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By
Leif Banke Rasmussen

Dansk sammendrag:

Det marine Øvre Miocæn i Sønderjylland og dets molluskfauna

I Kommission hos
C. A. REITZELS FORLAG (AXEL SANDAL)
KØBENHAVN 1956

With 10 plates

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PREFACE

Collections of fossils and geological investigations in the clay pit of Gram Brickworks, which were carried out during the period 1938–52, form the basis of the present paper. Additionally the material of Upper Miocene mollusca from South Jutland in the collections of the Geological Survey of Denmark and the Mineralogical Museum of the University of Copenhagen have been included in the study.

The fossil material of the Mineralogical Museum was procured by various collectors, among whom were: MARTIN REIMERS (doctor in Gram about 1840–70), C. E. D'ORIGNY (secondary school teacher in Ribe 1850–61), F. JOHNSTRUP, H. N. P. VILANDT (doctor in Ribe 1869–1917), E. LØFFLER, CHR. LEVINSEN a.o., while the fossils in the Geological Survey were mainly collected by VICTOR MADSEN and HILMAR ØDUM.

For permission to use the collections of the Mineralogical Museum I am indebted to professor A. ROSENKRANTZ and professor CHR. POULSEN. I furthermore want to thank Dr. H. WIENBERG RASMUSSEN for good help during my studies in the Museum.

I am grateful to the director of the Geological Survey, Dr. H. ØDUM, for placing the fossil material from South Jutland in the Survey at my disposal. It gives me great pleasure to thank TH. SORGENFREI, state geologist, for the excellent working conditions in his department of the Geological Survey and for many inspiring discussions on the subject.

Finally I owe my thanks to Mrs. ULLA ANDERSEN, Miss INGER PETERSEN, and Mrs. RIGMOR RASMUSSEN for the drawings, to Mr. CHR. WESTERGAARD for photographing the palaeontological material and to Mr. W. E. CALVERT for the English translation.

Charlottenlund, April 1st., 1956.

LEIF BANKE RASMUSSEN.

CONTENTS

ABSTRACT

A description is given of five Tertiary exposures in South Jutland: Gram, Spandetgaard, Ravning, Storlund and Tornskov.

At all these places there are or have been brickworks pits in marine mica-clay: Gram clay. Sandy sediments have also been found at Gram.

The molluscan fauna from Gram, Spandetgaard and Ravning is described in detail; a variation-statistical analysis is also given of the *Astarte reimersi* populations from all three localities.

The 65 species described are employed as a basis for a biostratigraphical evaluation, with the following result:

The fauna at Spandetgaard and Ravning is of the same character as that at Gram and comprises exactly similar populations of species. They must accordingly be assumed to be contemporaneous.

The two types of sediments on the whole contain the same molluscan fauna. About 14 species are dominant in the Gram clay, about 5 in the silty sediments. The age difference between them can be only slight.

The fauna in all three localities must be determined as before as of Upper Miocene age, and it is closely associated with the molluscan fauna in the North German "Glimmerton".

The following species may for the present be employed as index fossils in the Upper Miocene of the North Sea Basin:

Sipho distinctus
Aquilofusus eximius — A. semiglaber
Astarte vetula — A. reimersi.

The author makes a critical examination of the subdivision of the Upper Miocene in North Germany and considers STAESCHE's "Gühlitz-Mecklenburger Stufe" and THIELE's "Basisschichten" invalid.

He points out that less common species must be employed with caution in the stratigraphical evaluation, whereas species with a large individual number provide a better foundation for conclusions.

The most common molluscan species at Langenfelde and an as yet almost unstudied locality at Maade, east of Esbjerg, are compared and the similarities singled out. The faunas from Maade and Gram are then compared and the differences underlined.

The conclusion to be drawn from the author's inquiry on the whole is that the molluscan fauna does not seem to provide arguments sufficiently tenable in favour of a more exact biostratigraphic placing of the occurrences at Gram, Spandetgaard and Ravning in relation to the whole Upper Miocene complex in the North Sea Basin.

The relation of the Gram fauna to the Neogene in the rest of Europe and North Africa is examined quite superficially, a more detailed study being postponed until the molluscan fauna in the Danish Upper Miocene as a whole has been completely analyzed. Nevertheless the author maintains that the Gram fauna and its equivalents may best be placed in the period between the Tortonien and the Plaisancien.

INTRODUCTION

The Miocene mica-clay in South Jutland was first described by FORCHHAMMER (1828) in a paper on the Tertiary in the island of Sylt. Later, in the middle of the 19th century, the German geologists L. MEYN, E. BEYRICH, J. O. SEMPER and A. v. KOENEN published their studies of the molluscan fauna in these sediments.

O. MØRCH in 1874 gave a list of the molluscs in the Mineralogical Museum in Copenhagen, but the first real description of that material was provided by J. P. J. RAVN in 1907. Since then, K. STAESCHE (1930) and W. HINSCH (1952) have dealt with the fauna in the mica-clay of South Jutland and Northern Germany.

The age of this mica-clay was described as Upper Miocene by E. BEYRICH as long ago as in 1854. Subsequently, several workers, including STAESCHE (1930), S. THIELE (1941) and HINSCH (1952) have essayed a finer stratigraphical subdivision of the sediments (see later, page 122).

The palaeontological material on which the present work is based is contained in the Mineralogical Museum, Copenhagen, and the Geological Survey of Denmark, Charlottenlund.

The material originates from three localities: Gram, Spandetgaard and Ravning. In addition, the literature refers to molluscs from two more localities: Storlund and Tornskov. All five localities are marked on the map fig. 10 (p. 118) and described below.

DESCRIPTION OF LOCALITIES

1. Gram.

Situation: About 800 metres north of Gram castle, about 1.5 km. north of the village of Gram and about 75 metres west of the Gram-Rødding highway. (See the map p. 118).

Historical: The mica-clay at Gram was first mentioned by L. MEYN (1848), but regular brick-making seems not to have started until after 1857 (see "Schulzeitung für die Herzogthümer Schleswig, Holstein und Lauenburg" No. 17, 24th Jan. 1857, p. 82).

The molluscan fauna was studied by J. O. SEMPER (1861), A. v. KOENEN (1872, 1882), O. MØRCH (1874) and J. P. J. RAVN (1907). The most recent examination of the molluscs from Gram was by HINSCH (1952).

The other fauna groups are mentioned only en passant. CLODIUS dealt with the foraminifera (1922) and WEILER with the otolites in 1942.

Description of locality: The earliest brickworks at Gram were situated about 100 metres WNW of the present works (see sketch map fig. 6). The clay was dug from a slope where weathered Tertiary clay is still to be seen under 1–2 m. of yellowish boulder clay. It is probable that most of the molluscs referred to by SEMPER, v. KOENEN and RAVN came from that old clay pit.

The present brickworks were built about 1900 and clay digging was begun simultaneously north of the new buildings. In the course of time the clay pit has attained the dimensions sketched on fig. 6. Initially the clay was extracted manually and a relatively considerable depth could be reached; later on (from about 1932) mechanical excavators were adopted, whereafter clay could not be taken deeper than 7.5 m. below the ground.

The southernmost part of the brickworks pit lies at contour level +26 m. and the northern end at +32 m. The average thickness of the superficial soil is 1.5 m. everywhere, so that the upper surface of the Tertiary lies between levels +25 m. and +31 m.

North of the buildings the overlying ground consists of boulder clay, and to the south meltwater sand.

At the present time (1952) the brickworks pit measures about 325 m. in the longest direction and its greatest breadth is about 100 m.

The main vertical exposure (AB on the sketch fig. 6) in August 1952

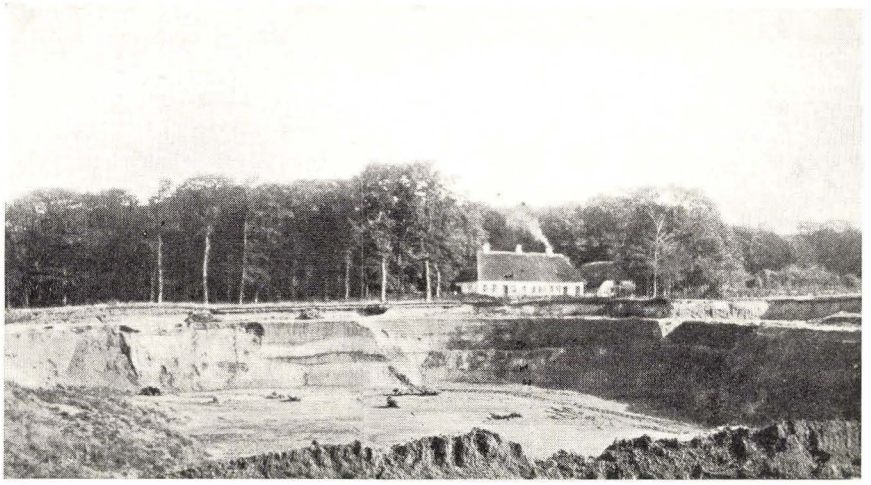


Fig. 1. The clay pit at Gram Brickworks 1908.
Looking E. The house in the picture is the westernmost of the three houses NE of the old flooded pit north of the brickworks shown on sketch map p. 17.
The section includes boulder clay on top to about 1 m. below the surface, corresponding to the dug terrace. Below is Gram clay partly weathered.
(VICTOR MADSEN phot.).

Fig. 2. The clay pit at Gram Brickworks 1952.
The wall where the excavator is working is identical with AB on sketch map fig. 6.
(L. B. RASMUSSEN phot.).

Fig. 3. The clay pit at Gram Brickworks 1952.
Vertical section corresponding to middle part of AB on the sketch map fig. 6. Steep wall with Gram clay. The horizontal stripes in the upper part of the wall are not bedding; they originate from the excavator.
(L. B. RASMUSSEN phot.).

Fig. 4. The clay pit at Gram Brickworks 1952.
Vertical section in the middle of the northeastern part of AB shown on sketch map fig. 6. Running water has washed the silt (which is the sediment in this part of AB) and exposed the dipping strata.
(L. B. RASMUSSEN phot.).

had a length of about 185 m. Uppermost is 1.5 m. of boulder clay, which is removed and used for fill. Below it is 6 m. of Tertiary sediments which are divisible into two main groups: 1) below: Gram clay proper, and 2) overlying it an alternating sequence of silty clay and clayey silt. There seems to be no sharply definable boundary between these strata, and as the face is always concealed behind fallen material it has been impossible to obtain any clear impression of the border between the two groups of sediments. The section fig. 7 shows their mutual positions.

The true Gram clay is dark grey, fairly homogeneous without visible stratification, and calcareous. On the other hand the silty sediments overlying the Gram clay are heterogeneous in size of grain and their colours are shades of grey. They are distinctly stratified, sometimes handsomely banded and only slightly calcareous.

In the northeast corner of the pit the following section at right-angles to the main face was measured:

Elevation: about +32 m.

0–1.5 m.	Boulder clay, sandy, stony, weathered, yellowish.
1.5–1.7 m.	Clay, sandy, stoneless, rusty-yellow, with remnants of plant roots. Possibly weathered Tertiary beds.
1.7–2.7 m.	Mica-clay, silty, grey, approaching clayey mica-silt. Most silty strata are pale grey with rusty-yellow, irregular areas.
2.7–3.0 m.	Clay, less micaceous, with irregular spots of colour, there being many greyish-yellow, sticky parts as well as more sandy parts with a faint greenish tone. Many walnut to hen's egg sized, irregular concretions.
3.0–3.5 m.	Mica-silt, stratified, pale grey in colour with irregular rusty-yellow areas. A few small irregular lumps almost quite black.
3.5–5.4 m.	Mica-clay, silty, brownish grey on fresh exposures with many irregular accumulations of glauconite. Fossiliferous. Here and there from 4.6 to 5.4 m. the strata have a distinct dip, especially round about 4.6 m., 4.8 m. and 5.4 m.
5.4–6.9 m.	Mica-clay, silty, grey to greyish-brown, mainly as above. Stratification visible in parts. Fossiliferous.

The deposits seem to lie parallel with a dip of 6° to 8° eastwards. Here and there the dip is greater, as on fig. 4.

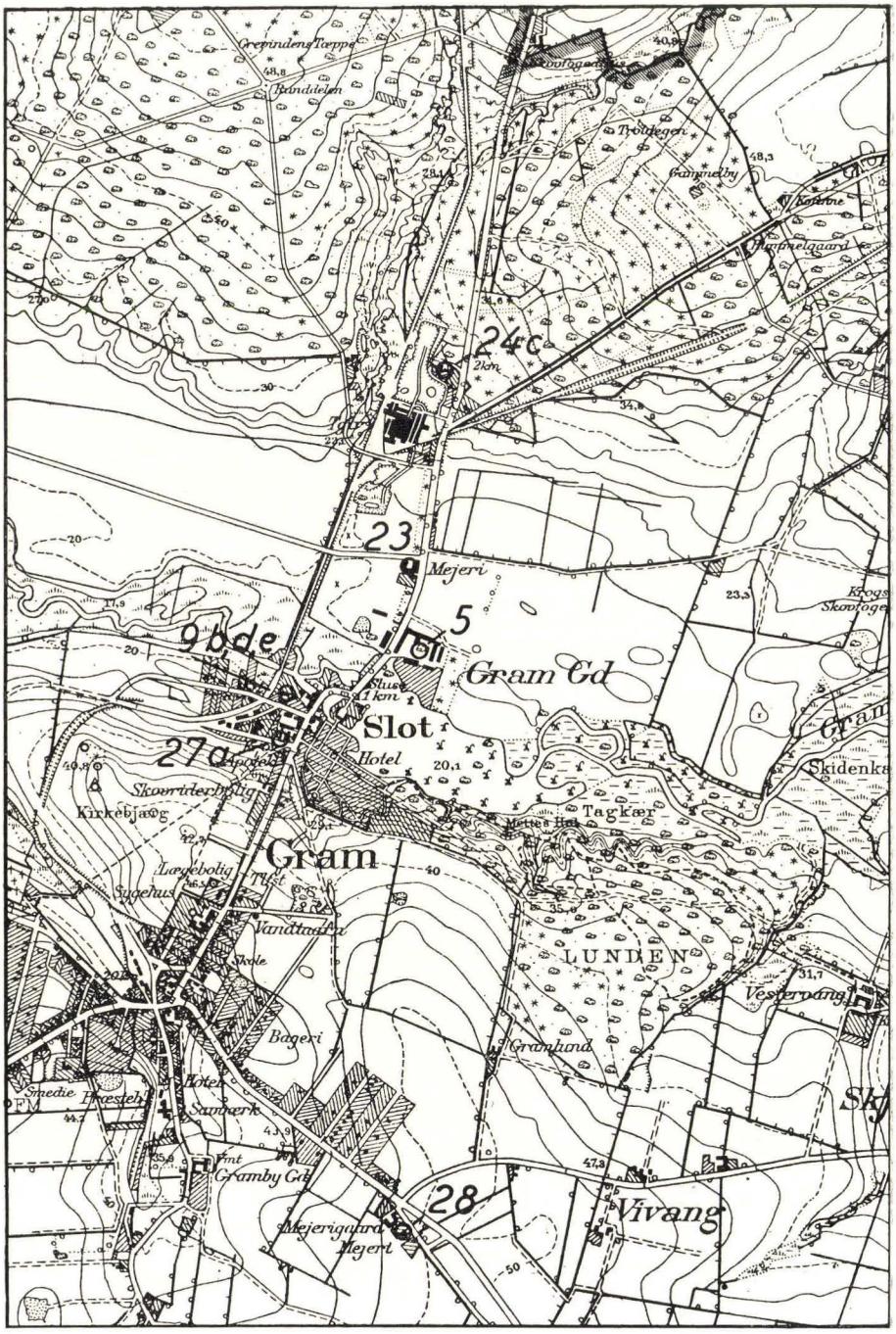
Local borings in the Tertiary: The Tertiary seems almost to reach the ground surface at several places round about Gram. The principal borings are marked on the map fig. 5. The sections of these borings are:

D.G.U. Arch. No. 141.24.c. Gram Brickworks, manager's house.
Made 1943.

about +28.0 m.	0– 1.0 m.	Fill.
— +27.0 m.	1.0–36.0 m.	Black clay, gradually harder downwards.
– — 8.0 m.	36.0–38.5 m.	Mixed clay and gravel, grey.
	38.5–49.0 m.	Fine, washed sand.
	49.0–50.8 m.	Sharp, grey sand.
	50.8–51.1 m.	Hard clay.
	51.1–51.3 m.	Sharp sand.
	51.3–54.5 m.	Fine, washed sand.
	54.5–60.0 m.	Fine mica-sand.

D.G.U. Arch. No. 141.23. Gram Dairy, about 500 m. S of brickworks.
Made 1936.

about +21.0 m.	0–13.0 m.	Outwash sand.
– + 8.0 m.	13.0–26.5 m.	Mica-clay.
– — 5.5 m.	26.5–31.0 m.	Mica-sand, clayey, with lignite and black mud.
	31.0– m.	Mica-clay.



Borings in Tertiary deposits in the neighbourhood of Gram. The numbers are the D.G.U. Archive numbers mentioned in the text p. 13–16.
(Section of plane table M. 3707. Authorized by the Geodetic Institute of Denmark).
Fig. 5.

D.G.U. Arch. No. 141.5. Gramgård.
Made 1927.

about	+20.0 m.	0–14.5 m.	Quaternary.
–	+ 5.5 m.	14.5–23.1 m.	Black mica-clay.
–	— 3.1 m.	23.1–24.0 m.	Grey sand.

D.G.U. Arch. No. 141.9.b. Gram Waterworks.
Made 1936.

about	+20.0 m.	0– 8.0 m.	Quaternary.
–	+12.0 m.	8.0–22.0 m.	Mica-clay, dark grey, non-calcareous.
–	— 2.0 m.	22.0–28.0 m.	Quartz gravel, grey, non-calcareous.
		28.0–29.0 m.	Quartz sand, coarse, grey, with mica, non-calcareous.
		29.0–31.0 m.	Mica-sand, grey, non-calcareous.

D.G.U. Arch. No. 141.9.d. Gram Waterworks.
Made 1950.

about	+20.0 m.	0– 7.0 m.	Quaternary.
–	+13.0 m.	7.0–20.4 m.	Mica-clay, dark grey and silt, lighter gray, non-calcareous.
–	— 0.4 m.	20.4–23.5 m.	Quartz sand and gravel, grey, non-calcareous.
		23.5–26.0 m.	Quartz sand and mica-sand, grey, non-calcareous.
		26.0–27.3 m.	Mica-clay, silty, dark grey, non-calcareous.

D.G.U. Arch. No. 141.9.e. Gram Waterworks.
Made 1953.

about	+20.0 m.	0– 8.2 m.	Quaternary.
–	+11.8 m.	8.2–21.6 m.	Mica-clay, black (Gram clay).
–	— 1.6 m.	21.6–27.0 m.	Quartz sand, coarse-grained. clayey, greyish brown.
		27.0–27.1 m.	Mica-clay, blackish brown, with organic remains, lignite.
		27.1–28.2 m.	Quartz sand, coarse, grey.
		28.2–28.4 m.	Mica-clay, dark brown-black.
		28.4–30.0 m.	Quartz sand, medium-grained, grey.
		30.0–32.0 m.	Mica-clay, sandy, greyish-black.

D.G.U. Arch. No. 141.27.a. Gram Carpet Mill.
Made 1937.

about	+22.5 m.	0– 4.5 m.	Outwash sand.
–	+18.0 m.	4.5–22.5 m.	Mica-clay, silty, dark grey, slightly calcareous.
–	+ 0.0 m.	22.5–29.0 m.	Quartz gravel and coarse-grained quartz sand, grey, non-calcareous.
		29.0–29.2 m.	Mica-silt, clayey, dark grey, with some larger quartz grains, non-calcareous.
		29.2–33.0 m.	Quartz gravel and coarse-grained quartz sand, grey, with some mica, non-calcareous.
		33.0– m.	Mica-sand and quartz sand, grey, non-calcareous.

D.G.U. Arch. No. 141.28. Østergård Dairy.
Made year .... ?

about	+50.0 m.	0– 5.0 m.	Diluvial sand.
–	+45.0 m.	5.0–57.0 m.	Mica-clay.
–	— 7.0 m.	57.0–60.0 m.	Clayey mica-sand.
			Later deepened to 127 m.

