoden, 2, 1, p. 67, Pl. 9, f. 6; Pl. 12, f. 6.
1964. *Triphora fritschi* (KOENEN) – ANDERSON, Reinbek-Stufe, p. 212.

Original diagnosis. Not adduced.

Type material. v. KOENEN's type specimen, which is pictured in v. KOENEN, *op. cit.*, is found in Coll. KOENEN, Geologisch-Paläontologisches Institut der Universität Göttingen.

Material. Hodde Clay.

Gram	141.277	30.50–30.95 m.:	1 def. shell

Gram Clay.

Lille Torup	85.379	16.8 –20.0 m.:	1 almost complete shell
Sønder Hygum	141.261	13 –19 m.:	1 almost complete, juvenile shell and 1 fragm. shell
Sæd	167.445	97.40–97.90 m.:	1 fragment

Description. The following description is based on the specimen pictured in Plate VIII, fig. 10.

The shell is slender, turriculate, sinistral. The specimen consists of 9–9½ whorls with three sculptural main parts.

The protoconch comprises 7 whorls. The initial whorl is obliquely bud-shaped. It is provided with a microsculpture of numerous very small granulae, which seem to be spirally arranged. They are only faintly visible at 100 times magnification.

The following whorls are all provided with two distinctive carina-like prominent spiral ribs, the intervals of which are broader than they are. They are placed immediately above the abapical suture, so that the adapical spiral rib is close to the middle of the whorl. Furthermore, all the whorls are provided with thin collabral threads, which pass irregularly over the surface of the

shell from suture to suture in large numbers and give the surface an impression of being covered by an irregular network. The two spiral ribs are smooth and uninfluenced by the collabral ornamentation, which is also seen in the intervals between the spiral ribs. The suture is almost invisible.

The teleoconch consists of only 2–2½ whorls on the present specimen, which has a strong sculpture of three close-set spiral ribs, one spiral thread of the second order being found immediately below the adapical suture and two spiral ribs of the first order on the abapical part of the whorl. All the spiral ribs are disintegrated into round granules as a consequence of the passage of numerous collabral ribs over them. These ribs are weaker than the spiral bands, but approximately of the same strength as the spiral ribs of the second order. The sutures are deep-set, narrow, groove-shaped, and partly invisible.

The base is smooth and demarcated adapically by a projecting disc, the rounded-off edge of which appears as a smooth spiral rib immediately abapically to spiral rib no. 2 of the first order.

The siphonal canal is short. The aperture is oval, almost circular. Columella is smooth. Labrum of the present shell has been broken off.

Measurements. Length of the axis of the shell: 2.4 mm. Maximum diameter: 0.8 mm.

Remarks. This species, as described in detail by V. KOENEN and ANDERSON, is clearly distinct from the Miocene and recent *Triphora perversa* (LINNÉ) by the spiral band of the second order of the latter species being found *between* the two spiral bands of the first order.

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation. North Germany: Vierland-Stufe, Hemmoor-Stufe, Reinbek-Stufe (ANDERSON). Holland: Middle. Belgium: Anversien (GLIBERT).

FAMILIA: SCALIDAE

Genus: *Opalia* H. & A. ADAMS 1853
(Type: *Scalaria australis* LAMARCK)

Opalia vilandti (MØRCH 1874)
Plate X, fig. 5

1956. *Opalia (Pliciscala) vilandti* (MØRCH) – RASMUSSEN, South Jutland, p. 54, Pl. IV, f. 3.

Material. Gram Clay.

Drantum	104.1241	36.00–40.00 m.:	1 fragm.	(1)
Odderup	103.150	14.5 –20.0 m.:	1 def. shell	(1)
Hesselho	113.121	50.0 –56.0 m.:	1 def. shell	(1)
Tønding. Clay pit:			1 def. shell and 2 fragments	(1)
Holleskov	132.46b	4.9 –11.2 m.:	1 fragm.	(1)
Sønder Hygum	141.261	13 –19 m.:	2 def. sh.	(2)

Gram	141.277	6.40– 6.90 m.:	1 def. sh.	(1)
–	–	7.30– 7.65 m.:	1 fragm.	(1)
Spandetgård. Clay pit:			4 def. sh. and 2 fragm.	(5)
Brodersmark	166.351 b	22.6 –24 m.:	2 def. sh.	(2)
–	–	25 –26 m.:	1 def. sh.	(1)
–	–	26 –27 m.:	1 fragm.	(1)
–	–	29 –30 m.:	1 def. sh.	(1)
–	–	30 –31 m.:	4 fragm.	(3)
–	–	31 –32 m.:	1 fragm.	(1)
Sæd	167.445	93.00–93.70 m.:	2 fragm.	(1)
–	–	94.75–95.50 m.:	1 fragm.	(1)

Description. The shell is slender, turriculate. The protoconch is broken off all the present shells, its appearance is hitherto unknown.

The whorls of the teleoconch are highly convex, separated by deep-set sutures. The number of whorls exceeds seven. The ornamentation consists of 11–12 rather narrow, rounded-off, collabral ribs, placed rather far from each other. In the intervals between them there are 4–5 evenly distributed, somewhat rounded-off spiral ribs, which are narrower than the collabral ribs.

On the young whorls of certain older shells up to 8 rather close-set spiral ribs of somewhat different strengths have been observed.

The base is slightly convex, shaped as a twisted disc with a rounded margin, which projects a little in relation to the curvature of the youngest whorls. On the surface of it three very weak and blurred spiral ribs are seen. No labrum has been found on any of the present shells. The inner lip is narrow, only a little spread over the base. The aperture is semicircular.

Remarks. A few shells of this species have been found in Shell Bed I at Hoddemark. A specimen is pictured on Plate X, fig. 5. In every respect the shells correspond to those of *O. vilandti* from the Gram Clay.

O. (*Turriscala*) *straeleni* GLIBERT (1952, p. 38, Plate IV, fig. 5) from the Anversien of Belgium according to the description and the picture seems to be closely related to *O. vilandti* and may be identical with it.

Distribution.

North Sea Basin. Miocene. Denmark: Hodde Formation, Gram Formation. North Germany: Dingden (v. KOENEN). Belgium: Anversien ? (? *Opalia straeleni*, GLIBERT).

Genus: *Scala* (KLEIN 1873) BRUGUIÉRE 1792

(Type: *Scalaria scalaris* LINNÉ 1758)

Scala frondicula (WOOD 1848)

Plate VIII, figs. 12–13

1848. *Scalaria frondicula* – WOOD, Crag. Moll. I, p. 92, Pl. VIII, f. 16.

1882. *Scalaria frondicula* S. WOOD – v. KOENEN, Mioc. Nordd. II, p. 295.

1891. *Hirtoscala* (*vel Linctoscala*) *frondicula* (WOOD) – SACCO, I Molluschi IX, p. 26, Pl. I, f. 38.

1907. *Scalaria frondicula* S. WOOD – RAVN, Jylland, p. 295 (91), Pl. III, f. 14.
1920. *Scala (Linctoscala) frondicula* (S. V. WOOD) – HARMER, Plioc. Moll. II, p. 531, Pl. XLVIII, f. 19, 20.
1925. *Scala (Spiniscala) frondicula* WOOD – KAUTSKY, Hemmoor, p. 79, Pl. 6, f. 35.
1952. *Scala (Spiniscala) frondicula* WOOD *sp.* – GLIBERT, Mioc. Belg. II, p. 47, Pl. III, f. 12, 13.
1958. *Scala cf. frondicula* (WOOD) – SORGENFREI, Middle Mioc., p. 174.
1958. *Scala (Spiniscala) frondicula* WOOD *sp.* – GLIBERT, I.R.S.N.B. Bull., T. XXXIV, no. 15, p. 13.

Original diagnosis. Testa elongata, turrita; spira subulata; apice acuto; anfractibus rotundatis, contiguis costellatis; costellis lamellosis, superne angulatis, spiniferis; interstitiis laevigatis; apertura rotundata (WOOD 1848).

Type material. The holotype is the shell pictured in WOOD 1848, Plate VIII, fig. 16. – Locality: ?. Stratum typicum: Coralline Crag. Depository: ?

Material. Gram Clay.

Spandetgård. The clay pit:			1 defective adult shell and 1 juvenile shell, which has later partly been lost
Brodersmark	166.351 b	31–32 m.:	1 small, defective shell

Description. The shell is turriculate, lanceolate.

The protoconch, which could be studied on a juvenile shell from Spandetgård, which unfortunately was broken during the photographing, is elongated conical, consisting of 4–5 convex, smooth whorls, on which opisthocyrt growth lines were clearly seen. Immediately after the protoconch the first lamellae of the teleoconch make their appearance. These lamellae have already from the beginning been protracted into spines a short distance below the adapical suture.

The teleoconch can in part be studied on an about 6 mm. long fragment of a rather large shell from Spandetgård. On this fragment there are 11–12 thin, leaf-shaped, highly protracted, oblique lamellae, protracted into spines at a short distance below the adapical suture. The intervals between the lamellae are great. The whorls are highly convex, if anything semicircular in cross-section.

A third shell, from Brodersmark, lacks the upper part of the apex and a little of the youngest whorl with the labrum. There are four whorls present. They bear 17 collabral lamellae, which, however, are so much worn down that it is not possible to decide whether they had spines. Some of the base is present. It is shaped like a twisted disc, the round margin of which projects a little over the curvature of the youngest whorl as a spiral band. It is also seen close above the abapical suture on the other whorls. The collabral lamellae continue on the base as thin, highly prominent threads, which often take a radial course finally to change direction along the inner lip.

This shell is with some doubt referred to *S. frondicula.*

Measurements. Spandetgård. Clay pit. 1 shell: maximum diameter: 3.6 mm. Brodersmark. (166.351 b): maximum diameter: 1.3 mm. and length of preserved part of shell: 2.9 mm.

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Gram Formation. North Germany: Holsteiner Gestein (v. KOENEN), Hemmoor-Stufe (KAUTSKY), Dingden (v. KOENEN), Glimmerton at Langenfelde and Gühlitz (v. KOENEN). Holland: Middle (SPAINK). Belgium: Anversien (GLIBERT), Deurnien (GLIBERT). – Pliocene. Holland: Scaldisien (TESCH). Belgium: Scaldisien (GLIBERT). England (HARMER).

Mediterranean Basin. Pliocene. Italy: (SACCO, CERULLI – IRELLI).

FAMILIA: ACLIDIDAE

Genus: *Aclis* LOVÉN 1846

(Type: *Turritella minor* BROWN 1827)

Aclis minor (BROWN 1827)

Plate VIII, fig. 6, and Plate X, figs. 3–4

(1819. *Turbo ascaris* – TURTON, Conch. Dictionary, p. 217, no. 60.)
(1827. *Turritella minor* – BROWN, Ill. Conch., Pl. 51, f. 57 and 58.)
(1842. *Alvania supranitida* – S. V. WOOD, Ann. and Mag., IX, p. 534, t. 5.)
1848. *Alvania ascaris* TURT. – S. WOOD, Crag Moll. I, p. 99, Pl. XII, f. 11a–c.
1853. *Aclis ascaris* TURTON – FORBES & HANLEY, Brit. Moll. III, p. 219, Pl. LXXXVIII, f. 8.
1853. *Aclis supranitida* S. WOOD – FORBES & HANLEY, Brit. Moll. III, p. 220, Pl. XC, f. 2, 3.
1867. *Aclis ascaris* TURTON – JEFFREYS, Brit. Conch. IV, p. 102; V (1869) Pl. LXXII, f. 2.
1868. *Aclis ascaris* TURTON – WEINKAUFF, Conch. d. Mittelmeeres II, p. 231.
1872. *Alvania supranitida* – S. WOOD, Crag Moll., Suppl. I, p. 55.
1888. *Aclis supranitida* WOOD – PETERSEN, Skalb. Moll., p. 70.
1888. *Aclis ascaris* TURTON – PETERSEN, Skalb. Moll., p. 71.
1901. *Aclis supranitida* WOOD – BRØGGER, Kristianiafeltet, p. 661, Pl. XIX, f. 11.
1901. *Aclis ascaris* MONT. – BRØGGER, Kristianiafeltet, p. 661, Pl. XIX, f. 7.
1925. *Aclis supranitida* (S. V. WOOD) – HARMER, Plic. Moll. II, Part IV, p. 868, Pl. LXV, f. 24.

Material. Gram Clay.

Rødding	141.75	10.80–16.75 m.:	1 juvenile shell
Gram	141.277	12.10–12.60 m.:	1 complete and one def. shell

Description. The shell is small, slender, turriculate, semitranslucent.

The protoconch is slenderly conical, multispiral, consisting of $4\frac{1}{2}$ whorls, which are smooth, convex, and separated by comparatively deep-set sutures. The initial whorl is small, bud-shaped, smooth, orthostrophic to slightly heterostrophic. The diameter of the whorls only a little increasing by age. The growth lines are seen on the otherwise smooth and glossy surface as rather close-set, slightly sigmoidal lines. The transition to the teleoconch is sharp.

The whorls of the teleoconch are convex. The sutures are deep-set. On the oldest of the present shells there are three adult whorls.

The sculpture consists of spiral ribs only, which are narrow, rather sharp-edged, and comparatively greatly prominent. On the oldest whorl there are on the shell from Rødding only two, and on the largest shell from Gram three spiral ribs. Already on the following whorl the number is three on the shell from Gram, and on the youngest whorl there are four. The most adapical of these ribs is placed below the adapical suture at a distance corresponding to about one third of the height of the whorl. This part of the whorl is smooth and slopes rather much abaxially from the suture down to the spiral rib. The growth lines are seen as sigmoidal curves on the otherwise glossy surface.

The aperture is oval, tapering adapically as well as abapically. Labrum is slightly thickened and rises a little above the surface of the base. Between the margin of the labium and the base there is a narrow pseudumbilicus. The surface of the base is smooth.

Remarks. To all appearances this species seems to be identical with the Pliocene and recent *A. minor* = *A. supranitida* (S. WOOD). Two closely related forms: *A. ascaris* (TURTON) and *A. supranitida* (WOOD) have now been separated into two different species (FORBES & HANLEY, JEFFREYS, BRØGGER, HARMER), now united into one species (WOOD, WEINKAUFF). The former is characterized by its very small shell, by a slender shape of the shell, and by having the spiral sculpture distributed rather evenly over the whole whorl. The shells of the latter form, on the other hand, are somewhat larger (according to JEFFREYS ten times larger) and more solid, less slender, and their spiral ribs only appear at some distance below the adapical suture.

The shells from the Gram Clay join in the *ascaris* type with its small size and its slenderness. On the other hand, conditions of the spiral sculpture are identical with those of the *supranitida* type.

Measurements. The best preserved shell from Gram measures:

Length: 1.7 mm., maximum diameter: 0.6 mm., and the length of the protoconch: 0.6 mm.

The fragmentary shell from Gram must have been about 2 mm. long and have had a maximum diameter of 0.8 mm.

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation. – Plio-Pleistocene: England (HARMER). – Recent in the Kattegat, the North Sea, the coasts of Great Britain and Norway. The Atlantic off France and Spain, the Mediterranean off Algeria and Tunis (WEINKAUFF), the Adriatic, and the Aegean Sea.

FAMILIA: MELANELLIDAE

Genus: *Leiostraca* H. & A. ADAMS 1853
(Type: *L. subulata* (DONOVAN))

Leiostraca glabra (DA COSTA 1778)
Plate VIII, fig. 11

1778. *Strombiformis glaber* – DA COSTA, Hist. Nat. Test. Brit., p. 117.
1843. *Eulima subulata* RISSO – NYST, Coq. et. Polyp., p. 415, Pl. XXXVII, f. 17.
1848. *Eulima subulata* MONT. – WOOD, Crag Moll. I, p. 97, Pl. XIX, f. 3.
1856. *Eulima subulata* DON. – HOERNES, Wiener Becken I, p. 547, Pl. 49, f. 20.
1867. *Eulima subulata* DON. – JEFFREYS, Brit. Conch. IV, p. 208; V (1869), Pl. LXXVII, f. 7.
1882. *Eulima subulata* DON. – v. KOENEN, Mioc. Nordd. II, p. 281.
1903. *Eulima (Leiostraca) subulata* DON. – DOLLFUS, COTTER & GOMES, Moll. Tert. Portugal, Pl. XXXV, f. 11 (p. 20).
1907. *Eulima subulata* DON. – RAVN, Jylland, p. 300 (96).
1925. *Eulima (Subularia) subulata* DON. – KAUTSKY, Hemmoor, p. 78.
1944. *Leiostraca (Leiostraca) subulata* (DONOVAN) – VOORTHUYSEN, Mioz. Gastr., p. 31, Pl. 8, f. 23–25.
1952. *Strombiformis taurinensis* (SACCO) – GLIBERT, Mioc. Belg. II, p. 49, Pl. 4, f. 2.
1958. *Leiostraca glabra* (DA COSTA) – GLIBERT, I.R.S.N.B. Bull., T. XXXIV, no. 15, p. 16.
1964. *Strombiformis tauriniensis* (SACCO) – ANDERSON, Reinbek-Stufe, p. 218, Pl. 17, f. 140.

Original diagnosis: Strombiformis parvus corneus glaber (DA COSTA). DA COSTA does not give any picture, but refers to PENNANT: Brit. Zool. No. 115, tab. 79, "the upper figure?".

Material. Gram Clay.

Muldbjerg	83.1006	5.0 – 6.0 m.:	1 very defective shell
Brande Brickworks. Clay pit:			1 shell in piece of concretion and 1 fragm.
Ålbæk Eng	102.59	23.8 –24.8 m.:	1 apex of a shell
Hauge. Clay pit:			1 small fragment of a shell
Måde Brickworks. Eastern clay pit:			2 fragm. shells, 1 protoconch, 2 apices and 1 fragm.
Holleskov	132.46b	4.9 –11.2 m.:	2 def. shells
Sønder Hygum	141.260	12 –40 m.:	1 def. shell
Gram	141.277	5.30– 5.70 m.:	1 def. shell
–	–	8.50– 9.00 m.:	2 def. shells and 1 fragm.
–	–	13.10–13.50 m.:	1 def. sh., 2 halfs of one sh. and 1 fragm.
–	–	14.60–15.10 m.:	1 shell without protoconch
–	–	16.00–16.50 m.:	1 def. shell
–	–	17.50–18.00 m.:	1 small, almost complete sh.
Sæd	167.445	91.50–91.75 m.:	1 def. shell
–	–	91.75–92.00 m.:	1 def. shell
–	–	92.00–92.25 m.:	4 def. shells
–	–	92.25–92.70 m.:	1 almost complete shell
Rends	167.236	140′–160′ :	1 def. shell

Description. The shell is very slender, pointedly turriculate, semitransparent, and with completely flat whorls. The nucleus of the protoconch is small, heterostrophic. On the whorls, even at great magnification, no sculpture or characteristic features different from whorls of the teleoconch can be seen.

The oldest three to three and half whorls on the shell are more convex and the sutures more deep-set than on the younger whorls. Perhaps the transition to the quite flat whorls forms the boundary between protoconch and teleoconch.

The whorls of the teleoconch are all quite flat and the sutures can only be seen as thin lines through the semitransparent surface of the shell. On the youngest whorls it is possible to observe the faint impressions of a thin spiral line between the middle of the whorl and the abapical suture. The growth lines are sometimes faintly visible as prosocyrt lines.

The aperture is much elongated and tapering adapically. The columellar lip is smooth. Labrum is broken off in the case of the present shells.

Remarks. Among the *Strombiformis* species described so far from the Younger Tertiary of Northern Europe it seems to me that the present material from the Younger Miocene of Denmark must be referred to the form which so often in the literature is termed *Eulima subulata* DONOVAN. This form is identical with *S. glaber* DA COSTA 1778.

Whereas the shells from the Miocene of Holland and Northwest Germany have consistently been referred to *Eulima subulata*, GLIBERT (1952, pp. 49–51) describes shells from the "Horizon de Houthaelen" and Anversien of Belgium under the specific name of *S. taurinensis* (SACCO) and furthermore adduces *S. bilineatus* (ALDER) from Diestien as an intermediary form between *S. taurinensis* and *S. glaber*. The main difference between them is in the size of the apical angle and in the diameter index (see further GLIBERT *loc. cit.* pp. 50–51).

Later (1958, p. 16) GLIBERT, however, has entertained the idea that actually it is a question of one and the same species. The specific names of *glaber* DA COSTA 1778, *subulata* DONOVAN 1803, and *bilineata* ALDER 1848 then should be considered synonyms for the Atlantic form.

Measurements: Length of the axis on the shell pictured: 2.9 mm. Maximum diameter of the same shell: 0.9 mm.

There are fragments of shells available which have been considerably larger.

Distribution.

North Sea Basin. Miocene. Denmark: ? Arnum Formation (SORGENFREI: *Melanella taurostricta* (COSSMANN & PEYROT)), Gram Formation. North Germany: Hemmoor-Stufe (DITTMER: *Strombiformis taurinensis*), Reinbek-Stufe (ANDERSON: *Strombiformis taurinensis*), Glimmerton at Elbtunnel (HORN: *Eulima subulata* DON.), and at Morsum Kliff, Sylt (RAVN: *Eulima subulata* DONOVAN sp.). Holland: Middle (VOORTHUYSEN: *Leiostraca subulata* (DONOVAN)). Belgium: Horizon de Houthaelen, Anversien (GLIBERT: *Strombiformis taurinensis* (SACCO)), Diestien (GLIBERT: *Strombiformis bilineatus* (ALDER)). – Plio-

Pleistocene. Holland. (BEETS: *Leiostraca subulata* (DONOVAN)). Belgium: Scaldisien (GLIBERT). England: St. Erth, Estuarine clays – Belfast (HARMER: *Eulima bilineata* ALDER). Recent (JEFFREYS).

Atlantic Region. France. Loire Basin: Miocene Moyen (Faluns) (GLIBERT: *Strombiformis taurinensis* SACCO sp.). Aquitanian Basin: Aquitanien (COSSMANN & PEYROT: *Eulima burdigalina* BENOIST), Helvétien (*Eulima taurostricta* SACCO), Tortonien (*Eulima taurinensis* SACCO)). – Portugal: Helvétien, Tortonien (DOLLFUSS, COTTER & GOMES: *Eulima subulata*). Recent: The coast off Finmark (Norway) and Western Norway, South England and Iceland, France, Spain, Portugal, Madeira and the Canary Islands (WEINKAUFF).

Mediterranean Basin. Italy: Elveziano (SACCO: *Eulima subulata taurostricta*). France: Rhône Valley: Pliocène (FONTANNES: *Eulima subulata*). Spain: Placenciense (DONOVAN, ALMERA y BOFILL y POCH: *Eulima subulata*). Recent: The coasts off Spain, France, Italy, Greece, and Algeria (WEINKAUFF: *Eulima subulata* DONOVAN).

Vienna Basin. Austria: "Unterer Tegel und Sand", "Tegel und Sand des Leythakalkes", (HÖRNES: *Eulima subulata* DON.). Hungary: "Miozän-Mediterran" (STRAUSZ: *Eulima glabra* and *Eulima glabra subulata*).

Poland: Miozän (FRIEDBERG: *Eulima subulata* DON.).

FAMILIA: XENOPHORIDAE DESHAYES 1864

Genus: *Xenophora* FISCHER v. WALDHEIM 1807

(Type: *Turbo trochiformis* BORN 1778)

Xenophora testigera (BRONN 1831)

1956. *Xenophora* (*Xenophora*) *testigera* (BRONN) – RASMUSSEN, South Jutland, p. 55, Pl. IV, f. 5a, b.

Material. Gram Clay.

Skærum Mølle. Clay pit:			Fragments	(4)
Videbæk	84.1727	8.4 – 9.4 m.:	–	(1)
Sandfeldbjerg. Clay pit:			–	(?1)
Alkærsig. Clay pit:			–	(1)
Karlsgårde Canal:			–	(1)
Måde Brickworks. Eastern clay pit:			–	(10)
Sønder Hygum	141.260	12 –40 m.:	–	(1)
Gram	141.277	6.40– 6.90 m.:	–	(1)
–	–	10.80–11.25 m.:	–	(1)
–	–	11.25–11.65 m.:	–	(1)
–	–	13.50–14.00 m.:	–	(1)
–	–	14.00–14.60 m.:	–	(1)
–	–	16.00–16.50 m.:	–	(1)
–	–	17.50–18.00 m.:	–	(1)
Spandetgård. Clay pit:			–	(3)
Tønder	166.398	58.85–59.00 m.:	–	(2)
–	–	74 m.:	–	(1)
Sæd	167.445	95.90–96.20 m.:	–	(1)
–	–	97.40–97.90 m.:	–	(1)
–	–	97.90–98.60 m.:	–	(1)
Rends	167.236	140′–160′	–	(1)

Description. The following additions can be made to my previous description of this species:

The whorls of the teleoconch are very slightly concave or quite flat, separated by linear sutures with a very irregular course. The abapical, outer part of the whorl often projects a little beyond the suture or at a very short distance drops steeply down towards the suture. The growth lines are irregular, mostly prosocline. Irregular spiral folds are dimly seen in places all over the whorl, but mostly they are strongest and most distinct on the abapical part. It is also here that the impressions (or even shells) of molluscs or remnants of other marine animals so characteristic of the genus occur. Thus on the present material impressions have been found of *Nucula*, *Astarte*, *Cardita* and *Archimediella* (in a single case with the shell preserved); furthermore zoaria of *Cupuladria.*

Completely preserved shells from the Younger Miocene of Denmark are rare. Among such shells only the specimen (from Gram) has been found which was pictured and described in 1956. On the other hand there are some fragments of i.a. the base of the shell. On these fragments of old shells strong growth lines are seen which sometimes form folds conformally with the aperture from the centrally situated umbilicus.

Remarks. It is difficult to indicate distinct differences between this species and *X. deshayesi* (MICHELOTTI), which occurs in earlier Miocene formations in the North Sea Basin and other European Tertiary basins. SACCO (1896, p. 25) remarks that *X. testigera* differs from the typical *Xenophora* species by having a more markedly conical shape and by having, to a less degree, an agglutinating power. v. KOENEN (1882, p. 307) points out that it is characteristic of *X. testigera* that the shell has comparatively high whorls, concave above (adapically), on which the serrated spirals concentrate more downwards (i.e. abapically) than upwards (i.e. adapically). According to the same author the apical angle is somewhat wider than that of *X. deshayesi.* The material from the Gram Clay in Denmark, from the lower layers at Måde as well as the upper layers at Gram and elsewhere, is in very good agreement with the facts which have been pointed out by SACCO and v. KOENEN. However, we lack a satisfactory characterization of the two species, more especially of the differences between them. *X. testigera* is remarkably rare north of the Mediterranean Basin.

Measurements: The apical angles of three shells from Måde:
85°, 89°, 90°.

A few fragments of the bases of shells from Måde show that there are shells the maximum diameter of which is more than 30 mm.

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation. North Germany: Glimmerton of Langenfelde and Lüneburg (v. KOENEN).

Mediterranean Basin. Italy: Elveziano, Tortoniano, Piacenziano, Astiano (SACCO).

Vienna Basin. Baden, Vöslau, Forchtenau (M. HOERNES).

FAMILIA: APORRHAIDAE

Genus: *Aporrhais* DA COSTA 1778

(Type: *Strombus pes-pelicani* LINNÉ 1758)

Aporrhais alata (EICHWALD 1830)

1956. *Aporrhais alata* (EICHWALD) – RASMUSSEN, South Jutland, p. 56, Pl. IV, f. 4a, b.
1958. *Aporrhais alata* (EICHWALD) – SORGENFREI Middle Mioc. p. 182, Pl. 33, f. 116.
1964. *Aporrhais alata* (EICHWALD) – ANDERSON, Reinbek-Stufe, p. 221, Pl. 17, f. 143a–c.

Material. Hodde Clay.

Leding	93.155	19 –27 m.:	1 apex of a shell
Gram	141.277	34.70–35.00 m.:	3 fragm.
–	–	35.30–35.70 m.:	1 apex and 4 fragm.
Tønder	166.398	85.5 m.:	2 fragm.

Gram Clay.

Alkærsig. Clay pit:			2 fragm. of a protoconch
Odderup	103.150	20.0 –21.0 m.:	1 fragm.
Hoddemark. Karlsgårde Canal:			1 def. shell
Esbjerg. Clay pit:			1 def. shell
Måde Brickworks. Eastern clay pit:			8 def. shells
Sæd	167.445	94.10–94.75 m.:	2 fragm.

Description. As no other complete shells from the Younger Miocene series are available than the one specimen from Gram which was described by me in 1956, reference is made partly to this description, partly to SORGENFREI's thorough investigations into the rich material from the sandy beds of the Arnum Formation.

The shells from Måde, which are preserved best, all lack the digitation. Otherwise they are in good agreement with the shell from Gram previously described.

Remarks. VAN VOORTHUYSEN (1944) considers the shells which have a number of slight tubercles immediately above the abapical suture, to be intermediate forms between *A. alata* and *A. pespelicani.* Such a row of tubercles can be seen on the shells from Gram as well as Måde. According to WIRTZ (1949, p. 63) this is also the case with the large number of shells of *Aporrhais* found in the so-called "*Aporrhais* lumps" in the upper part of the Mica Clay series in Morsum Kliff on the island of Sylt. They are by WIRTZ (*loc. cit.*) referred to *A. pespelicani.*

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Hodde Formation, Gram Formation. North Germany: Holsteiner Gestein (v. KOENEN), Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON), Glimmerton of Sylt, Lieth, Langenfelde, Gühlitz, and Lüneburg (v. KOENEN). Holland: Middle (VOORTHUYSEN). Belgium: Boldérien, Horizon de Houthalen, Anversien (GLIBERT).

Atlantic Region. Aquitanian Basin: Burdigalien, Helvetien (COSSMANN & PEYROT: *Chenopus burdigalensis* D'ORBIGNY, according to SORGENFREI).

Vienna Basin: "Unterer Tegel und Sand", "Tegel und Sand des Leythakalkes" (M. HÖRNES: *Chenopus pes pelecani* PHIL.).

Poland: Miozän (FRIEDBERG).

FAMILIA: NATICIDAE FORBES 1838

Naticidae often occur in large numbers in most localities, but the great majority of shells are those of juvenile individuals, a fact which mostly prevents a determination as to species, as the characters of the shells which are used for the distinction between the species have not yet been completely developed on the young individuals.

In the Younger Miocene formations of Denmark only three species have been demonstrated with certainty. A fourth *Natica* has previously been stated to have been found in the clay pit of Gram Brickworks (may be the clay pit at Storlund, cf. the remarks on REIMERS's letter to FORCHHAMMER in Part I, p. 144 ff.). It was described by RAVN (1907, p. 291) under the name of *Natica Josephinia* (RISSO) and mentioned by RASMUSSEN (1956, p. 60) under the name of *Polynices submamillaris.*

I now consider it to be doubtful that the specimen in question should have been found at Gram. The chief reason is that REIMERS, Physicus in Gram, who submitted the specimen to FORCHHAMMER together with some other molluscan shells from the Gram region, in his letter concerning the forwarding (cf. Part I, p. 145) expressly stated that among the species from which he submitted shells, he had more specimens in his collection. Later REIMERS lent his whole collection to v. KOENEN, who used it during the working up of the North German Miocene faunas and carefully stated REIMERS as collector at the mention of a large number of species. Remarkably enough v. KOENEN did not mention shells of the appearance stated as regards the specimen from Gram mentioned above. Indeed, this species is so characteristic that it would necessarily have attracted both REIMERS's and v. KOENEN's attention.

In the above-mentioned letter REIMERS i.a. wrote that he sent the following Naticidae: "*Natica helicina* BROCCH. 12 specimens, *Natica millepunctata* LAM. 1 specimen, and *Natica spec. nova* 2 specimens."

By examining the material from Gram kept at the Mineralogical Museum I found all the specimens of molluscs to be present which were mentioned in REIMERS's letter, with the exception of the two shells which he termed "*Natica spec. nova*"; but a specimen of *Natica* was found in a box labelled "*Natica spec.* Gram. Reimers 1862" and with the addition (presumably by O. MØRCH) "*N. dilatata* PHIL.?" Under this name MØRCH mentions the specimen in his list of Danish Tertiary molluscs from 1874, and this is the specimen which RAVN in 1907 referred to *Natica Josephinia* (RISSO).

If the species in question had not been rarer than for REIMERS to spare a specimen (or two?) to FORCHHAMMER, it is remarkable that the species should not later have been shown to occur in the large material of Naticidae which is now available from the Younger Miocene formations of Denmark.

The specimen has been compared with shells of *Natica hantoniensis* (PILKINGTON) from the Middle Oligocene fine-grained sand at Århus. These shells are identical with the material which P. HARDER used for his work of 1913 and which is found in the collection of D.G.U. There are so pronounced points of similarity between the shell stated to have been found at Gram and the shells from Århus that the "Gram shell" must be referred to the Oligocene species. The callus on the adapical part of the labium varies in shape and size on the specimens from Århus. As a rule it is greatly spread over the deep and sharply defined umbilicus, but in a single specimen the callus is of the same shape and relative extension as on the specimen which is maintained to have been found at Gram. All other characters: the low apex, the curved growth lines, the oblique spherical shape and the appearance of the umbilicus are in agreement. GLIBERT (1957, p. 58) and ANDERSON (1960b, p. 89) refer the species *hantoniensis* to the genus *Sigatica*.

In the specimen which was labelled "Gram" some dark, almost black, micaceous, clayey quartz sand (fine-grained sand) was found, which sediment is unknown in the Gram Formation.

For all these reasons it is probable that the shell which in 1956 was described by me under the name of *Polynices submamillaris*, actually originates from Oligocene beds and that the label accidentally has been exchanged by mistake. O. MØRCH worked up molluscs from the Middle Oligocene fine sand at Århus and from the Upper Miocene Mica Clay at the same time (1874). An exchange by mistake is therefore possible in connection with these investigations and may explain the fact that this characteristic species was labelled as found at Gram.

In the marine Younger Miocene of Denmark two genera have been shown to occur: *Polinices*, the umbilicus of which is without a plug, but which, in return, is contracted through a callus on the labium, and *Natica*, which has a wide umbilicus with a plug.

The spelling *Polinices* (MONTFORT 1810) seems to have a priority to *Polynices* (HERMANSEN 1847).

Genus: *Polinices* MONTFORT 1810

(Type: *Nerita mamilla* LINNÉ 1758)

Polinices catena (DA COSTA 1778)

Plate X, figs. 11–12

1956. *Polynices* (*Lunatia*) *helicina* (BROCCHI) – RASMUSSEN, South Jutland, p. 58, Pl. IV, f. 6a, b.

1958. *Natica* (*Lunatia*) *catena* (DA COSTA) – SORGENFREI, Middle Mioc., p. 185, Pl. 34, f. 117a, b.

Material. The main part of the Naticidae are listed in Tables 4–66 as Naticidae indet. (see Part I, pp. 208–285). Only a few shells could be determined with certainty.

Hodde Clay.

Måde Brickworks. Northwestern clay pit:			?1 shell
–	Eastern clay pit:		15 shells

Gram Clay.

Skærum Mølle. Clay pit:			9 shells
Alkærsig. Clay pit:			2 shells
Karlsgårde Canal. Unknown locality:			1 shell
Hodde	113.33a	9.0–10.0 m.:	?1 shell
Esbjerg. Clay pit and beach:			8 shells
Måde Brickworks. Eastern clay pit:			59 shells
Strandgård Brickworks. Clay pit:			1 shell
Ravning. Clay pit:			8 shells
Gram	141.277	5.30– 5.70 m.:	3 shells
–	–	12.10–12.60 m.:	1 shell
–	–	18.50–19.00 m.:	2 shells
–	–	19.50–20.00 m.:	1 shell
–	–	20.00–20.50 m.:	2 shells
Spandetgård. Clay pit:			2 shells
Tønder	166.398	58.85–59.00 m.:	3 shells
Rends	167.236	140′–160′ :	64 shells

Description. The shell has a relatively high apex. The protoconch is a flattened cone, difficult to demarcate from the teleoconch. The whorls of the latter are highly convex, smooth, with clearly visible, prosocline growth lines. On the surface of the shell numerous extremely fine spiral lines can be dimly seen. The aperture is semicircular. The labrum is sharp-edged. The inner lip extends somewhat over the umbilicus.

Remarks. The species is very variable, for which reason a number of independent species and subspecies have been set up in the course of time.

The specimens from the Danish Gram Clay were previously referred to *P. helicina*, which is often considered a subspecies of *P. catena* (see lists of synonyms in the works cited above and in ANDERSON's discussion of the *catena* form cycle, 1960, pp. 84–86).

In the case of the North Sea Basin ANDERSON (*loc. cit.*) suggests a division into three subspecies with the following chronostratigraphical limitations:

P. achatensis (KONINCK 1838) : Lattorfien – Chattien.
P. helicina (BROCCHI 1814) : Chattien – Reinbek-Stufe.
P. johannae (MAYER-EYMAR 1895) : Hemmoor-Stufe – Sylt-Stufe.

These forms are, however, as also pointed out by ANDERSON, connected by so many transitional forms that a clear distinction is not possible. The question about the justification of setting up the subspecies must therefore be left open until a careful investigation of the variations within the populations

of the various basins has been carried out. It should, e.g., be stated that *P. helicina* has been set up by BROCCHI on the basis of specimens from the Pliocene Piacenziano stage in Northern Italy, whereas in the North Sea Basin it is only supposed to occur as far back in time as the Reinbek-Stufe and early Miocene formations.

For the time being I therefore wish to refer the material from the Younger Miocene formations in Denmark to *P. catena.*

As to the relation of this species to *P. protracta* see the remarks under the mention of the latter species.

Distribution.

North Sea Basin. Oligocene. Denmark: Middle and Upper Oligocene (HARDER: *Natica Nysti*). North Germany: Lattorf-Stufe, Chatt-Stufe (ANDERSON). Holland: Oligocene in the Peel area (MOLENGRAAF & WATERSHOOT V. D. GRACHT: *N. Nysti*). Belgium: Tongrien, Rupelien, Chattien (GLIBERT: *N. achatensis*). – Miocene. Denmark: Klintinghoved Clay (SORGENFREI), Arnum Formation (SORGENFREI), Hodde Formation, Gram Formation. North Germany: Vierland, Hemmoor, Reinbek, Langenfelde, Gram, and Sylt Stufe (ANDERSON). Holland: "Mittel Miozän" in the Peel area (MOLENGRAAF & WATERSHOOT V. D. GRACHT). Belgium: Anversien (GLIBERT). – Plio-Pleistocene. Holland: Scaldisien (HARMER). Belgium: Scaldisien (GLIBERT). England: Coralline Crag, Waltonian Crag, Newbournian, Butleyan, Icean, Weybournian, Middle Glacial Sands (HARMER). – Recent.

Atlantic Region. Aquitanian Basin: (?) Burdigalien, (?) Helvetien, (?) Tortonien (COSSMANN & PEYROT). Portugal: Tortonien (DOLLFUS, COTTER & GOMES). – Recent: From the coasts of Southern Norway to Gibraltar.

Mediterranean Basin. Oligocene. Italy: Tongriano (SACCO). – Miocene. Italy: Elveziano, Tortoniano (SACCO). – Plio-Pleistocene. Italy: Piacenziano, (?) Astiano (SACCO), Monte Mario (CERULLI – IRELLI). France: Rhône Valley: Pliocène (FONTANNES: *Natica helicina*). Spain (Cataluna): Placenciense (ALMERA y BOFILL: *Natica helicina*). – Recent. – South Germany (Bavaria): Burdigal (HÖLZL). – Hungary: "Miozän – Mediterran" (STRAUSZ).

Poland: Miozän (FRIEDBERG: *Natica helicina*).

Polinices protracta (EICHWALD 1830)

Plate X, figs. 6–9

1830. *Neritina protracta* – EICHWALD, Naturh. Skizze, p. 218.
1853. *Natica protracta* – EICHWALD, Lethaea rossica, III, p. 255; Atlas (1859), Pl. 10, f. 43a, b.
1882. *Natica Alderi* FORBES – V. KOENEN, Mioc. Nordd. II, p. 234, Pl. V (IV), f. 11–14.
1907. *Natica Alderi* FORBES – RAVN, Jylland, p. 292, Pl. III, f. 9.
1952. *Polynices* (*Lunatia*) *varians f. protractus* EICHWALD – GLIBERT, Mioc. Belg. II, p. 71, Pl. VI, f. 1.
1956. *Polynices* (*Lunatia*) *alderi* (FORBES) – RASMUSSEN, South Jutland, p. 59, Pl. IV, f. 8a, b.
1960. *Polinices* (*Lunatia*) *varians protracta* (EICHWALD) – ANDERSON, Die Gastropoden, 2, 2, p. 86, Pl. 2, f. 4–5.
1964. *Polinices* (*Lunatia*) *varians protractus* (EICHWALD) – ANDERSON, Reinbek-Stufe, p. 228.

Original diagnosis. Testa elongato-ovata, spira elongato-protracta, apertura semicirculari, umbilico magno laterali; color fusco-rufus (EICHWALD 1830).

Material. Only safely determinable specimens are listed below.

Hodde Clay.

Leding	93.155	Unknown depth:	1 shell
Gram	141.277	29.50–30.00 m.:	1 shell

Gram Clay.

Sandfeldbjerg. Clay pit:			1 shell
Hauge. Clay pit (Glauconite Clay):			1 shell
Hjortvad	141.178	7.6 –10.2 m.:	4 shells
–	–	10.2 –15.1 m.:	2 shells
Gram	141.277	5.30– 5.70 m.:	1 shell
–	–	9.90–10.30 m.:	2 shells
–	–	10.30–10.80 m.:	1 shell
Spandetgård. Clay pit:			4 shells
Sæd	167.445	91.75–92.00 m.:	2 shells
–	–	92.70–93.00 m.:	1 shell
–	–	93.00–93.70 m.:	1 shell
–	–	93.70–94.10 m.:	1 shell
–	–	94.10–94.75 m.:	1 shell

Description. The shell varies from short, spherical to longer and slenderer forms. The apex is comparatively high.

The protoconch is truncated conical, with a very small initial whorl, which is slightly sinistral and on a level with the following whorl. The transition to the teleoconch is indistinct.

The whorls of the teleoconch increase fairly quickly in diameter. Immediately below the abapical suture there is a more or less distinct depression. The growth lines are distinct, prosocline, on the first short part below the suture, however, slightly prosocyrt, but they change direction at the passage across the depression. The aperture is semicircular. The labrum is sharp. The inner lip spreads adapically with a more or less extended callus over the umbilicus. This abapical part appears as large and deep.

Variations. The species is very variable as regards the shape of the shell, as is particularly apparent in the rich population found in the Mica Clay in Morsum Kliff on Sylt. There one sees all possible transitions from forms with relatively high spires to almost spherical specimens with very short apices.

Remarks. In the Gram Clay the slender form is rarely found. The commonest form there is that pictured in RASMUSSEN (1956, Plate IV, fig. 8). A single specimen of the slender type has been found in the lower Gram Clay at Hauge. On the other hand, this form is common in Shell Bed I at Hoddemark (the

Karlsgårde Canal), from where several specimens are available which completely correspond to GLIBERT's picture of *P. varians protracta*. A single shell is pictured in Plate X, figs. 6–7.

As pointed out by ANDERSON the feature most characteristic of the species is probably the thickened labium, which adapically extends over the umbilicus and sometimes only leaves rather a narrow aperture.

The species will often, as repeatedly stated in the literature, be difficult to distinguish from *P. catena*. Apart from the above-mentioned conditions of the inner lip, there is reason to mention the highly convex whorls of *P. catena* and the directions of the growth lines on the adapical part of the whorls, which on *P. protracta* to begin with are slightly prosocyrt before they become prosocline. On *P. catena* they are prosocline immediately from the suture.

It is nearly always impossible to group juvenile shells unambiguously.

Distribution.

North Sea Basin. Miocene. Denmark: Hodde Formation, Gram Formation. North Germany: Reinbek-Stufe, Langenfelde-Stufe, Gram-Stufe, and Sylt-Stufe (ANDERSON). Belgium: Anversien (GLIBERT). – Plio-Pleistocene: England (HARMER: *Natica exvarians* SACCO).

The Miocene of Eastern Europe (EICHWALD).

Genus: *Natica* SCOPOLI 1777

(Type: *Nerita vitellus* LINNÉ 1758)

Natica koeneni SACCO 1891

1956. *Polynices* (*Polynices*) *koeneni* (SACCO) – RASMUSSEN, South Jutland, p. 60, Pl. IV, f. 7a, b.

1960. *Natica* (*Natica*) *koeneni* SACCO – ANDERSON, Die Gastropoden 2, 2, p. 92, Pl. 4, f. 2.

Material. Hodde Clay.

Gram	141.277	28.50–29.00 m.:	1 shell

Gram Clay.

Lille Spåbæk. Lignite pit:			1 shell
Videbæk	84.1727	11.4 –12.4 m.:	1 shell
Sandfeldbjerg. Clay pit:			?1 shell
Brande Brickworks. Clay pit:			3 shells
Leding	93.155	18 –19 m.:	1 shell
Hauge. Clay pit:			2 shells
Tønding. Clay pit:			2 shells
Karlsgårde Canal. Unknown locality:			1 shell
Esbjerg. Clay pit and beach:			2 shells
Holleskov	132.46b	4.9 –11.2 m.:	1 shell
Gram	141.277	6.40– 6.90 m.:	1 shell
–	–	7.30– 7.65 m.:	1 shell

Gram	141.277	9.50– 9.90 m.:	1 shell
–	–	9.90–10.30 m.:	1 shell
–	–	12.10–12.60 m.:	1 shell
–	–	12.60–13.10 m.:	3 shells
–	–	13.10–13.50 m.:	2 shells
–	–	14.60–15.10 m.:	1 shell
–	–	17.00–17.50 m.:	1 shell
–	–	17.50–18.00 m.:	2 shells
Spandetgård. Clay pit:			2 shells
Sæd	167.445	97.40–97.90 m.:	1 shell
Rends	167.236	140'–160' :	1 shell

Description. The shell is approximately as high as broad, with a comparatively low apex and a relatively large body whorl.

The protoconch is small, very flat, conical, comprising 2–2½ whorls, which seem to be quite smooth. The initial whorl is orthostrophic.

The whorls of the teleoconch are fast increasing in diameter, convex, with prosocline growth lines. The surface of the adapical part of the whorls is disintegrated into numerous conformal grooves. Otherwise the whorls are covered with numerous very fine and close-set, almost invisible spiral lines. The aperture is semicircular. Labrum is sharp-edged. Labium abapically is also sharp-edged, but forms a large plug over the umbilicus and adapically forms rather an extended parietal callus over part of the body whorl. Various bluish-coloured parts of some of the shells may be remnants of original colouring.

Remarks. This is the species among the Naticidae in the Gram Clay which is most easily recognized, as it is the only one of them which has an umbilical plug. It also attains to the greatest size.

Measurements. The size of the present shells varies from about 1 mm. in the greatest whorl diameter to 28.0 mm. in a specimen from the clay pit of Gram Brickworks. This shell has a 27.0 mm. long axis and a 20.2 mm. long aperture.

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation. North Germany: Langenfelde-Stufe, Gram-Stufe, and Sylt-Stufe (ANDERSON).

FAMILIA: CASSIDIDAE HERRMANNSEN 1845

Genus: *Galeodea* LINK 1807

(Type: *Buccinum echinophora* LINNÉ 1758)

Galeodea echinophora (LINNÉ 1758)

1956. *Cassidaria echinophora* (LINNÉ) – RASMUSSEN, South Jutland, p. 61, Pl. V, f. 3.

Material. Gram Clay.

Skærum Mølle. Clay pit:				4 def. shells and 36 fragm. (4)
Lillelund	73.88	49.5 –62.0	m.:	1 fragm. (1)
Grønbjærg. Clay pit:				1 fragm. (1)
Kodal-Fjaldene	84.1749	21.55–22.55	m.:	1 fragm. (1)
Videbæk	84.1748	22.95–23.95	m.:	?1 fragm. (?1)
–	84.483	2.0 –10.8	m.:	4 fragm. (1)
–	84.525	6.2 – 9.0	m.:	11 fragm. (1)
Møltrup Brickworks. Clay pit:				1 labrum (1)
–	84.1509	4.6 –18.7	m.:	4 fragm. (1)
Gjødstrup	85.861	54.0	m.:	1 fragm. (1)
Vester Høgild	95.1510b	3.9 – 5.7	m.:	1 apex and 4 fragm. (1)
Drantum	104.1241	36.0 –40.0	m.:	?1 small fragm. (?1)
Alkærsig Brickworks. Clay pit:				2 labra and 1 fragm. (3)
–	93.101	10.0	m.:	18 small fragments of 1 shell (1)
Forsum Brickworks. Clay pit:				2 fragm. (1)
Hauge. Clay pit:				Basal parts of 4 shells, 1 apex, and 5 fragm. (5)
Tønding. Clay pit:				3 fragm. (2)
Esbjerg	130.59	76.5 –77.5	m.:	?1 fragm. (?1)
Esbjerg. Clay pit and beach:				2 compl. shells, 4 def. shells, 1 apex, 5 labra, and 50 fragm. (15)
Måde Brickworks. Eastern clay pit:				10 apices, 1 labrum, 1 def. shell, and 51 fragm. (23)
Strandgård Brickworks. Clay pit:				1 compl. sh., 2 def. sh., 3 apex, 1 cast and 15 fragm. (9)
Gørding. Clay pit:				1 fragm. (1)
Holleskov	132.46b	4.9 –11.2	m.:	6 fragm. (1)
Ravning. Clay pit:				1 fragm. (1)
Sønder Hygum.	141.261	13 –19	m.:	3 small parts of base of shells (3)
Gram	141.277	6.90– 7.30	m.:	7 small fragm. (1)
–	–	7.30– 7.65	m.:	?1 fragm. (?1)
–	–	8.05– 8.50	m.:	1 small fragm. (1)
–	–	16.00–16.50	m.:	5 fragm. (1)
–	–	17.00–17.50	m.:	1 apex and 2 fragm. (1)
–	–	17.50–18.00	m.:	1 fragm. (1)
–	–	19.50–20.00	m.:	48 fragm. (1)
Spandetgård. Clay pit:				1 def. shell, 8 apices, 4 basal parts, 51 fragm. (17)
Brodersmark	166.351b	22.6 –24	m.:	1 fragm. (1)
–	–	30 –31	m.:	1 fragm. (1)
Sæd Custom-house	167.445	92.70–93.00	m.:	6 fragm. (1)
–	–	94.10–94.75	m.:	2 fragm. (1)
–	–	95.40–96.20	m.:	?1 fragm. (?1)
–	–	96.75–97.40	m.:	11 fragm. (1)
–	–	97.90–98.60	m.:	1 fragm. (1)
–	–	98.60–99.05	m.:	4 fragm. (1)
Rends	167.236	140′–160′	:	12 fragm. (1)

Description. The shell is large, ovoid, with a somewhat variable apical angle. The protoconch of the present shells is worn.

The oldest teleoconch whorls are convex, covered by narrow spiral bands and thin spiral threads, which are gradually crossed by narrow collabral folds. The younger whorls of the teleoconch are angular, as, approximately in the middle, there is an edge or carina. Its location, however, is often a little shifted adapically or abapically to the middle. The part adapically to the carina is slightly concave, while the surface of the abapical part is parallel to the axis or slopes a little abaxially. On the carina there is a number of more or less pointed, somewhat distantly placed tubercles (14–17). The whorls are covered by flat, broad or narrow spiral bands. A well-marked band is found on the carina where it crosses the tubercles. On younger whorls of older shells this spiral band may have been divided into two narrower ones. Adapically to the carina there are 4–6 spiral bands, between which there may be more spiral bands. Abapically to the carina there are 3–4 spiral bands, which are often a little broader than the adapical ones. On the last whorl there are spiral bands all over the surface right out to the short, oblique spout which encloses the oblique and very narrow siphonal canal.

Labrum is highly thickened and stands out as a broad bulge on which the spiral bands project as clearly as on the rest of the surface of the shell. On the inside of the labrum there are 17–18 short ridges, the uppermost (adapical) one of which stands out as a more or less pointed tubercle. Labium is mostly smooth and extends greatly over the base and forms a narrow pseudumbilicus. Its edge is sharp. Adapically there are 3–4 parietal folds, the two adapical ones of which are rather pronounced bulges.

The aperture is obliquely guttiform, tapering adapically and a little constricted where the adapical one of the parietal folds and the adapical one of the interior teeth of the labrum occur immediately opposite to each other.

Several of the present shells have varices, which have arisen where the growth for some time has been at a standstill and a thickened labrum has developed.

Distribution as mentioned in RASMUSSEN 1956, p. 63.

Genus: *Phalium* LINK 1807

Subgenus: *Semicassis* MOERCH 1852
(Type: *Cassis japonica* REEVE)

Phalium (Semicassis) miolaevigatum (SACCO 1890)

1956. *Phalium* (*Semicassis*) *miolaevigatum* (SACCO) – RASMUSSEN, South Jutland, p. 63, Pl. V, f. 4.

1964. *Phalium* (*Semicassis*) *miolaevigatum* (SACCO) – ANDERSON, Reinbek-Stufe, p. 231.

Material. Gram Clay.

Brande Brickworks. Clay pit:			2 complete shells in concretions and 1 def. shell
Drantum	104.1241	46.0–50.0 m.:	1 small, juvenile shell
Esbjerg. Clay pit and beach:			1 def. shell
Strandgård Brickworks. Clay pit:			1 complete shell and 1 fragm.
Spandetgård. Clay pit:			5 complete shells, 6 def. shells and 10 fragments

Description. The shell is large, ovoid to globular, with a comparatively pointed and low apex.

The protoconch is truncated conical, multispiral, comprising 3–4 smooth, convex whorls, which rise comparatively high above the rest of the apex. The initial whorl is small, slightly sinistral, on a level with the following whorl.

The old whorls of the teleoconch are flatly convex or almost flat, covered by 8–9 very flat spiral bands separated by considerably narrower intervals. The sutures are depressed. The body whorl is 3–4 times as high as the apex, convex, mainly smooth. The adapical part has a slight depression in which there are 1–2 depressed spiral lines. The adapical part is covered by numerous distinct, comparatively broad spiral bands, separated by filamentous spiral lines. Such lines are also seen as very weak, often almost obliterated, equidistant lines all over the whole of the body whorl. Sometimes also some slightly prominent spirals are seen.

Labrum is thickened and smooth. The inside is provided with 8–9 short ridges. The adapical ridges are often somewhat weaker than the abapical ones or are completely obliterated. Thus in the case of all ridges on some of the shells. Labium is smooth, with a somewhat rough surface, extending adapically over the last whorl. It is abapically detached from the last whorl by a narrow pseudumbilicus. On the abapical part 3–4 irregular, but strong folds are seen. Adapically there are 2–3 weaker parietal folds.

The aperture is rounded-off rectangular, tapering adapically. The siphonal canal is short, greatly bent, surrounded by a short spout.

Remarks. As for the relation of this species to the recent *Cassis saburon* BRUGUIÈRE, see RASMUSSEN 1956. Recent shells of the latter species in Coll. NORDMANN (D.G.U.) from the Mediterranean show strong spiral grooves all over the surface of the shell, furthermore numerous (18–22) ridges on the inside of the labrum as well as numerous folds on the abapical part of the inner lip. The same characters are found on a shell in the same collection from Couches à Strombes (Pleistocene) at Tarento, Sicily.

Distribution as mentioned in RASMUSSEN 1956, p. 65.

FAMILIA: FICIDAE

Genus: *Ficus* (BOLTEN) RØDING 1798
(Type: *Murex ficus* LINNÉ 1758)

Ficus conditus (BRONGNIART 1823)

1956. *Pyrula condita* BRONGNIART – RASMUSSEN, South Jutland, p. 65, Pl. 5, f. 5a, b.

Remarks. No further material of this species is available than the specimen from Gram Brickworks which was described in 1956.

ORDO: NEOGASTROPODA
(= STENOGLOSSA)

FAMILIA: MURICIDAE FLEMING 1828

Genus: *Murex* LINNÉ 1758
(Type: *Murex pecten* MONTFORT 1810 = *Murex tribulus* LINNÉ 1758)

Murex spinicosta (BRONN 1831)

1831. *Murex spinicosta* – BRONN, Italiens Tert., p. 34.
1854. *Murex spinicosta* BRONN – BEYRICH, Conchylien, p. 209, Pl. 14, f. 2.
1872. *Murex spinicosta* BRONN – v. KOENEN, Mioc. Nordd. I, p. 147.
1893. *Murex spinicosta* BRONN – ALMERA Y BOFILL, Mol. fósiles, Muricidae, p. 38, Pl. 1, f. 7, 8.
1944. *Murex (Tubicauda) spinicosta* BRONN – VOORTHYUSEN, Mioz. Gastrop., p. 63, Pl. 4, f. 21–23.
1956. *Murex cf. (Tubicauda) spinicosta* BRONN – RASMUSSEN, South Jutland, p. 66, Pl. 5, f. 2.
1964. *Murex (Tubicauda) spinicosta* BRONN – ANDERSON, Reinbek-Stufe, p. 238, text-fig. 15.

Material. Gram Clay.

Brande Brickworks. Clay pit:			1 labium of a large shell and 1 fragment of a juvenile shell
Drantum	104.1241	36.0 –40.0 m.:	1 fragm. of a protoconch
Holleskov	132.46b	4.9 –11.2 m.:	1 fragm.
Sønder Hygum	141.260	12 –40 m.:	1 small, juvenile shell
Rødding	141.247	20 m.:	1 small, juvenile shell without apex
Gram	141.277	5.30– 5.70 m.:	6 fragm. of at least 3 shells
–	–	5.70– 6.10 m.:	1 juvenile shell, 2 fragm. of 1 shell
–	–	6.40– 6.90 m.:	1 def. juvenile shell
–	–	7.30– 7.65 m.:	1 fragm.
–	–	7.65– 8.05 m.:	1 fragm. of a protoconch
–	–	8.05– 8.50 m.:	1 small fragm.
–	–	8.50– 9.00 m.:	2 small fragm.
–	–	9.00– 9.50 m.:	1 juvenile shell
–	–	9.50– 9.90 m.:	1 small fragm.
–	–	11.25–11.65 m.:	1 fragm.
–	–	11.65–12.10 m.:	1 small fragm.
–	–	13.50–14.00 m.:	2 fragm.
–	–	15.10–15.55 m.:	1 small fragm. of a protoconch

Gram	141.277	16.50–17.00 m.:	1 juvenile shell
–	–	17.00–17.50 m.:	2 fragm. of a small shell
–	–	18.00–18.50 m.:	1 juvenile shell and 1 fragm.
Brodersmark	166.351 b	22.6 –24 m.:	1 protoconch
–	–	26 –27 m.:	1 protoconch
–	–	29 –30 m.:	1 protoconch
Sæd	167.445	92.70–93.00 m.:	1 def. juvenile shell and 1 protoconch
–	–	97.40–97.90 m.:	1 very def. juvenile shell

Remarks. There are still no shells of adult individuals of the present species available from the Younger Miocene in Denmark; but in 1962 a fragment of an adult shell was found in the clay pit of Brande Brickworks. It consists of a labrum, which in two places is protracted into the spines characteristic of the species, the adapical one of which must have been the longest. As the fragment measures 22 mm. in its full extent, the original shell must have been rather large.

From a number of localities juvenile shells are available, which all correspond to the specimens from Gram Brickworks which were described in 1956.

In contrast to that time it must now be considered certain that also the juvenile shells belong to the present species.

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation. North Germany: Hemmoor-Stufe (DITTMER), Reinbek-Stufe (ANDERSON), Glimmerton at Breklum (STRUCK), Schmalfeld (STRUCK), Lieth (GOTTSCHE & WIBEL), Langenfelde (v. KOENEN), Elbtunnel (HORN), and Lüneburg (MÜLLER). Holland: Middle (VOORTHUYSEN).

Atlantic Region. France. Aquitanian Basin: Burdigalien, Helvetien, Tortonien (COSSMANN & PEYROT). Portugal: Miocène (DA COSTA).

Mediterranean Basin. France. Rhône Valley: Pliocène (FONTANNES). Italy: Piacenziano (SACCO). Spain (Cataluna): Placenciense (ALMERA Y BOFILL).

Vienna Basin. Austria: "Unterer Tegel und Sand", "Tegel und Sand des Leythakalkes" (M. HÖRNES).

Hungary: "Miozän-Mediterran" (STRAUSZ).

Genus: *Trophonopsis* BUCQUOY, DAUTZENBERG & DOLLFUS 1882

(Type: *T. muricata* (MONTAGU))

Trophonopsis semperi (v. KOENEN 1872)

Plate XV, figs. 5–6

1956. *Trophon* (*Pagodula*) *vaginata* (JAN) var. semperi v. KOENEN – RASMUSSEN, South Jutland, p. 68, Pl. V, f. 6.

1963. *Trophonopsis* (*Pagodula*) *semperi semperi* (v. KOENEN) – TEMBROCK, Muriciden, p. 313, Pl. II, f. 3; Pl. III, f. 3a, b; Pl. V, f. 5.

1963. *Trophonopsis* (*Pagodula*) *semperi angustevaricata* (GRIPP) – TEMBROCK, ibidem, p. 314, Pl. V, f. 6.

Material. Gram Clay.

Kodal-Fjaldene	84.1749	17.55–18.55 m.:	1 fragment
Gjødstrup	85.861	55.00 m.:	1 small, almost complete shell
Odderup	103.150	14.5 –20.0 m.:	1 complete, juvenile shell
Hesselho	113.121	50.0 –56.0 m.:	1 small, defective shell
Måde Brickworks. Eastern clay pit:			3 def. shells
Gram	141.277	11.65–12.10 m.:	1 small, complete shell
Brodersmark	166.351 b	31 –32 m.:	1 small shell

Description. The shell is comparatively slender, fusiform.

The protoconch is paucispiral, consisting of $2\frac{1}{2}$ whorls. The initial whorl is relatively large, vesicular. Its surface has a microsculpture which is seen at 25 times magnification: numerous fine parallel collabral threads pass highly prosocline from suture to suture. At certain intervals there are connecting threads at right angles to the prosocline set, at a first glance arranged in a way as if numerous opisthocline threads form a regular network together with the first set. At 150 times magnification it is, however, clearly seen that the connecting threads are shifted rather considerably in relation to each other. If the protoconch should be turned about 90° in relation to the axis of the shell, a beautifully regular pattern looking like brickwork would appear. All the threads are extremely fine. The other whorls of the protoconch are completely smooth and highly convex. On the youngest whorls there is a spiral thread at some distance above the abapical suture. The sutures are deep-set.

The whorls of the teleoconch are angular, with a carina provided with a ring of greatly projecting spines. Immediately at the transition from the protoconch there is a prominent, narrow, collabral rib, which curves sigmoidally. The following collabral ribs soon become more laminate and, already after traversing the first one whorl and a half, extend leaflike over part of the surface of the whorl. It seems as if the growth of the shell has been stopped for a short time after the formation of each lamella. Simultaneously with the formation of these lamellae a strong spine develops in the middle of each lamella. These spines are slightly bent in an adapical direction. Their number is 11–12 on the shell from Gram pictured in RASMUSSEN 1956, Plate V, fig. 6. On a larger shell from Måde only 8–9. On the younger parts of older adult shells the whorls have a highly angular relief, the row of spines having been shifted to the middle of each whorl, whereas both the adapical and the abapical part are lowered by approximately 45° adaxially. While the adapical part of the whorls is nearly smooth or only has a rough, undulate surface, there are on the abapical part 2–4 spiral folds. These are rather irregular and often indistinct. On a larger, but defective shell from Måde they are almost obliterated, whereas in the above-mentioned specimen from Gram they are well developed and even provided with small spines.

The aperture is a rounded-off oval. Labrum has been broken off the present shells. The labium is simple, smooth, well demarcated from the surface of the base. The siphonal canal is narrow, long, and straight.

Remarks. The relation of this species to the recent *T. vaginata* (JAN) is not definitively clarified. According to v. KOENEN (1872, p. 151) *T. semperi* is more slender. Furthermore, the spines are not directed so obliquely adapically. The lamellae are more slightly developed, and on the last whorl there are abapically to the carina 2–3 flat, rounded-off spiral bands, which rise somewhat on the lamellae and furthermore are partly visible on the old whorls of the teleoconch. v. KOENEN also mentioned the differences of the species from *T. squamulatus* (BROCCHI) and *T. pauwelsii* (DE KONINCK).

Latest M. L. TEMBROCK has thoroughly investigated the *Trophonopsis* species in the Middle and Upper Oligocene formations and adduced material from the Upper Miocene at Lüneburg in her investigations. TEMBROCK divides *T. semperi* into two subspecies: (1) *T. (Pagodula) semperi semperi* (v. KOENEN) with 2–3 spiral bands abapically to the carina of the last whorl, and (2) *T. (P.) semperi angustevaricata* (GRIPP) with 4 more close-set spirals on this side of the shell. Both subspecies are represented in the Lüneburg material, and TEMBROCK pictures a shell of each of the subspecies from this locality. Both types are represented in the material from the Danish Gram Formation, but I prefer not to let a spiral band more or less be decisive of a division into sub-species.

Measurements. The pictured shell from Odderup measures:
Length of the axis of the shell: 2.7 mm., diameter: 1.4 mm., height of the last whorl (including the canal): 2.0 mm., length of the aperture: 0.8 mm., length of the protoconch: 0.6 mm., diameter of the protoconch: 0.6 mm., length of the canal: 1.1 mm.

Distribution.

North Sea Basin. Oligocene. Germany: Ober-Oligozän (TEMBROCK) – Miocene. Denmark: Gram Formation. North Germany: Oberoligozän, Vierlandschichten, Hemmoor-Stufe, Obermiozän (TEMBROCK). Belgium: Anversien (GLIBERT).