The boring records show that the surface of the Tertiary drops a few metres under Gramå valley, to rise again both north and south of it. This suggests an intimate association between the surface levels of the Tertiary and the fluvioglacial erosion.

The thickness of the mica-clay at the brickworks is about 35 m., at Gramgård only 8–9 m., but somewhat thicker again south of the valley, about 14 m. at the waterworks and 18 m. at the carpet mill.

Underlying the mica-clay is quartz sand, quartz gravel or mica-sand, which has never yielded any fauna. It was not until the boring at Østergård Dairy was deepened that much lower strata produced a rich, well-preserved Middle Miocene molluscan fauna at present being described by TH. SORGENFREI. No non-clayey sand beds have hitherto been demonstrated in the Danish or North German Upper Miocene. Thus the probability is that the sediments underlying the mica-clay belong to an earlier phase of the Miocene, presumably the Middle Miocene.

Upper Miocene mica-clay is very characteristic, and P. HARDER (USSING 1913, p. 163) called it "Astarte clay" because of the high frequency of *Astarte reimersi*.

The term "Astarte clay" is here replaced by the term "Gram clay", which I define as the clay exposed in the clay pit at Gram Brickworks. Upwards it is overlain by mica silt, which I here term "Gram silt". Gram clay and Gram silt constitute the "Gram formation". Downwards the Gram formation is underlain by gravel and sand, which have been proved at a depth of 36 m. in boring D.G.U. Arch. No. 141.24.c (see p. 13) located quite near the clay pit. The whole section of the Gram formation in this boring has a thickness of about 35 m., which thus is the thickness of the formation in the area. The main characters of the Gram clay appear from the following.

Tertiary sediments in the brickworks pit: Here the description will be confined to the principal features, as no petrographic examination of the sediments has been made.

Gram clay in the dry state is grey to dark grey with a brownish tinge; when wet it is dark grey. It is silty and sometimes slightly sandy, usually rather hard and contains numerous stems of pyrite. The elution residue consists preponderantly of small ellipsoidal coprolites, a quantity of mineral grains, as well as foraminifera, remnants of echinoides and shell fragments of molluscs. No mechanical analyses were made for the

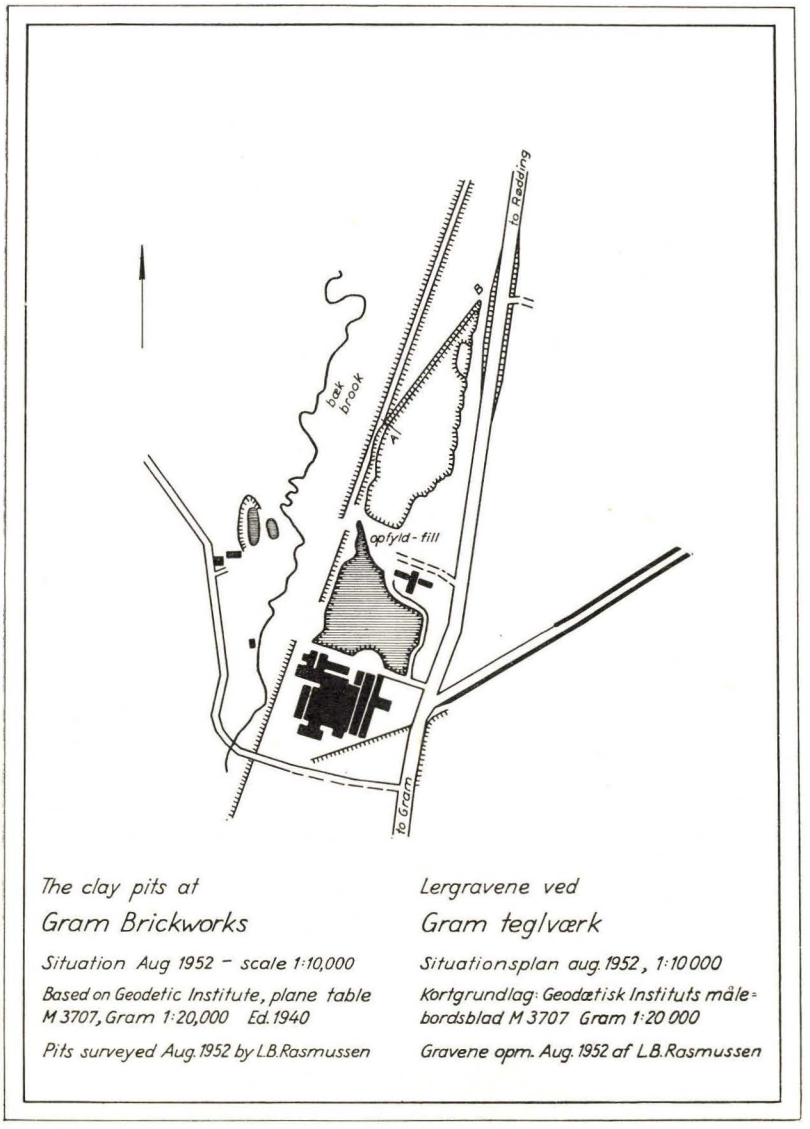
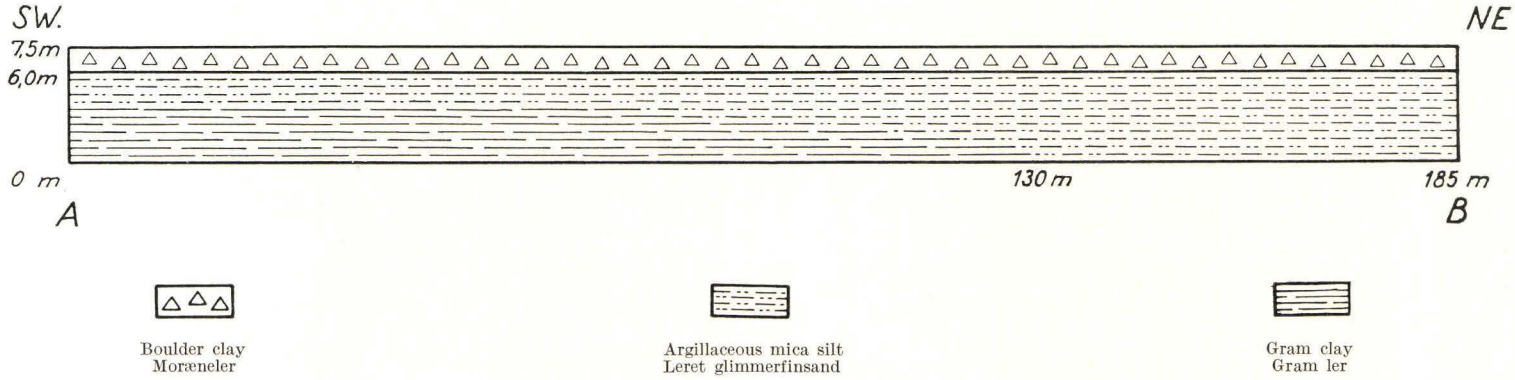


Fig. 6.

present work. A single analysis was published by R. WEYL (1936, p. 388).

Sporadically in the clay are isolated, highly calcareous, ellipsoidal concretions which have formed in association with fossils, usually the carapace of a crab, giving rise to the popular term "crab buns". Beds of concretions have not been observed in the brickworks pit.

Organic material is occasionally found to play a large role in the Gram clay, as witness an analysis of water from the bottom of the pit, made by K. SKOUSBØLL HANSEN 1938. The high content of organic matter was



Lithological section of the northern wall in the clay pit at Gram Brickworks.
Skematisk profil af nordvæggen i Gram teglværks lergrav.
Length 1:1000 Height 1:500 Længde 1:1000 Højde 1:500
Surveyed Aug. 1952 by L. B. Rasmussen
Opmålt Aug. 1952 af L. B. Rasmussen

Fig. 7.

evidenced by the considerable loss on ignition (54.9%) and oxygen consumption (about 1000 mg./l.).

The silty sediments consist of a series of more or less arenaceous, often argillaceous rocks of varying grey tones. Small calcareous concretions occur in some strata and here and there are accumulations of glauconite. The elution residues show that there are also coprolites in these sediments which, moreover, contain much more quartz and mica than the Gram clay (cf. section description p. 13).

Fauna. Fossils were found in all Tertiary sediments in the brickworks pit. Pelecypodes are mentioned by MEYN, 1848, SEMPER, 1861, MØRCH, 1874 and especially RAVN, 1907. The latter gives the following species:

1. *Pecten clavatus* POLI sp.
2. *Nucula Georgiana* SEMPER
3. *Portlandia Philippiana* NYST sp.
4. *Limopsis aurita* BROCCHI sp.
5. *Venericardia orbicularis* SOWERBY
6. *Astarte Reimersi* SEMPER
7. *Isocardia Forchhammeri* BECK

Scaphopodes are mentioned by v. KOENEN, 1882:

8. *?Cadulus subfusiformis* SARS
9. *Dentalium entale* L.

Gastropods are enumerated by v. KOENEN (1872, 1882):

10. *Tiphys fistulosus* BROC.
11. *Cancellaria Rothi* SEMPER
12. – *subangulosa* WOOD
13. *? Fusus crispus* BORSON
14. *Fusus Puggaardi* BEYR.
15. – *eximius* BEYR.
16. – *semiglaber* BEYR.
17. – *distinctus* BEYR.
18. *Terebra Forchhammeri* BEYR.
19. *Nassa Bocholtensis* BEYR.
20. – *Holsatica* BEYR.
21. – *limata* CHEMN.
22. *Purpura Reimersi* v. KOENEN
23. *Cassis saburon* BRUG.
24. *Cassidaria echinophora* L.
25. *Conus antediluvianus* BRUG.
26. *Pleurotoma turbida* SOL.
27. – *rotata* BROC.
28. – *turricula* BROC.

29. *Pleurotoma Helena* SEMPER
30. – *intorta* BROC.
31. – *modiola* JAN
32. *Defrancia reticulata* REN.
33. – *Luisae* SEMPER
34. *Mangelia obtusangula* BROC. sp.
35. – *Kochi* v. KOENEN
36. – *maitreja* SEMPER
37. *Natica plicatella* BRONN
38. – *helicina* BROC.
39. – *Alderi* FORBES
40. *Eulimella Scillae* SCACCHI
41. *Odontostoma conoideum* BROC.
42. *Turbonilla costellata* GRAT.
43. – *Facki* v. KOENEN
44. *Turritella tricarinata* BROC.
45. – *Archimedis* BRONGN.
46. *Scalaria Vilandti* MØRCH sp.
47. *Bulla cylindracea* PENN

This list is supplemented by RAVN 1907 with the following three species:

48. *Natica Josephinia* RISSO sp.
49. *Buccinopsis Dalei* JEFFR.
50. *Mitra Borsoni* BELL.

Of other fauna groups representatives have been found of foraminifera (CLODIUS, 1922), echinoids (indeterminable spicules and shell fragments of spatangides), bryozoa (two species of *Lunulites*, previously identified as *L. radiata* GOLDFUSS and *L. rhomboidalis* GOLDFUSS), crustaceae (one or more species of the crab family *Coeloma*, not further examined, and ostracodes and balanae), shark (numerous teeth of *Isurus*, *Odontaspis*, *Cetorrhinus* etc.), teleosts (bones and numerous otolites, described by WEILER, 1942), reptiles (*Psephophorus sp.*, see A. ROSENKRANTZ, 1921) and cetaceae (many vertebrae, costae and other bones. In 1925 the greater part of a whale skeleton was found, excavated by H. ØDUM but not yet thoroughly examined).

WEILER describes and partly illustrates the following otolites from Gram (1942):

1. *Scopelus debilis* KOK.
2. *Sciaena holsatica* KOK.
3. *Gadus friedbergi* CH. et DUV.
4. – *luscus* L.
5. *Phycis simplex* KOK. *mut. miocenica* WEILER
6. *Merluccius vulgaris* FL.

2. Storlund.

Situation: The situation of this locality is not known with certainty. Storlund is the name of a collection of farms and houses between Enderupskov and Vr. Nybøl in the parish of Gram. (See the map p. 118).

Historical: SEMPER (1861, p. 89) and v. KOENEN (1872, 1882) both refer to Storland (= Storlund) as the finding place of Miocene gastropods. There are no details of the locality in the literature.

Description of locality: The locality has not been found again. According to information by KR. ØSTERGAARD NIELSEN, teacher at Enderupskov school, and chief forester FRÖLICH, Gram, there was once a brickworks at Storlund, probably prior to 1870.

At some small fallen-in clay pits on the edge of Brogaard plantation, presumed by ØSTERGAARD NIELSEN to be the old brickworks pits, a tentative boring was made in 1953 by the D.G.U. (D.G.U. Archives No. 141.84). No mica-clay was encountered before a depth of about 6 metres, so it is improbable that mica-clay was excavated from these pits. Two other borings (D.G.U. Arch. No. 141.95 and 141.96) by the DANISH AMERICAN PROSPECTING COMPANY seem only to have reached the mica-clay about two metres lower. The descriptions of the samples are somewhat imperfect, however.

Judging from L. MEYN's geological survey map of Schleswig-Holstein (1881), there is an area with Miocene deposits close to the surface in the near vicinity of the stream Gramå at Vr. Nybøl farm, north of Storlund itself.

Fauna: Apart from *Astarte reimersi* SEMPER, referred to by STAESCHE, 1930, p. 65 and HINSCH, 1952, pp. 150–154, the following species are given by v. KOENEN, 1872–1882:

1. *Tiphys fistulosus* BROC.
2. *Cancellaria Rothi* SEMPER
3. *Fusus Puggaardi* BEYR.
4. – *eximius* BEYR.
5. – *semiglaber* BEYR.
6. – *distinctus* BEYR.
7. *Buccinopsis Dalei* JEFFREYS
8. *Nassa Bocholtensis* BEYR.
9. – *Holsatica* BEYR.
10. *Cassis saburon* BRUG.
11. *Cassidaria echinophora* L.
12. *Conus antediluvianus* BRUG.
13. *Pleurotoma turbida* SOL.
14. – *rotata* BROC.
15. – *turricula* BROC.
16. – *obeliscus* DES MOUL.

17. *Pleurotoma intorta* BROC.
18. – *modiola* JAN
19. *Defrancia Luisae* SEMPER
20. *Mangelia obtusangula* BROC.
21. *Mitra Borsoni* BELL.
22. *Voluta (Scapha) Bolli* KOCH
23. *Natica plicatella* BRONN.
24. – *Alderi* FORBES
25. *Odontostoma conoideum* BROC.
26. *Turritella tricarinata* BROC.
27. – *subangulata* BROC.
28. *Xenophora testigera* BRONN
29. *Dentalium entale* L.
30. *?Cadulus subfusiformis* SARS.

WEILER (1942) mentions the following otolites: *Gadus friedbergi* CH. et DUV. and *Gadus luscus* L.

3. Ravning.

Situation: The locality lies between the stream Kongeå and the Ribe-Kolding highway, about 3 km. NE of Kalvslund church and 1.3 km. W of Mejlby, in the parish of Kalvslund, Ribe county. (See the map p. 118).

Historical: First mentioned by MØRCH (1874, "Mejlby Brickworks"). RAVN referred to it in 1897 and described some molluscs from it in 1907.

Description of locality: The brickworks have long been closed down and the clay pits overgrown.

The locality was visited in September 1906 by A. JESSEN and V. NORDMANN, whose field-books (in the care of D.G.U.) record that uppermost in the sections is 1 m. of late-Glacial outwash gravel, followed by mica-clay (cf. footnote No. 2, page 213 in NORDMANN, 1908).

Local borings in the Tertiary: Whether or not the Tertiary at Ravning is in situ is a matter of conjecture, but it is probable that it is in situ, because it was encountered in a boring at Mejlby Dairy 1.3 km. more to the SE (D.G.U. Archives No. 132.21) with the following section:

Elevation: about +22 m.

	0– 24 m.	Quaternary.
– 2 m.	24– 42 m.	Black mica-clay.
	42– 49 m.	Fine, clayey mica-sand.
	49–110 m.	Black mica-clay with thin sand beds.
	110–117 m.	Fine quartz gravel.

Two km. N of the brickworks similar sediments were found in a boring at Tobøl School (BANKE RASMUSSEN, 1954).

Fauna: MØRCH (1874) lists the following molluscs from Ravning:

1. *Cassidaria subechinophora* MØRCH (= *C. echinophora* L.)
2. *Cassis texta* BRONN (= *C. saburon* BRUG.)
3. *Fusus* (*Sipho*) *distinctus* BEYR.
4. *Pleurotoma rotata* BROC.
5. – (*Borsonia*?) *cataphracta* BROC.

RAVN (1907) adds:

6. *Astarte Reimersi* SEMP.
7. *Isocardia Forchhammeri* BECK
8. *Fusus semiglaber* BEYR.
9. *Conus antediluvianus* BRUG.

WEILER (1942) mentions the otolites: *Gadus friedbergi* CH. et DUV. and *G. luscus* L.

4. Spandetgaard.

Situation: The locality is about 200 m. NE of the farm Spandetgaard, parish of Spandet, Tønder county. (See the map p. 118).

Historical: Our knowledge of the occurrence dates back to FORCHHAMMER (1848, p. 5) and MEYN (1848, p. 31). BEYRICH (1853–57) and SEMPER (1861) also refer to the locality as a finding place of molluscs, but neither they nor, later on, MØRCH (1874) and RAVN (1907) mention the geological conditions there.

GOTTSCHE, in a short note in Schr. Naturw. Ver. f. Schleswig-Holstein, Vol. IX, Part 1, p. 150–151, Kiel 1891, says that the clay-ironstone beds in the mica-clay at Esbjerg do not occur at Spandet.

When HARDER visited the locality in April 1900 (diary, in the custody of D.G.U.), clay digging had ceased.

Excavation of mica-clay was resumed in the old deposit in the summer of 1955.

Description of locality: The sides of the brickworks pit are now so overgrown that it is difficult to gain an impression of the stratification. Uppermost in the west wall is stony diluvial sand and lowest in the section: yellowish, weathered mica-clay (Gram clay).

Tertiary borings in the vicinity: According to verbal communication, two borings at Spandet Dairy (D.G.U. Arch. No. 150.17.a–c), which is close to the brickworks pit, got through 50 m. of diluvial sand down into about 100 m. of Gram clay, followed by mica-sand. Accordingly the mica-clay (Gram clay) at Spandet must be in situ.

Fauna: The molluscan fauna was first described by MEYN (1848), SEMPER (1861) and BEYRICH (1853–57). As regards gastropods and scaphopods v. KOENEN (1872, 1882) lists 24 species:

1. *Trophon Semperi* v. KOENEN
2. *Cancellaria Rothi* SEMPER
3. *Fusus eximius* BEYR.
4. – *semiglaber* BEYR.
5. – *distinctus* BEYR.
6. *Nassa Bocholtensis* BEYR.
7. *Purpura Reimersi* v. KOENEN
8. *Cassis saburon* BRUG.
9. *Cassidaria echinophora* L.
10. *Conus antediluvianus* BRUG.
11. *Pleurotoma turbida* SOL.
12. – *rotata* BROC.
13. – *turricula* BROC.
14. – *Helena* SEMPER
15. – *intorta* BROC.
16. *Defrancia reticulata* REN.
17. – *Luisae* SEMPER
18. *Mangelia obtusangula* BROC. sp.
19. *Natica plicatella* BRONN
20. – *Alderi* FORBES
21. *Odontostoma conoideum* BROC.
22. *Turritella tricarinata* BROC.
23. *Dentalium entale* L.
24. ?*Cadulus subfusiformis* SARS.

The following three mollusc species are mentioned by MØRCH (1874):

25. *Nassa Syltensis* BEYR.
26. *Astarte Reimersi* SEMPER
27. *Nucula Georgiana* SEMPER

and seven more molluscs by RAVN (1907):

28. ?*Pecten clavatus* POLI sp.
29. *Limopsis aurita* BROCCHI sp.
30. *Isocardia Forchhammeri* BECK
31. *Natica helicina* BROCCHI
32. *Buccinopsis Dalei* SOW. sp.
33. *Pleurotoma modiola* JAN
34. *Mangilia* sp.

WEILER (1942) refers to three species of fishes: *Sciaena holsatica* KOK., *Gadus friedbergi* CH. et DUV. and *Gadus luscus* L., and NORDMANN (1905, p. 18) says that a tarsal bone of a seal was found at Spandet.

5. Tornskov.

Situation: The locality is 4 km. N of Løgumkloster, W of the road to Arrild, inside the eastern margin of Vognshøj hills, 200–300 m. south of the two farms bearing the name of Tornskov, in the parish of Nørre-Løgum, Tønder county. (See the map p. 118).

Historical: Stoneless clay in the Vognshøj area is mentioned by both FORCHHAMMER (1848, p. 5) and MEYN (1848, p. 562), but SEMPER was the first to recognize that the occurrence at Tornskov particularly is Miocene. v. KOENEN (1872, 1882) names Tornskov as the finding place of several of the gastropods he describes, usually indicating SEMPER as his source. The latter author, however, makes no mention of the locality in his printed works.

The deposit has not been worked since about 1890.

Description of locality: In 1940 TH. SORGENFREI found mica-clay in the southernmost erosion gully cutting into the ridge west of the Tornskov farms. There, in the northern slope, was a section about 4 metres high, uppermost with yellowish, weathered mica-clay, passing downwards into dark grey mica-clay. About 3.5 m. below the upper edge of the section is a thin band of moraine sand or diluvial sand, below which again is mica-clay (field book 1940, in the custody of D.G.U.).

There is no information of borings in the Tertiary in the vicinity of the locality. The nearest boring to reach the Tertiary was made in Løgumkloster (D.G.U. Arch. No. 159.6.a.). Mica-clay seems to have been encountered at a depth of 14 m.

Fauna: Apart from *Astarte reimersi* SEMPER (mentioned by STAESCHE, 1930, p. 65) and the two otolites *Sciaena holsatica* KOK. and *Gadus luscus* L. (mentioned by WEILER, 1942), we know only of the 37 species of gastropods and scaphopods listed by v. KOENEN (1872, 1882) as found at Tornskov:

1. *Cancellaria Rothi* SEMPER
2. – *cancellata* L.
3. – *subangulosa* WOOD
4. *Fusus sexcostatus* BEYRICH
5. – *Puggaardi* BEYRICH
6. – *festivus* BEYRICH
7. – *eximius* BEYRICH
8. – *semiglaber* BEYRICH
9. *Buccinopsis Dalei* JEFFREYS
10. *Terebra Forchhammeri* BEYR.
11. *Nassa Holsatica* BEYR.
12. – *pseudoclathrata*? MICH.
13. *Cassis saburon* BRUG.
14. *Columbella nassoides* GRAT.

15. *Pleurotoma Helena* SEMPER
16. – *obeliscus* DES MOUL.
17. – *intorta* BROCC.
18. *Defrancia reticulata* REN.
19. – *Mariae* SEMPER
20. *Mangelia obtusangula* BROC.
21. *Mitra scrobiculata* BROC.
22. – *Borsoni* BELL.
23. *Voluta (Scapha) Bolli* KOCH
24. *Natica plicatella* BRONN
25. *Odontostoma conoideum* BROCC.
26. – *fraternum* SEMPER
27. *Turbonilla costellata* GRAT.
28. *Aporrhais alata* EICHW.
29. *Turritella tricarinata* BROC.
30. – *Archimedis* BRONGN.
31. – *subangulata* BROC.
32. *Xenophora testigera* BRONN
33. *Dentalium badense* PARTSCH
34. ?*Cadulus subfusiformis* SARS
35. *Tornatella tornatilis* L.
36. *Ringicula auriculata* MÉN.
37. *Bulla cylindracea* PENN.

The gastropod fauna is rather different from that described from the other localities in South Jutland. For example, the occurrences of *Cancellaria cancellata* L., *Fusus sexcostatus* BEYR., *F. festivus* BEYR. and *Mitra scrobiculata* BROCC. are worthy of note. Normally these species do not form part of the mica-clay fauna, but occur in the underlying Dingden-Reinbeck stage (GRIPP, 1915, 1919, 1933; KAUTSKY 1925, p. 214). Thus there is a possibility that earlier deposits than the mica-clay (Gram clay) were also accessible at Tornskov.

MOLLUSCAN FAUNA

In the following description and discussion of the molluscan fauna from the South Jutland localities I have confined myself chiefly to the taxonomy in J. THIELE: "Handbuch der systematischen Weichtierkunde I–II" (Jena 1931–35), which is the most recent taxonomic manual on living mollusca.

Reservation is, however, made for the Pyramidellidae which have been ranged among the Opisthobranchiata in accordance with the evidence recently brought about by studies of living Pyramidellidae (FRETTER and GRAHAM, 1949).

The principal purpose in my report on these molluscs is first and foremost to identify the material rather than to group it taxonomically. For the same reason I have not devoted time to questions of profound nomenclatory character.

Wherever possible the original diagnoses are included in order to present the chief basis upon which the various species are set up.

The shell material from the South Jutland localities is rather homogeneous in a specific sense while there are some differences if these shells are compared with the fossils collected at Maade near Esbjerg. It was decided, therefore, to postpone the writing of new diagnoses until the fossils from Maade have been thoroughly studied.

When dealing with the type material I have mentioned where the types are or presumably are preserved, and also whether or not I have been able to compare my material with these types. The purpose here was to indicate the method of identification employed and thus the degree of certainty with which the identification was made.

The following abbreviations are used:

D.G.U. = Collection of the Geological Survey of Denmark.
M.M. = Collection of the Mineralogical Museum, Copenhagen.
u. = upper m. = middle l. = lower.

PELECYPODA

FAMILIA: NUCULIDAE

Genus: Nucula, Lamarck 1799.

Subgenus: *Nucula* s.s. (Typus: *N.* (*N.*) *nucleus* (LINNÉ)).

1. Nucula (Nucula) georgiana, Semper in Ravn 1907.

(Plate I, fig. 1a, b).

1861. *Nucula Georgiana*; SEMPER, Pal. Unters.; p. 71.
1874. *Nucula Georgiana* SEMPER; MØRCH, Forst. i Tert.; p. 293.
1907. *Nucula Georgiana* SEMPER; RAVN, Jylland; p. 257, pl. I, f. 6.

Original diagnosis: Not given by SEMPER. The species was first described by RAVN (1907).

Type material: The type is the valve illustrated by RAVN (1907, pl. I, fig. 6). Locality: Skjærum Mølle (Denmark). Repository: M.M.

Material: Gram (D.G.U., 126 shells and numerous fragments; M.M., 72 shells). Spandetgaard (M.M., 3 shells). Ravning (D.G.U., 12 shells).

Description: No additions to RAVN's description (1907, p. 257).

Relation to other species: *N. georgiana* is scarcely a variety of *N. nucleus* (L.), as HINSCH seems to assume (cf. HINSCH, 1952, p. 182: "*N.* (*N.*) *nucleus georgiana*"). On *N. nucleus* the radial striae (and with them the crenulations on the basal margin) are much closer and finer than on *N. georgiana*, and the shells of fully grown specimens are much larger.

There would seem to be many points of close resemblance between *N. georgiana* and the Oligocene *N. compta* GOLDF. However, an entire valve of the latter species from the Oligocene at Aarhus (see HARDER, 1913, p. 48, pl. III, f. 9), which has been used for comparison, has not the obtuse angle on the posterior dorsal margin which on *N. georgiana* appears opposite the lower termination of the teeth.

Remarks: The species is very common in the Gram clay; small shells (juvenile specimens?) are particularly numerous in the silty sediments.

Measurements: Five valves from Gram measure (in mm.):

Height:	16.4	14.5	13.7	16.6	12.7
Length:	19.8	17.3	17.5	20.2	15.0
Thickness of double valves:				12.7	8.7

Distribution:

North Sea Basin. Miocene. Denmark: u. (RAVN). North Germany: u. (SEMPER, RAVN).

FAMILIA: LEDIDAE

Genus: Leda, Schumacher 1817.

Subgenus: *Jupiteria* BELLARDI 1875 (Typus: *L. (J.) concava* BRONN).

2. Leda (Jupiteria) pygmaea (Münster in Goldfuss 1837).

(Plate I, fig. 2a, b).

1835. *Nucula pygmaea*; MÜNSTER, N. Jahrb. Min. etc.; p. 448.
1837. *Nucula pygmaea* MÜNST.; GOLDFUSS, Petr. Germ. II; p. 157, pl. CXXV, f.17.
1843. *Nucula Philippiana*; NYST, Coq. et polyp.; p. 224, pl. XVII, f. 5.
1861. *Leda pygmaea* MÜNST.; WOOD, Crag, II; p. 95, pl. X, f. 11.
1861. *Leda pygmaea* MÜNST.; SEMPER, Pal. Unters.; p. 146.
1884. *Leda pygmaea* MÜNST.; SPEYER–v. KOENEN, Cassel; pl. XVII, f. 4–5.
1907. *Portlandia pygmaea* MÜNST. sp.; RAVN, Jylland; p. 260, pl. I, f. 9–10.
1907. *Portlandia Philippiana* NYST sp.; ibid.; p. 261.
1914. *Leda (Portlandia) pygmaea* MÜ. sp.; GRIPP, Itzehoe; p. 6.
1916. *Portlandia pygmaea* MÜ. sp.; NØRREGAARD, Esbjerg; p. 12.
1925. *Leda (Jupiteria) pygmaea* MÜNST.; KAUTSKY, Hemmoor; p. 24.
1940. *Leda (Jupiteria) pygmaea* MÜNST.; SORGENFREI, Klintinghoved; p. 17.
1942. *Leda (Jupiteria) pygmaea* (v. MÜNST.); HEERING, Oligoc. Tax.; p. 17, pl. III, f. 6–7.
1942. *Leda (Jupiteria) pygmaea* (MÜNST.); IJSPEERT, Mioz. Tax.; p. 31, pl. 1, f. 7.
1945. *Leda (Jupiteria) pygmaea* MÜNST. sp.; GLIBERT, Mioc. Belg. I; p. 31, pl. I, f. 6.
1952. *Leda (Jupiteria) pygmaea* (MÜNST.); GÖRGES, Meress. Kassel; p. 11.

Original diagnosis: GOLDFUSS, 1837: "*Nucula testa obovata convexa laevi, umbonibus submedianis, lunula elliptica subconvexa, angulo cardinali obtuso*".

Type material: Not used. The whereabouts of MÜNSTER's and GOLDFUSS' types not known to me.

Material: Gram (D.G.U., 132 shells; M.M., 46 shells).

Description: See descriptions by IJSPEERT and GLIBERT.

The number of teeth in the hinge depends upon the age of the animal. For 19 shells examined a minimum of 6 was found on either side of the umbo (on the smallest) and a maximum of 10 (on the largest). IJSPEERT gives 12 as the maximum for his material from the Dutch Middle Miocene.

Relation to other species: The thicker and shorter forms have been referred to a separate species, *Portlandia Philippiana* NYST (see RAVN, 1907, p. 261).

L. pygmaea is reported to occur in the Upper Oligocene at Aarhus (HARDER, 1913, p. 52, pl. III, f. 15). This particular specimen, kept at D.G.U., seems to conform closely to the Upper Miocene shells from Gram.

The recent *L. tenuis* (PHILIPPI) is identified with *L. pygmaea* by some authors.

Remarks: The species seems to have had a preference for a sandy bottom, being more numerous in the sandy sediments. By the way, owing

to its small size it has often been overlooked in previous collections from the Gram clay localities.

Measurements: On 16 double valves the thickness varied from 0.7 mm. to 1.7 mm. The other measurements for these two extremes were: height 1.2 mm. and 2.2 mm. respectively, and length 1.9 mm. and 3.0 mm.

Distribution:

North Sea Basin. Oligocene. Denmark: u. (HARDER). North Germany: m. (v. KOENEN, 1868, p. 241), u. (GÖRGES). Holland: u. (HEERING). —Miocene. Denmark: l. (SORGENFREI), m. (RAVN), u. (*Portlandia Philippiana*, RAVN). North Germany: l. (GRIPP), m. (KAUTSKY), u. (STAESCHE, 1930). Holland: m. (IJSPEERT). Belgium: Houthaelen (GLIBERT), Anversien (GLIBERT).—Pliocene?

Recent occurrence (of *Leda tenuis*): Atlantic Ocean at the coasts of Greenland, Svalbard, Scandinavia, Great Britain and Western Europe. Mediterranean (JEFFREYS, WEINKAUFF).

Genus: Yoldia, Möller 1842.

Subgenus: *Yoldia* s. s. (Typus: *Y.* (*Y.*) *hyperborea* (LOVÉN)).

3. Yoldia (Yoldia) glaberrima (Münster in Goldfuss 1837).

1835. *Nucula glaberrima*; MÜNSTER, N. Jahrb. Min. etc.; p. 448.
1837. *Nucula glaberrima* MÜNST.; GOLDFUSS, Petr. Germ. II; p. 157, pl. CXXV, f. 14.
1884. *Leda* (*Yoldia*) *glaberrima* MÜNST.; SPEYER–v. KOENEN, Cassel; pl. XVII, f. 1–2.
1907. *Yoldia glaberrima* MÜNST. sp.; RAVN, Jylland; p. 261, pl. I, f. 13.
1913. *Yoldia glaberrima* MÜNST. sp.; HARDER, Aarhus; p. 52, pl. III, f. 16.
1914. *Yoldia glaberrima* MÜNST. sp.; GRIPP, Itzehoe; p. 6.
1925. *Yoldia glaberrima* MÜNST. sp.; KAUTSKY, Hemmoor; p. 24.
1940. *Yoldia glaberrima* MÜNST. sp.; SORGENFREI, Klintinghoved; p. 18, pl. IV, f. 4.
1942. *Yoldia* (*Yoldia*) *glaberrima* (MÜNST.); IJSPEERT, Mioz. Tax.; p. 33, pl. 1, f. 8.
1942. *Yoldia* (*Yoldia*) *glaberrima* MÜNST.; HEERING, Oligoc. Tax.; p. 21, pl. III, f. 1–3.
1945. *Yoldia* (*Yoldia*) *glaberrima* MÜNST. sp.; GLIBERT, Mioc. Belg. I; p. 33, pl. I, f. 9.
1950a. *Yoldia* (*Yoldia*) *glaberrima* (MÜNST.); HEERING, Pelec. Plioc.; p. 26.

Original diagnosis: GOLDFUSS, 1837: "*Nucula testa ovata convexa glaberrima pellucida, umbonibus retusis submedianis, angulo cardinali valde obtuso, dentibus exiguis*".

Type material: Not used. The whereabouts of MÜNSTER's and GOLDFUSS' types not known to me.

Material: Gram (D.G.U., remnants of at least 26 shells; M.M., 5 shells).

Description: Fragments only. The nature of the hinge and surface of the shell make it probable that the species is *Y. glaberrima*.

Remarks: The specimen is fairly common in the silty sediments at Gram, but less so in the Gram clay itself.

Distribution:

North Sea Basin. Oligocene. Denmark: u. (HARDER). North Germany: u. (GÖRGES). Holland: u. (HEERING).—Miocene. Denmark: l. (SORGENFREI), m. (RAVN). North Germany: l. (GRIPP), m. (KAUTSKY), u. (RAVN). Holland: m. (IJSPEERT). Belgium: Houthaelen (GLIBERT), Anversien (GLIBERT).—Pliocene. Denmark: Sæd, near Tønder, according to ØDUM, 1934. North Germany: Morsum Kliff, island of Sylt, according to GRIPP, 1933, and at Bredstedt, according to H.-L. HECK, 1942.

FAMILIA: LIMOPSIDAE

Genus: Limopsis, Sasso 1827.

Subgenus: *Limopsis* s.s. (Typus: *L.* (*L.*) *aurita* (BROCCHI)).

4. Limopsis (Limopsis) aurita (Brocchi 1814).

(Plate I, fig. 3a, b).

1814. *Arca aurita*; BROCCHI, Conch. subapp. II; p. 485; pl. XI, f. 9.
1871. *Limopsis aurita* BROCCHI; S. WOOD, Crag. II; p. 70, pl. IX, f. 2.
1863. *Limopsis aurita* BROCCHI; JEFFREYS, Brit. Conch. II; p. 161, pl. XXX, f. 1.
1898. *Limopsis aurita* BROCCHI; SACCO, I Molluschi XXVI; p. 39, pl. IX, f. 23–30.
1907. *Limopsis aurita* BROCCHI sp.; RAVN, Jylland; p. 265, pl. I, f. 18.
1913. *Limopsis aurita* BROCC. *var. parva*; HARDER, Aarhus; p. 53, pl. III, f. 19–21.
1914. *Limopsis aurita* BROCC.; GRIPP, Itzehoe; p. 7.
1925. *Limopsis aurita* BROCC. *var. minuta*; KAUTSKY, Hemmoor; p. 19, pl. 2, f. 4–5.
1940. *Limopsis aurita* BROCC.; SORGENFREI, Klintinghoved; p. 19, pl. IV, f. 5–6.
1942. *Limopsis aurita* (BROCC.); IJSPEERT, Mioz. Tax.; p. 56, pl. 4, f. 3–6.
1945. *Limopsis* (*Limopsis*) *aurita* BROCC. sp.; GLIBERT, Mioc. Belg. I; p. 47, pl. II, f. 2.

Original diagnosis: BROCCHI, 1814: "*Testa ovata, obliqua, superne angustata, transversim circinnatim rugosa, rugis crebis, elevatis, cardine aurito, foveola triangulari notato, margine integro*".

Type material: Not used. The type is the shell illustrated by BROCCHI (1814, pl. XI, f. 9) and probably kept at Milan (Museo civico di Storia Naturale).

Material: Gram (D.G.U., 1 shell; M.M., 2 shells). Spandetgaard (M.M., 2 shells).

Description: No additions to the descriptions of RAVN, HARDER and SORGENFREI.

Relation to other species: *L. aurita* seems to be closely related to the Upper Oligocene *L. goldfussi* NYST. According to GÖRGES, the difference is that the latter has more than twice the number of axial ribs, the intercostal spaces being much narrower than on *L. aurita*.

Shells from the Upper Oligocene at Aarhus, determined by P. HARDER as *L. aurita* and kept at D.G.U., are indistinguishable from the Upper Miocene specimens.

Remarks: The species is uncommon at Gram and Spandetgaard, whereas in the locality with Gram clay at Maade, east of Esbjerg, it is very common.

Measurements: A valve from Gram measures in length 8.9 mm. and in height 8.0 mm. The ratio: $\frac{L}{H}=1.11$.

Distribution:

North Sea Basin. Oligocene. Denmark: u. (HARDER). North Germany: u.? (*L. Goldfussi*, GÖRGES). Holland: u. (HEERING).—Miocene. Denmark: l. (SORGENFREI), u. (RAVN). North Germany: l. (GRIPP), m. (KAUTSKY), u. (GOTTSCHE). Holland: m. (IJSPEERT). Belgium: Anversien (GLIBERT).—Pliocene. England: Coralline Crag (S. V. WOOD). Holland: Scaldisien (TESCH, HEERING). Belgium: Castelien (NYST).

Atlantic Region. Bordeaux Basin: Tortonien (*L. dumasi*, COSSMANN & PEYROT).

Mediterranean Region. Spain: Plaisancien (GIGNOUX et FALLOT). Italy: Elveziano, Tortoniano, Piacenziano (SACCO). Cyprus: Pliocène inférieur (DUBERTRET, VAUTRIN, KELLER, DAVID). Syria: Miocène supérieur, Pliocène (DUBERTRET, VAUTRIN, KELLER, DAVID). Algeria: Plaisancien (DE LAMOTHE).

Recent occurrence: Atlantic Ocean (up to coast of West Greenland, POSSELT). Mediterranean (POSSELT, JENSEN & SPÄRCK; not mentioned by WEINKAUFF).

FAMILIA: PECTINIDAE

Genus: Chlamys, (Bolten) Röding 1798.

Subgenus: *Peplum* BUCQUOY, DAUTZENBERG & DOLLFUS 1889.

(Typus: *C. (P.) clavata* (POLI)).

5. Chlamys (Peplum) clavata (Poli 1795).

(Plate I, fig. 5a, b).

1795. *Ostrea clavata*; POLI, Test. utriusq. Sic. II; p. 161, pl. XXVIII, f. 17.
1874. *Pecten octoradialis* MØRCH; MØRCH, Forst. i Tert.; p. 294.

1889. *Pecten (Peplum) clavatus* POLI; BUCQ., DAUTZ., DOLLF., Rousillon II; p. 68, pl. XVI, f. 10–17.
1907. *Pecten clavatus* POLI sp.; RAVN, Jylland; p. 252, pl. I, f. 2.
1913. *Chlamys (Peplum) clavatus* POLI; GIGNOUX, Form. mar. plioc. et quatern.; p. 378, pl. XVIII, f. 7–8.
1939. *Chlamys clavata* POLI; ROGER, Genre *Chlamys*; p. 208, pl. XXVIII, f. 4–5, 9–12, 14.
1952. *Chlamys clavata* (POLI); LECOINTRE, Néog. et quat. Maroc; p. 58.