Genus: *Lyrotyphis* JOUSSEAUME 1880

(Type: *Murex cuniculosus* NYST 1845)

Lyrotyphis sejunctus (SEMPER 1861)

1861. *Tiphys sejunctus* – SEMPER, Pal. Unters., p. 116.
1956. *Typhis (Cyphonochelus) fistulosus* (BROCCHI) – RASMUSSEN, South Jutland, p. 69, Pl. VI, f. 1a, b.
1958. *Typhis fistulosus* (BROCCHI) – SORGENFREI, Middle Mioc., p. 204, Pl. 43, f. 138.
1963. *Lyrotyphis (Eotyphis) sejunctus priscus* (RUTOT) – TEMBROCK, Muriciden, p. 325, Pl. VII, f. 6, 7; Pl. VIII, f. 3, 4; Pl. IX, f. 7a, b, 8; Pl. X, f. 8.
1964. *Lyrotyphis (Eotyphis) sejunctus priscus* (RUTOT) – ANDERSON, Reinbek-Stufe, p. 242, Pl. 20, f. 176, 176a.

Material. Hodde Clay.

Måde Brickworks. Eastern clay pit:				1 complete shell and 1 def. shell
Gram	141.277	30.50–30.95	m.:	1 fragm.
–	–	31.35–31.65	m.:	1 apex
–	–	33.40–33.80	m.:	?1 protoconch
–	–	33.80–34.25	m.:	1 fragm. shell and 6 fragm.
–	–	35.30–35.70	m.:	1 fragm.

Gram Clay.

Kodal-Fjaldene	84.1749	15.55–16.55	m.:	1 apex and 1 fragm.	(1)
–	–	17.55–18.55	m.:	1 fragm.	(1)
–	–	22.55–23.55	m.:	1 def. shell	(1)
Videbæk	84.1748	23.95–24.95	m.:	1 def. shell	(1)
–	84.358	7.2 –15.1	m.:	1 compl. shell	(1)
–	84.1727	11.4 –12.4	m.:	1 def. shell	(1)
Møltrup Brickworks. Clay pit:				1 def. shell	(1)
Lille Torup	85.379	16.8 –20.0	m.:	1 complete shell, 1 def. shell, and 2 fragm.	(4)
Tværmose	85.381	21.0 –25.0	m.:	1 def. shell	(1)
Gjødstrup	85.861	58.0	m.:	1 def. shell	(1)
Brande Brickworks. Clay pit:				1 compl. shell and 2 fragm.	(2)
Drantum	104.1241	36.0 –40.0	m.:	3 def. shells and 1 fragm.	(3)
–	–	40.0 –44.0	m.:	2 compl. shells and 1 def. shell	(3)
–	–	46.0 –50.0	m.:	1 apex and 1 fragm.	(2)
Hjortsballe	105.320	3.4 – 8.2	m.:	1 def. shell	(1)
Odderup	103.150	14.5 –20.0	m.:	1 protoconch, 2 def. shells, and 1 fragm.	(3)
Hesselho	113.121	44.0 –50.0	m.:	1 def. shell	(1)
–	–	50.0 –56.0	m.:	2 def. shells	(2)
Hauge		Clay pit:		3 def. sh. and 1 fragm.	(3)
Esbjerg	130.59	76.5 –77.5	m.:	?1 very def. shell	(?1)
– Clay pit and beach:				1 compl. shell	(1)
Måde Brickworks. Eastern clay pit:				19 almost complete sh. and 7 def. shells	(26)
Tiset	141.244	15.0 –43.5	m.:	1 protoconch	(1)
Holleskov	132.46b	4.9 –11.2	m.:	2 def. shells and 1 fragm.	(3)
Ravning. Clay pit:				1 fragm.	(1)
Sønder Hygum	141.260	12 –40	m.:	1 def. shell	(1)
–	141.261	13 –19	m.:	2 compl. and 4 def. shells, 3 basal parts, and 1 fragm.	(9)
–	–	20	m.:	1 fragm.	(1)
Gram	141.277	5.30– 5.70	m.:	1 almost compl. and 4 def. shell, 2 fragm.	(5)
–	–	5.70– 6.10	m.:	3 def. shells and 1 fragm.	(3)
–	–	6.90– 7.30	m.:	2 almost complete shells, 1 def. shell, and 1 fragm.	(3)
–	–	7.30– 7.65	m.:	3 def. shells	(3)
–	–	8.50– 9.00	m.:	2 def. shells and 2 fragm.	(2)
–	–	9.00– 9.50	m.:	1 fragm.	(1)
–	–	9.50– 9.90	m.:	1 complete shell	(1)

Gram	141.277	12.10–12.60 m.:	1 small fragm.	(1)
–	–	14.00–14.60 m.:	1 def. shell and 1 protoconch	(2)
–	–	15.10–15.55 m.:	1 def. shell	(1)
–	–	15.55–16.00 m.:	1 juvenile shell and 1 fragm.	(2)
–	–	16.00–16.50 m.:	3 almost complete and 2 def. shells	(5)
–	–	16.50–17.00 m.:	2 def. shells and 1 fragm.	(2)
–	–	17.50–18.00 m.:	4 def. shells	(4)
–	–	18.00–18.50 m.:	1 def. shell	(1)
–	–	19.00–19.50 m.:	2 def. shells	(2)
Spandetgård. Clay pit:			6 complete and 5 def. sh.	(11)
Tønder	166.398	37 m.:	1 fragm.	(1)
–	–	58.85–59.00 m.:	1 def. shell	(1)
Brodersmark	166.351 b	22.6 –24 m.:	7 shells	(7)
–	–	24 –25 m.:	1 def. shell	(1)
–	–	25 –26 m.:	1 complete and 2 def. shells, 1 protoconch	(4)
–	–	27 –28 m.:	1 juvenile shell	(1)
–	–	28 –29 m.:	1 juvenile shell	(1)
–	–	30 –31 m.:	3 small shells	(3)
–	–	31 –32 m.:	2 fragm.	(1)
Sæd Custom-house	167.445	93.00–93.70 m.:	1 complete and 1 def. shell, 3 fragm.	(2)
–	–	93.70–94.10 m.:	1 protoconch	(1)
–	–	94.10–94.75 m.:	1 protoconch and 4 fragm.	(1)
–	–	94.75–95.00 m.:	1 complete, juvenile shell and 3 fragm.	(3)
–	–	95.90–96.20 m.:	1 compl. shell	(1)
–	–	96.20–96.75 m.:	1 compl., juvenile shell	(1)
–	–	96.75–97.40 m.:	2 def. shells	(2)
–	–	97.40–97.90 m.:	6 fragm.	(1)
–	–	94.00–97.70 m.:	1 complete juvenile shell, 1 def. shell, 1 apex, and 1 fragm.	(3)
–	–	97.90–98.60 m.:	1 def. shell and 1 fragm.	(1)
–	–	98.60–99.05 m.:	1 compl. juvenile shell, 2 def. shells, and 1 fragm.	(3)
–	–	99.05–99.55 m.:	1 fragm.	(1)
Rends	167.236	140′–160′ :	4 complete and 9 def. shells, 2 fragm.	(14)

Description. The shell is rather small, subfusiform – fusiform.

The protoconch is pointed conical, multispiral, comprising about four smooth whorls. The initial whorl is small, vesicular. The other whorls are convex, somewhat more convex on the abapical part. Close to the abapical suture there fairly soon appears a spiral thread, which is not seen on the whorls of the teleoconch. On the transition from protoconch to teleoconch a highly curved leaflike collabral rib is observed on a few shells.

The whorls of the teleoconch are convex, smooth, and provided with a strong collabral sculpture, which consists of riblike broad, rounded-off folds of the surface of the shell formed like flat tubes. These folds are grouped in four groups with two folds in each. One of the folds is more or less prosocyrt

and without an opening, the other more or less opisthocyrt and ending in an open projecting tube. The two folds meet at some distance below the adapical suture, which gives the shell an impression of being provided with an edge in this place. Abapically the folds pass undiminished down to the abapical suture and are there comparatively distant from each other. As a consequence of the presence of the folds the sutures are somewhat irregularly wavy. They are a little oblique in relation to the axis of the shell. The tubes point obliquely adapically, sometimes they are a little turned. The folds on the last whorl continue beyond the ramp and only stop at the neck of the canal.

The aperture is oval, a little protracted in the abapical direction. Labrum is sharp-edged. Labium is smooth, only a little extended, placed as a thin well-defined layer (callus) covering a small part of the surface of the base. The siphonal canal is rather short, narrow, oblique, sometimes completely surrounded by the neck of the canal, so that it forms a closed tube.

Remarks. The systematic conditions within the subfamily Typhinae have recently been investigated by PAUL VELLA (1961), who arranges it in six groups on the basis of the types of varix.

Out of these groups the *Siphonochelus* group is represented in the Younger Miocene of Denmark. According to VELLA the group is characterized by having "varices broadly rounded, fold-like, typically without spines, curving back at the top to coalesce with the tubes." It includes the following genera:

Siphonochelus: 4.2 growth steps per whorl (JOUSSEAUME 1880).
Lyrotyphis : 5 – – – – (– –).
Semityphis : 3 – – – – (MARTIN 1931).

VELLA refers i.a. *L. fistulosus* (BROCCHI) to *Siphonochelus* and *L. cuniculosus* (NYST) and *L. schlotheimi* (BEYRICH) to *Lyrotyphis.*

Still later MARIA LUISE TEMBROCK (1963) has investigated Typhinae from the Oligocene formations of Germany as well as material from the Upper Miocene at Lüneburg. She refers *L. fistulosus*, *L. cuniculosus*, and *L. schlotheimi* = *L. sejunctus* to the genus *Lyrotyphis*, but divides this into two subgenera: *Lyrotyphis* s.s. and a new subgenus: *Eotyphis.* The latter, as distinct from the former, is characterized by having a lengthy, more slender protoconch, by only having a single leaflike collabral rib at the transition from the protoconch to the teleoconch, by usually having only 4–4½ tubes on the whorls of the teleoconch, etc.

TEMBROCK considers *L. sejunctus* to be different from *L. fistulosus* because the latter seems to have fewer whorls (2½–3½ instead of 4–5½) on the protoconch and to be more slender.

L. sejunctus is by TEMBROCK subdivided into two subspecies: *L. sejunctus priscus* (RUTOT 1876) and *L. sejunctus sejunctus* (SEMPER 1861). The former differs from the latter in the shapes of the protoconch and the tubes, the

protoconch having equally broad and lower whorls, just as the tubes are narrower.

However, it seems doubtful to me whether *L. fistulosus* and *L. sejunctus* should be two species, as the size of the protoconch, which seems to be the main argument in favour of their separation, can very well be different in the same species under different ecological conditions (cf. THORSEN 1946). The other differences stated to be present are indistinct and variable. I wish to refer the shells from the Younger Miocene clay series in Denmark to *L. sejunctus* on the ground that at any rate they seem identical with SEMPER's species. Presumably the identification also applies to *L. fistulosus* from the Mediterranean Pliocene, as previously assumed, but the certainty in this case is less evident as long as the problem has not been investigated as regards variation statistics of various populations from the Tertiary beds of the Mediterranean area and the North Sea Basin.

Distribution.

North Sea Basin. Eocene. Germany: Latdorf-Stufe (TEMBROCK). – Oligocene. Denmark: Middle and Upper Oligocene (RAVN: *Tiphys schlotheimi*). Germany: Mitteloligozän, Oberoligozän (TEMBROCK). Belgium: Tongrien, Rupelien (GLIBERT: *T. fistulosus schlotheimi*). – Miocene. Denmark: Arnum Formation (SORGENFREI), Hodde Formation, Gram Formation. North Germany: Vierland-Stufe, Hemmoor-Stufe, Reinbek-Stufe, Obermiozän (TEMBROCK). Holland: Middle, Upper (VOORTHUYSEN). Belgium: Anversien (GLIBERT).

FAMILIA: BUCCINIDAE

Genus: *Liomesus* STIMPSON 1865

(Type: *L. dalei* (SOWERBY))

Liomesus ventrosus (BEYRICH 1856)

1956. *Liomesus ventrosus* (BEYRICH) – RASMUSSEN, South Jutland, p. 70, Pl. VI, f. 2.

Material. Gram Clay.

Skærum Mølle. Clay pit:	1 defective shell on cast of concretionary clay.
Karlsgårde Canal. Unknown locality:	1 weathered apex of a shell.
Esbjerg. Clay pit and beach:	2 def. shells and 1 cast.
Strandgård Brickworks. Clay pit:	1 def. shell and 1 fragment.

Description. The shell is large, ovoid – subfusiform, with rather a large body whorl.

The protoconch has not been preserved on the present material.

The whorls of the teleoconch are convex, covered by comparatively close-set, rather broad spiral bands (6–10), between which narrower spiral bands or threads are often intercalated. The sutures are deep-set. The growth lines are opisthocyrt. The last whorl is large, distended. The labrum is smooth,

rather sharp-edged. The inner lip is spreading adapically on the last whorl with a thin callus, abapically forming an erect edge separated from the body whorl by a slight pseudumbilicus. On the boundary to the siphonal canal there is a fold. The aperture is rounded-off quadrangular, abapically passing into a short, broad and oblique canal.

Variations. The shells available show variations in the strength of the spiral sculpture and the shape of the shell, there being shells which are short and broad with a highly convex body whorl and shells which are more slender and more subfusiform.

Remarks. Otherwise reference is made to my previous mention of the species and the literature cited there.

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation. North Germany: Glimmerton at Morsum Kliff, Sylt (BEYRICH, HINSCH).

Genus: *Sipho* BRUGUIÈRE 1792

(Type: *S. gracilis* (DA COSTA))

Sipho distinctus (BEYRICH 1856)

1956. *Sipho* (*Sipho*) *distinctus* (BEYRICH) – RASMUSSEN, South Jutland, p. 71, Pl. VI, f. 3a, b.
1958. *Sipho distinctus* (BEYRICH) – HINSCH, Maade, p. 471.
1958. *Sipho distinctus* (BEYRICH) – RASMUSSEN, Sæd, p. 10, Pl. I, f. 6.

Material. Gram Clay.

Skærum Mølle. Clay pit:			5 def. sh. and 1 fragm.	(5)
Vinding	74.329	76 m.:	3 fragm.	(1)
Lille Spåbæk. Lignite pit:			1 def. sh. and 1 apex	(2)
Grønbjærg. Clay pit:			1 def. shell	(1)
Fjaldene	84.238	1.0 –15.0 m.:	?2 fragm.	(?1)
Muldbjerg	83.1006	8.0 – 9.0 m.:	1 apex and 7 fragm.	(1)
Kodal-Fjaldene	84.1749	14.55–15.55 m.:	5 fragm.	(1)
Videbæk	84.1748	16.95–17.95 m.:	1 protoconch	(1)
–	–	23.95–24.95 m.:	2 fragm.	(1)
–	84.358	7.2 –15.1 m.:	1 fragm.	(1)
–	84.456	2.2 –15.0 m.:	1 apex and 12 fragm.	(1)
–	84.492	5.1 –15.5 m.:	6 fragm.	(1)
–	84.1727	11.4 –12.4 m.:	1 small fragm.	(1)
Møltrup Brickworks. Clay pit:			1 apex	(1)
Gjellerup	85.380	13 –20 m.:	1 fragm.	(1)
Snejbjerg	85.775	22.25–23.25 m.:	1 fragm.	(1)
Sandfeldbjerg. Clay pit:			1 almost compl. sh. and 2 def. sh.	(3)
Brande Brickworks. Clay pit:			1 juvenile sh., 2 def. sh., 3 fragm.	(5)

Drantum	104.1241	36.0 –40.0 m.:	1 shell (1)
–	–	46.0 –50.0 m.:	2 apices and 3 fragm. (2)
Alkærsig. Clay pit:			1 almost complete sh., 11 def. sh., and 1 apex (13)
Forsum. Clay pit:			1 fragm. (1)
Odderup	103.150	14.5 –20.0 m.:	1 fragm. (1)
Harkes. Clay pit:			3 def. sh. and 3 fragm. (3)
Hesselho	113.121	50.0 –56.0 m.:	1 fragm. (1)
–	–	56.0 –65.0 m.:	1 def. sh. (1)
Hauge. Clay pit			4 almost compl. sh. and 12 def. sh., and 4 fragm. (16)
Tønding. Clay pit:			1 almost compl. sh., 2 def. sh., and 1 fragm. (4)
Hoddemark. Karlsgårde Canal:			4 def. sh. (4)
–	–	Unknown loc.:	1 def. sh. (1)
Esbjerg. Clay pit and beach:			377 more or less def. shells (377)
Måde Brickworks. Eastern clay pit:			282 more or less def. shells (282)
Strandgård Brickworks. Clay pit:			58 more or less def. shells (58)
Holleskov	132.46b	4.9 –11.2 m.:	1 def. shell and 1 fragm. (1)
Ravning. Clay pit:			12 almost compl. shells (12)
Hjortvad	141.178	20.1 –23.1 m.:	1 fragm. (1)
Hygum	141.260	12 –40 m.:	1 def. shell (1)
–	141.261	13 –19 m.:	1 def. sh. and 1 fragm. (2)
–	–	20 m.:	3 fragm. (2)
Gram	141.277	6.10– 6.40 m.:	Base of 1 sh. and 3 fragm. (2)
–	–	6.40– 6.90 m.:	1 def. protoconch and 2 fragm. (2)
–	–	9.00– 9.50 m.:	1 fragm. (1)
–	–	9.50– 9.90 m.:	1 protoconch and 1 fragm. (1)
–	–	11.65–12.10 m.:	1 fragm. (1)
–	–	12.10–12.60 m.:	2 fragm. of 1 protoconch and 1 fragm. of 1 shell (1)
–	–	13.10–13.50 m.:	1 fragm. (1)
–	–	14.00–14.60 m.:	3 fragm. (1)
–	–	14.60–15.60 m.:	1 fragm. (1)
–	–	15.10–15.55 m.:	1 fragm. (1)
–	–	17.00–17.50 m.:	1 def. sh. and 1 fragm. (1)
–	–	17.50–18.00 m.:	?1 fragm. of 1 protoconch (?1)
–	–	18.50–19.00 m.:	1 def. sh. and 2 fragm. (1)
–	–	19.00–19.50 m.:	6 fragm. (1)
Spandetgård. Clay pit:			75 more or less def. shells (75)
Tønder	166.398	45 m.:	1 fragm. (1)
–	–	58.85–59.00 m.:	1 fragm. (1)
Brodersmark	166.351b	26 –27 m.:	1 def. sh., 1 apex, and 1 fr. (2)
–	–	27 –28 m.:	1 def. shell (1)
Sæd Custom-house	167.445	93.00–93.70 m.:	1 def. apex and 14 fr. (1)
–	–	93.70–94.10 m.:	3 fr. (1)
–	–	94.10–94.75 m.:	1 fr. (1)
–	–	94.75–95.50 m.:	1 fr. (1)
–	–	95.90–96.20 m.:	4 fr. (1)
–	–	94.00–97.70 m.:	1 fr. (1)
Rends	167.236	140′–160′ :	2 fr. (1)

Description. The shell is large, more or less slender, fusiform.

The protoconch is small, obtuse, comprising about 2½ convex whorls. The initial whorl is very small, smooth, slightly sinistral. The medial whorl is smooth, convex. The terminal whorl has two strong spiral threads abapically to the middle.

The whorls of the teleoconch are first subangular, with one, later two and three slighter spiral threads besides the two strong ones. Finally there is abapically to the two original spiral threads a slighter thread situated a little above the abapical suture. A slight spiral thread is often found between the two strongest ones and gradually there appear slighter threads of the third or fourth order between the others, so that the whole whorl is covered by spiral threads with somewhat irregular distances. Simultaneously the whorls become flatly convex, sometimes almost quite flat. The whole of the body whorl is covered by spiral threads or bands right out to the end of the rather long neck of the canal. The strength of these spiral threads is also variable. The shell is completely without any collabral sculpture. The growth lines are flattened opisthocyrt. The sutures are moderately depressed.

Labrum is mostly broken off the shells found in the Gram Clay, but seems to have been sharp-edged. Labium is smooth, fairly demarcated from the surface of the base. The aperture is lengthily oval, abapically rather evenly into the rather long, somewhat oblique siphonal canal.

Variations. The spiral sculpture varies in strength, both as regards the interrelations between the spiral threads and bands and as regards relations between all of them. Furthermore, the shells vary with regard to slenderness. The population from Gram is comparatively slender-shelled, while among the shells from Måde Brickworks there may be some comparatively short and broad ones with a somewhat larger apical angle. Unfortunately the material from Måde was collected without regard to horizon, for which reason it is not possible to decide with certainty whether the broader and shorter type has been collected in the lower part of the Gram Clay.

Remarks. This species was presumably by PHILIPPI (1846) originally included in the variation range of his *Fusus gregarius*. BEYRICH segregated *Fusus distinctus* as a particular species, but according to the latter author both forms occurred in the Mica Clay at Lüneburg and Gühlitz.

The difference between the two forms appears most clearly from BEYRICH's pictures (Plate 20, figs. 7–10): *S. gregarius* has 5–6 spiral bands evenly distributed on the older whorls of the teleoconch, while *S. distinctus* has two especially prominent spiral bands on the abapical half of the older whorls of the teleoconch besides slighter spiral threads or bands on both sides of the two strong ones.

It has not been possible to arrange the material from the easternmost clay pit of Måde Brickworks in two distinct groups corresponding to *S. gregarius* and *S. distinctus*. Very few shells have been found with the protoconch pre-

served, and they have all two spiral threads on the youngest whorl of the protoconch.

HINSCH (1958) is of the opinion that nine shells of *Sipho* found by him in the older parts of the Gram Clay at Måde should be referred to *S. gregarius*, because these shells have an apical angle at an average of 36.7° at a diameter of the whorl of 10 mm. as against the shells from the younger parts of the Gram Clay, in which the corresponding value is 27.9°. The measurements, however, have only been made on 4 and 7 specimens, respectively, which is hardly sufficient to decide whether there are two different species.

If future investigations should show that the two species ought to be merged, PHILIPPI's specific name must have the priority to that of BEYRICH. As long as this has not been decided, and as I have not been able to demonstrate sure specimens of the type *gregarius* in my material, I shall retain the name of *distinctus* as designation of the species of *Sipho* occurring in the Gram Clay in Denmark.

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation. North Germany: Langenfelde-Stufe, Gram-Stufe (HINSCH). – Pliocene. North Germany: Limonite Sandstone, Morsum Kliff, Sylt (GRIPP).

FAMILIA: NASSARIIDAE

Genus: *Hinia* LEACH in GRAY 1847

(Type: *Buccinum reticulatum* LINNÉ 1758)

Hinia bocholtensis (BEYRICH 1854)

Plate XI, figs. 4 and 8

1956. *Nassa (Telasco) bocholtensis* (BEYRICH) – RASMUSSEN, South Jutland, p. 72, Pl. VI, f. 5a, b.
1958. *Nassa bocholtense* (BEYRICH) – SORGENFREI, Middle Mioc., p. 213.
1962. *Nassa bocholtensis* BEYRICH, figure only – HINSCH, Twistringen, Pl. 28, f. 7 (pp. 310–311).
1964. *Hinia (Hinia) bocholtensis* (BEYRICH) – ANDERSON, Reinbek-Stufe, p. 255, Pl. 24, f. 191.

Material. Hodde Clay.

Leding	93.155	See under *H. fuchsi*		
Grøde. Karlsgårde Canal:			2 shells	(2)
Hodde	113.33a	18.5 –18.9 m.:	1 fragment	(1)
Måde. Eastern clay pit. North wall:			2 compl. sh., 4 def. sh.	(6)

Gram Clay.

Brejning Kro	83.197	42 –45 m.:	1 fr.	(1)
Kodal-Fjaldene	84.1749	15.55–16.55 m.:	1 def. sh.	(1)
Brande Brickworks. Clay pit:			1 def. sh., 2 apices, and 1 fragm.	(3)
Drantum	104.1241	36.0 –40.0 m.:	1 def. sh. and 3 fr.	(2)
Alkærsig. Clay pit:			2 def. sh.	(2)

Lønborg	102.55	6.3 – 7.3 m.:	?2 fr.	(?1)
–	–	9.3 –10.3 m.:	1 fr.	(1)
Forsum Brickworks. Clay pit:			1 almost compl. sh.	(3)
Odderup	103.150	14.5 –20.0 m.:	1 def. sh. and 7 fr.	(1)
Harkes. Clay pit:			2 almost compl. sh.	(2)
Hesselho	113.121	44.0 –50.0 m.:	1 def. sh.	(1)
–	–	50.0 –56.0 m.:	4 def. sh.	(4)
Hauge. Clay pit:			1 def. sh.	(1)
Esbjerg	130.59	73.8 –74.5 m.:	1 def. sh.	(1)
Esbjerg. Clay pit and beach:			3 compl. sh. and 2 def. sh.	(5)
Måde Brickworks. Eastern clay pit:			4 compl. sh., 8 def. sh., and 2 fragm.	(12)
Holleskov	132.46b	4.9 –11.2 m.:	2 def. sh.	(2)
Ravning. Clay pit:			1 fr.	(1)
Lintrup	132.140	3.25– 3.75 m.:	1 fr.	(1)
Sønder Hygum	141.260	12 –40 m.:	1 fr.	(1)
–	141.261	13 –19 m.:	2 almost compl. sh. and 9 fr.	(4)
–	–	20 m.:	1 apex and 1 fr.	(1)
Rødding	141.76	28.35–37.15 m.:	1 def. sh.	(1)
Gram	141.277	5.30– 5.70 m.:	6 fr.	(1)
–	–	5.70– 6.10 m.:	1 def. sh. and 7 fr.	(3)
–	–	6.40– 6.90 m.:	1 def. sh. and 1 fr.	(1)
–	–	6.90– 7.30 m.:	3 def. sh. and 8 fr.	(3)
–	–	7.30– 7.65 m.:	7 fr.	(1)
–	–	7.65– 8.05 m.:	1 def. sh. and 6 fr.	(1)
–	–	8.05– 8.50 m.:	1 def. sh. and 4 fr.	(2)
–	–	9.90–10.30 m.:	2 fr.	(1)
–	–	10.80–11.25 m.:	1 fr.	(1)
–	–	11.25–11.65 m.:	1 fr.	(1)
–	–	14.00–14.60 m.:	1 fr.	(1)
–	–	17.00–17.50 m.:	2 fr.	(1)
–	–	20.50–21.00 m.:	2 def. sh. and 3 fr.	(2)
Spandetgård. Clay pit:			10 compl. sh., 13 def. sh., and 3 fr.	(25)
Tønder	166.398	74 m.:	2 fr.	(1)
Brodersmark	166.351b	22.6 –24 m.:	2 def. sh.	(2)
–	–	24 –25 m.:	1 fr.	(1)
–	–	25 –26 m.:	2 def. sh.	(2)
–	–	26 –27 m.:	4 def. sh. and 1 fr.	(5)
–	–	28 –29 m.:	2 apex-fragm. and 1 other fragm.	(2)
–	–	29 –30 m.:	1 protoconch and 2 def. sh.	(3)
–	–	31 –32 m.:	1 fr. of 1 protoconch	(1)
Sæd Custom-house	167.445	92.00–92.25 m.:	?17 fr.	(?2)
–	–	92.25–92.70 m.:	?9 fr.	(?1)
–	–	93.00–93.70 m.:	6 fr.	(1)
–	–	96.20–96.75 m.:	3 fr.	(1)
–	–	96.75–97.40 m.:	1 fr.	(1)
–	–	97.40–97.90 m.:	3 fr.	(1)
–	–	94.00–97.70 m.:	1 def. sh. and 4 fr.	(1)
–	–	97.90–98.60 m.:	1 compl. sh. and 3 fr.	(2)
–	–	98.60–99.05 m.:	1 def. sh. and 1 fr.	(1)
Rends	167.236	140′–160′ :	1 def. sh. and 3 fr.	(3)

Description. The shell is relatively small, subfusiform.

The protoconch is conical, paucispiral, comprising three smooth whorls rapidly increasing in diameter. The initial whorl is very small, slightly sinistral. The other whorls are rather greatly convex.

The whorls of the teleoconch are subangular, adapically with a narrow, abaxially sloping part against an edge or shoulder, the situation of which is immediately abapically to the suture. The part abapically to the edge is flat, provided with 5–7 rather broad, flat spiral bands separated by narrow grooves. The interval between the spiral band on the edge and the abapically following band is a little broader than that between the others.

Collabral narrow ribs, which especially are highly prominent on the part abapically to the edge, narrow, with broad intervals. Number: 12–15. The spiral bands pass over the collabral ribs. On the edge short, projecting, often pointed tubercles are formed in this way.

The spiral sculpture is furthermore undiminished all over the last whorl, including the ramp and the neck of the canal. The number of spiral bands on this part of the shell is 12–16.

The aperture is oval, tapering adapically. The siphonal canal is short, oblique. The labrum is thickened, interiorly with 11–12 short ridges parallel to the spiral bands. The inner lip is smooth, with a somewhat rough surface, demarcated towards the base by a prominent edge.

Remarks. Juvenile shells of *H. bocholtensis* will sometimes be difficult to distinguish from *H. fuchsi*, as the spiral bands – or rather the separating spiral grooves – may be so indistinct on the oldest part of the former species that there will be similarity to *H. fuchsi* (cf, remarks in HINSCH, *op. cit.*, legend on p. 310).

SORGENFREI (*op. cit.*) is of the opinion that *Nassa vulgatissima* (MAYER), described in COSSMANN & PEYROT, 1925, p. 115, pictured Plate II, figs. 65–67, 69–71, is identical with *H. bocholtensis*.

Measurements. Eight shells from the clay pit of Gram Brickworks have the following measurements:

	Length of shell:	Greatest diameter of shell:	Length of aperture:	Protoconch Maximum diameter:	Protoconch Length:
(1)	9.5 mm.	4.4 mm.	4.4 mm.	1.3 mm.	0.9 mm.
(2)	6.8 –	3.4 –	3.2 –	1.3 –	1.2 –
(3)	6.7 –	3.7 –	3.0 –	1.4 –	0.9 –
(4)	7.2 –	3.6 –	3.2 –	1.2 –	0.9 –
(5)	9.7 –	4.8 –	4.3 –	1.3 –	1.0 –
(6)	10.8 –	5.3 –	4.7 –	?	?
(7)	10.5 –	4.9 –	4.1 –	?	?
(8)	6.9 –	3.8 –	3.2 –	1.1 –	0.7 –

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Hodde Formation, Gram Formation. North Germany: Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (HINSCH), Obermiozän (STAESCHE). Holland: Mittelmiozän (VOORTHUYSEN). Belgium: Anversien (GLIBERT).

Atlantic Region. Aquitanian Basin: Burdigalien, Helvetien (PEYROT: *Nassa vulgatissima*). South Germany (Bavaria): Burdigal (HÖLZL).

Hinia fuchsi (V. KOENEN 1872)

Plate XI, figs. 1–2

1856. *Nassa turbinellus* BROCCHI – HÖRNES, Wienerbecken, I, p. 150, Pl. 12, f. 17.
1872. *Nassa Fuchsi* (see under *N. Bocholtensis* BEYR.) – V. KOENEN, Mioc. Nordd. I, p. 193.
1907. *Nassa Fuchsi* V. KOENEN – RAVN, Jylland, p. 315 (111), Pl. V, f. 2.
1958. *Nassa Fuchsi* V. KOENEN – SORGENFREI, Middle Mioc., p. 215, Pl. 44, f. 147.

Material. Hodde Clay.

Leding	93.155	27–28 m.:	3 def. sh.		(3)
–	–	31 m.:	14 def. sh., 2 fr.	including *H. bocholtensis*	(15)
–	–	28–32 m.:	1 def. sh.		(1)
–	–	Unknown depth:		1 compl. sh., 11 def. sh.	(12)
Odderup		130.150	24.8 –25.6 m.:	7 fragm. sh., 9 fragm.	(7)
Måde. Eastern clay pit:				165 more or less compl. sh.	(165)
Rødding		141.241	20.0 –33.0 m.:	1 protoconch of a shell	(1)
–		141.242	32 m.:	6 small fragm.	(1)
–		141.243	30 m.:	5 fragm. of one shell	(1)
–		–	34.5 m.:	?1 fragm.	(?1)
Grønnebæk		141.205	20 m.:	?2 small fragm.	(?1)
Enderupskov		141.191	35 m.:	1 apex of a shell and 1 fragm.	(1)
Gram		141.277	27.00–27.50 m.:	1 very fragm. sh.	(1)
–		–	28.00–28.50 m.:	8 fragm.	(1)
–		–	28.50–29.00 m.:	2 protoc. and 5 fragm.	(2)
–		–	29.00–29.50 m.:	2 almost compl. sh., 13 def. sh., 16 fragm.	(15)
–		–	29.50–30.00 m.:	7 def. sh., 31 small fragm.	(7)
–		–	30.00–30.50 m.:	22 def. sh., 74 fragm.	(22)
–		–	30.50–30.95 m.:	5 def. sh., 14 fragm.	(5)
–		–	30.95–31.75 m.:	17 def. sh., 36 fragm.	(17)
–		–	31.35–31.65 m.:	4 def. sh., 9 small fragm.	(4)
–		–	31.65–31.95 m.:	1 juvenile shell, 7 fragm.	(2)
–		–	31.95–32.30 m.:	9 def. sh. 15 fragm.	(9)
–		–	32.30–32.70 m.:	4 fragm.	(1)
–		–	32.70–33.05 m.:	2 fragm. of 2 sh.	(2)
–		–	33.05–33.40 m.:	3 small fragm.	(1)
–		–	33.40–33.80 m.:	1 very def. shell	(1)
–		–	33.80–34.25 m.:	4 protoc., 14 small fragm.	(4)
–		–	34.25–34.70 m.:	3 apices, 5 small fragm.	(3)
–		–	34.70–35.00 m.:	2 apices, 1 def. sh., 6 fr.	(3)

Sønder Hygum	141.215	26.2 –32.8	m.:	4 def. sh.	(4)
Tønder	166.398	85	m.:	1 def. sh. and 12 fragm.	(1)
Hajstrup	167.235	154′–174′	:	?1 small fragm.	(?1)
–	–	174′–194′	:	18 def. sh., 14 fragm.	(22)

Description. The shell is rather small, ovoid, more or less slender.

The protoconch is conical, multispiral, comprising $2\frac{3}{4}$–$3\frac{3}{4}$ whorls, mostly moderately flattened, but sometimes more pointed. The initial whorl is small, only a little raised above the following whorls, which are highly convex and smooth.

At the transition to the teleoconch there is about $\frac{1}{4}$ of a whorl with 5–6 first slightly prominent, later conspicuous, narrow, straight, collabral ribs.

The whorls of the teleoconch are flat, with 11–18 sharp-edged, distant, collabral ribs running parallelly to the axis. They are adapically constricted by a narrow, marked, subsutural spiral groove. In this way a spiral band with pointed tubercles is formed on the collabral ribs. The remaining and highly predominant part of the whorl is either completely smooth or also provided with three slight spiral grooves, which are almost invisible. Sometimes slight tubercles are also formed on the collabral ribs in this way.

The surface of the shell, however, is always glossy and smooth. The younger whorls of older shells are provided with more or less distinct spiral grooves, which cut off broad spiral bands. On the body whorl they are found right down to the abapical end of the base.

The aperture is a rounded-off oval. Labrum is sharp-edged, sometimes thickened and interiorly provided with some five short ridges. The inner lip is smooth, extended a little over the base as a well-defined and well-demarcated covering layer.

On a few shells there are a few folds on the adapical part, approximately in the middle of the part situated above the curvature of the last whorl.

The siphonal canal is comparatively broad, short, and oblique.

Remarks. The species is characteristic of the fauna in the Hodde Clay, in which it is rather common in places.

v. KOENEN set up the species on the basis of material from the Vienna Basin which M. HÖRNES termed *Buccinum turbinellus* BROCCHI. As to the relation of this species to *H. fuchsi* reference is made to SORGENFREI's remarks on *H. turbinella* (1958, p. 214).

H. fuchsi is distinguished from *H. bocholtensis* by its pointed tubercles on the adapical group of the collabral ribs, by usually lacking the well-defined and mostly more numerous spiral grooves of the other species, and by its otherwise smooth and glossy shell.

As to the difference between *H. fuchsi* and *H. schlotheimi* (BEYRICH) reference is made to SORGENFREI's remarks on the latter species (1958, pp. 218–219).

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Hodde Formation. North Germany: ? Reinbek-Stufe (GOTTSCHE).

Vienna Basin. Miocene. Austria: "Tegel und Sand des Leythakalkes", Ottnang (M. HÖRNES: *Buccinum turbinellus*).

Hinia ? schlotheimi (BEYRICH 1854)

1958. *Nassa Schlotheimi* (BEYRICH) – SORGENFREI, Middle Mioc., p. 216, Pl. 45, f. 148.

Material. Hodde Clay.

Gram	141.277	29.00–29.50 m.:	2 fragm.	(1)
–	–	29.50–30.00 m.:	2 fragm.	(1)
–	–	30.50–30.95 m.:	1 fragm.	(1)
–	–	30.95–31.35 m.:	3 fragm.	(1)
–	–	31.95–32.30 m.:	2 fragm.	(1)

Remarks. The present very poor material does not permit any close determination as to species. The spiral as well as the collabral sculpture, however, suggests that the fragments belong to *H. schlotheimi.*

This species is common in Shell Bed I at Hoddemark (the Karlsgårde Canal). See picture Plate XII, figs. 1 and 2.

Distribution.

North Sea Basin. Oligocene. Denmark: Upper (HARDER). North Germany: Upper (BEYRICH). – Miocene. Denmark: Klintinghoved Clay, Arnum Formation (SORGENFREI), Hodde Formation. North Germany: Vierland-Stufe (GRIPP), Hemmoor-Stufe (KAUTSKY). Holland: Middle (VOORTHUYSEN).

Hinia holsatica (BEYRICH 1854)
Plate XI, figs. 3, 5, 6, and 7

1854. *Buccinum Holsaticum* – BEYRICH, Conchylien, p. 137, Pl. 7, f. 11a, b, c.
1872. *Nassa Holsatica* BEYRICH – v. KOENEN, Mioc. Nordd. I, p. 193.
1944. *Nassa (Telasco) holsatica* (BEYRICH) – VOORTHUYSEN, Mioz. Gastrop., p. 105, Pl. 12, f. 8–11.
1958. *Nassa holsatica* (BEYRICH) – SORGENFREI, Middle Mioc., p. 219, Pl. 48, f. 149.
1964. *Hinia (Hinia) holsatica* (BEYRICH) – ANDERSON, Reinbek-Stufe, p. 258, Pl. 25, f. 195.

Original diagnosis. Not given.

Type. The shell from Lieth near Elmshorn pictured by BEYRICH, 1856, Plate 7, fig. 11, is the holotype. Stratum typicum: "Glimmerton" (i.e. Upper Miocene clay). Depository: unknown.

Material. Gram Clay.

Måde Brickworks. Eastern clay pit:			64 more or less compl. sh.
Gram	141.277	19.00–19.50 m.:	5 more or less compl. sh.
–	–	19.50–20.00 m.:	4 more or less compl. sh.
–	–	20.00–20.50 m.:	4 more or less compl. sh.

Description. The shell is small, ovoid.

The protoconch is conical, with a somewhat flat apex, paucispiral, comprising three rather highly convex, smooth whorls. The initial whorl, which is slightly sinistral, rises but little over the following whorls.

The whorls of the teleoconch are flatly convex, with 5–7 mostly well-defined, flat spiral bands, separated by equally broad intervals, passing over 19–22 collabral ribs, which are a little stronger than the spiral bands, rather narrow and separated by much broader intervals.

The collabral ribs gradually disappear on the youngest whorl, whereas the spiral bands persist almost undiminished all over the base. On many shells a varix is seen on one of the younger whorls.

The labrum is thickened, interiorly provided with 7–8 ridges, the 4 adapically situated ones of which are somewhat more close-set than the others. Labium is smooth, extending over the base, from which it is demarcated by a sharp edge. Adapically on the inner lip there is a more or less prominent parietal fold. The aperture is a pointed oval. The siphonal canal is short, oblique.

Remarks. This species, which generally is a small form and at any rate the smallest of the Nassaidae from the Younger Miocene clay series in Denmark, may perhaps be mistaken for *H. syltensis* (BEYRICH) from the younger Gram Clay. The collabral as well as the spiral sculpture of *H. holsatica* is, however, more constant as regards the number and proportions, just as the species usually seems to be smaller than *H. syltensis*. These differences, however, are only conspicuous when whole populations are observed. In certain cases it will only with difficulty be possible to distinguish single young individuals of *H. holsatica* from *H. syltensis*.

Extraordinarily enough v. KOENEN (1872, pp. 193–194) refers the shell from Gram to *H. holsatica*. All the shells from this locality in Danish collections belong to *H. syltensis*, to which RAVN (1907), indeed, without hesitation referred them.

For comparison I have had five shells from Langenfelde labelled "*Nassa holsatica*" by C. GOTTSCHE. They correspond in every respect to the shells from Måde.

Measurements. The dimensions of 25 shells from Måde (Older Gram Clay) are grouped within the following intervals:

Length:	3.6–5.4 mm.
Maximum diameter:	2.3–3.3 –
Length of aperture:	1.3–1.9 –
Length of protoconch:	0.7–0.9 –
Longest diameter of protoconch:	1.2–1.3 –

A single one of the specimens, however, measured about 10 mm. in length and 5.4 mm. in diameter.

Distribution.

North Sea Basin. Miocene. North Germany: Reinbek-Stufe (v. KOENEN), Glimmerton (v. KOENEN). Holland: Middle Miocene (VOORTHUYSEN). Denmark: Arnum Formation (SORGENFREI), Gram Formation.

Hinia syltensis (BEYRICH 1854)

1956. *Nassa (Telasco) syltensis* (BEYRICH) – RASMUSSEN, South Jutland, p. 73, Pl. VI, f. 4a, b.

Material. Gram Clay.

Lille Torup	85.379	16.8 –20.0 m.:	2 def. sh.	(2)
Brande Brickworks. Clay pit:			1 compl. sh. and 3 fragm.	(2)
Drantum	104.1241	30.0 –40.0 m.:	2 small def. sh.	(2)
–	–	40.0 –44.0 m.:	1 def. sh.	(1)
–	–	46.0 –50.0 m.:	1 small, almost compl. sh.	(1)
Nyholm	104.1166	8.2 – 9.2 m.:	?1 fragm.	(?1)
–	–	11.2 –12.2 m.:	1 fragm.	(1)
Esbjerg	130.59	72.5 m.:	1 def. sh. (may be of *H. holsatica*)	(?1)
Måde Brickworks. Northwestern clay pit:			1 compl. sh.	(1)
Måde Brickworks. Eastern clay pit:			? Apex of 1 sh.	(?1)
Holleskov	132.46b	4.9 –11.2 m.:	1 almost compl. sh.	(1)
Sønder Hygum	141.260	12 –40 m.:	1 protoconch	(1)
–	141.261	13 –19 m.:	2 juvenile sh., 20 fragm.	(4)
Rødding	141.75	10.80–16.75 m.:	1 small fragm.	(1)
Gram	141.277	5.30– 5.70 m.:	1 compl. sh., 3 def. sh., 4 fragm.	(5)
–	–	5.70– 6.10 m.:	2 def. sh., 2 fragm.	(3)
–	–	6.40– 6.90 m.:	1 small def. sh.	(1)
–	–	6.90– 7.30 m.:	1 apex, 1 def. sh., 1 fr.	(2)
–	–	7.65– 8.05 m.:	1 def. sh.	(1)
–	–	9.00– 9.50 m.:	2 apices, 4 fragm.	(2)
–	–	9.50– 9.90 m.:	3 fragm.	(1)
–	–	10.30–10.80 m.:	1 compl. sh., 1 def. sh., 1 fragm.	(3)
–	–	10.80–11.25 m.:	1 def. small sh.	(1)
–	–	12.10–12.60 m.:	3 fragm. of a shell	(1)
–	–	13.10–13.50 m.:	1 apex and 4 fragm.	(1)
–	–	13.50–14.00 m.:	1 fragm. protoconch, 1 fr.	(1)
–	–	14.00–14.60 m.:	1 def. sh. and 1 fragm.	(1)
–	–	14.60–15.10 m.:	2 fragm.	(1)
–	–	15.10–15.55 m.:	2 def. sh., 1 fragm.	(2)
–	–	15.55–16.00 m.:	1 small fragm.	(1)
–	–	16.00–16.50 m.:	1 fragm.	(1)
Spandetgård. Clay pit:			5 compl. sh., 4 fragm.	(6)
Brodersmark	166.351b	24 –25 m.:	1 def. sh.	(1)
–	–	25 –26 m.:	2 fragm. shells	(2)
–	–	26 –27 m.:	1 small shell	(1)
–	–	28 –29 m.:	2 fragm.	(1)
Sæd Custom-house	167.4	70 m.:	5 compl. sh. and 1 fragm.	(6)
–	167.445	91.50–91.75 m.:	2 protoconchs, 6 fr.	(2)
–	–	91.75–92.00 m.:	5 protoconchs, 24 fr.	(5)

Sæd Custom-house	167.445	92.00–92.25 m.:	3 def. sh., 2 fragm.	(3)
–	–	92.25–92.70 m.:	1 compl. sh., 1 def. sh., 4 protoconchs, 27 fragm.	(6)
–	–	92.70–93.00 m.:	1 apex, 2 protoconchs, 13 fragm.	(3)
–	–	93.00–93.70 m.:	2 fragm.	(1)
–	–	94.75–95.50 m.:	9 fragm.	(2)
–	–	94.00–97.70 m.:	4 fragm.	(1)
–	–	99.05–99.55 m.:	1 fragm.	(1)
–	–	99.55–100.10 m.:	5 fragm.	(1)
Rends	167.236	140′–160′ :	2 compl. sh., 2 def. sh., 3 apices, 15 fr.	(9)

Description. The shell is rather small, ovoid.

The protoconch is conical, multispiral, with 3–3½ smooth, convex whorls.

The whorls of the teleoconch are flatly convex, covered by 9–12 close-set, rather narrow spiral bands, separated by narrow grooves. The collabral sculpture comprises 14–19 rounded-off, rather narrow ribs, which are either straight or oblique or slightly opisthocyrt. On the last whorl there are about 25 spiral bands, which continue on to the neck of the canal.

The aperture is roundly oval. Labrum is thickened, interiorly with 14 narrow ridges placed at more or less regular intervals. Labium is smooth, extending very little over the base as a well-defined cover. Adapically there is sometimes a faint parietal fold. The siphonal canal is rather broad, short and oblique.

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation. North Germany: Obermiozän (STAESCHE). Holland: ? Mittelmiozän (VOORTHUYSEN).

Hinia prismatica (BROCCHI 1814)

1956. *Nassa* (*Uzita*) *prismatica* (BROCCHI) – RASMUSSEN, South Jutland, p. 73, Pl. VII, f. 1a, b.

Material. Gram Clay.

Gram	141.277	7.30– 7.65 m.:	1 compl. sh.	(1)
–	–	10.30–10.80 m.:	1 def. sh.	(1)
Spandetgård. Clay pit:			1 def. sh.	(1)
Sæd Custom-house	167.445	93.70–94.10 m.:	1 def. sh., 10 fr.	(1)
–	–	94.10–94.75 m.:	1 compl. sh., 4 def. sh., 6 fragm.	(5)
–	–	95.90–96.20 m.:	1 apex, 4 fragm.	(1)
Rends	167.236	140′–160′ :	2 def. sh., 4 fragm.	(3)

Description. The shell is rather large, ovoid to subfusiform, with a comparatively pointed apex as compared with the other *Hinia* species.

The protoconch is conical, multispiral, comprising 2¾–3 smooth, rather high, convex whorls. The initial whorl is small, slightly sinistral.

On the transition to the teleoconch there is one fourth of a whorl with widely spaced collabral ribs, after which there are all over the whorl some close-set spiral threads, which gradually broaden. On the present shells their number vary between 10 and 14. They cross about 14–20 slightly opisthocyrt, rather narrow collabral ribs, the intervals between which are rather broad. On the body whorl the spiral ornamentation continues undiminished, with about 30 spiral bands right out to the neck of the canal. On the other hand, the collabral ribs are lost on the ramp down to the neck of the canal.

Labrum is not preserved on the present shells. The inner lip is smooth, clearly demarcated against the surface of the base. The aperture is oval. The siphonal canal is short, oblique, and rather broad, surrounded by a short straight spout.

Remarks. Furthermore, reference is made to my mention of the species in the work cited.

Distribution as mentioned in RASMUSSEN 1956, p. 74.

Hinia cimbrica (RAVN 1907)
Plate XII, figs. 3–4

1907. *Nassa cimbrica* – RAVN, Jylland, p. 315, Pl. V, f. 4.
1916. *Nassa cimbrica* RAVN – NØRREGAARD, Esbjerg, p. 26.
1925. *Nassa (Hima) cimbrica* RAVN – KAUTSKY, Hemmoor, p. 107.
1944. *Nassa (Hima) cymbrica* RAVN – VOORTHUYSEN, Mioz. Gastrop., p. 92, Pl. 10, f. 16–17.
1958. *Nassa cimbrica* RAVN – SORGENFREI, Middle Mioc., p. 228, Pl. 47, f. 155.
1964. *Hinia (Hinia) cimbrica* (RAVN) – ANDERSON, Reinbek-Stufe, p. 256, Pl. 25, f. 193.

Material. Hodde Clay.

Lønborg	102.55	21.3 –22.3 m.:	2 def. sh. and 2 fragm.	(3)
Hodde	113.33a	18.5 –18.9 m.:	5 juvenile shells	(5)
Gram	141.277	29.50–30.00 m.:	4 def. shells	(4)
–	–	30.00–30.50 m.:	1 def. shell and 2 fragm.	(1)

Description. In the older, lower parts of the Hodde Clay some shells of this species have been found, which, however, have been poorly preserved. In characters they are closely related to the form which occurs so abundantly in Shell Bed I at Hoddemark (the Karlsgårde Canal) and which is to be briefly described here:

The shell is rather small, ovoid, comprising $3\frac{1}{2}$ smooth, convex whorls.

The protoconch is conical, multispiral, more or less slender.

On the transition to the teleoconch there is about $\frac{1}{4}$ of a whorl with straight, narrow collabral ribs. The whorls of the teleoconch are rather flat. There are 9–11 collabral ribs to each whorl, which are crossed by 3, more rarely 4 narrow, indistinct spiral bands, which often are invisible between the collabral ribs,

but at the passage across them form small pointed tubercles, which lend a special character to the shell.

On the body whorl there are 6–8 spiral bands, and as the collabral ribs continue right down to the neck of the canal, the characteristic pointed small tubercles are also found right down on the base of the shell.

The aperture is oval, tapering adapically and continuing in the relatively broad siphonal canal, which is rather oblique, surrounded by a short spout.

Labrum is often highly thickened, interiorly with six narrow ridges. Labium is smooth, well-defined, adapically with a few parietal folds.

Remarks. This form differs from *H. cimbrica* described by RAVN and SORGENFREI by having constantly 3, more rarely 4 spiral bands. Furthermore, the number of collabral ribs seems to be a little smaller on the form from the Hodde Formation, which is also on the whole a little more slender than the shells of the Arnum Formation.

As there are few specimens available from the Hodde Clay, a close investigation of the relation between the forms in the two formations has been postponed to a later opportunity.

The shell from the Middle Miocene beds of Holland (bore-hole at Maasbree) mentioned by VOORTHUYSEN seems to correspond to the form in the Hodde Formation.

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Hodde Formation, Gram Formation. North Germany: Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (HINSCH). Holland: Mittelmiozän (VOORTHUYSEN).

Hinia slieswicia (RASMUSSEN 1966)

1966. *Nassa slieswicia nov. sp.* – RASMUSSEN, Molluscan Faunas I, p. 190.

As to this species reference is made to the description *op. cit.*

FAMILIA: FASCIOLARIIDAE

Genus: *Lathyrus* MONFORT 1810

(Type: *Murex gibbulus* GMELIN)

Lathyrus rothi (BEYRICH 1856)

Plate XVII, fig. 3 and Plate XIII, fig. 8

1856. *Fusus crispus* BORS. – M. HÖRNES, Wienerbecken I, p. 291, Pl. 32, f. 3.
1856. *Fusus Rothi* – BEYRICH, Conchylien, p. 289, Pl. 24, f. 1a, b, c.
1872. *Fusus crispus* BORSON – v. KOENEN, Mioc. Nordd. I, p. 172.
1890. *Fusus crispoides* – HÖRNES & AUINGER, I. u. II. Meditter., p. 251.

1907. *Fusus crispus* BORSON – RAVN, Jylland, p. 329 (125), Pl. VI, f. 10.
1925. *Dolicholathyrus* (*Pseudolathyrus*) *rothi* BEYR. – KAUTSKY, Hemmoor, p. 115, Pl. 8, f. 19.
1937. *Lathyrus* (*Dolicholathyrus*) *rothi* BEYR. – SIEBER, Fasciolariidae, p. 141.
1940. *Dolicholathyrus* (*Pseudolathyrus*) *rothi* BEYR. – SORGENFREI, Klintinghoved, p. 45, Pl. VI, f. 7.
1952. *Lathyrus* (*Dolicholathyrus*) *rothi* BEYR. *sp.* GLIBERT, Mioc. Belg. II, p. 111, Pl. VIII, f. 11.
1958. *Lathyrus* (*Dolicholathyrus*) *Rothi* (BEYRICH) – SORGENFREI, Middle Mioc., p. 232, Pl. 50, f. 157.
1964. *Latirus* (*Dolicholatirus*) *rothi* (BEYRICH) – ANDERSON, Reinbek-Stufe, p. 262, Pl. 27, f. 201.

Original diagnosis. Not given. The essential part of BEYRICH's original description is rendered in SORGENFREI *op. cit.*

Type material. The shell pictured by BEYRICH – the only specimen known at the time – is the holotype. Depository: unknown. Type locality: Schildstein near Lüneburg (Northern Germany). Stratum typicum: Glimmerton.

Material. Gram Clay.

Hoddemark. Karlsgårde Canal:			1 shell
Esbjerg. Clay pit or beach:			1 shell
Måde Brickworks. Eastern clay pit:			60 more or less complete shells
Gram	141.277	18.00–18.50 m.:	2 shells
–	–	19.00–19.50 m.:	1 shell
Tønder	166.398	58.85–59.00 m.:	1 shell

Description. The shell is large, fusiform, greatly sculptured.

The protoconch is rather pointed, oblong conical, multispiral, comprising about four convex and smooth whorls. (A more detailed description of the protoconch is found in SORGENFREI 1958.) On the transition to the teleoconch there are some distant collabral threads.

The whorls of the teleoconch are convex. The collabral threads on the youngest part of the protoconch soon develop into large, strong, rounded-off ribs, which in a number of 8–9 occur on all whorls, including the body whorl, where they are lost on the ramp towards the long neck of the canal.

Simultaneously with the appearance of the collabral sculpture – and often shortly before – a spiral ornamentation makes its appearance. This ornamentation comprises first three narrow, later broader, equidistant spiral bands, which unimpaired cross the collabral ribs. Immediately below the adapical suture there is rather a weak irregular spiral band. Gradually there appear weaker spiral bands or threads: first a spiral band of the second order between the adapical one of three original strong spiral bands and the adapical suture, later some weaker spiral bands or threads of the third order, which on the

younger whorls are close-set all over the surface of the shell in among the stronger spiral bands.

The sutures are formed as thin, depressed, regularly wavy lines. On the last whorl, adapically to the 3–4 ordinary strong spiral bands, there are furthermore about 10 just as strong bands far on to the neck of the canal. The intervals between these are also covered by 3–4 thin, close-set spiral threads.

The aperture is roundly oval, almost circular, abapically merged into the comparatively narrow and very long siphonal canal, which is a little oblique. The labrum is thickened. The inner lip is smooth, narrow, with an oblique columellar fold.

Remarks. This species is very characteristic, but seems to occur only in the older part of the Gram Clay.

The specimens from Denmark are in good agreement with the type described by BEYRICH, RAVN, and SORGENFREI.

The form from the Vienna Basin mentioned and pictured by HÖRNES as *Fusus crispus* has four spiral bands, especially the two abapical ones of which are prominent. SIEBER has pointed out that the shells from the sandy beds at Grund have a considerably coarser sculpture than the specimens from the so-called "Tegel" in the same place. The latter author identifies both forms with *L. rothi.*

According to HÖRNES & AUINGER the only difference between *L. rothi* and *Fusus crispus* seems to be that in the former species there are several spiral threads between the main spiral bands, whereas there is only one spiral thread in this place in *Fusus crispus.*

Distribution.

North Sea Basin. Miocene. Denmark: Klintinghoved Clay (SORGENFREI), Arnum Formation (SORGENFREI), Gram Formation. North Germany: Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON), Obermiozän (v. KOENEN). Belgium: Anversien (GLIBERT).

Atlantic Region. Aquitanian Basin: Aquitanien (*Lathyrus peyreirensis* PEYROT, according to SORGENFREI = *L. rothi*).

Mediterranean Basin. Italy: Miocene superiore (MICHELOTTI, SIEBER).

Vienna Basin. Niederösterreich: Grund, Niederleis, Vöslau, Soos, Baden, Möllersdorf (SIEBER).

Genus: *Exilia* CONRAD 1860

(Type: *Exilia pergracilis* CONRAD 1860)

Exilia contigua (BEYRICH 1857)

Plate XV, figs. 7–8

1857. *Fusus contiguus* – BEYRICH, Conchylien, p. 298, Pl. 23, f. 2a, b, c, d.
1872. *Fusus attenuatus* PHIL. – v. KOENEN, Mioc. Nordd. I, p. 171.
1925. *Exilia contigua* BEYR. – KAUTSKY, Hemmoor, p. 116.

1964. *Streptochetus (Streptolathyrus) contiguus* (BEYRICH) – ANDERSON, Reinbek-Stufe, p. 265, Pl. 27, f. 204.

Type material. The holotype is the specimen pictured by BEYRICH. Type locality: Dingden (Western Germany).

Material. Hodde Clay.

Odderup	103.150	24.8 –25.6 m.:	1 apex and 4 fragm.
Hodde	113.33a	18.5 –18.9 m.:	1 small shell without protoconch.
Måde Brickworks. Eastern clay pit:			2 shells
Gram	141.277	30.00–30.50 m.:	?1 fragment
–	–	30.50–30.95 m.:	1 defective shell and 4 fragments

Description. As the material available from the Hodde Clay is rather incomplete, it has been necessary also to examine shells from the shell bed under the Hodde Clay at Hoddemark (= Shell Bed I).

The shell is mostly very slender, fusiform, with only slightly convex whorls.

The protoconch consists of about a whorl and a half, which are smooth, paucispiral, rather obtuse and convex.

The three oldest whorls of the teleoconch are provided with collabral ribs, which are opisthocline. On the following whorls, which are completely flat, the collabral ornamentation has completely disappeared. On the other hand the opisthocline growth lines are always visible.

When the collabral ribs begin, the spiral ornamentation also starts, consisting of four or five broad, very flat spiral bands which are evenly distributed over the whorl. Their interspaces are somewhat smaller than their breadth. They are found on the whole teleoconch including the neck of the canal, where they are especially numerous and close-set with intercalated spiral bands of the second order.

The aperture is narrow and oblong oval. Labrum has been broken off the present shells. The columellar lip is usually smooth, but some of the spiral bands of the neck of the canal continue over it with undiminished strength. The siphonal canal is long and narrow.

Remarks. The shell from Måde pictured lacks the protoconch, and furthermore it is somewhat corroded on the surface. The spiral ornamentation and the course of the growth lines are as in the shell from Hoddemark described above, but it differs by a spiral thread being intercalated between some of the spiral bands. The shell must also have been somewhat longer than the specimen from Hoddemark. It corresponds completely to specimens from Twistringen, where I have collected nine shells which also have spiral threads in the intervals between the bands and, for that matter, vary a little as regards the size of the apical angle.

It has not been possible to verify the placing of this species in the genus of *Exilia*, and it is still doubtful how this genus should be placed in relation to the other siphonostomatous gastropods. I have here exclusively followed KAUTSKY's view.

Distribution.

North Sea Basin. Miocene. Denmark: Hodde Formation. North Germany: Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON), Lieth (fide SEMPER in v. KOENEN). Holland: Berssenbrück and Eibergen (v. KOENEN). Belgium: Anversien at Edeghem (v. KOENEN and KAUTSKY).

Genus: *Streptochetus* COSSMANN 1889

(Type: *Fusus intortus* LAMARCK)

Streptochetus sexcostatus (BEYRICH 1856)

Plate XII, figs. 5–6

1856. *Fusus sexcostatus* – BEYRICH, Conchylien, p. 287, Pl. 24, f. 2a, b, c.
1872. *Fusus sexcostatus* BEYR. – v. KOENEN, Mioc. Nordd. I, p. 174.
1907. *Fusus sexcostatus* BEYRICH – RAVN, Jylland, p. 331.
1925. *Streptochetus sexcostatus* BEYR. – KAUTSKY, Hemmoor, p. 116, Pl. 8, f. 20, 21.
1940. *Streptochetus sexcostatus* BEYRICH – SORGENFREI, Klintinghoved, p. 46.
1952. *Streptochetus sexcostatus* BEYRICH *sp.* – GLIBERT, Mioc. Belg. II, p. 110, Pl. VIII, f. 4.
1958. *Fusus cf. sexcostatus* BEYRICH – SORGENFREI, Middle Mioc., p. 233, Pl. 50, f. 158.
1961. *Streptochetus (Streptodictyon) sexcostatus* (BEYRICH) – TEMBROCK, Determination, p. 372, Pl. I, f. 7, 8, Pl. II, f. 5, 6.
1964. *Streptochetus (Streptodictyon) sexcostatus* (BEYRICH) – ANDERSON, Reinbek-Stufe, p. 263, Pl. 27, f. 202.

Original diagnosis. Not given. The chief part of the original description by BEYRICH has been rendered in SORGENFREI 1958.

Type material. The shell depicted by BEYRICH *op. cit.* Plate 24, figs. 2a, b, is the holotype. Depository: unknown. Type locality: Dingden.

Material. Hodde Clay.

Gram	141.277	30.00–30.50 m.:	4 fragments
–	–	31.95–32.30 m.:	1 fragment
–	–	32.70–33.05 m.:	1 fragment of a protoconch
–	–	34.25–34.70 m.:	2 fragments
–	–	35.30–35.70 m.:	5 fragments
Hajstrup	167.235	174′–194′ :	1 fragment

Description. (On the basis of material from Shell Bed I, Hoddemark). The shell is rather large, fusiform.

The protoconch is conical, multispiral, comprising up to some five convex whorls. The initial whorl is small, vesicular, slightly heterostrophic. The medial

whorls are smooth. The terminal whorls, of which there are generally two, have a regular lattice-work of five equidistant spiral threads crossed by numerous collabral threads, which at first are slightly opisthocyrt, later more orthocline. On a well preserved shell from Twistringen in Northern Germany there are 51 collabral threads on the youngest terminal whorl and 35 on the youngest but one. The abapical one of the five spiral threads is on all the present shells from Denmark and Northern Germany immediately above the suture.

The whorls of the teleoconch are convex, covered by rather close-set spiral bands or threads. On the last whorl there are five spiral threads. They are a direct continuation of the spiral threads of the terminal protoconch.

Already on the following whorl there is on several shells a new spiral thread between the five persistent ones. The new spiral threads soon become of the same strength as the five, so that it is a case of a sculpture of rather close-set homogeneously shaped spiral threads or bands. Already on the oldest whorl of the teleoconch there are comparatively broad, rounded-off collabral ribs at rather great mutual interspaces. On the shells from Twistringen there are six collabral ribs, whereas on the shells from Shell Bed I at Hoddemark (Karlsgårde Canal) there are eight or nine. None of the present juvenile shells from the Hodde Clay have a single complete teleoconch whorl.

The aperture is oval. Labrum is sharp-edged, but has not been completely preserved on any of the present shells. The inner lip is smooth, well delimited from the surface of the base, provided with an oblique columellar fold. The siphonal canal is rather short and straight.

Variations. Among shells from Shell Bed I at Hoddemark there are specimens with constantly only five collabral ribs. These ribs are placed regularly below each other on all whorls, so that the shell as seen towards the apex in the direction of the base has a characteristic, regular, pentagonal outline. It is doubtful whether these shells should be referred to a special species or not. In the analytical list of the shells from Shell Bed I on pp. 204–206 in Part I this form is denoted as *S. nov. sp.* A specimen is pictured on Plate XV, figs. 1 and 4 (under the name of *S.* "*quinquecostatus*").

Remarks. The Oligocene *S. retrorsicosta* (SANDBERGER 1863) is interpreted as a predecessor of *S. sexcostatus.* Both of these species and other species of *Streptochetus* are discussed in detail in the cited work of TEMBROCK, who has shown that in all the species of the genus there are two different forms of protoconchs: Form *a* with four smooth initial and medial whorls and three fourths of the terminal whorl with a lattice-work sculpture and Form *b*, on which the number of these whorls are three and one and one fourth, respectively. Similar deviations are seen in the Danish material. TEMBROCK interprets these forms as respectively male and female individuals.

Measurements. A complete shell from Twistringen has the following dimensions: Length: 7.8 mm., greatest diameter: 3.3 mm., length of the aperture (including the canal): 4.0 mm., length of the protoconch: 2.0 mm., and greatest diameter of the protoconch: 1.4 mm.

Distribution.

North Sea Basin. Miocene. Denmark: Klintinghoved Clay (SORGENFREI), Arnum Formation (SORGENFREI), Hodde Formation. North Germany: Untermiozän (KAUTSKY) Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON), Obermiozän (STAESCHE). Holland: Mittelmiozän (MOLENGRAAF & v. d. GRACHT). Belgium: Horizon de Houthaelen, Anversien (GLIBERT).