Original diagnosis: POLI, 1795: "*Testa subovata, inaequivalvis, radiis quinis crassis, subabbreviatis, laevibus; margine crenulato, auriculis minimis*". (Cited here after ROGER, 1939, p. 208).

Type material: Not used. The whereabouts of POLI's types is not known to me.

Material: Gram (D.G.U., 57 shells; M.M., 3 shells). Spandetgaard (M.M., 1 shell). Ravning (D.G.U., 1 shell).

Description: See descriptions by RAVN and ROGER.

Relation to other species: *C. clavata* is often combined with *C. septemradiata* MÜLLER (see WEINKAUFF 1867–68 and RAVN 1907). ROGER (1930, p. 210) points out that the former species is distinguishable from the latter by 1) its flat or only slightly depressed left valve, 2) its more prominent but less pointed corners on the left valve, 3) its usually more pronounced folds and 4) its less open apical angle.

The shell of *Pecten clavatus* mentioned and illustrated by HARDER (1913, p. 47, pl. III, fig. 6) from the Upper Oligocene at Aarhus is scarcely of that species.

Remarks: *C. clavata* is common in almost all fossiliferous Gram clay localities and is characteristic of the Upper Miocene in the North Sea Basin. It is remarkable that it does not occur in sediments older than Pliocene in the Mediterranean area.

Measurements: 5 left valves from Gram:

	Height: mm.	Length: mm.	Apical angle:
1)	35.0	34.8	108°.0
2)	31.0	29.7	97°.8
3)	30.0	29.6	96°.3
4)	27.0	26.7	103°.7
5)	27.0	25.7	99°.0

Distribution:

North Sea Basin. Miocene. Denmark: u. (RAVN). North Germany: u. (GOTTSCHE, GRIPP, HINSCH).—Pliocene. Belgium: Scaldisien at Antwerp and Berchem, according to ROGER, 1939, p. 211.

Atlantic Region. Morocco: Pliocène (LECOINTRE-ROGER).

Mediterranean Region. Italy: Piacenziano, Astiano, Calabriano

(SACCO, GIGNOUX). Syria: Pliocène de Mandjila (ROGER). Algeria: Plaisancien (DE LAMOTHE).

Recent occurrence: Atlantic Ocean from coasts of Portugal to the Hebrides and Shetlands (ROGER). Mediterranean (ROGER).

FAMILIA: ASTARTIDAE

Genus: Astarte, J. Sowerby 1816.

Subgenus: *Carinastarte* HINSCH 1952 (Typus: *A.* (*C.*) *reimersi* SEMPER).

6. Astarte (Carinastarte) reimersi, Semper in Ravn 1907.

(Plate II, fig. 1a, b).

1874. *Astarte Reimersi* SEMPER; MØRCH, Forst. i Tert.; p. 292.
1907. *Astarte Reimersi* SEMPER; RAVN, Jylland; p. 272, pl. II, f. 4–6.
1930. *Astarte reimersi* SEMPER; STAESCHE, Zur Gliederung; p. 65.
1952. *Astarte* (*Carinastarte*) *reimersi* SEMP.; HINSCH, Leit. Moll.; p. 149, pl. A. f. 4–5.

Original diagnosis: Not given by SEMPER. First described by RAVN. HINSCH, 1952, gives the following diagnosis: "*Eine Carinastarte von relativ grosser Höhe. Die Aussenseite ist dicht und unregelmässig berippt. Der Ventralrand ist gerade. Lunula und Area sind unscharf begrenzt und wenig asymmetrisch. Der Abfall der Aussenseite hinter dem Kiel ist ziemlich steil*".

Type material: RAVN's types are in M.M. Type locality: Esbjerg. HINSCH's neotypes are in "Geologisches Staatsinstitut", Hamburg (Nos. 168 and 169).

Material: Gram (D.G.U., 3189 shells: M.M., 866 shells). Spandetgaard (M.M., 310 shells). Ravning (D.G.U., 134 shells; M.M., 6 shells).

Description: See descriptions by RAVN and HINSCH.

Relation to other species: *A. reimersi* is very like the Pliocene *Astarte trigonata* NYST (pl. II, fig. 2a, b) from Holland and Belgium (described and figured by NYST 1881, p. 195, pl. XXI, fig. 6 and HEERING 1950. a., p. 73, pl. I, fig. 3–5, 9). Through the mediation of TH. SORGENFREI I received NYST's syntypes (locality: Deurne in Belgium) from the Musée Royal d'Histoire Naturelle de Belgique, Brussels (No. 4147, right valve, and No. 4148, left valve), kindly sent by Dr. M. GLIBERT, 2 left valves from a boring at Mill, Holland, and 2 right valves from a boring at Reek, Holland, all four belonging to the Geologische Stichting, Haarlem, kindly sent by Dr. L. A. AE. VAN EERDE.

All these shells have the characters enumerated by HINSCH in the diagnosis of his newly set-up subgenus *Carinastarte*: the keel from umbo

to posterior corner, the rather marked convexity and the mostly straight ventral margin. On the other hand, *Astarte* (*Carinastarte*) *trigonata* NYST differs from *Astarte* (*Carinastarte*) *reimersi* SEMPER by its high, pointed umbonal region and by its sharp delimitation of lunula and area. Further, on *A. trigonata* the shell margin from umbo to posterior corner is more arcuate and the angle between the ventral margin and the posterior dorsal margin is not right, but more obtuse. On the whole, the shell of *A. trigonata* is more triangular and seems to be less convex than that of *A. reimersi*.

Another closely related species: *Astarte* (*Carinastarte*) *rollei* SEMPER (pl. II, fig. 3a, b) was examined by HINSCH (1952, p. 151, t. A, fig. 7). All shells from Morsum Kliff, Sylt, formerly referred to *A. reimersi*, are named *A. rollei* by him. The *Carinastarte* shells from Morsum Kliff are distinctly flatter than those from Gram, cf. HINSCH, 1952, Abb. 6, p. 155, this in fact being the only real difference between *A. rollei* and *A. reimersi*.

I may add that the opposite is the case with *Astarte* (*Carinastarte*) *vetula* PHILIPPI, (pl. II, fig. 4a, b) which, compared with *A. reimersi*, has a very convex shell, a deeper lunula and area, a greater shell length in proportion to its height and a slightly curved ventral margin. (Regarding *A. vetula*, see HINSCH, 1952, p. 149.)

Another characteristic species of the genus *Astarte* from the North German "Glimmerton": *Astarte* (*Astharota*) *anus* PHILIPPI is considered by HINSCH (1952, p. 157) to be closely related to *Astarte omalii* JONKAIRE from the Mio-Pliocene of Holland and Belgium. *A. anus* (pictured on plate II, fig. 5a, b) has a few large concentric folds instead of concentric ribs, it has a slightly triangular outline and an indistinctly developed carina.

Remarks: SEMPER seems to have regarded the *Astarte* material from Storlund as covering several species. In M. M. there are a left and a right valve from Storlund under the name of *Astarte vicina* SEMPER. These valves, labelled by GOTTSCHE and sent to J. P. J. RAVN in 1905, came from SEMPER's collection in the Naturhistorisches Museum, Hamburg. (One species, very different from the Storlund form, bearing the name *Astarte vicina*, was described by SAY in 1824 from the North American Miocene (Journ. Acad. Nat. Sc. Phila., Vol. IV, 1st. ser., p. 151, pl. IX, fig. 6—see also Maryland Geol. Survey, Miocene, Baltimore 1904, p. 350, pl. XCIII, figs. 10–11)).

P.-H. NYST found close resemblance between *A. trigonata* and *A. Besniersi* SEMPER, "une espèce de l'oligocène de Storland", which he found in BOSQUET's collection (1881, p. 195).

Both *Astarte vicina* SEMPER and *Astarte Besniersi* SEMPER seem to be identical with *A. reimersi*.

A. reimersi is the most common mollusc in the Gram clay. It is found

Astarte reimer

Variation-statistic

Variationsstatistisl

Index	Gram			Gram (after W. HINSCH)		
$\frac{L}{H}$ 100	M 116.2±0.1	σ 4.5±0.1	n=910	M 116.9±0.2	σ 4.3±0.1	n=693
$\frac{D \cdot a}{L}$ 100	93.2±0.1	σ 1.8±0.0	n=910	93.3±0.1	σ 1.7±0.1	n=694
$\frac{T}{L}$ 100	M	σ	n	M	σ	n
I – B	26.3±0.2	1.8±0.1	119	26.8±0.2	2.1±0.1	218
I – C	27.7±0.2	2.4±0.1	220	28.0±0.2	2.3±0.1	191
I – D	30.0±0.3	2.4±0.2	48	29.1±0.3	2.2±0.2	46
II – B	30.6±0.8	2.6±0.6	11	30.2±0.3	1.6±0.2	38
II – C	30.4±0.2	2.3±0.1	215	29.9±0.2	2.1±0.1	172
II – D	31.3±0.1	2.4±0.1	297	30.5±0.2	2.2±0.1	191
B	26.7±0.2	2.2±0.1	130	27.3±0.2	2.3±0.1	255
C	29.0±0.1	2.8±0.1	435	28.9±0.1	2.4±0.1	363
D	31.1±0.1	2.5±0.1	345	30.2±0.2	2.3±0.1	237
I	27.5±0.1	2.5±0.1	387	27.5±0.1	2.2±0.1	455
II	30.9±0.1	2.5±0.1	523	30.2±0.1	2.1±0.1	401
I+II	29.5±0.1	3.0±0.1	910			

Class I: with smooth ventral margin; Class II: with crenulated ventral margin; Class B: H less than 10 mm.; Class C: H between 10 and 15 mm.; Class D: H more than 15 mm.

(see also the text page 36-38)

in all Danish localities with fossiliferous Gram clay and therefore may be regarded as a suitable index fossil for these sediments.

Measurements: Following the example of HINSCH I have made a variation-statistical examination of the Danish material from Gram, Spandetgaard and Ravning.

The measurements taken were: 1) shell length L: length from anterior end to posterior end, 2) shell height H: distance from umbo to ventral border, 3) thickness T (convexity) measured immediately ventrally of the laterals and 4) distance D.a.: as shown on the fig. of the shell on the graph, which is the distance from the anterior dorsal margin to the opposite shell border (see figs. 8-9).

SEMPER

analyses
undersøgelser.

Spandetgaard			Ravning			Storlund (after W. HINSCH)		
M 119.0±0.4	σ 4.7±0.3	n=157	M 119.7±0.4	σ 4.0±0.8	n=126	M 114.3±1.2	σ 4.1±0.8	n=14
93.0±0.1	σ 1.8±0.1	n=157	92.4±0.2	σ 1.9±0.4	n=126	94.5±0.5	σ 1.7±0.4	n=14
M	σ	n						
25.6±0.3	1.7±0.2	27						
26.3±0.3	2.3±0.2	64						
27.7±0.9	2.2±0.6	7						
30.8±0.5	1.1±0.4	4						
28.5±0.2	1.5±0.2	31						
29.8±0.5	2.5±0.4	22						
26.2±0.4	2.3±0.3	31						
27.0±0.2	2.3±0.2	95						
29.3±0.5	2.7±0.4	29						
			M	σ	n	M	σ	n
26.2±0.2	2.2±0.2	98	27.6±0.3	1.8±0.2	32			
29.2±0.3	2.1±0.2	57	30.3±0.2	1.9±0.4	94			
27.3±0.2	2.6±0.1	157	29.6±0.2	2.2±0.4	126	30.6±0.6	2.2±0.4	14

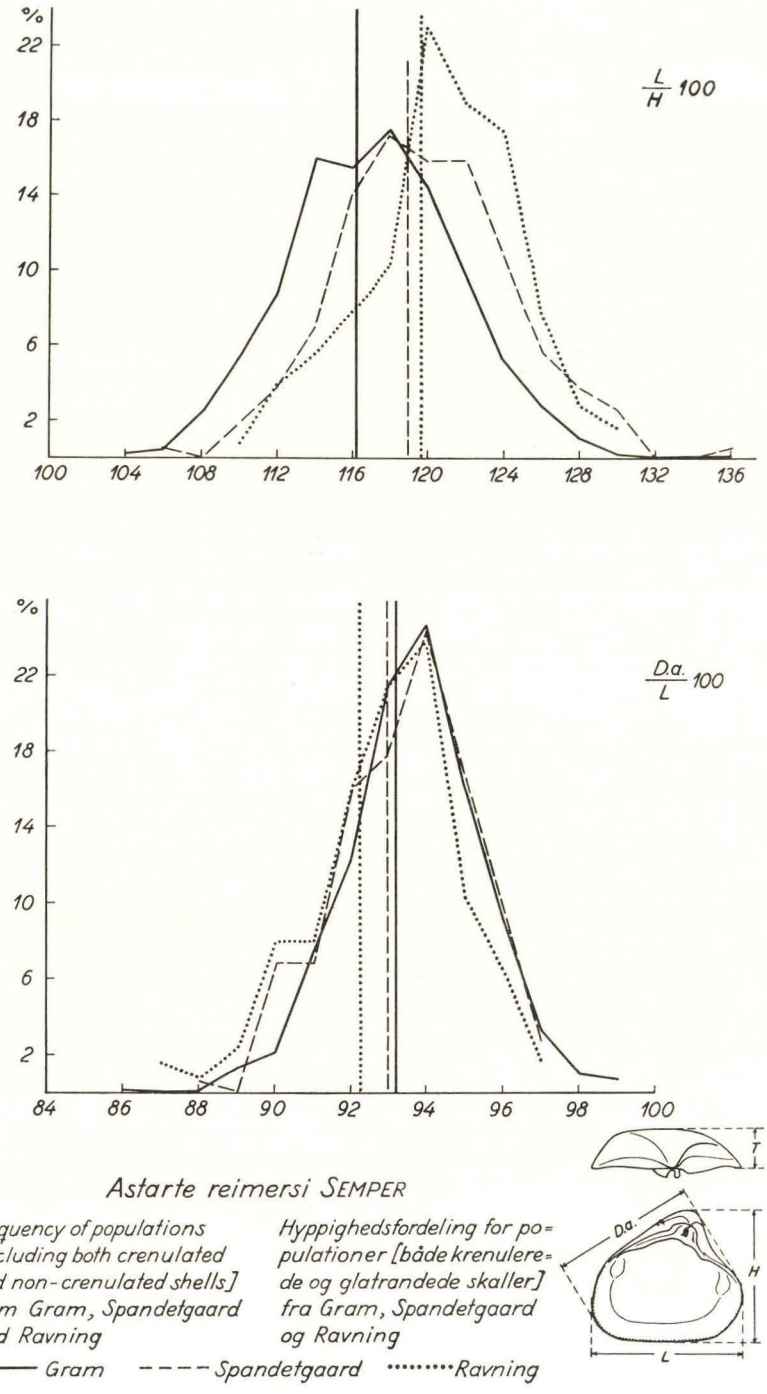
Klasse I: glatrandede; Klasse II: med krenuleret rand; Klasse B: H mindre end 10 mm.; Klasse C: H fra 10 til 15 mm.; Klasse D: H større end 15 mm.

(se iøvrigt teksten p. 36-38).

The variation values were calculated with the aid of the following formulae:

1) mean value $M = \frac{\Sigma x}{n}$, where x = the individual measurement and n = the number of shells measured.

2) standard deviation $\sigma = \sqrt{\frac{\Sigma d^2}{n-1}}$, where d = the deviation from the mean value: $(x—M)$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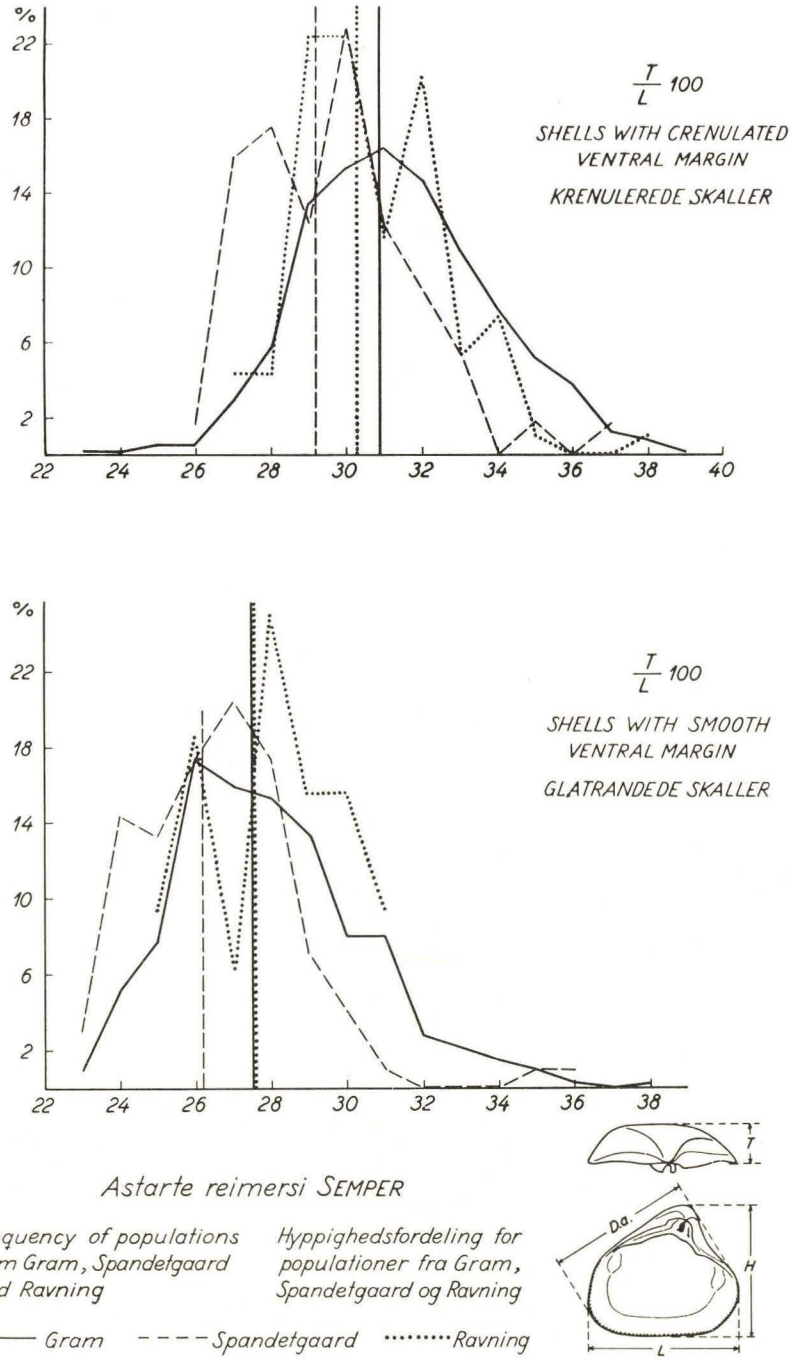
Astarte reimersi SEMPER
Frequency of populations [including both crenulated and non-crenulated shells] from Gram, Spandetgaard and Ravning
Hyppighedsfordeling for populationer [både krenulerede og glatrandede skaller] fra Gram, Spandetgaard og Ravning
Gram
Spandetgaard
Ravning

Fig. 8.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SHELLS WITH CRENULATED VENTRAL MARGIN
KRENULEREDE SKALLER
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T/L 100
SHELLS WITH SMOOTH VENTRAL MARGIN
GLATRANDEDE SKALLER
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Da.
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L
Astarte reimersi SEMPER
Frequency of populations from Gram, Spandetgaard and Ravning
Hyppighedsfordeling for populationer fra Gram, Spandetgaard og Ravning
Gram
Spandetgaard
Ravning

Fig. 9.

The respective mean errors were calculated thus:

a) on the mean value $\sigma_M = \frac{\sigma}{\sqrt{n}}$;

b) on the standard deviation $\sigma_\sigma = \frac{\sigma}{\sqrt{2n}}$

The result of the calculations is shown in the table page 36-37 and in the distribution curves figs. 8-9. It will be seen that the values and the curves for the populations from Gram, Spandetgaard and Ravning agree so closely as to make it a reasonable assumption that these populations are of exactly the same character.

As to the delimitation of *A. reimersi* and *A. rollei*, some values are given by HINSCH (1952, p. 154). It is evident that the material from Gram, Spandetgaard and Ravning is within the values for *A. reimersi*.

HINSCH also measured 14 shells from Storlund; his results are shown in the table page 37.

Distribution:

North Sea Basin. Miocene. Denmark: u. (RAVN, HINSCH). North Germany: u. (RAVN, HINSCH).

Genus: Cardita, Bruguière 1792.

Subgenus: *Cyclocardia* CONRAD 1867. (Typus: *C.* (*C.*) *borealis* CONRAD).

7. Cardita (Cyclocardia) orbicularis (Sowerby 1825).

1825. *Venericardia orbicularis*; SOWERBY, Conch. Gr. Brit. V; p. 145, pl. CCCCXC, f. 2.
1843. *Cardita orbicularis* SOW.; NYST, Coq. et polyp. p. 214, pl. XVI, f. 10.
1853. *Cardita orbicularis* LEATHES'MS.; S. WOOD, Crag II, p. 167, pl. XV, f. 4.
1907. *Venericardia orbicularis* SOW.; RAVN, Jylland; p. 267.
1925. *Pteromeris orbicularis* SOW.; KAUTSKY, Hemmoor; p. 27, pl. 3, f. 5–6.
1944. *Cardita orbicularis* (SOW.); HEERING, Oberolig. Bivalv.; p. 25, pl. 6, f. 1–8.
1945. *Cardita* (*Cyclocardia*) *orbicularis* SOW. sp.; GLIBERT, Mioc. Belg. I; p. 123, pl. VI, f. 14.

Original diagnosis: SOWERBY, 1825: "*Orbicular, rather convex, concentrically striated; ribs about 16, not close, crenated; hinge small*".

Type material: Not used. The whereabouts of SOWERBY's types is not known to me.

Material: Gram (M.M., 1 shell).

Description: See GLIBERT's description and discussion on the species.

Remarks: No new finds since RAVN described the solitary specimen from South Jutland, now in M.M. It is somewhat deteriorated by weathering.

In the Gram clay at Maade, E of Esbjerg, the species is one of the most common molluscs.

Distribution:

North Sea Basin. Oligocene. Denmark: u. (*C. tuberculata* (MÜNST.), RAVN). North Germany: u. (GÖRGES). Holland: u. (HEERING).—Miocene. Denmark: u. (RAVN). North Germany: m. (KAUTSKY), u. (SEMPER, GOTTSCHE, HORN). Holland: m. (HEERING). Belgium: Houthaelen (GLIBERT), Anversien (GLIBERT).—Pliocene. England: Coralline Crag (S. V. WOOD). Holland: Diestien supérieur, Scaldisien (TESCH, HEERING), Belgium: Scaldisien, Castelien (NYST).

FAMILIA: KELLYELLIDAE

Genus: Kellyella, M. Sars 1870 (Kelliella).

Subgenus: *Kellyella* s.s. (Typus: *K.* (*K.*) *miliaris* (PHILIPPI)).

8. Kellyella (Kellyella) sp.

Material: Gram (D.G.U., 1 shell).

Description: The shell circular with central, forward directed, and incurved umbo. The shell surface, now somewhat weathered, seems to have been quite smooth, except for faint traces of concentric growth lines. The margin simple.

Anterior to the umbo a groove runs between the shell margin and the long tooth which thickens posteriorly and has an indentation to receive the tooth of the right valve.

The species does not seem to have been described previously. It will be dealt with by TH. SORGENFREI in a work on the molluscan fauna of the Middle Miocene in South Jutland under the name of *K. rotunda*.

Measurements: This shell from Gram measures 0.9 mm. in height and 0.9 mm. in length.

FAMILIA: ISOCARDIIDAE

Genus: Isocardia, (Klein) Lamarck 1799.

Subgenus: *Isocardia* s.s. (Typus: *I.* (*I.*) *humana* (LINNÉ)).

9. Isocardia (Isocardia) forchhammeri, Beck in Ravn 1907.

(Plate III, fig. 1a, b).

1857. *Isocardia Forchhammeri* BECK; KARSTEN, Nachrichten; p. 12.
1861. *Isocardia Olearii*; SEMPER, Pal. Unters.; p. 69.

1874. *Isocardia Forchhammeri* BECK; MØRCH, Forst. i Tert.; p. 293.
1907. *Isocardia Forchhammeri* BECK; RAVN, Jylland; p. 273, pl. II, f. 7.
1930. *Isocardia forchhammeri* BECK; STAESCHE, Zur Gliederung; p. 65.

Original diagnosis: The species is not mentioned by BECK. Originally named on museum labels only. First description given by RAVN (1907).

Type Material: RAVN's type in M.M. Type locality: Skjærum Mølle.

Material: Gram (D.G.U., 104 shells; M.M., 24 shells). Spandetgaard (M.M., 4 shells). Ravning (M.M., 1 fragment).

Description: No additions to RAVN's description.

Historical: *I. forchhammeri* was illustrated as long ago as 1674 by A. OLEARIUS in "Gottorffische Kunst-Kammer" and is referred to under the name of *Bucardia*. FORCHHAMMER refers to it in 1835 as *Isocardia Cor.* H. H. BECK, keeper at the "Shell Cabinet" of Crown Prince Chr. Frederik (later King Christian VIII), named the species after FORCHHAMMER on museum labels, a species name which KARSTEN made use of in 1857. SEMPER in 1861 changed the name to *Olearii* after the aforesaid OLEARIUS. MØRCH in 1874 resumed the use of BECK's species name, which was given nomenclatory validity by RAVN in 1907.

Relation to other species: *I. forchhammeri* differs from the recent *I. humana* LINNÉ = *I. cor.* LINNÉ, inter alia by being slightly more elongated, by its less arcuate (often indeed quite straight) ventral border, its less winding umbo and its less sharply delimited area.

Remarks: Fragments of *I. forchhammeri* are very numerous in the Gram clay, but intact shells are rare.

Measurements: Four double valves from Gram have the following dimensions:

Thickness of double valves	Height	Length
37.3 mm.	35.6 mm.	46.5 mm.
31.6 –	31.0 –	ca. 38 –
41.0 –	ca. 40 –	
36.7 –		

Distribution:

North Sea Basin. Miocene. Denmark: u. (RAVN). North Germany: m. (KAUTSKY), u. (RAVN, SEMPER, HINSCH).

(The recent *I. humana* occurs in the Atlantic Ocean from Lofoten to the Azores, round about Ireland and probably up into Davis Strait (POSSELT). In Danish waters found in the North Sea and Kattegat southwards to Grenaa-Anholt (JENSEN & SPÄRCK, 1934). The species is also found in the Mediterranean (WEINKAUFF)).

FAMILIA: UNGULINIDAE

Genus: Thyasira, (Leach) Lamarck 1818.

Subgenus: *Thyasira* s.s. (Typus: *T. (T.) flexuosa* (Montagu)).

10. Thyasira (Thyasira) sp.

(Plate I, fig. 7).

Material: Gram (D.G.U., 1 double valve).

Description: There remains merely a defective double valve, from which the umbonal region is missing. The surface is covered with numerous faint concentric growth lines but otherwise it is smooth. Posteriorly on the dorsal part of the valves is a depressed region sharply delimited by a carina.

It has proved impracticable to determine the species of this specimen.

FAMILIA: CARDIIDAE

Genus: Corculum, (Bolten) Röding 1798.

Subgenus: *Papillicardium* Sacco 1899. (Typus: *C. (P.) papillosum* (Poli)).

11. Corculum (Papillicardium) papillosum (Poli 1791).

(Plate I, fig. 6a, b).

1791. *Cardium papillosum*; Poli, Test. utriusq. Sic. I; p. 56, pl. XVI, f. 2–4.
1862. *Cardium papillosum* Poli; M. Hoernes, Wiener Becken II; p. 191, pl. XXX, f. 8.
1863. *Cardium papillosum* Poli; Jeffreys, Brit. Conch. II; p. 275, pl. XXXV, f. 1.
1867. *Cardium papillosum* Poli; Weinkauff, Conch. Mittelm. I; p. 138.
1879–82. *Cardium papillosum* Poli; Fontannes, Moll. plioc. II; p. 83 pl. V, f. 4–5.
1899. *Papillicardium papillosum* Poli; Sacco, I Molluschi, XXVII; p. 44, pl. XI, f. 1–3.
1925. *Cardium (Parvicardium) papillosum* Poli; Kautsky, Hemmoor; p. 37, pl. 4, f. 4.
1934. *Cardium (Parvicardium) papillosum* Poli; Jensen et Spärck, Saltvandsm.; p. 108, f. 90.
1950. *Cardium (Parvicardium) papillosum* Poli; Heering, Pelec. Plioc.; p. 116, pl. 11, f. 9–10.
1950. *Cardium (Parvicardium) papillosum* Poli; Heering, Mioc. Pelec.; p. 31, pl. 6, f. 127, 135–36, 145.

Original diagnosis: Poli, 1791: "*Testa minima, cordiformis, subaequilatera, in longum profunde sulcata, transversimque rugosa; costis elevatis, papillisque prominulis seriatim digestis exornata; margine antico intrinsecus serrato, purpurascenti*".

Type material: Not used. The whereabouts of POLI's types is not known to me.

Material: Gram (D.G.U., 18 shells; M.M., 1 shell).

Description: Two intact left valves have the following characters:

Circular. The circumference may be considered as consisting of two circular arcs with a short and a long radius of curvature and a straight line on each side of the whorl. The surface covered by about 25 flat radial ribs, their widths increasing towards the youngest part of the shell. On the ribs are numerous, regular, round nodules. The intercostal spaces rather narrower than the ribs themselves and have numerous transversal striae whose number increases on the younger part of the shell.

The heterodont hinge has a cardinal tooth situated under the umbo, rather thick and prolonged transversally. Posteriorly it is delimited by a relatively large triangular hollow intended for one of the cardinal teeth of the right valve. The anterior lateral tooth is thin and short, prominent and separated from the shell border by a narrow, deep groove. The posterior lateral tooth is longer, thin, less prominent and coincides almost with the posterior dorsal border. On its posterior aspect it is slightly grooved.

The pallial line and the adductor impressions are only faintly visible on the two valves.

Relation to other species: The Oligocene *C.* (*P.*) *kochi* SEMPER differs only very slightly from the present species (see KAUTSKY, 1925, p. 37).

GLIBERT describes a new species from the Belgian Anversien: *C.* (*P.*) *straeleni*, which is very like *C. papillosum*. As the main difference GLIBERT states that *C. straeleni* has many more transversal striae per mm. of intercostal space than *C. papillosum*.

Measurements: Two well-preserved left valves from Gram measure:

	Length	Height
1)	1.5 mm.	1.5 mm.
2)	1.8 –	1.7 –

Distribution:

North Sea Basin. Miocene. North Germany: m. (KAUTSKY), u. (STAESCHE). Holland: m. (HEERING).—Pliocene. Holland (HEERING).—Quaternary. Denmark: Eem (NORDMANN).

Atlantic Region. Bordeaux Basin: Burdigalien, Helvétien Tortonien (COSSMANN & PEYROT).—Morocco: Pliocène, Quaternaire (LECOINTRE).

Mediterranean Region. Spain: Pleistocène (DOUVILLÉ).—Italy: Elveziano, Tortoniano, Piacenziano, Astiano (SACCO).—France (Rhône valley and Roussillon): Pliocène (FONTANNES).—Cyprus: Pliocène in-

férieur (var., Dubertret, Vautrin, Keller & David).—Syria and Lebanon: Pliocène ancien (Dubertret, Vautrin et Keller).—Egypt: Miocän (Blanckenhorn).—Algeria: Plaisancien (De Lamothe).

Vienna Basin: Grunder Schichten, 2. Mediterranstufe (Kautsky).

Recent occurrence: Atlantic Ocean from south coasts of England to Morocco, the Canary Islands and the Azores (Weinkauff). Mediterranean (Weinkauff).

FAMILIA: MACTRIDAE

Genus: Spisula, Gray 1837.

Subgenus: *Spisula* s.s. (Typus: *S.* (*S.*) *solida* (Linné)).

12. Spisula (Spisula) subtruncata (Da Costa 1778) var. triangula (Renieri 1804).

(Plate II, fig. 6a, b).

1778. *Trigonella subtruncata*; Da Costa, Brit. Conch.; p. 198.
1804. *Mactra triangula*; Renieri, Tavolo alfabetica; p. 6.
1814. *Mactra triangula* Renieri; Brocchi, Conch. subapp. II; p. 535, pl. XIII, f. 7.
1836. *Mactra triangula* Renieri; Philippi, Enumeratio, I; p. 12.
1867. *Mactra triangula* Renieri; Weinkauff, Conch. Mittelm. I; p. 48.
1870. *Mactra triangula* Renieri; M. Hoernes, Wiener Becken II; p. 66, pl. VII, f. 11.
1879–82. *Mactra triangula* Renieri; Fontannes, Moll. plioc. II; p. 23, pl. I, f. 27.
1901. *Spisula subtruncata var. triangula* (R.). Sacco, I Molluschi, XXIX; p. 26, pl. VI, f. 7–8.
1907. *Mactra trinacria* Semp.; Ravn, Jylland; p. 281, pl. III, f. 1–2.
1916. *Mactra subtruncata* var. *trinacria* Semp.; Nørregaard, Esbjerg; p. 17.
1925. *Mactra* (*Spisula*) *subtruncata* Da Costa *var. triangula* Ren.; Kautsky, Hemmoor; p. 46.
1945. *Spisula* (*Spisula*) *subtruncata triangula* Ren. sp.; Glibert, Mioc. Belg. I; p. 195, pl. XII, f. 5.

Original diagnosis: The species diagnosed by Da Costa, 1778: "*Trigonella albescens laevis, lateribus subtruncatis. Subtruncata.*" The variety not diagnosed by Renieri. Brocchi's diagnosis 1814 (II, p. 535): "*Testa inflata trigona, transversim sulcata, latere antico et postico obtuse carinatis, dentibus lateralibus perpendiculariter striatis*".

Type material: Not used. Brocchi's type is presumably in the Museo civico di Storia Naturale di Milano. The whereabouts of Da Costa's and Renieri's types is unknown to me.

Material: Gram (D.G.U., 1 fragment; M.M., 1 right valve).

Description: Besides the intact right valve in M.M. there is a small

fragment of a left valve at D.G.U. On the latter shell the hinge is well preserved with an anterior lateral tooth with about 6 transversal grooves and cardinal teeth.

Relation to other species: It seems difficult to distinguish the Oligocene *S. subtruncata var. trinacria* SEMPER from *var. triangula*, and therefore some authors consider them to be identical.

Remarks: The present-day *S. subtruncata* is a typical sandy bottom form (JENSEN & SPÄRCK, 1934, p. 159).

Distribution:

North Sea Basin. Miocene. Denmark: m. (*M. trinacria*, RAVN). North Germany: m. (KAUTSKY), u. (RAVN). Holland: m. (HEERING). Belgium: Boldérien, Houthaelen, Anversien (GLIBERT).—Pliocene. Holland: Scaldisien, Diestien supérieur (TESCH, HEERING). Belgium: ? (NYST).

Atlantic Region. Bordeaux Basin: Helvétien (COSSMANN & PEYROT). Morocco: Miocène (LECOINTRE).

Mediterranean Region. Italy: Elveziano, Tortoniano, Piacenziano, Astiano (SACCO).

Vienna Basin: Grunder Schichten (KAUTSKY).—Poland: Torton (FRIEDBERG, 1938).

Recent occurrence: Mediterranean and Atlantic Ocean off Morocco and the Canary Islands (WEINKAUFF). (*Spisula subtruncata* is also found in the Atlantic off the coast of Europe from Spain to Finmark. In Danish waters it occurs in the North Sea and Kattegat as far south as Svendborg Sund (JENSEN & SPÄRCK).

FAMILIA: SEMELIDAE

Genus: Abra, (Leach) Lamarck 1818.

Subgenus: *Abra* s.s. (Typus: *A.* (*A.*) *tenuis* (MONTAGU)).

13. Abra (Abra) prismatica (Montagu 1808).

(Plate I, fig. 4).

1808. *Ligula prismatica*; MONTAGU, Test. Brit. Suppl.; p. 23, pl. 26, f. 3.
1843. *Ligula donaciformis*; NYST, Coq. et polyp.; p. 92, pl. IV, f. 9.
1863. *Scrobicularia prismatica* MONT.; JEFFREYS, Brit. Conch. II; p. 435, pl. XLV, f. 1.
1867. *Syndosmya angulosa* REN.; WEINKAUFF, Conch. Mittelm. I; p. 54.
1874. *Abra prismatica* MONT.; WOOD, Crag II; p. 239, pl. XXII, f. 13.
1881. *Semele prismatica* MONT.; NYST, Conch. terr. tert.; p. 230, pl. XXV, f. 6.
1901. *Syndosmya stricta* BROCC.; SACCO, I Molluschi XXIX; p. 121, pl. 26, f. 25–28.

1925. *Abra angulosa* REN.; KAUTSKY, Hemmoor; p. 45.
1934. *Syndosmya prismatica* (MONT.); JENSEN og SPÄRCK, Saltvandsm. p. 141.
1940. *Abra angulosa* REN.; SORGENFREI, Klintinghoved; p. 25, pl. IV, f. 13–14.
1950. *Abra prismatica* (MONTAGU); HEERING, Pelec. Plioc.; p. 162, pl. 16, f. 5–6.

Original diagnosis: MONTAGU, 1808: "*Shell oblong, flat, thin, glossy, white, considerably attenuated at one end, and obsoletely striated concentrically; the umbo very small, placed nearest to, and turning towards the smaller end. Inside smooth and glossy; hinge furnished with a horizontal tooth, having a sub-triangular depression for the reception of the connecting cartilage, and a minute erect tooth in both valves, besides a small lamina or lateral tooth in one valve on each side, remote; of which the other is destitute. Length three-eighths of an inch; breadth double its length*".

Type material: Not used. The whereabouts of MONTAGU's type is not known to me.

Material: Gram (D.G.U., 7 shells; M.M., 1 shell).

Description: A double valve exhibits the form characteristic of *A. prismatica*: the elongated valves with the rounded anterior end and rather pointed posterior end.

The material includes several umbonal fragments including the hinge, which is exactly in accordance with recent shells.

The surface of the shell is smooth and has numerous growth striae, visible only under magnification.

Relation to other species: *A. prismatica* comes very close to the Oligocene *A. bosqueti* (SEMPER, 1861, p. 132) and GLIBERT's *A.* (*A.*) *antwerpiensis*. Regarding these two species, see GLIBERT's detailed examinations (1945, p. 200–204).

Measurements: The only almost intact double valve from Gram measures 4.1 mm. in height and 7.0 mm. in length.

Distribution:

North Sea Basin. Miocene. Denmark: l. (SORGENFREI). North Germany: m. (*A. angulosa*, KAUTSKY), u. (*A. angulosa*, STAESCHE). Holland: m. (HEERING). Belgium: ?—Pliocene. England: Coralline Crag (S. V. WOOD). Holland: Scaldisien (TESCH, HEERING). Belgium: Castelien (NYST).—Quaternary. Denmark: Eem (NORDMANN). England: Clyde beds (S. V. WOOD).

Atlantic Region. Morocco: Pliocène (LECOINTRE).

Mediterranean Region. Italy: Tortoniano, Piacenziano, Astiano (SACCO). Calabrien, Sicilien (GIGNOUX).

Recent occurrence. Mediterranean and Atlantic Ocean from coasts of Portugal to Norwegian Sea and the waters around Iceland (WEINKAUFF). In Danish waters: North Sea, Skagerak and Kattegat down to Hesselø and Hjelm (JENSEN & SPÄRCK).

FAMILIA: TEREDINIDAE

Genus: Teredo, Linné 1758.

14. Teredo sp.

(Plate III, fig. 2).

Material: Gram (D.G.U., 4 shells).

Description: The material includes several more or less fragmentary shells whose shape and sculpturing correspond completely to the species occurring in the Middle Miocene (Hemmoor stage) at Toftlund in South Jutland, to be described and illustrated by TH. SORGENFREI in a forthcoming work.

FAMILIA: THRACIIDAE

Genus: Thracia, (Leach) Blainville 1824.

Subgenus: *Thracia* s.s. (Typus: *T.* (*T.*) *pubescens* (PULTENEY)).