Streptochetus abruptus (BEYRICH 1856)
Plate XIII, fig. 7, and Plate XVI, figs. 1–2 and 5–6

1856. *Fusus abruptus* – BEYRICH, Conchylien, p. 286.
1872. *Fusus abruptus* BEYRICH – v. KOENEN, Mioc. Nordd. I, p. 172.
1933. *Fusus (Aquilofusus) abruptus* – GRIPP, Hamburg, Pl. VI, f. 3.
1962. *Streptochetus abruptus* (BEYRICH) – HINSCH, Twistringen, Pl. 28, f. 10.
1964. *Streptochetus (Streptodictyon) abruptus* (BEYRICH) – ANDERSON, Reinbek-Stufe, p. 264, Pl. 27, f. 203.

Diagnosis. Not given by BEYRICH. – A *Streptochetus* with collabral sculpture on the oldest $1\frac{1}{2}$–2 whorls of the teleoconch, but only with spiral ornamentation on the other adult whorls.

Type material. BEYRICH's types consisted of impressions of shells in sandstone from Bokup and of a few juvenile shells from Reinbek. The neotype chosen is the shell pictured on Plate XVI, fig. 1, which is kept in the collection of Danmarks Geologiske Undersøgelse and was collected by the present writer on 26.4.1959. Type locality: the clay pit of Twistringen Brickworks, Northwest Germany.

Material. Hodde Clay.

The northwestern pit of Måde Brickworks: 1 shell, the eastern pit: 1 shell. In the investigations are furthermore included 1 shell from the shell bed under the Hodde Clay at Hoddemark and 9 shells from Twistringen, Northwest Germany.

Description. The shell is slender, fusiform, with flat, sometimes slightly concave whorls.

The protoconch, which is trochiform, multispiral with a small nucleus, consists of 4–5 whorls, which soon increase in height and diameter. The oldest one or two whorls are smooth and moderately convex. The youngest 2–3 whorls are more highly convex and provided with a cancellate sculpture of 4 very thin spiral threads crossed by opisthocyrt collabral threads. The net-

work thus arising has rather wide meshes. The collabral threads are actually prominent growth lines. On shells from Twistringen they are on certain sections of the whorls very close-set and numerous, on other sections more scattered and few in number.

The teleoconch comprises up to six whorls, which as regards sculpture fall into two main sections, the oldest $1\frac{1}{2}$–2 whorls having collabral as well as spiral ornamentation, while the other whorls have only spiral sculpture.

The first whorl after the protoconch has 8–9 strong, rounded, collabral ribs, which have arisen by a few of the collabral threads of the protoconch becoming more and more prominent and after a distance of about one fourth of a whorl developing into ribs. The distance between them is increasing and already on the following whorl they disappear on most specimens. On a few shells, however, this only takes place on the next whorl.

The spiral ornamentation is on the oldest whorls a distinct further development of the four spiral threads on the youngest part of the protoconch. Four rather strong spiral bands make their appearance, their breadth, however, being smaller than the interspaces between them, and they pass undiminished over the collabral ribs. Adapically to these spiral bands there are furthermore one, later two spiral threads immediately below the suture. On the following whorls more spiral bands are soon added, so that the surface of the shell is completely covered with some twelve flat spiral bands, the breadth of which is varying. On some shells four of the spiral bands are constantly more pronounced than the others, especially on the older whorls of the shells. The dense spiral ornamentation continues uninterruptedly on to the neck of the canal, right to the extreme end of the canal.

The growth lines close to the adapical suture curve adaxially for a short distance, in order then to pass orthocline over the rest of the whorl.

The aperture is oblong oval and continues abapically as a narrow canal of moderate length. The labrum has been broken off all the present shells. The columellar lip is smooth. On the columella there is an oblique fold.

On the specimen from Hoddemark the surface of the shell is very slightly folded, as can partly be seen at oblique light, partly is indicated when the shell is observed in transverse section when seeing the apex in the axial direction.

The shell from the eastern pit of Måde Brickworks lacks the uppermost whorls of the protoconch and its adult whorls are slightly concave.

Measurements. The shells pictured have the following dimensions:

	Twistringen	Hoddemark	Måde
Length of the axis:	19.9 mm.	20.0 mm.	14.4 mm.
Maximum diameter:	6.8 –	7.3 –	5.0 –
Height of the protoconch:	1.0 –	1.2 –	
Height of the aperture:	5.6 –	5.6 –	4.4 –
Length of the canal:	3.3 –		3.3 –

Remarks. A closely related form from the Lower Miocene Mica Clay at Itzehoe in Holstein has been described and pictured by GRIPP (1914, p. 21, Plate 2, figs. 17–19) under the name of *Fusus abruptus var. Gottschei.* As differences from the main form GRIPP states that his subspecies has a somewhat smaller apical angle and obviously no fold on the columella, and the spiral ornamentation is characterized by the fact that four spiral bands are more prominent than the other spiral bands, also on the youngest whorls.

Besides, *S. abruptus* is characterized by GRIPP (1933 p. 92) as a guiding species for the Reinbek-Stufe in Germany. So far the species has not been described, as BEYRICH had no suitable material at his disposal. A picture of a shell from the Middle Miocene beds of Langenfelde was given by GRIPP in 1933 (Plate VI, fig. 3). After completion of the manuscript to the present work a description was given by ANDERSON (1964, see list of synonyms).

Distribution.

North Sea Basin. Miocene. Denmark: Hodde Formation. North Germany: Reinbek-Stufe (ANDERSON).

Genus: *Aquilofusus* KAUTSKY 1925
(Type: *Fusus waeli* NYST)

Aquilofusus festivus (BEYRICH 1856)
Plate XIII, figs. 2–3 and Plate XIV, figs. 3 and 8

1856. *Fusus festivus* – BEYRICH, Conchylien, p. 262, Pl. 19, f. 1a, b, 2, 2a.
1872. *Fusus festivus* BEYR. – v. KOENEN, Mioc. Nordd. I, p. 175.
1925. *Aquilofusus festivus* BEYR. – KAUTSKY, Hemmoor, p. 125.
1962. *Aquilofusus festivus* (BEYRICH) – HINSCH, Twistringen, Pl. 28, f. 9 (only fig.).
1964. *Aquilofusus festivus* (BEYRICH) – ANDERSON, Reinbek-Stufe, p. 266, Pl. 27, f. 205 and 205a.

Original diagnosis. Not given. *Outlines of the original description:* "Die Schale ist spindelförmig. Das Gewinde mit einem kleinen, stumpfen Embryonalende von nur einer flach liegenden Windung. Die Mittelwindungen sind gewölbt, nach oben kantig, oberhalb der Kante rinnenartig ausgehöhlt, unterhalb derselben gewölbt und zur unteren Naht hin eingezogen ... Die oberen Mittelwindungen haben einen schon am Embryonalende beginnenden Nahtsaum, eine stärkere über die Kante fortlaufende und dieselbe erhebende Leiste, und darunter anfangs einen, dann zwei minder starke Querstreifen. Zu dieser Querskulptur treten schwache, auf der Kante in einem stumpfen Winkel geknickte Längsfältchen hinzu ... In den unteren Windungen verliert sich der Nahtsaum, die Rinne bleibt ohne Querstreifen ..." (BEYRICH 1856).

Type material. The specimen pictured by BEYRICH, *op. cit.* Plate 19, figs. 1a and b, is the holotype. Depository: unknown. Type locality: Bersenbrück.

Material. Hodde Clay.

Måde. Eastern clay pit, north wall: 1 defective and weathered shell.

Description. Because of the poorly preserved material from the Hodde Clay the material from Shell Bed I at Hoddemark (Karlsgårde Canal) and Twistringen (North Germany) has been used as basis of the following description.

The shell is large, fusiform.

The protoconch is comparatively small, dome-like, paucispiral, comprising 1–1½ smooth whorls and ½ terminal whorl with a spiral thread immediately below the adapical suture and a spiral thread on about the middle of the whorl.

The whorls of the teleoconch are subangular. The oldest whorl with a weak spiral thread immediately below the adapical suture and two strong spiral threads or bands in the middle. Simultaneously collabral filamentous ribs appear, which at first are widely spaced and later close-set. On the next whorl the collabral ribs increase in size and simultaneously the number of spiral ribs increases to three. The adapical spiral rib increases in strength and gives rise to the formation of rather a conspicuous shoulder or edge while at the same time a cavity forms adapically to it. On the following whorls weak spiral threads appear adapically to Spiral Rib 2.

The collabral ribs, which are placed obliquely, are gradually only seen abapically to the adapical spiral rib. They are weaker on the younger whorls of most shells, but never disappear completely. The spiral sculpture continues right on to the neck of the canal.

The aperture is roundly oval. Labrum has been broken off the present shells. The inner lip is smooth, sharply delimited from the surface of the base, often with an oblique columellar fold. The siphonal canal is comparatively long and straight.

Variations. The material from Hoddemark shows rather a great variation as regards the sculpture. There are shells with a highly developed carina and shells without a carina, but with evenly convex whorls. The number of spiral ribs varies as well.

The only shell from Twistringen available to me lacks collabral ribs on the youngest whorls, and the spiral bands on these whorls are greatly blurred.

Remarks. Shells of the type with the convex whorls from Shell Bed I at Hoddemark may become so greatly similar to the figures of *A. beyrichi* (NYST 1861) in the literature (KAUTSKY 1925 and GLIBERT 1952) that it seems that they ought to be referred to this species. I have not had any material of *A. beyrichi* for comparison at my disposal, but if my assumption is correct, the species seems to be a forerunner of *A. festivus*. The two forms may even be connected through even transitions so that both of them belong to *A. beyrichi*. *A. festivus* then must be considered a subspecies. So far, however, more material is needed before this problem can be solved.

A. festivus seems to be limited to occurring in the German Reinbek-Stufe. The previous statements of the occurrence of the species at Gühlitz in Mecklenburg have later been invalidated by GRIPP (1959, p. 101), who states that there has been a confusion with *A. lategradatus* (KAUTSKY 1925).

v. KOENEN's having recorded *A. festivus* from Tornskov in Slesvig suggests that this species together with several others (cf. RASMUSSEN 1956, p. 26) originates from beds which are equivalent to the Reinbek beds. From the same locality mainly such species are known as belong to the Gram Formation.

Measurements.

Locality	Length	Diameter	Length of the aperture including the canal	Protoconch Length	Protoconch Diameter
Hoddemark	6.3 mm.	3.4 mm.	3.6 mm.	0.8 mm.	1.2 mm.
–				1.2 –	1.4 –
Twistringen	26.3 –	11.8 –	11.4 –	1.2 –	1.4 –

A defective shell from Hoddemark must have been at least 25 mm. long.

Distribution.

North Sea Basin. Miocene. Denmark: Hodde Formation. North Germany: Reinbek-Stufe (GRIPP, ANDERSON). Holland: Mittelmiozän (MOLENGRAAFF & v. D. GRACHT).

Aquilofusus luneburgensis (PHILIPPI in VOLGER 1845)

1845. *Fusus Luneburgensis* PHILIPPI – VOLGER, De Agri Luneburgici, p. 36.
1846. *Fusus luneburgensis* – PHILIPPI, Verzeichniss, p. 74, Pl. Xa, f. 6.
1856. *Fusus luneburgensis* PHIL. – BEYRICH, Conchylien, p. 267, Pl. 19, f. 10.
1872. *Fusus lüneburgensis* PHIL. – v. KOENEN, Mioc. Nordd. I, p. 177.
1925. *?Aquilofusus lüneburgensis* PHIL. – KAUTSKY, Hemmoor, p. 122.
1952. *β-Aquilofusus luneburgensis* (PHILIPPI) – HINSCH, Leit. Moll., p. 164, Pl. B, f. 9–11.
1958. *β-Aquilofusus luneburgensis* (PHILIPPI) – HINSCH, Maade, p. 472.

Original diagnosis. F. testa elongato-fusiformi; anfractibus rotundatis, sutura profunda divisis, lineisque impressis transversis, plicisque frequentibus longitudinalibus, arcuatis exaratis; cauda satis abrupta; apertura cum canali, spiram haud aequante. Long 17‴; lat. $8\frac{1}{2}$‴ (PHILIPPI in VOLGER 1845).

New diagnosis by HINSCH 1952: Ein relativ gedrungener *β-Aquilofusus*. Die letzte Embryonalwindung trägt *drei* oder vier Primärspiralen. Die Rippen verlöschen sehr selten auf der Schlusswindung. Der Kanal ist relativ kurz.

Type material. PHILIPPI's holotype (pictured in 1846, Plate Xa, fig. 6) has presumably been lost. HINSCH's neotypes are kept at the Geologisches Staatsinstitut in Hamburg as Nos. 180, 181a, and 181b. Type localities: PHILIPPI's material originated from Lüneburg (clay pit at Ziegelberg), while HINSCH's material has been found in the clay pits at Langenfelde. Stratum typicum:

Glimmerton. Derivatio nominis: luneburgensis = from the town of Lüneburg in Northern Germany.

Description. In the *luneburgensis*-form-cycle I include all the *Aquilofusus* forms with the following common characters:

(1) Three spiral threads on the protoconch.
(2) Three main spiral bands on, at any rate, the oldest whorls of the teleoconch.

The variations in the spiral as well as the collabral ornamentation are great. The material can, however, be grouped in four subspecies, which are connected through even transitions, but which have each their characteristic stamp, so that at any rate part of the material can easily be referred to the subspecies in question.

Distribution. This species has only been found in Upper Miocene strata of North Germany and Denmark.

1. *Aquilofusus luneburgensis tricinctus* (BEYRICH 1856)
Plate XIII, fig. 4, and Plate XIV, fig. 9

1856. *Fusus tricinctus* – BEYRICH, Conchylien, p. 263, Pl. 19, f. 4.
1872. *Fusus tricinctus* BEYR. – v. KOENEN, Mioc. Nordd. I, p. 175.

Description of an incomplete specimen from Langenfelde kept in the collections of the Mineralogical Museum of the University of Copenhagen (submitted to the museum in 1897 from the Naturhistorisches Museum at Hamburg).

The shell is big, fusiform. The protoconch is paucispiral. The initial whorl has been broken off. The terminal whorl is evenly convex with an adapical, subsutural spiral thread and three other spiral threads, all crossed by numerous thin orthocline collabral threads.

The whorls of the teleoconch are angular. The subsutural spiral thread has disappeared. The three other spiral threads have been fortified into strong and broad spiral bands, the abapical one of which is a little weaker than the others. The region between the adapical suture and the adapical spiral band is shaped as rather a steep ramp. The abapical two thirds of the whorl is flatly convex. In the middle of this section is the middle spiral bands, while the abapical spiral band is close to the abapical suture. The collabral ornamentation is fortified simultaneously to the spiral ornamentation by the forming of ribs. The number of ribs varies between 13 and 16 per whorl.

The basal parts of the shell have been broken off.

Main characters. Three particularly prominent spiral bands and often angular whorls.

Distribution.

North Sea Basin. Upper Miocene. Germany: Gühlitz, Reinbek, Lüneburg, Langenfelde (V. KOENEN).

This subspecies has not so far been recorded from Denmark.

2. *Aquilofusus luneburgensis luneburgensis* (PHILIPPI 1845)

Plate XIV, figs. 1–2 and 7

For list of synonyms see p. 153

Material. Gram Clay.

Hoddemark. Karlsgårde Canal:	3 shells
Grøde. Karlsgårde Canal:	1 shell
Måde Brickworks. Northwestern clay pit:	1 shell
– Eastern clay pit:	21 shells
Strandgård Brickworks. Clay pit:	5 shells

Description. The shell is big, fusiform. The protoconch as in the preceding subspecies. The initial whorl is smooth, fairly small, hardly raised over the following whorl.

The whorls of the teleoconch are convex, with a strong spiral and collabral ornamentation. There are three characteristic spiral bands of the first order on the abapical two thirds of the whorl, and a spiral band of the second order between the abapical suture and the abapical spiral band of the first order. Gradually there appears one or more spiral bands of weaker orders between the stronger ones. There are collabral ribs, more or less opisthocyrt, of varying breadth and prominence, the number ranging from 10 to 19 per whorl. The aperture is roundly oval. The labrum is sharp-edged. The inner lip is smooth, well-defined. The siphonal canal is fairly long, often a little oblique.

Main characters. Strong, sometimes rather coarse, spiral and collabral ornamentation on all whorls. Three spiral bands are especially prominent. The whorls are convex.

Measurements. The shell pictured on Plate XIV, figs. 1 and 2, measures: Length of the axis: 41.4 mm., longest diameter: 16.2 mm., length of the aperture (including the canal): 18.5 mm.

Most of the other adult shells from the eastern clay pit of Måde Brickworks measure from 18 to 40 mm. in length and from 8 to 17 mm. in the longest diameter. The apical angle varies from about 34° to about 41°. The largest number of adult whorls recorded is 6 in all.

Nearly all the present shells are more or less defective, so that very few specimens can have all dimensions measured.

Distribution.

North Sea Basin. Upper Miocene. Germany: Lüneburg, Langenfelde, Elbtunnel, Wohltorf, Lieth (HINSCH). Denmark: Måde Brickworks, eastern clay pit, Gram Clay (the oldest horizon).

3. *Aquilofusus luneburgensis meyni* (SEMPER in V. KOENEN 1872)
Table XIV, fig. 4

1872. *Fusus Meyni* SEMPER – V. KOENEN, Mioc. Nordd. I, p. 178, Pl. 1, f. 6a, b, c.

Material. Gram Clay.

Måde Brickworks. Eastern clay pit: 4 or 5 shells.

Description. The shell is big, fusiform.

The protoconch as in the case of the other subspecies.

The whorls of the teleoconch are moderately convex. The oldest whorl has three spiral bands of the first order. Between the adapical suture and the abapical spiral band there is a spiral band of a lower order. A similar one is seen close to the abapical suture. The next whorl but one and the following ones are covered by numerous flat and narrow spiral bands of nearly the same prominence. The number ranges from 9 to 15 per whorl. The collabral ornamentation consists of mostly rather narrow, more or less opisthocyrt ribs in a number of 10–20 per whorl.

The basal parts are as in the other subspecies.

Main characters. Three prominent spiral bands of the first order occur only on the oldest whorl of the teleoconch. The other whorls have numerous rather fine spiral bands and comparatively narrow collabral ribs.

Measurements. A shell from Langenfelde (in the collections of the Mineralogical Museum of the University of Copenhagen) has the following measures: Length: 36.3 mm., longest diameter: 13.8 mm., and length of the aperture: 17.3 mm. (including the canal).

Another shell from the eastern clay pit of Måde Brickworks shows in the case of the corresponding dimensions: 29.5 mm., 12.3 mm., and 14.1 mm., respectively.

Distribution.

North Sea Basin. Miocene. North Germany: Lüneburg, Langenfelde, Lieth, Teufelsbrücke (V. KOENEN). Denmark: Gram Formation (Måde, Gram Clay).

4. *Aquilofusus luneburgensis eximius* (BEYRICH 1856)
Plate XIV, figs. 5–6, and Plate XV, figs. 2–3

1856. *Fusus eximius* – BEYRICH, Conchylien, p. 265, Pl. 19, f. 3, 5, 5a, 6, 7.
1872. *Fusus eximius* BEYR. – V. KOENEN, Mioc. Nordd. I, p. 176.

1907. *Fusus eximius* BEYRICH – RAVN, Jylland, p. 328.
1952. *β-Aquilofusus eximius* (BEYRICH) – HINSCH, Leit. Moll., p. 167.

Material. Gram Clay.

Lille Spåbæk. Lignite pit:			1 shell
Møltrup Brickworks. Clay pit:			1 shell
Alkærsig Brickworks. Clay pit:			1 shell
Esbjerg.	130.59	73.0 –74.5 m.:	1 shell
–	Clay pit and beach:		17 shells
Gram	141.277	14.00–14.60 m.:	1 shell

Description. The shell is big, fusiform. The protoconch has three spiral threads crossed by numerous slightly raised collabral threads, which actually are well-marked growth lines.

The whorls of the teleoconch are convex, with three distinctive spiral bands. On whorls 3 and 4 there is a spiral band of the second order between the adapical and the middle one of the three spiral bands of the first order. There is a collabral sculpture of ribs, the mutual distance between which corresponds to the distance between the spiral bands, with which, for that matter, they may be compared as regards breadth. The ornamentation of the teleoconch therefore is often a fairly regular lattice-work.

The basal parts of the shell are as in the other subspecies.

Main characters. Three spiral bands are most prominent. The collabral ribs and the spiral bands often form a regular lattice-work.

Measurements. The pictured shell from Morsum Kliff measures:
Length 29.5 mm., longest diameter 12.3 mm., and length of the aperture (including the canal) 13.0 mm.

Distribution.

North Sea Basin. Upper Miocene. North Germany: Morsum Kliff (HINSCH). Denmark: Lille Spåbæk, Møltrup, Alkærsig, Esbjerg, Gram.

Remarks. The commonest of the subspecies described here is *A. luneburgensis* sensu stricto.

HINSCH (*loc. cit.* p. 167) states that *A. eximius* has only two primary spirals (spirals of the first order). This does not apply to the shells of this subspecies from Morsum Kliff in the collection of D.G.U., which clearly have three spiral bands of the first order (cf. picture Plate XV, figs. 2–3).

For that matter, I have not sufficient material at my disposal to decide with certainty whether the form from Morsum Kliff and the form from the Gram Clay at Esbjerg are completely identical.

Aquilofusus semiglaber (BEYRICH 1856)

1956. *Aquilofusus semiglaber* (BEYRICH) – RASMUSSEN, South Jutland, p. 75, Pl. VII, f. 2a, b.

1958. *β-Aquilofusus semiglaber* (BEYRICH) – HINSCH, Maade, p. 472.

Material. Gram Clay.

Shell material is available from the following localities (cf. Tables 15–66 in Part I):

Skærum Mølle (clay pit), Lille Spåbæk (clay pit), Grønbjærg (clay pit), Gjellerup (85.382), Sandfeldbjerg (clay pit), Brande Brickworks (clay pit), Drantum (104.1241), Alkærsig Brickworks (clay pit), Forsum Brickworks (clay pit), Hauge (clay pit, transition to *A. eximius*), Tønding (clay pit), Hoddemark (Karlsgårde Canal), Esbjerg (clay pit and beach), Måde Brickworks (eastern clay pit), Strandgård Brickworks (clay pit), Gørding (unknown pit), Holleskov (132.46b), Ravning (clay pit), Sønder Hygum (141.260 and 141.261), Rødding (141.243), Gram (141.277), Spandetgård (clay pit), Brodersmark (166.351b), Sæd (167.445), and Rends (167.236).

Description. The shell is big, fusiform.

The protoconch is dome-like, paucispiral, comprising about two whorls and a half. The initial whorl is small, smooth, on a level with the following whorl. The other whorls are convex. The terminal part comprises about a whorl and a half with two spiral threads in the middle of the whorl at some distance from each other, crossed by numerous thin, orthocline, collabral threads.

The whorls of the teleoconch are convex. The oldest of these has two distinctive spiral bands of the first order in the middle of the whorl, and a spiral band of the second order between the adapical suture and the adapical spiral band of the first order. The spiral band of the second order is stronger on the younger whorls and gradually new spiral bands develop between the two of the first order and between the abapical one of these and the abapical suture. The spiral bands are gradually somewhat weakened and then appear with the same prominence.

The collabral sculpture comprises a number (11–17 or more) slightly opisthocyrt ribs, which appear already on the oldest whorl of the teleoconch, but disappear or are weakened already on the fourth or the fifth whorl, so that the youngest ones are smooth, apart from the weakened spiral sculpture.

On the lower part of the base and the neck of the canal the spiral sculpture is again more prominent and directed obliquely in relation to the axis of the shell.

The aperture is oval, passing abapically into a long, somewhat oblique siphonal canal surrounded by a straight, comparatively long neck of the canal. Labrum is sharp-edged, but mostly broken off. The inner lip is well-defined, smooth.

Remarks. This species, as pointed out by HINSCH (1952), clearly differs from the closely related *A. luneburgensis* by having only two spiral threads on the

terminal part of the protoconch and two pronounced spiral bands on the oldest whorls of the teleoconch. On the other hand, the absence of collabral ribs on the youngest whorls of the shell must be considered a secondary character. Specimens of *A. luneburgensis* may also show this character. In 1958 HINSCH pointed out that *A. semiglaber* generally seems to have a smaller apical angle than *A. luneburgensis*.

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation. North Germany: Gram-Stufe at Fresenmoor (HINSCH).

Aquilofusus sp.

Plate XIII, fig. 1

Material. Gram Clay.

Måde. Strandgård Brickworks: 1 shell
Hodde. Unknown locality on the Karlsgårde Canal: 1 shell.

Description. The shell is big, fusiform, with angular whorls.

The protoconch has been broken off.

The teleoconch has six whorls provided with two distinctive spiral bands. The part adapical to the adapical spiral band forms an acute angle with the axis of the shell, while the section abapical to the abapical spiral band has a relatively slighter inclination adaxially. On the latter part the fifth whorl has a spiral thread of the second order. The ramp towards the neck of the canal and the surface of the neck is provided with 15 prominent spiral bands.

The collabral sculpture consists of opisthocyrt ribs, which are somewhat narrower than the spiral bands and which, following the growth lines, are only prominent in the interval between the spiral bands, and are perpendicular to these. On the third whorl there are 17, on the fourth 19, and on the fifth whorl 23 collabral ribs. On the sixth and youngest whorl they are greatly blurred.

The aperture is oval, subangular, abapically passing into a siphonal canal of moderate length. Labrum is sharp-edged. The inner lip is smooth, well-defined.

Remarks. It has not been possible to identify the shells with any species described so far. They can to a certain extent be compared with *A. luneburgensis tricinctus*, but they have two spiral bands of the first order instead of three. It would be tempting to consider the present form as a corresponding subspecies of *A. semiglaber*. For that matter, the shell from Strandgård Brickworks was found together with shells of the latter species.

So far the question whether there is here a new species must be left open until further material is available, at best also with the protoconch preserved.

Aquilofusus puggaardi (BEYRICH 1856)
Plate XIII, figs. 5–6

1956. *Aquilofusus puggaardi* (BEYRICH) – RASMUSSEN, South Jutland, p. 76, Pl. VII, f. 3.

Material. Gram Clay.

Shell material is available from the following localities (cf. Tables 15–66 in Part I):

Skærum Mølle (clay pit), Lille Spåbæk (lignite pit), Videbæk (83.344), Møltrup Brickworks (clay pit), Lille Torup (85.379), Alkærsig Brickworks (clay pit), Odderup (103.150), Hesselho (113.121), Hauge (clay pit), Tønding (clay pit), Hoddemark (Karlsgårde Canal), Esbjerg (clay pit and beach), Måde Brickworks (Eastern clay pit), Strandgård Brickworks (clay pit), and Gram (141.277).

Description. The shell is of moderate size, fusiform.

The protoconch is obtuse, paucispiral, comprising two whorls and a half. The initial whorl is fairly small, only a little raised over the following whorl. The terminal whorl is relatively high, with four prominent spiral threads. The adapical thread is somewhat below the adapical suture. The spiral threads are crossed by numerous thin collabral threads.

The whorls of the teleoconch are convex, with four, later five spiral bands. Between the adapical suture and the adapical one of the four spiral bands on the oldest whorls there is a greater interspace than between the other spiral bands mutually and between these and the abapical suture. In this interspace there are first five spiral bands, later perhaps some more, which are thinner.

On the teleoconch there are immediately after the protoconch some very prominent, rounded collabral, slightly opisthocyrt ribs, which are somewhat more widely spaced than themselves. Their number increases from about 10–11 on the oldest whorls to 17–18 on the youngest ones.

The aperture is oval. Labrum is sharp-edged. Labium is smooth, well-defined. The siphonal canal is comparatively short, slightly twisted.

Variations. The species varies somewhat as regards the collabral sculpture, as, especially in the older layers of Gram Clay at Måde, there are shells with collabral ribs on the youngest whorls, while shells without such ribs on the younger part of the shell are most common in the younger layers of the Gram Clay, e.g. at Gram Brickworks.

Remarks. See RASMUSSEN *loc. cit.*

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation. North Germany: Langenfelde-Stufe, Gram-Stufe, Sylt-Stufe (HINSCH). Holland: Upper Miocene at Oploo (GRIPP).

FAMILIA: MITRIDAE

Genus: *Uromitra* BELLARDI 1887

(Type: *Voluta cupressinum* BROCCHI 1814)

Uromitra cimbrica (OPPENHEIM in KAUTSKY 1925)

Plate XVII, figs. 5–6

1952. *Uromitra wirtzi* – HINSCH, Leit. Moll., p. 169, Pl. C, f. 4.

1952. *Uromitra cimbrica* (OPPENHEIM in KAUTSKY) – HINSCH, Leit. Moll., p. 169, Pl. C, f. 3.

1956. *Uromitra cimbrica* (OPPENHEIM in KAUTSKY) – RASMUSSEN, South Jutland, p. 77, Pl. VII, f. 4.

Material. Gram Clay.

Lillelund	73.88	28.5 –49.5 m.:	1 shell	
Videbæk	84.1748	23.95–24.95 m.:	1 shell	
Møltrup Brickworks. Clay pit:			1 shell	
Drantum	104.1241	46.0 –50.0 m.:	1 shell	
Nyholm	104.1166	15.2 –16.2 m.:	1 shell	
Alkærsig Brickworks. Clay pit:			2 shells	
Hauge. Clay pit:			2 shells	
Hoddemark. Karlsgårde Canal:			1 shell	(type: *wirtzi* HINSCH)
Esbjerg. Clay pit and beach:			43 shells	
Måde Brickworks. Eastern clay pit:			*U. cimbrica wirtzi:*	13 shells
			U. cimbrica cimbrica or *U. cimbrica wirtzi:*	55 shells
Strandgård Brickworks. Clay pit:			*U. cimbrica wirtzi:*	1 shell
			U. cimbrica cimbrica:	1 shell
Holleskov	132.46b	4.9 –11.2 m.:	1 shell	
Sønder Hygum	141.261	20 m.:	1 shell	
Gram	141.277	14.00–14.60 m.:	1 shell	
–	–	14.60–15.10 m.:	1 shell	
–	–	15.10–15.55 m.:	1 shell	

Description. The shell is more or less slender, fusiform.

The protoconch is bud-shaped, paucispiral, consisting of one and one fourth smooth whorls.

The teleoconch has relatively many (up to 8) whorls, which are quite flat or very flatly convex, provided with a spiral belt immediately below the adapical suture, which gives the shell a more or less pronouncedly stepped relief. Shells with a broad and prominent spiral belt are comparatively broader and have a shorter apex than shells with a narrow spiral belt. This belt has arisen by the merging of 2–3, more rarely 4, spiral bands, and its breadth occupies from one third to half of the height of the whorl, in very slender shells, however, a considerably smaller part. The region abapical to the spiral belt is provided with 3–4 spiral bands. On a few shells with particularly tall whorls, however, up to six such spiral bands are seen. They are flat and are of the same breadth

as the interspaces between them. These interspaces, however, are often considerably narrower and may even be reduced to being narrow grooves. The distance between the spiral belt and the adapical spiral band in most shells seems to be a little broader than between the other spiral bands.

The spiral sculpture crosses numerous (10–21 or more) collabral ribs, which are almost orthocline, but still a little obliquely placed over the spiral belt. The number increases rather considerably with age in the same individual. They are of the same breadth as the interspaces between them. On the slenderer and more finely sculptured shells the spiral bands cross the collabral ribs. In the more coarsely sculptured forms with a broader subsutural spiral belt only the spiral bands in the interspaces between the collabral ribs are seen, the collabral ribs dominating considerably in prominence as compared with the spiral sculpture. Both the spiral bands and the collabral ribs continue on the last whorl right down to the neck of the canal, where there are 3–6 oblique spiral bands.

The aperture is oblong oval, often comparatively narrow. Labrum is sharp-edged. The inner lip is smooth, in the case of some shells well delimited from the surface of the base. The columella has four narrow, oblique folds, the adapical one being the largest and the abapical one the smallest. They seem to form a continuation of the spiral bands on the neck of the canal. The siphonal canal is short and broad in relation to the aperture.

Variations. This species varies rather considerably as regards the sculpture, the prominence of the spiral belt, and the slenderness of the shell. Shells with a relatively short apex and an extremely broad and prominent subsutural spiral belt have been found in the clay pit of Gram Brickworks. In no other localities completely corresponding shells have been found, but in the younger part of the Gram Clay at Måde Brickworks there are shells with a spiral belt which is rather strong although not to the same degree as is the case of the Gram shells. These specimens, however, clearly point towards the form from Gram Brickworks and form an even transition from the slender form with a narrow spiral belt and regular spiral and collabral sculptures found in the older parts of the Gram Clay at Måde Brickworks. On a certain number of the latter specimens there is practically no subsutural spiral belt.

Remarks. The form from Gram Brickworks is by HINSCH (*op. cit.*) considered a species different from the form at Langenfelde, which corresponds to the one occurring in the early parts of the Gram Clay at Måde and by HINSCH has been referred to a new species: *U. wirtzi.*

There is so even a transition between the two types that it may not be a question of two different species. The material from Måde Brickworks includes specimens which cannot clearly be referred to one of the two "species". It seems, however, to be a fact that the slender, more finely sculptured form (the type *wirtzi*) belongs to the oldest beds of the Gram Clay and the shorter,

more coarsely sculptured form (the type *cimbrica* sensu HINSCH) to its youngest beds. Thus there is here apparently an evolutional form of which at any rate the extremes have a certain biostratigraphical value. The two forms have therefore been entered as subspecies in the list of the molluscan fauna of the Gram Clay in Part I of the present work (see RASMUSSEN 1966, p. 289).

Measurements. The shell from Måde pictured measures:
Length 10.8 mm., diameter: 3.9 mm., length of the protoconch: 0.6 mm., and height of the youngest whorl (including the canal): 5.6 mm.

The largest of the shells available must have been more than 21 mm. in length and 6.7 mm. in diameter.

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation. North Germany: Langenfelde-Stufe (*U. wirtzi*, HINSCH), Gram-Stufe (HINSCH). Belgium: ? Anversien (GLIBERT).

FAMILIA: VOLUTIDAE CHENU 1859

Genus: *Scaphella* SWAINSON 1832
(Type: *Voluta junonia* CHEMNITZ 1785)

Scaphella bolli (KOCH 1861)
Plate X, fig. 10, Plate XIII, fig. 9, and Plate XVI, figs. 3–4

1854. *Voluta Siemssenii* BOLL (pars) – BEYRICH, Conchylien, p. 81, Pl. 5, f. 3.
1872. *Voluta (Scapha) Bolli* KOCH – v. KOENEN, Mioc. Nordd. I, p. 254.
1925. *Scaphella Bolli* KOCH – KAUTSKY, Hemmoor, p. 132, Pl. 9, f. 13.
1907. *Voluta Bolli* KOCH – RAVN, Jylland, p. 338 (134).
1952. *Scaphella (Scaphella) bolli* KOCH *sp.* – GLIBERT, Mioc. Belg. II, p. 119, Pl. IX, f. 6.
1964. *Scaphella bolli* (F. E. KOCH) – ANDERSON, Reinbek-Stufe, p. 269, Pl. 28, f. 209.

Material. Gram Clay.

Hoddemark. Karlsgårde Canal:	1 defective shell
Måde Brickworks. Eastern clay pit:	14 defective shells and many fragments
Strandgård Brickworks. Clay pit:	1 fragm. shell

Description. The shell is very big, fusiform, more or less slender, with an obtuse apex.

The protoconch is very big, paucispiral, comprising only a big, wart-shaped whorl, apparently without ornamentation (the surface of the shell denuded in the specimens available).

The whorls of the protoconch are flatly convex, with the exception of a more or less pronounced concave depression on the adapical region below the suture. This is very obliquely placed in relation to the axis of the shell and not depressed, as the following whorl fits tight to the preceding one for a short distance and in this way completely covers it abapically.

Immediately below the adapical suture there is a flat zone, which abapically is replaced by the depression mentioned, which, again, is followed by the flatly convex about two thirds of the whorl. This is covered by numerous close-set, thin and weak spiral threads, which, when magnified, prove to be stylolith-like and irregularly undulate. The distance between them is somewhat broader than the threads themselves.

The growth lines form an extremely flat sinus in the deepest part of the depression, but are otherwise almost orthocline.

The aperture is oblong oval, tapering adapically, Labrum has not been observed. The inner lip is smooth, with three prominent, oblique columellar folds.

The abapical part of the base has been broken off the shells from the Gram Clay. On shells from Shell Bed I at Hoddemark (Karlsgårde Canal) it is seen that the aperture abapically passes evenly into a gradually rather narrow siphonal canal, which seems to be completely straight.

Remarks. From Shell Bed I at Hoddemark there are some very slender shells. The specimens from the Gram Clay on the other hand are comparatively broader.

In the literature the relations of this species to *Scaphella lamberti* SOWERBY from the Pliocene beds in England and Belgium as well as *Scaphella siemsseni* (BOLL) from the Middle and Upper Oligocene beds in the North Sea Basin are often discussed, but an unambiguous definition of the species is not available.

Because of its considerable size *S. bolli* attracted attention at an early stage. In the Mica Clay on Sylt (Morsum Kliff) already FORCHHAMMER (1828, p. 374) observed shells of this species. Later he (1835, p. 97) as well as H. BECK (1835, p. 219) identified the species with *Voluta Lambertii* from the English Crag. BEYRICH (1854) stresses the size of the specimens from Sylt as "kolossal" as compared with the shells from the Upper Oligocene strata, uniting the North German shells under the name *V. Siemssenii.*

According to v. KOENEN (1872) there was in the German collections material of this species from three Slesvig localities: Tornskov, Arrild, and Storlund (according to information from J. O. SEMPER). In Danish collections there is only material from the older Gram Clay at Måde Brickworks. It seems to be missing from the somewhat younger strata (e.g. the clay pit of Gram Brickworks), but appears again in the very youngest strata, occurring, as stated above, in the Mica Clay of Morsum Kliff on Sylt.

Distribution.

North Sea Basin. Miocene. Denmark: Hodde Formation, Gram Formation. North Germany: Holsteiner Gestein (v. KOENEN), Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON), Obermiozän (v. KOENEN). Holland: Mittelmiozän (MOLENGRAAF & v. D. GRACHT). Belgium: Bolderien, Anversien (GLIBERT).

FAMILIA: CANCELLARIIDAE H. & A. ADAMS 1853

Genus: *Narona* H. & A. ADAMS 1854
(Type: *Cancellaria clavatula* SOWERBY)

Narona lyrata (BROCCHI 1814)
Plate XVII, figs. 1–2

1814. *Voluta lyrata* – BROCCHI, Conch. subapp. II, p. 311, Pl. III, f. 6 (1843 edit. p. 83).
1814. *Voluta spinulosa* – BROCCHI, Conch. subapp. II, p. 309, Pl. III, f. 15 (1843 edit. p. 81).
1841. *Cancellaria lyrata* BROCCHI – BELLARDI, Cancellariidae, p. 14, Pl. I, f. 1, 2.
1856. *Cancellaria lyrata* BROCC. – HÖRNES, Wienerbecken I, p. 308, Pl. 34, f. 4, 5.
1857. *Cancellaria lyrata* BROC. *sp.* – BEYRICH, Conchylien, p. 332, Pl. 27, f. 7, 8a, b, c.
1872. *Cancellaria lyrata* BROC. – v. KOENEN, Mioc. Nordd. I, p. 164.
1894. *Sveltia lyrata* (BR.) – SACCO, I Molluschi, XVI, p. 59, Pl. III, f. 57–65.
1899. *Sveltia* (*Calcarata*) *lyrata* BROCCHI – COSSMANN, Essais, 3, p. 22, Pl. I, f. 5.
1925. *Sveltia* (*Calcarata*) *lyrata* BROCCH. *var. parvicarinata* nov. sp. – KAUTSKY, Hemmoor, p. 139, Pl. 10, f. 4.
1928. *Sveltia lyrata* (BROCCHI) *var. spinulosa* BROCCHI – COSSMANN & PEYROT, Conch. Néog. A.S.L.B. LXXIX, p. 226, Pl. XIII, f. 27–28.
1952. *Narona* (*β-Sveltia*) *lyrata parvicarinata* (KAUTSKY) – HINSCH, Leit. Moll. p. 170.
1955. *Sveltia lyrata* (BROCCHI) – ROSSI RONCHETTI, I tipi, p. 270, f. 144.
1964. *Narona* (*Sveltia*) *lyrata* (BROCCHI) – ANDERSON, Reinbek-Stufe, p. 274, Pl. 30, f. 215.

Original diagnosis. Testa turrita, leviter transversim striata, longitudinaliter oblique costata anfractubus tumidiusculis, infra medium carinatis, carina coronata, columella triplicata, basi integra (BROCCHI 1814).

Type material. The shell pictured by BROCCHI (*op. cit.* Plate III, fig. 6) is the holotype. Depository: Museo Civico di Storia Naturale di Milano, collezione Brocchi, No. 89. – Type locality: Parlascio (Toscana). – Stratum typicum: Pliocene.

Material. Gram Clay.

Måde Brickworks. Eastern clay pit:	2 shells of the typical form and 29 shells with a slightly developed carina

Description. The shell is rather big, ovoid-subfusiform.

The protoconch is naticiform, with rather a low apex in relation to the broad terminal whorl. The initial whorl is small. The number of whorls is about three and one fourth. They are smooth, convex, and separated by rather deep-set sutures. On the youngest part of the terminal whorl there are 4–5 weak spiral elevations of the surface of the shell, which become 4–5 rather prominent spiral ribs. The adapical rib is somewhat below the suture, while the abapical one is immediately above the abapical suture.

The whorls of the teleoconch are slightly subangular, Spiral Rib 2, which is in the middle of the whorls, being somewhat prominent, so that a faint carina is formed. This carina has, however, disappeared from many shells, so

that the whorls are regularly convex. The adapical spiral rib is always the weakest one. Between the ribs there are up to five very slight spiral threads, which often are more or less blurred.

On the teleoconch there are furthermore highly prominent, rather narrow collabral ribs in a number of 11–12 per whorl. The spiral sculpture crosses the collabral sculpture. On Spiral Rib 2 some small prominent spines are formed on some of the shells. Both sculptural elements continue undiminished over the base, where the collabral sculpture gradually is lost down towards the neck of the canal. The sutures are deep-set, a little oblique in relation to the axis, undulate because of the placing of the collabral ribs.

The aperture is oval or drawn out semicircularly, broadest adapically, passing into a very short, oblique siphonal canal abapically. Labrum is sharp-edged, on the inside with about seven palatal folds. The inner lip is smooth, with a rough surface, passing imperceptibly into the surface of the base, having three very oblique columellar folds, the adapical one of which is the most prominent one, the abapical one being the slightest. A siphonal fasciole is found on many of the shells. A more or less well-developed pseudumbilicus is seen on some of the shells.

Remarks. This species, which is first of all known from the Miocene and Pliocene formations, is very variable as regards the more or less angular form of the whorls. Generally the Italian shells have a prominent carina-like margin on the whorls, most pronounced in the subspecies *spinulosa* (BROCCHI 1814). The same applies to the shells from the Miocene of the Vienna Basin. As pointed out by KAUTSKY, the shells in the Miocene of the North Sea Basin have only a slightly developed margin, for which reason he set up the subspecies *parvicarinata* for these shells. The material from the Upper Miocene beds of Northern Germany as well as Denmark belongs to this type. The shells from Måde Brickworks, however, generally have an extremely slightly developed carina or completely lack the carina. Thus a development towards *N. rothi* (q.v.) is indicated.

Measurements. The shell pictured in Plate XVII, figs. 1 and 2, measures: Length: 18.2 mm., diameter: 10.3 mm., length of the protoconch: 1.7 mm., diameter of the protoconch: 1.9 mm., and length of the aperture: 9.0 mm. The largest shell from Måde measures 28.6 mm. in length and 14.2 in longest diameter.

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation. North Germany: Reinbek-Stufe (ANDERSON), Glimmerton at Gühlitz, Lüneburg (BEYRICH), Langenfelde (GOTTSCHE), in a glacial floe at Hemmoor (KAUTSKY).

Atlantic Region. Aquitanian Basin: Helvétien (COSSMANN & PEYROT).

Mediterranean Basin. Italy: Elveziano, Tortoniano, Piacenziano (SACCO). Spain (Cataluna): Placenciense (ALMERA Y BOFILL).

Vienna Basin. Austria: "Unterer Tegel und Sand" at Baden, Vöslau, Pfaffstätten, Grinzing, Grund, Forchtenau (M. HÖRNES). – Hungary: "Miozän-Mediterran" (STRAUSZ).

Narona rothi (SEMPER 1861)

1956. *Cancellaria* (*Narona*) *rothi* (SEMPER) – RASMUSSEN, South Jutland, p. 79, Pl. VII, f. 8a, b.

Material. Gram Clay.

Shells are available from the following localities (see Part I, Tables 15–66):

Skærum Mølle (clay pit), Sandfeldbjerg (clay pit), Brande Brickworks (clay pit), Alkærsig Brickworks (clay pit), Odderup (103.150), Hesselho (113.121), Hauge (clay pit), Karlsgårde Canal (unknown locality), Esbjerg (130.59, clay pit and beach), Måde Brickworks (northwestern and eastern clay pits), Strandgård Brickworks (clay pit), Holleskov (132.46b), Ravning (clay pit), Sønder Hygum (141.260, 141.261), Rødding (141.75), Gram (141.277), Spandetgård (clay pit), Brodersmark (166.351b), Sæd (167.445), and Rends (167.236).

Description. The shell is fairly big, ovoid-subfusiform.

The protoconch is naticiform, with smooth whorls in a number of three and one fourth and increasing rather soon in diameter. The youngest part of the terminal whorl has four spiral threads.

The whorls of the teleoconch are regularly convex, with four strong and rather prominent spiral bands, of which No. 2 is in the middle of the whorl. No. 1 is between the adapical suture and Spiral Band 2 and is the weakest. No. 4 is immediately above the abapical suture, while No. 3 is halfway between this and Band 2. On the younger whorls there is furthermore a spiral thread between the adapical suture and Spiral Band 1, and there are often very faint spiral threads in the interspaces between the stronger ones.

The spiral sculpture crosses 10–12 prominent oblique, rounded collabral ribs, the interspaces of which are broader than the ribs themselves. At the passages of the spiral bands over the ribs there are slight, oblong knobs. On the younger whorls the spiral bands are rather broad and prominent. They continue on to the base. There are 12–14 broad spiral bands on the last whorl. The collabral ribs are only lost down towards the neck of the canal. The sutures are rather deep-set, undulate.

The aperture is oblong, semicircular. Labrum is sharp-edged, sometimes thickened, interiorly with 6–7 palatal folds. Labium is smooth, passing evenly into the surface of the base without any sharp demarcation, provided with 2–3 oblique columellar folds, the adapical fold being the largest. A more or less well developed siphonal fasciole is seen on some shells. On some shells there is also a distinct pseudumbilicus.

Remarks. This form, which is only found in the younger strata of the Gram Formation, differs from *N. lyrata* only by having coarser and broader spiral ribs and by the whorls of the teleoconch always being regularly convex. However, it is a fact that the form which occurs in the Mica Clay at Langenfelde and in the stratigraphically deepest parts of the Gram Clay at Måde *as a whole* appears different from the form in the younger Gram Clay, which crops up at Gram, Spandetgård, etc. Perhaps it will appear that *N. rothi* does not clearly differ from *N. lyrata.* Many shells of the latter species from Måde thus have not any distinct carina and only differ from the Gram shells by their finer spiral sculpture. It seems doubtful whether the latter character is sufficient to distinguish the species. Perhaps the isolated occurrence of *N. rothi* in the North Sea Basin is indicative of the fact that it is a locally developed subspecies of *N. lyrata.*

Measurements. See RASMUSSEN 1956, p. 80.

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation. – North Germany: Gram-Stufe (HINSCH).

Narona calcarata (BROCCHI 1814)
Plate XII, figs. 8–9

1955. *Sveltia* (*Calcarata*) *calcarata* (BROCCHI) – ROSSI RONCHETTI, I tipi, p. 275, f. 147.
1956. *Cancellaria* (*Narona*) *calcarata* (BROCCHI) – RASMUSSEN, South Jutland, p. 78, Pl. VII, f. 7.
1958. *Cancellaria* (*Narona*) *calcarata* (BROCCHI) – SORGENFREI, Middle Mioc., p. 243, Pl. 51, f. 168a, b.
1964. *Narona* (*Calcarata*) *calcarata* (BROCCHI) – ANDERSON, Reinbek-Stufe, p. 275, Pl. 30, f. 217.

Material. Gram Clay.

Gram. The clay pit:			1 shell (leg. H. ØDUM 1926)
–	141.277	12.10–12.60 m.:	1 juvenile shell

Description. The previously described specimen from Gram lacks its apex. The later appearing juvenile shell from the bore-hole at Gram Brickworks offers the following information about the form in the Gram Clay:

The shell is rather small, ovoid-subfusiform, with angular whorls.

The protoconch is relatively large, globular, comprising about three and one fourth highly convex, smooth whorls fast increasing in diameter. The initial whorl is small.

Only one and one fourth whorl of the teleoconch are available. The transition to this part of the shell is even, as gradually there appears a more distinct carina somewhat below the adapical suture. Simultaneously a number of

collabral lamellae appear (a total of 11 on the youngest whorl), which at the passage over the carina form spines, the youngest of which point upwards (adapically). The surface of the shell is otherwise smooth, apart from the somewhat oblique, a little irregular, but otherwise orthocline growth lines.

The base is demarcated adapically by a rounded-off, but otherwise pronounced edge starting from the adapical corner of the aperture. The aperture is trapezoidal. Labrum is sharp-edged and the inner lip narrow. There is a narrow pseudumbilicus.

Remarks. This characteristic species is very rare in the Gram Clay. This also applies to the corresponding deposits in Northern Germany. BEYRICH had only one specimen at his disposal (from the Middle Miocene beds at Dingden), while v. KOENEN had none. On the other hand GOTTSCHE (1876, p. 101) mentions that the species has been shown in the Mica Clay at Langenfelde. This statement seems to refer to the only finding in the Upper Miocene beds of Northern Germany.

Measurements. The juvenile specimen from Gram has the following measures: Length: 3.0 mm., diameter: 2.2 mm., length of the protoconch: 1.3 mm., diameter of the protoconch: 1.1 mm., and length of the aperture: 1.7 mm.

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Gram Formation. North Germany: Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON), Glimmerton at Langenfelde (GOTTSCHE).

Atlantic Region. Aquitanian Basin: Tortonien (COSSMANN & PEYROT).

Mediterranean Basin. Italy: Tortoniano, Elveziano, Piacenziano, Astiano (SACCO). Spain (Cataluna): Placenciense (ALMERA Y BOFILL: *C. calcarata quadrulata*).

Vienna Basin. Austria: "Tegel und Sand des Leythakalkes" at Enzelfeld, Gainfahren, Pfaffstätten, Kienberg (M. HÖRNES). – Hungary: "Miozän-Mediterran" (STRAUSZ).

Genus: *Admete* KRØYER in MØLLER 1842

(Type: *A. crispa* MØLLER)

Admete fusiformis (CANTRAINE 1836)

1835. *Cancellaria fusiformis* – CANTRAINE, Diagnoses moll., p. 391.
1956. *Admete (Babylonella) subangulosa* (S. WOOD) – RASMUSSEN, South Jutland, p. 80, Pl. VII, f. 5a, b.
1958. *Admete cf. fusiformis* (CANTRAINE) – SORGENFREI, Middle Mioc., p. 246, Pl. 51, f. 170.
1964. *Babylonella fusiformis* (CANTRAINE) – ANDERSON, Reinbek-Stufe, p. 276, Pl. 30, f. 219, 219a.

Material. Hodde Clay.

Shells are available from the following localities (see Part I, Tables 4–66):

Leding (93.155), Enderupskov (141.196), Gram (141.277), and Hygum (141.215).

Gram Clay.

Kodal-Fjaldene (84.1749), Videbæk (84.1748), Møltrup Brickworks (clay pit), Lille Torup (85.379), Gjødstrup (85.861), Brande Brickworks (clay pit), Drantum (104.1241), Hjortsballe (105.320), Hesselho (113.121), Hauge (clay pit), Esbjerg (130.59), Måde Brickworks (eastern clay pit), Holleskov (132.46b), Hjortvad (141.178), Sønder Hygum (141.260, 141.261, 141.273), Gram (141.277), Spandetgård (clay pit), Tønder (166.398), Brodersmark (166.351b), Sæd (167.445), and Rends (167.236).

Description. The shell is ovoid-fusiform.

The protoconch is bud-shaped, paucispiral, comprising about $2\frac{1}{2}$–3 whorls. The initial whorl is slightly heterostrophic, only slightly raised above the following whorl. The other whorls are convex. The terminal whorl has numerous sigmoid collabral threads, which are connected with numerous, slightly prominent and irregularly passing spiral threads, which point in different directions in relation to the axis of the shell. This spiral sculpture is a continuation of a bivirgate spiral striation on the medial whorls.

The whorls of the teleoconch are more or less angular, with rather narrow, but greatly prominent collabral ribs numbering 10–14, the interspaces between which are considerably broader than the ribs themselves. The spiral sculpture consists of narrow, often highly prominent bands, which cross the collabral ribs. Their numbers range from 5 to 10. The spiral sculpture continues right down to the end of the canal, while the collabral ribs are soon lost on the base.

The aperture is more or less rounded-off trapezoidal. Labrum is simple, sharp-edged. As a rule it has been broken off the shells found. Labium often abapically has a projecting, smooth, rounded-off margin. Between this and the base there is a frequently well-developed pseudumbilicus. The siphonal canal is short and broad.

Variations. The species varies as regards the number of spiral bands. Thus the majority of shells from Shell Bed I at Hoddemark have only 5 to each whorl, whereas the shells from the Gram Clay have 8–10 spiral bands, which are more close-set than those on the Hodde shells. The material from the Gram Clay thus is more similar to the shells from the Arnum Formation described by SORGENFREI.

Remarks. It has not been possible for me to verify the identity of *A. subangulosa* and *A. fusiformis*, but according to the information in the literature the former species seems only to be a more subangular variant of the latter.

Distribution.

North Sea Basin. Oligocene. Denmark: Upper (HARDER), Germany: Middle, Upper (v. KOENEN). – Miocene. Denmark: Arnum Formation (SORGENFREI), Gram Formation. North Germany: Vierland-Stufe (GRIPP), Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON), Glimmerton (v. KOENEN). Belgium: Anversien (GLIBERT). – Pliocene. England: Coralline Crag (WOOD, HARMER).

Atlantic Region. Aquitanian Basin: ? Aquitanien (*Sveltia pyrenaica* PEYROT).

Mediterranean Basin. Italy: Tortoniano, Piacenziano, Astiano (SACCO).

FAMILIA: CONIDAE SWAINSON 1840

Genus: *Conus* LINNÉ 1758

(Type: *Conus marmoreus* LINNÉ 1758)

Conus antediluvianus BRUGUIÈRE 1792

1956. *Conus* (*Conospira*) *antediluvianus* BRUGUIÈRE – RASMUSSEN, South Jutland, p. 97, Pl. IX, f. 4a, b.

1964. *Conus* (*Conolithus*) *antediluvianus* BRUGUIÈRE – ANDERSON, Reinbek-Stufe, p. 317, Pl. 45, f. 274, 274a, b.

Material. Gram Clay.

Shells are available from the following localities (see Part I, Tables 15–66):

Skærum Mølle (clay pit), Kodal-Fjaldene (84.1749), Lille Torup (85.379), Frølund (85.383), Sandfeldbjerg (clay pit), Brande Brickworks (clay pit), Drantum (104.1241), Hjortsballe (105.320), Alkærsig Brickworks (clay pit), Odderup (103.150), Harkes Brickworks (clay pit), Hauge (clay pit), Tønding (clay pit), Hoddemark (Karlsgårde Canal), Grøde (Canal sect.), Hodde (113.33a), Esbjerg (clay pit and beach), Måde Brickworks (eastern clay pit), Strandgård Brickworks (clay pit), Holleskov (132.46b), Ravning (clay pit), Sønder Hygum (141.261), Rødding (141.76), Gram (141.277), Spandetgård (clay pit), Tønder (166.398), Brodersmark (166.351b), Sæd (167.445), and Rends (167.236).

Description. The shell is rather slender, with a pronounced conic apex and base.

The protoconch is conical, multispiral, comprising about five whorls. The initial whorl is small, slightly heterostrophic. The other whorls are flatly convex and smooth.

The transition to the teleoconch is marked by 10–12 collabral ribs. Furthermore, there is a carina, which gradually becomes rather sharp and prominent. The collabral ribs develop into knobs on this carina. They are somewhat tapering abapically and slightly oblique. The number to each whorl ranges from 15 to about 30 on the youngest whorls of old shells. The part between the adapical suture and the carina is concave, forming a more or less deep depression, in which the sinus of the growth lines is situated. The growth lines sometimes stand out relief-like in the depression. The part abapical to the carina slopes adaxially and besides the above-mentioned oblique collabral

folds as a continuation of the knobs has some six thin and very weak spiral ribs, which on young whorls are still weaker and often cannot be seen at all on the old shells. The spiral ribs, however, also occur on the surface of the drawn out conical base, especially on its abapical part. Apart from these often quite obliterated spiral ribs or bands the surface of the base is quite smooth. The apex is considerably shorter than the base.

The aperture is narrow and oblong, fissure-shaped. Labrum has been broken off all the shells available. An inner lip has not been marked.

Remarks. It seems that this species can clearly be distinguished from *C. dujardini* DESHAYES by the very weak or completely missing knobs on the carina of the latter species, which obviously also varies somewhat as regards height of the apex.

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation. North Germany: Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON), Glimmerton (BEYRICH, v. KOENEN). Holland: Mittel- und Obermiozän (MOLENGRAAF & v. D. GRACHT).

Mediterranean Basin. Italy: Elveziano, Tortoniano, Pliocene (SACCO). Spain (Cataluna): Placenciense, Astiense (ALMERA Y BOFILL).

Vienna Basin. Austria: Grunder Schichten, 2. Mediterranstufe (KAUTSKY). – Hungary: "Miozän-Mediterran" (STRAUSZ).

FAMILIA: TURRIDAE MELVILL 1917

Genus: *Gemmula* WEINKAUFF 1875

(Type: *Pleurotoma gemmata* REEVE 1843)

Gemmula zimmermanni (PHILIPPI 1846)

Plate XVIII, figs. 3–4, and Plate XIX, fig. 1

1846. *Pleurotoma Zimmermanni* – PHILIPPI, Verzeichniss, p. 69, Pl. Xa, f. 3a, b.
1872. *Pleurotoma rotata* BROC. *var. complanata* – v. KOENEN, Mioc. Nordd. I, p. 218, Pl. II, f. 9a, b.
1925. *Pleurotoma Zimmermanni* PHILIPPI – KAUTSKY, Hemmoor, p. 161, Pl. 11, f. 9.
1954. *Turris* (*Gemmula*) *zimmermanni* PHILIPPI sp. – GLIBERT, Pleurotomes, p. 6, Pl. II, f. 3a–h.
1958. *Gemmula Zimmermanni* (PHILIPPI) – SORGENFREI, Middle Mioc., p. 257, Pl. 53, f. 176.
1964. *Gemmula* (*Gemmula*) *zimmermanni* (PHILIPPI) – ANDERSON, Reinbek-Stufe, p. 282, Pl. 32, f. 228.

Material. Hodde Clay.

Leding	93.155	31	m.:	3 small, defective shells and 1 fragm.	(4)

Odderup	103.150	24.8 –25.6	m.:	3 protoconchs and 1 def. shell, 3 fragm. (4)
Hodde	113.33a	18.5 –18.9	m.:	1 apex of a shell and 1 basal part of a shell (2)
Måde Brickworks.	Southwestern clay pit:			1 defective shell (1)
–	Eastern clay pit:			13 more or less def. shells (13)
Gram	141.277	29.00–29.50	m.:	2 def. shells and 2 apices (4)
–	–	29.50–30.00	m.:	3 apices and 8 fragm. (3)
–	–	30.00–30.50	m.:	1 def. shell (1)
–	–	30.50–30.95	m.:	2 def. shells (2)
–	–	30.95–31.35	m.:	1 def. sh. and 6 fragm. (1)
–	–	31.35–31.65	m.:	1 def. sh. and 4 fragm. (1)
–	–	31.65–31.95	m.:	6 fragments (1)
–	–	31.95–32.30	m.:	1 def. apex and 9 fragm. (?2)
–	–	32.70–33.05	m.:	5 fragments (1)
–	–	33.05–33.40	m.:	2 apices and 7 fragm. (3)
–	–	33.80–34.25	m.:	15 fragments (1)
–	–	34.25–34.70	m.:	2 apices and 3 fragm. (2)
–	–	34.70–35.00	m.:	1 apex and 11 fragm. (1)
–	–	35.00–35.30	m.:	1 small, complete shell and 1 fragm. (1)
–	–	35.30–35.70	m.:	1 small, complete shell, 1 apex and 2 fragm. (2)
Sønder Hygum	141.215	26.2 –32.8	m.:	3 def. shells (3)
Tønder	166.398	76	m.:	?5 fragments (?1)

Description. The shell is comparatively big, subfusiform-turriform, with a relatively high conical apex.

The protoconch is conical, multispiral, comprising about five convex whorls. The initial whorl is small, smooth. The other whorls have distant, sharp, slightly opisthocyrt, collabral ribs, which rise like sharp crests, highest on the abapical part of the whorls. The intervals are completely smooth.

The whorls of the teleoconch are rather flat, with a very weak spiral belt under the adapical suture and another, slightly more developed spiral belt with a number of close-set, slightly prominent knots immediately above the abapical suture. The region between these weak spiral belts constitutes the main part of the height of the whorls and is slightly convex. On the older whorls the spiral belts are conspicious, just as the intermediate region is somewhat more convex than on the younger whorls. The whole surface is covered by some 8–12 spiral threads, which are rather slightly prominent and separated by relatively large interspaces. The knots, the number of which ranges from about 14 on the oldest whorls to about 25 or more on the youngest ones, are most sturdily developed on the oldest whorls and soon become weaker and often disappear completely on the youngest whorls. At the same time the convex spiral belt as well as the concave belt have been so much levelled that the whorls seem to be quite flat. The sinus of the growth lines is on the abapical spiral belt with the row of knots, which is actually only short elevations of the former.

The base is convex and forms a steep ramp. The spiral sculpture continues on the base right out to the end of the canal. The labrum is broken off all the shells available. The inner lip is smooth and is well-defined. The aperture is oval. The siphonal canal is rather long, narrow and somewhat obliquely placed.

Remarks. The identity of PHILIPPI's species and the form occurring in the Hodde Clay and other Miocene formations is not quite certain. PHILIPPI (*loc. cit.*) states that one of his specimens originates from Lüneburg and the other, which is juvenile, has been found at Eversen near Aerze. We are not informed of the place near Lüneburg where the former was found. If, like the other shells from Lüneburg mentioned by PHILIPPI, it originates from the Upper Miocene Mica Clay, it is probable that it is identical with the form of *G. badensis* occurring in the older beds of the Gram Clay (thus at Måde Brickworks). This form, which is mentioned in the remarks on *G. badensis* (p. 175), is not, however, identical with the species from the Middle Miocene formations in the North Sea Basin which in the literature is usually denoted as *G. zimmermanni*. As the difference between them especially consists in the conditions of the protoconch, it is not possible to decide with certainty whether the variety *complanata* (of *P. rotata*) set up by v. KOENEN (in this case = *G. badensis*) is identical with the early form of *G. badensis* or with *G. zimmermanni*. v. KOENEN mentions that the variety *complanata* occurs at Gühlitz and Lüneburg as extreme forms of *P. rotata* (i.e. *G. badensis*), but that it has otherwise especially been recorded from Berssenbrück, Dingden, Eibergen, Antwerp, Edeghem, and Bolderberg, thus from the beds of the Reinbek-Stufe.

The difference in the microsculpture of the protoconch found between *G. badensis* from the older Gram Clay and *G. zimmermanni* from the Hodde Clay was not observed by v. KOENEN. In his diagnosis of *G. zimmermanni*, PHILIPPI does not mention the appearance of the protoconch at all.

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Hodde Formation. North Germany: Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON). Belgium: Boldérien, Anversien (GLIBERT).

Gemmula badensis (R. HOERNES 1875)
Plate XVIII, figs. 2, 5, and 6

1956. *Turris* (*Gemmula*) *badensis* (R. HOERNES) – RASMUSSEN, South Jutland, p. 84, Pl. VIII, f. 2a, b.

1958. *Gemmula badensis* (HÖRNES) – SORGENFREI, Middle Mioc., p. 252, Pl. 52, f. 173.

Material. Gram Clay.

Shell material is available from the following localities (see Part I, Tables 15–66):

Skærum Mølle (clay pit), Lillelund (73.88), Lille Spåbæk (lignite pit), Muldbjerg (83.1006), Kodal-Fjaldene (84.1749), Videbæk (84.1748, 84.358, 84.456, 84.483, 84.492),

Møltrup Brickworks (clay pit), Lille Torup (85.379), Gjellerup (85.380), Tværmose (85.381), Gjellerup (85.382), Frølund (85.383), Gjødstrup (85.861), Snejbjerg (85.775), Bording (86.177), Brande Brickworks (clay pit), Drantum (104.1241), Nyholm (104.1166), Hjortsballe (105.320), Alkærsig Brickworks (clay pit), Lønborg (102.55), Forsum Brickworks (new clay pit), Odderup (103.150), Harkes Brickworks (clay pit), Ålbæk Eng (102.59), Hesselho (113.121), Hauge (clay pit), Tønding (clay pit), Hoddemark (Karlsgårde Canal), Esbjerg (130.59, clay pit and beach), Måde Brickworks (clay pits), Strandgård Brickworks (clay pit), Tiset (141.244), Holleskov (132.46b), Ravning (clay pit), Hjortvad (141.178), Sønder Hygum (141.260, 141.261), Rødding (141.76), Gram (141.277), Spandetgård (clay pit), Tønder (166.398), Brodersmark (166.351b), Sæd (167.4, 167.445), and Rends (167.236).