15. Thracia (Thracia) cf. ventricosa, Philippi 1844.

(Plate II, fig. 7).

1844. *Thracia ventricosa*; PHILIPPI, Enumeratio II; p. 17.
1851–61. *Thracia ventricosa* PHIL.; WOOD, Crag II; p. 262, pl. XXVI, f. 5.
1870. *Thracia ventricosa* PHIL.; M. HOERNES, Wiener Becken II; p. 48, pl. III, f. 15.
1901. *Thracia convexa* WOOD; SACCO, I Molluschi XXIX; p. 136, pl. XXVII, f. 21–23.
1907. *Thracia ventricosa* PHIL.; RAVN, Jylland; p. 283, pl. II, f. 11.
1916. *Thracia ventricosa* PHIL.; NØRREGAARD, Esbjerg; p. 18.
1925. *Thracia ventricosa* PHIL.; KAUTSKY, Hemmoor; p. 49, pl. 5, f. 5.
1940. *Thracia ventricosa* PHIL.; SORGENFREI, Klintinghoved; p. 26, pl. IV, f. 16.
1945. *Thracia* (*Thracia*) *ventricosa* PHIL.; GLIBERT, Mioc. Belg. I; p. 219, pl. III, f. 7.
1950. *Thracia ventricosa* PHIL.; HEERING, Pelec. Plioc.; p. 204.

Original diagnosis: R. A. PHILIPPI, 1844, p. 17: *Thracia ventricosa.* "*Thr. testa ovato-oblonga, tumida, umbonibus prominentibus; extremitate antica angustata, truncata.*"

Type material: Not used. The whereabouts of PHILIPPI's types is uncertain to me.

Material: Gram (D.G.U., 1 double valve).

Description: A very defective cast with shell remnants attached, sufficient to establish it as a *Thracia*. To determine the species is impossible, but the obvious course is to compare the material with *T. ventricosa*,

of which there are well-preserved specimens from the Gram clay at Esbjerg and Maade Brickworks.

Distribution:

North Sea Basin. Miocene. Denmark: l. (SORGENFREI), u. (RAVN). North Germany: m. (KAUTSKY), u. (STAESCHE). Belgium: Anversien (GLIBERT).—Pliocene. Holland: ? (HEERING). Belgium: Scaldisien (NYST). England: Coralline Crag (S. V. WOOD).

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

Vienna Basin: 2. Mediterranstufe (KAUTSKY).

FAMILIA: LATERNULIDAE

Genus: Cochlodesma, Couthoy 1839.

16. Cochlodesma sp.

Material: Gram (D.G.U., 6 specimens).

Description: From the Gram clay at Gram there are 6 umbonal fragments of a *Cochlodesma* with the characteristic rather large, oval ligament plate. A carina runs from the umbo in the direction of the posterior corner of the shell. No sculpturing except growth striae.

The species cannot be determined. Similar fragments were found at Holleskov (BANKE RASMUSSEN, 1954, p. 533).

SCAPHOPODA

FAMILIA: SIPHONODENTALIIDAE

Genus: Cadulus, Philippi 1844. (Typus: C. (G.) gadus (Montagu)).

17. Cadulus (Gadila) gadus (Montagu 1803).

(Plate III, fig. 3).

1803. *Dentalium gadus*; MONTAGU, Test. Brit. II; p. 496, pl. 14, f. 7.
1838. *Creseis Gadus*; BRONN. Leth. geogn. II; p. 984, pl. XL, f. 3.
1856. *Dentalium gadus* MONTAGU; M. HOERNES, Wiener Becken I; p. 661, pl. 50, f. 40.
1869. *Cadulus subfusiformis* SARS; JEFFREYS, Brit. Conch. V; p. 196, pl. CI, f. 3.
1882. ?*Cadulus subfusiformis* SARS; v. KOENEN, Mioc. Nordd. II; p. 327.
1897. *Gadila gadus* (MONTG.); SACCO, I Molluschi XXII; p. 116, pl. X, f. 79–85.
1925. *Cadulus (Gadila) gadus* MONTG.; KAUTSKY, Hemmoor; p. 54.
1930. *Cadulus (Gadila) gadus* MONTG.; STAESCHE, Zur Gliederung; p. 65.

Original diagnosis: MONTAGU, 1803: "*D. with a sub-pellucid, subarcuated shell, tapering to a small point, pervious, contracting a little towards the larger end; is white, glossy, and perfectly smooth, without the smallest appearance of wrinkles or striæ. Length scarce three-eighths of an inch; diameter of the largest part, about one sixteenth*".

Type material: Not used. The present whereabouts of MONTAGU's type is uncertain to me.

Material: Gram (D.G.U., 86 fragments; M.M., numerous fragments).

Description: Nothing but fragments, among which it is seen that the width of the shell increases rather rapidly. In the genus *Cadulus* the medial part of the shell is widened, but the Gram material does not seem to contain any fragment with a distinctly decreasing width on both sides of such a widening.

v. KOENEN's and STAESCHE's determination is maintained, however, because for the present there is no better suggestion.

The surface of the fragments from South Jutland is glossy, but magnification shows concentric growth lines which, by the way, are oblique in relation to the axis of the shell and often are emphasized by coloured bands whose tints are sometimes brown, sometimes white.

Relation to other species: The same species seems to occur in the mica-clay of Morsum Kliff, island of Sylt, though it has been referred to various species: ?*Cadulus subfusiformis* SARS (v. KOENEN), *Dentalium strangulatum* DESHAYES (WETZEL, 1937, p. 79) and *C.* (*G.*) *gadus* (MONT.) (STAESCHE).

I would point out that the species determination of the materials from both Sylt and Gram is not quite definite.

Distribution:

North Sea Basin. Miocene. Denmark: u. (v. KOENEN). North Germany: m. (KAUTSKY), u. (v. KOENEN). Holland: m. (MOLENGRAAFF & W. VAN DER GRACHT, 1913, p. 53). Belgium: Anversien (v. KOENEN).

Atlantic Region. Bordeaux Basin: Burdigalien (*Gadila Benoisti* COSSMANN & PEYROT, 1916, p. 182–183), Helvétien, Tortonien (*Gadila gracillina* SACCO, COSSMANN & PEYROT, 1916, p. 182–183).

Mediterranean Region. Italy: ?Elveziano, Tortoniano, Piacenziano (SACCO).

Vienna Basin: 2. Mediterranstufe (KAUTSKY; locality: Baden; "sehr selten", according to M. HÖRNES, 1856, p. 661. Other occurrence according to HÖRNES: Lapugy in Siebenbürgen).

Recent occurrence: Mediterranean, Atlantic Ocean and North Sea (JEFFREYS).

GASTROPODA

PROSOBRANCHIA

FAMILIA: ADEORBIDAE

Genus: Adeorbis, S. Wood 1842. (Typus: A. subcarinatus (Montagu)).

18. Adeorbis carinatus (Philippi 1843).

(Plate III, fig. 4a, b, c).

1843. *Delphinula carinata*; Philippi, Beiträge; p. 21, pl. III, f. 26.
1866. *Adeorbis carinatus* Philippi; Speyer, Lippe-Detmold; p. 23, pl. III, f. 1.
1867. *Adeorbis carinatus* Philippi; v. Koenen, Mittel-Oligocän; p. 116.
1869. *Adeorbis carinatus* Philippi; Speyer, Cassel; p. 317, pl. XXXIV, f. 10–12.
1882. *Adeorbis carinata* Philippi; v. Koenen, Mioc. Nordd. II; p. 313.
1914. *Adeorbis carinata* Philippi; Gripp, Itzehoe; p. 11.

Original diagnosis: Philippi, 1843: "*Schale klein, flach kegelförmig, weit genabelt, die letzte Windung mit drei Kielen von denen der oberste undeutlich ist*".

Type material: Not used. The whereabouts of Philippi's type is uncertain to me. But as it is a juvenile specimen, Speyer's shell (1866, pl. III, fig. 1) should be chosen as the neotype.

Material: Gram (D.G.U., 2 shells).

Description: The shell slightly convex, circular, consisting of 4–5 whorls whose width increases rapidly, the youngest whorl being almost twice the width of the others together.

The protoconch and the oldest whorls devoid of sculpturing, this apparently appearing first in the course of the penultimate whorl in the form of spirals on the flatter region below the suture. On the youngest whorl are numerous spirals which, however, lie closest and are narrowest on the flat upper region.

Medially on the body whorl a peripheral carina which delimits the base of the shell from the convex upper side. The base is dominated by a broad umbilicus, within which the other whorls are distinctly visible. Midway between the umbilicus and the peripheral carina is another, relatively faint basal carina. The shell surface is otherwise furnished with faint, flat spirals.

The growth lines are visible over the entire shell in the form of regular arcs.

The aperture is unsymmetrically oval.

Relation to other species: The literature contains descriptions of several *Adeorbis* species, from the British Crag and the German Miocene sediments. Unfortunately, both descriptions and illustrations are inade-

quate for providing a clear account of the relation of these species to *A. carinatus*.

Remarks: SPEYER (1866, p. 23) points out that the three carinae on the final whorl mentioned in PHILIPPI's diagnosis occur only on very young shells; adult shells have no more than two.

A. carinatus has mostly been found in North German Middle and Upper Oligocene sediments, for which reason it is remarkable that the species seems to occur right up in the Upper Miocene.

At Gram it has been found only in the silty sediments.

Measurements: The one solitary complete shell has a diameter of 4.4 mm. and a height of 1.9 mm.

Distribution:

North Sea Basin. Oligocene. North Germany: m., u. (SPEYER, v. KOENEN).—Miocene. North Germany: l. (GRIPP), m. (v. KOENEN), u. (HINSCH).

FAMILIA: TURRITELLIDAE

Genus: Turritella, Lamarck 1799.

Subgenus: *Turritella* s.s. (Typus: *T.* (*T.*) *terebra* (LINNÉ)).

19. Turritella (Turritella) tricarinata (Brocchi 1814).

(Plate IV, fig. 1a, b).

1814. *Turbo tricarinatus*; BROCCHI, Conch. subapp. II; p. 374, pl. VI, f. 21.
1882. *Turritella tricarinata* BROCCHI; v. KOENEN, Mioc. Nordd. II; p. 283.
1895. *Turritella tricarinata* (BR.); SACCO, I Molluschi XIX; p. 5, pl. I, f. 14.
1907. *Turritella tricarinata* BROCCHI sp.; RAVN, Jylland; p. 296, pl. III, f. 16.
1924. *Turritella tricarinata* BROCCHI; GUILLAUME, Classif. Turritelles; p. 305.
1925. *Turritella tricarinata var. communis* RISSO.; KAUTSKY, Hemmoor; p. 79.
1930. *Turritella tricarinata* var. *communis* RISSO.; STAESCHE, Zur Gliederung.; p. 66.
1952. *Turritella* (*Turritella*) *tricarinata* BROC. sp.; GLIBERT, Mioc. Belg. II; p. 27, pl. I, f. 10.

Original diagnosis: BROCCHI, 1814: "*Testa turrita, subulata, anfractubus convexis, carinis tribus acutiusculis distinctissimis, interstitiis leviter striatis*".

Type material: Not used. BROCCHI's types are in the Museo civico di Storia Naturale in Milan. One of the syntypes is figured by SACCO, 1895, pl. I, fig. 14a.

Material: Gram (D.G.U., 632 shells; M.M., 26 shells). Spandetgaard (M.M., 57 shells).

Description: See RAVN's description.

The characteristic feature of this species is the three principal spiral ribs, of which the middle one is the most pronounced, the lower one and

the upper coming next in that order. Sometimes there may be a secondary spiral, though on the shells from South Jutland this is always very faint.

The upper spiral rib is sometimes so indistinct that there seem to be only two as on *T. archimedis* Brongniart.

Relation to other species: There seems to be a smooth transition between *T. tricarinata* and the recent *T. communis* (Risso) (= *T. terebra* L.), for which reason Sacco (1895, p. 6) named the former *T. tricarinata communis*, under which name Kautsky and Staesche refer to it in their descriptions and list of species.

The South Jutland material is very constant and distinct as regards the sculpturing, and none of the specimens from there display any trend towards or identity with that of the recent *T. communis*.

Remarks: *T. tricarinata* is very common in the Gram clay and in the silty sediments and may be considered a characteristic fossil of the marine Upper Miocene in South Jutland.

Distribution:

North Sea Basin. Miocene. Denmark: m., u. (Ravn). North Germany: m. (Kautsky), u. (v. Koenen, Ravn). Holland: ?. Belgium: Anversien (Glibert).—Pliocene. England: Coralline Crag (Harmer). Holland: Diestien supérieur? (Tesch). North Germany: Pliocene at Bredstedt (Heck, 1944).

Atlantic Region. Morocco: Pliocène (Lecointre).

Mediterranean Region. Italy: Tongriano, Elveziano, Tortoniano, Piacenziano, Astiano (Sacco). Algeria: Miocène (Brives), Plaisancien (De Lamothe). Cyrenaica: Miocène (*T. communis*, Tavani). Egypt: Miocän (Blanckenhorn). Syria and Lebanon: Pliocène (Dubertret, Vautrin & Keller).

Subgenus: *Archimediella* Sacco 1895 (Typus: *T.* (*A.*) *archimedis* Brongniart).

20. Turritella (Archimediella) archimedis, Brongniart 1823.

(Plate IV, fig. 2).

1823. *Turritella Archimedis* A. Br.; Brongniart, Terr. séd. sup.; p. 55, pl. II, f. 8.
1856. *Turritella Archimedis* Brongn.; M. Hoernes, Wiener Becken I; p. 424, pl. 43, f. 13–14.
1882. *Turritella Archimedis* Brongn.; v. Koenen, Mioc. Nordd. II; p. 285.
1907. *Turritella Archimedis* Brongn.; Ravn, Jylland; p. 296, pl. III, f. 15.

Original diagnosis: Brongniart, 1823: "*Subulata, transversè sulcata, anfractibus bicarinatis, interstitiis subtilissimè striatis*".

Type material: Not used. The whereabouts of Brongniart's type

(in the MARASCHINI collection) from localities in the Ronca valley, N.E. of Verona, Northern Italy, is unknown to me.

Material: Gram (D.G.U., 15 shells; M.M., 10 shells).

Description: See v. KOENEN's and RAVN's descriptions, which cover the material from the Danish and North German mica-clay.

To this species have been referred all *Turritella* shells with only two spiral ribs appearing in the form of two carinae and with not even faint traces of other spirals. At any rate in some cases there may be a question of extreme shells of *T. tricarinata*.

Distribution: In the literature I have considered only such authors as refer to the species under the name of *archimedis*, not those whose opinion is that *T. archimedis* rightly belongs to another species and therefore place it in different lists of synonyms.

North Sea Basin: Miocene. Denmark: u. (RAVN). North Germany: u. (v. KOENEN).

Mediterranean Region. Italy: Sundry varieties in Tongriano, Elveziano, Piacenziano (SACCO). Algeria: Miocène (BRIVES). Plaisancien (DE LAMOTHE).

Vienna Basin: "Unterer Tegel und Sand" and "Tegel und Sand des Leythakalkes" (M. HOERNES).

Hungarian Basin: Helvet, Torton (BOGSCH).

FAMILIA: SCALIDAE

Genus: Opalia, H. & A. Adams 1853.

Subgenus: *Pliciscala* DE BOURY 1887 (Typus: *O.* (*P.*) *gouldi* (DESH.)).

21. Opalia (Pliciscala) vilandti (Mørch 1874).

(Plate IV, fig. 3).

1874. *Cerithium* (*Bittium*) *Vilandti*; MØRCH, Forst. i Tertiært.; p. 298.
1882. *Scalaria Vilandti* MØRCH sp.; v. KOENEN, Mioc. Nordd. II; p. 299.
1907. *Scalaria Vilandti* MØRCH sp.; RAVN, Jylland; p. 295, pl. III, f. 13.

Original diagnosis: MØRCH, 1874: "*Testa abbreviato-subulata, craticulata; anfr. convexis suturis profundis, costis circiter X angustis sat distantibus. Lirae spirales distantes 4 latiusculae in intersectionibus costarum obsolete tuberculatis. Basis laevis, plana, lirulis 2 obsoletissimis, angulo circumscripta. Long. circ. 4 mm.*"

Type material: MØRCH's type, illustrated by RAVN, preserved in M.M. Type locality: Gram.

Material: Gram (D.G.U., 4 shells; M.M., 1 shell).

Description: The Gram specimens are defective (without proto-

conch).—The species was described by V. KOENEN and RAVN.—Two spiral ribs are still to be seen on the final whorl, inserted between the four principal spiral ribs. The three broad, flat spirals on the base of the shell, mentioned by V. KOENEN, are only faintly visible.

Remarks: SACCO names *Scalaria Vilandti* MØRCH: *Funiscala? mioturrita* (SACCO) *var. delineata* SACCO (1891, parte IX, p. 71). Judging from SACCO's illustration the spiral sculpturing on the species *mioturrita* is much finer than on *vilandti*.

With some hesitation I refer *vilandti* to the genus *Opalia* and subgenus *Pliciscala* in THIELE's sense.

Distribution:

North Sea Basin. Miocene. Denmark: u. (RAVN). North Germany: m., u. (V. KOENEN).

FAMILIA: XENOPHORIDAE

Genus: Xenophora, Fischer von Waldheim 1807.

Subgenus: *Xenophora* s.s. (Typus: *X.* (*X.*) *trochiformis* (BORN)).

22. Xenophora (Xenophora) testigera (Bronn 1831).

(Plate IV, fig. 5a, b).

1831. *Phorus testigerus*; BRONN, Italiens Tertiärgeb.; p. 61, nr. 323.
1847. *Phorus testigerus* BRONN; MICHELOTTI, Terr. miocènes; p. 174, pl. 7, f. 6.
1856. *Xenophora testigera* BRONN; M. HOERNES, Wiener Becken I; p. 444, pl. 44, f. 14.
1882. *Xenophora testigera* BRONN; V. KOENEN, Mioc. Nordd. II; p. 307.
1896. *Xenophora testigera* (BRONN); SACCO, I Molluschi, XX; p. 24, pl. III, f. 1.
1907. *Xenophora testigera* BRONN sp.; RAVN, Jylland; p. 289.

Original diagnosis: BRONN, 1831: "*T. testa depresso-conica, anfractuum margine hinc inde conchyliophora; superficie superiore subregulari, radiatim-strigosa, in anfractibus inferioribus transversim ruguloso-sulcata; facie inferiore subplana, obsolete arcuato-strigosa; umbilico semitecto.*"

Type material: Not used. The whereabouts of BRONN's types is not known to me.

Material: Gram (D.G.U., 4 shells).

Description: Shell trochoid. Apical angle about 76°. Protoconch consists of 4–5 smooth whorls, of which the youngest have arcuate growth lines. The other whorls have an irregular surface but on the whole are flat. No sculpturing beyond rather obsolete spiral ribs on the youngest whorls, which also have more prominent spirals just above the suture. Here also are the impressions of foreign bodies characteristic of the genus (mollusc shells, remains of bryozoa, etc.).

Base delimited by a sharp downward peripheral border. On the whole

furnished with numerous growth lines emanating from the umbilical region in a direction at right angles to the periphery. After traversing about two thirds of the distance to the latter they curve posteriorly in a large arc and then run parallel with the periphery. Around the umbilical region are the faint traces of a few flat spiral ribs.

Relation to other species: According to HOERNES the present species differs from *X. deshayesi* MICHELOTTI especially in the spiral sculpturing and impressions of foreign bodies on the region just above the suture.

Measurements: The one intact specimen from Gram measures 6.1 mm. in height and 8.0 mm. diameter of the base.

Distribution:

North Sea Basin. Miocene. Denmark: u (RAVN), North Germany: m., u. (v. KOENEN).

Mediterranean Region. Italy: Elveziano, Tortoniano, Piacenziano, Astiano (SACCO).

Vienna Basin: Baden, Vöslau, Forchtenau (M. HOERNES).

FAMILIA: APORRHAIDAE

Genus: Aporrhais, Da Costa 1778 (Typus: A. pes pelecani (Linné)).

23. Aporrhais alata (Eichwald 1830).

(Plate IV, fig. 4a, b).