Remarks. This species, which is common in the Gram Clay, has been described by HINSCH 1952, p. 174 (Plate C, fig. 9), and in the works of RASMUSSEN and SORGENFREI cited. A description in Danish has furthermore been given by RAVN (1907, p. 355, picture Plate VIII, fig. 4). Further description of the species therefore is hardly necessary.

HINSCH (*op. cit.* p. 175 and fig. 11) has pointed out that the number of knobs on the shells from Langenfelde (early layers of Glimmerton) is higher than on the specimens from Gram (younger Gram Clay). The same fact can be observed on the material from Måde Brickworks. See figs. 2, 5, and 6 on Plate XVIII.

On the other hand it is doubtful whether *G. zimmermanni* represents the early link in an evolutionary series towards *G. badensis* as indicated by HINSCH (*op. cit.*), as the protoconch of the former species has a sculpture that is different from that of the latter species.

However, we still miss a direct comparison between *G. badensis* from the Miocene formations of Denmark and shells of this species from the type strata in the Vienna Basin, for which reason there is still a little uncertainty as to the identity.

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Gram Formation. North Germany: Hemmoor-Stufe (KAUTSKY), Langenfelde-Stufe, Gram-Stufe (HINSCH).

Vienna Basin. Austria: Schlier, 2. Mediterranstufe (HOERNES & AUINGER). – Hungary: "Miozän-Mediterran" (STRAUSZ).

Gemmula annae (HOERNES & AUINGER 1891)

1956. *Turris* (*Hemipleurotoma*) *annae* (HOERNES & AUINGER) – RASMUSSEN, South Jutland, p. 86, Pl. VIII, f. 3a, b.

Material. Gram Clay.

Shell material is available from the following localities (see Part I, Tables 15–66):

Skærum Mølle (clay pit), Lille Spåbæk (lignite pit), Muldbjerg (83.1006), Kodal-Fjaldene (84.1749), Videbæk (84.1748, 84.344, 84.358, 84.456), Møltrup Brickworks (clay pit), Lille

Torup (85.379), Gjellerup (85.380), Tværmose (85.381), Frølund (85.383), Gjødstrup (85.861), Sandfeldbjerg (clay pit), Brande Brickworks (clay pit), Drantum (104.1241), Alkærsig Brickworks (clay pit), Odderup (103.150), Harkes Brickworks (clay pit), Hauge (clay pit), Tønding (clay pit), Karlsgårde Canal (unknown loc.), Esbjerg (130.59, clay pit and beach), Måde Brickworks (eastern clay pit), Strandgård Brickworks (clay pit), Holleskov (132.46b), Ravning (clay pit), Hjortvad (141.178), Lintrup (132.140), Sønder Hygum (141.260, 141.261), Rødding (141.243), Gram (141.277), Spandetgård (clay pit), Tønder (166.348), Brodersmark (166.351b), Sæd (167.445), and Rends (167.236).

Description. The shell is big, slender, fusiform, with the apex higher than the base.

The protoconch is conical, multispiral, comprising about five whorls, which are all provided with numerous microscopical granulae on the surface. The initial whorl is slightly sinistral. The medial whorls are convex, more so abapically. This also at first applies to the terminal part of the protoconch, the youngest part, however, being almost completely flat. The terminal region comprises one and a fourth up to about two whorls, which have some (14–18 per whorl) first opisthocline, then opisthocyrt, narrow, rather distant collabral ribs.

The whorls of the teleoconch generally are convex or slightly subangular. Immediately below the adapical suture there is a more or less conspicious spiral belt, which abapically demarcates a comparatively narrow concave region or depression. Then, a little below the middle of the whorl, there is a convex belt, which is more or less prominent and sometimes forms an indistinct shoulder. The abapical part of the whorl slopes adaxially down towards the suture.

The subsutural belt may be dissolved into knobs, thus especially on the older whorls. The second convex belt or the shoulder always bears comparatively strong knobs (in a number of 14–21 per whorl), appearing as short, rather sickle-shaped elevations of the growth-lines, the sinus of which is just found on this spiral belt.

The surface of the whorls, for that matter, is covered by numerous close-set, but weak spiral threads, which also cover the whole surface of the base. On the knob-bearing spiral belt three spiral threads pass over the knobs. On the youngest whorls of the older shells the spiral threads are often so obliterated that the surface becomes almost quite smooth.

The aperture is oblong oval, abapically passing into the comparatively long, narrow siphonal canal. The labrum has been broken off all the shells available. The inner lip is smooth, clearly delimited from the sculptured surface of the base.

Remarks. The identification with the species from the Vienna Basin is mainly due to KAUTSKY's authority, as he knew both the Austrian and the North German form from personal experience. I have not myself had any opportunity to compare them.

As the whole form cycle connected with *Pleurotoma turricula*, to which the present species belongs, comprises a number of related forms in various European Tertiary basins, the problem of the inter-relations between the various forms can only be solved satisfactorily after a closer statistical treatment of a larger material on the basis of biometry.

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation. North Germany: Hemmoor-Stufe (KAUTSKY), Langenfelde-Stufe, Gram-Stufe (HINSCH).

Vienna Basin. Austria: Schlier, Grunder Schichten, 2. Mediterranstufe (KAUTSKY). – Hungary: "Miozän-Mediterran" (STRAUSZ).
Poland: Miozän (FRIEDBERG).

Gemmula boreoturricula (KAUTSKY 1925)
Plate XIX, figs. 2–3

1872. *Pleurotoma turricula* BROC., pars – v. KOENEN, Mioc. Nordd. I, p. 221.
1925. *Pleurotoma (Hemipleurotoma) boreoturricula* – KAUTSKY, Hemmoor, p. 165, Pl. 11, f. 14.
1925. *Pleurotoma (Hemipleurotoma) boreoturricula var. densestriata* – KAUTSKY, ibid., p. 165, Pl. 11, f. 15.
1925. *Pleurotoma (Hemipleurotoma) boreoturricula var. laevigata* – KAUTSKY, ibid., p. 165, Pl. 11, f. 16.
1954. *Turris (Gemmula) boreoturricula* KAUTSKY *sp.* – GLIBERT, Pleurotomes, p. 9, Pl. II, f. 8.
1958. *Gemmula boreoturricula* (KAUTSKY) – SORGENFREI, Middle Mioc., p. 254, Pl. 52, f. 174a–c, Pl. 53, f. 174.
1964. *Gemmula (Gemmula) boreoturricula* (KAUTSKY) – ANDERSON, Reinbek-Stufe, p. 280, Pl. 32, f. 225.

Material. Hodde Clay.

Odderup	103.150	24.8 –25.6 m.:	1 somewhat fragmentary shell
Hodde	113.33a	18.5 –18.9 m.:	1 very defective, juvenile shell
Måde Brickworks. Eastern clay pit:			2 shells
Sønder Hygum	141.215	26.2 –32.8 m.:	1 juvenile, well-preserved shell
Gram	141.277	29.50–30.00 m.:	1 defective shell
–	–	31.95–32.30 m.:	1 defective, juvenile shell

Description. The shell is rather small, more or less slender, often fusiform.

The protoconch is conical, paucispiral, comprising about five whorls. The initial whorl is small, slightly sinistral, with numerous microscopical granulae. The medial whorls are convex, often highest in the abapical part and also with numerous granulae. The terminal part, which also has convex whorls, comprises about $1\frac{1}{4}$–2 whorls, which are provided with distant, narrow, first opisthocline, afterwards opisthocyrt, collabral ribs. The surface of the shell in the interspaces of these is granulated as on the other whorls of the protoconch.

The whorls of the teleoconch are, if anything, flat. Immediately below the adapical suture there is a slightly convex belt consisting of two spiral threads. On the older whorls, however, there is, as a rule, only a single, more prominent, spiral thread. Abapically to this belt there is a broad, slightly convex region with 4–6 rather weak spiral bands.

Next, there is a narrow, slightly convex belt, on which the sinus of the growth lines form slightly prominent, short, sickle-shaped knobs, crossed by three weak spiral bands of the same appearance as those on the rest of the whorl. Between this knob-bearing belt and the abapical suture there is a narrow flat belt with 1–2 weak spiral bands. The base is covered by flat spiral bands right out to the end of the canal.

The aperture is oblong oval, abapically passing into rather a long siphonal canal. The labrum has been broken off all the shells available. The inner lip is smooth and delimited from the sculptured surface of the base with a well-defined edge.

Remarks. The material from the Hodde Clay is very modest. However, it corresponds excellently to the present material from Shell Bed I at Hoddemark and Twistringen (Northern Germany). From the latter locality there are shells which only have traces of knobs on the one or two oldest whorls of the teleoconch and thus correspond to KAUTSKY's two varieties *densestriata* and *laevigata*.

The present material undoubtedly belongs to KAUTSKY's *G. boreoturricula*. This species may, however, be identical with *G. annae* (HOERNES & AUINGER), which is very variable (cf. HOERNES & AUINGER's figures, 1891, Plate XXXVII, figs. 17–25).

SORGENFREI (*op. cit.*) as the only reason why he did not include *G. boreoturricula* among the synonyms for *G. annae* adduces the fact that *Pleurotoma monilis* (must be a mistake for *P. turricula*, HOERNES, 1856, p. 351!) = *G. annae* (HOERNES & AUINGER 1891, p. 296) has only two whorls of the protoconch. In all other conditions they are seen to be alike.

The relation between *G. annae* and *G. boreoturricula* can hardly be solved satisfactorily except after a closer examination of all species and populations belonging to the form cycle including *G. turricula* and *G. annae*.

In this work the specific name of *boreoturricula* is retained with reference to the shells of the Hodde Clay, as well as those of the other Middle Miocene shells, as these partly are certainly identical with KAUTSKY's species, partly can be distinguished rather clearly from shells of *G. annae* in the Gram Clay (see further sub this species).

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Hodde Formation. North Germany: Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON). Belgium: Boldérien, Anversien (GLIBERT).

Genus: *Fusiturris* THIELE 1929
(Type: *Pleurotoma undatiruga* BIVONA 1832)

Fusiturris duchasteli (NYST 1836)
Plate XVII, figs. 4 and 7

1836. *Pleurotoma Duchastelii* – NYST, Kleyn-Spauwen, p. 172, Pl. 1, f. 80.
1867. *Pleurotoma Duchastelii* NYST – v. KOENEN, Mitteloligocän, p. 38.
1870. *Pleurotoma Duchastelii* NYST – SPEYER, Cassel, p. 111, Pl. 15, f. 6–13, Pl. 16, f. 1–3.
1907. *Pleurotoma Duchasteli* NYST – RAVN, Jylland, p. 351, Pl. VII, f. 10, 15.
1913. *Pleurotoma Duchasteli* NYST – HARDER, Aarhus, p. 94, Pl. VII, f. 26–37.
1914. *Pleurotoma Duchasteli* NYST – GRIPP, Itzehoe, p. 29.
1916. *Pleurotoma Duchasteli* NYST – NØRREGAARD, Esbjerg, p. 32, Pl. 3, f. 9.
1925. *Pleurotoma* (*Hemipleurotoma*) *Duchasteli* NYST *var. flexiplicata* NYST – KAUTSKY, Hemmoor, p. 168, Pl. 11, f. 21.
1940. *Pleurotoma* (*Hemipleurotoma*) *Duchastelii* NYST – SORGENFREI, Klintinghoved, p. 53, Pl. VI, f. 15.
1954. *Turris* (*Fusiturris*) *duchasteli f. flexiplicata* KAUTSKY sp. – GLIBERT, Pleurotomes, p. 10, Pl. II, f. 9a, b, c.
1958. *Fusiturris Duchastelii* (NYST) – SORGENFREI, Middle Mioc., p. 258, Pl. 54, f. 177.
1964. *Turris* (*Fusiturris*) *flexiplicata* (KAUTSKY) – ANDERSON, Reinbek-Stufe, p. 285, Pl. 33, f. 232, 232a.

Material. Hodde Clay.

Leding	93.155	19 –27 m.:	1 small, defective shell	(1)
Grøde. Karlsgårde Canal:			1 defective shell	(1)
Hodde	113.33a	18.5 –18.9 m.:	1 shell without protoconch, and 2 juvenile shells	(3)
Måde Brickworks. Northwestern clay pit:			1 shell	(1)
–	Eastern clay pit:		10 more or less defective shells	(10)
Gram	141.277	27.00–27.50 m.:	2 very fragm. sh. and 1 fragm.	(2)
–	–	27.50–28.00 m.:	1 fragm. sh. and 3 fragm.	(1)
–	–	29.00–29.50 m.:	4 small fragments	(1)
–	–	29.50–30.00 m.:	3 small fragments	(1)
–	–	30.00–30.50 m.:	1 juvenile shell and 4 fragm.	(2)
–	–	30.50–30.95 m.:	2 small fragments	(1)
–	–	31.35–31.65 m.:	6 small fragm.	(1)
–	–	31.65–31.95 m.:	1 fragm.	(1)
–	–	32.30–32.70 m.:	8 fragm. of 1 shell	(1)
–	–	33.05–33.40 m.:	1 apex and 7 other fragm.	(1)
–	–	33.40–33.80 m.:	1 fragm. sh. and 2 fragm.	(1)
–	–	33.80–34.25 m.:	10 fragments	(1)
–	–	34.70–35.00 m.:	1 apex and 2 other fragm.	(2)
–	–	35.00–35.30 m.:	8 small fragments	(1)
–	–	35.30–35.70 m.:	2 fragm.	(1)
Hajstrup	167.235	174′–194′ :	1 small fragment	(?1)

Description. The shell is comparatively big, slender, fusiform.

The protoconch is tapering, paucispiral, comprising four or five whorls. The initial whorl is small, smooth, slightly sinistral. The medial whorls are

smooth, slightly convex or almost flat. The terminal whorl is flat, with mutually distant narrow collabral ribs (11–14 in number).

Even transition to the teleoconch, the whorls of which are flat or slightly convex. They are covered with rather a weak spiral sculpture. Immediately below the adapical suture there is a narrow zone without spiral sculpture, which, however, may be so narrow that it must be termed a spiral groove. Abapically to this groove there is a larger, slightly convex region with 4–6 flat spiral bands. The growth lines form a sinus of moderate depth in the middle of the whorl.

On most of the shells some of the growth lines on the oldest whorls stand out as short curved collabral ribs. As a rule they disappear already on the third whorl of the teleoconch, but there are a few shells in which they are also found on the younger whorls. The apex of the shell is often long as compared with the base.

As a rule the labrum has been broken off the Danish material, but it seems to have been sharp-edged. The inner lip is smooth, well-defined as regards the base. The aperture is oblong oval, passing evenly into the straight, moderately long siphonal canal.

Variations. This species is rather variable as regards shape of the shell and sculpture, as there are short, comparatively broad forms as well as forms that are slender, with a high apex in relation to the base. The shells from the Hodde Clay have a spiral sculpture of varying prominence, but it always seems to be rather weak.

Remarks. A comparison between the material from the Hodde Clay and shells from the Middle Oligocene clay occurring at Grundfør Brickworks north of Århus shows small differences. The latter shells have one or two subsutural spiral bands, a narrow depressed region with a weak spiral band and the 6–8 rather broad spiral bands separated by narrow spiral grooves. Other shells from Grundfør are without the narrow depressed region, but have the same spiral ornamentation. Available shells from the Middle Oligocene clay at Ulstrup (Sophienlund Brickworks) have a coarser spiral sculpture and collabral ribs on all the whorls, but the sculptural scheme is here, too: 1–2 spiral bands, 1 spiral groove (which crosses the collabral sculpture), and a concave region with several broader as well as narrower spiral bands, which, however, can be almost merged or obliterated.

Distribution.

North Sea Basin. Oligocene. Denmark: Middle, Upper (RAVN, HARDER). Germany: Middle, Upper (v. KOENEN). Belgium: Tongrien, Rupélien, Chattien (GLIBERT). Miocene. Denmark: Klintinghoved Clay, Arnum Formation (SORGENFREI), Hodde Formation. North Germany: Vierland-Stufe (GRIPP), Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON). Belgium: Boldérien, Anversien (GLIBERT).

South Germany (Bavaria): Burdigal (HÖLZL: *Turris duchasteli flexiplicata*).

Fusiturris helena (SEMPER in v. KOENEN 1872)

1956. *Turris (Fusiturris) helena* (SEMPER) – RASMUSSEN, South Jutland, p. 83, Pl. VIII, f. 1 a, b.

Material. Gram Clay.

Gram	141.277	5.30– 5.70 m.:	2 defective, juvenile shells	(2)
–	–	12.60–13.10 m.:	1 apex of a shell	(1)
–	–	15.55–16.00 m.:	1 protoconch	(1)
–	–	17.00–17.50 m.:	1 juvenile shell	(1)
Spandetgård. Clay pit:			1 juvenile shell	(1)
Sæd	167.4	70 m.:	2 small, juvenile shells	(2)
–	167.445	92.25–92.70 m.:	1 juvenile shell	(1)
–	–	92.70–93.00 m.:	2 fragments	(?1)
–	–	95.90–96.20 m.:	1 defective shell	(1)
–	–	99.05–99.55 m.:	1 small, juvenile shell	(1)
Rends	167.236	140′–160′ :	2 small, juvenile shells	(2)

Description. The shell is fusiform or subconical.

The protoconch is conical, multispiral, comprising $4\frac{1}{2}$–5 whorls. The initial whorl is comparatively small, vesicular, slightly sinistral. The medial whorls are moderately convex, mainly corroded on the shells available, but seem to have had numerous small papillae on the greater part of the whorls, especially the abapical part. The terminal whorl, which only comprises about $\frac{1}{2}$–$\frac{3}{4}$ of a whole whorl, is rather flat and provided with some (about 12) narrow, mutually rather distant, slightly opisthocyrt, almost orthocline collabral ribs, which disappear on the transition to the teleoconch.

The apex is almost regularly conical, while the base of several shells is considerably shorter than the apex. The whorls of the teleoconch are almost flat. On the oldest whorl there is a very narrow subsutural spiral zone, which becomes considerably fainter already on the next whorl and then disappears almost completely. There is, however, a small suggestion of it to be seen on the other whorls, too. Abapically to the spiral zone there is a faintly developed concave region, which already on the second or third whorl becomes flat. The next, abapical half of the whorl is slightly convex. In the middle of this region the deep sinus of the growth lines is seen.

From the periphery which delimits the apex from the base, the surface of the shell slopes steeply down towards the canal in a convex curve. The aperture is oval. The siphonal canal is often rather narrow and comparatively short. The labrum has been broken off all the specimens. The inner lip is smooth, on the shells available only indistinctly delimited from the surface of the base.

Remarks. It is possible that this species will prove only to be a subspecies of *F. duchasteli*. Cf. the remarks in my previous work.

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation. North Germany: Obermiocän von Sylt, Langenfelde, Lüneburg (v. KOENEN).

Genus: *Bathytoma* HARRIS & BURROWS 1891
(Type: *Murex cataphracta* BROCCHI 1814)

Bathytoma cataphracta (BROCCHI 1814)

The shells belonging to the form cycle of *B. cataphracta* is so variable as regards shape as well as sculpture, that in the course of time a number of species have been set up. This also applies to the material from the Younger Marine Miocene formations in the North Sea Basin. Thus in Denmark a form of a special appearance occurs in the Hodde Clay and another form occurs in the younger Gram Clay. An intermediate stage is that of the shells from the older Gram Clay at Måde. When viewed apart, the form in the Hodde Clay and that in the younger Gram Clay seem to be quite different species. I consider them two subspecies of *B. cataphracta* and shall describe them apart.

Bathytoma cataphracta jugleri (PHILIPPI 1846)
Plate XXII, fig. 7, and Plate XXIV, figs. 2–3

1846. *Pleurotoma Jugleri* – PHILIPPI, Verzeichniss, p. 68, Pl. Xa, f. 1.
1856. ? – BEYRICH, Conchylien, Pl. 30, f. 1 (figure only).
1872. *Pleurotoma turbida* SOL. – v. KOENEN, Mioc. Nordd. I, p. 215 (pars).
1925. *Bathytoma Jugleri* PHIL. – KAUTSKY, Hemmoor, p. 179, Pl. 12, f. 1, 2.
1952. *Bathytoma jugleri* (PHILIPPI) pars – HINSCH, Leit. Moll., p. 171, Pl. C, f. 5.
1964. *Epalxis (Bathytoma) cataphracta jugleri* (PHILIPPI) – ANDERSON, Reinbek-Stufe, p. 287, Pl. 34, f. 234.

Original diagnosis. Pl. testa oblonga, biconica; anfractibus superioribus parum elevatis, canali profundo mediano duplicatis; parte superiore convexa lineis elevatis transversis striata; parte inferiore aeque convexa plicis parvis, confertissimis arcuatis sculpta; basi cingulis transversis distantibus ornata (PHILIPPI, 1846, p. 69).

Material. Hodde Clay.

Grøde. Karlsgårde Canal:			2 shells
Måde Brickworks. Eastern clay pit:			6 shells
Gram	141.277	30.50–30.95 m.:	1 defective shell and 3 fragments

Description. The shells from the Hodde Clay in many cases lack the protoconch. Otherwise the shells correspond completely to material from Twistringen in Northern Germany collected by myself. Therefore this has also been used for the following characterization.

The shell is comparatively big, more or less slender, oblong ovoid-fusiform.

The protoconch tapers more or less. It is multispiral, comprising about five whorls. The initial whorl is small, semi-sinistral, smooth. The medial whorls are convex, smooth.

The terminal whorl is rather flat, with slightly opisthocyrt, narrow, widely

separated collabral riblets, after which a subsutural spiral band occurs immediately below the adapical suture.

Immediately after the distinct boundary between protoconch and teleoconch there is a convex, depressed zone approximately in the middle of the whorl so that all the whorls of the teleoconch are divided into three sections: (1) A flat or slightly convex, adapical region immediately below the adapical suture, first narrow, later usually rather broad, (2) A rather narrow, more or less groove-shaped, convex zone in or a little abapical to the middle, and (3) A rather narrow, convex zone situated immediately above the abapical suture or shifted somewhat adapically, so that a narrower or broader, flat, somewhat adaxially sloping region appears between the zone itself and the suture. The abapical convex zone is narrower than the adapical one.

The surface of the whorls is covered by close-set, mostly weak spiral threads or bands, separated by very narrow grooves. On the adapical part of the whorls the growth lines are prosocyrt, but change directions when crossing the concave zone, and over the abapical convex zone form a long and deep sinus, lying in the middle of the zone. On the last whorl and the base of the shell the growth lines pass in large prosocyrt curves.

The spiral threads and the growth lines are sometimes equally prominent, so that together they stand out as a regular network. On some shells, especially of juvenile individuals, and on the older parts of old shells, the abapical zone is disintegrated into numerous small, faint knobs. Often, however, the shells are quite without such a sculpture. Sometimes there is immediately below the abapical zone on the youngest whorls of older shells a prominent spiral thread.

The base is covered by numerous weak spiral bands and threads.

The labrum has been broken off all the shells examined. It seems to have been sharp-edged and to have curved in a prosocyrt direction, conformally to the growth lines. The inner lip is smooth, often clearly delimited from the base, the surface of which rises to a slightly higher level, demarcated by a well-marked edge. The columella has a more or less distinct, oblique fold.

The aperture is oblong oval, passing more or less imperceptibly into the rather broad, short, and straight siphonal canal.

Chief characters. Very faint knobs on the abapical spiral zone. A rather broad adapical zone, which is often flat. Slightly prominent spiral sculpture.

Distribution.

North Sea Basin. Denmark: Hodde Formation. North Germany: Reinbek-Stufe (ANDERSON).

Bathytoma cataphracta mioturbida KAUTSKY 1925

1856. ? – BEYRICH, Conchylien, Pl. 30, f. 2 (figure only).

1872. *Pleurotoma turbida* SOL. – v. KOENEN, Mioc. Nordd. I, p. 215 (pars).

1907. *Pleurotoma cataphracta* BROCCHI *sp.* – RAVN, Jylland, p. 350 (146), Pl. VII, f. 12.
1874. *Pleurotoma* (*Borsonia* ?) *cataphracta* BROCCHI – MØRCH, Forst. i Tert., p. 290 (17).
1925. *Bathytoma mioturbida* – KAUTSKY, Hemmoor, p. 180, Pl. 12, f. 3, 4.
1952. *Bathytoma mioturbida* KAUTSKY – HINSCH, Leit. Moll., p. 172, Pl. C, f. 6.
1956. *Bathytoma cataphracta* (BROCCHI) – RASMUSSEN, South Jutland, p. 91, Pl. IX, f. 3a, b.

Original diagnosis: Not given. New diagnosis by HINSCH, 1952, p. 172: Eine *Bathytoma* mit kräftigem, knotigen Nahtwulst, über den ziemlich kräftige Spiralen laufen. Kiel mit kräftiger Knotenreihe.

Material. Gram Clay.

Shell material is available from the following localities (cf. Tables 15–66 in Part I):

Skærum Mølle (clay pit), Lillelund (73.88), Kodal-Fjaldene (84.1749), Videbæk (84.344, 84.492), Møltrup Brickworks (clay pit), Lille Torup (85.379), Gjellerup (85.380), Sandfeldbjerg (clay pit), Brande Brickworks (clay pit), Drantum (104.1241), Hjortsballe (105.320), Alkærsig Brickworks (clay pit), Lønborg (102.55), Harkes Brickworks (clay pit), Hesselho (113.121), Hauge (clay pit), Tønding (clay pit), Hoddemark (Canal section), Grøde (Canal section), Esbjerg (beach, clay pit, 130.59), Måde Brickworks (clay pit), Strandgård Brickworks (clay pit), Holleskov (132.46b), Ravning (clay pit), Sønder Hygum (141.261), Gram (141.277), Spandetgård (clay pit), ? Tønder (166.398), Brodersmark (166.351b), Sæd (167.4, 167.445), and Rends (167.236).

Description. The shell is comparatively big, more or less slender, oblong ovoid – broadly fusiform.

The protoconch is pointed, conical, multispiral, comprising about five whorls. The initial whorl is small, semi-sinistral, smooth. The medial whorls are convex, smooth. The terminal whorl has about 14 thin, widely spaced, opisthocyrt, collabral riblets.

The whorls of the teleoconch have immediately below the adapical suture a narrow, convex, sometimes knob-bearing spiral zone, abapically replaced by a convex zone, which, again, is followed by a convex, knob-bearing zone, which on the younger whorls on older shells is raised somewhat above the suture. Between the suture and the zone there is then a more or less broad, slightly adaxially sloping region. In this case the abapical zone forms a more or less rounded margin.

The sculpture first of all consists of numerous close-set spiral bands, which especially are strong on the youngest whorl and on the base. Furthermore there are small knobs on the adapical spiral zone of the older whorls, and on the margin of all the whorls or their abapical spiral zone. The last-mentioned knobs are often prominent and round.

The spiral sculpture passes over the knobs, which, for that matter, have formed at the highest points of the growth lines. The sinus, which is rather lengthy and deep, is on the margin (respectively the abapical spiral zone).

Besides, the growth lines have the same form as the type mentioned above.

Reference is made to the description of this type as regards the labrum, the inner lip, the columella, the aperture, and the siphonal canal, as on these points there is identity.

Chief characters. Rather prominent knobs on the abapical spiral zone, which on the younger whorls forms a rounded margin. A narrow adapical spiral zone with distinct spiral bands. A rather prominent spiral sculpture, especially on the base.

Distribution.

North Sea Basin. Denmark: Gram Formation. North Germany: Gram-Stufe (HINSCH). Belgium: Boldérien, Anversien (GLIBERT).

The Intermediary Type in the Lower Gram Clay

From the lower Gram Clay at Måde Brickworks there are a few shells available which in certain respects point towards the *jugleri* type, e.g. by the fact that the younger whorls completely lack knobs on the margin. On the other hand the spiral sculpture is almost as prominent as on the *mioturbida* type.

Most shells in the lower Gram Clay at Måde, however, have a weak row of knobs on the margin and a moderately prominent spiral sculpture. However, they especially seem to be characterized by mostly lacking an adapical spiral zone on the younger whorls, the adapical part of which passes evenly into a more or less faint, concave hollow, which abapically is delimited by the margin. It has not been possible to demonstrate specimens in the Måde locality which are completely similar to the form in the Hodde Clay.

Variations. Both the two subspecies and the connecting, intermediary form are each of them very variable as regards both the shape of the shell and the sculpture. Short, broad forms occur together with longer and narrower shells. The knob-bearing margin is more or less rounded. The spiral sculpture varies as regards the number and prominence of bands and threads.

Remarks. B. mioturbida, which occurs in the Miocene formations of Belgium, according to GLIBERT's figures, seems to correspond to the intermediary type in the older Gram Clay.

The same applies to the shells from Lüneburg and Langenfelde referred to *B. jugleri* by HINSCH.

The form cycle of *B. cataphracta*, for that matter, seems to include a number of species the primitive form of which may be the Eocene *Pleurotoma turbida* SOLANDER. The similarity of this species to *B. cataphracta* and its subspecies is so great that v. KOENEN (1872) united all Eocene, Oligocene, Miocene, and

Pliocene shells belonging to this form cycle under *P. turbida* on the following grounds:

"In der Gestalt des Gewindes, der Lage des Kiels, der Stärke und Körnelung der Spiralstreifen, der Gestalt und Stärke der Anwachsstreifen finde ich ferner bei nochmaligem, sorgfältigem Vergleiche nicht den geringsten Unterscheid, vielmehr variiren in der Regel die Exemplare sogar derselben Lokalität hierin sehr bedeutend."

Genus: *Turricula* SCHUMACHER 1817
(Type: *Turricula flammea* SCHUMACHER 1817)

Turricula steinvorthi (SEMPER in V. KOENEN 1872)
Plate XX, fig. 2

1872. *Pleurotoma Steinvorthi* SEMPER – V. KOENEN, Mioc. Nordd. I, p. 228, Pl. 2, f. 10.
1914. *Pleurotoma (Surcula) Steinvorthi* SEMPER – GRIPP, Itzehoe, p. 29, Pl. III, f. 8–10.
1916. *Pleurotoma Steinvorthi* SEMP. – NØRREGAARD, Esbjerg, p. 33, Pl. 3, f. 10.
1925. *Surcula Steinvorthi* SEMP. – KAUTSKY, Hemmoor, p. 158, Pl. 11, f. 4.
1940. *Surcula Steinvorthi* SEMPER – SORGENFREI, Klintinghoved, p. 50, Pl. VI, f. 13.
1954. *Turricula steinvorthi* (SEMPER) KOENEN sp. – GLIBERT, Pleurotomes, p. 13, Pl. III, f. 1a, b, c.
1958. *Turricula Steinvorthi* (VON KOENEN) – SORGENFREI, Middle Mioc., p. 262, Pl. 53, f. 180a–b.
1964. *Turricula steinvorthi* (SEMPER in KOENEN) – ANDERSON, Reinbek-Stufe, p. 288, Pl. 35, f. 235.

Material. Hodde Clay.

Leding	93.155	19–27 m.:	1 fragment of a whorl
Måde Brickworks. Eastern clay pit, the north wall:			1 fragment of a shell

Description. The available material is too incomplete for a description which covers the whole shell, for which reason reference is made to the literature.

From the Hodde Clay at Måde Brickworks there is rather a big fragment available, consisting of two whorls and a half of rather a big shell. The fairly flat whorls have a flatly convex zone or depression in the middle, in which the growth lines form rather a deep sinus. Otherwise the surface is covered by flat, almost obliterated spiral ribs.

The shell from Hoddemark pictured (Shell Bed I) has a worn protoconch and a partly worn surface on the older part of the teleoconch. The young part of the latter shows an almost levelled subsutural spiral zone and quite a flat depression. The abapical, very flatly convex part of the whorls occupy almost two thirds of their height.

Variations. The three zones into which it is possible to divide the whorls on the teleoconch of this species, vary somewhat as regards their breadth.

Distribution.

North Sea Basin. Miocene. Denmark: Klintinghoved Clay, Arnum Formation (SORGENFREI), Hodde Formation. North Germany: Vierland-Stufe (GRIPP), Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON), Glimmerton at Langenfelde, Reinbek, Gühlitz, Lüneburg (v. KOENEN), Kummer, Hohenwoos, and Bockup (METZMACHER). Belgium: Boldérien, Anversien (GLIBERT).

Genus: *Spirotropis* G. O. SARS 1878

(Type: *Pleurotoma carinata* BIVONA 1832)

Spirotropis modiola (JAN 1832)

Plate XXI, figs. 1–4

1956. *Drillia* (*Spirotropis*) *modiola* (JAN) – RASMUSSEN, South Jutland, p. 82, Pl. VII, f. 6.
1960. *Spirotropis modiola* JAN sp. – GLIBERT, I.R.S.N.B., Bull., T. XXXVI, no. 33, p. 10, Pl. IV, f. 7.

Material. Gram Clay.

Skærum Mølle. Clay pit:			1 almost complete shell	(1)
Lille Spåbæk. Lignite pit:			1 defective shell	(1)
Grønbjærg. Clay pit:			1 defective and weathered shell	(1)
Videbæk	84.483	2.0 –10.8 m.:	1 fragmentary shell	(1)
Drantum	104.1241	36.0 –40.0 m.:	1 fragment	(?1)
–	–	46.0 –50.0 m.:	Apex of a shell	(1)
Alkærsig Brickworks. Clay pit:			2 defective shells	(2)
Hauge. Clay pit:			1 fragment	(1)
Esbjerg. Beach and clay pit:			22 more or less defective shells	(22)
Måde Brickworks. Eastern clay pit:			33 more or less defective shells	(33)
Strandgård Brickworks. Clay pit:			1 shell	(1)
Gram	141.277	12.10–12.60 m.:	1 fragment	(1)
Sæd	167.445	92.25–92.70 m.:	2 fragments	(1)
–	–	92.70–93.00 m.:	1 defective shell and 2 fragm.	(1)
–	–	93.70–94.10 m.:	1 fragment	(1)

Description. The shell is fusiform, with edged whorls.

The protoconch is paucispiral, comprising about one whorl and a half, smooth, convex.

The whorls of the teleoconch are smooth, with a carina situated in the middle or more abapically. The carina has a rounded or sharp edge, sometimes directed somewhat upwards (adapically). Between the carina and the adapical suture there is a broad, concave region with the sinus. The highest point of the sinus is closest to the carina. The concave zone is otherwise smooth, on certain shells, however, with numerous very weak spiral threads. The adaxially directed slope from the carina to the abapical suture is almost inclining 45°. A more or less weak rounded edge appears in continuation of the suture on the last whorl. On the neck of the canal there are highly oblique folds.

The aperture is oval, edged, sometimes trapezoidal. The labrum is sharp

and simple, with a round, sometimes deep, circular incision in the sinus zone, conformal with the sinus and sometimes with a slightly swollen margin. The inner lip is smooth, sharply delimited from the neck of the canal, with a somewhat oblique, irregular bulge. The canal is rather long in relation to the aperture.

Variations. The appearance of the carina in this species varies considerably, as especially seen in the material from Måde. There are shells with a highly rounded, comparatively broad carina and shells with a sharp-edged, upwards-adapically directed carina. Sometimes the margin of the carina rises as a thick wall. The specimens with the sharp-edged carinae were found in the older beds of the Gram Clay.

Remarks. The genus *Spirotropis* was set up by SARS (1878, p. 242), with *S. carinata* PHILIPPI as type, on the basis of this animal's especially equipped radula. POWELL (1942) was unable to decide the systematic position of this genus. GLIBERT (1960) suggests that it should be placed in the subfamily Clavinae. It is, however, still undecided where it ought to be placed. Here it has been chosen to follow GLIBERT's interpretation.

S. modiola was named by JAN (*Fusus modiolus*), but without any description and picture, on the basis of material from the Tertiary of Italy. PHILIPPI (1844, p. 176, Plate XXVI, fig. 19) pictured and described a form originally named by BIVONA, *Pleurotoma carinatum*, from the Tertiary of Calabria, but did not refer it to JAN's species. To all appearances they are identical, but this has not yet been proved.

S. carinata is stated by JEFFREYS (1869, p. 221) to have been found as recent near the Orkneys and the Hebrides and by SARS (1878, pp. 242–43, Plate 17, figs. 5a, b) near the coasts of Norway (the Finmark, Lofoten) at depths from 60 to 300 fathoms. The carina on the shell pictured by SARS has a fairly rounded margin, and the sinus region is only slightly concave. The shell pictured by PHILIPPI, on the other hand, has a sharp-edged carina. The same applies to the shells from the Tertiary of Italy pictured by SACCO (1904, XXX, Plate XII, figs. 41a, b).

HOERNES & AUINGER (1891, p. 324, Plate XLI, figs. 9 and 10) state that the labrum on the shells from the Miocene of the Vienna Basin has been drawn out into a wing-like extension. Nothing similar has been observed in the Danish material.

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation. North Germany: Glimmerton at Sylt, Langenfelde, Lüneburg (v. KOENEN). Holland: "Obermiozän" at Oploo (GRIPP). – Plio-Pleistocene. Germany: Limonite sandstone in Morsum Kliff, Sylt (GRIPP). Belgium: Scaldisien (GLIBERT). England: Coralline Crag, Red Crag (WOOD, HARMER).

Mediterranean Basin. Italy: Terreno miocenico, pliocenico (BELLARDI).

Vienna Basin. Austria: Baden, Möllersdorf, Nussdorf (M. HÖRNES), Walbersdorf (HÖRNES & AUINGER). – Hungary: Torton near Sopron (CSEPREGHY-MEZNERICS), "Miozän-Mediterran" (STRAUSZ).

Genus: *Tahusyrinx* POWELL 1942

(Type: *Parasyrinx finlayi* ALLAN 1926)

Tahusyrinx corneti (v. KOENEN 1872)

Plate XXI, figs. 5–7

1872. *Pleurotoma Corneti* – v. KOENEN, Mioc. Nordd. I, p. 235, Pl. 3, f. 11 (under *P. circumfossa*).
1925. *Surcula (Ancistrosyrinx) Cornety* v. KOEN. – KAUTSKY, Hemmoor, p. 159, Pl. 11, f. 5.
1952. *Ancistrosyrinx (Tahusyrinx) corneti* KOENEN sp. – GLIBERT, Pleurotomes, p. 15, Pl. III, f. 4.
1958. *Tahusyrinx cf. Corneti* (VON KOENEN) – SORGENFREI, Middle Mioc., p. 264.
1964. *Ancistrosyrinx corneti* (KOENEN) – ANDERSON, Reinbek-Stufe, p. 289, Pl. 35, f. 236, 236a.

Material. Hodde Clay.

Odderup	103.150	24.8 –25.6 m.:	1 defective shell
Grøde (Carlsgårde Canal):			1 fragment of a shell
Måde Brickworks. Eastern clay pit, the north wall: 1 shell			
Unknown section in the same clay pit, leg. K. DREYER JØRGENSEN: 1 shell			
Gram	141.277	28.00–28.50 m.:	1 defective apex of a shell
–	–	31.35–31.65 m.:	1 broken-off protoconch of a shell

Description. The shell is fusiform, with highly edged whorls.

The protoconch is short, conical, comprising a small, smooth, slightly sinistral initial whorl and $1\frac{1}{2}$ smooth whorls with a slightly prominent central or a little abapical edge.

On the whorls of the teleoconch this edge soon becomes more prominent, forming a carina, on which there are about 12 rather pointed mutually distant knobs. The number of these is increased with the age of the animal (from about 16 to about 23) and they soon develop into triangles, the apices of which point obliquely upwards and later inwards towards the axis of the shell. The edge of the carina is gradually drawn somewhat upwards (adapically) and on the youngest whorls the edge gets up over the suture. The suture takes a somewhat more oblique course than that of the edge of the carina and is seen as an extraordinarily thin, almost invisible spiral groove. The region between the carina and the adapical suture has, from being an oblique shoulder on the oldest whorls of the teleoconch, gradually become more and more concave, forming a deep, broad groove.

The growth lines have a very deep incurvation of the sinus in the groove

somewhat adapically to the middle of it. The abapical region of the whorls, delimited by the edge of the carina and the abapical suture, is mostly somewhat convex, but on the youngest whorl of large shells it is straight. It is smooth and turns inwards towards the axis at an angle of about 45°. The suture continues from the aperture on to the last whorl as rather a prominent edge, which sharply delimits an adapical region with an inclination of about 45° towards the axis and a neck of the canal with some 8 oblique folds, which have disintegrated into many knobs.

The aperture is rather narrowly triangular, abapically passing into the long, narrow canal. The labrum has been broken off the present shells. The inner lip is smooth, with a distinct delimitation from the neck of the canal.

Measurements. The shell from Måde pictured has the following dimensions:

Length: 11.6 mm. Length of the protoconch: 0.4 mm. Diameter: 5.1 mm. Length of the aperture: 3.3 mm. Length of the canal: 1.7 mm.

Another shell collected at Måde by K. DREYER JØRGENSEN lacks the protoconch, but must have been 14–15 mm. in length. Diameter: 6 mm. Length of the aperture: 4 mm. Length of the canal: 2 mm.

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Hodde Formation. North Germany: Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON). Belgium: Anversien (GLIBERT).

Genus: *Clavatula* LAMARCK 1801
(Type: *Clavatula coronata* LAMARCK 1801)

? Clavatula sp.

A very fragmentary and worn shell from the bore-hole at Hajstrup (167.235, core 174′–194′) shows features characteristic of the genus *Clavatula*. A sure determination is, however, impossible.

Genus: *Acamptogenotia* ROVERETO 1899
(Type: *Murex intorta* BROCCHI 1814)

Acamptogenotia intorta (BROCCHI 1814)
Plate XXIII, fig. 8

1956. *Acamptogenotia intorta* (BROCCHI) – RASMUSSEN, South Jutland, p. 96, Pl. X, f. 1 a, b.
1964. *Acamptogenotia intorta straeleni* GLIBERT – ANDERSON, Reinbek-Stufe, p. 293.
1964. *Acamptogenotia escheri* (MAYER) – ANDERSON, Reinbek-Stufe, p. 293, Pl. 36, f. 242, 242 a.

Material. Gram Clay.

Sandfeldbjerg. Clay pit:			2 shells
Karlsgårde Canal. Unknown locality:			1 shell
Esbjerg. Beach and clay pit:			13 more or less complete shells
Måde Brickworks. Eastern clay pit:			11 more or less complete shells
Gram	141.277	13.10–13.50 m.:	?1 fragment
–	–	19.00–19.50 m.:	1 shell
Spandetgård. Clay pit:			6 shells

Description. The shell is big, subfusiform.

The protoconch has not been preserved on the present shells.

The whorls of the teleoconch are more or less angular. On the adapical region there is a concave depression, which abapically is delimited by a more or less well-defined edge. The abapical half of the whorl is sloping slightly towards the abapical suture. The sculpture consists of numerous, close-set, weak spiral threads or bands, which cover the whole whorl. On the margin there is a number of more or less faint, rounded knobs (15–16), which may be a little drawn out in the abapical direction. The growth lines form a sinus of moderate depth, situated in the depression, and then take a course in a slightly oblique direction towards the abapical suture. On the younger whorls of the teleoconch these growth lines are sometimes somewhat elevated, filiform, and almost are as prominent as the spiral threads.

The aperture is oblong oval, passing evenly into the rather short canal. The labrum has mostly been broken off, but is seen to have been simple. Its edge must have taken a course conformal to the growth lines and have been curved outwards abapically and depressed adapically. The inner lip is smooth, well-defined.

Remarks. The form cycle to which *A. intorta* belongs, comprises a number of forms, which have not yet been clearly defined because of the variability of the shells.

A. morreni (De Koninck 1837) from the Belgian Rupélien supérieur (described by De Koninck 1837, p. 21, Plate I, fig. 3) has the greatest similarity to *A. intorta*, from which, however, according to Glibert (1954, p. 24) it differs by i.a. having collabral ribs on the last whorls and by, on the whole, having coarser and more close-set spiral bands (cf. picture in Glibert, *loc. cit.*, Plate IV, fig. 8).

A. escheri Glibert 1954 (*loc. cit.* pp. 23–24, Plate IV, fig. 9) from the Anversien of Belgium has close-set fine spiral threads all over the surface of the whorl, but only collabral ribs or knobs on the youngest whorls. The last whorl is subangular. There is a moderately convex abapical section of whorl without an edge or only with a highly rounded edge.

Thus it is the fineness of the spiral and the collabral sculpture and the relief of the whorls that have been determinative of the delimitation of the species

mentioned, but as no comparative statistical investigations of the various populations have been made, it is possible that it is only a case of ecological variations or perhaps subspecies.

The material from the early sections of the Gram Clay at Måde Brickworks has a clearly developed edge, somewhat finer spiral threads and weaker collabral knobs than the shells from the younger Gram Clay at Gram and in other localities. It seems to be a form which stands between *A. straeleni* and *A. intorta*.

From Shell Bed I at Hoddemark there are numerous specimens of a form which has the greatest affinity to *A. straeleni* (cf. Plate XXIII, fig. 7). On the other hand, my material (2 shells and 1 fragment) from the Mica Clay at Twistringen Brickworks in Northern Germany (Reinbek-Stufe) corresponds best to *A. escheri*.

Distribution.

Presumably *A. intorta* from the North Sea Basin is not quite identical with the same form from the Mediterranean Pliocene beds of Italy, but perhaps is only a subspecies of it. Therefore reference is made to my work of 1956 as regards the distribution.

Genus: *Inquisitor* HEDLEY 1918

(Type: *Pleurotoma sterrha* WATSON 1886)

Inquisitor borealis (KAUTSKY 1925)

1925. *Drillia* (*Crassispira*) *obeliscus* DESM. *var. borealis* – KAUTSKY, Hemmoor, p. 173, Pl. 11, f. 25, 26.
1954. *Clavus* (*Crassispira*) *borealis* KAUTSKY sp. – GLIBERT, Pleurotomes, p. 26, Pl. IV, f. 11.
1956. *Turris* (*Crassispira*) *obeliscus* (DES MOULINS) – RASMUSSEN, South Jutland, p. 87, Pl. VIII, f. 4.
1958. *Inquisitor obeliscus* (DES MOULINS) – SORGENFREI, Middle Mioc., p. 268, Pl. 56, f. 189.
1964. *Crassispira borealis* (KAUTSKY) – ANDERSON, Reinbek-Stufe, p. 294, Pl. 36, f. 243.

Material. Hodde Clay.

Leding	93.155	19 –27	m.:	1 fragmentary shell (1)
Grøde (Karlsgårde Canal):				2 def. shells (2)

Gram Clay.

Måde Brickworks. Eastern clay pit:				2 fragments of a shell (1)
Sønder Hygum	141.261	13 –19	m.:	1 juvenile shell and 1 protoconch (2)
Gram	141.277	16.00–16.50	m.:	1 fragment (?1)
–	–	16.50–17.00	m.:	1 juvenile shell (1)
Spandetgård. Clay pit:				1 almost complete shell and 1 worn shell (2)

Description. The shell is subfusiform, with the apex somewhat longer than the base.

The protoconch is lengthened conically, multispiral, comprising about four whorls and a half.

The initial whorl is rather small, globular, slightly sinistral, smooth. The medial whorls are moderately convex, smooth. On the youngest one a very thin spiral thread is seen immediately above the abapical suture. The terminal part constitutes about one fourth of a whorl with a collabral sculpture of narrow opisthocyrt ribs.

The whorls of the teleoconch have a spiral zone immediately below the adapical suture, followed by rather a broad concave zone, in which the sinus of the growth lines is found. The abapical two thirds of the whorls are convex and provided with somewhat oblique, rather broad, rounded-off collabral ribs in a number of 10–12 per whorl. Their interspace is of approximately the same breadth as themselves. On the oldest few whorls the surface of the shell is covered by some 8 close-set spiral ribs, which on the younger whorls become somewhat more numerous, but more and more obliterated and often are almost invisible. However, they are usually seen on the abapical half of the whorls and especially on the base of the shell.

The aperture is oblong oval, abapically passing evenly into the comparatively short siphonal canal. The labrum has been broken off the present shells. The inner lip is smooth, clearly delimited from the more highly situated surface of the base.

Remarks. A thorough investigation of the form cycle of *I. obeliscus* (DES MOULINS) with all its species and subspecies is still lacking.

The material from the Gram Clay, which in KAUTSKY's opinion (*op. cit.* p. 173) perhaps should be considered a special subspecies of *I. obeliscus*, different from *I. borealis*, however, does not seem to differ decisively from the form in the Hodde Clay and Shell Bed I at Hoddemark. The shells from the latter layer are more slender than the form in the Gram Clay and have a more pronounced spiral sculpture. They correspond completely to GLIBERT's picture of a shell of *I. borealis* from the Anversien of Belgium. At any rate forms from the Gram Clay are very closely related to the form in the Anversien and in the Reinbek-Stufe, and its broader shells with the obliterated spiral sculpture and the comparatively short, broad ribs can very well be an ecologically conditioned form.

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI: *I. obeliscus*), Hodde Formation, Gram Formation. North Germany: Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON), Glimmerton at Morsum Kliff, Sylt (RAVN), Breklum (STRUCK), Lieth (GOTTSCHE & WIBEL), Ütersen (WOLFF), Langenfelde (v. KOENEN). Belgium: Anversien (GLIBERT).

Genus: *Splendrillia* HEDLEY 1922
(Type: *Drillia woodsi* BEDDOME 1883)

Splendrillia selenkae (V. KOENEN 1872)
Plate XVIII, fig. 1

1872. *Pleurotoma Selenkae* – V. KOENEN, Mioc. Nordd. I, p. 241, Pl. 3, f. 4a, b, c.
1904. *Drillia Selenkae* (V. KOENEN) – SACCO, I Molluschi, XXX, p. 46, Pl. XII, f. 39, 40a, b.
1925. *Drillia* (*Cymatosyrinx*) *Selenkae* V. KOENEN – KAUTSKY, Hemmoor, p. 176, Pl. 11, f. 29.
1940. *Drillia* (*Cymatosyrinx*) *Selenkae* V. KOENEN – SORGENFREI, Klintinghoved, p. 55, Pl. VI, f. 17.
1954. *Clavus* (*Cymatosyrinx*) *cf. selenkae* (KOENEN) – GLIBERT, Pleurotomes, p. 31, Pl. V, f. 2.
1958. *Splendrillia Selenkae* (VON KOENEN) – SORGENFREI, Middle Mioc., p. 270, Pl. 56, f. 190a–c.
1964. *Splendrillia selenkae* (KOENEN) – ANDERSON, Reinbek-Stufe, p. 301, Pl. 38, f. 252.

Material. Hodde Clay.

Måde Brickworks. Eastern clay pit, the north wall:			1 almost complete shell
Gram	141.277	35.30–35.70 m.:	4 small fragments
Hajstrup	167.235	174′–194′ :	1 fragment of a whorl of a shell

Description. The shell is fusiform.

The protoconch is paucispiral, obtuse, vesicular, smooth, comprising about $1\frac{1}{2}$ convex whorls. The initial whorl is slightly sinistral.

The teleoconch has up to 5 somewhat edged whorls, bearing a number of rounded knobs (about 9), which rise in the middle of the whorls. They are not completely lost until right down beside the abapical suture. Between the row of knobs and the adapical suture there is a concave region, in which the sinus of the growth lines is situated. This is moderately deep. The surface of the shell is smooth.

The aperture is oval. The labrum has been broken off the present shells. The inner lip is smooth, indistinctly delimited from the surface of the base. The canal is rather short.

Measurements.

	Shell		Protoconch		Aperture
	Length	Diameter	Length	Diameter	Length
Twistringen					
Shell No. 1	7.2 mm.	3.0 mm.	0.7 mm.	0.8 mm.	4.0 mm.
– – 2	8.0 –	3.3 –	0.6 –	0.6 –	4.0 –
– – 3	10.2 –	3.7 –	0.6 –	0.7 –	4.3 –
Hoddemark					
(Shell Bed I)	7.4 –	3.0 –	0.7 –	0.7 –	3.3 –

Distribution.

North Sea Basin. Miocene. Denmark: Klintinghoved Clay, Arnum Formation (SORGENFREI), Hodde Formation. North Germany: Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON), Glimmerton at Gühlitz (SCHULTE), Kummer and Hohenwoss (METZMACHER, W. v. BÜLOW). Belgium: Anversien (GLIBERT).

Mediterranean Basin. Italy: Formation not stated (SACCO).

Genus: *Microdrillia* CASEY 1903

(Type: *Pleurotoma cossmanni* MEYER 1903 (= *P. meyeri* ALDRICH))

Microdrillia serratula (BELLARDI 1878)

Plate XXII, figs. 1–2, 4, and 6

1847. *Pleurotoma crispata* JAN *var. A.* – BELLARDI, Pleurot. Piemonte, p. 70.
1872. *Pleurotoma crispata* JAN – v. KOENEN, Mioc. Nordd. I, p. 235.
1878. *Drillia serratula* – BELLARDI, I Molluschi, II, p. 133, Pl. IV, f. 22.
1891. *Pleurotoma (Drillia) serratula* BELL. – HOERNES & AUINGER, I, u. II. Meditter. p. 325, Pl. XLII, f. 1.
1914. *Pleurotoma (Drillia) crispata var. Adelae* HOERN. & AUING. – GRIPP, Itzehoe, p. 34, Pl. III, f. 29.
1925. *Drillia (Crassispira) serratula* BELL. – KAUTSKY, Hemmoor, p. 175.
1964. *Microdrillia crispata* (JAN) – ANDERSON, Reinbek-Stufe, p. 297, Pl. 37, f. 248.

Original differential diagnosis. Distinguunt hanc speciem a *Drillia crispata* (JAN) sequentes notae: Carina in omnibus anfractibus denticulata. Long. 14 mm. Lat. 5 mm. (BELLARDI 1878).

Material. Hodde Clay.

Måde Brickworks. Eastern clay pit, the north wall:

			3 shells
Gram	141.277	30.50–30.95 m.:	1 fragment
Hygum	141.215	26.2 –32.8 m.:	1 shell
Hajstrup	167.235	174′–194′ (0.8–1.3 m. below the top of the core):	1 shell

Gram Clay.

Kodal-Fjaldene	84.1749	20.55–21.55 m.:	1 fragmentary shell
Møltrup Brickworks. Clay pit:			1 defective shell
Hesselho	113.121	56.0 –65.0 m.:	1 complete shell
Måde Brickworks. Eastern clay pit. Western part of the south wall:			1 shell
Måde Brickworks. Eastern clay pit. No definite statement:			3 shells
Gram	141.277	13.10–13.50 m.:	1 fragment
–	–	14.60–15.10 m.:	1 fragment
–	–	15.55–16.00 m.:	1 complete shell
–	–	17.50–18.00 m.:	1 def. shell
–	–	18.50–19.00 m.:	1 small, almost complete shell
Tønder	166.398	58.85–59.00 m.:	1 apex of a shell

Description. The shell is comparatively short, fusiform, and has a well-marked sculpture.

The protoconch is conical, polygyral, consisting of about 5 whorls. The initial whorl is small and smooth. The other whorls are moderately convex, most in the abapical sections. They bear numerous thin, curved ribs, which by very weak transversal threads take an irregular course. The transition to the teleoconch is well-defined.

The whorls of the teleoconch are strongly sculptured. Immediately below the adapical suture there is a marked spiral band. Another, but more prominent one, forms the periphery of the whorl and is disintegrated into 14–17 strong knobs. Between these spiral bands there is a cavity formed as a concave, groove-shaped hollow, in which the growth lines stand out as curved threads, marking the sinus, which is in the middle of the hollow. Between the peripheral spiral band and the abapical suture there is yet a marked spiral band. On some shells there is a weak spiral band immediately above the suture. On the ramp down towards the neck of the canal and its surface there are at least 10 marked spiral bands.

The aperture is oblong oval. Labrum has been broken off the present shells. The inner lip is smooth. The canal is relatively short.

Variations. The shells from the Hodde Clay at Måde differ from the specimens of the Gram Clay from the same locality by having a thinner sculpture and a slighter cavity. On a single defective shell the cavity is even so flat that the sinus region instead forms a slope, on which the sinus lines do not stand out as threads.

Remarks. The present species has been referred to *Microdrillia*, which according to POWELL (1942, p. 33) is characterized by having a depressed sinus region, situated between a prominent subsutural carina and a peripheral one, and which has a polygyral protoconch, the top of which is smooth, but the other whorls of which have axial ribs. Mostly it is only a case of spiral sculpture.

On the closely related *M. adelae* (HOERN. & AUING.) the formation of knobs on the peripheral spiral band is but slightly developed. On the other hand, BALDI (1960, pp. 85–86) has shown that the species *crispata* JAN, which by HOERNES & AUINGER is considered closely related to *M. adelae*, is an *Asthenotoma* because of its obtuse, paucispiral protoconch. The shells from Lüneburg and Langenfelde which v. KOENEN (1872, p. 235) referred to *Pleurotoma crispata*, according to his description must belong to *Microdrillia*. A verification of the species is difficult because of the defective description and the absence of pictures.

The sculpture of the shells from the Gram Clay corresponds best to that of *M. serratula*, but seems to be a little coarser than appears from the pictures in HOERNES & AUINGER.

Measurements.

	Shell		Number of knobs on the peripheral spiral band, Whorl No.				
	Length	Diameter	1.	2.	3.	4.	Remarks
Hodde Clay.							
Måde	4.3 mm.	2.0 mm.	14	17			8 knobs on the youngest half whorl
Måde		2.2 –		11	13		The upper part of the apex broken off
Gram Clay.							
Måde	5.3 mm.	2.6 mm.	14				The upper part of the protoconch broken off
Måde	?	2.4 –					The apex broken off
Måde	?	2.7 –					

Distribution.

North Sea Basin. Miocene. Denmark: Hodde Formation, Gram Formation. North Germany: "Untermiozän" at Itzehoe (GRIPP 1914: *Pleurotoma (Drillia) crispata var. Adelae* HOERN. & AUING.), Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON: *Microdrillia crispata*), Glimmerton at Langenfelde and Lüneburg (v. KOENEN: *P. crispata*), Breklum (STRUCK: cf.).

Vienna Basin. Austria: Porzteich at Nikolsburg (Moravia) (HOERNES & AUINGER).

Mediterranean Basin. Italy: Miocene medio (BELLARDI).

Genus: *Asthenotoma* HARRIS & BURROWS 1891

(Type: *Pleurotoma meneghinii* MAYER 1868 = *tuberculata* PUSCH 1837)

Asthenotoma ravni nov. sp.

Plate XXII, fig. 3, and Plate XXIII, figs. 1–4 and 6

1907. *Mangilia sp.* – RAVN, Jylland, p. 360 (156).
1956. *Asthenotoma sp.* – RASMUSSEN, South Jutland, p. 90, Pl. IX, f. 1 a, b.

Diagnosis. An *Asthenotoma* with usually two marked, knob-bearing spiral bands on the abapical part of the whorls of the teleoconch.

Holotype. The shell described and pictured by RASMUSSEN *loc. cit.* is the holotype. Locus typicus: the clay pit of Gram Brickworks. Stratum typicum: Gram Clay.

Derivatio nominis. Named after J. P. J. RAVN (1866–1951), Docent of Palaeontology in the University of Copenhagen, who was the founder of the biostratigraphy of the Danish Tertiary and was the first to mention this species.

Material. Gram Clay.

Lillelund	73.88	28.5 –49.5 m.:	?1 fragment
Videbæk	84.456	2.2 –15.0 m.:	1 almost complete shell
Gjødstrup	85.861	46.0 m.:	1 defective shell
Hjortsballe	105.320	3.4 – 8.2 m.:	1 defective shell
Hesselho	113.121	56.0 –65.0 m.:	1 complete shell
Hauge. Clay pit:			1 complete shell
Tønning. Clay pit:			1 fragment
Måde Brickworks. Eastern clay pit. Younger section, eastern part:			1 shell
Måde Brickworks. Eastern clay pit. Without statement of horizon:			10 shells
Måde Brickworks. Eastern clay pit. New digging-zone:			1 shell
Gram	141.277	10.30–10.80 m.:	1 protoconch and 2 fragments
–	–	10.80–11.25 m.:	1 complete shell
–	–	12.10–12.60 m.:	1 defective shell
–	–	14.00–14.60 m.:	1 small, complete shell
–	–	16.00–16.50 m.:	2 halves of a complete shell
–	–	16.50–17.00 m.:	1 fragment
–	–	17.00–17.50 m.:	1 fragment
–	–	18.50–19.00 m.:	1 almost complete shell
Spandetgård. Clay pit, eastern part:			1 shell

Description. The shell is more or less slender, fusiform.

The protoconch is paucispiral, with $1\frac{1}{2}$–2 rather much swollen whorls. The initial whorl is sometimes clearly sinistral.

The whorls of the teleoconch have a spiral as well as a collabral sculpture. On the abapical part there are two well-marked spiral bands and a narrower spiral band immediately below the adapical suture. Between this and the two main spiral bands there is a more or less concave depression, with one or two spiral threads.

The two main spiral bands cross the collabral ribs, which in a number of 10–12 are rather prominent on the adapical part of the whorl. They are only slightly visible in the adapical, concave depression. At the intersection of the main spirals and the collabral ribs there are often large, round knobs, which may be so close-set because of their size, that they form two rows of knobs in place of the main spirals.

The base is covered by 13–18, gradually very obliquely placed, broad spiral bands. Between these there may be a few spiral threads. The growth lines form a moderately deep sinus, situated in the cavity, with the peaks immediately above the adapical main spirals. They are very prominent and filiform in the sinus region, where they form a network in relief together with the spiral bands and threads.

The aperture is narrow, oblong. Labrum is poorly preserved on the present shells. Labium is smooth, well delimited from the sculptured part of the last

whorl. The canal is rather broad, comparatively short, sometimes turned a little.

Variations. The collabral as well as the spiral sculpture varies highly in prominence. A few shells (Plate XXIII, figs. 1–2) have slightly developed, but a few more collabral ribs (13–16 instead of 10–12), nearly flat whorls and highly prominent growth lines, which cross all spiral elements while forming well-marked square knobs. Another extreme form (Table XXIII, figs. 3–4) instead of two main spiral bands has four narrower spiral bands and lacks knobs proper at the crossing of the collabral ribs by the spiral bands. Most shells seem to be provided with broad round knobs in these places (Plate XXII, fig. 3).

Measurements.

	Shell		Protoconch		Aperture
Locality	Length	Diameter	Length	Diameter	Length
Måde	6.5 mm.	2.6 mm.	0.6 mm.	0.7 mm.	3.1 mm.
–	5.4 –	2.1 –	0.6 –	0.7 –	2.9 –
–	6.2 –	2.3 –	0.4 –	0.7 –	3.6 –
–	6.7 –	2.7 –	0.6 –	0.7 –	3.3 –
–	5.3 –	2.3 –	0.6 –	0.7 –	2.8 –
–	7.8 –	2.8 –	0.7 –	0.7 –	
–	5.1 –	2.2 –	0.6 –	0.6 –	

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation.

Asthenotoma gliberti (HINSCH 1962)

Plate XIX, figs. 4–8

1872. *Pleurotoma Hosiusi* – v. KOENEN, Mioc. Nordd. I, p. 239, Pl. 2, f. 12a, b, c, d.
1925. *Peratotoma Hosiusi* v KOEN. – KAUTSKY, Hemmoor, p. 192, Pl. 12, f. 21.
1962. *Clavus* (*Brachytoma*) *gliberti* – HINSCH, Twistringen, p. 308, Pl. 28, f. 5 and 6.
1964. *Boreodrillia hosiusi* (KOENEN) – ANDERSON, Reinbek-Stufe, p. 300, Pl. 38, f. 251, 251a–e.

Original diagnosis. "Eine relativ schlanke *Brachytoma* mit Knotenreihe auf scharfem Kiel, sonst unberippt, Embryonalgewinde klein, mit $1\frac{1}{2}$ glatten Umgängen". (HINSCH 1962).

Type material. The holotype is the shell pictured by HINSCH, *loc. cit.*, Plate 28, fig. 5. Locality: Ziegelei Sunder, Twistringen, Northern Germany. Sediment: micaceous, silty clay. Formation: Reinbek-Stufe. Depository: Bundesanstalt für Bodenforschung, Hannover, Germany, Type Catalogue No. 3724.

Material. Hodde Clay. (Listed in Part I under the specific name of *Peratotoma hosiusi*).

Gram	141.277	28.50–29.00 m.:	1 fragment of an apex
–	–	29.00–29.50 m.:	2 broken-off apices and 8 other fragments
–	–	29.50–30.00 m.:	1 almost complete, juvenile shell
–	–	30.00–30.50 m.:	1 broken-off, somewhat corroded apex

Description. The shell is rather small, fusiform.

The protoconch is paucispiral, consisting of a relative large, vesicular, smooth whorl. The transition to the teleoconch comprises about $\frac{1}{4}$ whorl with curved, rather close-set collabral ribs.

The whorls of the teleoconch have an often well-marked spiral rib immediately below the adapical suture. Next, there is a broad, moderately convex, smooth zone with the sinus of the growth lines in the middle. The growth lines are distinct, but not prominent. The abapical boundary of the zone is at the height of about $\frac{1}{3}$ whorl, or somewhat less, above the abapical suture and consists of two well-marked close-set spiral ribs. The adapical one of these ribs forms a more or less projecting edge. On some shells a few thin spiral threads are seen in the concave zone and a single spiral thread occurs between the two close-set spiral ribs and the abapical suture. The latter section of the whorl, which only constitutes rather a small zone, slopes slightly adaxially. On the last whorl there are 10–15 well-marked, rather widely spaced spiral ribs right out to the abapical end of the base.

Besides the spiral sculpture there is a collabral sculpture of 9–13 prominent knobs on the edge. The continuation of these knobs is only in part visible on both sides of the edge. In the convex zone there is a curved elevation of the respective growth lines, and abapically to the edge there is an oblique elevation of the surface of the shell, which, however, has almost disappeared before it reaches the suture. On the last whorl the collabral sculpture in reality only shows knobs.

The aperture is oval. Labrum has not been preserved on the present shells. The inner lip is smooth, more or less well-defined. The siphonal canal is short and comparatively broad.

Remarks. The material available from the Danish Hodde Clay is so incomplete that it has been necessary to use shells from Shell Bed I at Hoddemark at the description of the species. There is no doubt that the shells from the two layers are identical.

For comparison I have had material from Twistringen and therefore can vouch for the identity with the form from Twistringen and Woltrup mentioned by HINSCH (*loc. cit.*).

This form may be identical with *Pleurotoma Hosiusi* v. KOENEN 1872, but

the pictures and description in this author are unfortunately too defective to establish the identity with certainty.

KAUTSKY's description and picture of *Peratotoma Hosiusi* do not completely correspond to those of v. KOENEN. KAUTSKY is also doubtful as to the identity with v. KOENEN's species. Nor does his publication of *P. Hosiusi* permit a sure identification of the shell from the Hodde Clay with this species. Under these circumstances I suggest that the Danish material should be named by HINSCH's specific name.

Differently from HINSCH I refer the species to the genus *Asthenotoma* because of the appearances of the protoconch and the sinus belt.

Measurements.

	Shell		Protoconch		Aperture
	Length	Diameter	Length	Diameter	Length
Hodde Clay					
Gram. 141.277					
(29.50–30.00 m.)	1.9 mm.	1.2 mm.	0.7 mm.	0.7 mm.	
(= Plate XIX, figs. 7–8)					
Shell Bed I					
Hoddemark					
(Plate XIX, fig. 4)	8.9 mm.	3.2 mm.	0.6 mm.	0.6 mm.	3.6 mm.
Hoddemark	6.8 –	2.8 –	0.6 –	0.6 –	
–	5.0 –	2.3 –	0.6 –	0.6 –	2.4 –
–	3.7 –	1.8 –	0.7 –	0.7 –	1.9 –

Distribution.

North Sea Basin. Miocene. Denmark: Hodde Formation. North Germany: Hemmoor-Stufe? (KAUTSKY), Reinbek-Stufe (HINSCH).

Genus: *Brachytoma* SWAINSON 1840

(Type: *Pleurotoma stromboides* SOWERBY 1842)

Brachytoma obtusangula (BROCCHI 1814)

1953. *Drillia obtusangula* BROCCHI – CSEPREGHY – MEZNERICS, Mittelmioz. Pleurot., p. 8, Pl. I, f. 11–14.
1955. *Drillia (Drillia) obtusangula* (BROCCHI) – ROSSI RONCHETTI, I tipi etc. p. 325, f. 175.
1956. *Brachytoma obtusangula* (BROCCHI) – RASMUSSEN, South Jutland, p. 89, Pl. VIII, f. 6a, b.
1958. *Brachytoma obtusangula* (BROCCHI) – SORGENFREI, Middle Mioc., p. 275, Pl. 58, f. 195.
1964. *Brachytoma obtusangula* (BROCCHI) – ANDERSON, Reinbek-Stufe, p. 295, Pl. 37, f. 245.

Material. Hodde Clay.

Gram	141.277	28.00–28.50 m.:	?1 fragm.	(?1)
–	–	32.70–33.05 m.:	1 –	(?1)
–	–	34.25–34.70 m.:	2 –	(1)
–	–	35.00–35.30 m.:	2 –	(1)

Gram Clay.

Shell material is available from the following localities (see Part I, Tables 15–66):

Lillelund (73.88), Aulum (74.321), Spjald (83.127), Muldbjerg (83.1006), Kodal-Fjaldene (84.1749), Videbæk (84.1748, 84.344, 84.358, 84.456, 84.483, 84.525, 84.1727), Møltrup Brickworks (clay pit), Lille Torup (85.379), Tværmose (85.381), Frølund (85.383), Gjødstrup (85.861), Brande Brickworks (clay pit), Drantum (104.1241), Hjortsballe (105.320), Skjerris gårde (104.1165), Leding (93.155), Alkærsig Brickworks (clay pit), Lønborg (102.55), Forsum Brickworks (clay pit), Odderup (103.150), Harkes Brickworks (clay pit), Ålbæk Eng (102.59), Hesselho (113.121), Hauge (clay pit), Tønding (clay pit), Hodde (113.33a), Esbjerg (130.59, clay pit and beach), Måde Brickworks (clay pits), Brøstrup (141.255), Holleskov (132.46b), Hjortvad (141.178), Lintrup (132.140), Sønder Hygum (141.260, 141.261), Rødding (141.243), Gram (141.277), Spandetgård (clay pits), Spandet (150.184), Tønder (166.398), Brodersmark (166.351b), Sæd (167.4, 167.445), and Rends (167.236).

Description. The shell is rather small, subfusiform, more or less slender.

The protoconch is relatively big, conical, multispiral, comprising 4–5 slightly convex whorls. The initial whorl is small, slightly sinistral, generally broken off. The medial and terminal whorls have numerous extremely thin spiral threads on the abapical part, taking an oblique and irregular course, casually arranged. The rest of the medial whorls are smooth. The terminal whorls have numerous (29 to more than 40) narrow, opisthocline, collabral ribs, which to begin with are faint and later become very prominent, more opisthocyrt and abapically drawn somewhat along the suture.

The whorls of the teleoconch have a carina a little adapical to the middle. A marked spiral band is often seen immediately below the adapical suture. Between this suture and the carina there is a more or less pronounced cavity in which the sinus of the growth lines and 2–4 spiral bands are situated. On the carina there is a spiral band and between this and the abapical suture there are a further 2–5 spiral bands. The ramp down towards the neck of the canal and the canal are covered by 20–25 spiral bands, which on the neck of the canal become more axially, obliquely placed.

The collabral sculpture comprises 10–14 rounded-off ribs, the breadth of which corresponds to the interspaces between them and which pass at right angles to the suture or are placed slightly obliquely. They are most prominent on the surface of the shell between the carina and the abapical suture, but are often seen as more or less faint elevations on the adapical part of the whorls. The spiral sculpture crosses the collabral ribs undiminished.

Labrum has in most cases been broken off. It seems to have been simple. The inner lip is smooth. The aperture is often oblong oval, sometimes little extended in relation to the canal.

Remarks. According to Rossi Ronchetti, Brocchi's holotype of this species has only 8 collabral ribs, whereas Cipolla (1914, pp. 116–117) mentions that

the specimens from the Pliocene layers at Altavilla (Palermo) have 12–13 collabral ribs.

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Hodde Formation, Gram Formation. North Germany: "Untermiozän" at Itzehoe (GRIPP), Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON), Glimmerton at Morsum Kliff (Sylt), Lieth, Teufelsbrücke, Gühlitz, Bockup, and Lüneburg (v. KOENEN).

Mediterranean Basin. Italy: Elveziano, Tortoniano, Piacenziano (BELLARDI, SACCO). Spain (Cataluna): Placenciense (ALMERA Y BOFILL).

Vienna Basin. Austria: Tegel at Baden and Lapugy (common), Gainfahrn, Steinabrunn, Forchtenau, Kestej, Lissitz, Niederleis, Jeromierčič, Vienna (a few shells; HOERNES & AUINGER). – Hungary: Szob, Szokolya (CSEPREGHY-MEZNERICS), "Miozän-Mediterran" (STRAUSZ).

Genus: *Borsonia* BELLARDI 1839
(Type: *Borsonia prima* BELLARDI 1839)

Borsonia uniplicata v. KOENEN 1872
Plate XIX, fig. 9, and Plate XX, figs. 1 and 3

1872. *Borsonia uniplicata* NYST sp. – v. KOENEN, Mioc. Nordd. I, p. 252, Pl. III, f. 10a–f.
1925. *Borsonia uniplicata* NYST – KAUTSKY, Hemmoor, p. 178, Pl. 11, f. 32.
1904. *Borsonia uniplicata* (NYST) – SACCO, I Molluschi, XXX, Pl. XIII, f. 19, 20.
1954. *Borsonia uniplicata* (NYST) KOENEN – GLIBERT, Pleurotomes, p. 41, Pl. V, f. 14.
1964. *Borsonia uniplicata* KOENEN – ANDERSON, Reinbek-Stufe, p. 301, Pl. 39, f. 253, 253a.

Material. Hodde Clay.

Måde Brickworks. Eastern clay pit, the north wall: 2 almost complete shells

Description. The shell is rather big, spindle-shaped.

The protoconch has been broken off or is corroded in the case of both of the shells present. To judge from specimens from Twistringen, Northern Germany, it was short, paucispiral.

The teleoconch comprises 5–7 whorls, which all have a central edge, which, however, is often somewhat abapical to the middle. Immediately below the adapical suture there is a narrow, convex spiral zone. Between this zone and the edge there is a broad concave depression, in which is the sinus of the growth lines, which is moderately deep, with its peak approximately in the middle of the depression. The edge bears a number (8–11) of rather big round knobs, which are more or less prominent, and the interspaces of which correspond to their breadth. The knobs are sometimes drawn out a little abapically in a highly oblique direction, but in any case are soon lost. The growth lines are very oblique abapically to the edge. The surface of the shell usually bears two or three weak spiral bands (between which there are sometimes a few other weaker ones) to be seen on the abapical region below the edge.

On the edge of the material from Måde there are two thin close-set spiral threads, which cross the knobs. In the cavity there is a small number of weak spiral threads on the present shells from Twistringen. On the convex, subsutural spiral zone a few very weak spiral threads can also dimly be seen. The spiral ornamentation on the base stands out most clearly. On the base there are numerous (up to 20) spiral bands, which come to hold a more and more oblique position on to the neck of the canal. The transition from the last whorl to the neck of the canal is somewhat convex. The sutures are often very oblique in relation to the axis.

The aperture is oval, tapering adapically, with an adapical canal. Labrum has been broken off all the shells available. The inner lip is smooth, with a well developed columellar fold. The siphonal canal is rather short.

Remarks. This species usually varies somewhat in the formations in which it occurs, as appears from the pictures in the literature. According to KAUTSKY the species varies considerably as regards the slenderness of the shell, the subsutural spiral belt, the prominence of the knobs, conditions of the spiral sculpture, etc.

According to GLIBERT the species seems to be common in the Anversien of Belgium. In the other formations in the North Sea Basin it is less common.

The shells from the Hodde Clay are rather uniformly shaped and correspond completely to the material collected at Twistringen (Northern Germany).

Measurements.

Locality	Length	Diameter	Length of the aperture	Number of whorls	Number of knobs
Hodde Clay					
Måde	?	4.2 mm.	4.8 mm.	5+	10
Twistringen	10.7 mm.	4.3 –	5.3 –	6	8–10
–	10.7 –	4.4 –	4.9 –	6½	8–11

Distribution.

North Sea Basin. Miocene. Denmark: Hodde Formation. North Germany: Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON, HINSCH). Belgium: Anversien (GLIBERT).

Genus: *Neoguraleus* POWELL 1939

(Type: *Drillia sinclairi* GILLIES 1882)

Neoguraleus kochi (v. KOENEN 1872)

Plate XXIV, fig. 1

1872. *Mangelia Kochi* – v. KOENEN, Mioc. Nordd. I, p. 249, Pl. 3, f. 8a, b, c.
1907. *Mangilia Kochi* v. KOENEN – RAVN, Jylland, p. 360 (156), Pl. VIII, f. 8.
1956. *Cythara (Mangelia) kochi* (v. KOENEN) – RASMUSSEN, South Jutland, p. 92, Pl. VIII, f. 7.

Material. Glauconite Clay.

Gram 141.277 25.00–25.50 m.: 1 fragment of an apex

Gram Clay.

Shells are available from the following localities (see Part I, Tables 15–66, pp. 228–285):

Skærum Mølle (clay pit), Videbæk (84.1748), Møltrup Brickworks (clay pit), Lille Torup (85.379), Frølund (85.383), Gjødstrup (85.861), Snejbjerg (85.775), Brande Brickworks (clay pit), Drantum (104.1241), Nyholm (104.1166), Odderup (103.150), Hauge (clay pit), Holleskov (132.46b), Hjortvad (141.178), Sønder Hygum (141.261), Gram (141.277), Spandetgård (clay pits), Brodersmark (166.351b), Sæd (167.445), and Rends (167.236).

Description. The shell is small, rather slender, subfusiform.

The protoconch comprises 3–4 convex whorls. The initial whorl is small, slightly sinistral, a little downward curved (abapically). The medial whorls are smooth. The terminal whorl has numerous (20–30) opisthocyrt, filiform, collabral ribs, which to begin with are very weak, later more prominent. They are crossed by 4–5 spiral threads, which are parallel to the sutures and separated by approximately equally broad interspaces. The two sculptural elements together form a regular network, which especially on the youngest part of the terminal whorl stands out rather strongly.

The whorls of the teleoconch are moderately convex, with a rounded carina a little adapically to the middle. Between the adapical suture and the carina there is a more or less faint depression. The surface of the shell is covered by numerous (about 13–20) close-set, little prominent, narrow spiral bands of nearly the same strength.

The collabral sculpture consists of 12–14 rather strong and broad, rounded-off, a little obliquely placed ribs, of the same breadth as their interspaces, and most strongly marked on the slightly adaxially sloping region between the carina and the abapical suture. The growth lines are more or less prominent, with rather a deep sinus in the middle of the depression.

The aperture is oblong oval, passing evenly into the rather short canal. Labrum is simple. Labium is smooth, well delimited from the base.

Remarks. See Remarks on *N. sæthensis* (RASMUSSEN 1966, p. 192).

Measurements.

	Shell		Protoconch		Aperture + canal
	Length	Diameter	Length	Diameter	Length
Gram Silt					
Gram Brickworks	4.3 mm.	2.0 mm.	0.7 mm.	0.8 mm.	2.1 mm.
–	3.3 –	1.7 –	0.9 –	0.9 –	
–	2.1 –	1.2 –	0.8 –	0.9 –	1.2 –
–	2.6 –	1.3 –	0.8 –	0.9 –	1.4 –
–	1.7 –	0.9 –	0.9 –	0.9 –	1.1 –

Gram Clay

Gram Brickworks	4.9 mm.	2.2 mm.	0.6 mm.	0.8 mm.	2.4 mm. Original to RASMUSSEN, 1956, Pl. VIII, fig. 7
–	3.4 –	1.8 –	0.9 –	1.0 –	1.7 mm.
Brodersmark	1.9 –	1.1 –	0.8 –	0.9 –	1.1 –
Spandetgård	2.4 –	1.2 –	0.9 –	0.9 –	1.3 –
–	1.7 –	1.0 –	0.9 –	0.9 –	1.2 –
–	3.8 –	1.9 –			1.9 –
–	2.3 –	1.4 –	0.9 –	1.0 –	1.2 –

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation.

Neoguraleus sæthensis RASMUSSEN 1966

Plate XXIV, fig. 4

1966. *Neoguraleus sæthensis nov. sp.* – RASMUSSEN, Molluscan Faunas, I, p. 191.

This species is described in the work cited (Part I) to which reference is made.

Neoguraleus sp.

Plate XXIII, fig. 5

Material. Hodde Clay.

Måde Brickworks. Eastern clay pit. The north wall: 1 shell

Description. The shell is rather small, subfusiform.

The protoconch comprises about 3 whorls rapidly increasing in diameter. The initial whorl is small. The medial whorls are convex and seem to be quite smooth. The terminal whorls have about 13 opisthocyrt, filiform, collabral ribs, which are crossed by 5 spiral cords forming a wide-meshed network.

The whorls of the teleoconch are almost angular with a prominent carina-like spiral rib in the middle. All 5 spirals from the protoconch continue on the teleoconch. The adapical and the abapical ones are situated close to the sutures, the latter rib being the most prominent. The three strongest spiral ribs are on the middle part of the whorls.

Three, four, or five spiral cords are seen between each of the spiral ribs. They are crossed by numerous growth lines, and small granules are formed at every point of intersection between them. The whole surface of the adult whorls are thus covered by thousands of granulae, beautifully arranged in spiral and curved lines.

The teleoconch whorls are furthermore sculptured by well-marked, rather narrow and distant collabral ribs in a number of about 10. At the intersections between these and the middle spiral rib or carina small spine-like excrescences are formed. Both the spiral and the collabral sculpture continue out on the neck of the canal.

The siphonal canal is rather long. Labrum is broken on the present shell. The inner lip is smooth and well delimited from the base.

Remarks. This shell is considered a species of the genus *Neoguraleus*. It has not been possible to identify it with any known species.

Better preserved specimens must be required before a possible new species can be established.

Genus: *Haedropleura* BUCQUOY, DAUTZENBERG & DOLLFUS 1883
(Type: *Murex septangularis* MONTAGU 1803)

Haedropleura maitreja (SEMPER in v. KOENEN 1872)
Plate XX, figs. 4–6

1956. *Haedropleura maitreja* (SEMPER in v. KOENEN) – RASMUSSEN, South Jutland, p. 88, Pl. VIII, f. 5.
1964. *Haedropleura maitreja* (SEMPER in KOENEN) – ANDERSON, Reinbek-Stufe, p. 307, Pl. 40, f. 260.

Material. Hodde Clay.

Måde Brickworks. Eastern clay pit:			1 complete, but worn shell
Rødding	141.241	28.0 –33.0 m.:	1 juvenile shell
Gram	141.277	29.50–30.00 m.:	2 small fragm.
–	–	30.00–30.50 m.:	2 defective shells
–	–	30.95–31.35 m.:	1 def. shell and 1 broken apex
–	–	31.35–31.65 m.:	1 def. shell
–	–	34.25–34.70 m.:	2 fragments

Gram Clay.

Måde Brickworks. Eastern clay pit:			3 complete shells
Holleskov	132.46b	4.9 –11.2 m.:	1 defective shell
Gram	141.277	6.90– 7.30 m.:	?1 fragment
–	–	15.55–16.00 m.:	2 fragments

Description. The shell is slender, spindle-shaped. The apex is often rather long as compared with the base.

The protoconch is short, paucispiral, comprising $1\frac{1}{2}$–2 convex whorls without sculpture. The initial whorl is slightly sinistral. The teleoconch has about 5, sometimes more, more or less flat whorls, with a slightly concave region below the adapical suture. The growth lines are opisthocyrt, with a flat sinus a little abapically to the middle of the whorls.

The surface of the shell is smooth, forming 9–11 collabral folds or more prominent ribs conformal to the growth lines. These collabral ribs are more or less sharp-edged and often are most prominent on the abapical part. The sutures are but slightly depressed.

The aperture is oblong oval. Labrum has been broken off the present shells. The inner lip is smooth, more or less clearly delimited from the rest of the surface of the shell. On some shells there is a narrow, highly constricted pseudumbilicus. The canal is short, comparatively broad.

Variations. The present shells from the Hodde Clay have stronger collabral ribs than the shells of the Gram Clay. Furthermore, the slightly concave region is flatter and the collabral also very prominent adapically (cf. Plate XX, fig. 5). A single shell from the clay pit of Gram Brickworks (leg. H. ØDUM 1926) is extremely long (10.5 mm.), but in the other dimensions it is normal. This shell has a well developed pseudumbilicus. A shell from the Gram Clay at Måde has 7 oblique, close-set spiral bands on the surface of the neck of the canal.

Measurements.

Locality	Shell Length	Shell Diameter	Protoconch Length	Protoconch Diameter	Aperture Length	Number of collabral ribs
Hodde Clay						
Måde	5.0 mm.	2.3 mm.			2.1 mm.	9–10
–	4.8 –	2.1 –			2.2 –	9
Gram Clay						
Måde	6.1 –	2.6 –	0.4 mm.	0.7 mm.	2.8 –	9–11
–	6.9 –	2.7 –	0.3 –	0.7 –	3.0 –	9–12

Distribution.

North Sea Basin. Miocene. Denmark: Hodde Formation, Gram Formation. North Germany: Hemmoor-Stufe (DITTMER), Reinbek-Stufe (ANDERSON), Glimmerton at Langenfelde (v. KOENEN), Elbtunnel (HORN), and Lüneburg (MÜLLER). – Plio-Pleistocene. Holland (BEETS).

Genus: *Pleurotomoides* BRONN 1831

(Type: *Defrancia pagoda* MILLET 1826)

Pleurotomoides luisae (SEMPER in v. KOENEN 1872)

Plate XXII, fig. 5

1956. *Lienardia luisae* (SEMPER) – RASMUSSEN, South Jutland, p. 93, Pl. IX, f. 2a, b.
1958. *Pleurotomoides cf. Luisae* (v. KOENEN) – SORGENFREI, Middle Mioc., p. 285, Pl. 62, f. 204a, b.
1964. *Pleurotomoides luisae* (SEMPER in KOENEN) – ANDERSON, Reinbek-Stufe, p. 307, Pl. 39, f. 261.

Material. Hodde Clay.

Hygum	141.215	26.2–32.8 m.:	1 def. shell
Hajstrup	167.235	174′–194′ :	1 fragment

Gram Clay.

Shell material is available from the following localities (see Part I, Tables 15–66):

Skærum Mølle (clay pit), Lillelund (73.88), Aulum (74.321), Muldbjerg (83.1006), Kodal-Fjaldene (84.1749), Videbæk (84.1748, 84.344), Lille Torup (85.379), Tværmose (85.381), Frølund (85.383), Gjødstrup (85.861), Brande Brickworks (clay pit), Drantum (104.1241), Nyholm (104.1166), Hjortsballe (105.320), Leding (93.155), Odderup (103.150), Harkes Brickworks (clay pit), Ålbæk Eng (102.59), Hesselho (113.121), Hauge (clay pit), Tønding (clay pit), Grøde (Karlsgårde Canal), Hodde (113.33a), Esbjerg (clay pit and

beach), Måde Brickworks (clay pits), Tiset (141.244), Holleskov (132.46b), Ravning (clay pit), Sønder Hygum (141.260, 141.261), Gram (141.277), Spandetgård (clay pits), Tønder (166.398), Brodersmark (166.351b), Sæd (167.445), and Rends (167.236).

Description. The shell is spindle-shaped.

The protoconch is conical, almost trochiform, comprising up to 5 whorls, $1\frac{1}{2}$ of which constitute the small, smooth initial whorl. The others are provided with a carina a little abapically to the middle. It divides the whorl into an adapical and an abapical region. The former slopes greatly abaxially, while the latter inclines adaxially at a somewhat smaller angle and is provided with a microsculpture of numerous thin, obliquely placed, non-parallel, collabral threads.

The teleoconch comprises up to 6 sculptured whorls. On the abapical part of the whorl there are two prominent spiral bands. On the youngest whorls of large shells there are sometimes thin spiral threads between these spiral bands. The adapical part is slightly convex and bears some 5 spiral threads or narrow bands. The one of these spiral threads nearest to the middle of the whorl is the strongest. The sinus of the growth lines is moderately deep and is situated between the adapical one of the two main spirals and the adapical suture.

On the whorls there are also 10–13 relatively broad, rounded, collabral ribs, the highest elevation of which is found on the adapical one of the two spiral bands, but which are otherwise more prominent on the abapical than on the adapical part. The interspaces of the collabral ribs are of the same breadth as the ribs themselves. The spiral bands all pass over the collabral ribs.

The base has up to 18 relatively broad spiral bands, which slope more and more down on the neck of the canal. The surface of the shell is in several places seen to be slightly granulated. On most shells it is not, however, possible, even at high magnification, to see any granulae.

The aperture is oblong oval. Labrum has been broken off the shells present. The inner lip is smooth, well delimited from the sculptured surface of the base.

Measurements.

Locality	Shell Length	Shell Diameter	Protoconch Length	Protoconch Diameter	Aperture Length
Gram Clay					
Måde Brickworks					
Eastern clay pit	8.3 mm.	3.8 mm.	1.7 mm.	1.7 mm.	3.9 mm.
– – –	ab. 7.0 –	3.3 –	1.6 –	1.6 –	ab. 3.5 –
– – –	15.1 –	6.0 –	1.7 –	1.7 –	7.7 –
– – –	10.2 –	4.3 –	1.6 –	1.6 –	1.6 –
– – –	10.0 –	4.3 –	?	1.2 –	5.0 –
– – –	7.0 –	3.0 –	1.7 –	1.5 –	3.3 –
– – –	ab. 9.0 –	3.8 –	1.8 –	1.3 –	4.2 –
– – –	9.5 –	3.8 –	–	1.2 –	4.7 –
– – –	14 –	4.2 –	–	–	7.2 –

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (cf., SORGENFREI), Gram Formation. North Germany: Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON), Glimmerton of Sylt, Langenfelde, Lüneburg, Gühlitz (v. KOENEN).

Pleurotomoides sp.

Material. Gram Clay.

Sæd 167.445 92.25–92.70 m.: 1 defective shell

Description. There is only an incomplete shell available, which lacks the whole of the base and the abapical part of the apex.

The shell is small, slender. It must have been fusiform.

The protoconch is high, conical, multispiral, comprising about 4 whorls. The initial whorl has been broken off. The medial part is convex. The terminal region consists of about 2 whorls with a sharp carina on the abapical part somewhat above the suture, immediately above which there is a thin spiral thread. The surface is somewhat worn, so that no microsculpture is seen. Traces of a thin network of weak threads are, however, seen abapically to the carina.

The whorls of the teleoconch have a slight concave depression adapically, comprising nearly half of the height of the whorls. They are convex abapically and sculptured with 11 collabral ribs, which first stand out on the abapical part of the whorls and, besides, are crossed by 8–11 spiral threads, which are weakest and densest on the concave part of the whorls, while on the convex part there are 2–4 spiral bands of the first order, with interspaces considerably broader than they are.

The surface of the shell is close-set with numerous granulae arranged in three close-set lines in the interspace between each pair of spiral ribs.

Remarks. The shell undoubtedly belongs to the genus *Pleurotomoides*, but it has not been possible to identify it with any species described in the literature. It is considerably slenderer than *P. luisae*, from which it also differs in the conditions of the spiral sculpture.

Genus: *Philbertia* MONTEROSATO 1884
(Type: *Pleurotoma philberti* MICHAUD 1829)

Philbertia cordieri (PAYRAUDEAU 1826)

1956. *Philbertia* (*Philbertia*) *reticulata* (RENIERI) – RASMUSSEN, South Jutland, p. 94, Pl. IX, f. 5a, b.

1964. *Philbertia echinata* (BROCCHI) – ANDERSON, Reinbek-Stufe, p. 311, Pl. 42, f. 266, 266a, b.

Material. Gram Clay.

This species is cited in the lists of analyses, Tables 15–66 in Part I, as *Philbertia reticulata* (RENIERI).

Brande Brickworks. Clay pit:			1 defective shell
Drantum	104.1241	36.0 –40.0 m.:	2 protoconchs
–	–	40.0 –44.0 m.:	1 protoconch and another fragment
Odderup	103.150	20.0 –21.0 m.:	1 apex of a shell
Holleskov	132.46b	4.9 –11.2 m.:	1 juvenile shell
Sønder Hygum	141.261	13 –19 m.:	1 shell
Gram	141.277	5.30– 5.70 m.:	1 protoconch and another fragment
–	–	5.70– 6.10 m.:	1 protoconch and 1 fragment
–	–	6.10– 6.40 m.:	1 small, complete shell
–	–	6.90– 7.30 m.:	1 defective shell
–	–	7.30– 7.65 m.:	1 fragment
–	–	9.90–10.30 m.:	1 almost complete shell
–	–	12.10–12.60 m.:	1 complete shell and 2 fragments
–	–	15.10–15.55 m.:	1 protoconch, probably of this species
–	–	15.55–16.00 m.:	1 protoconch
–	–	16.00–16.50 m.:	6 fragments of the same shell
–	–	19.00–19.50 m.:	1 small, worn shell
Spandetgård. Clay pit:			1 almost complete shell and 1 beautifully preserved shell
Brodersmark	166.351 b	22.6 –24 m.:	3 complete and 3 defective shells
–	–	24 –25 m.:	1 defective shell
–	–	25 –26 m.:	1 fragmentary shell
–	–	28 –29 m.:	1 almost complete shell
–	–	30 –31 m.:	1 fragment
Sæd	167.445	93.70–94.10 m.:	2 small fragments
–	–	94.10–94.75 m.:	3 fragments
–	–	94.00–97.10 m.: (special sample)	1 fragment
–	–	99.55–100.10 m.:	1 fragment
Rends	167.236	140′–160′ :	1 protoconch and 5 fragments

Remarks. Shells of this characteristic species were described by me in 1956 under the name of *P. reticulata.* However, BUCQUOY, DAUTZENBERG & DOLLFUS' argumentation (1882, pp. 92–94) in favour of an invalidation of RENIERI's specific name seem so weighty to me that I find it necessary to give up the specific name of *reticulata* in favour of *cordieri.*

The three authors mentioned state in their work that they have examined a large number of shells of the type *cordieri* and that they can separate a special species *P. rudis* (SCACCHI) from *P. cordieri* (PAYRAUDEAU). It is maintained that the latter species differs from the former by always having a smaller shell, by its slenderer form, its pointed spire, its long canal, and its collabral sculpture without lamellae. Furthermore, it is stated that RENIERI referred to two earlier pictures of his new species, viz. one in LISTER and one in GUALTIERI. Both figures are, however, so defective that they do not resemble any of the

Philbertia species from the Mediterranean, for which reason it is not possible to identify them with *P. cordieri* or *P. rudis*.

BROCCHI's picture (1814, Plate VIII, fig. 3) of *Murex echinatus* BROCCHI is considered by BUCQUOY, DAUTZENBERG & DOLLFUS as a sure documentation of the identity of this species with *P. cordieri*. However, the specific name *echinatus* had already in 1814 been preoccupied for an exotic *Pleurotoma* species.

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation. North Germany: Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON: *P. echinata*) – Plio-Pleistocene. England: Coralline Crag, Waltonian, Newbournian (WOOD, HARMER). Holland: Diestien superieur (TESCH).

Atlantic Region: Recent (BUCQUOY, DAUTZENBERG & DOLLFUS).

Mediterranean Basin. Miocene. Italy: Miocene medio (BELLARDI). – Plio-Pleistocene. Italy: Pliocene inferiore, P. superiore (BELLARDI), Monte Mario, Roma (CERULLI – IRELLI). France: Rhône Valley: Pliocène (FONTANNES: *Homotoma reticulata*). Recent (WEINKAUFF, BUCQUOY, DAUTZENBERG & DOLLFUS).

Philbertia sinuosula SORGENFREI 1958

Plate XXIV, figs. 5–7

1958. *Philbertia sinuosula* – SORGENFREI, Middle Mioc., p. 290, Pl. 63, f. 209 a–c, Pl. 76, f. 209.
1964. *Philbertia sinuosula* SORGENFREI – ANDERSON, Reinbek-Stufe, p. 312, Pl. 42, f. 268, 268 a.

Material. Hodde Clay.

Gram	141.277	31.95–32.30 m.:	1 defective shell

Gram Clay.

Lille Torup	85.379	16.8 –20.0 m.:	1 small, complete shell
Drantum	104.1241	46.0 –50.0 m.:	1 juvenile shell
Hesselho	113.121	56.0 –65.0 m.:	1 protoconch, probably of this species
Hauge. Clay pit:			1 protoconch, probably of this species
Sønder Hygum	141.261	13 –19 m.:	1 worn shell and 1 fragment of another shell
Gram	141.277	9.50– 9.90 m.:	1 juvenile shell and 1 protoconch of another shell
–	–	17.50–18.00 m.:	1 juvenile shell
–	–	19.50–20.00 m.:	1 juvenile shell
–	–	21.00–21.50 m.:	1 juvenile shell
Spandetgård. Clay pit:			1 beautifully preserved shell
Sæd	167.445	92.25–92.70 m.:	1 protoconch, probably of this species

Description. The shell is relatively small, subfusiform.

The protoconch is pointed-conical, consisting of about $5\frac{1}{2}$ whorls. The initial stage consists of $1\frac{1}{4}$ slightly sinistral whorls, on the surface of which there are numerous small granulae arranged in parallel spirals. The following medial whorls (about $3\frac{1}{2}$) are covered by a diagonal network of elevated thin

threads. The adapical third of these whorls, however, have only one set of collabral threads, which abapically enter into the dense abapical network. The terminal stage comprises $\frac{1}{2}$–$\frac{3}{4}$ whorl, where, simultaneously with the retention of the reticulate ornamentation there is rather a marked carina a little abapically to the middle of the whorls. Abapically to this carina, there is one more or less prominent spiral rib, and adapically to this there is a very weak one.

The sculptural shaping of the teleoconch is introduced by the appearance of a collabral rib, which takes an oblique course from suture to suture, but which only really stands out a little below the adapical suture. The terminal carina of the protoconch continues as a spiral rib on the teleoconch and sometimes keeps its rank of being the most prominent rib. Like the carina mentioned, it is found a little abapically to the middle of the whorl.

Between this carina and the abapical suture there are 2–3 almost equally prominent spiral ribs, one of which is close to the suture. This total of 3–4 spiral ribs are sometimes weakened somewhat on the younger whorls of the shell. On the adapical part of the whorl there are 2–9 weak spiral ribs, which become weaker adapically. The rather flat sinus of the growth lines is found immediately below the adapical suture. There are 9–11 collabral ribs. They are, if anything, sub-angular and rather narrow.

The surface of the whole teleoconch is densely set with granulae, which are easily seen at 20 × magnification. On larger shells it is seen that they are irregularly arranged in rows parallel to the spiral ribs (2–5 rows).

The aperture is a rounded oval. The canal is straight, rather short. Labrum has been broken off the present shells. The inner lip is smooth, well delimited from the base.

Remarks. The main difference between this species and *P. scabra* (PHILIPPI) is that the latter species has a well-defined sinus belt, rounded collabral ribs and an apertural sinus of moderate depth.

The shells from Hesselho and Drantum have a fairly distinct sinus belt and seem to suggest the possibility of even transitions between *P. scabra* and *P. sinuosula*.

Otherwise reference is made to the mention and description of the two species in SORGENFREI (1958, pp. 289 ff.).

Measurements.

	Shell		Protoconch		Aperture
Locality	Length	Diameter	Length	Diameter	Length
Spandetgård	6.5 mm.	3.2 mm.	5.7 mm.	1.2 mm.	3.1 mm.
Lille Torup	3.0 –	2.0 –			
Hesselho	2.4 –	1.3 –			

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Hodde Formation, Gram Formation. North Germany: Reinbek-Stufe (ANDERSON).

SUBCLASSIS: OPISTHOBRANCHIATA

ORDO: PLEUROCOELA

FAMILIA: ACTEONIDAE

Genus: *Actaeon* MONTFORT 1810

(Type: *Voluta tornatilis* LINNÉ 1758)

Actaeon semistriatus (FERUSSAC in GRATELOUP 1840)

Plate XXV, figs. 1–2

1821. *Tornatella semistriata* DEFRANCE – FÉRUSSAC, Table system. moll., p. 108.
1825. *Tornatella semistriata* – BASTEROT, Mém. Bordeaux, p. 25.
1840. *Tornatella semistriata* FÉR. – GRATELOUP, Bassin de l'Adour 1, Pl. 11, f. 18.
1856. *Actaeon semistriatus* FÉR. – HOERNES, Wienerbecken I, p. 507, Pl. 46, f. 22–23.
1897. *Actaeon semistriatus* (FÉR.) – SACCO, I Molluschi XXII, p. 33, Pl. 3, f. 21–23.
1907. *Actaeon tornatilis* LINNÉ sp. (pars) – RAVN, Jylland, p. 363 (159), Pl. VIII, f. 10.
1925. *Actaeon semistriatus* FÉR. – KAUTSKY, Hemmoor, p. 201.
1932. *Actæon semistriatus* FÉRUSSAC – COSSMANN & PEYROT, Conch. Néog. A.S.L.B. LXXXIV, p. 154, P. XI, f. 36, 45, 46, 58–60.
1952. *Actæon semistriatus* FÉRUSSAC sp. – GLIBERT, Mioc. Belg. II, p. 139, Pl. X, f. 10.
1956. *Actaeon sp.* – RASMUSSEN, South Jutland, p. 98.
1958. *Acteon semistriatus* (BASTEROT) – SORGENFREI, Middle Mioc., p. 298, Pl. 65, f. 216.
1964. *Actaeon semistriatus* (FERUSSAC) – ANDERSON, Reinbek-Stufe, p. 330, Pl. 50, f. 295.

Material. Gram Clay.

Videbæk	84.1748	23.95–24.95 m.:	1 fragment	(1)
–	84.358	7.2 –15.1 m.:	1 def. shell and 1 fragment	(2)
Lille Torup	85.379	16.8 –20.0 m.:	1 fragment	(1)
Drantum	102.1241	36.0 –40.0 m.:	1 fragment	(1)
Måde Brickworks. Eastern clay pit:			3 defective shells	(3)
Holleskov	132.46b	4.9 –11.2 m.:	1 complete, juvenile shell	(1)
Hygum	141.260	12 –40 m.:	1 broken-off apex	(1)
–	141.261	13 –19 m.:	1 complete, juv. sh. and 4 protoconchs	(5)

Description. The shell is rather small, ovoid, more or less slender.

The protoconch is heterostrophic, sinistral, and deeply depressed, so that only part of the convex last whorl rises above the teleoconch. The whorls are smooth. The axis of the protoconch forms rather a small angle with the axis of the teleoconch.

The whorls of the teleoconch are flatly convex or more convex and have a sculpture of narrow spiral grooves, which are disintegrated into numerous points. As a rule the grooves occur all over the whorl. Still, two more close-set grooves are often seen under the adapical suture. Next, a narrow, smooth zone follows which looks as if lacking a spiral groove. On the rest of the whorl they are found right down under the abapical suture and on the last whorl right down to the abapical end of the base. The grooves are either equidistant or at varying distances. On the last whorl there are often 15–20 spiral grooves.

The suture is canaliculate. The last whorl, including the aperture and the base, is high in relation to the spire.

The aperture is guttiform, tapering adapically, rounded abapically. Labrum has been broken off all shells. It continues uninterrupted into the inner lip, which abapically rises in a narrow edge, but adapically forms a thin callus on the base. Between the base and the inner lip there is a narrow umbilicus or pseudumbilicus. On the columella there is a narrow, oblique fold.

Remarks. SORGENFREI points out that the convexity of the whorls is very variable. As the present material from the Gram Clay mainly consists of juvenile shells, I have not made corresponding observations. On the other hand, the shells of the Gram Clay on the whole seem to have more spiral grooves than the Middle Miocene shells, which seem to have a broader smooth area on the adapical part of the whorls. Perhaps the Upper Miocene shells represent an intermediate stage between *A. semistriatus* and the Pliocene and Recent *A. tornatilis* (LINNÉ).

Measurements.

Locality	Shell		Aperture
	Length	Maximum diameter	Length
Måde Brickworks	ab. 3.0 mm.	2.1 mm.	2.1 mm.
Holleskov	1.7 –	1.2 –	1.0 –
Sønder Hygum. 141.261	1.3 –	1.0 –	0.9 – (pictured on the plate)
Sæd	1.8 –	1.2 –	1.2 –
Rends	1.2 –	0.8 –	0.8 –

There are defective shells available which must have been larger, thus a shell from Måde Brickworks must have been about 4 mm. in length.

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Gram Formation. North Germany: Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON), Glimmerton at Morsum Kliff, Sylt (RAVN 1907: *Actaeon tornatilis* LINNÉ sp.). Belgium: Anversien (GLIBERT).

Atlantic Region. Aquitanian Basin: Aquitanien, Burdigalien, Helvétien (COSSMANN & PEYROT). Portugal: Tortonien, Helvétien (DOLLFUS, COTTER & GOMES).

Mediterranean Basin. Italy: Elveziano, Tortoniano, Piacenziano, Astiano (SACCO). France: Rhône Valley: Pliocène (FONTANNES: *A. tornatilis semistriata*).

Vienna Basin. Austria: Baden and Vöslau beds (M. HÖRNES). – Hungary: "Miozän-Mediterran" (STRAUSZ).

Poland: Miozän (FRIEDBERG).

FAMILIA: PYRAMIDELLIDAE

Genus: *Chrysallida* CARPENTER 1857
(Type: *Odostomia torrita* DALL & BARTSCH)

Chrysallida pygmaea (GRATELOUP 1840)
Plate XXV, figs. 10–11, and Plate XXVI, fig. 4–5

1840. *Acteon pygmaea* – GRATELOUP, Bassin de l'Adour, Pl. 11, f. 77.
1856. *Turbonilla pygmaea* GRATELOUP – HOERNES, Wienerbecken I, p. 502, Pl. 43, f. 32.
1892. *Pyrgulina pygmaea var. postica* – SACCO, I Molluschi, XI, p. 651, Pl. 1, f. 113.
1918. *Chrysallida pygmaea* (GRAT.) – COSSMANN & PEYROT, Conch. Néog., A.S.L.B. LXX, p. 134, Pl. IX, f. 61–63.
1925. *Pyrgulina pygmaea* GRAT. – KAUTSKY, Hemmoor, p. 73, Pl. 6, f. 26.
1952. *Chrysallida cf. pygmaea* (GRATELOUP) – GLIBERT, Mioc. Belg. II, p. 53, Pl. IV, f. 6.
1958. *Chrysallida pygmaea* (GRATELOUP) – SORGENFREI, Middle Mioc., p. 309, Pl. 68, f. 229.
1964. *Chrysallida (Pyrgulina) pygmaea* (GRATELOUP) – ANDERSON, Reinbek-Stufe, p. 321, Pl. 46, f. 279, 279a.

Material. Hodde Clay.

Hajstrup	167.235	194′–214′	:	1 fairly whole shell

Gram Clay.

Drantum	104.1241	36.0 –40.0	m.:	2 defective shells
Gram	141.277	16.00–16.50	m.:	1 well-preserved shell

Description. The shell is small.

The protoconch is heterostrophic, smooth, comprising about $1\frac{1}{2}$ visible whorls, which rise a little above the teleoconch, thus making the shell look as if having rather a flat apical end.

The whorls of the teleoconch are angular-subangular. The transition between the protoconch and the teleoconch consists of about half a whorl with close-set, slightly curved collabral ribs. Next, there is a prominent subsutural spiral zone immediately below the adapical suture. This spiral zone stands out so much that an edge is formed on the whorl immediately below the suture. On the other parts of the whorls there are 6–8 flat, regular spiral ribs, the interspaces between which are now quite narrow, as filiform depressions, now are of the same breadth as the ribs themselves. These are found right on to the abapical end of the base.

Besides with the spiral sculpture the teleoconch is ornamented with a prominent collabral sculpture in the shape of narrow, prominent ribs, with an almost orthocline direction, the interspaces between which are mostly somewhat broader than the ribs themselves. The spiral ribs are often visible only between the collabral ribs. These are found on the whole of the base and only disappear together with the spiral ribs.

The aperture is oval. Labrum is sharp-edged, simple, passing in an even

curvature into the also sharp-edged inner lip, which rises into a projecting edge. This edge is by a pseudumbilicus separated from the base. The columella bears a narrow, slightly oblique fold.

Variations. The species seems chiefly to vary as regards the breadth of the spiral ribs, the shape of the subsutural spiral zone, and the narrower or broader shape of the collabral ribs.

Remarks. The species is common in Shell Bed I at Hoddemark. The form occurring there corresponds to the material from Hajstrup and Drantum.

The shell from Gram has smaller angular whorls and a less pronounced subsutural spiral zone, just as the spiral ribs are broader and more blurred, so that the interspaces between them are seen only as narrow grooves between the collabral ribs. The latter are broader and more rounded than those on the other shells available.

Measurements. Besides the shells from the Gram Clay 11 shells from Shell Bed I at Hoddemark have also been measured.

			Shell Length	Shell Diameter	Number of whorls on the teleoconch
Gram Clay					
Drantum	104.1241	36 –40 m.	1.8 mm.	1.0 mm.	
–	–	–	1.7 –	0.9 –	
Gram	141.277	16.00–16.50 m.	2.1 –	1.1 –	3
Hodde Clay					
Hajstrup	167.235	194′–214′	2.1 mm.	1.1 mm.	
Shell Bed I. Hoddemark			2.6 –	1.3 –	$4\frac{1}{4}$
– –	–		2.9 –	1.3 –	$4\frac{1}{4}$
– –	–		2.9 –	1.3 –	$4\frac{1}{4}$
– –	–		2.7 –	1.3 –	4
– –	–		2.7 –	1.3 –	$3\frac{1}{2}$
– –	–		2.7 –	1.3 –	4
– –	–		2.6 –	1.2 –	$3\frac{3}{4}$
– –	–		2.4 –	1.3 –	$4\frac{1}{2}$
– –	–		2.7 –	1.3 –	4
– –	–		1.8 –	1.0 –	$2\frac{3}{4}$
– –	–		2.2 –	1.2 –	$3\frac{3}{4}$

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Gram Formation. North Germany: Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON), Glimmerton at Elbtunnel (HORN). Belgium: ? Anversien (GLIBERT).

Atlantic Region. Aquitanian Basin: Burdigalien (COSSMANN & PEYROT).

Mediterranean Basin. Italy: ? Tortoniano, Piacenziano (SACCO).

Vienna Basin. Austria: Baden and Steinabrunn (HOERNES). Hungary: "Miozän-Mediterran" (STRAUSZ).

Chrysallida nodifera SORGENFREI 1958

1958. *Chrysallida nodifera* – SORGENFREI, Middle Mioc., p. 306, Plates 66 and 67, fig. 224.

Material. Hodde Clay.

Leding. Unknown depth:			1 defective, juvenile shell
Hodde	113.33a	18.5–18.9 m.:	1 defective shell and 1 defective juvenile shell

Description. The present shell fragments give an incomplete impression of this species, only.

The protoconch is heterostrophic, with an oblique axis in relation to that of the teleoconch, and is deeply depressed, so that only part of the youngest of the whorl rises a little above the adapical end of the teleoconch.

The whorls of the teleoconch slope immediately below the adapical suture for a very short distance down towards a fairly marked projecting edge. Next, there is a very faint depression, which, again, is followed by a somewhat broader, concave region. The sculpture consists of curved, rather slightly rounded collabral ribs, which form quite small knobs on the subsutural edge and then curve down towards the abapical suture. The basis is smooth.

The aperture is oval, tapering adapically. Labrum has been broken off. It must have passed evenly into an erect inner lip. Between this and the base there is a narrow pseudumbilicus. No fold is seen on the columella.

Remarks. The species has been thoroughly described by SORGENFREI. The material from the Hodde Clay corresponds completely to the shells from the Arnum Formation. It is also common in Shell Bed I at Hoddemark.

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Hodde Formation.

Chrysallida semireticulata SORGENFREI 1958

Plate XXV, figs. 8–9, and Plate XXVI, fig. 3

1958. *Chrysallida semireticulata* – SORGENFREI, Middle Mioc., p. 308, Pl. 67, 227a–b.

Material. Gram Clay.

Brande Brickworks. Clay pit:			1 shell
Gram	141.277	11.65–12.10 m.:	1 shell
–	–	12.60–13.50 m.:	1 shell
–	–	14.00–14.60 m.:	2 shells (with half smooth whorls on the teleoconch)
Spandetgård. Clay pit:			1 shell

Description. The shell is small.

The protoconch is heterostrophic, smooth, consisting of only one visible whorl, while the others are completely depressed.

The teleoconch has about 3–4 rather flat whorls, which are sculptured with 22–30 curved collabral ribs. These are rather close-set and separated by interspaces of the same breadth as their own. On the abapical part of the whorls there are 3–4 narrow spiral bands, which only stand out between the collabral ribs. On the last whorl at least 6 are seen, while the older whorls have first 1, then 2, and finally 3–4 spiral bands. The basis is convex. Otherwise the surface of the shell is smooth.

The aperture is oval, tapering somewhat adapically. Labrum is sharp-edged, passing unbroken into the also sharp-edged inner lip, which rises as an edge. The columella has a narrow, oblique fold.

Remarks. From the drillings at Gram Brickworks there is a shell available of a *Chrysallida*, pictured on Plate XXVI, fig. 3, and presumably belonging to the present species. Its heterostrophic protoconch seems to form a slightly wider axial angle with the axis of the teleoconch. Its whorls have only collabral ribs or folds on the oldest one or two whorls. Only faint traces of a single spiral rib are seen immediately above the abapical suture. The shell is well preserved. This is perhaps a case of a particularly smooth specimen of *C. semireticulata.* A juvenile shell from the same depth in the borehole shows an anlage of a corresponding semiglabrous shell surface. So far these shells have been denoted as *Chrysallida sp..*, but it must be assumed that they can justly be considered as belonging to *C. semireticulata.*

Measurements.

Locality	Shell Length	Shell Diameter	Aperture Length	Remarks:
Gram. 141.277. 14.00–14.60 m.	2.1 mm.	1.0 mm.	0.7 mm.	Almost smooth shell
Sæd. 167.4. 70–82 m.	1.7 –	0.9 –	0.6 –	
Rends. 167.236. 140′–160′	1.6 –	0.7 –	0.6 –	

Distribution.

North Sea Basin. Miocene. Arnum Formation (SORGENFREI), Gram Formation.

Genus: *Kleinella* A. ADAMS 1860

(Type: *Kleinella cancellaris* A. ADAMS 1860)

Kleinella nordmanni SORGENFREI 1958

Plate XXVI, figs. 1–2

1958. *Kleinella* (*Leucotina*) *Nordmanni* – SORGENFREI, Middle Mioc., p. 310, Pl. 68, f. 230a–c.

1964. *Kleinella* (*Leucotina*) *nordmanni* SORGENFREI – ANDERSON, Reinbek-Stufe, p. 322, Pl. 46, f. 281.

Material. Gram Clay.

Gram	141.277	9.00–9.50 m.:	1 shell
Hauge. Clay pit:			1 very defective shell

Description. The shell from Gram consists of $2\frac{1}{2}$ whorls besides the heterostrophic protoconch.

The shell is small, with a truncated apex.

The protoconch is heterostrophic, comprising $1\frac{1}{2}$ smooth, convex whorls, which soon increase in breadth. The initial whorl is rather deeply depressed.

The teleoconch has rather high, flatly convex whorls. The initial whorl has 7–9 spiral grooves distributed all over the whorl. The adapical part of the following whorls constitutes a broad, smooth zone, in which the growth lines form a flat sinus. The last part of the whorls is provided with 6 thin spiral grooves, the interspaces between which are broad and equidistant. On the last whorl there are about 10 spiral grooves in a broad zone around the periphery. They disappear on the extreme part of the base.

The aperture is oval. Labrum and the inner lip have been broken off. The columella has a rather faint, narrow, and oblique fold.

Remarks. The shell from Gram is in good agreement with SORGENFREI's description of the material from the Arnum Formation. This shows rather a great variation as regards the number of spiral grooves.

Measurements. The pictured shell from Gram measures in length: 1.7 mm., diameter: 0.8 mm., and height of the aperture: 0.8 mm.

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Gram Formation. North Germany: Reinbek-Stufe (ANDERSON).

Genus: *Odostomia* FLEMING 1817

(Type: *Turbo plicatus* MONTAGU 1803)

Odostomia conoidea (BROCCHI 1814)

1956. *Odostomia* (*Odostomia*) *conoidea* (BROCCHI) – RASMUSSEN, South Jutland, p. 99, Pl. X, f. 5.

1958. *Odostomia conoidea* (BROCCHI) – SORGENFREI, Middle Mioc., p. 312, Pl. 70, f. 231 a–c.

1964. *Odostomia* (*Megastomia*) *conoidea* (BROCCHI) – ANDERSON, Reinbek-Stufe, p. 323, Pl. 46, f. 282, 282 a.

Material.

Shell material is available from the following localities (see Part I, Tables 4–66):

Hodde Clay.

Leding (93.155), Enderupskov (141.196), Gram (141.277), and Hajstrup (167.235).

Gram Clay.

Randbæk (83.597), Muldbjerg (83.1006), Kodal-Fjaldene (84.1749), Videbæk (84.1748, 84.1727), Møltrup Brickworks (clay pit), Lille Torup (85.379), Gjødstrup (85.861), Brande Brickworks (clay pit), Drantum (104.1241), Nyholm (104.1166), Forsom Brickworks (clay pit), Odderup (103.150), Harkes Brickworks (clay pit), Hesselho (113.121), Hauge (clay pit), Tønding (clay pit), Esbjerg (130.59), Måde Brickworks (eastern clay pit), Holleskov (132.46b), Ravning (clay pit), Hjortvad (141.178), Lintrup (132.140), Sønder Hygum (141.260, 141.261), Rødding (141.76, 141.242), Gram (141.277), Spandetgård (clay pit), Tønder (166.398), Brodersmark (166.351b), Sæd (167.4, 167.445), and Rends (167.236).

Description. The shell is relative small, ovoid, with rather a high spire as compared with the base.

The protoconch is heterostrophic, with the axis turned obliquely in relation to that of the teleoconch and in part pressed down below the first adult whorl, so that only part of the youngest whorl is visible.

The whorls of the teleoconch are flatly convex and smooth. Sometimes an obtuse edge delimiting the slightly convex base from the spire, sometimes issues from the adapical end of the aperture.

The aperture is oval or almost rhomboidal. Labrum is sharp-edged, simple, curving into the also sharp-edged inner lip, which rises as an edge. Between this and the base there is a pseudumbilicus. On the columella there is a narrow, often rather sharp-edged, oblique fold. At some distance within the labrum there are often 6–7 more or less faint, rounded lists.

A further description is found in the cited work by SORGENFREI.

Variations. The shells from the Gram Clay vary in the same way as those from the Arnum Formation, as there are partly shells with an edge on the last whorl, partly shells with a characteristic edge and a more conical apex.

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Hodde Formation, Gram Formation. North Germany: Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON, HINSCH), Glimmerton at Langenfelde (v. KOENEN). Belgium: Horizon de Houthaelen, Anversien (GLIBERT). – Plio-Pleistocene. Belgium: Scaldisien (GLIBERT). England: Coralline Crag (HARMER). Recent (JEFFREYS).

Atlantic Region: Recent from the British Isles to the coasts of Portugal (JEFFREYS). Aquitanian Basin: Helvétien (COSSMANN & PEYROT: *O. polysarcula*). Portugal: Helvétien, Tortonien (DOLLFUS, COTTER & GOMES).

Mediterranean Basin. Italy: Tortoniano, Piacenziano, Astiano (SACCO). Spain (Cataluna): Placenciense (ALMERA Y BOFILL). Recent.

Vienna Basin. Austria: ? Baden, ? Steinabrunn (M. HOERNES: *O. plicatum*). Hungary: "Miozän-Mediterran" (STRAUSZ).
Poland: Miozän (FRIEDBERG).

Odostomia mutinensis (SACCO 1892)

1958. *Odostomia mutinensis* (SACCO) – SORGENFREI, Middle Mioc., p. 317, Pl. 69, f. 235a–b, Pl. 70, f. 235.

Material. Hodde Clay.

Gram	141.277	33.80–34.25 m.:	1 slightly defective shell
–	–	34.25–34.70 m.:	1 defective shell and 1 fragment

Description. The material from the Hodde Clay is only fragmentary and insignificant. The following description therefore is incomplete.

The shell is small, ovoid.

The protoconch is heterostrophic, partly hidden. Only part of the last whorl rises over the teleoconch, its axis being very oblique in relation to that of the teleoconch.

The whorls of the teleoconch are very flatly convex, with an adapical shoulder immediately below the suture. The surface of the shell has a weak spiral striation, which is especially visible under the microscope at incident light (observed on the specimen from Gram, at a depth of 33.80–34.25 m.). An edge starting from the abapical corner of the aperture demarcates the base, which is in part destroyed on the material from Gram.

The columella has an oblique fold. Between the inner lip and the base there is a narrow umbilicus.

A more detailed description is found in the work by SORGENFREI cited.

Remarks. Peculiarly enough, this rather characteristic species has so far been found only in the Miocene beds of Denmark and Italy. The shell from the Hodde Formation is in very good agreement with SORGENFREI's description.

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Hodde Formation.

Mediterranean Basin. Italy: Tortoniano (SACCO).

Genus: *Eulimella* GRAY 1847

(Type: *Turbonilla scillae* SCACCHI 1836)

Eulimella scillae (SCACCHI 1836)

1956. *Eulimella (Eulimella) scillae* (SCACCHI) – RASMUSSEN, South Jutland, p. 100, Pl. X, f. 2.

1958. *Eulimella Scillae* (SCACCHI) – SORGENFREI, Middle Mioc., p. 322, Pl. 69, f. 239a–c.

Material. Gram Clay.

Brande Brickworks. Clay pit:			1 almost whole shell
Odderup	103.150	14.50–20.00 m.:	1 defective shell
Gram	141.277	17.00–17.50 m.:	1 whole shell
Sæd (Custom-house)	167.445	92.25–92.70 m.:	?1 small, whole juvenile shell
–	–	92.70–93.00 m.:	?1 fragm. shell
–	–	95.90–96.20 m.:	1 defective shell

Description. The shell is turriculate, forming a narrow, high, pointed cone with a short base.

The protoconch is heterostrophic, consisting of about 2 smooth whorls, the axis of which forms an oblique angle with the axis of the teleoconch.

The teleoconch comprises a total of 9 whorls on the largest shell (from Gram Brickworks, pictured on Plate X, fig. 2, in RASMUSSEN 1956). These whorls are quite flat and smooth. The suture is situated in a filiform groove, which is a little oblique in relation to the axis. The growth lines, which are only slightly visible, form an extremely flat S-shaped curve. The base is convex.

The aperture is regularly rhomboidal. Labrum has been broken off. It must have passed evenly into the inner lip, which rises as a sharp edge.

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Gram Formation. North Germany: Glimmerton of Sylt and Langenfelde (v. KOENEN).

Atlantic Region. Portugal: Helvétien (DOLLFUS, COTTER & GOMES). Recent from Lofoten to Madeira and the Canary Islands.

Mediterranean Basin. Italy: Tortoniano, Piacenziano, Astiano (SACCO), Monte Mario (CERULLI – IRELLI). – Spain (Cataluna): Placenciense (ALMERA Y BOFILL). Recent.

Eulimella acicula (PHILIPPI 1836)

1836. *Melania acicula* – PHILIPPI, Enum. Moll. Siciliae I, p. 158, Pl. 9, f. 6.

1867. *Odostomia acicula* PHILIPPI – JEFFREYS, Brit. Conch. IV, p. 170 – V (1869), Pl. LXXVI, f. 6 and 7.

1868. *Eulimella acicula* PHILIPPI – WEINKAUFF, Conch. Mittelm. II, p. 224.

1882. *Eulimella acicula* PHIL. – v. KOENEN, Mioc. Nordd. II, p. 243, Pl. VI (V), f. 8a, b.

1883. *Eulimella acicula* PHILIPPI sp. – BUCQUOY, DAUTZENBERG & DOLLFUS, Roussillon, I, p. 187, Pl. XX, f. 17–18.

1888. *Eulimella acicula* PHIL. – PETERSEN, Skalb. Moll., p. 73.

1952. *Eulimella acicula* PHILIPPI sp. – GLIBERT, Mioc. Belg. II, p. 56, Pl. IV, f. 11.

1958. *Eulimella acicula* (PHILIPPI) – SORGENFREI, Middle Mioc., p. 324.
1964. *Eulimella acicula* (PHILIPPI) – ANDERSON, Reinbek-Stufe, p. 323, Pl. 47, f. 283, 283a–d.

Material. Gram Clay.

Kodal-Fjaldene	84.1749	15.55–16.55 m.:	1 small juvenile shell	(1)
Videbæk	84.1748	16.95–17.95 m.:	1 small def. shell	(1)
–	84.456	2.2 –15.0 m.:	1 def. sh.	(1)
Lille Torup	85.379	16.8 –20.0 m.:	1 complete sh.	(1)
Drantum	104.1241	36.0 –40.0 m.:	1 def. sh.	(1)
Holleskov	132.46b	4.9 –11.2 m.:	1 def. sh.	(1)
Hjortvad	141.178	20.1 –23.1 m.:	1 def. sh.	(1)
Gram	141.277	12.60–13.10 m.:	1 def. sh.	(1)
–	–	14.60–15.10 m.:	1 small, complete sh.	(1)
–	–	15.10–15.55 m.:	1 def. sh.	(1)
–	–	18.50–19.00 m.:	1 almost complete sh.	(1)
Brodersmark	166.351b	28–29 m.:	2 def. sh.	(2)

Description. The shell is rather small, slender, turriculate.

The protoconch is heterostrophic, with a small, oblique axis in relation to the axis of the teleoconch. The youngest whorl but one is only in part visible, while the youngest whorl goes rather high above the teleoconch. This whorl is very convex and has a smooth surface. Its diameter is 0.4 mm. on a single one of the shells.

The whorls of the teleoconch are convex and have a smooth surface. Sometimes the adapical part of the whorls is slightly depressed, as seen in fig. 11 in GLIBERT. This applies to a shell from Gram (18.50–19.00 m.). The whorls, however, are mostly regularly convex like JEFFREYS' var. *ventricosa* (see JEFFREYS 1867, p. 170, and 1869, Plate LXXVI, fig. 7). This applies to the shell from Lille Torup. The sutures are deep-set. The growth lines form slightly sigmoidal curves.

The base is convex. The aperture is rounded, rhomboidal or almost oval. Labrum is simple. The inner lip is smooth. There is neither a columellar fold nor an umbilicus.

Measurements. The only three whole shells have the following measures:

			Length	Maximum diameter
Ll. Torup	85.379	16.80–23.00 m.	1.9 mm.	0.8 mm.
Gram	141.277	14.60–15.10 m.	1.4 –	0.7 –
–	–	18.50–19.00 m.	1.4 –	0.6 –

A third shell from Gram and the shell from Hjortvad must both have been more than 2.5 mm. in length.

Remarks. This species clearly differs from *E. scillae*, which has flat whorls, a rounded edge on the periphery of the base and in general considerably larger shells.

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Gram Formation. Northern Germany: Reinbek-Stufe (ANDERSON). Belgium: Anversien (GLIBERT). – Recent (JEFFREYS, C. G. JOHS. PETERSEN).

Atlantic Region. Portugal: Helvétien, Tortonien (DOLLFUS, COTTER & GOMES). Recent along the coasts of Western Europe from Norway to Spain (JEFFREYS).

Mediterranean Basin: Recent in the Mediterranean (WEINKAUFF).
Hungary: ? "Miozän-Mediterran" (STRAUSZ).

Eulimella cf. hoernesi (v. KOENEN 1882)

1882. *Turbonilla Hoernesi* – v. KOENEN. Mioc. Nordd. II, p. 263, Pl. VI (V), f. 1a, b.
1925. *Eulimella Hoernesi* v. KOEN. – KAUTSKY, Hemmoor, p. 74, Pl. 6, f. 29.
1952. *Eulimella hoernesi* v. KOENEN sp. – GLIBERT, Mioc. Belg. II, p. 57, Pl. IV, f. 8.
1964. *Eulimella hoernesi* (KOENEN) – ANDERSON, Reinbek-Stufe, p. 324, Pl. 47, f. 284, 284a, b.

Original diagnosis: Not given. Main features of original description: "Unterscheiden sich von dem, was HÖRNES und GRATELOUP unter diesem Namen (d.h. *Turbonilla subumbilicata*) angeführt haben, sehr bedeutend, namentlich durch fast quadratische Gestalt der Mündung. – Die Windungen sind eben oder ganz flach gewölbt, mitunter, zumal im Alter, schwach treppenförmig. – Die Schlusswindung bekommt an der Stelle, wo die Naht liegen würde, oder ein wenig höher, eine starke Wölbung, welche nach der Spindel zu sich bedeutend abflacht. Die Spindel ist gerade und trägt ganz oben eine niedrige, schräge Falte." (v. KOENEN 1882)

Type material. The shell pictured by v. KOENEN (1882) in Plate VI, fig. 1a, is the holotype. Locus typicus: Stolpe (Germany). Stratum typicum: "Holsteiner Gestein". Depository: probably the "Sammlung KOENEN" in the Geol.-Palaeont. Institute of the University of Göttingen (Germany).

Material. Hodde Clay.

Gram	141.277	30.00–30.50 m.:	1 def. shell without apex

Gram Clay.

Gram	141.277	19.50–20.00 m.:	1 def. shell without apex

Description. The present material is too incomplete as a basis of a description proper. Reference is made to the work by GLIBERT cited.

Both shells lack the apex. Their whorls are relatively high and almost quite flat. The sutures are little depressed. The surface of the shell is smooth. The growth lines are almost completely orthocline. A few of them stand out on one shell as very thin collabral threads, which can be observed by incident light.

The aperture is trapezoidal. Labrum is parallel to the inner lip, but abapically it curves so much that it comes to be at right angles to the inner lip. Columella adapically bears a weak, oblique fold.

Remarks. It seems difficult to distinguish this species from another species set up by v. KOENEN, *T. Neumayri*, which according to this author has been found i.a. at Gühlitz and Dingden.

According to GLIBERT *E. hoernesi* differs from *E. neumayri* by having a larger shell, by having more whorls, which often are plane, by its straight and regularly conical shell, and by its comparatively larger last whorl.

As these characters are in good agreement with those of the shells from Gram, they are referred to *E. hoernesi*, although with reservations.

Distribution.