1830. *Rostellaria alata*; EICHWALD, Lithauen, Volhynien etc.; p. 225.
1854. *Aporrhais alata* EICHW. sp.; BEYRICH, Conchylien; p. 176, pl. 11, f 7–8.
1856. *Chenopus pes pelecani* PHIL.; M. HOERNES, Wiener Becken I, p. 194, pl. 18, f. 2–4.
1882. *Chenopus alatus* EICHW., sp.; HILBER, Conch. ostgal. Mioc.; p. 4.
1882. *Aporrhais alata* EICHW.; v. KOENEN, Mioc. Nordd. II; p. 276.
1884. *Chenopus* (*Aporrhais*) *alatus* EICHWALD; R. HOERN. & AUING., Gasteropoden; p. 166, pl. XVIII, f. 6 og 8.
1907. *Aporrhais alata* EICHWALD sp.; RAVN, Jylland; p. 304, pl. III, f. 25.
1925. *Chenopus alatus* EICHW.; KAUTSKY, Hemmoor; p. 86.
1930. *Chenopus alatus* EICHW.; STAESCHE, Zur Gliederung; p. 66.
1944. *Aporrhais* (*Aporrhais*) *alata* (EICHW.); VOORTHUYSEN, Mioz. Gastrop.; p. 40, pl. 4, f. 6–14, 16–20.
1952. *Aporrhais alata* EICHW. sp.; GLIBERT, Mioc. Belg. II; p. 68, pl. V, f. 7.

Original diagnosis: EICHWALD, 1830: "*Testa turrita, transversim striata longitudinaliter costata, anfractu ultimo in marginem latum excurrente, bicarinato, carina utraque, tuberculata in processum digitiformem prolongata; tertio processu columellari ad tertium usque anfractum adscendente, spira extrema omnino libera*".

Type material: Not used. The whereabouts of EICHWALD's types is not known to me.

Material: Gram (D.G.U., 1 fragmentary shell, legit L.B.R.; M.M., 1 shell, legit FRIIS, 1910).

Description: The only fairly entire shell from Gram lacks the protoconch. The other (six) whorls have spiral ribs. On the second-oldest of the whorls are numerous arcuate elevations following the growth lines. They become more marked on the following whorl and below the middle of the next they swell into nodules which, on the youngest whorl, become short and robust, the intervals between them having become doubled. On the youngest whorl there are 18 nodules, on the next about 21. The spiral rib immediately over the apertural suture gradually becomes more list-like. A hint of nodules is observable on the second-youngest whorl.

On the youngest whorl are three carinae with nodules: 1. uppermost: continuation of the robust line of nodules, 2. medially: continuation of the spiral rib over the apertural suture and 3. lowest: a new-formed carina. These carinae together with the spiral ribs continue out on the wing. Here the carinae form ribs which terminate in the corners of the wing. From the uppermost of these a border extends along the valve up to the fourth of the remaining whorls. The edge of the border is broken off.

The inner lip has but little width. The aperture is rectangular and ends downwards in a very short, fine-drawn channel. A gutter-shaped depression runs from the aperture towards the uppermost excrescence of the wing.

Relation to other species: HOERNES & AUINGER and especially VOORTHUYSEN discuss its relation to allied species. The following ontogenetic evolution is assumed:

A. speciosa SCHLOTHEIM (Oligocene—Lower Miocene) → *A. alata* EICHW. (Middle—Upper Miocene) → *A. pes pelecani* L. (Pliocene—Recent).

The Gram shell is mostly affined to *A. alata*, but there are other features recalling *A. pes pelecani* L., e.g. the secondary row of nodules immediately above the apertural suture.

Remarks: Two shells from the Upper Miocene at Maade Brickworks, east of Esbjerg, have exactly the same characters as that from Gram.

Distribution:

North Sea Basin. Miocene. North Germany: m., u. (v. KOENEN), Holland: m. (VOORTHUYSEN), Belgium: Boldérien, Horizon de Houthaelen, Anversien (GLIBERT).

Mediterranean Region: ?

Vienna Basin: Grunder Schichten, 2. Mediterranstufe (KAUTSKY).

FAMILIA: NATICIDAE

Genus: Polynices, Montfort 1810.

Subgenus: *Lunatia* GRAY 1847 (Typus: *P. (L.) ampullaria* (LAMARCK)).

24. Polynices (Lunatia) helicina (Brocchi 1814).

(Plate IV, fig. 6a, b).

1814. *Nerita helicina*; BROCCHI, Conch. subapp. II; p. 297, pl. I, f. 10.
1868. *Natica helicina* BROCCHI; WEINKAUFF, Conch. Mittelm. II; p. 249.
1882. *Natica helicina* BROCCHI; v. KOENEN, Mioc. Nordd. II; p. 231.
1890. *Natica catena var. helicina*; SACCO, I Molluschi VIII; p. 70, pl. II, f. 43.
1907. *Natica helicina* BROCCHI; RAVN, Jylland; p. 294, pl. III, f. 11.
1918. *Natica (Lunatia) helicina* BROCCHI; COSSM. & PEYR., Conch. Néog., A. S. L. B. LXX; p. 228, pl. XI, f. 39–41, pl. XII, f. 29.
1940. *Natica (Lunatia) helicina* BROCCHI; SORGENFREI, Klintinghoved; p. 32, pl. V, f. 5.
1952. *Polynices (Lunatia) catena f. helicina* BROC. sp.; GLIBERT, Mioc. Belg. II; p. 69, pl. V, f. 8.
1952. *Polynices (Euspira) helicina* BROCCHI sp.; GLIBERT, Gastr. Loire II; p. 243, pl. I, f. 4.

Original diagnosis: BROCCHI, 1814: "*Testa solida subglobosa, anfractibus rotundatis distinctis, umbilico semiclauso, labio adnato, incrassato, calloso.*"

Type material: Not used. BROCCHI's types are presumably in the "Museo civico di Storia Naturale", in Milan.

Material: Gram (D.G.U., 13 shells; M.M., 21 shells). Spandetgaard (M.M., 9 shells). Ravning (D.G.U., 1 shell).

Description: See RAVN's description.

The chief characters of this species seem to be that immediately below the suture the growth lines run towards the umbilicus, and that the latter is rather large and relatively distinctly delimited.

Relation to other species: After having seen BROCCHI's type specimens JEFFREYS declared (1884, p. 29) that the present species had been set up merely on small forms of *N. catena* DA COSTA. SACCO subdivides *N. catena* into a long series of varieties and refers the Miocene *N. helicina* to *N. catena var. cyclostomoides* SACCO (1890, VIII, p. 292, pl. II, fig. 40). The questions of the relation of the Miocene forms to *P. catena*, and of whether *P. helicina* is an independent species or not, can be settled only after a close study of a large recent and fossil material.

Distribution:

North Sea Basin. Miocene. Denmark: l. (SORGENFREI), u. (RAVN). North Germany: u. (v. KOENEN). Holland: m. (MOLENGRAAF & v. DER GRACHT). Belgium: Anversien (GLIBERT). Pliocene. England: Coralline Crag (WOOD, HARMER). Holland: Scaldisien (TESCH). Quaternary. England: Waltonian (HARMER).

Atlantic Region. Loire Basin: Miocène Moyen (GLIBERT). Bordeaux Basin: Helvétien, Tortonien (COSSMANN & PEYROT).

Mediterranean Region: Italy: Elveziano, Tortoniano. Piacenziano. ? Astiano (SACCO).

25. Polynices (Lunatia) alderi (Forbes 1838).

(Plate IV, fig. 8a, b).

1853. *Natica nitida* DONOVAN; FORBES & HANLEY, Hist. Brit. Moll. III; p. 330, pl. C, f. 2–4.
1867–69. *Natica alderi* FORBES; JEFFREYS, Brit. Conch. IV; p. 224; V; pl. 78, f. 5.
1878. *Lunatia intermedia* PHILIPPI; SARS, Moll. Reg. Arct. Norv.; p. 157.
1882. *Natica Alderi* FORBES; WOOD, Crag. Suppl.; p. 74, pl. 7, f. 27.
1882. *Natica Alderi* FORBES; v. KOENEN, Mioc. Nordd. II; p. 234, pl. 5, f. 11–14.
1907. *Natica Alderi* FORBES; RAVN, Jylland; p. 292, pl. III, f. 9.
1916. *Natica Alderi* FORBES; NØRREGAARD, Esbjerg; p. 22.
1925. *Natica (Naticina) pulchella* RISSO *var. Alderi* FORB.; KAUTSKY, Hemmoor; p. 69.

Original diagnosis and type material: Both are unknown to me.

Material: Gram (D.G.U. 1 shell; M.M., 9 shells). Spandetgaard (M.M., 9 shells).

Description: The main characters of this species seem to be as follows: Under the apical suture there is sometimes a slight depression. The growth lines do not run directly under the suture in a straight line towards the umbilicus but, on the upper part of the whorls (in the depression) are arcuate before becoming straight. The umbilicus is not clearly delimited. The angle of the inner apertural border to the axis of the shell is somewhat smaller than the corresponding angle on *P. helicina*.

Relation to other species: The shells from the South Jutland Upper Miocene referred by RAVN to *Natica alderi* seem not to be of this species, but *P. helicina*.

P. alderi is often united with *P. pulchella* (RISSO), which lives in the Mediterranean, and KAUTSKY considers the former to be a variant of the latter.

Distribution:

North Sea Basin. Miocene. Denmark: u. (RAVN). North Germany: m. (KAUTSKY), u. (v. KOENEN). Holland: m. (MOLENGRAAF & v. DER GRACHT).—Pliocene. England: Coralline Crag (WOOD, HARMER). Holland: Scaldisien (TESCH).—Quaternary. England: Waltonian, Newbournian, Butleyan, Icenian (WOOD, HARMER).

Recent occurrence: North Sea from Lofoten southwards along the border of the northern Atlantic, the Adriatic and both sides of the Mediterranean (JEFFREYS).

Subgenus: *Polynices* (Typus: *P.* (*P.*) *mammilla* (LINNÉ)).

26. Polynices (Polynices) koeneni (Sacco 1891).

(Plate IV, fig. 7a, b).

1883. *Natica plicatella* BRONN.; v. KOENEN, Mioc. Nordd. II; p. 229, pl. 5, f. 6–7, 9.
1907. *Natica plicatula* BRONN.; RAVN, Jylland; p. 291, pl. III, f. 7.
1925. *Natica Koeneni* SACCO; KAUTSKY, Hemmoor; p. 68, pl. 6, f. 18.
1930. *Natica Koeneni* SACCO; STAESCHE, Zur Gliederung; p. 66.

Original diagnosis: The species has not been diagnosed. First described under the name of *N. plicatella* by v. KOENEN and referred by SACCO (1891, VIII, p. 287) to a variety of *N. epiglottina* LK. Elevated to a separate species by KAUTSKY (1925).

Type material: Not used. v. KOENEN's types are lost. KAUTSKY's type of *N. Koeneni* is in the "Geologisches Landesmuseum" in Berlin.

Material: Gram (D.G.U., 69 shells; M.M., 37 shells). Spandetgaard (M.M., 7 shells).

Description: See RAVN's description of *N. plicatula* BRONN.

The chief characters of this species seem to be: The growth lines form narrow, sharp folds on the region below the apical suture. Most of the umbilical aperture is covered by a plug, which is an extension of the inner apertural margin. The spire is flattened.

Relation to other species: SACCO (1891) and KAUTSKY (1925) have described the difference between the present species and the Pliocene *N. plicatella* (= *N. plicatula* (BRONN, 1831)), but the difference does not emerge quite clearly in the literature. I have not had an opportunity of examining Pliocene material from Italy.

Distribution:

North Sea Basin. Miocene. Denmark: u. (RAVN). North Germany: m. (KAUTSKY), u. (v. KOENEN). Holland: m. (MOLENGRAAF & VAN DER GRACHT).

27. Polynices (Polynices) submamillaris (D'Orbigny 1852).

(Plate V, fig. 1a, b).

1852. *Natica submamillaris*; D'ORBIGNY, Prodrome III; p. 38.
1882. *Natica Josephinia* RISSO; v. KOENEN, Mioc. Nordd. II; p. 231.
1890. *Natica submamillaris* D'ORBIGNY; SACCO, I Molluschi VIII; p. 314, pl. II, f. 62.
1907. *Natica Josephinia* RISSO; RAVN, Jylland; p. 291, pl. III, f. 7.
1925. *Natica* (*Polinices*) *submamillaris* D'ORB.; KAUTSKY, Hemmoor; p. 71, pl. 6, f. 24–25.
1940. *Natica* (*Polinices*) *submamillaris* D'ORB.; SORGENFREI, Klintinghoved; p. 33.
1952. *Polynices* (*Polynices*) *submamillaris f. dertomamilla* SACCO; GLIBERT, Mioc. Belg. II; p. 73, pl. V, f. 12.

Original diagnosis: Not given by D'Orbigny. The following is given by Sacco, 1891, p. 314: "*Testa parva, oblongo-ovata, spira sat elata, subconica. Anfractus quatuor-quinque, convexi, ultimus permagnus, ad suturam depressus. Apertura subovato-faseoliformis. Labium externum simplex, arcuatum. Umbilicus latus, maxima in parte detectus*; *funiculus umbilicalis depressus vel suboblitus.*"

Type material: Not used. The species seems to have been figured first by Sacco (1891, pl. II, fig. 62), so that specimen may be regarded as the type. Type locality: Colli torinesi. Preserved: Museo geol. di Torino.

Material: Gram (M.M., 1 shell, leg. Reimers 1862).

Description: The present shell was described by Ravn under the name of *N. Josephinia* Risso, though that species has a characteristically oblique form and its entire umbilicus is covered by a large plug.

Chief characters of *P. submamillaris* D'Orbigny: Low spire and large, well-defined, semicircular umbilicus. The internal lip of the aperture extends only slightly over the youngest whorl and intersects only a small part of the upper corner of the umbilicus.

Relation to other species: The species bears very close resemblance to the Oligocene *N. hantoniensis* Pilkington (see Ravn and Kautsky).

Distribution:

North Sea Basin. Miocene. Denmark: l. (Sorgenfrei), u. (Ravn). North Germany: m. (Kautsky). Belgium: Boldérien, Horizon de Houthaelen, Anversien (Glibert).

Mediterranean Region. Italy: Elveziano, Tortoniano (Sacco).

Vienna Basin: Grunder Schichten (Kautsky).

FAMILIA: CASSIDIDAE

Genus: Cassidaria, Lamarck 1812 (Typus: C. echinophora (Linné)).

28. Cassidaria echinophora (Linné 1758).

(Plate V, fig. 3).

1758. *Buccinum echinophorum*; Linné, Systema Naturae, Ed. X; T. I, p. 735 (no. 381).
1854. *Cassidaria echinophora* L. sp.; Beyrich, Conchylien; p. 164, pl. 8, f. 8–9.
1856. *Cassidaria echinophora* Lam.; M. Hoernes, Wiener Becken I; p. 183, pl. 16, f. 4–6.
1867. *Cassidaria echinophora* L.; Da Costa, Gastér. tert. Port.; p. 133, pl. XVII, f. 2.
1868. *Cassidaria echinophora* L.; Weinkauff, Conch. Mittelm. II; p. 47.
1872. *Cassidaria echinophora* L.; v. Koenen, Mioc. Nordd. I; p. 73.
1879–82. *Galeodea echinophora* L.; Fontannes, Moll. plioc. I; p. 100, pl. VII, f. 1.
1882–86. *Cassidaria echinophora* L. sp.; Bucquoy, Dautzenberg & Dollfus, Rousillon, I; p. 68, pl. VIII, f. 1–5, pl. IX, f. 1–2.

1884. *Cassidaria (Galeodea) echinophora* LINNÉ; R. HOERNES & AUINGER, 1. u. 2. Mediterr.; p. 161.
1890. *Galeodea echinophora var. placentina* (D.); SACCO, I Molluschi VII; p. 521, pl. II, f. 7.
1904. *Cassidaria echinophora var. placentina* (D.); SACCO, ibid. XXX; p. 98, pl. XXI, f. 3–7.
1904. *Cassidaria echinophora var. pliotriseriata*; SACCO, ibid. VII; p. 522–XXX, pl. XXI, f. 8–10.
1907. *Cassidaria echinophora* L.; RAVN, Jylland; p. 306, pl. IV, f. 5.

Original diagnosis: LINNÉ, 1758: "*B. testa cingulis quatuor tuberculosis, cauda prominente.*"

Type material: Not used. The whereabouts of LINNÉ'S types is unknown to me.

Material: Gram (D.G.U., 51 shells; M.M., 15 shells). Spandetgaard (M.M., 7 shells). Ravning (M.M., 1 shell).

Description: See RAVN's description. A few of the Gram shells have varices.

Relation to other species: The species is extremely variable as to both whorl and nodular sculpturing (see illustrations in the literature) e.g. SACCO, 1890 & 1904).

None of the varieties illustrated by SACCO correspond exactly to the South Jutland shells. The nearest is *var. pliotriseriata* SACCO, on which the two lower rows of nodules on the last whorl are relatively weakly developed. This agrees almost completely with the shell from Spandetgaard referred to by RAVN (1907, p. 306) and a large, intact shell from Gram in the D.G.U. collection.

Most of the South Jutland specimens lack the second and third rows of nodules on the final whorl, but traces of nodules are often seen on two of the spiral ribs below the carina.

Remarks: This species is common in the Gram clay, though entire specimens are rarely found.

It has not been found in the Middle Miocene of Denmark, North Germany, Holland or Belgium or in the Pliocene of these countries and England. But it is common in the marine Neogene sediments in the Mediterranean Region, especially Italy. Therefore its occurrence in the Upper Miocene Gram clay in the North Sea Basin is so much the more remarkable.

Measurements: Three entire shells from Gram (D.G.U.) measure:

Height	Width	Height of aperture
66 mm.	40 mm.	44 mm.
65 mm.	39 mm.	49 mm.
70 mm.	51 mm.	46 mm.

Distribution:

North Sea Basin. Miocene. Denmark: u. (Ravn). North Germany: u. (v. Koenen).

Atlantic Region. Portugal: Miocène (Da Costa, 1867, p. 133, pl. XVIII, fig. 2).

Mediterranean Region. Italy (varieties of *C. echinophora*): Tongriano, Aquitaniano?. Elveziano, Tortoniano, Piacenziano (Sacco), Calabrien, Sicilien, Couches à Strombes (Gignoux, 1913).

Vienna Basin: 1st and 2nd Mediterranstufe (Hoern. & Auing.).

Recent occurrence: Mediterranean (Weinkauff). The closely related *C. tyrrhena* Chemnitz according to Weinkauff also occurs in the Atlantic off the coasts of Spain, Portugal and Southwest France.

Genus: Phalium, Link 1807.

Subgenus: *Semicassis* (Klein) Mørch 1852 (Typus: *P. (S.) japonicum* (Reeve)).

29. Phalium (Semicassis) miolaevigatum (Sacco 1890).

(Plate V, fig. 4).

1854. *Cassis saburon* Brug. sp.; Beyrich, Conchylien; p. 158, pl. 9, f. 5.
1856. *Cassis saburon* Lam.; M. Hoernes, Wiener Becken I; p. 177, pl. 15, f. 2–7.
1872. *Cassis (Semicassis) saburon* Lamk.; R. Hoern. & Auing., 1. u. 2. Mediterr.; p. 157.
1872. *Cassis saburon* Brug.; v. Koenen, Mioc. Nordd. I; p. 203.
1890. *Semicassis miolaevigata*; Sacco, I Molluschi VII; p. 490, pl. 1, f. 23.
1907. *Cassis saburon* Bruguière sp.; Ravn, Jylland; p. 309, pl. IV, f. 4.
1923. *Semicassis miolaevigata* Sacco; Cossmann & Peyrot, Conch. Néog., A.S.L.B. LXXV; p. 76, pl. XII, f. 14–15.
1925. *Cassidea (Semicassis) miolaevigata* Sacco; Kautsky, Hemmoor; p. 88, pl. 7, f. 12.
1936. *Cassis (Semicassis) miolaevigata* Sacco; Bogsch, Nógrádszákal; p. 75, pl. II, f. 13.
1944. *Semicassis (Semicassis) miolaevigata* Sacco; Voorthuysen, Mioz. Gastrop.; p. 51, pl. 13, f. 22–27.
1952. *Phalium (Semicassis) miolaevigatum* Sacc. sp.; Glibert, Mioc. Belg. II; p. 83, pl. VI, f. 12.