North Sea Basin. Miocene. Denmark: Hodde Formation, Gram Formation. North Germany: Untermiozän near Stolpe (v. KOENEN), Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON). Belgium: Houthaléen (GLIBERT).

Vienna Basin. Austria: Enzesfeld, Lapugy (v. KOENEN).

Genus: *Turbonilla* (LEACH) RISSO 1826

(Type: *Turbo lacteus* LINNÉ 1758)

Turbonilla costellata (GRATELOUP 1840)

Plate XXV, figs. 6–7

1840. *Acteon costellata* – GRATELOUP, Bassin de l'Adour, p. 280, Pl. 11, f. 69–70.
1882. *Turbonilla costellata* GRAT. – v. KOENEN, Mioc. Nordd. II, p. 250, Pl. VI (V), f. 9a, b, 10a, b.
1907. *Turbonilla costellata* GRATELOUP sp. – RAVN, Jylland, p. 297 (93), Pl. III, f. 12.
1918. *Turbonilla costellata* (GRATELOUP) – COSSMANN & PEYROT, Conch. Néog. A.S.L.B. LXX, 2 fasc., p. 145, Pl. IX, f. 68–70 and 79–81.
1925. *Turbonilla pseudocostellata* SACCO *var. Koeneniana* SACCO – KAUTSKY, Hemmoor, p. 75.
1958. *Turbonilla costellata* (GRATELOUP) – SORGENFREI, Middle Mioc., p. 325, Pl. 70, f. 242.
1964. *Turbonilla* (*Turbonilla*) *pseudocostellata* SACCO *fa. koeneniana* SACCO – ANDERSON, Reinbek-Stufe, p. 325, Pl. 48, f. 287.

Material. Hodde Clay.

Hodde	113.33a	18.5 –18.9 m.:	2 juvenile, almost complete shells
Gram	141.277	34.25–34.70 m.:	1 defective shell
–	–	34.70–35.00 m.:	Apex of one shell and 1 fragment
–	–	35.00–35.70 m.:	1 defective shell

Gram Clay.

Muldbjerg	83.1006	8.0 – 9.0 m.:	1 fragm.	(1)

Kodal-Fjaldene	84.1749	16.55–17.55 m.:	5 fragm. (1)
–	–	20.55–21.55 m.:	1 almost complete shell (1)
Videbæk	84.1748	22.95–23.95 m.:	1 defective shell (1)
Møltrup Brickworks. Clay pit:			1 complete shell, 1 defective shell, 1 fragm. (2)
Lille Torup	85.379	16.8 –20.0 m.:	2 complete sh., 6 basal parts, 2 apices (8)
Drantum	104.1241	36.0 –40.0 m.:	10 fragm. (7)
–	–	46.0 –50.0 m.:	1 defective shell (1)
Nyholm	104.1166	7.2 – 8.2 m.:	1 fragm. (?1)
Odderup	103.150	20.0 –21.0 m.:	1 fragm. (?1)
Hesselho	113.121	50.0 –56.0 m.:	1 complete sh. and 1 fragm. (2)
–	–	56.0 –65.0 m.:	1 fragm. (1)
Hauge. Clay pit:			1 complete shell, 2 def. shells and 4 fragm. (4)
Måde Brickworks. Eastern clay pit:			4 complete sh., 5 fragm. (4)
Holleskov	132.46 b	4.9 –11.2 m.:	2 def. sh. (2)
Lintrup	132.140	9.8 –14.8 m.:	1 def. shell (1)
Sønder Hygum	141.260	12 –40 m.:	1 fr. of 1 whorl (1)
–	141.261	13 –19 m.:	1 complete sh., 2 apices, 1 protoconch. (4)
Gram	141.277	5.70– 6.10 m.:	5 def. sh., 3 fr. (5)
–	–	6.10– 6.40 m.:	1 protoc. (1)
–	–	9.00– 9.50 m.:	1 def. shell (1)
–	–	10.80–11.25 m.:	1 def. and weathered sh. (?1)
–	–	11.25–11.65 m.:	1 fr. (1)
–	–	12.10–12.60 m.:	1 well-preserved sh., 1 fr. (2)
–	–	12.60–13.10 m.:	4 def. sh., 2 fr. (4)
–	–	14.00–14.60 m.:	3 def. sh., 2 fr. (3)
–	–	14.60–15.10 m.:	4 def. sh., 2 fr. (4)
–	–	15.10–15.55 m.:	1 def. small sh., 3 fr. (1)
–	–	15.55–16.00 m.:	3 def. sh., 2 fragm. (3)
–	–	16.50–17.00 m.:	1 def. shell (1)
–	–	17.00–17.50 m.:	1 def. sh., 2 basal parts of 2 sh., 2 fr. (3)
–	–	18.00–18.50 m.:	3 def. sh., 2 fr. (3)
–	–	18.50–19.00 m.:	1 def. shell (1)
–	–	20.50–21.00 m.:	1 def. sh., 1 fr. (1)
Spandetgård. Clay pit:			4 almost complete sh., 1 def. sh., 1 fr. (4)
Spandet	150.184	33.0 –37.1 m.:	1 juvenile sh. (1)
Tønder	166.398	58.85–59.00 m.:	8 fr. (1)
Brodersmark	166.351 b	22.6 –24 m.:	1 small sh. (1)
–	–	26 –27 m.:	1 def. sh., 2 fr. (1)
–	–	28 –29 m.:	2 def. sh. (2)
Sæd	167.445	93.00–93.70 m.:	7 basal parts of 7 sh., 1 protoconch, 2 fr. (7)
–	–	93.70–94.10 m.:	1 def. sh., 2 fr. (2)
–	–	94.75–95.50 m.:	1 fr. (1)
–	–	96.20–96.75 m.:	1 complete sh. (1)
–	–	94.00–97.70 m.: (special sample)	2 def. sh., 2 fragm. (2)
Rends	167.236	140′–160′ :	2 def. sh. (2)

Description. The shell is rather small, turriculate, with a relatively large apical angle.

The protoconch is heterostrophic, smooth, comprising about two convex whorls, the axis of which form a more or less acute angle with that of the teleoconch.

The whorls of the teleoconch are flatly convex, with 11–13 (on the last whorl, however, more) collabral ribs per whorl. They are evenly rounded, and the distance between them corresponds to their breadth or is a little broader. Otherwise the surface of the shell is glossy and smooth. The collabral ribs are placed a little obliquely and disappear on the boundary of the base, which is convex and without any sculpture.

The aperture is more or less regularly rhomboidal. Labrum is simple, sharp-edged, and passes evenly into the somewhat erect inner lip, which is also sharp-edged and smooth. There is no umbilicus.

Remarks. This species is somewhat variable, and the variations have caused SACCO (1892, I Molluschi, XI, p. 77) to segregate the forms from the North Sea Basin, the Mediterranean Basin, and the Vienna Basin as a particular species, *T. pseudocostellata*, as different from *T. costellata* in the Aquitanian Basin. SACCO furthermore characterized the forms in the North Sea Basin and the Vienna Basin as special varieties, *var. Koeneniana* and *var. Hoernesiana*, respectively.

However, a carefully documented investigation of the whole form cycle is missing, for which reason, like SORGENFREI, I prefer to refer the Danish material to the French original form.

There is good agreement with the shells from the Arnum Formation.

Measurements.

Locality			Shell Length	Shell Diameter	Protoconch Diameter	Protoconch Length	Aperture Breadth
Kodal-Fjaldene	84.1749	20.55–21.55 m.	2.8 mm.	1.2 mm.			
Møltrup Brickworks. Clay pit:			2.6 –	1.1 –	0.3 mm.	0.6 mm.	0.4 mm.
Lille Torup	85.379	16.8 –20.0 m.	2.0 –	0.9 –		0.4 –	0.3 –
–	–	–	1.3 –	0.9 –	0.3 –	0.4 –	0.3 –
Hauge. Clay pit:			1.9 –	0.9 –	0.3 –	0.4 –	0.3 –
Gram	141.277	12.10–12.60 m.	2.9 –	1.1 –	0.3 –	0.7 –	0.4 –
Spandetgård. Clay pit:			2.9 –	1.3 –	0.3 –	0.8 –	0.6 –
Sønder Hygum	141.261	13 –19 m.	3.0 –	1.4 –	0.3 –	0.9 –	0.6 –

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Hodde Formation, Gram Formation. North Germany: Hemmoor-Stufe (KAUTSKY: *T. pseudocostella koeneni* SACCO). Reinbek-Stufe (ANDERSON: *Turbonilla pseudocostellata koeneni* SACCO).

Atlantic Region. Aquitanian Basin: Burdigalien, Helvétien (COSSMANN & PEYROT). Portugal: Tortonien (DOLLFUS, COTTER & GOMES).

Probably it is the same species as occurs in the Vierland-Stufe and Glimmerton, in the Middle Miocene of Holland, in the Anversien of Belgium, in the "2. Mediterranstufe" of the Vienna Basin, in the Elveziano and Tortoniano of Italy, and in the "Miozän-Mediterran" of Hungary. This problem has not yet been solved.

Turbonilla pseudoterebralis SACCO 1892

1882. *Turbonilla plicatula* BROCC. – v. KOENEN, Mioc. Nordd. II, p. 256, Pl. VI (V), f. 6a, b.
1892. *Turbonilla (Pyrgolampros) pseudoterebralis* – SACCO, I. Molluschi, XI, p. 88, Pl. II, f. 94.
1925. *Turbonilla (Pyrgolampros) pseudoterebralis* SACCO – KAUTSKY, Hemmoor, p. 76, Pl. 6, f. 32.
1952. *Turbonilla (Pyrgolampros) pseudoterebralis* SACCO – GLIBERT, Mioc. Belg. II, p. 60, Pl. IV, f. 15.
1958. *Turbonilla pseudoterebralis* (SACCO) – SORGENFREI, Middle Mioc., p. 329, Pl. 72, f. 245a–c.
1964. *Turbonilla (Pyrgolampros) pseudoterebralis* (SACCO) – ANDERSON, Reinbek-Stufe, p. 326, Pl. 48, f. 289.

Material. Hodde Clay.

Leding	93.155	27 –28 m.:	1 def. shell	(1)
–	–	31 m.:	2 fragm.	(1)
–	–	Unknown depth:	1 complete shell	(1)
Gram	141.277	29.00–29.50 m.:	1 complete sh. and 1 def. shell	(2)
–	–	29.50–30.00 m.:	3 fragm.	(2)
–	–	30.50–30.95 m.:	7 fragm.	(2)
–	–	30.95–31.35 m.:	4 fragm.	(2)
–	–	31.95–32.30 m.:	1 def. sh.	(1)
–	–	33.05–33.40 m.:	1 def. sh. and 1 fr.	(2)
–	–	33.40–33.80 m.:	7 fragm.	(1)
–	–	34.25–34.70 m.:	2 def. sh. and 2 fr.	(2)
–	–	34.70–35.00 m.:	2 def. sh.	(2)
Sønder Hygum	141.215	26.2 –32.8 m.:	1 def. sh.	(1)
Tønder	166.398	85.5 m.:	?1 fragm.	(?1)

Description. Only juvenile shells and fragments are available.

The shell is small, slender, turriculate.

The protoconch is heterostrophic, consisting of about two whorls. Its axis is almost at right angles to that of the teleoconch. The initial whorl is small and vesicular. Both whorls are convex and smooth.

The oldest whorl of the teleoconch is flatly convex and smooth. The following whorls are almost quite flat and have a sculpture of almost orthocline, regularly rounded, collabral ribs, the breadth of which correspond to the interspaces between them. Immediately below the adapical suture there is a spiral-like elevation of the surface of the shell, which mostly is only slightly demonstrable between the ribs. Sometimes this slight elevation, however, may give rise to the formation of a small knob on the adapical part of each rib. The interspaces between the collabral ribs often have the appearance of

lengthy grooves, the bottoms of which slope evenly adapically as well as abapically.

The base of the shell is convex and smooth without distinct delimitation from the apex.

The aperture is rhomboid. Labrum has been broken off the present shells. It must have passed evenly into the edge-shaped, erect inner lip. On the columella there is a narrow, oblique fold.

Remarks. The shells from the North Sea Basin were formerly (v. KOENEN) considered identical with the South European Pliocene *P. plicatula* BROCCHI.

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Hodde Formation. North Germany: Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON), ? Glimmerton in Morsum Kliff, Sylt (v. KOENEN). Belgium: Anversien (GLIBERT).

Mediterranean Basin. Italy: Tortoniano (SACCO).

Vienna Basin. Austria: Baden, Steinabrunn (M. HOERNES: *T. plicatula* (BROC.)). Hungary: "Miozän-Mediterran" (STRAUSZ).

Turbonilla sp.

Material. Gram Clay.

Lille Torup	85.379	16.80–20.00 m.:	2 defective shells
Brande Brickworks. Clay pit:			1 def. shell in concretion
Gram	141.277	5.30– 5.70 m.:	1 defective shell

Description. All the present material is very defective. The following remarks on the appearance of the species may be made:

The protoconch has been broken off together with the upper part of the apex.

The whorls of the teleoconch are flatly convex and provided with rather flat and relatively broad collabral ribs (12–14 per whorl), separated by interspaces the breadths of which vary a little. In the intervals there are five fine, equidistant spiral grooves, which are not, or only slightly, marked on the ribs themselves.

The base seems to be smooth and convex.

The region of the aperture is defective on all the shells available.

Remarks. From Brande Brickworks there is a very defective specimen of a turriculate Opistobranchiata which is lacking a great part of the upper region of the apex, as well as the whole of the basal part. The sculpture consists of collabral ribs as well as weaker spiral ribs. This may be a *Turbonilla* of the same character as the defective shells described above.

It has not been possible to determine the fragments of shells. They may have belonged to *T. rufa* (PHILIPPI) or *T. lactea* (LINNAEUS).

Genus: *Pyramidella* LAMARCK 1799
(Type: *Trochus dolabratus* LINNÉ 1758)

Pyramidella plicosa BRONN 1838

1956. *Pyramidella* (*Pyramidella*) *plicosa* BRONN – RASMUSSEN, South Jutland, p. 102, Pl. X, f. 6.
1958. *Pyramidella plicosa* BRONN – SORGENFREI, Middle Mioc., p. 332, Pl. 72, f. 247.
1964. *Pyramidella plicosa* (BRONN) – ANDERSON, Reinbek-Stufe, p. 329, Pl. 50, f. 293, 293 a–c.

Material. Gram Clay.

Hesselho	113.121	50.0 –56.0 m.:	2 def. sh.
Gram	141.277	15.55–16.00 m.:	1 nearly whole sh. and the base of 1 sh.
Brodersmark	166.351 b	25 –26 m.:	4 more or less def. sh.
Sæd	167.445	94.00–97.70 m.:	1 nearly whole sh.
Rends	167.236	140′–160′ :	3 nearly whole and 7 def. sh.

Description. The shell is oblong conical.

The protoconch is heterostrophic, consisting of 1–1½ whorls, which are highly convex and form an oblique angle with the axis of the shell. The initial whorl is partly hidden by the oldest adult whorl.

The teleoconch comprises 5½ whorls on the shell from Gram. All the whorls are very slightly convex or almost flat. The sutures are deep-set and a little oblique in relation to the axis of the shell. The surface of the base is convex. The whole surface of the shell is smooth.

The aperture is rhomboid. Labrum has been broken off, but interiorly it has at least two lists. Columella has 2–3 oblique folds, the adapical one of which is the most prominent.

Distribution.

North Sea Basin. Miocene. Denmark: Klintinghoved Clay, Arnum Formation (SORGENFREI), Gram Formation. North Germany: Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON), Glimmerton at Lüneburg (v. KOENEN). Holland: Middle (VOORTHUYSEN). Belgium: Anversien (GLIBERT). – Plio-Pleistocene. Holland: Scaldisien (TESCH). Belgium: Scaldisien, Casterlien (NYST). England: *P. laeviuscula* in Coralline Crag, Lenham beds (WOOD, HARMER).

Atlantic Region. Aquitanian Basin: Helvétien, Tortonien (COSSMANN & PEYROT).

Mediterranean Basin. Italy: Elveziano, Tortoniano, Piacenziano, Astiano (SACCO). Spain (Cataluna): Placenciense (ALMERA Y BOFILL).

Vienna Basin. Austria: 2. Mediterranstufe (KAUTSKY). Poland: Torton (FRIEDBERG). Hungary: Torton (BOGSCH), "Miozän-Mediterran" (STRAUSZ).
Poland: Miozän (FRIEDBERG).

FAMILIA: RINGICULIDAE

Genus: *Ringicula* DESHAYES 1838
(Type: *Auricula ringens* LAMARCK 1804)

Ringicula buccinea (BROCCHI 1814)
Plate XXV, figs. 3–5, and Plate XXVI, fig. 6

1814. *Voluta buccinea* – BROCCHI, Conch. subapp. II, p. 319, Pl. IV, f. 9. (edit. 1843, p. 93).
1848. *Ringicula buccinea* J. SOW. – S. V. WOOD, Crag Moll. I, p. 22, Pl. IV, f. 2a–b.
1856. *Ringicula buccinea* DESH. – M. HÖRNES, Wienerbecken I, p. 86, Pl. 9, f. 3–4.
1868. *Ringicula buccinea* RENIERI – WEINKAUFF, Conch. Mittelm. II, p. 204.
1892. *Ringicula auriculata var. buccinea* (BR.) – SACCO, I Molluschi, XII, p. 20, Pl. I, f. 7.
1907. *Ringicula auriculata* MÉNARD sp. – RAVN, Jylland, p. 365 (161).
1907. *Ringicula striata* PHILIPPI – RAVN, Jylland, p. 365 (161), Pl. VIII, f. 11 (pars).
1925. *Ringicula* (*Ringiculella*) *auriculata* MÉN. *var. ventricosa* SOW. – KAUTSKY, Hemmoor, p. 197 (pars).
1932. *Ringicula* (*Ringiculella*) *buccinea* BROCCHI – COSSMANN & PEYROT, Conch. Néog. A.S.L.B. LXXXIV, 2 fasc., p. 142, Pl. XI, f. 9, 14, 15.
1952. *Ringicula* (*Ringiculina*) *buccinea* BROCCHI *sp.* – GLIBERT, Mioc. Belg. II, p. 141, Pl. X, f. 13.
1955. *Ringicula* (*Ringiculina*) *auriculata* MÉN. *var. buccinea* (BROCCHI) – ROSSI RONCHETTI, I tipi, p. 333, f. 179.
1958. *Ringicula buccinea* (BROCCHI) – SORGENFREI, Middle Mioc., p. 334, Pl. 73, f. 249a–l.
1964. *Ringicula* (*Ringiculina*) *buccinea* (BROCCHI) – ANDERSON, Reinbek-Stufe, p. 332, Pl. 51, f. 299.

Original diagnosis. Testa minuta, subovata, inflata, spira brevi acuta, basi emarginata, columella plices tribus acutis, labio sinistro expanso adnato, altero marginato (BROCCHI 1814).

Type material. The holotype is located in "Collezione Brocchi" in the Museo Civico di Storia Naturale di Milano, No. inv. 104. – Locality: S: Giusto, Piemonte, Italy. – Formation: Piacentino. – Age: Pliocene.

Material. Hodde Clay.

Leding	93.155	19	–27	m.:	2 defective broken-off labrum-fragments	(2)
–	–	27	–28	m.:	3 defective broken-off labrum-fragments	(3)
–	–		31	m.:	7 complete sh., 6 labrum-fragm., 1 broken-off apex, 2 fr. of collumella and 1 other fragm.	(14)
–	–	28	–32	m.:	6 labrum-fr., 2 collumella-fr.	(5)
–	–	Unknown depth:			6 complete sh., 5 broken apices and 1 fr.	(11)
Lønborg	102.55	17.3	–18.3	m.:	1 labrum-fr.	(1)
–	–	19.3	–20.3	m.:	1 labrum and 1 collumella-fr.	(1)
–	–	21.3	–22.3	m.:	1 collumella-fr.	(1)
Odderup	103.150	24.8	–25.6	m.:	7 labrum-fr. and 2 collumella-fr.	(7)

Grøde. Karlsgårde Canal:			1 def. shell (1)
Hodde	113.33a	18.5 –18.9 m.:	1 whole sh., 1 apex and 1 labrum-fr. (2)
Måde Brickworks. Northwestern pit:			1 complete shell (1)
–	Eastern pit:		5 complete sh., 8 def. sh. (13)
Gram	141.277	26.50–27.00 m.:	1 labrum-fr. and 1 collumella-fr. (1)
–	–	28.00–28.50 m.:	1 defective sh. and 4 fragm. (1)
–	–	29.00–29.50 m.:	1 broken-off apex and 7 small fr. (1)
–	–	29.50–30.00 m.:	1 collumella-fr. and 4 fragm. (3)
–	–	30.00–30.50 m.:	1 broken-off apex and 3 fragm. (1)
–	–	30.50–30.95 m.:	2 small fragm. (1)
–	–	30.95–31.35 m.:	5 small fragm. (1)
–	–	31.35–31.65 m.:	1 broken-off apex and 3 fragm. (1)
–	–	32.30–32.70 m.:	4 small fr. (2)
–	–	33.05–33.40 m.:	4 labrum-fr. and 4 collumella-fr. (4)
–	–	33.40–33.80 m.:	2 labrum-fr. and 1 collumella-fr. (2)
–	–	33.80–34.25 m.:	1 labrum-fr. (1)
–	–	34.25–34.70 m.:	3 labrum-fr., 2 collumella-fr. and 3 broken-off apices (3)
–	–	34.70–35.00 m.:	1 labrum-fr., 1 collumella-fr. (1)
–	–	35.00–35.30 m.:	3 labrum-fr., 1 collumella-fr. (2)
–	–	35.30–35.70 m.:	1 labrum-fr., 1 collumella-fr. (1)
Tønder	166.398	85.5 m.:	1 broken-off labrum (1)
–	–	90.0 m.:	1 broken-off labrum (1)
Hajstrup		173′–194′ :	3 fragm. (1)

Gram Clay.

Muldbjerg	83.1006	7.0 – 8.0 m.:	1 broken-off labrum (1)
Videbæk	84.1748	23.95–24.95 m.:	1 fragm. of 1 collumella (1)
–	84.358	7.2 –15.1 m.:	1 small fr. (1)
Lille Torup	85.379	16.8 –20.0 m.:	3 labrum-fragm. and 3 collumella-fragm. (3)
Gjellerup	85.380	13 –20 m.:	1 labrum-fragm. (1)
Tværmose	85.381	21.0 –25.0 m.:	1 defective shell (1)
Frølund	85.383	9.2 –17.9 m.:	1 defective shell (1)
Brande Brickworks. Clay pit:			2 defective sh. and 1 fr. (2)
Nyholm	104.1166	14.2 –15.2 m.:	1 fragm. (1)
–	–	15.2 –16.2 m.:	1 labrum-fragm. (1)
Alkærsig Brickworks. Clay pit:			1 defective shell (1)
Odderup	103.150	14.5 –20.0 m.:	1 broken-off labrum (1)
–	–	20.0 –21.0 m.:	1 labrum-fragm. and 1 collumella-fragm. (1)
Oddum. Lignite pit:			1 defective shell (1)
Hauge. Clay pit:			7 broken-off apex, 1 labrum, 21 collumella-fragm., and 14 other fragm. (20)
Tønding. Clay pit:			1 very defective shell (1)
Esbjerg. Clay pit or beach:			2 complete sh. and 1 def. sh. (3)
Måde Brickworks. Eastern clay pit:			5 complete sh. and 5 def. sh. (10)
Sønder Hygum	141.260	12 –40 m.:	6 labrum-fragm. and 1 other fragm. (6)
Gram	141.277	11.65–12.10 m.:	1 def. sh. and 1 broken-off labrum (1)
–	–	12.10–12.60 m.:	17 labrum-fr., 7 apex-fr. and 11 collumella-fr. (17)

Gram	141.277	12.60–13.10 m.:	13 labrum-fr., 6 apex-fr. and 7 collumela-fr.	(13)
–	–	13.10–13.50 m.:	11 labrum-fr., 1 apex-fr. and 8 collumela-fr.	(11)
–	–	14.00–14.60 m.:	5 labrum-fr., 1 apex-fr. and 6 collumella-fr.	(5)
–	–	14.60–15.10 m.:	1 def. sh., 8 labrum-fr., 1 apex-fr., 8 collumella-fr.	(9)
–	–	15.10–15.55 m.:	1 def. sh., 1 labrum-fr., 2 apex-fr., 1 collumella-fr.	(3)
–	–	15.55–16.00 m.:	4 labrum-fr., 1 apex-fr., 4 collumella-fr.	(4)
–	–	16.00–16.50 m.:	9 labrum-fr., 5 apex-fr., 9 collumella-fr.	(7)
–	–	16.50–17.00 m.:	2 def. sh., 1 labrum	(2)
–	–	17.00–17.50 m.:	1 labrum-fragm. and 2 other fragm.	(2)
–	–	18.50–19.00 m.:	1 labrum-fragm.	(1)
–	–	19.00–19.50 m.:	1 small def. sh.	(1)
–	–	20.00–20.50 m.:	1 def. sh.	(1)
–	–	20.50–21.00 m.:	2 def. sh., 1 labrum and 1 other fragm.	(2)
Spandet	150.184	27.0 –33.0 m.:	1 broken-off labrum	(?1)
Sæd	167.445	92.25–92.70 m.:	3 broken-off labrum-fr., rolled	(?3)
–	–	99.55–100.10 m.:	3 labrum-fragm., 2 collumella-fragm., and 1 broken-off apex	(3)

Description. The shape of the shell is ovoid-globular, with a large thickened labrum.

The protoconch, which is comparatively large, has mostly been broken off. It consists of about $1\frac{1}{2}$ smooth convex whorls. The initial whorl is sinistral and a little introflexed. Its outermost part is not visible.

The teleoconch consists of about four convex whorls increasing rather rapidly in diameter. The apex is rather pointed. The youngest whorl is highly inflated. The surface is covered by rather widely spaced spiral grooves. On the older whorls there are 5–7 grooves, and on the youngest whorl (the body whorl) they are very weak or quite obliterated. Sometimes we may see distinct prosocyrt growth lines.

Labrum is large and broad, irregularly longitudinally furrowed and smooth interiorly.

Labium spreads somewhat on to the base with a smooth callus, which is delimited by a highly oblique line. There is a prominent parietal fold and two prominent folds on the collumella. The abapical one of the latter forms the boundary of an oblique, comparatively broad spout. The aperture is auriform and tapers highly adapically.

Remarks. This species is extremely common in certain beds of the Arnum Formation. SORGENFREI (1958) has investigated its variation thoroughly and has given a detailed account of the relation of the species to other *Ringicula* species.

Very few shells in a good state of preservation are known from the Hodde Clay and the Gram Clay, mainly the pictured two shells, only, the dimensions of which appear from the legend of Plate XXV.

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Hodde Formation, Gram Formation. North Germany: Hemmoor-Stufe (KAUTSKY: *R. auriculata ventricosa* SOW.), Reinbek-Stufe (ANDERSON), Glimmerton at Breklum (STRUCK 1908), Langenfelde (GOTTSCHE 1876), Elbtunnel (HORN), and Lüneburg (MÜLLER) (from all these deposits *R. auriculata* (MÉNARD) is recorded). Belgium: Boldérien, Anversien (GLIBERT). – Plio-Pleistocene. Belgium: Scaldisien (GLIBERT). England: Coralline Crag and Red Crag (S. V. WOOD).

Atlantic Region. Aquitanian Basin: Helvétien (COSSMANN & PEYROT). Portugal: Miocène (DA COSTA). Recent from the Bay of Biscay to Madeira and the Canary Islands (WEINKAUFF).

Mediterranean Basin. Italy: Elveziano (?), Tortoniano, Piacenziano, Astiano (SACCO). Spain (Cataluna): Placenciense (ALMERA Y BOFILL). – Recent (WEINKAUFF).

Vienna Basin. Austria: Grund, Baden (HÖRNES). – Hungary: "Miozän-Mediterran" (STRAUSZ: *Ringicula auriculata buccinea*).

Two small, defective shells from Gram, bore-hole 141.277, from 20.00–20.50 m. and 20.50–21.00 m., respectively, are considerably slenderer than the other *Ringicula* shells from the Gram Clay. Furthermore, their surface is sculptured with well marked spiral ribs. Both specimens lack the region round the aperture with the labrum (see picture Plate XXVI, fig. 6).

Presumably the shells belong to the species *R. buccinea*, as they agree with specimens of this species from the Arnum Formation. On the other hand, it is remarkable that they differ in the characters mentioned from the other shells of *R. buccinea* in the Gram Clay, and that this commonest form has also been found in the same depth intervals at Gram.

FAMILIA: DIAPHANIDAE

Genus: *Diaphana* T. BROWN 1837
(Type: *Diaphana minuta* BROWN 1837)

Diaphana moerchi nov. sp.
Plate XXVI, figs. 7–10

Diagnosis: A *Diaphana* with a short and broad shell, the adapical part of which may be more or less concave.

Derivatio nominis: Named in honour of the Danish conchyliologist O. A. L. MØRCH (1828–1878), who was the first Danish scientist to describe molluscs from the Gram Formation of Denmark.

Holotype: The shell pictured in Plate XXVI, figs. 7–8, is chosen as holotype. Locus typicus: Gram. Bore-hole D.G.U. File No. 141.277. Depth: 9.50–9.90 m. Stratum typicum: Gram Clay. Age: Upper Miocene. Depository: Danmarks Geologiske Undersøgelse, Charlottenlund.

Material. Gram Clay.

Muldbjerg	83.1006	5.0 – 6.0 m.:	1 def. shell
–	–	7.0 – 8.0 m.:	1 rather complete sh.
Odderup	103.150	20.0 –21.0 m.:	1 small, def. sh.
Hauge. Clay pit:			1 small, def. sh.
Tønding. Clay pit:			1 small, def. sh.
Gram	141.277	9.50– 9.90 m.:	1 rather complete sh.
–	–	11.25–11.65 m.:	1 small, rather whole sh.
–	–	12.60–13.10 m.:	1 def. sh.
–	–	13.10–13.50 m.:	1 slightly def. sh.
–	–	16.00–16.50 m.:	2 small def. sh.
–	–	17.00–17.50 m.:	1 small def. sh.

Description. The shell is small, thin, cylindrical, with a long diameter in relation to the fairly short axis of the shell.

The axis is depressed in relation to the last whorl, so that the adapical part of the shell seems quite flat when the shell is viewed sidewise (cf. Plate XXVI, fig. 7). The initial whorl is rather large, vesicular, and smooth. It is followed by a smooth whorl, which shows only the adapical, rounded edge. The next whorl, i.e. the body whorl, completely dominates the visible part of the shell. It is convex and smooth. Adapically there is often a slightly convex zone, which at the top ends in a rounded-off edge, from which the surface of the whorl slopes down towards the circular depression in the middle of which the apex is situated.

The aperture is narrow adapically and extended abapically. Adaxially and abapically it forms a convex curve, while adaxially it has a concave contour on the adapical part and a more convex contour on the abapical part. Labrum rises a little above the flat adapical end of the shell. On the shells available the outermost part and the whole of the abapical part have been broken off.

There is a comparatively wide umbilicus between the short, sharp-edged and erect inner lip and the base of the shell.

Remarks. Most shells from the Gram Clay have the appearance described above. From Muldbjerg (Bore-hole 83.1006. Depth: 7.0–8.0 m.) originates a more extreme form, which has a broad, concave area on the adapical part of the shell and an adapical edge which rises fairly high above the depressed apex (cf. Plate XXVI, figs. 9–10). As the shell in its other characters corresponds to the type described above, it is presumably a question of a more extreme form of this type.

All the specimens available are full of pyrite and are already more or less destroyed.

It seems that *D. moerchi* compares best with the recent *D. hyalina* (TURTON), which is known i.a. from the northern seas off Norway (SARS) and the seas round Great Britain (JEFFREYS). This species, however, has fine spiral lines on the adapical part of the shell.

As the specimens from the Gram Clay perhaps are all juvenile shells, we must await further findings before it is possible to clear up the problem of the appearance of the species and its relation to other species completely.

Measurements. The dimensions of the two shells pictured are as follows:

Locality		Depth	Length of preserved shell	Maximum diameter	Diameter of adapical delimitation
Gram	141.277	9.50–9.90 m.	1.5 mm.	1.5 mm.	0.9 mm.
Muldbjerg	83.1006	7.0 –8.0 m.	2.3 –	1.8 –	0.9 –

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation.

FAMILIA: ACERIDAE

Genus: *Acera* MÜLLER 1776

(Type: *Acera bullata* MÜLLER 1776)

Acera bellardii (V. KOENEN 1882)

Plate XXVI, figs. 11–12

1882. *Bulla Bellardii* – V. KOENEN, Mioc. Nordd. II, p. 346, Pl. VII (VI), f. 10a, b.
1925. *Acera Bellardi* V. KOEN. – KAUTSKY, Hemmoor, p. 198, Pl. 12, f. 26–27.
1958. *Cylichna Bellardii* (VON KOENEN) – SORGENFREI, Middle Mioc., p. 343.
1964. *Tornatina bellardii* (KOENEN) – ANDERSON, Reinbek-Stufe, p. 332, Pl. 50, f. 298.

Material. Hodde Clay.

Odderup	103.150	24.8–25.6 m.:	1 def. sh.	(1)
Måde Brickworks. Eastern clay pit:			2 def. sh.	(2)
Hajstrup	167.235	174′–194′ :	10 fragm.	(6)
–	–	214′–234′ :	1 def. sh.	(1)

Description. The shell is cylindrical, tapering a little at the abapical end, thick-walled.

The region of the apex is defective on the shells available. On shells from Twistringen (North Germany) the apex is seen to be raised a little above the rest of the shell, but on these shells, too, the region of the apex is somewhat defective. The large last whorl completely dominates the visible part of the shell. The whorl is practically flat, but on the adapical part there is a narrow

zone where the surface of the shell curves inward towards the axis of the shell.

The surface is sculptured by numerous, rather close-set, very thin spiral grooves, which take a slightly undulate course in certain places and which especially stand out on the adapical part of the whorl. They are crossed by numerous only slightly visible, very fine collabral growth lines. When magnified (50 times) some few of the shells show that the two sculpture elements cover the surface of the shell as a fine, regular network.

The aperture forms rather a narrow, oblong opening, which widens abapically.

Labrum has been broken off the present shells. The collumella is callous on the abapical part. Furthermore, there are two oblique, well-marked folds.

Measurements. See information in the legend of Plate XXVI, figs. 11–12.

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Hodde Formation. North Germany: Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (Anderson).

FAMILIA: SCAPHANDRIDAE

Genus: *Cylichna* LOVÉN 1846

(Type: *Bulla cylindracea* PENNANT 1777)

Cylichna cylindracea (PENNANT 1777)

1956. *Cylichna* (*Cylichna*) *cylindracea* (PENNANT) – RASMUSSEN, South Jutland, p. 104, Pl. X, f. 4a, b.

1958. *Cylichna cf. cylindracea* (PENNANT) – SORGENFREI, Middle Mioc., p. 342, Pl. 74, f. 251a–c.

1964. *Cylichna cylindracea* (PENNANT) – ANDERSON, Reinbek-Stufe, p. 333, Pl. 51, f. 300.

Material. Gram Clay.

Brande Brickworks. Clay pit:			1 slightly def. sh.	(1)
Odderup Brickworks	103.150	14.5–20.0 m.:	2 def. sh.	(2)
Hauge. Clay pit:			1 def. sh. and 1 fragm.	(1)
Gram	141.277	13.10–13.50 m.:	1 def. sh.	(1)
–	–	14.60–15.10 m.:	1 juvenile def. sh.	(1)
Spandetgård. Clay pit:			1 almost whole sh., 2 def. sh., 5 apex fragm., 8 fragm.	(8)
Sæd	167.445	92.00–92.25 m.:	1 def. sh.	(1)

Description. As the material is mainly very fragmentary, I have nothing to add to my mention of the species in 1956.

Distribution.

North Sea Basin. Miocene. Denmark: Klintinghoved Clay, Arnum Formation (SORGENFREI), Gram Formation. North Germany: Vierland-Stufe (GRIPP), Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON), Glimmerton in Morsum Kliff, Sylt (RAVN). Belgium: Houthaléen, Anversien (GLIBERT). – Plio-Pleistocene. England: Coralline Crag, Red Crag (S. V. WOOD), Lenham Crag, Waltonian, Newbournian (HARMER). – Recent (JEFFREYS).

Atlantic Region. Portugal: Helvétien, Tortonien (DOLLFUS, COTTER & GOMES). – Recent (WEINKAUFF).

Mediterranean Basin. Italy: Elveziano, Tortoniano, Piacenziano, Astiano (SACCO), Quaternaire (GIGNOUX), Upper Pliocene at Monte Mario (CERULLI – IRELLI). – Recent (WEINKAUFF).

Vienna Basin. Austria: Steinabrunn (HÖRNES). – Hungary: "Miozän-Mediterran" (STRAUSZ: *C. cylindracea convoluta, C. cylindracea subcylindracea*).

FAMILIA: RETUSIDAE

Genus: *Retusa* BROWN 1827
(Type: *Bulla obtusa* MONTAGU 1803)

Retusa elongata (EICHWALD 1830)

1956. *Retusa* (*Cylichnina*) *elongata* (EICHWALD) – RASMUSSEN, South Jutland, p. 103, Pl. X, f. 3a, b.
1958. *Retusa elongata* (EICHWALD) – SORGENFREI, Middle Mioc., p. 345, Pl. 74, f. 254a–c.
1964. *Retusa elongata* (EICHWALD) – ANDERSON, Reinbek-Stufe, p. 335, Pl. 51, f. 303, 303a.

Material. Hodde Clay.

Leding	93.155	27–28 m.:	7 fragments

Gram Clay.

Shell material probably belonging to this species is available from the following localities (see Part I, Tables 15–66):

Brejning Kro (83.197), Kodal-Fjaldene (84.1749), Videbæk (84.1748, 84.1727), Møltrup Brickworks (clay pit), Lille Torup (85.379), Frølund (85.383), Gjødstrup (85.861), Vester Høgild (95.1510b), Brande Brickworks (clay pit), Drantum (104.1241), Nyholm (104.1166), Hjortsballe (105.320), Lønborg (102.55), Odderup (103.150), Hesselho (113.121), Hauge (clay pit), Tønding (clay pit), Esbjerg (unknown locality), Måde Brickworks (eastern clay pit), Holleskov (132.46b), Ravning (clay pit), Hjortvad (141.178), Sønder Hygum (141.260, 141.261, 141.273), Rødding (141.75), Gram (141.277), Spandetgård (clay pit), Brodersmark (166.351b), Sæd (167.4, 167.445), and Rends (167.236).

Description. The form of the shell is almost conical.

The apex is depressed and on the uppermost part of the shell forms an umbilicus, which is demarcated by a sharp edge. Only the youngest whorl is

visible. Its surface is more or less slightly convex and partly covered by thin spiral grooves, which mostly are visible only at the two ends of the shell, whereas the middle region is smooth. Furthermore, many fine, curved growth lines are seen.

On the adapical two thirds of the youngest shell the aperture is delimited by parallel sides, which, however, diverge towards the abapical aprt, so that it forms an oblong oval.

Labrum forms a simple, sharp, somewhat curved edge, parallel to the growth lines. Adapically the edge round the umbilical opening rises somewhat above the opening and then continues in the labrum, which at the base passes evenly into the smooth, rectilinear inner lip. Between this and the base a pseudumbilicus is seen.

Measurements. The measures of small specimens from Regions I, II, and III are adduced here as examples of the dimensions of the shell. All fairly complete shells are very small, but fragments of somewhat larger shells have been found.

			Length	Maximum diameter	Diameter of the apical umbilicus
Gjødstrup	85.861	57.00 m.:	1.3 mm.	0.8 mm.	0.2 mm.
Vester Høgild	95.1510b	3.9– 5.7 m.:	3.4 –	1.8 –	0.6 –
Drantum	102.1241	36.0–40.0 m.:	2.4 –	1.3 –	0.3 –
–	–	– :	1.0 –	0.9 –	0.2 –
Odderup	103.150	14.5–20.0 m.:	1.7 –	0.9 –	0.3 –

Remarks. It seems that the whole material from the Hodde Clay and the Gram Clay should be referred to *R. elongata*. *R. umbilicata* (MONTAGU) resembles it in shape, but has no spiral grooves.

It should be noted that on none of the shells so many spiral grooves are seen as on SORGENFREI's figure, where they are also found on the middle region.

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Hodde Formation, Gram Formation. North Germany: Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON), Glimmerton in Morsum Kliff, Sylt (RAVN). Belgium: Anversien (GLIBERT).

Atlantic Region. Aquitanian Basin: Burdigalien, Helvétien, Tortonien (COSSMANN & PEYROT). Portugal: Helvétien, Tortonien (DOLLFUS, COTTER & GOMES).

Mediterranean Basin. Italy: Elveziano, Tortoniano, Piacenziano, Astiano (SACCO).

Vienna Basin. Austria: Steinabrunn and Baden (HÖRNES). – Hungary: "Miozän-Mediterran" (STRAUSZ).

Poland: Miozän (FRIEDBERG).

Genus: *Scaphander* MONTFORT 1810
(Type: *Bulla lignaria* LINNÉ 1758)

Scaphander lignarius (LINNÉ 1758)

1758. *Bulla lignaria*. – LINNÉ, Systema naturæ. Edit. X, p. 727.
1848. *Bulla lignaria* LINNÉ. – WOOD, Crag Moll. I p. 173, Pl. XXI, f. 8a–b.
1853. *Scaphander lignarius* LINNÆUS – FORBES & HANLEY, Brit. Moll. III, p. 536, Pl. 114F, f. 3.
1856. *Bulla lignaria* LINNÉ. – HÖRNES, Wienerbecken I, p. 616, Pl. 2, f. 1.
1867. *Scaphander lignarius* LINNÉ – JEFFREYS, Brit. Conch., IV, p. 443; V (1869), Pl. XCV, f. 5.
1868. *Scaphander lignarius* LINNÉ – WEINKAUFF, Conch. Mittelmeeres, II, p. 192.
1878. *Scaphander lignarius* LINNÉ – SARS, Moll. Arct. Norveg., p. 292, Pl. 18, f. 7; Pl. 26, f. 4.
1886. *Scaphander lignarius* LINNÉ sp. – BUCQUOY, DAUTZENBERG & DOLLFUS, Roussillon, I, p. 536, Pl. 63, f. 1–3.
1897. *Scaphander lignarius* (L). – SACCO, I. Molluschi, XXII, p. 43, Pl. III, f. 94–112.
1914. *Scaphander lignarius var. Grateloupi* MICH. – GRIPP, Itzehoe, p. 36.
1921. *Scaphander lignarius* (LINNÉ). – HARMER, Plioc. Moll. II, p. 806, Pl. LXIII, f. 14, 15.
1925. *Scaphander lignarius* L. *var. Grateloupi* MICH. – KAUTSKY, Hemmoor, p. 198.
1932. *Scaphander lignarius* LINNÉ *mut. Grateloupi* MICH. – COSSMANN & PEYROT, Conch. Néog., A.S.L.B. LXXXIV, 2 fasc., p. 202, Pl. XII, f. 15, 17–21.
1940. *Scaphander lignarius* L. *var. Grateloupi* MICH. – SORGENFREI, Klintinghoved, p. 57, Pl. VI, f. 19.
1952. *Scaphander* (*Scaphander*) *grateloupi* MICHELOTTI *sp.* – GLIBERT, Mioc. Belg. II, p. 146, Pl. X, f. 17.
1958. *Scaphander lignarius* (LINNÉ). – SORGENFREI, Middle Mioc., p. 349.
1964. *Scaphander grateloupi* (MICHELOTTI) – ANDERSON, Reinbek-Stufe, p. 335, Pl. 51, f. 302.

Material. Gram Clay.

Måde Brickworks. Eastern clay pit. Unknown horizon: 1 defective shell

Description. The present specimen is very incomplete and actually consists of a cast of clay, only, which indicates the form of the shell, and on which there are some remnants of the shell itself.

Both the form and the spiral sculpture show with certainty that the specimen belongs to *S. lignarius*. It must have been a little more than 1 cm. in length.

Remarks. From the Gram Clay found in several localities there are some fragments available with a spiral sculpture corresponding to that of this species. Very possibly it is in these cases a question of remnants of *S. lignarius*.

Distribution.

North Sea Basin. Miocene. Denmark: Klintinghoved Clay (SORGENFREI), Arnum Formation (SORGENFREI), Gram Formation. North Germany: Vierland-Stufe (GRIPP), Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON).

Atlantic Region. Portugal: Helvétien, Tortonien (DOLLFUS, COTTER & GOMES). – Hungary: "Miozän-Mediterran" (STRAUSZ). South Germany (Bavaria): Burdigal (HÖLZL: *S. lignarius grateloupi*).

Genus: *Roxania* (LEACH) GRAY 1847

(Type: *Bulla utricula* BROCCHI 1814)

Roxania utriculus (BROCCHI 1814)

1814. *Bulla utriculus* – BROCCHI, Conch. subapp. II, p. 633, Pl. I, f. 6.
1856. *Bulla utricula* BROCC. – HÖRNES, Wienerbecken I, p. 618, Pl. I, f. 2.
1867. *Bulla utriculus* BROCCHI – JEFFREYS, Brit. Conch. IV, p. 440; V (1869), Pl. XCV, f. 4.
1868. *Bulla utriculus* BROCCHI – WEINKAUFF, Conch. Mittelm., II, p. 189.
1882. *Bulla* (*Atys*) *utriculus* BROC. – v. KOENEN, Mioc. Nordd. II, p. 338.
1897. *Roxania utriculus* (BR.). – SACCO, I Molluschi XXII, p. 45, Pl. III, f. 127–134.
1907. *Atys utriculus* BROCCHI sp. – RAVN, Jylland, p. 367 (163), Pl. VIII, f. 13.
1910. *Roxania utriculus* BR. sp. – CERULLI – IRELLI, Fauna mal. mariana, p. 36, Pl. IV, f. 8–9.
1913. *Atys utriculus* BROCCHI sp. – HARDER, Aarhus, p. 103, Pl. IX, f. 26.
1914. *Atys utriculus* BROCC. – GRIPP, Itzehoe, p. 35,
1916. *Atys utriculus* BROC. sp. – NØRREGAARD, Esbjerg, p. 36.
1925. *Roxania utriculus* BROCCH. – KAUTSKY, Hemmoor, p. 200.
1932. *Roxania subutricula* D'ORBIGNY – COSSMANN & PEYROT, Conch. Néog. A.S.L.B. LXXXIV, 2 fasc., p. 193, Pl. XII, f. 43, 48.
1940. *Roxania utriculus* BROCCHI – SORGENFREI, Klintinghoved, p. 58.
1952. *Sabatia* (*Damoniella*) *utricula* BROCCHI sp. – GLIBERT, Mioc. Belg. II, p. 145, Pl. X, f. 16.
1958. *Roxania utriculus* (BROCCHI) – SORGENFREI, Middle Mioc., p. 350, Pl. 76, f. 260a–b.
1964. *Roxania utriculus* (BROCCHI) – ANDERSON, Reinbek-Stufe, p. 334, Pl. 51, f. 301.

Material. Hodde Clay.

Leding 93.155 Unknown depth: 1 defective shell.

Description. The shell is comparatively small, globular, with spiral grooves all over the surface. They are, however, most close-set at the two ends of the shell. The spiral grooves have been disintegrated into numerous dots.

Because of the fragmentary state of the shell, it is not possible to offer an all-embracing description. Reference may be made to the literature cited, especially the most recent of SORGENFREI's works.

Distribution.

North Sea Basin. Oligocene. Denmark: Upper (HARDER). North Germany: Upper (SPEYER 1870). – Miocene. Denmark: Klintinghoved Clay, Arnum Formation (SORGENFREI), Hodde Formation. North Germany: Vierland-Stufe (GRIPP), Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (ANDERSON), Glimmerton in Morsum Kliff, Sylt (v. KOENEN), and the Elbtunnel (HORN). Belgium: Houthaléen, Anversien (GLIBERT).

Atlantic Region. Portugal: Helvétien, Tortonien (DOLLFUS, COTTER & GOMES). Recent from the coasts of Norway to the Canary Islands (JEFFREYS).

Mediterranean Basin. Italy: Elveziano, Tortoniano, Piacenziano, Astiano (SACCO), Upper Pliocene at Monte Mario (CERULLI – IRELLI) – Recent (WEINKAUFF).

Vienna Basin. Austria: Baden, Steinabrunn (HÖRNES). – Hungary: "Miozän-Mediterran" (STRAUSZ).

ORDO: PTEROPODA

FAMILIA: SPIRATELLIDAE THIELE 1931

Genus: *Spiratella* BLAINVILLE 1817

(Type: *Spiratella helicina* PHIPPS 1774)

Spiratella valvatina (REUSS 1867)

Plate XXVII, figs. 1–3, and 11

1882. *Spirialis valvatina* REUSS – v. KOENEN, Mioc. Nordd. II, p. 357.
1886. *Spirialis valvatina* REUSS – KITTL. Mioc. Pterop., p. 69, Pl. II, f. 38.
1914. *Spirialis valvatina* REUSS – GRIPP, Itzehoe, p. 36.

Description. The shell is small, thin-walled, half transparent, helicoid, with a low apex and smooth, highly convex whorls, which fairly soon increase in diameter. The number of whorls is 4–5. They are smooth, sometimes with slightly visible growth lines, which are first orthocline, but on the base bend in a very oblique direction towards the umbilicus, with the edge of which they form a very acute angle. Immediately below the adapical suture the whorls are rather flat in a narrow zone, before they become convex. The sutures are deep-set.

The base is convex and the aperture is almost semilunular.

Umbilicus is deep, circular.

Remarks. The species is common in the Hodde Clay, where, as a rule, only pyrite casts are found. The height of the apex varies somewhat.

Dimensions. See legend of Plate XXVII.

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Hodde Formation. North Germany: Vierland-Stufe (GRIPP), Hemmoor-Stufe (KAUTSKY), Reinbek-Stufe (HINSCH), Glimmerton at Langenfelde and Gühlitz (?) (v. KOENEN). Belgium: Anversien (GLIBERT).

Spiratella atlanta (MØRCH 1874)

Plate XXVII, figs. 8–10

1956. *Spiratella atlanta* (MØRCH) – RASMUSSEN, South Jutland, p. 105, Pl. X, f. 7a, b, c.
1958. *Spiratella atlanta* (MØRCH) – SORGENFREI, Middle Miocene, p. 352.

Material. All specimens are more or less defective. Often there are only a few or no remnants of shells on a cast of pyrite.

Shell material is available from the following localities (see Part I, Tables 10–66):

Hodde Clay.

Gram (141.277), and Sønder Hygum (141.215).

Gram Clay.

Skærum Mølle (clay pit), Aulum (74.321), Grønbjerg Brickworks (clay pit), Spjald (83.127), Randbæk (83.597), Brejning Kro (83.197), Muldbjerg (83.1006), Kodal-Fjaldene (84.1749), Videbæk (84.1748, 84.344, 84.358, 84.456, 84.483, 84.492, 84.525, 84.1727), Møltrup Brickworks (clay pit), Lille Torup (85.379), Tværmose (85.381), Frølund (85.383), Gjødstrup (85.861), Snejbjerg (85.775), Bording (86.177), Vester Høgild (95.1510b), Fasterholt Plantage (95.849), Drantum (104.1241), Nyholm (104.1166), Store Langkjær (104.1158), Hjortsballe (105.320), Skjerris gårde (104.1165), Leding (93.155), Alkærsig (93.101), Lønborg (102.55), Odderup (103.150), Ålbæk Eng (102.59), Hesselho (113.121), Hauge (clay pit), Tønding (clay pit), Hodde (113.33a), Måde Brickworks (eastern clay pit), Brøstrup (141.224), Rojbøl (141.194), Tiset (141.244), Holleskov (132.46b), Ravning (clay pit), Hjortvad (141.178), Lintrup (132.140), Sønder Hygum (141.260, 141.261, 141.273), Rødding (141.75, 141.76, 141.243), Gram (141.277), Spandetgård (clay pit), Spandet (150.184), Tønder (166.398), Brodersmark (166.351b), Sæd (167.4a, 167.445), and Rends (167.236).

Description. The shell is small, thin, semitranslucent, planorbid. The apex is very low. The oldest whorls are only comparatively slowly increasing in diameter. The youngest whorl has a considerably longer diameter, is highly convex, and rises somewhat above the apex, which in this way comes to hold a central position in a circular depression. Umbilicus is very broad, circular, tapering inward in the shell (adapically). The older whorls are visible in the opening.

The aperture is regularly semicircular.

Dimensions. See legend of Plate XXVII.

Distribution.

North Sea Basin. Miocene. Denmark: Arnum Formation (SORGENFREI), Hodde Formation, Gram Formation. North Germany: Reinbek-Stufe (ANDERSON), Glimmerton in Morsum Kliff, Sylt (RAVN), Langenfelde, Lüneburg (v. KOENEN), and the Elbtunnel (HORN).

Spiratella gramensis nov. sp.
Plate XXVII, figs. 4–7

Diagnosis. A relatively large *Spiratella* of variable shape, with a more or less drawn-out apex and often with the axis longer than the diameter.

Derivatio nominis: *gramensis*, i.e. from Gram (in South Jutland, Denmark). The only finding-place of the species so far.

Holotype. The shell pictured in Plate XXVII, figs. 4, 5, 6, and 7, is the holotype. Locus typicus: Boring D.G.U. File No. 141.277 at Gram Brickworks. Depth: 21.00–21.50 m. Stratum typicum: Gram Clay. Age: Upper Miocene. Depository: Danmarks Geologiske Undersøgelse, Charlottenlund, Denmark.

Material. Gram Clay.

Gram	141.277	18.00–18.50 m.:	3 def. sh.	(3)
–	–	18.50–19.00 m.:	6 def. sh.	(6)
–	–	19.50–20.00 m.:	2 almost complete and 10 def. sh.	(12)
–	–	20.00–20.50 m.:	8 almost complete sh.	(8)
–	–	21.00–21.50 m.:	45 more or less complete shells	(45)
–	–	21.50–22.00 m.:	2 def. sh.	(2)

Description. The shell is small, thin, semitranslucent, ovoid-pupiform, sinistral, consisting of 5–6 whorls. The colour is whitish or, mostly, blueish. The apex is somewhat drawn-out, with a flat end. There is rather a great variation as regards the height of the spire and the shape of the shell, there being both helicoid, pupiform, and turbiniform shells.

The whorls are smooth, convex, and rather slowly increasing in diameter. The sutures are rather deep-set. The aperture is oval or ear-shaped. A deep, narrow umbilicus is found in the centre of the base, immediately within the abapical corner of the aperture.

Remarks. This species does not seem to have been described previously. It may be identical with the form described by KITTL (1886, p. 68, Plate II, fig. 37) from Glimmerton at Langenfelde under the name of *Spirialis Koeneni* KITTL. This description, however, has only been made on the basis of two slightly defective casts, for which reason it will be almost impossible to decide whether KITTL's species is identical with *S. gramensis.*

The species thus is so far known from Gram, only. It is larger than the other *Spiratella* species in the Hodde Clay and the Gram Clay.

Measurements.

Length	Diameter
1.5 mm.	1.2 mm.
1.1 –	0.9 –
1.1 –	0.8 –
1.2 –	1.0 –
1.0 –	0.9 –
1.3 –	1.3 –
0.8 –	0.8 –
0.9 –	0.9 –
0.9 –	0.9 –
0.9 –	1.0 –

Distribution.

North Sea Basin. Miocene. Denmark: Gram Formation.

GASTROPODA NON DETERMINATA

Gastropoda non det. 1

Plate IX, figs. 1–4

Material. Gram Clay.

Muldbjerg	83.1006	8.0 – 9.0 m.:	1 shell
Gram	141.277	17.00–17.30 m.:	1 def. shell

Description. The shell is very small, turbiniform, thin, almost as high as broad. The protoconch is paucispiral, consisting of a comparatively large, vesicular whorl. The whorls of the teleoconch are highly convex, smooth, separated by deep-set sutures, rather soon increasing in diameter. The base is convex. The aperture is oval, pointed adapically. The labrum and the inner lip are sharp-edged, in part broken off the shells available. Between the inner lip and the base there is a broad umbilical groove, continuing in a deep umbilicus. The groove is delimited from the base by a sharp edge. On the base of the shell pictured two broad, parallel, spiral colour zones are seen. The abapical (or adaxial) one of these zones is yellowish, the other is greyish. This may be a case of primary colouring.

Remarks. The present species may be new. Because of the poor material it is not possible to define a particular species.

The genus is also doubtful. The shell reminds me of the Archaegastropod genus *Cyclostrema.* Some features also resemble shell characters of the Arctic genus *Trachysma* and genus *Jeffreysia.*

Gastropoda non det. 2

Plate VIII, figs. 1–2

Material. Gram Clay.

Hesselho	113.121	50.0–56.0 m.:	1 shell

Description. The shell is just as high as broad. The protoconch consists of a single large, vesicular, slightly sinistral, and smooth whorl. The teleoconch comprises about $1\frac{1}{2}$ whorl on the present shell. There is both a spiral and a collabral sculpture. Immediately after the smooth protoconch three spiral threads make their appearance: one on the periphery of the whorl and two others between this and the adapical suture. These spiral threads become somewhat more prominent. The most adapical one of them, however, is somewhat fainter than the two others. Abapical to the periphery there are later 3–4 faint spiral threads, and on the base, too, some faint spiral threads are seen. On the youngest section of the shell there is a faint spiral thread between the two most prominent ones. The spiral sculpture is crossed by some 20 collabral ribs, which are rather narrow and form small knobs at the passage

across the spiral ribs. The aperture is circular. The base is partly destroyed by pyrite. The shell contains nacre. – The present shell is probably juvenile.

Remarks. It has not been possible to identify the shell with any known species. Its juvenile character, however, prevents its being excluded that it has not already been described.

Gastropoda non det. 3

Plate XII, fig. 7

Material. Gram Clay.

Gram 141.277 6.90–7.30 m.: 1 juvenile shell

Description. The present juvenile shell is fusiform-ovoid.

The protoconch is conical, multispiral, comprising 3½ whorl. The initial whorl is small, a little inflated, and slightly sinistral, depressed a little abapically and provided with many rows of close-set, faint, punctiform depressions, which can be seen at 50 magnification. It is followed by 1½ smooth, highly convex, medial whorls, and finally a whorl covered by 7–8 very faint spiral bands. The sutures are deep-set.

The teleoconch is barely present. After the protoconch there is ¼ whorl with 8–9 faint, very narrow collabral folds, which are only visible on the adapical part of the whorl. On the last whorl 17 spiral threads are seen. They cover the whorl right on to the neck of the canal. The growth lines are extremely slightly sigmoid.

The aperture is oblong oval, passing evenly into the siphonal canal, which is short and narrow. The labrum has been broken off. The inner lip is smooth.

The shell is full of pyrite and has cracked in several places.

Measurements. The shell shows the following dimensions:

Length: 2.8 mm. Maximum diameter: 1.7 mm. Length of the aperture: 1.8 mm.

Diameter of the protoconch: 1.1 mm. Diameter of the initial whorl: 0.3 mm.

Gastropoda non det. 4

Plate XXVII, figs. 12–13

Material. Gram Clay.

Gram 141.277 9.90–11.30 m.: 1 shell

Description. The shell is small, juvenile and fragmentary, consisting of 2¼ whorls.

The protoconch is deviated paucispiral and partly covered by the oldest adult whorl. This is apparently smooth, but under high magnification seems to be sculptured by numerous dotted spiral furrows all over the shell-surface. The aperture is oval, delimited by a sharp margin. On the base is an umbilicus.

Remarks. Neither the genus nor the species of the shell has been identified.

DANSK SAMMENDRAG

De danske marine yngre miocæne formationers molluskfaunaer og biostratigrafi

II. Palæontologi

Indledning

Dette bind slutter sig nær til Part I, som udkom i 1966, og det var oprindelig tanken, at de to bind skulle udkomme på samme tid. Det danske manuskript var afsluttet samtidig med Part I, men af økonomiske grunde var det imidlertid ikke muligt at trykke de to dele samtidig.

Bindet indeholder udelukkende beskrivelser og afbildninger af de pelecypoder, scaphopoder og gastropoder, der er fundet i Hodde leret og Gram leret i Danmark. Lister over de omtalte former findes i Part I, Tabel 13 (Hodde lerets mollusker) og Tabel 67 (Gram lerets mollusker). Arterne er omtalt under de samme navne som i disse lister, dog med enkelte undtagelser, nemlig:

Volsella phaseolina	er erstattet med	*Modiolus phaseolinus*
Astarte goldfussi	– – –	*Astarte gracilis*
Goodallia angulata	– – –	*Astarte* (*Goodallia*) *angulata*
Goodallia esbjergensis	– – –	*Astarte* (*Goodallia*) *esbjergensis*
Codokia jutensis	– – –	*Codakia jutensis*
Chione multilamella	– – –	*Venus multilamella*
Limatula subauriculata	– – –	*Lima* (*Limatula*) *subauriculata*
Semicassis miolaevigata	– – –	*Phalium* (*Semicassis*) *miolaevigatum*
Nassa – genusnavnet	– – –	*Hinia*
Peratotoma hosiusi	– – –	*Asthenotoma gliberti*
Philbertia reticulata	– – –	*Philbertia cordieri*

Blandt de beskrevne arter er følgende fire nye for videnskaben:

Solariella jutensis
Asthenotoma ravni
Diaphana moerchi
Spiratella gramensis

Til disse nye arter kommer yderligere tre andre nye arter, som blev beskrevet i Part I, nemlig: *Astarte* (*Goodallia*) *esbjergensis*, *Hinia slieswicia* og *Neoguraleus sæthensis*. Disse arter spiller en så vigtig biostratigrafisk rolle, at de nødvendigvis måtte beskrives i Part I. De er derfor kun nævnt i nærværende bind med henvisning til Part I.

Artsbeskrivelserne

Identifikationen

Beskrivelserne af de enkelte arter er som regel ret indgående, til trods for, at de fleste tidligere har været beskrevet i den udenlandske litteratur. Det har været hensigten at beskrive de enkelte arter sådan som de ser ud i de danske formationer. Desuden har kun de færreste været beskrevet på engelsk tidligere.

Identifikationen af arterne fra lokalitet til lokalitet må betragtes som i det store og hele sikker. Desuden er identifikationen med de arter, som kendes fra de nordtyske lokaliteter omtrent lige så sikker. Derimod er identifikationen med de arter, som er opstillet fra det mediterrane neogen mindre sikker, så længe der ikke er udført sammenligninger med typeeksemplarerne og så længe de pågældende arters variation i de forskellige aflejringsområder ikke er bedre kendt, end tilfældet er i dag.

Der er i forbindelse med undersøgelserne af det danske materiale foretaget sammenligninger med materiale fra udenlandske neogen-lokaliteter, især nordtyske. Derimod er der kun i få tilfælde foretaget sammenligninger med selve typeeksemplarerne af de arter, som er opstillet fra det nordtyske neogen. Det har imidlertid været en stor hjælp ved en sikker identifikation, at sådanne studier har været foretaget af H.-J. ANDERSON og andre tyske forskere på materiale fra lokaliteter, jeg selv har besøgt og foretaget indsamlinger på (Twistringen, Morsum Kliff) eller på allerede foreliggende materiale, tyske geologer selv har identificeret og etiketteret (Langenfelde, Reinbek).

Et særligt problem er identificeringen af visse miocæne arter med recente arter. Der kan her naturligvis kun være tale om sammenligning med selve skallerne, og selv om det må fremhæves, at der ikke har kunnet påvises nogen forskel mellem de miocæne og de recente skaller af de pågældende arter, må der være en vis tvivl tilbage, om der er fuldstændig identitet. Neo-malakologerne vil her, måske med rette, have grund til kritik af denne fremgangsmåde, men jeg har ikke ment at burde se bort fra mine iagttagelser, der går ud på, at ligheden mellem de miocæne og recente skaller hos de pågældende arter forekommer mig så udpræget, at der ikke har været nogen rimelig grund til at beskrive dem under et andet navn. Fremtidige undersøgelser vil muligvis ændre dette forhold.

Beskrivelserne

Beskrivelserne af de enkelte arter følger det sædvanlige skema:

1) *Synonymlister.* I de tilfælde, hvor der findes en synonymliste for den pågældende art hos RASMUSSEN 1956 eller SORGENFREI 1958 henvises til disse arbejder for den ældre litteraturs vedkommende.

For hvert enkelt værk er anført forkortelser, som kan findes under den pågældende forfatter i litteraturlisten.

2) *Originaldiagnoser*. Sådanne er i visse tilfælde anført, dog kun for så vidt de ikke allerede er gengivet hos RASMUSSEN 1956 eller SORGENFREI 1958.

3) *Typer*. Angivelser af holotyper, typelokaliteter (locus typicus), typeaflejringer (stratum typicum) og opbevaringssted findes hos de fleste af de arter, hvortil der er anført en original diagnose.

4) *Materiale*. Der er i de fleste tilfælde givet en udtømmende angivelse af det foreliggende materiale fra hver lokalitet. I talrige tilfælde er der ud for anførelsen af antal fragmenter eller skaller angivet det vurderede antal individer, som materialet ligger til grund for. Disse tal er anført i parentes og svarer til de respektive tal i faunaanalyserne i Part I.

Hos de arter, hvoraf der foreligger et særligt stort materiale, er af pladshensyn kun anført lokaliteterne, hvor de er fundet. Man må derefter søge individantallet i analyselisterne i Part I. De tilgrundliggende egentlige tællinger opbevares i Danmarks Geologiske Undersøgelses arkiv.

5) *Beskrivelser*. Disse er gjort så grundige som muligt, men kunne utvivlsomt være endnu mere indgående, hvis der var lagt større vægt på biometri.

6) *Variationer*. For visse arters vedkommende er de vigtigste variationskarakterer anført i en særlig rubrik.

7) *Bemærkninger*. Til næsten alle arter knyttes en del bemærkninger, der som oftest skal belyse forholdet til andre, lignende arter eller give supplerende oplysninger om specielle fundforhold eller lignende.

8) *Målinger*. Sådanne er meddelt for de fleste arter.

9) *Udbredelse*. Kendskabet til de enkelte arters udbredelsesforhold afhænger af de foreliggende afhandlinger. Molluskerne fra aflejringsområderne er bearbejdet i ældre tid, og identifikationen fra bassin til bassin er ofte usikker. En stor del af udbredelsesangivelserne må derfor tages med forbehold.

I nærværende arbejde er oplysningerne ordnet efter bassiner og inden for disse efter chronostratigrafi, lande og formationer. De pågældende autorer, hvorfra oplysninger er hentet, er anført i parentes.

Molluskerne

Bevaringstilstand. Molluskskallerne i de danske miocæne formationer er som regel velbevarede så længe de befinder sig i selve aflejringerne. På grund af lagenes betydelige pyritindhold er skallerne oftest fyldt med pyrit. Dette er ødelæggende for skallerne, når de opbevares under de sædvanlige forhold med luftens frie adgang til materialet, i nogen grad afhængende af luftens fugtighedsindhold. I mange tilfælde er kun få års ophold i luften tilstrækkeligt til at de ødelægges.

Det meste af det undersøgte materiale har været friskt på undersøgelsestidspunktet, men det må desværre imødeses, at en stor del af det vil undergå ødelæggende forandringer i årenes løb.

Pelecypoderne. I såvel Hodde leret som Gram leret er pelecypoderne den mollusk-gruppe, der er repræsenteret ved det største antal individer. Til gengæld er antallet af arter betydeligt lavere end for gastropodernes vedkommende. Alle tykskallede former er ofte velbevarede, hvis de ikke som *Isocardia* har en mere betydelig størrelse. De fleste af disse sidstnævnte er knuste ligesom de små, tyndskallede former. Disse arter er derfor muligvis underrepræsenteret i materialet.

Nuculidae og Nuculanidae er sammen med Astartidae og Carditidae de almindeligste pelecypod-familier. Hos de to sidstnævnte familier, især hos Astartidae, spores en morfologisk ændring af formerne fra de ældre til de yngre lag. Dette er påvist af HINSCH allerede i 1952 og bekræftedes ved undersøgelsen af det danske materiale.

Scaphopoderne. I de yngre lag af Gram leret optræder en lille, ikke sikkert identificeret *Siphonodentalium* i stort antal, næsten altid i fragmentarisk tilstand. Andre scaphopoder er i reglen sjældne i det danske yngre miocæn. Dentalier spiller dog en ikke ubetydelig rolle i Hodde leret og den ældre del af Gram leret.

Gastropoderne. Den største formfylde falder inden for gastropodernes gruppe. De er gennemgående velbevarede, undtagen for de største formers vedkommende, som f.eks. *Scaphella* og *Galeodea.*

Blandt de almindeligste gastropod-familier i Gram leret må nævnes Turritellidae, Naticidae, Fasciolariidae og Turridae, medens Hodde leret i særlig grad præges af Naticidae, Nassariidae og Turridae.

Der synes at kunne påvises visse evolutions-rækker, især inden for slægterne *Aquilofusus* og *Bathytoma.* Andre slægter, hvis arter ændrer sig i løbet af den yngre miocæne lerseries aflejringsperiode er *Hinia, Uromitra, Narona, Gemmula* og *Spirotropis.*

Blandt opistobranchiaterne spiller især Odostomierne en talmæssigt stor rolle. I hele lerserien er desuden pteropod-slægten *Spiratella* et meget hyppigt og karakteristisk fossil med specielle arter i henholdsvis Hodde leret og Gram leret.

De enkelte arter kan med få undtagelser findes afbildet på tavlerne i nærværende bind og i mit tidligere arbejde fra 1956. Ved den systematiske anordning er i hovedsagen fulgt håndbøgerne af J. THIELE (1931–35), WENTZ (1938–44) og *Treatise on Invertebrate Paleontology. Part I. Mollusca 1* (1960), dog tillige delvis med benyttelse af systematikken hos SORGENFREI (1958) og ANDERSON (1964).

BIBLIOGRAPHY

The abbreviated titles used in the lists of synonyms are placed in parenthesis and printed with *Italics*

ALMERA, D. JAIME y D. ARTURO BOFILL, 1893. Moluscos fósiles de los terrenos terciarios superiores de Cataluña. Muricidos. – Boletin d. 1. Comisión del Mapa geológico. Madrid. (*Mol. fósiles, Muricidae*).

ANDERSON, H.-J., 1959a. Die Muschelfauna des nordwestdeutschen Untermiozän. – Palaeontographica, Bd. 113, Abt. A, pp. 61–179, Tafel 13–18. Stuttgart. (*Untermiozän*).

— 1959b. Die Gastropoden des jüngeren Tertiärs in Nordwestdeutschland. Teil 1: Prosobranchia Archaeogastropoda. – Meyniana, Bd. 8, pp. 37–81. Kiel (*Die Gastropoden 1*).

— 1960a. Die Gastropoden des jüngeren Tertiärs in Nordwestdeutschland. Teil 2: Prosobranchia Mesogastropoda. 1. Littorinacea, Rissoacea, Cerithiacea. – Meyniana, Bd. 9, pp. 13–79, Tafel 1–12. Kiel. (*Die Gastropoden 2. 1*).

— 1960b. do. 2. Revision der Naticacea. – ibid., Bd. 9, pp. 80–97, Tafel 1–4. (Kiel). (*Die Gastropoden 2. 2*).

— 1964. Die miocäne Reinbek-Stufe in Nord- und Westdeutschland und ihre Mollusken-Fauna. – Fortschr. Geol. Rheinland und Westfalen. Bd. 14, pp. 31–368, 52 Tafeln. Krefeld. (*Reinbek-Stufe*).

BÁLDI, T., 1960. Tortonische Molluskenfauna von "Badener Tegelfazies" aus Szokolya, Nordungarn. – Ann. Hist.-Nat. Musei Nat. Hungarici, Tom. 52, Pars Miner. et Palaeont., pp. 51–99, Tafel I–III. Budapest.

BASTEROT, M. B., 1825. Mémoire Géologique sur les environs de Bordeaux. Paris. (*Mém. Bordeaux*).

BECK, H. H., 1835. Notes on the geology of Denmark. – Proceed. Geol. Soc. London, Vol. II, No. 43, pp. 217–220. London.

BEETS, C., 1946. The Pliocene and Lower Pleistocene gastropods in the collections of the Geological Foundation in the Netherlands (with some remarks on other Dutch collections). – Meded. v. d. Geol. Sticht. Serie C – IV – 1 – No. 6. Maastricht. (*Plioc. a. Lower Pleistoc. Gastrop.*)

— 1950. Oligozäne und wahrsch. miozäne Gastropoden aus dem Peel-Gebiete (südliche Niederlande). – Meded. v. d. Geol. Sticht. Ser. C – IV – 1 – No. 8. Maastricht.

BELLARDI, L., 1841. Description des Cancellaires fossiles des terrains tertiaires du Piémont. – Mém. d. l'Acad. d. Scienc. d. Turin, sér. II, t. III. Turin. (*Cancellariidae*).

— 1847. Monografia delle Pleurotome fossili del Piemonte. – Memoire d. R. Acad. d. Scienze d. Torino, ser. II, t. IX. Torino. (*Pleurot. Piemonte*).

— 1872–1890. I Molluschi dei terreni terziarii del Piemonte e della Liguria. Parte I–VI. – Also published in: Mem. d. Reale Acad. d. Scienze d. Torino. Torino. Parte I, T. XXVII, pp. 33–294, 15 pl., 1873. Parte II, T. XXIX, pp. 1–364, 9 pl., 1878. Parte III, T. XXXIV, pp. 219–469, 12 pl., 1883. Parte IV, T. XXXVII, pp. 3–62, 2 pl., 1886. Parte V, T. XXXVIII, pp. 79–166 and pp. 257–321, 4 pl., 1888. Parte VI, T. XL (completed by F. SACCO), pp. 295–368, 2 pl., 1890. (Continuation, see F. SACCO). (*I Molluschi*).

BEYRICH, ERNST, 1853–57. Die Conchylien des norddeutschen Tertiärgebirges. – Zeitschr. d. Deutsch. Geol. Gesell. Bd. 5–8. – Reprint with special pagination, pp. 1–336, 30 plates. Berlin. (*Conchylien*).

BLANCKENHORN, M., 1901. Neues zur Geologie und Paläontologie Aegyptens. III. Das Miocän. – Zeitschr. d. Deutsch. Geol. Gesell. Bd. 53, pp. 52–132; IV. Das Pliocän- und Quartärzeitalter usw., ibid. Bd. 53, pp. 307–502. Berlin.

BOGSCH, L., 1936. Tortonische Fauna von Nógradszakál. – Mitt. a. d. Jahrb. d. Kgl. Ungar. Geol. Anstalt, Bd. XXXI. Heft 1. Budapest.

BRIVES, A., 1897. Matériaux pour la Carte Géologique de l'Algerie. – 1. Sér. No. 3. Fossiles Miocènes (1 re partie). Alger.

BROCCHI, G. B., 1814. Conchiologia fossile subappenina I–II. Milano. (New edit. 1843). (*Conch. subapp.*).

BRONN, H. G., 1831. Italiens Tertiärgebirge und deren organische Einschlüsse. Heidelberg. (*Italiens Tert.*).

BROWN, T., 1827. Illustrations of the Conchology of Great Britain and Ireland. London. (*Ill. Conch.*).

BRØGGER, W. C., 1900–01. Om de senglaciale og postglaciale nivåforandringer i Kristianiafeltet (Molluskfaunan). – Norges Geol. Unders. No. 31. Kristiania. (*Kristianiafeltet*).

BUCQUOY, E., PH. DAUTZENBERG et G. DOLLFUS, 1882–1898. Les Mollusques Marins du Roussillon. T. I. Gastropodes. Text (570 pp.) + Atlas (66 pl.). 1882–86. T. II. Pélécypodes. Text (884 pp.) + Atlas (99 pl.). 1887–98. Paris. (*Roussillon*).

BÜLOW, WERNER VON, 1960. Über stratigraphische Untersuchungen am obermiozänen Glimmerton von Hohen Woos (SW-Mecklenburg). – Geologie, Jahrg. 9, Heft 2, pp. 185–189. Berlin.

CANTRAINE, F., 1835. Notice contenant les diagnoses ou descriptions succintes de quelques espèces nouvelles de mollusques. – Bull. d. l'Acad. Roy. d. Sciences, T. 2. Bruxelles.

CERULLI – IRELLI, S., 1907–12. Fauna malacologica mariana. Parte 1–6. 356 pp., 46 pl. – Palaeontographia Italica. Memorie di Paleontologia. Vol. XIII (1907), pp. 65–140, tavl. III–XII; Vol. XIV (1908), pp. 1–64, tav. I–XII; Vol. XV (1909), pp. 125–214, tav. XIII–XXIII; Vol. XVI (1910), pp. 23–70, tav. III–VI; Vol. XVII (1911), pp. 229–276, tav. XXI–XXVI, and Vol. XVIII (1912), pp. 141–170, tav. XXIII–XXV. Pisa. (*Fauna mal. mariana*).

CIPOLLA, F., 1914. Le Pleurotomidi del Pliocene di Altavilla (Palermo). – Palaeontographia Italica. Mem. di Palaeont. Vol. XX, pp. 105–181, tav. I–III. Pisa.

COSSMANN, M., 1895–1925. Essais de Paléoconchologie comparée. Tom. I–XII. Paris. (*Essais*).

COSSMANN, M. et PEYROT, 1909–34. Conchologie Néogénique de l'Aquitaine. – Actes de la Société Linnéenne de Bordeaux. Vol. LXIII–LXVI, LXVIII–LXX, LXXIII–LXXV, LXXVII–LXXIX, LXXXII–LXXXVI. Bordeaux. (*Conch. Néog. A.S.L.B.*).

CSEPREGHY – MEZNERICS, I., 1953. Mittelmiozäne Pleurotomen aus Ungarn. – Annales Historico-Naturales Musei Nationalis Hungarici (Series Nova). Tom. IV, pp. 5–22, 4 plates. Budapest. (*Mittelmioz. Pleurot.*).

DA COSTA, E. M., 1778. Historia Naturalis Testaceorum Britanniae or The British Conchology. London. (*Hist. Nat. Test. Brit.*).

— PEREIRA, 1866. Gastéropodes des dépôts tertiaires du Portugal. 252 pp., 28 pl. Lisbonne.

DESHAYES, G.-P., 1832. Histoire des Mollusques. – Expédition scientifique de Morée. III. Zoologie et Botanique, pp. 81–209, 9 plates. Paris. (*Expéd. scientif. Morée*).

DITTMER, E., 1957. Das Hemmoor im nordwestlichen Schleswig-Holstein. – Die Küste, Jahrg. 6, Heft 2, pp. 147–154. Heide/Holst.

— 1959. Jungtertiäre Ablagerungen im westlichen Schleswig-Holstein. – Meyniana, Bd. 8, pp. 1–21. Kiel.

DOLLFUS, COTTER et GOMES, 1903–04. Mollusques tertiaires du Portugal. Planches de Céphalopodes, Gastéropodes et Pélécypodes laissées par F. A. PEREIRA DA COSTA. – Comm. Serv. Géol. Portugal. Lisbonne. (*Moll. Tert. Portugal*).

DOLLFUS et DAUTZENBERG, 1902–20. Conchyliologie du Miocene Moyen du Bassin de la

Loire. I. Pélécypodes. – Mém. Soc. Géol. France (Paléont.). Mémoire No. 27. Published in the "Memoires", Serie Paléontologie as follows: Pp. 1–106, Pl. I–V, in Tome X, fasc. 2–3, 1902. Pp. 107–162, Pl. VI–X, in Tome XI, fasc. 3–4, 1904. Pp. 163–240, Pl. XI–XV, in Tome XIV, fasc. 1, 1906. Pp. 241–296, Pl. XVI–XXII, in Tome XVI, fasc. 2, 1909. Pp. 297–378, Pl. XXIII–XXXIII, in Tome XX, fasc. 1–2, 1913. Pp. 379–497, Pl. XXXIV–LI, Tome XXII, fasc. 2, 3 et 4, 1920. Paris. (*Bassin Loire*).

DUBERTRET, VAUTRIN et KELLER, 1937. Stratigraphie du Pliocène et du Quaternaire de la region de Lattaquié. – Contribution a l'étude geologique de la côte Libano – Syrienne. I. Stratigraphie. II. Paléontologie, pp. 98–121. – Haut-Commisariat de la Républ. Française en Syrie et au Liban, Notes et Mémoires, T. II. Paris.

EAMES, F. E. and L. R. COX, 1956. Some Tertiary Pectinacea from East Africa, Persia, and the Mediterranean Region. – Proceed. Malacolog. Society, London, Vol. 32, parts 1 and 2, pp. 1–68, plates 1–20. London.

EICHWALD, E., 1830. Naturhistorische Skizze von Lithauen, Volhynien und Podolien. Wilna. (*Nat. Skizze*).

— 1853. Lethaea Rossica. Stuttgart.

ELLERMANN, CLARA, 1963. Beitrag zur Gliederung und Verbreitung des Tertiärs im West-Emsland. – Neues Jahrb. f. Geol., Paläont., Abh., Bd. 117, Festband Lotze, pp. 111–130. Stuttgart.

FÉRUSSAC, A. E. J. PJ. F. D'AUDEBARD DE, 1821–22. Tableaux Systématiques des Animaux Mollusques. Paris. (*Table system. moll.*).

FONTANNES, F., 1879–1882. Les Mollusques Pliocènes de la vallée du Rhone et du Roussillon. I–II. Paris.

FORBES, EDW. and S. HANLEY, 1853. A history of British mollusca, and their shells. Vol. I–IV. London. (*Brit. Moll.*).

FORCHHAMMER, GEORG, 1828. Geognostiske Bidrag. Første Stykke. Sylt. – Kongl. danske Vid. Selsk. Skrifter. Naturv. Afh. Bd. III, pp. 362–378. Kjøbenhavn.

FRIEDBERG, W., 1938. Katalog meiner Sammlung der Miozänmollusken Polens. – Mém. l'Acad. Polonaise d. Sc. et Lettres Cl. Sc. Math. et Nat. Sér. B. Sciences Naturelles. No. 12. 164 pp. Cracovie.

GIGNOUX, M., 1913. Les formations marins pliocènes et quaternaires de l'Italie du Sud et de la Sicile. Lyon-Paris.

GLIBERT, M., 1945. Faune Malacologique du Miocène de la Belgique. – Mém. d. Musée Royal d'Hist. Nat. d. Belg. Mém. No. 103. I. Pélécypodes. Bruxelles. (*Mioc. Belg. I*).

— 1949–52. Gastropodes du Miocène Moyen du Bassin de la Loire. I–II. – Inst. Royal d. Scien. nat. de Belg. Mém. 2. Sér. Fasc. 30 et 46. Paris. (*Gastr. Loire*).

— 1952. Faune Malacologique du Miocène de la Belgique. II. Gastropodes. – Instit. Royal d. Sciences nat. de Belg. Mém. Nr. 121. Bruxelles. (*Mioc. Belg. II*).

— 1954. Pleurotomes du Miocène de la Belgique et du Bassin de la Loire. – Inst. Royal d. Sciences nat. de Belg. Mém. No. 129. Bruxelles. (*Pleurotomes*).

— 1957a. Pélécypodes et gastropodes du Rupélien supérieur et du Chattien de la Belgique. – Inst. Royal d. Sciences nat. d. Belgique. Mém. No. 137. Bruxelles. (*Rupél., Chattien*).

— 1957–59. Pélécypodes du Diestien, du Scaldisien et du Merxemien de la Belgique. – Inst. Royal d. Sciences nat. de Belg. Bulletin. Bruxelles. – 1.ere note, I.R.S.N.B. Tome XXXIII, no. 9, 40 pp., 1 plate, 1957. – 2me note, ibid. T. XXXIII, no. 47, 28 pp., 1 pl., 1957. – 3me note, ibid. T. XXXIV, no. 42, 27 pp., 2 pl., 1958. – 4me note, ibid. T. XXXV, no. 36, 24 pp., 1 pl., 1959. (*I.R.S.N.B.*).

— 1957–60. Gastropodes du Diestien, du Scaldisien et du Merxemien de la Belgique. – I.R.S.N.B. 1.ere note, ibid., T. XXXIII, no. 36, 27 pp., 1 pl., 1957. – 2me note, T. XXXIV, no. 15, 36 pp., 1 pl., 1958. – 3me note, T. XXXV, no. 10, 27 pp., 1 pl., 1959.

– 4me note. Annexe. Additions aux Pleurotomes du Néogene du Bassin de la Loire (France), T. XXXVI, no. 33, 44 pp., 2 pl. 1960. (*I.R.S.N.B.*).

GLIBERT, M., 1962. Revision de la faune d'invertébrés du Diestien typique. – Mém. d. l. Soc. belg. de Géol., de Paléont. et d'Hydrol. Serie in – 8° – No. 6 – 1962, pp. 40–55. Bruxelles.

— et J. DE HEINZELIN DE BRAUCOURT, 1955. La faune et l'age Miocène supérieur des sables de Deurne. I. Descriptions. – Inst. Royal d. Sciences nat. de Belg. Bulletin, T. XXXI, nr. 71, 27 pp. Bruxelles. – II. Conclusions, ibid. no. 72. 12 pp. Bruxelles.

GOLDFUSS, A., 1837. Petrefacta Germaniae. II. Düsseldorf (*Petrefac. Germ.*).

GÖRGES, J., 1952. Die Lamellibranchiaten und Gastropoden des oberoligozänen Meeressandes von Kassel. – Abh. Hessisch. Landesamt f. Bodenfor. H. 4. Wiesbaden.

GOTTSCHE, C. und F. WIBEL, 1876. Skizzen und Beiträge zur Geognosie Hamburgs und seiner Umgebung. – Hamburg in naturh. u. medizin. Beziehung, pp. 81–118. Hamburg.

GRATELOUP, J. P. S. DE, 1827. Description de plusieurs éspèces de coquilles fossiles des environs de Dax (Landes). – Bull. Hist. Natur. Soc. Linnéenne Bordeaux, Vol. II, pp. 3–26. Bordeaux. (2me édition 1845).

— 1840. Conchyliologie fossile des terrains tertiaires du bassin de l'Adour. I. Univalves. 45 plates with explanations. Bordeaux. (Supplement with plates 46–48 with expl. Bordeaux 1846). (*Bassin de l'Adour*).

GRIPP, K., 1914. Über eine untermiozäne Molluskenfauna von Itzehoe. – Jahrb. d. Hamburg. wissensch. Anst. XXXI. 1913. Hamburg. (*Itzehoe*).

— 1922. Marines Pliocän und *Hipparion gracile* KAUP. vom Morsumkliff auf Sylt. – Zeitschr. d. Deutsch. Geol. Gesellsch. Bd. 74, Abh., pp. 169–206, 1 pl. Berlin.

— 1933. Geologie von Hamburg und seiner näheren und weiteren Umgebung. Hamburg. (*Hamburg*).

— 1940. *Cardita laevicosta weingärtneriana n. var.* und *Astarte magdalenae n. sp.* aus dem tiefsten obermiozänen Glimmerton. – Arch. f. Molluskenkunde, Bd. 72, H. 5–6, pp. 145–151. Frankfurt a. M.

— 1961. Bericht über das Internationale Symposium zur Stratigraphie des Miocän im Nordseebecken, Kiel, 21.–29. April 1959. – Meyniana, Bd. 10, 188 pp. Kiel.

— 1964. Erdgeschichte von Schleswig-Holstein. Neumünster.

HARDER, POUL, 1913. De oligocæne Lag i Jærnbanegennemskæringen ved Aarhus Station. – Danm. geol. Unders. II. Rk. Nr. 22. Kjøbenhavn. (*Aarhus*).

HARMER, F. W., 1914–25. The Pliocene Mollusca of Great Britain. Vol. I–II. – The Palaeontographical Society. London. (*Plioc. Moll.*).

HECK, H.-L., 1944. Marines Pliozän in Schleswig-Holstein und der "Bredstedter Ton". – Jahrb. d. Reichsamts f. Bodenforsch. für 1942, Bd. 63, pp. 1–38. Berlin.

HEERING, J., 1942. Die oligocänen taxodonten Bivalven aus dem Peelgebiete (die Niederlande). – Meded. Geol. Sticht. Ser. C – IV – 1 – No. 2. Maastricht. (*Oligoc. Taxodonten*).

— 1944. Die oberoligocänen Bivalven (mit Ausnahme der Taxodonten) aus dem Peelgebiete (die Niederlande). – Meded. Geol. Sticht. Ser. C – IV – 1 – No. 4. Maastricht. (*Oberolig. Bivalv.*).

— 1950a. Pelecypoda (and Scaphopoda) of the Pliocene and Older-Plistocene deposits of the Netherlands. – Meded. Geol. Sticht. Ser. C – IV – 1 – No. 9. Maastricht. (*Plioc. a. old. Pleist.*).

— 1950b. Miocene Pelecypoda of the Netherlands (Peel-Region). – Meded. Geol. Sticht. Ser. C – IV – 1 – No. 10. Maastricht. (*Mioc. Pelec.*).

HINSCH, W., 1952. Leitende Molluskengruppen im Obermiozän und Unterpliozän des östlichen Nordseebeckens. – Geol. Jahrb., Bd. 67, pp. 143–194, 3 Tafeln. Hannover. (*Leit Moll.*).

HINSCH, W., 1955. Miozängliederung in den Erdölfeldern Heide und Bramstedt. – Neues Jahrb. f. Geol., Paläont., Monatshefte, 1955, Heft 8, pp. 348–357. Stuttgart.

— 1958. Die Bedeutung des Aufschlusses von Maade bei Esbjerg für die Gliederung des Obermiozäns. – Zeitschr. Deutsch. Geol. Gesellsch. Bd. 109, pp. 463–474. Berlin. (*Maade*).

— 1962. Die Molluskenfauna des Mittelmiozäns von Twistringen und Woltrup. – Geol. Jahrb., Bd. 80, pp. 295–312, 1 Taf. Hannover. (*Twistringen*).

— 1965. Neuere Obermiozän-Aufschlüsse in NW-Deutschland. – Senckenberg Lethaea. Bd. 46a (Weiler – Festschrift), pp. 145–160. Frankfurt a. M.

HÖLZL, D., 1958. Die Mollusken-Fauna des oberbayerischen Burdigals. – Geologica Bavarica. Nr. 38, 348 pp., 22 pl. München. (*Oberbayer. Burdigal.*).

HÖRNES, M., 1856. Die fossilen Mollusken des Tertiær-Beckens von Wien. I. Band: Univalven. Abh. d. kaiserl.-königl. Geol. Reichanst. Bd. III. 736 pp. 52 Tafeln. Wien. (*Wienerbecken I*).

— 1870. do. II. Band: Bivalven. ibid. Bd. IV. 479 pp. 85 Tafeln. Wien. (*Wienerbecken II*).

HOERNES, R. & M. AUINGER, 1879–91. Die Gastropoden der Meeresablagerungen der ersten und zweiten miocänen Mediterran-Stufe in der österreichich-ungarischen Monarchie. – 1.–3. Lieferung in Abh. d. K. K. Geolog. Reichsanst. Bd. XII, Heft I–III. 4.–8. Lief. in 5 parts published as reprints. 1. Lief., pp. 1–52, Tafel 1–6, 1879; 2. Lief., pp. 53–113, Taf. 7–12, 1880; 3. Lief., pp. 114–152, Taf. 13–16, 1882; 4. Lief., pp. 153–192, Taf. 17–22, 1884; 5. Lief., pp. 193–232, Taf. 23–29, 1885; 6. Lief., pp. 233–282, Taf. 30–37, 1890; 7. Lief., pp. 283–330, Taf. 38–43, 1891; 8. Lief., pp. 331–382, Taf. 44–51, 1891. Wien. (*I. u. II. Meditter.*).

HORN, E., 1912. Die geologischen Verhältnisse des Elbtunnels nebst einem Beitrage zur Geschichte des unteren Elbtales. – 4. Beiheft z. Jahrb. d. Hamburg. Wissensch. Anstalten. XXIX, 1911, pp. 35–58. Hamburg.

IJSPEERT, C., 1942. Monographie der miozänen taxodonten Bivalven aus dem Peelgebiete (die Niederlande). – Meded. v. d. Geol. Sticht. Ser. C – IV – 1 – No. 1. Maastricht. (*Mioz. Taxodonten*).

JEFFREYS, I. G., 1862–69. British Conchology. Vol. I–V. London. (*Brit. Conch.*).

JENSEN, AD. S. og R. SPÄRCK, 1934. Saltvandsmuslinger. Danmarks Fauna, Bd. 40. København. (*Saltvandsmuslinger*).

KAUTSKY, F., 1925. Das Miocän von Hemmoor und Basbeck-Osten. – Abh. d. Preuss. Geol. Landesanst. Neue Folge. Heft 97. 255 pp. 12 plates. Berlin. (*Hemmoor*).

KITTL, ERNST, 1886. Ueber die miocenen Pteropoden von Oesterreich-Ungarn. – Annalen des k. k. naturh. Hofmuseums, Bd. I, Heft 2, pp. 47–74, 1 plate. Wien. (*Mioc. Pterop.*).

KOENEN, A. VON, 1867–68. Das marine Mitteloligocän Norddeutschlands und seine Molluskenfauna. – Palaeontographica, Bd. 16. Kassel. (*Mitteloligocän*).

— 1872. Das Miocaen Nord-Deutschlands und seine Mollusken-Fauna. I. Teil. – Schr. d. Gesellsch. z. Beför. d. gesammt. Naturw. z. Marburg. Bd. 10, pp. 137–262, Tafel I–III. Cassel. (*Mioc. Nordd. I*).

— 1882. Die Gastropoda holostomata und tectibranchiata, Cephalopoda und Pteropoda des Norddeutschen Miocän. – (II. Theil von "Das Norddeutsche Miocän und seine Molluskenfauna"). – Neues Jahrb. f. Mineralogie etc. Beilage-Bd. II, pp. 223–363, Tafel V–VII. Stuttgart. (*Mioc. Nordd. II*).

KONINCK, L. DE, 1837. Description des coquilles fossiles de l'argile de Basele, Boom, Schelle, etc. – Mém. d' l'Acad. Royal d. Sciences et Belles-Lettre de Bruxelles. T. XI, 37 pp. 4 plates. Bruxelles.

LAMARCK, J. B., 1818–22. Histoire Naturelle des Animaux sans Vertebres. Vol. V. Paris.

LAMOTHE, L. DE, 1907. Les gites fossiliferes des marnes plaisanciennes du Sahel d'Alger. – Bull. Soc. Géol. France, T. 17. Fasc. 7–8, pp. 481–505. Paris.

LECOINTRE, G., 1952. Recherches sur le Néogène et le Quaternaire marins de la côte atlantique du Maroc. I. Stratigraphie. II. Paléontologie. – Protectorat d. l. Rép. Franc. au Maroc. Serv. Géol. Notes et Mémoires, No. 99. Paris.

LEHMANN, F., 1892. Die Lamellibranchiaten des Miocäns von Dingden. I. Theil: Asiphonida und Siphonida Integripalliata. – Verh. naturh. Ver. Rheinl. Westf. u. Osnabrück, Bd. XXXXIX (5. Folge, Bd. IX), pp. 198–243 (+ Tafel IV). Bonn. (*Dingden I*).

— 1893. Do. II. Theil: Siphonida sinupalliata. Ibid. Bd. I (5. Folge, Bd. X), pp. 273–294 (+ Tafel V). Bonn. (*Dingden II*).

LINNÉ (LINNÆUS), CARL (CAROLUS), 1758. Systema Naturæ. Tomus I. Editio Decima. Holmia. (Facsimile edition, London 1956). (*Systema naturæ*).

LOCARD, A., 1892. Les coquilles marines des côtes de France. Paris. (*Côtes d. France*).

METZMACHER, A., 1903. Die Fauna des miocänen Glimmertons von Kummer, Hohenwoos und Bockup. – Arch. d. Vereins d. Freunde d. Naturgeschichte in Mecklenburg. 57. Jahr; pp. 166–181. Güstrow.

— 1917. Zur Fauna des Mecklenburgischen miocänen Glimmertons. – Arch. d. Vereins d. Freunde d. Naturgeschichte in Mecklenburg. 71. Jahr, pp. 95–97. Güstrow.

MICHELOTTI, G., 1847. Description des fossiles des terrains miocènes de l'Italie septentrionale. – Naturh. Verh. Holl. Maatsch. Wetensch. Haarlem, 2. Vers. III. 408 pp., 17 pl. Haarlem.

MOLENGRAAF, G. A. F. und W. A. J. M. VAN WATERSCHOTT VAN DER GRACHT, 1913. Niederlande. – Handbuch der Regionalen Geologie. Bd. I, 3. Heidelberg.

MONTAGU, G., 1803–08. Testacea Britannica or Natural History of British Shells. Part 2. 1803. – Suppl. 1808. London. (*Test. Brit.*).

MOORE, R. C. (edit.), 1960. Treatise on Invertebrate Paleontology. Part I. Mollusca 1. New York.

MUUS, BENT J., 1959. Skallus, Søtænder, Blæksprutter. – Danmarks Fauna. Bd. 65. København.

MÜLLER, G., 1904. Blatt Lüneburg. – Erläut. z. Geol. Karte von Preussen. Lief. 108. Berlin. (2. Auflage 1912).

MÜLLER, O. F., 1776. Zoologiæ Danicae Prodomus. Hafnia (*Zool. Dan. Prodomus*).

— 1777–80. Zoologiae Danicae, seu animalium Daniae et Norvegiae rariorum ac minus notorum icones. – Fasc. I–II, 120 pl. Hafniae. (*Zool. Dan.*).

MØRCH, O., 1874. Forsteningerne i Tertiærlagene i Danmark. – Beretn. om det 11te skandinaviske Naturforskermøde i Kjøbenhavn 1873, pp. 274–298. Kjøbenhavn. (*Forst. i Tert.*).

NORDMANN, V., 1910. Den diluviale Molluskfauna ved Skærumhede, pp. 111–151 in A. JESSEN, V. MILTHERS, V. NORDMANN, N. HARTZ and A. HESSELBO: En boring gennem de kvartære Lag ved Skærumhede. – Danm. geol. Unders. II. Rk. Nr. 25. København.

— 1928. La position stratigraphique des dépôts d'Eem. – Danm. geol. Unders. II. Rk. Nr. 47. København.

NYST, H., 1836. Recherches sur les coquilles fossiles de Kleyn-Spauwen et Housselt (Province du Limbourg). Messager des Sciences et des Arts de la Belgique. 4, p. 139. Gand. (*Kleyn – Spauwen*).

— 1843. Description des coquilles et des polypiers fossiles des terrains tertiaires de la Belgique. Bruxelles. (*Coq. et Polyp.*).

— 1861. Description succinctes de dix espèces nouvelles, de coquilles fossiles du Crag

noir d'Edeghem, près d'Anvers. – Bull. Acad. Roy. etc. de Belgique, p. 188. Bruxelles. (*Crag noir d'Edeghem*).

NYST, H., 1878–81. Conchyliologie des terrains tertiaires de la Belgique. 1. partie. Terrain Pliocene Scaldisien. Text (1881), 263 pp.; Atlas (1878), 28 planches. – Ann. d. Musee R. d'Histoire Nat. d. Belg. Sér. Paléont. Tome III. Bruxelles. (*Conch. Terr. Tert.*).

— et G. D. WESTENDORP, 1839. Nouvelles recherches sur les coquilles fossiles de la province d'Anvers. – Bull. Acad. R. Sci. Bell.-Lettr. Bruxelles, II, 6, pp. 393–414, 19 figs. Bruxelles. (*Nouv. rech. prov. Anvers*).

NØRREGAARD, E. M., 1916. Mellem-miocæne Blokke fra Esbjerg. – Danm. Geol. Unders. IV. Rk. Bd. 1. Nr. 5. København. (*Esbjerg*).

OLIVI, A. G., 1792. Zoologia Adriatica. Bassano.

PETERSEN, C. G. JOH., 1888. Om de skalbærende Molluskers Udbredningsforhold i de danske Have indenfor Skagen. Kjøbenhavn. (*Skalb. Moll.*).

PHILIPPI, R. A., 1836. Enumeratio Molluscorum Siciliae. Vol. I. 1836. Berolini. (*Enum. Moll. Siciliae I*).

— 1844. do. Vol. II. 1844. Halis Saxonum. (*Enum. Moll. Siciliae II*).

— 1846. Verzeichniss der in der Gegend von Magdeburg aufgefundenen Tertiärversteinerungen. – Palaeontographica, Bd. I. 1851. (Erste Lieferung, August 1846), pp. 42–90 (+ Tafel VII–X, Xa). Cassel. (*Verzeichniss*).

POSSELT, H. J., 1898. Grønlands Brachiopoder og Bløddyr. – Medd. om Grønland. Bd. XXIII. København.

POWELL, A. W. B., 1942. The New Zealand recent and fossil mollusca of the family Turridae. – Bull. Auckland Instit. and Museum No. 2. Auckland.

RASMUSSEN, L. BANKE, 1956. The Marine Upper Miocene of South Jutland and its Molluscan Fauna. – Danm. Geol. Unders. II. Rk. Nr. 81. 166 pp., 10 plates. København. (*South Jutland*).

— 1958. Det marine ungtertiær ved Sæd. – Medd. f. Dansk Geol. Foren., Bd. 14, pp. 1–28, 2 plates. København. (*Sæd*).

— 1966. Molluscan Faunas and Biostratigraphy of the Marine Younger Miocene Formations in Denmark. Part I. Geology and Biostratigraphy. – Danm. Geol. Unders. II. Rk. Nr. 88. 358 pp. København. (*Molluscan Faunas*).

RAVN, J. P. J., 1907. Molluskfaunaen i Jyllands Tertiæraflejringer. – Kgl. danske Vidensk. Selsk.s Skrifter, 7. R. naturv. og mathem.Afd. III, 2, pp. 215–386, 8 plates. København. (*Jylland*).

ROGER, J., 1939. Le genre *Chlamys* dans les formations néogenes de l'Europe. – Mém. Soc. Géol. France. No. 40. Paris. (*Chlamys*).

RONCHETTI, C. ROSSI, 1952. I tipi della "Conchiologia fossile subapennina" di G. Brocchi. I Crostacei, Lamellibranchi. – Rivista Ital. Paleont. e Stratigr. Memoria V, Parte I. Milano (*I tipi*).

— 1955. do. II. Gastropodi, Scafopodi. – ibid. Parte II. Milano. (*I tipi*).

SACCO, F., 1890–1904. I Molluschi dei Terreni Terziarii del Piemonte e della Liguria. Parte VII–XXX. Torino. (Continuation of a work started by BELLARDI, see there). (*I Molluschi*).

SARS, G. O., 1878. Bidrag til Kundskaben om Norges arktiske Fauna. I. Mollusca Regionis Arcticae Norvegiæ. Bløddyr. 418 pp. 52 plates. Christiania. (*Moll. Arct. Norveg.*).

SEIFERT, FR., 1959. Die Scaphopoden des jüngeren Tertiärs (Oligozän – Pliozän) in Nordwestdeutschland. – Meyniana, Bd. 8, pp. 22–36. Kiel. (*Die Scaphopoden*).

SEMPER, J. O., 1861. Paläontologische Untersuchungen. Erster Theil. Neubrandenburg. (*Pal. Unters.*).

SIEBER, RUD., 1937. Die Fasciolariidae des niederösterreichischen Miozäns. – Arch. f. Molluskenkunde, Bd. 69, pp. 138–160. Frankfurt a. Main. (*Fasciolariidae*).

SORGENFREI, TH., 1940. Marint Nedre-Miocæn i Klintinghoved på Als. – Danm. Geol. Unders. II. Rk. Nr. 65, 143 pp., 8 plates. København. (*Klintinghoved*).

— 1958. Molluscan Assemblages from the Marine Middle Miocene of South Jutland and their Environments. – Danm. Geol. Unders. II. Rk. Nr. 79, Vol. I–II. 503 pp., 76 plates. København. (*Middle Mioc.*).

SOWERBY, J. C., 1818–25. The Mineral Conchology of Great Britain. Vol. II–V. (*Min. Conch.*).

SPAINK, K. G., 1959. Vorläufige Namenliste der miozänen Mollusken aus den Niederlanden. (Mit Supplement 1 (1960), 2 (1960) und 3 (1962). Haarlem. (Stencilled).

SPEYER, O., 1870. Die Conchylien der Casseler Tertiärbildungen. I. Univalven. Cassel. (*Cassel*).

— und A. VON KOENEN, 1884. Die Bivalven der Casseler Tertiär-Bildungen. – Abh. Geol. Specialk. von Preussen u. d. Thüring. Staaten. Bd. IV. H. 4. Berlin.

STAESCHE, KARL, 1930. Zur Gliederung des obermiozänen Glimmertons. – Jahrb. d. Preuss. Geol. Landesanst. für 1930. Bd. 51, pp. 55–87. Berlin.

STRAUSZ, LÁSZLÓ, 1966. Die miozän-mediterranen Gastropoden Ungarns. 535 pp., 79 plates. Budapest.

STRUCK, R., 1908. Neue Beobachtungspunkte tertiärer und fossilführender diluvialer Schichten in Schleswig-Holstein und Lauenburg. – Mitt. d. Geogr. Gesell. u. d. Naturh. Mus. in Lübeck. 2. Reihe, H. 23, pp. 49–96. Lübeck.

TEMBROCK, MARIA LUISE, 1961. Zum Problem der Determination von Gastropodenschalen. – Ber. d. Geol. Gesellsch. in d.D.D.R., Heft 4, pp. 365–381 (+ 2 Tafeln). Berlin. (*Determination*).

— 1963. Muriciden aus dem Mittel- und Oberoligozän und den Vierlandschichten des Nordseebeckens. – Paläont. Abh., Bd. I, Heft 4, pp. 299–351, Tafel I–X. Berlin. (*Muriciden*).

TESCH, P., 1912. Beiträge zur Kenntnis des marinen Mollusken im West-Europäischen Pliocänbecken. – Meded. v. d. Rijksopsp. v. Delfstoff. No. 4. 'S-Gravenhage.

THIELE, I., 1931–35. Handbuch der systematischen Weichtierkunde. I–II. Jena.

THORSON, GUNNAR, 1946. Reproduction and larval development of Danish marine bottom invertebrates, with special reference to the planktonic larvae in the Sound (Øresund). – Medd. f. Komm. Danm. Fiskeri- og Havunders. Ser. Plankton. Bd. 4. Nr. 1. København.

TURTON, W., 1810. A Conchological Dictionary of the British Islands. London.

VOLGER, G. H. O., 1845. Dissertatio inauguralis de agri Luneburgici constitutione geognostica. Gottingae. (*De agri Luneburgici*).

VOORTHUYSEN, J. H. VAN, 1944. Miozäne Gastropoden aus dem Peelgebiet (Niederlande). (Rissoidae – Muricidae, nach Zittel's Einteilung 1924). – Meded. v. d. Geol. Sticht. Ser. C – IV – 1 – No. 5. Maastricht. (*Mioz. Gastrop.*).

WEINKAUFF, H. C., 1867–68. Die Conchylien des Mittelmeeres. I–II. Kassel. (*Conch. Mittelm.*).

WENZ, W., 1938–44. Gastropoda. Teil I: Allgemeiner Teil und Prosobranchia. – Handbuch der Paläozoologie. Bd. 6. Berlin.

WIRTZ, D., 1949. Die Fauna des Sylter Crag und ihre Stellung im Neogen der Nordsee. – Mitt. Geol. Staatsinst. Hamburg, Heft 19, pp. 57–76 and 3 plates. Hamburg.

WOLFF, W., 1913. Blatt Pinneberg. – Erläut. z. Geol. Karte v. Preussen. Lief. 192. Berlin.

WOOD, S. V., 1840–42. Catalogue of Crag Shells. – Ann. and Mag. of Natural History. London. (*Ann. and Mag.*).

— 1848–82. A Monograph of the Crag Mollusca. Vol. I–II + Suppl. – The Palaeontographical Society. London. (*Crag. Moll.*).

ZIMMERMANN, K. G., 1847. Petrefacten von Reinbeck – Amt. Ber. d. 24. Naturf. Versamml. z. Kiel, p. 240. Kiel (*Reinbeck*).

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PLATES

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		D.G.U. Catalogue No.	Text page
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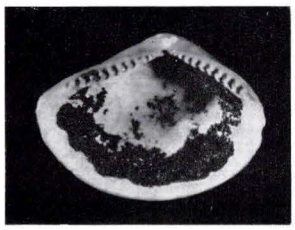

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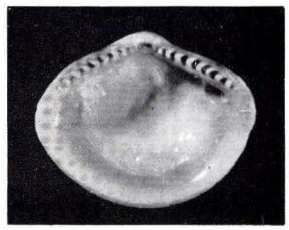

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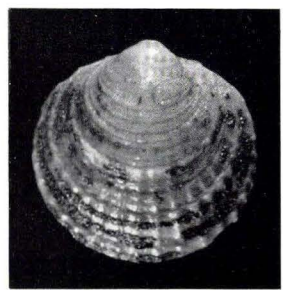

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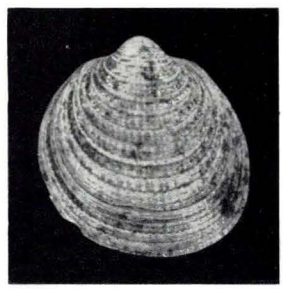

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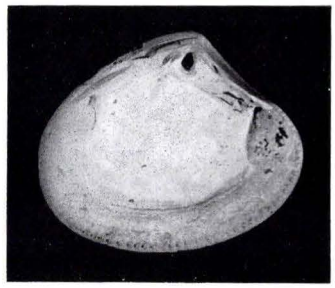

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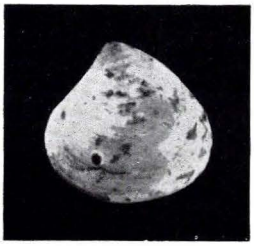

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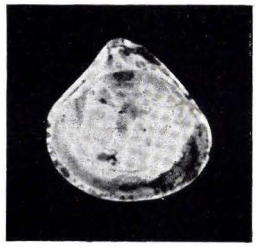

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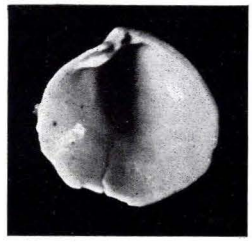

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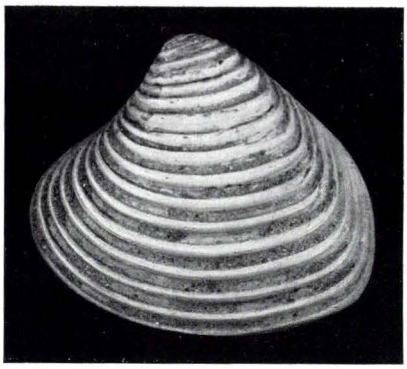

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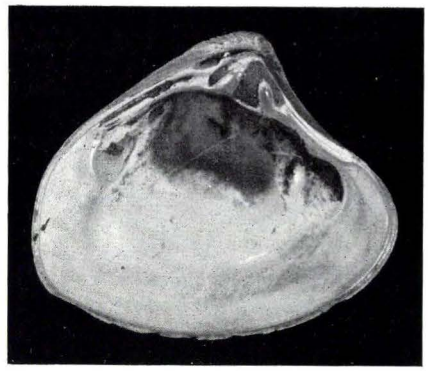

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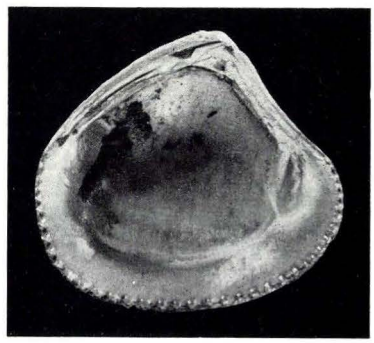

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Plate III

		D.G.U. Catalogue No.	Text page
Figs. 1 and 2	*Astarte gracilis* V. MÜNSTER Locality: Måde Brickworks. Eastern clay pit. Hodde Clay. Length: 8.1 mm. Height: 7.0 mm. Fig. 1: Left valve. Exterior ×5.0 Fig. 2: Left valve. Interior ×5.0	1968-LBR-12	35
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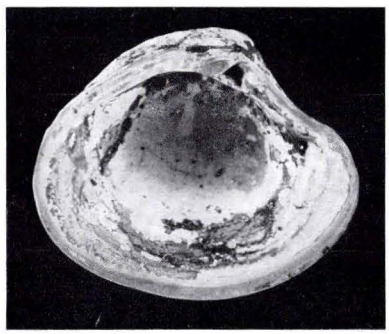

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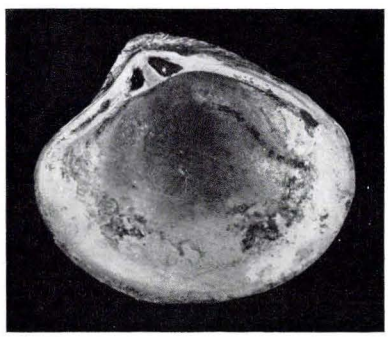

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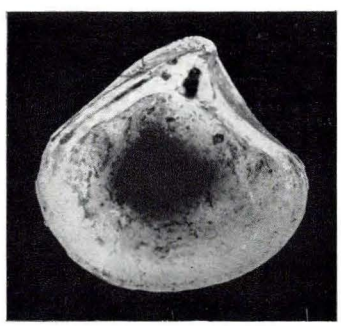

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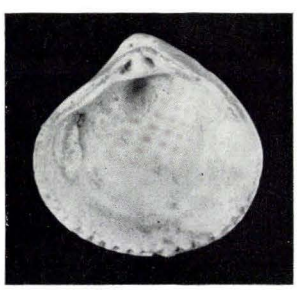

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Plate IV

		D.G.U. Catalogue No.	Text page
Figs. 1 and 2	*Cardita orbicularis* (SOWERBY) Locality: Måde Brickworks. Eastern clay pit. Gram Clay. Length: 5.9 mm. Height: 6.3 mm. Fig. 1: Left valve. Exterior ×5.6 Fig. 2: Left valve. Interior ×5.6	1968-LBR-17	49
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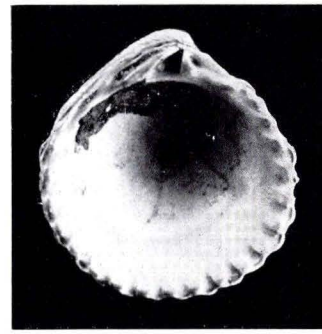

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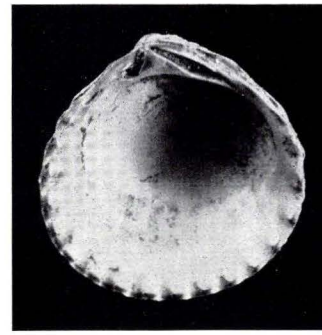

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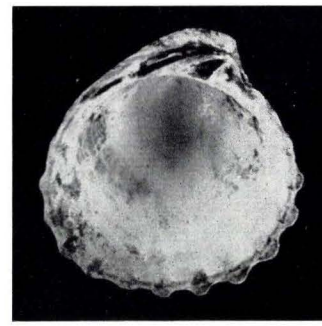

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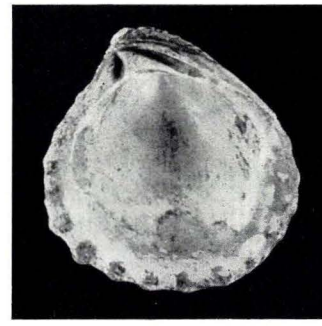

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Plate V

		D.G.U. Catalogue No.	Text page
Fig. 1	*Modiolus phaseolinus* (PHILIPPI) Locality: Gram. 141.277. 27.00–27.50 m. Gram Clay. Length: 1.1 mm. Height: 1.4 mm. Left valve. Exterior ×25.0	1968-LBR-21	27
Figs. 2 and 3	*Astarte* (*Goodallia*) *esbjergensis pseudo-ovata* RASMUSSEN Locality: Sæd. 167.445. 92.00–92.25 m. Gram Clay. Length: 3.2 mm. Height: 2.9 mm. Fig. 2: Left valve. Exterior ×10.3 Fig. 3: Left valve. Interior ×10.3	1968-LBR-22	49
Fig. 4	*Lima* (*Limatula*) *subauriculata* (MONTAGU) Locality: Gram. 141.277. 17.50–18.00 m. Gram Clay. Length: 7.5 mm. Height: 4.1 mm. ×33	1968-LBR-23	33
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Fig. 7	*Thyasira flexuosa* (MONTAGU) Locality: Gram. 141.277. 12.60–13.10 m. Gram Clay. Length: 2.0 mm. Height: 1.8 mm. Left valve. Exterior ×15	1967-LBR-26	59
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Fig. 9	*Thyasira spec.* Locality: Gram. 141.277. 9.50–9.90 m. Gram Clay. Length of the pictured part of the shell: 1.9 mm. abt. ×33	1968-LBR-28	60

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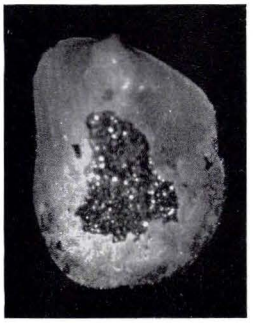

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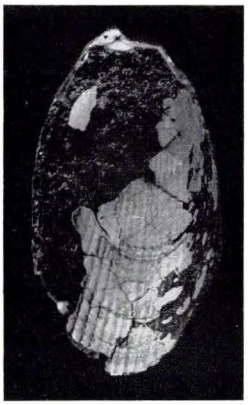

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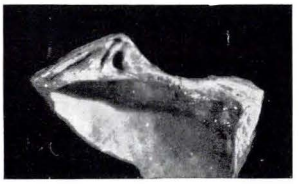

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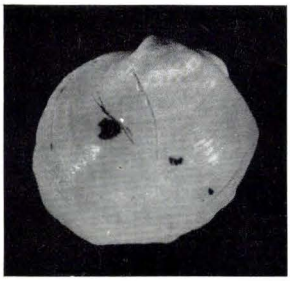

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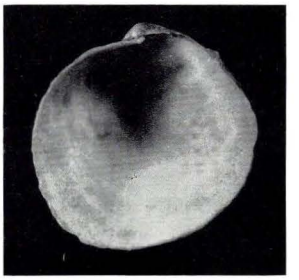

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Plate VI

		D.G.U. Catalogue No.	Text page
Figs. 1 and 2	*Pygocardia rustica* (SOWERBY) Locality: Gørding. Brickworks pit. Gram Clay ? Length: 37.7 mm. Height: 32.5 mm. Fig. 1: Right valve. Exterior ×1.5 Fig. 2: Double valve. ×1.5	1968-LBR-29	58
Figs. 3, 5, and 6	*Varicorbula gibba* (OLIVI) Locality: Måde Brickworks. Eastern clay pit. Gram Clay. Length: 8.0 mm. Height: 7.3 mm. Fig. 3: Right valve. Exterior ×4.8 Fig. 5: Left valve ×4.8 Fig. 6: Double valve ×4.8	1968-LBR-30	69
Fig. 4	*Varicorbula gibba* (OLIVI) Locality: Måde Brickworks. Eastern clay pit. Gram Clay. Length: 6.1 mm. Height: 5.7 mm. Right valve. Exterior ×6.1	1968-LBR-31	69
Fig. 7	*Pelecypoda non det.* Locality: Brodersmark. 166.351 b. 28–29 m. Gram Clay. Length: 3.9 mm. Height: 1.7 mm. ×13.8	1968-LBR-32	77
Fig. 8	*Cuspidaria cuspidata* (OLIVI) Locality: Måde Brickworks. Eastern clay pit. Gram Clay. Length: 7.9 mm. Height: 5.7 mm. Left valve. Exterior ×5.3	1968-LBR-33	73

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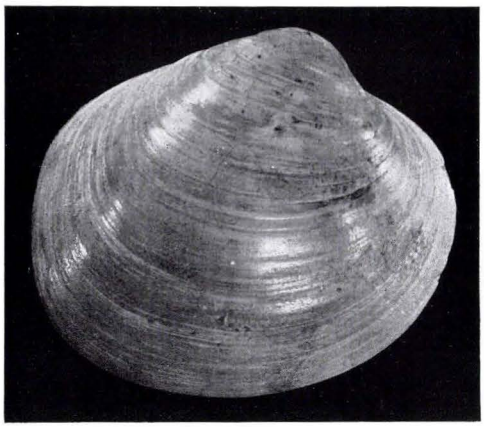

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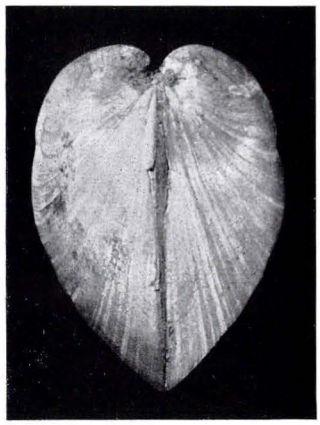

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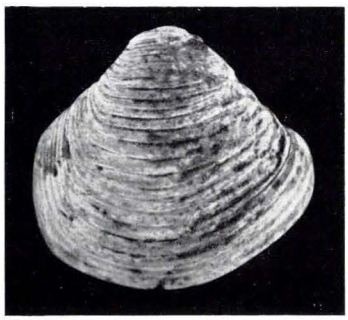

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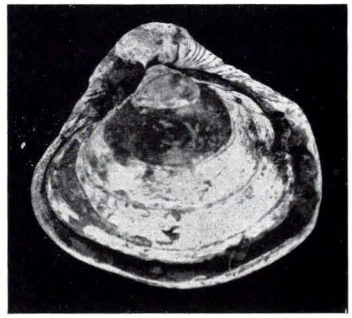

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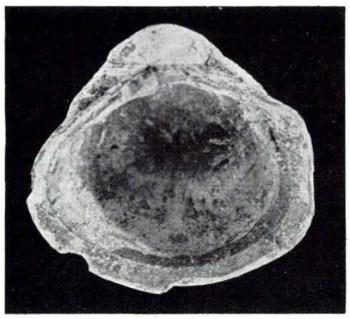

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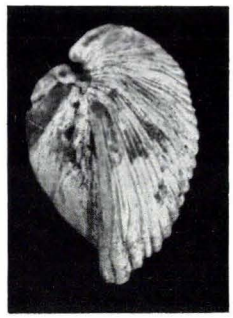

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Plate VII

		D.G.U. Catalogue No.	Text page
Figs. 1 and 3	*Dentalium dollfusi* v. KOENEN Locality: Måde Brickworks. Eastern clay pit. Northwall. Hodde Clay. Length: 11.3 mm. Diameter (exterior): 3.0 mm. Fig. 1: Cross-section Fig. 3: Exterior ×4.6	1968-LBR-34	79
Figs. 2 and 4	*Dentalium badense* PARTSCH Locality: Måde Brickworks. Eastern clay pit. South wall. Gram Clay. Length: 60.1 mm. Diameter (exterior): 7.7 mm. Fig. 2: Cross-section ×3.0 Fig. 4: Exterior ×1.3	1968-LBR-35	77
Figs. 5, 7, and 8	*Teinostoma pulchralis* (WOOD) Locality: Hauge. Clay pit. Glauconite Clay. Height: 1.8 mm. Diameter: 2.3 mm. Fig. 5: Apical view ×14.5 Fig. 7: Apertural view ×14.5 Fig. 8: Umbilical view ×14.5	1968-LBR-36	87
Fig. 6	*Teinostoma pulchralis* (WOOD) Locality: Hoddemark. 113.33a. 9–10 m. Gram Clay. Height: 1.4 mm. Diameter: 1.9 mm. Rear view ×17.8	1968-LBR-37	87
Figs. 9, 10, 12, and 13	*Calliostoma sp.* Locality: Måde Brickworks. Eastern clay pit. South wall. Gram Clay. Length: 5.7 mm. Diameter: 7.8 mm. Fig. 9: Dorsal view ×3.5 Fig. 10: Apertural view ×3.5 Fig. 12: Apical view ×3.8 Fig. 13: Basal view ×3.8	1968-LBR-38	86
Fig. 11	*Solariella jutensis nov. sp.* Locality: Måde Brickworks. Eastern clay pit. Gram Clay. Diameter: 0.8 mm. Apical view ×37.5	1968-LBR-39	84
Fig. 14	*Solariella jutensis nov. sp.* Locality: Brodersmark. 166.351b. 29–30 m. Gram Clay. Diameter: 0.9 mm. Basal view ×33.3	1968-LBR-40	84

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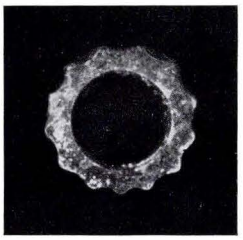

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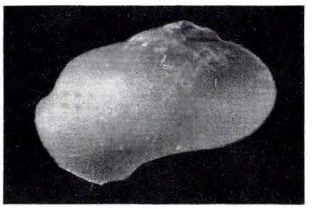

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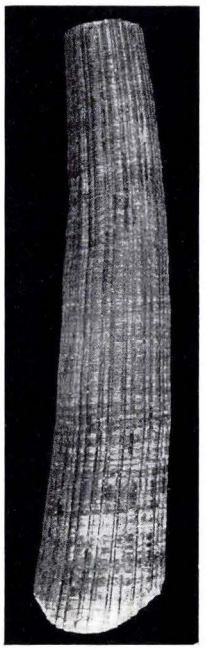

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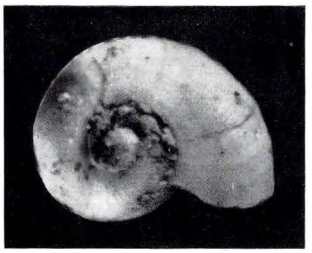

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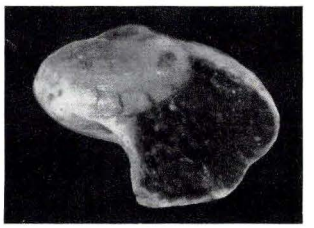

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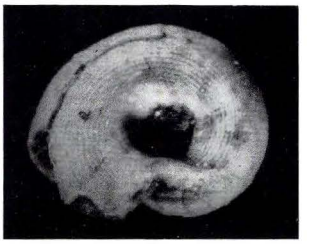

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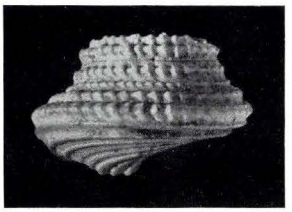

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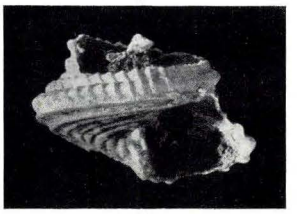

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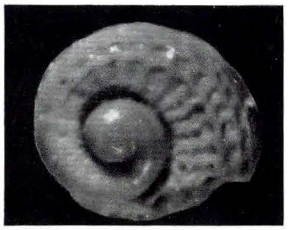

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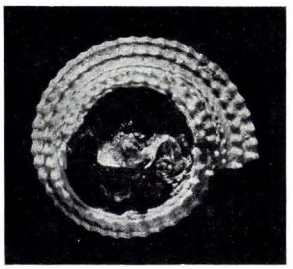

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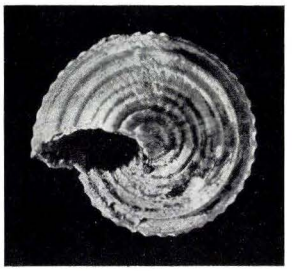

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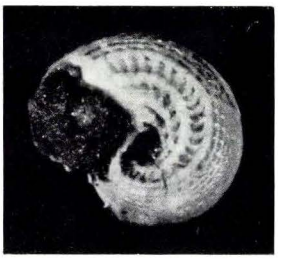

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Plate VIII

		D.G.U. Catalogue No.	Text page
Figs. 1 and 2	*Gastropoda non det. 2* Locality: Hesselho. 113.121. 50–56 m. Gram Clay. Height: 1.1 mm. Diameter: 1.2 mm. Fig. 1: Apical view ×27.5 Fig. 2: Apertural view ×27.5	1968-LBR-41	246
Figs. 3 and 4	*Putilla gottscheana* (V. KOENEN) Locality: Rødding. 141.75. 10.80–16.75 m. Gram Clay. Diameter of whorl no. 3: 0.6 mm. Fig. 3: Apex ×40.0 Fig. 4: Dorsal view ×40.0	1968-LBR-42	91
Fig. 5	*Putilla gottscheana* (V. KOENEN) Locality: Sønder Hygum. 141.261. 13–19 m. Gram Clay. Length: 0.9 mm. Apertural view ×44.4	1968-LBR-43	91
Fig. 6	*Aclis minor* (BROWN) Locality: Rødding. 141.75. 10.80–16.75 m. Gram Clay. Length: 0.9 mm. Apertural view ×33.3	1968-LBR-44	105
Fig. 7	*Archimediella subangulata* (BROCCHI) Locality: Måde Brickworks. Eastern clay pit. Gram Clay. Length: 9.9 mm. Diameter: 5.4 mm. Rear view ×4.3	1968-LBR-45	96
Fig. 8	*Archimediella subangulata* (BROCCHI) Locality: Måde Brickworks. Eastern clay pit. Gram Clay. Length: 13.8 mm. Diameter: 6.2 mm. Rear view ×3.1	1968-LBR-46	96
Fig. 9	*Bittium tenuispina* SORGENFREI Locality: Brodersmark. 166.351 b. 22.6–24.0 m. Gram Clay. Length: 1.6 mm. Apertural view ×25.0	1968-LBR-47	99
Fig. 10	*Triphora fritschi* (V. KOENEN) Locality: Lille Torup. 85.379. 16.8–20.8 m. Gram Clay. Length: 2.4 mm. Apertural view ×18.7	1968-LBR-48	101
Fig. 11	*Leiostraca glabra* (DA COSTA) Locality: Måde Brickworks. Eastern clay pit. Gram Clay. Length: 2.9 mm. Rear view ×13.8	1968-LBR-49	107
Fig. 12	*Scala cf. frondicula* (WOOD) Locality: Brodersmark. 166.351 b. 31–32 m. Gram Clay. Length: 2.9 mm. Apertural view ×13.8	1968-LBR-50	103
Fig. 13	*Scala cf. frondicula* (WOOD) Locality: Spandetgård. Clay pit. Gram Clay. Length: 6.0 mm. Rear view ×6.7	1968-LBR-51	103

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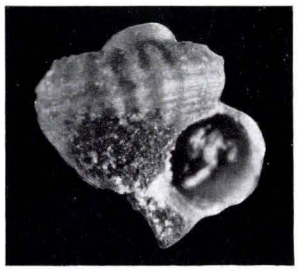

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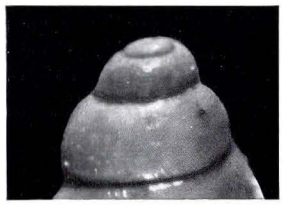

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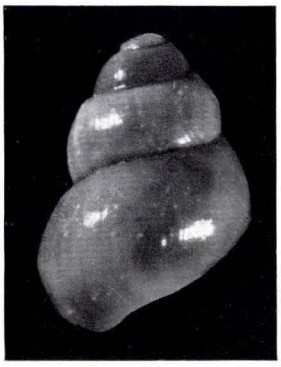

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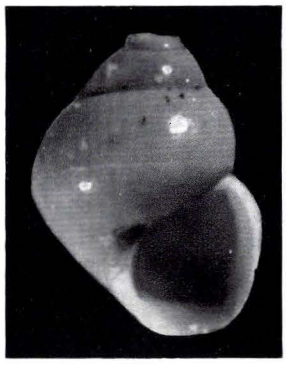

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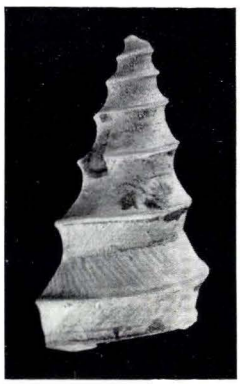

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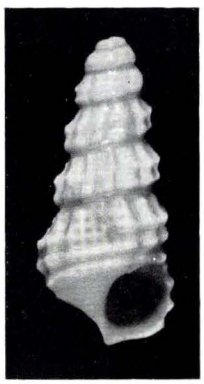

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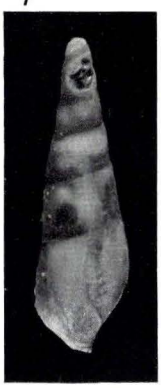

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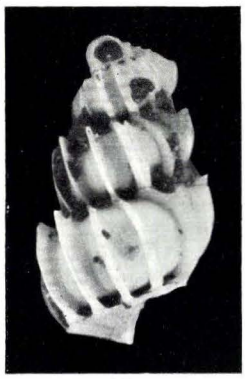

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Plate IX

		D.G.U. Catalogue No.	Text page
Figs. 1, 2, 3, and 4	*Gastropoda non det. 1*	1968-LBR-52	246

Locality: Muldbjerg. 83.1006. 8.0–9.0 m. Gram Clay.
Length: 1.0 mm. Diameter: 0.9 mm.
Fig. 1: Rear view ×30.0
Fig. 2: Apertural view ×30.0
Fig. 3: Apical view ×31.1
Fig. 4: Umbilical view ×31.1

Figs. 5 and 6	*Putilla gottscheana* (V. KOENEN)	1968-LBR-53	91

Locality: Gram. 141.277. 19.00–19.50 m. Gram Clay.
Length: 1.3 mm. Diameter: 0.9 mm.
Fig. 5: Rear view ×30.8
Fig. 6: Apertural view ×30.8

Fig. 7	*Cingula inusitata* (BEETS)	1968-LBR-54	94

Locality: Gram. 141.277. 18.00–18.50 m. Gram Clay.
Length: 2.9 mm. Diameter: 1.4 mm.
Rear view ×15.5

Fig. 8	*Cingula inusitata* (BEETS)	1968-LBR-55	94

Locality: Lille Torup. 85.379. 16.8–20.0 m. Gram Clay.
Length: 2.6 mm. Diameter: 1.3 mm.
Apertural view ×15.4

Figs. 9 and 10	*Cingula proxima laevigata* (V. KOENEN)	1968-LBR-56	93

Locality: Sønder Hygum. 141.261. 13–19 m. Gram Clay.
Length: 2.3 mm. Diameter: 1.2 mm.
Fig. 9: Rear view ×13.0
Fig. 10: Apertural view ×13.0

Figs. 11, 12, and 13	*Circulus praecedens* (V. KOENEN)	1968-LBR-57	89

Locality: Gram. 141.277. 35.30–35.70 m. Hodde Clay.
Height: 0.7 mm. Diameter: 1.2 mm.
Fig. 11: Apical view ×20.8
Fig. 12: Umbilical view ×20.8
Fig. 13: Apertural view ×20.8

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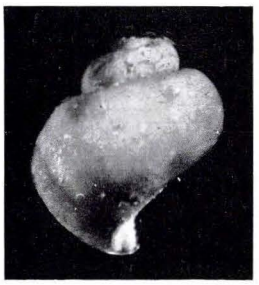

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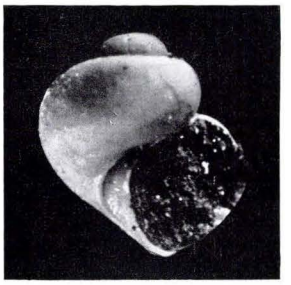

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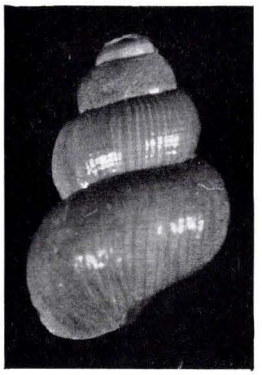

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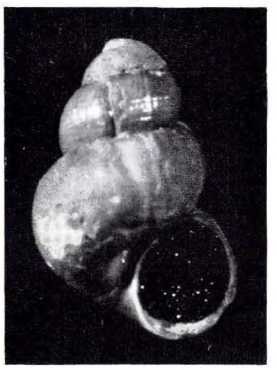

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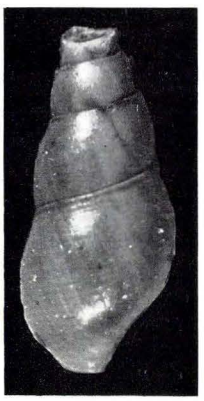

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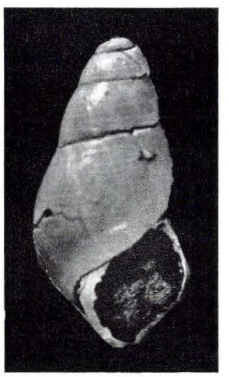

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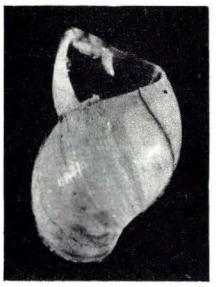

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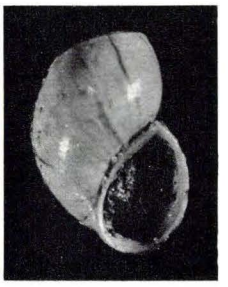

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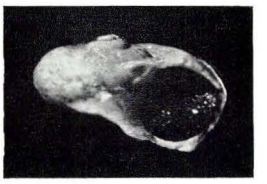

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Plate X

		D.G.U. Catalogue No.	Text page
Fig. 1	*Archimediella cochlias* (BAYAN)	1968-LBR-58	95
	Locality: Gram. 141.277. 11.65–12.10 m. Gram Clay. Length: 2.3 mm. Diameter: 1.2 mm. Apertural view ×17.4		
Fig. 2	*Solariella jutensis nov. sp.*	1968-LBR-59	84
	Locality: Gram. 141.277. 14.00–14.60 m. Gram Clay. Height: 0.7 mm. Diameter: 0.9 mm. Dorsal view ×27.8		
Figs. 3 and 4	*Aclis minor* (BROWN)	1968-LBR-60	105
	Locality: Gram. 141.277. 12.10–12.60 m. Gram Clay. Length: 1.7 mm. Diameter: 0.6 mm. Fig. 3: Rear view ×23.5 Fig. 4: Apertural view ×23.5		
Fig. 5	*Opalia vilandti* (MØRCH)	1968-LBR-61	102
	Locality: Hoddemark. Karlsgårde Canal. Shell Bed I. Length: 4.8 mm. Diameter: 1.9 mm. Apertural view ×9.4		
Figs. 6 and 7	*Polinices protracta* (EICHWALD)	1968-LBR-62	115
	Locality: Hoddemark. Karlsgårde Canal. Shell Bed I. Length: 14.1 mm. Diameter: 11.5 mm. Fig. 6: Rear view ×2.2 Fig. 7: Apertural view ×2.2		
Fig. 8	*Polinices protracta* (EICHWALD)	1968-LBR-63	115
	Locality: Morsum Kliff, Sylt (North Germany). Glimmerton. Length: 12.1 mm. Diameter: 10.1 mm. Rear view ×2.5		
Fig. 9	*Polinices protracta* (EICHWALD)	1968-LBR-64	115
	Locality: Hauge. Clay pit. Glauconite Clay. Length: 17.0 mm. Diameter: 12.0 mm. Rear view ×1.8		
Fig. 10	*Scaphella bolli* (KOCH)	1968-LBR-65	163
	Locality: Hoddemark. Karlsgårde Canal. Shell Bed I. Length: 37.3 mm. Diameter: 12.5 mm. Apertural view ×1.7		
Figs. 11 and 12	*Polinices catena* (DA COSTA)	1968-LBR-66	113
	Locality: Måde Brickworks. Eastern clay pit. Gram Clay. Length: 15.9 mm. Diameter: 16.2 mm. Fig. 11: Rear view ×1.9 Fig. 12: Apertural view ×1.9		

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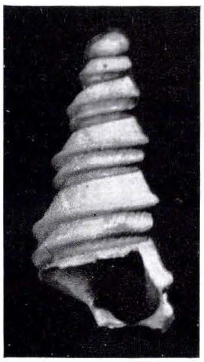

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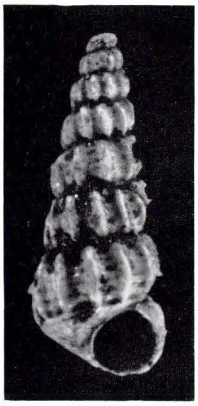

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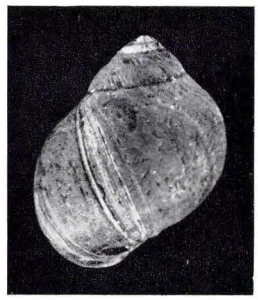

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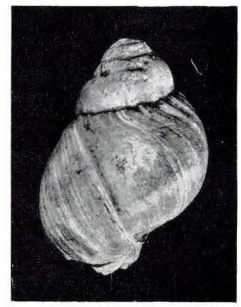

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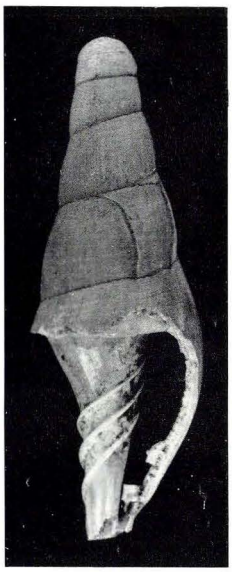

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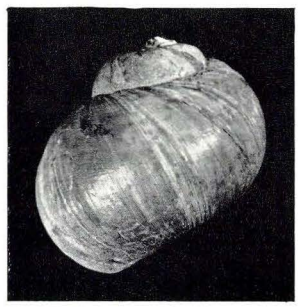

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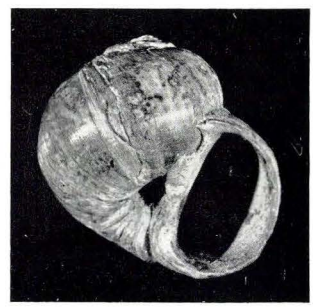

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Plate XI

		D.G.U. Catalogue No.	Text page
Figs. 1 and 2	*Hinia fuchsi* v. KOENEN	1968-LBR-67	136
	Locality: Måde Brickworks. Eastern clay pit. Hodde Clay. Length: 5.5 mm. Diameter: 3.0 mm. Fig. 1: Apertural view ×7.3 Fig. 2: Rear view ×7.3		
Figs. 3, 5, and 6	*Hinia holsatica* (BEYRICH)	1968-LBR-68	138
	Locality: Måde Brickworks. Eastern clay pit. Gram Clay. Length: 5.4 mm. Diameter: 3.2 mm. Diameter of the last protoconch-whorl: 1.2 mm. Fig. 3. Protoconch ×16.7 Fig. 5: Rear view × 9.4 Fig. 6: Apertural view × 9.4		
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Fig. 7	*Hinia holsatica* (BEYRICH)		138
	Locality: Langenfelde (Germany). Mica Clay. Length: 5.6 mm. Diameter: 3.3 mm. Apertural view ×9.1		

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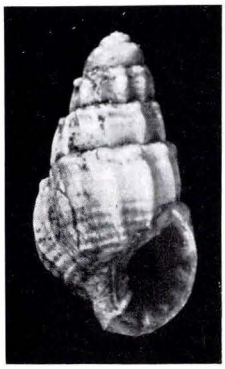
The originals of figs. 1–6 and 8 are kept in the collection of the Geological Survey of Denmark. The original of fig. 7 is in the Geological Museum of the University of Copenhagen.



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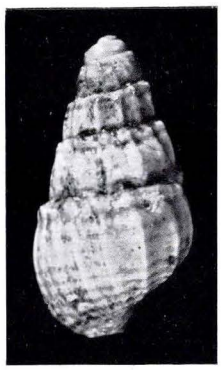

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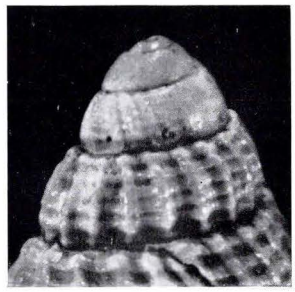

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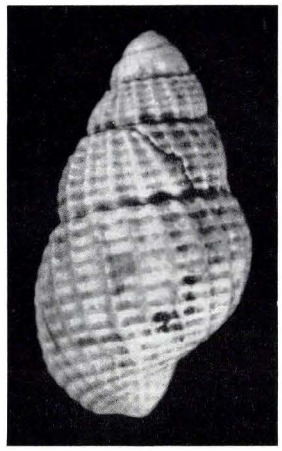

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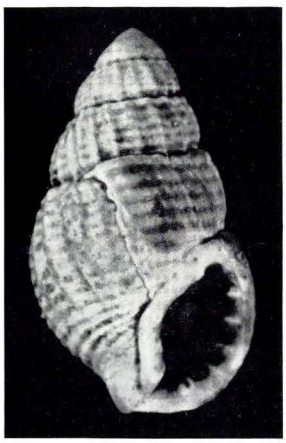

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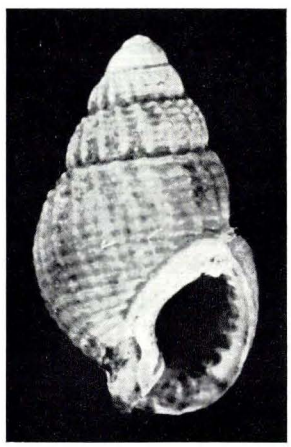

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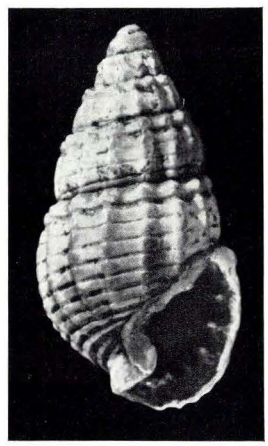

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Plate XII

		D.G.U. Catalogue No.	Text page
Figs. 1 and 2	*Hinia schlotheimi* (BEYRICH) Locality: Hoddemark. Karlsgårde Canal. Shell Bed I. Length: 15.7 mm. Diameter: 6.5 mm. Fig. 1: Rear view ×3.3 Fig. 2: Apertural view ×3.3	1968-LBR-70	138
Figs. 3 and 4	*Hinia cimbrica* RAVN Locality: Hoddemark. Karlsgårde Canal. Shell Bed I. Length: 5.8 mm. Diameter: 3.1 mm. Fig. 3: Rear view ×6.9 Fig. 4: Apertural view ×6.9	1968-LBR-71	142
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Fig. 7	*Gastropoda non det. 3* Locality: Gram. 141.277. 6.90–7.30 m. Gram Clay. Length: 2.8 mm. Diameter: 1.7 mm. Juvenile shell. Rear view ×14.6	1968-LBR-74	247
Figs. 8 and 9	*Narona calcarata* (BROCCHI) Locality: Gram. 141.277. 12.10–12.60 m. Gram Clay. Length: 3.0 mm. Diameter: 2.2 mm. Fig. 8: Rear view ×13.3 Fig. 9: Apertural view ×13.3	1968-LBR-75	168

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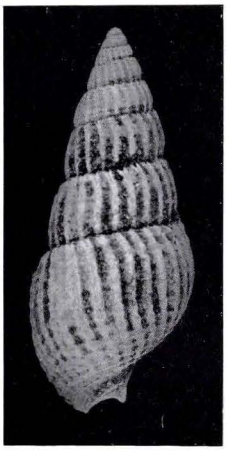

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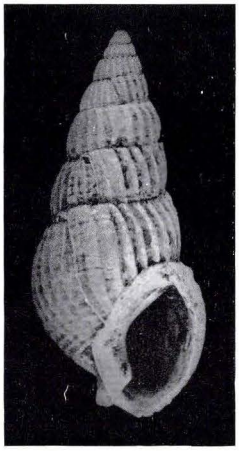

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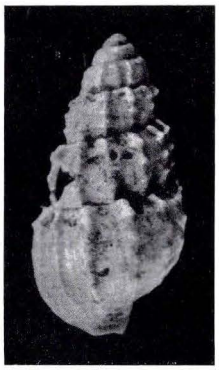

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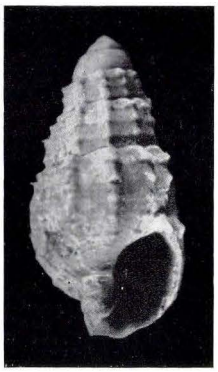

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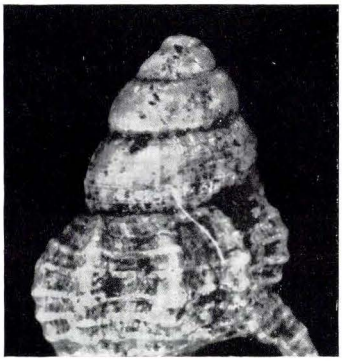

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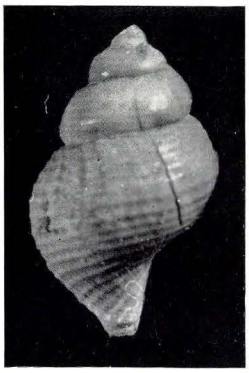

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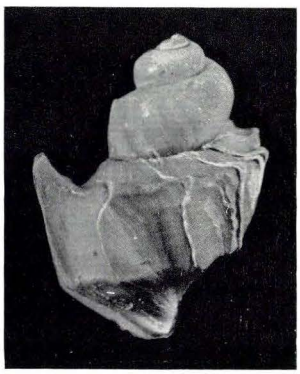

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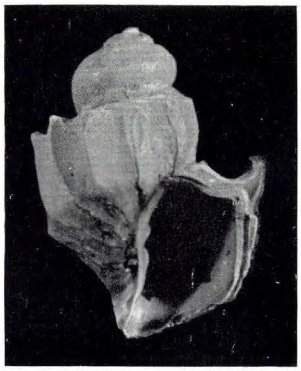

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Plate XIII

		D.G.U. Catalogue No.	Text page
Fig. 1	*Aquilofusus sp.* Locality: Måde. Strandgård Brickworks. Gram Clay. Length: 39.6 mm. Diameter: 16.5 mm. Apertural view ×1.5	1968-LBR-76	159
Fig. 2	*Aquilofusus festivus* (BEYRICH) Locality: Twistringen (Germany). Dark Mica Clay. Length: 26.3 mm. Diameter: 11.8 mm. Rear view ×2.3	1968-LBR-77	151
Fig. 3	*Aquilofusus festivus* (BEYRICH) Locality: Hoddemark. Karlsgårde Canal. Shell Bed I. Length of the fragment: 8.0 mm. Width: 5.6 mm. Fragment ×6.3	1968-LBR-78	151
Fig. 4	*Aquilofusus luneburgensis tricinctus* (BEYRICH) Locality: Langenfelde (Germany). Mica Clay. Length: 17.3 mm. Diameter: 10.7 mm. Rear view ×3.6		154
Fig. 5	*Aquilofusus puggaardi* (BEYRICH) Locality: Måde Brickworks. Eastern clay pit. Gram Clay. Length: 18.1 mm. Diameter: 6.3 mm. Rear view ×2.8	1968-LBR-79	160
Fig. 6	*Aquilofusus puggaardi* (BEYRICH) Locality: Måde Brickworks. Eastern clay pit. Gram Clay. Length: 14.6 mm. Diameter: 5.8 mm. Rear view ×3.4	1968-LBR-80	160
Fig. 7	*Streptochetus abruptus* (BEYRICH) Locality: Twistringen (Germany). Dark Mica Clay. Diameter of the last protoconch-whorl: 1.2 mm. Protoconch ×12.5	1968-LBR-81	149
Fig. 8	*Lathyrus rothi* (BEYRICH) Locality: Måde Brickworks. Eastern clay pit. Gram Clay. Diameter of the last protoconch-whorl: 1.4 mm. Protoconch ×14.3	1968-LBR-82	143
Fig. 9	*Scaphella bolli* (KOCH) Locality: Måde Brickworks. Eastern clay pit. Gram Clay. Diameter of protoconch: 11.1 mm. Protoconch ×2.3	1968-LBR-83	163

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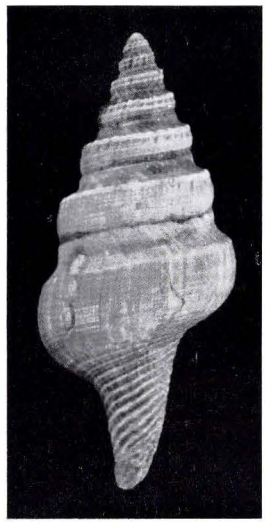

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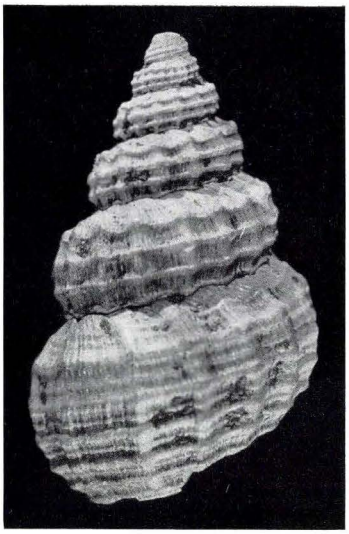

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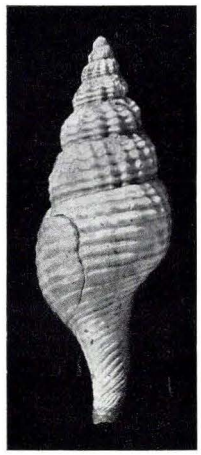

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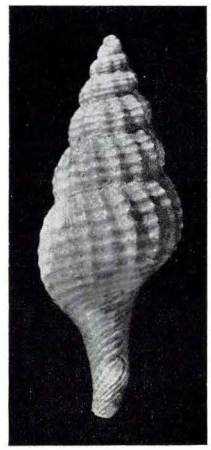

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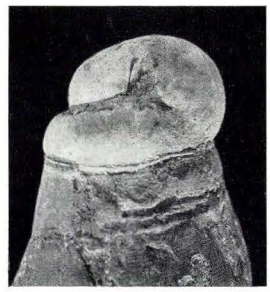

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Plate XIV

		D.G.U. Catalogue No.	Text page
Figs. 1 and 2	*Aquilofusus luneburgensis luneburgensis* (PHILIPPI) Locality: Måde Brickworks. Eastern clay pit. Gram Clay. Length: 41.4 mm. Diameter: 16.2 mm. Fig. 1: Rear view ×1.5 Fig. 2: Apertural view ×1.5	1968-LBR-84	155
Fig. 3	*Aquilofusus festivus* (BEYRICH) Locality: Hoddemark. Karlsgårde Canal. Shell Bed I. Length: 22.4 mm. Diameter: 11.9 mm. Rear view ×2.8	1968-LBR-85	151
Fig. 4	*Aquilofusus luneburgensis meyni* (V. KOENEN) Locality: Måde Brickworks. Eastern clay pit. Gram Clay. Length: 36.4 mm. Diameter: 14.1 mm. Rear view ×1.7	1968-LBR-86	156
Fig. 5	*Aquilofusus luneburgensis eximius* (BEYRICH) Locality: Langenfelde (Germany). Glimmerton. Length: 32.1 mm. Diameter: 13.5 mm. Rear view ×1.9		156
Fig. 6	*Aquilofusus luneburgensis eximius* (BEYRICH) Locality: Esbjerg. Beach SE of the town. Gram Clay. Length: 31.5 mm. Diameter: 12.3 mm. Rear view ×1.9	1968-LBR-87	156
Fig. 7	*Aquilofusus luneburgensis luneburgensis* (PHILIPPI) Locality: Måde Brickworks. Eastern clay pit. Gram Clay. Diameter of the last protoconch-whorl: 1.9 mm. Protoconch ×14.2	1968-LBR-88	155
Fig. 8	*Aquilofusus festivus* (BEYRICH) (Same shell as pictured on Plate XIII, fig. 2) Diameter of the last protoconch-whorl: 1.8 mm. Protoconch ×13.9	1968-LBR-77	151
Fig. 9	*Aquilofusus luneburgensis tricinctus* (BEYRICH) (Same shell as pictured on Plate XIII, fig. 4) Diameter of the last protoconch-whorl: 1.7 mm. Protoconch ×10.0		154

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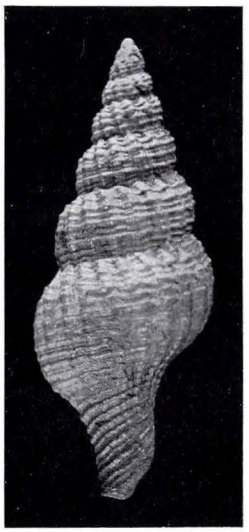

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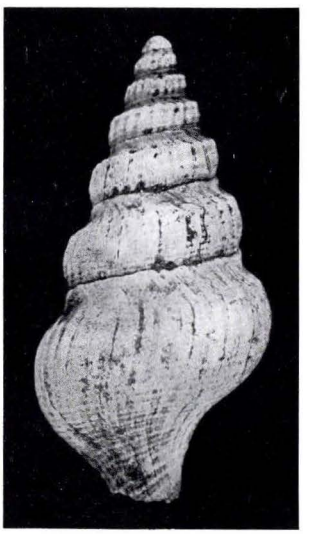

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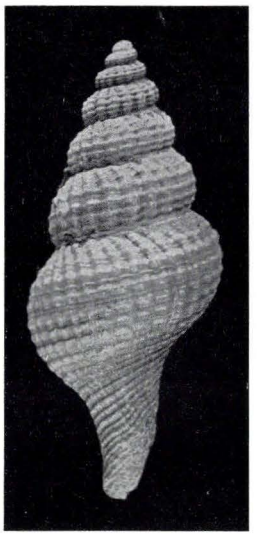

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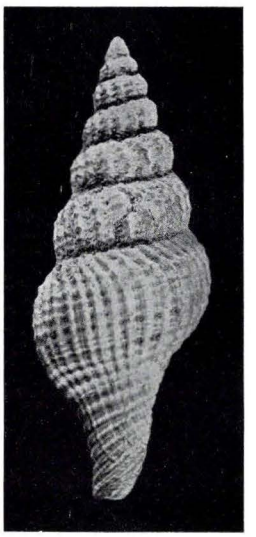

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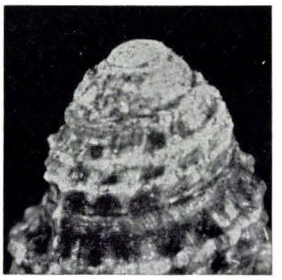

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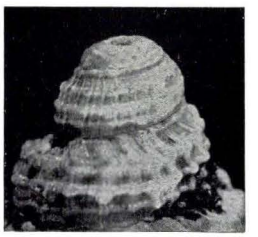

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Plate XV

		D.G.U. Catalogue No.	Text page
Figs. 1 and 4	*Streptochetus "quinquecostatus" (nov. sp.?)* Locality: Hoddemark. Karlsgårde Canal. Shell Bed I. Length: 22.8 mm. Diameter: 10.0 mm. Fig. 1: As seen towards the apex ×2.5	1968-LBR-89	148
Figs. 2 and 3	*Aquilofusus eximius* (BEYRICH) emend. HINSCH Locality: Morsum Kliff, Sylt (Germany). Glimmerton. Length: 29.5 mm. Diameter: 12.3 mm. Diameter of the last protoconch-whorl: 2.2 mm. Fig. 2: Protoconch ×5.2 Fig. 3: Rear view ×2.4	1968-LBR-90	157
Fig. 5	*Trophonopsis semperi* (V. KOENEN) Locality: Odderup. 103.150. 14.5–20.0 m. Gram Clay. Diameter of the last protoconch-whorl: 0.6 mm. Protoconch ×45.0	1968-LBR-91	123
Fig. 6	*Trophonopsis semperi* (V. KOENEN) Locality: Brodersmark. 166.351 b. 31–32 m. Gram Clay. Length: 5.3 mm. Diameter: 2.8 mm. Rear view ×11.3	1968-LBR-92	123
Fig. 7	*Exilia contigua* (BEYRICH) Locality: Hoddemark. Karlsgårde Canal. Shell Bed I. Length: 22.3 mm. Diameter: 4.8 mm. Rear view ×3.2	1968-LBR-93	145
Fig. 8	*Exilia contigua* (BEYRICH) Locality: Måde Brickworks. Eastern clay pit. Hodde Clay. Length: 13.6 mm. Diameter: 5.1 mm. Rear view ×5.1	1968-LBR-94	145

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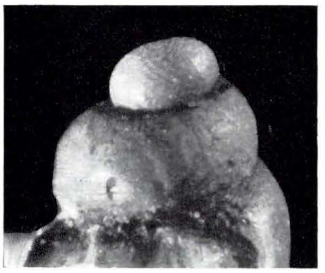

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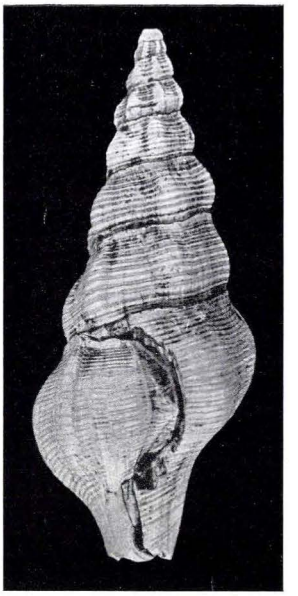

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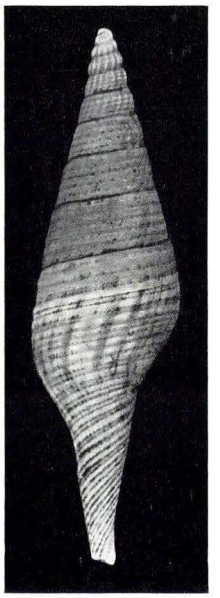

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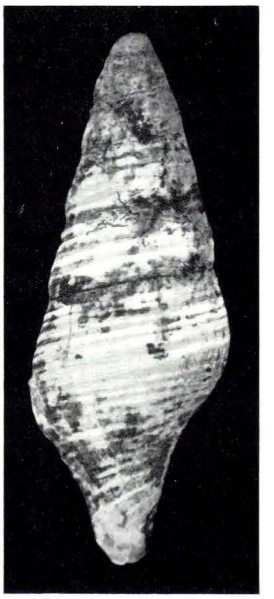

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Plate XVI

		D.G.U. Catalogue No.	Text page
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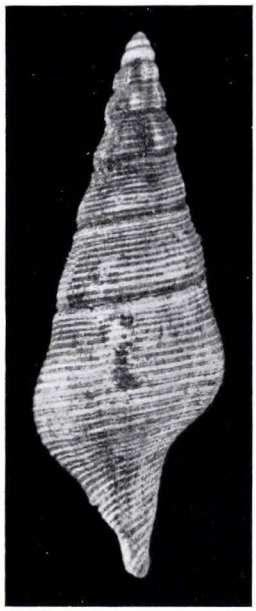

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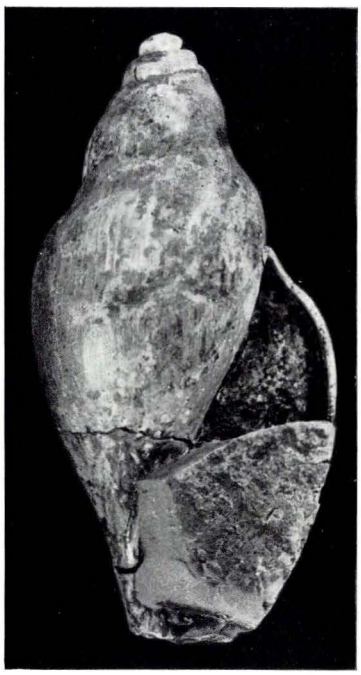

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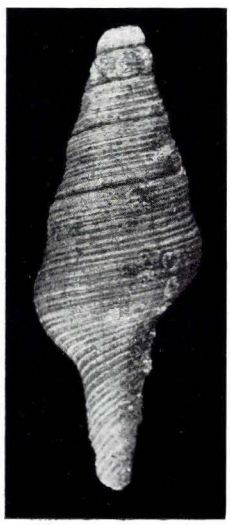

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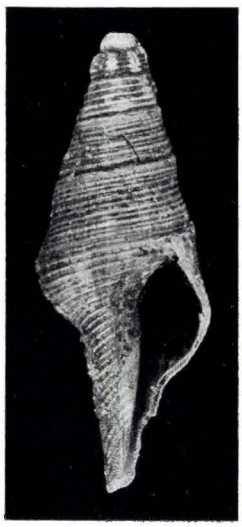

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Plate XVII

		D.G.U. Catalogue No.	Text page
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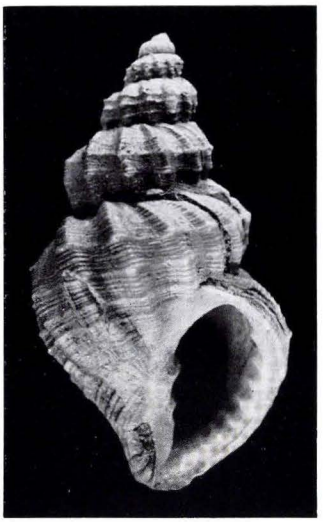

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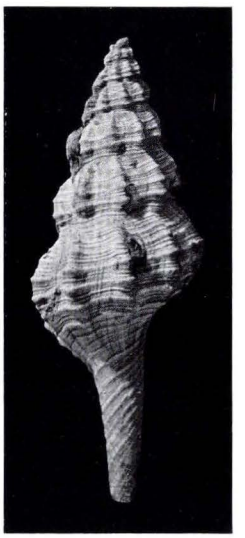

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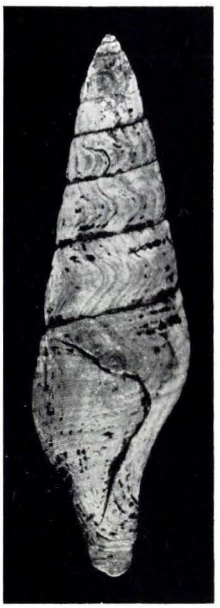

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Plate XVIII

		D.G.U. Catalogue No.	Text page
Fig. 1	*Splendrillia selenkae* (V. KOENEN) Locality: Måde Brickworks. Eastern clay pit. Hodde Clay. Length: 11.9 mm. Diameter: 9.9 mm. Rear view ×5.1	1968-LBR-103	194
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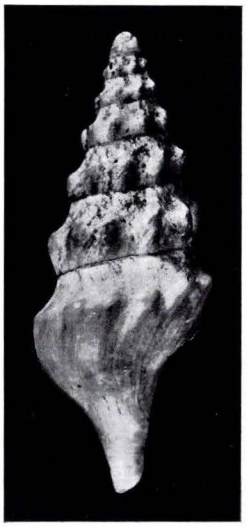

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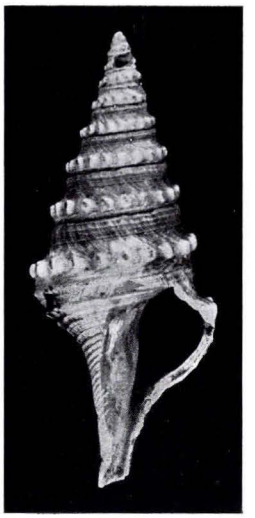

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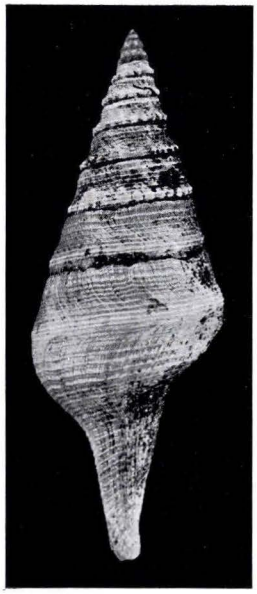

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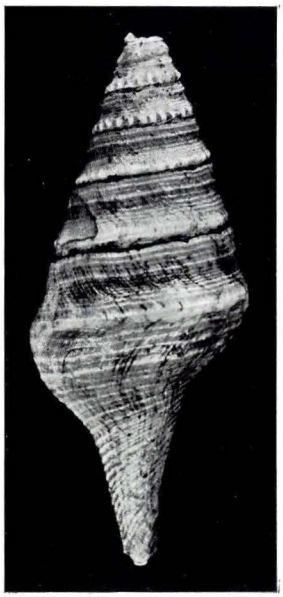

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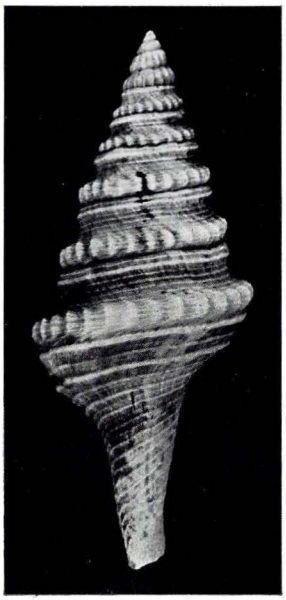

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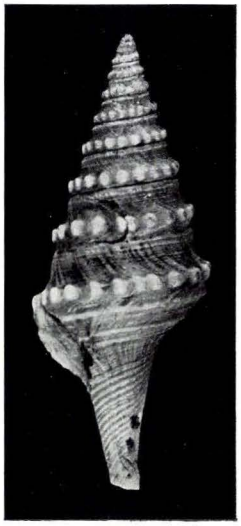

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Plate XIX

		D.G.U. Catalogue No.	Text page
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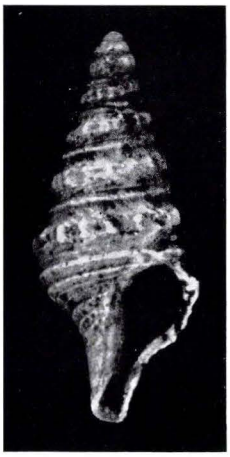

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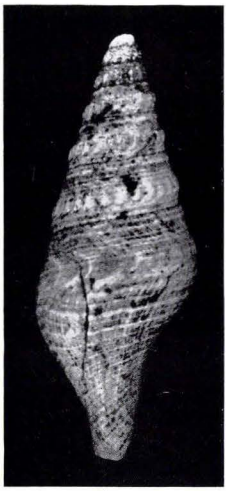

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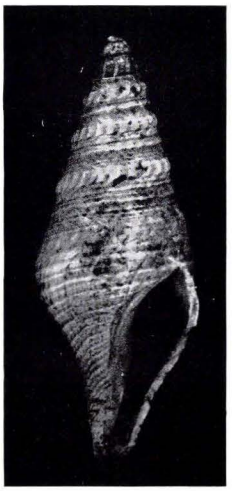

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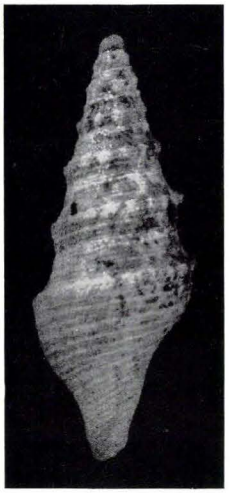

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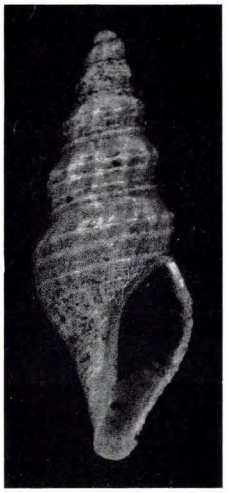

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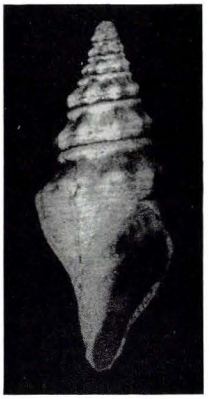

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Plate XX

		D.G.U. Catalogue No.	Text page
Fig. 1	*Borsonia uniplicata* (V. KOENEN) Locality: Måde Brickworks. Eastern clay pit. Hodde Clay. Length: 10.9 mm. Diameter: 4.6 mm. Apertural view ×5.6	1968-LBR-115	203
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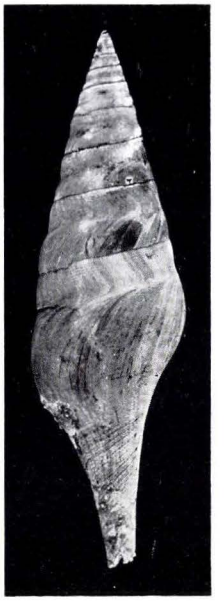

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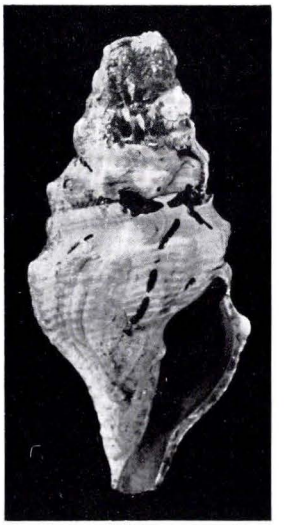

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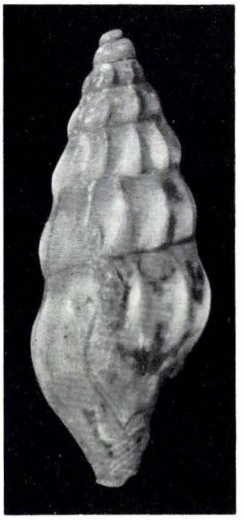

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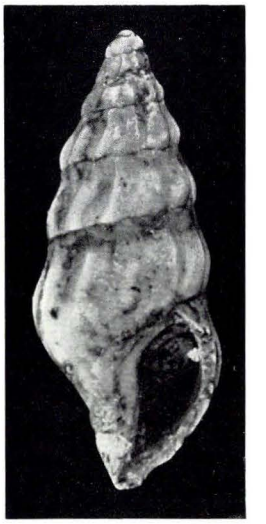

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Plate XXI

		D.G.U. Catalogue No.	Text page
Fig. 1	*Spirotropis modiola* (JAN) (with rounded-off carina) Locality: Måde Brickworks. Eastern clay pit. Gram Clay. Length: 9.7 mm. Diameter: 4.1 mm. Rear view ×7.3	1968-LBR-120	187
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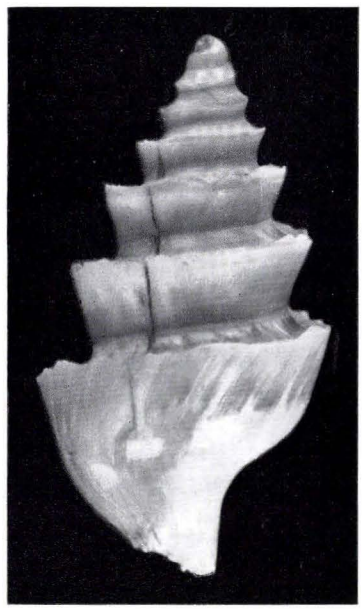

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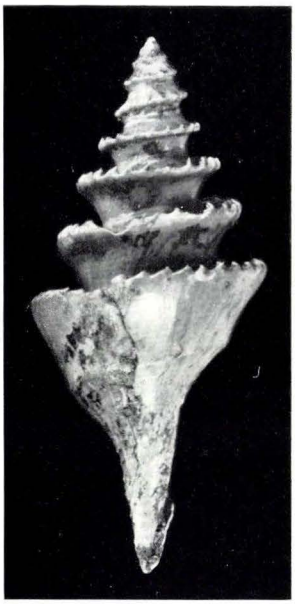

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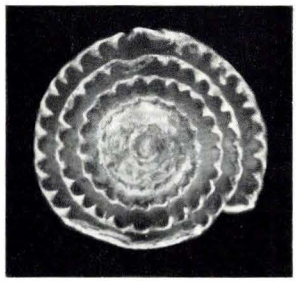

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Plate XXII

		D.G.U. Catalogue No.	Text page
Fig. 1	*Microdrillia serratula* (BELLARDI) Locality: Hesselho. 113.121. 56–65 m. Gram Clay. Length: 4.4 mm. Diameter: 2.0 mm. Rear view ×13.6	1968-LBR-125	195
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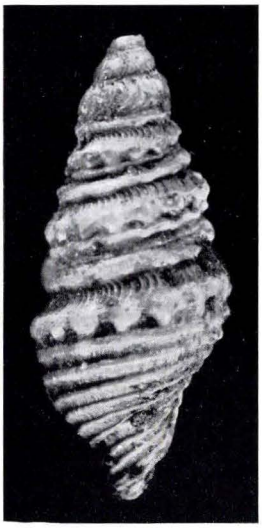

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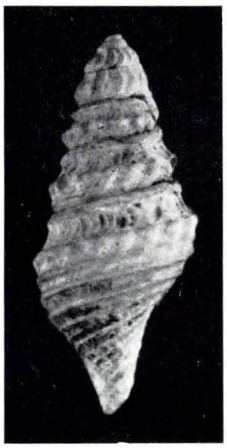

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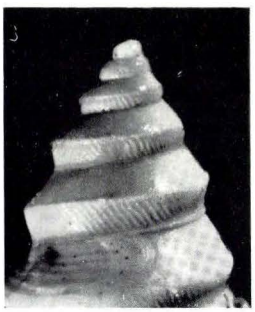

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Plate XXIII

		D.G.U. Catalogue No.	Text page
Figs. 1 and 2	*Asthenotoma ravni nov. sp.* Locality: Måde Brickworks. Eastern clay pit. Gram Clay. Length: 8.6 mm. Diameter: 2.9 mm. Fig. 1: Rear view ×7.0 Fig. 2: Apertural view ×7.0	1968-LBR-132	197
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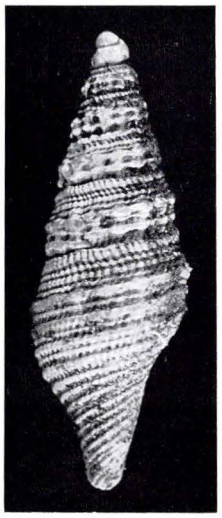

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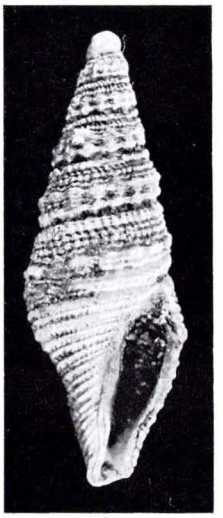

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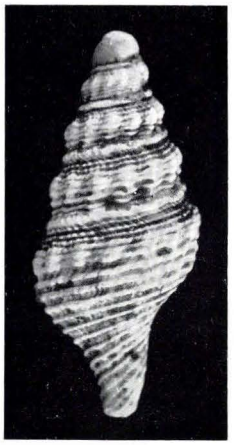

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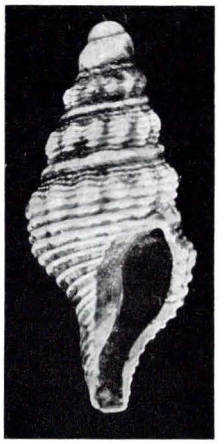

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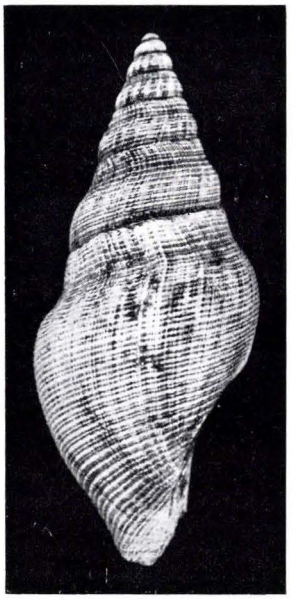

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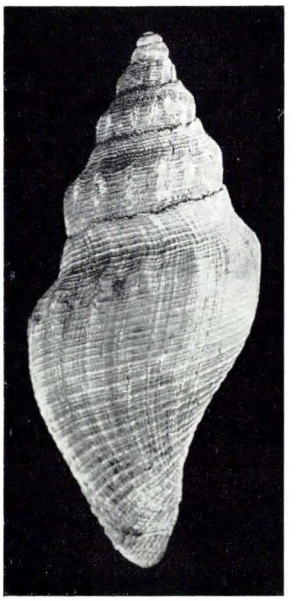

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Plate XXIV

		D.G.U. Catalogue No.	Text page
Fig. 1	*Neoguraleus kochi* (v. KOENEN) Juvenile shell Locality: Brodersmark. 166.351 b. 26–27 m. Gram Clay. Length: 2.1 mm. Diameter: 1.3 mm. Rear view ×19.0	1968-LBR-136	204
Figs. 2 and 3	*Bathytoma cataphracta jugleri* (PHILIPPI) Locality: Måde Brickworks. Eastern clay pit. Hodde Clay. Length: 15.0 mm. Diameter: 5.2 mm. Fig. 2: Rear view ×33.3 Fig. 3: Apertural view ×33.3	1968-LBR-137	182
Fig. 4	*Neoguraleus sæthensis* RASMUSSEN Locality: Sæd. 167.4. About 70–82 m. Gram Clay. Length: 3.0 mm. Diameter: 1.4 mm. Apertural view ×20.0	1968-LBR-138	206
Fig. 5	*Philbertia sinuosula* SORGENFREI Locality: Spandetgård. Clay pit. Gram Clay. Length: 7.1 mm. Diameter: 3.4 mm. Rear view ×8.5	1968-LBR-139	212
Fig. 6	*Philbertia sinuosula* SORGENFREI Locality: Hesselho. 113.121. 56–65 m. Gram Clay. Length: 2.4 mm. Diameter: 1.3 mm. Rear view ×20.8	1968-LBR-140	212
Fig. 7	*Philbertia sinuosula* SORGENFREI Locality: Drantum. 104.1241. 46–50 m. Gram Clay. Length: 2.5 mm. Diameter: 1.3 mm. Rear view ×20.4	1968-LBR-141	212

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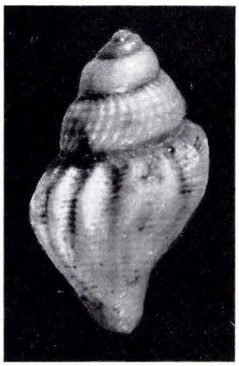

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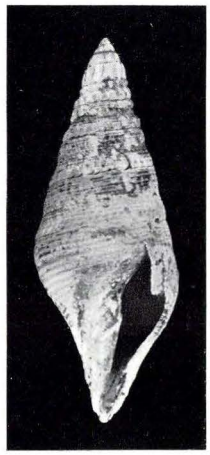

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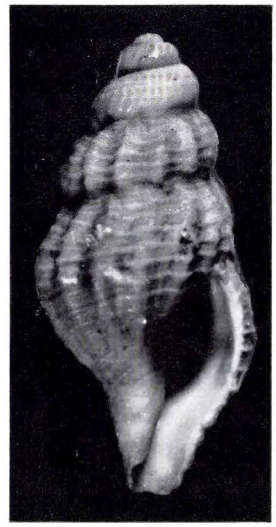

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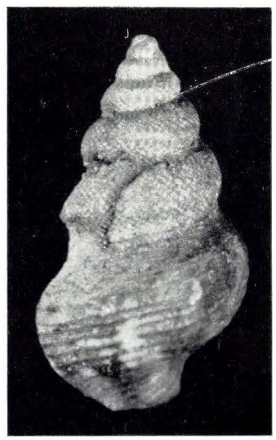

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Plate XXV

		D.G.U. Catalogue No.	Text page
Figs. 1 and 2	*Acteon semistriatus* (BASTEROT) Locality: Hygum. 141.261. 13–19 m. Gram Clay. Length: 1.3 mm. Diameter: 1.0 mm. Fig. 1: Rear view ×28.5 Fig. 2: Apertural view ×28.5	1968-LBR-142	214
Fig. 3	*Ringicula buccinea* (BROCCHI) Locality: Måde Brickworks. Eastern clay pit. Hodde Clay. Length: 4.8 mm. Width: 3.7 mm. Apertural view ×8.3	1968-LBR-143	232
Figs. 4 and 5	*Ringicula buccinea* (BROCCHI) Locality: Måde Brickworks. Eastern clay pit. Gram Clay. Length: 4.0 mm. Width: 3.0 mm. Fig. 4: Rear view ×10.3 Fig. 5: Apertural view ×10.3	1968-LBR-144	232
Fig. 6	*Turbonilla costellata* (GRATELOUP) Locality: Lille Torup. 85.379. 16.8–20.0 m. Gram Clay. Length: 2.0 mm. Diameter: 0.9 mm. Rear view ×21.1	1968-LBR-145	226
Fig. 7	*Turbonilla costellata* (GRATELOUP) Locality: Sønder Hygum. 141.261. 13–19 m. Gram Clay. Length: 3.0 mm. Diameter: 1.4 mm. Apertural view ×14.3	1968-LBR-146	226
Fig. 8	*Chrysallida semireticulata* SORGENFREI Locality: Rends. 167.236. 140′–160′. Gram Clay. Length: 1.6 mm. Diameter: 0.7 mm. Apertural view ×25.0	1968-LBR-147	218
Fig. 9	*Chrysallida semireticulata* SORGENFREI Locality: Sæd. 167.4. 70–82 m. Gram Clay. Length: 1.7 mm. Diameter: 0.9 mm. Rear view ×23.5	1968-LBR-148	218
Fig. 10	*Chrysallida pygmaea* (GRATELOUP) Locality: Hajstrup. 167.235. 194′–214′. Hodde Clay. Length: 2.1 mm. Diameter: 1.1 mm. Rear view ×19.0	1968-LBR-149	216
Fig. 11	*Chrysallida pygmaea* (GRATELOUP) Locality: Drantum. 104.1241. 36–40 m. Gram Clay. Length: 1.8 mm. Diameter: 1.0 mm. Apertural view ×22.2	1968-LBR-150	216

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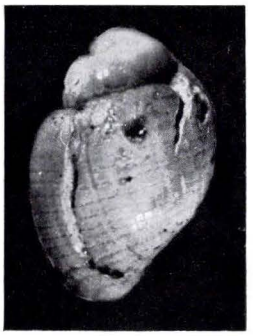

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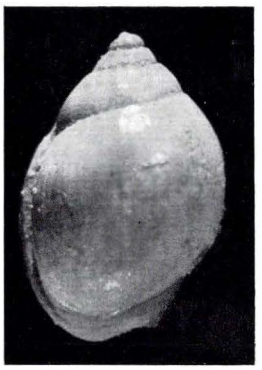

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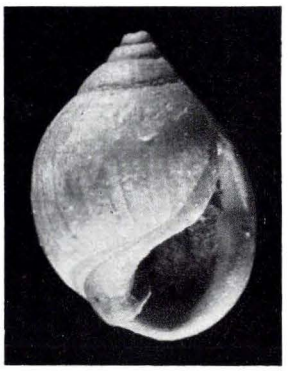

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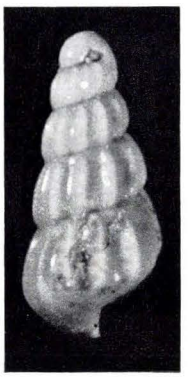

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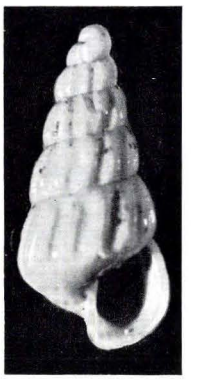

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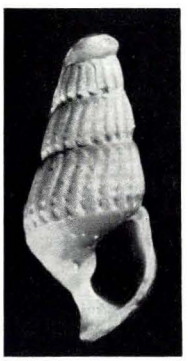

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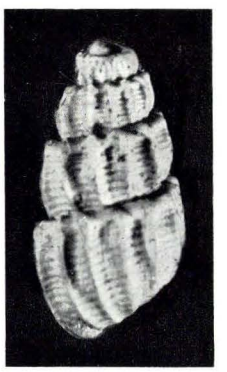

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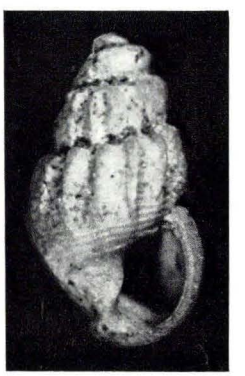

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Plate XXVI

		D.G.U. Catalogue No.	Text page
Figs. 1 and 2	*Kleinella nordmanni* SORGENFREI	1968-LBR-151	219
	Locality: Gram. 141.277. 9.00–9.50 m. Gram Clay. Length: 1.7 mm. Diameter: 0.8 mm. Fig. 1: Rear view ×23.5 Fig. 2: Apertural view ×23.5		
Fig. 3	*Chrysallida semireticulata* SORGENFREI	1968-LBR-152	218
	(specimen with smooth whorls) Locality: Gram. 141.277. 14.00–14.60 m. Gram Clay. Length: 2.1 mm. Diameter: 1.0 mm. Apertural view ×20.0		
Figs. 4 and 5	*Chrysallida pygmaea* (GRATELOUP)	1968-LBR-153	216
	Locality: Gram. 141.277. 16.00–16.50 m. Gram Clay. Length: 2.1 mm. Diameter: 1.1 mm. Fig. 4: Rear view ×19.5 Fig. 5: Apertural view ×19.0		
Fig. 6	*Ringicula sp.*	1968-LBR-154	235
	Locality: Gram. 141.277. 20.50–21.00 m. Gram Clay. Length: 1.3 mm. Diameter: 0.8 mm. Apertural view ×30.8		
Figs. 7 and 8	*Diaphana moerchi nov. sp.*	1968-LBR-155	235
	Locality: Gram. 141.277. 9.50–9.90 m. Gram Clay. Length: 1.5 mm. Diameter: 1.5 mm. Fig. 7: Apertural view ×20.7 Fig. 8: Apical view ×22.1		
Figs. 9 and 10	*Diaphana moerchi nov. sp.*	1968-LBR-156	235
	Locality: Muldbjerg. 83.1006. 7.0–8.0 m. Gram Clay. Length: 2.3 mm. Diameter: 1.8 mm. Fig. 9: Rear view ×13.6 Fig. 10: Apical view ×13.9		
Figs. 11 and 12	*Acera bellardii* (V. KOENEN)	1968-LBR-157	237
	Locality: Måde Brickworks. Eastern clay pit. Hodde Clay. Length: 5.9 mm. Diameter: 2.4 mm. Fig. 11: Rear view ×7.6 Fig. 12: Apertural view ×7.6		

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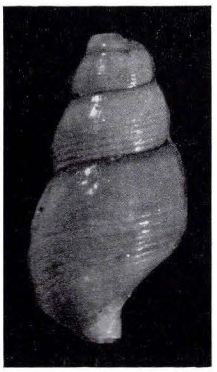

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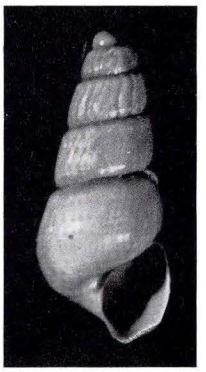

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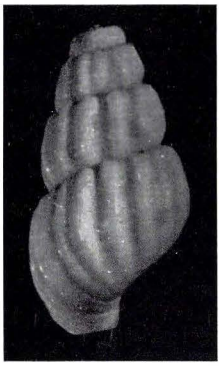

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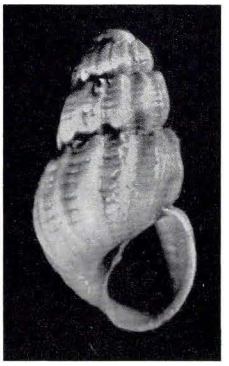

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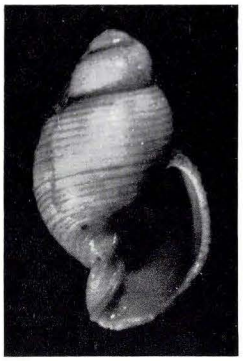

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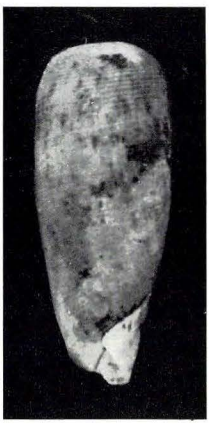

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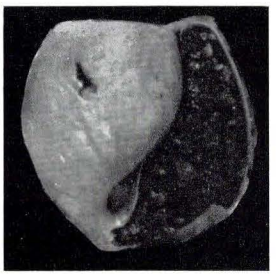

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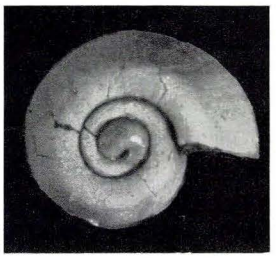

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Plate XXVII

		D.G.U. Catalogue No.	Text page
Figs. 1, 2, 3, and 11	*Spiratella valvatina* REUSS	1968-LBR-158	243

Locality: Gram. 141.277. 27.00–27.50 m. Hodde Clay.
Height: 1.0 mm. Diameter: 1.1 mm.
Fig. 1: Rear view ×30.0
Fig. 2: Apertural view ×30.0
Fig. 3: Apical view ×30.0
Fig. 11: Umbilical view ×30.0

Figs. 4, 5, 6, and 7	*Spiratella gramensis nov. sp.*	1968-LBR-159	244

Locality: Gram. 141.277. 20.00–21.50 m. Gram Clay.
Height: 1.5 mm. Diameter: 1.2 mm.
Fig. 4: Rear view ×20.0
Fig. 5: Apertural view ×20.0
Fig. 6: Apical view ×20.0
Fig. 7: Umbilical view ×20.0

Figs. 8, 9, and 10	*Spiratella atlanta* (MØRCH)	1968-LBR-160	243

Locality: Gram. 141.277. 27.00–27.50 m. Hodde Clay.
Height: 0.8 mm. Diameter: 1.3 mm.
Fig. 8: Apical view ×24.6
Fig. 9: Apertural view ×23.1
Fig. 10: Umbilical view ×24.6

Figs. 12 and 13	*Gastropoda non det. 4*	1968-LBR-161	247

Locality: Gram. 141.277. 9.90–10.30 m. Gram Clay.
Length: 1.2 mm. Diameter: 1.0 mm.
Fig. 12: Apertural view ×30.0
Fig. 13: Apex ×50.0

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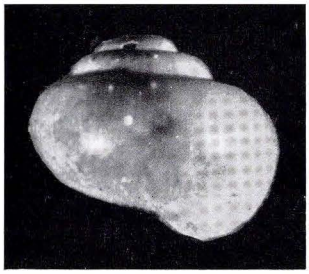

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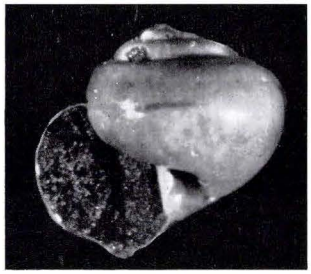

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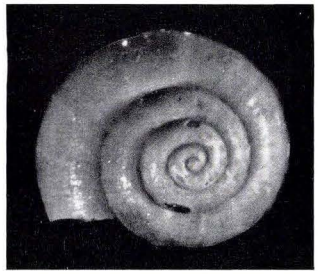

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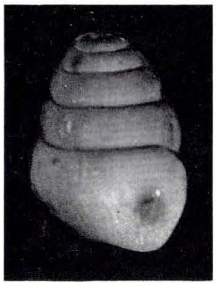

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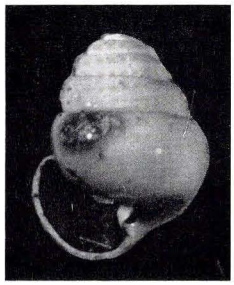

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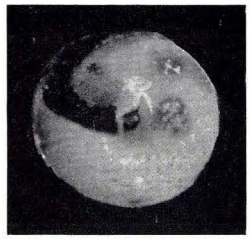

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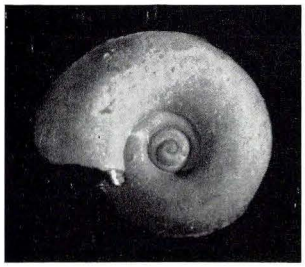

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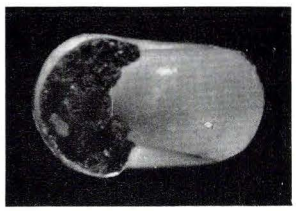

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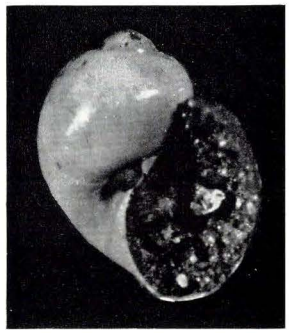

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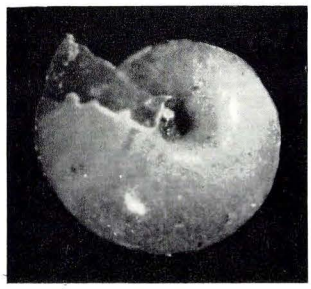

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