Original diagnosis: Sacco's differential diagnosis (in relation to *P. laevigatum* Defr.), 1890: "*Distinguunt hanc speciem a Semicassis laevigata* Defr. *sequentes notae*: *Testa crassa, globosior*; *spira aliquantulum depressior. Anfractus prope suturam valde depressiores; sulci prope caudam plerumque aliquantulum distantiores et profundiores; sulci prope suturam nulli, vel 1–2 sat profundi. Labium externum crassius, aliquantulum*

arcuatius. Labium columellare crassium, brevius, saepe minus plicatus. Cauda aliquantulum minus sinistrorsum deflexa."

Type material: Not used. The holotype is the shell from Colli torinesi illustrated by SACCO (1890, pl. I, fig. 23), now in the Museo geologico di Torino.

Material: Gram (D.G.U., 75 shells; M.M., 19 shells). Spandetgaard (M.M., 8 shells). Ravning (M.M., 1 shell).

Description: See RAVN's description.

The shells from South Jutland are almost all smooth except the spiral grooves, mentioned by RAVN, on the basal part of the youngest whorl and the fine, raised spiral striae on the whole of the last whorl. All the shells have a depressed region quite close under the apical suture. In this depression, which may be more or less pronounced, there are almost always one or several spiral grooves. The older whorls too often have visible but faint spiral grooves.

The external labium on almost all the shells has merely list-like teeth on the apertural part.

Relation to other species: All the Miocene shells were previously placed to *Cassis saburon* (BRUGUIÈRE, 1792, non ADANSON 1752: "*Le Saburon*"). SACCO, however, suggested (l.c.) a subdivision into three species, the recent and Quaternary form remaining as *P.* (*S.*) *saburon*, whereas the specimens occurring in the Pliocene sediments of the Mediterranean were to be named *P.* (*S.*) *laevigatum* (DEFRANCE, 1817) and the Miocene shells: *P.* (*S.*) *miolaevigatum*. On the differential diagnoses see SACCO, l.c. There seem to be smooth transitions between all three species. Although it is open to doubt that these species are confined particularly to stratigraphic zones I have made use of SACCO's name here, because the South Jutland material corresponds to the type which SACCO calls *P. miolaevigatum*.

Remarks: In the Danish Gram clay the present species is common locally; this seems to be the case at both Gram and Spandetgaard. At Maade Brickworks only one or two shells were found in the very large molluscan material.

In sediments now considered to be Quaternary (Newbournian Crag) in England a couple of weathered shells have been found which WOOD and HARMER regard as derivatives.

Measurements: The largest specimen in D.G.U.'s material from Gram has the following measurements: length 44.0 mm. and breadth 32.7 mm., the smallest 20.5 mm. and 14.6 mm. respectively, though the material also includes fragments of both larger and smaller shells.

Distribution:

P. (*S.*) *miolaevigatum* is recorded as having been found in the following regions:

North Sea Basin. Miocene. Denmark: u. (RAVN). North Germany: m. (KAUTSKY), u. (v. KOENEN). Holland: m., u. (VOORTHUYSEN). Belgium: Boldérien, Horizon de Houthaelen, Anversien (GLIBERT).—Pliocene. Holland: Scaldisien? (TESCH). Belgium: Scaldisien (NYST).—Quaternary: Newbournian Crag (derivative?) (WOOD, HARMER).

Atlantic Region. Bordeaux Basin: Helvétien (COSSMANN & PEYROT). Portugal: Miocène (*Cassis saburon*) (DA COSTA, 1867).

Mediterranean Region. Italy: Tortoniano, Elveziano (SACCO).

Vienna Basin: Grunder Schichten, 2. Mediterranstufe (KAUTSKY). Poland: Torton (FRIEDBERG). Hungary: Torton (BOGSCH).

P. (*S.*) *laevigatum* is stated to have been found in the following regions:

Atlantic Region. Morocco: Pliocène (LECOINTRE).

Mediterranean Region. Italy: Piacenziano, Astiano (SACCO).

P. (*S.*) *saburon* according to GIGNOUX, 1913, has been recovered from the Quaternary in Italy (in Sicilien at Ficarazzi and in Couches à Strombes at Tarento). WEINKAUFF (1868) states that the present-day species has been found in the Atlantic off Senegal, Portugal, Spain and Southwest France, as well as in the Mediterranean off South France, Piedmonte, Corsica, Sardinia, Naples, Sicily, Torento, Morea, Smyrna, Lyria and Algeria.

FAMILIA: PYRULIDAE

Genus: Pyrula, Lamarck 1799 (Typus: P. ficus (Linné)).

30. Pyrula condita, Brongniart 1823.

(Plate V, fig. 5a, b).

1823. *Pyrula condita*; BRONGNIART, Vicentin; p. 75, pl. VI, f. 4.
1848. *Pyrula reticulata* LAM.; WOOD, Crag I; p. 42, pl. 2, f. 12.
1854. *Pyrula reticulata* LAM.; BEYRICH, Conchylien; p. 231, pl. 15, f. 5, 6, 9, 10.
1856. *Pyrula condita* BRONGN.; M. HOERNES, Wiener Becken I; p. 270, pl. 28, f. 4, 5, 6.
1872. *Ficula reticulata* LAM.; v. KOENEN, Mioc. Nordd. I; p. 169.
1890. *Pyrula* (*Ficula*) *condita* BRONGN.; R. HOERNES & AUINGER, Gasteropoden; p. 245.
1891. *Ficula condita* (BRONGN.); SACCO, I Molluschi VIII; p. 247, pl. I, f. 27–32.
1907. *Ficula reticulata* LAM. sp.; RAVN, Jylland; p. 310.
1920. *Pirula condita* BRONGN.; COSSMANN & PEYROT, Conch. Néog. A.S.L.B. LXXIV; p. 333, pl. 10, f. 46.
1944. *Ficus* (*Ficus*) *condita* (BRONGN.); VOORTHUYSEN, Mioz. Gastrop.; p. 57; pl. 2, f. 12; pl. 3, f. 15, 16; pl. 4, f. 1–5.
1952. *Pirula condita* BRONGN.; GLIBERT, Mioc. Belg. II; p. 89, pl. VII, f. 4.

Original diagnosis: BRONGNIART, 1823: "*Testa pyriformis, spirâ retusâ, decussata, transversim sulcata, porcis latis, striis duabus in sulcis.*"

Type material: Not used. The type (locality: Torino) is the shell

illustrated on pl. VI, fig. 4a, b by BRONGNIART. Its whereabouts is uncertain.

Material: Gram (D.G.U., 1 shell).

Description: The solitary shell in the material lacks most of the final whorl.

The apex is very truncate, almost flat. On the whorls and the remaining parts of the final whorl (the upper, flat areas) the sculpturing can be seen to comprise flattened spiral ribs separated by very broad interstices which are crossed by numerous fine radial growth lines. There are no secondary spiral ribs between the main ribs.

Relation to other species: *P. condita* has been made identical with *P. reticulata* LAM. or regarded as its forerunner, the latter being credited with dating only to the Pliocene.

P. condita differs from *P. geometrica* (BORSON) by the fact that the latticework formed of the ribs and the longitudinal striae is not so regular. On the relation of *P. condita* to other species see also VOORTHUYSEN.

Distribution:

North Sea Basin. Oligocene. North Germany: u. (*Ficus reticulatus* LK., GÖRGES 1952).—Miocene. North Germany: m. (KAUTSKY), u. (v. KOENEN). Holland: m., u. (VOORTHUYSEN). Belgium: Boldérien, Horizon de Houthaelen, Anversien (GLIBERT).—Pliocene. England: Boxstones, Coralline Crag (WOOD, HARMER).

Atlantic Region. Bordeaux Basin: Aquitanien, Burdigalien (COSSMANN & PEYROT).

Mediterranean Region. Italy: Tongriano, Elveziano (SACCO).

Vienna Basin: 2. Mediterranstufe (R. HOERNES & AUINGER). Poland: Torton (FRIEDBERG). Hungary: Torton (BOGSCH).

P. reticulata LAM. is recorded from the Pliocene and Quaternary in the Mediterranean Region. In the present time it occurs in the Indian Ocean, the East Indies and Japan, according to LECOINTRE (II, 1952, p. 117).

FAMILIA: MURICIDAE

Genus: Murex, Linné 1758.

Subgenus: *Tubicauda* JOUSSEAUME 1880 (Typus: *M.* (*T.*) *brevispina* LINNÉ).

31. Murex cf. (Tubicauda) spinicosta, Bronn 1831.

(Plate V, fig. 2).

1831. *Murex spinicosta*; BRONN, Italiens Tertiärgeb.; p. 34.
1854. *Murex spinicosta* BRONN; BEYRICH, Conchylien; p. 209, pl. 14, f. 2.
1856. *Murex spinicosta* BRONN; M. HOERNES, Wiener Becken I; p. 259, pl. 26, f. 6, 7, 8.

1872. *Murex spinicosta* Bronn; v. Koenen, Mioc. Nordd. I; p. 147.
1873. *Murex spinicosta* Bronn; Bellardi, I Molluschi I; p. 74.
1904. *Murex* (*Tubicauda*) *spinicosta* Bronn; Sacco, I Molluschi XXX; p. 18, pl. IV, f. 21–22.
1923. *Murex* (*Tubicauda*) *spinicosta* Bronn; Cossmann & Peyrot, Conch. Neog., A.S.L.B. LXXV; p. 97, pl. XII, f. 26–27.
1944. *Murex* (*Tubicauda*) *spinicosta* Bronn; Voorthuysen, Mioz. Gastrop.; p. 63, pl. 4, f. 21–23.

Original diagnosis: Bronn, 1831: "*M. testa conico-turrita, subventricosa, longe caudata, trifariam varicosa; anfractibus 1 carinatis, ultimo bicarinato, transversim striatis; carinis ad varices spinosis, ad interstitia binodosis*".

Type material: Not used. The whereabouts of Bronn's types is not known to me.

Material: Gram (D.G.U., 2 shells).

Description: The two shells are juvenile and one is slightly weathered.

Under strong magnification the at least 5 convex whorls on the protoconch prove to be studded with numerous very small elevations and its termination towards the mature whorls is formed of a leaf-shaped, arcuate rib which formed the edge of the aperture.

The sculpturing on the following whorl consists of prominent axial ribs. Only four of these are discernible on the better preserved of the shells. They are crossed by 3 very distinct and 2 fainter spiral ribs. The weathered shell has only 2 visible spiral ribs, both almost equally prominent. At the intersections over the axial ribs all these spirals form a small nodule.

The uppermost of the prominent spiral ribs on crossing the axial ribs causes a bend on the latter, thus making the whorl angular. The nodule formed by the latter rib on crossing the last axial rib on the better preserved of the two shells is slightly elongated.

Remarks: These shells undoubtedly belong to the group of *Murex* which includes *M. spinicosta* Bronn and *M. inornatus* Beyrich. It is difficult to decide from the two shells which of the two species should be recorded as from Gram. As the protoconch of *M. spinicosta* according to Voorthuysen has two cardinal spirals, whereas *M. inornatus* has four, the Gram shells are placed to the first-named.

Measurements: One of the shells measures 3.5 mm. in length.

Distribution:

North Sea Basin. Miocene. North Germany: m. (Kautsky), u. (v. Koenen). Holland: m., u. (Voorthuysen).

Atlantic Region. Bordeaux Basin: Burdigalien, Helvétien, Tortonien (Cossmann & Peyrot).

Mediterranean Region. Italy: Piacenziano (SACCO).
Vienna Basin: Grunderschichten, 2. Mediterranstufe (KAUTSKY).

Genus: Trophon, Montfort 1810.

Subgenus: *Pagodula* MONTEROSATO 1884 (Typus: *T.* (*P.*) *carinatus* (BIVONA)).

32. Trophon (Pagodula) vaginata (Jan 1832) var. semperi, v. Koenen 1872.

(Plate V, fig. 6).

1832. *Murex vaginatus*; JAN, Museo Cristofori; p. 11.
1836. *Murex vaginatus*; PHILIPPI, Enumeratio I; p. 211, pl. XI, f. 27.
1856. *Murex vaginatus* JAN; M. HOERNES, Wiener Becken I; p. 229, pl. 23, f. 13.
1872. *Trophon Semperi* v. KOENEN; v. KOENEN, Mioc. Nordd. I; p. 151, pl. 1, f. 4.
1885. *Murex* (*Trophon*) *vaginatus* JAN; R. HOERNES & AUINGER, Gasteropoden, p. 216, pl. XXV, f. 1.
1925. *Fusus* (*Pagodula*) *vaginatus* JAN *var. Semperi* v. KOEN.; KAUTSKY, Hemmoor; p. 114, pl. 8, f. 18.
1952. *Fusus* (*Pagodula*) *vaginatus f. semperi* v. K.; GLIBERT, Mioc. Belg. II; p. 95, pl. VII, f. 11.

Original diagnosis: Not given by JAN. PHILIPPI, 1836, gives the following diagnosis of *M. vaginatus*: "*M. testa fusiformi-turrita, glabra*; *anfractibus medio carinatis, infra supraque planatis*; *varicibus in carina in spinas compressas, canaliculatas, sursum incurvas productis; cauda elongata gracili*". The variety has been described by v. KOENEN.

Type material: Not used. The whereabouts of the types is not known to me.

Material: Gram (D.G.U., 2 shells).

Description: The Gram material contains 2 shells: one a small, imperfect, juvenile specimen and a mature shell which lacks the canal and is somewhat corroded on the surface.

The juvenile specimen lacks the oldest part of the protoconch and has only the two lowest of the latter's whorls, both strongly convex. The upper one seems to have numerous small pits scattered all over the whorl. The lower one is quite plain. After the protoconch comes a whorl with transverse lamellae, of which the youngest is drawn out into a vertical spine.

On the mature shell the protoconch and the next three or four whorls are so affected by weathering that only part of the surface is left. On each of the whorls is a carina at about the middle. On crossing over this the lamellae (11 or 12 in all) are drawn out into points. Medially in the region

below the carina is a fairly prominent spiral. On the corresponding part of the final whorl are 4 spirals.

Relation to other species: See Kautsky, l.c., p. 114.

Distribution:

North Sea Basin. Miocene. North Germany: m. (Kautsky), u. (v. Koenen). Belgium: Anversien (Glibert).

T. vaginatus has been found in the 2. Mediterranstufe in the Vienna Basin (R. Hoernes & Auinger) and Italy's marine Neogene (Bellardi & Sacco). In the present day the species inhabits the Mediterranean (Weinkauff 1867).

Genus: Typhis, Montfort 1810.

Subgenus: *Cyphonochelus* Jousseaume 1882 (Typus: *T.* (*C.*) *arcuatus* Hinds).

33. Typhis (Cyphonochelus) fistulosus (Brocchi 1814).

(Plate VI, fig. 1a, b).

1814. *Murex fistulosus*; Brocchi, Conch. subapp. II; p. 394, pl. VII, f. 12.
1853. *Tiphys Schlotheimi*; Beyrich, Conchylien; p. 218, pl. 14, f. 7.
1856. *Murex* (*Typhis*) *fistulosus* Brocchi; M. Hoernes, Wiener Becken I; p. 261, pl. 26, f. 11.
1872. *Tiphys fistulosus* Brocchi; v. Koenen, Mioc. Nordd. I; p. 18.
1873. *Typhis fistulosus* (Brocchi); Bellardi, I Molluschi I; p. 70.
1885. *Typhis fistulosus* Broc.; R. Hoern. & Auing., Gasteropoden; p. 227.
1903. *Cyphonochilus fistulosus* (Brocchi); Cossmann, Essais V; p. 61, pl. 3, f. 2.
1904. *Typhis* (*Cyphonochilus*) *fistulosus* (Br.); Sacco, I Molluschi XXX; p. 17, pl. IV, f. 17–18.
1907. *Tiphys Schlotheimi* Beyrich; Ravn, Jylland; p. 321, pl. V, f. 13.
1923. *Cyphonochilus fistulosus* (Brocchi); Cossmann & Peyrot, Conch. Néog., A.S.L.B. LXXV; p. 241, pl. XV, f. 32–33.
1925. *Typhis* (*Cyphonochilus*) *fistulosus* Brocc.; Kautsky, Hemmoor; p. 99.
1935. *Typhis* (*Cyphonochilus*) *fistulosus* (Brocc.); Montanaro, Studi monogr.; p. 11, pl. I, f. 2.
1944. *Typhis* (*Cyphonochilus*) *fistulosus* (Brocc.); Voorthuysen, Mioz. Gastrop.; p. 67, pl. 6, f. 3–4, 9, 14.
1952. *Typhis* (*Cyphonochilus*) *fistulosus* Brocc. sp.; Glibert, Mioc. Belg. II; p. 95, pl. VII, f. 12.

Original diagnosis: Brocchi, 1814: "*Testa oblonga, angulis membranaceis acutis, anfractubus omnibus spinis fistulosis coronatis, apertura suborbiculari, canali clauso.*"

Type material: Not used. Brocchi's types presumably preserved in the Museo civico di Storia Naturale in Milan.

Material: Gram (D.G.U., 39 shells; M.M., 1 shell).

Description: See descriptions in BEYRICH, RAVN and VOORTHUYSEN.

Relation to other species: On the difference between *T. fistulosus* and *T. Schlotheimi* BEYR., see v. KOENEN, Unter-Oligocän, I, 1889, p. 79.

Distribution:

North Sea Basin. Miocene. Denmark: m., u. (RAVN). North Germany: l. (GRIPP), m. (KAUTSKY), u. (v. KOENEN). Holland: m., u. (VOORTHUYSEN). Belgium: Anversien (GLIBERT).

Atlantic Region. Bordeaux Basin: Helvétien, Tortonien (COSSMANN & PEYROT).

Mediterranean Region. Italy: Piacenziano (SACCO). (Helvet, Torton (KAUTSKY)).

Vienna Basin: 2. Mediterranstufe (HOERNES).

FAMILIA: BUCCINIDAE

Genus: Liomesus, Stimpson 1865 (Typus: L. dalei (J. Sowerby)).

34. Liomesus ventrosus (Beyrich 1856).

(Plate VI, fig. 2).

1856. *Fusus ventrosus*; BEYRICH, Conchylien; p. 249, pl. 17, f. 2–5.
1872. *Buccinopsis Dalei* JEFFREYS; v. KOENEN, Mioc. Nordd. I; p. 183.
1907. *Buccinopsis Dalei* JEFFREYS; RAVN, Jylland; p. 313, pl. V, f. 5.
1952. *Liomesus fossulatus grippi*; HINSCH, Leit. Moll.; p. 160, pl. B, f. 2–3.

Original diagnosis: Described first by BEYRICH. Diagnosis by HINSCH, 1952: *Liomesus fossulatus grippi*. "*Ein Liomesus mit schmaler, flacher Nahtrinne und ziemlich bauchigem Gehäuse. Alle adulten Umgänge sind mit kräftigen, flachen Spiralbändern bedeckt. Die ersten Mittelwindungen tragen 6 bis 8 Primärspiralen. Später kann man zwischen Primär—und Zwischenspiralen unterscheiden. Der Hals ist deutlich abgesetzt.*"

Type material: BEYRICH's types are in the Mineralogical Museum, Copenhagen.

Type locality: Morsum Kliff.

Material: Gram (D.G.U., 11 shells; M.M., 5 shells). Spandetgaard (M.M., 2 shells).

Description: To the descriptions by BEYRICH, RAVN and HINSCH I would add that the species seems to be rather variable as to the spiral sculpturing and the shape of the whorls and the shell. This variation is particularly prominent in the material from Morsum Kliff, whereas the shells from Gram are more constant in that respect.

Relation to other species: *L. ventrosus* was formerly considered to be identical with the Pliocene and recent *Buccinopsis dalei* (SOW). As GRIPP (1922, p. 186) points out, the final whorl on *L. ventrosus* is more

convex and its lower fourth as far as the apertural border more hollowed than on *L. dalei*. Moreover, the apex on this species seems to be more truncate than on *L. ventrosus*, judging from comparative material from Little Oakly, in the D.G.U. This is also observable on Harmer's illustrations.

The material from Gram is too slender for a variation-statistical study of the difference between the two forms, but there does not seem to be sufficient reason for combining the two species as v. Koenen and Ravn do; accordingly, I have preferred to maintain Beyrich's original designation of the species.

Hinsch places material of this species from Gram to a variety of *Ptychosalpinx fossulata* Conrad from the Lower Pliocene Yorktown formation in Virginia, U.S.A., on the basis of a description and illustrations of the latter in J. Gardner (1948, p. 235, pl. 32, figs. 1, 4, 8, 9). In my opinion, however, the similarity to both genus and species is little conspicuous.

Measurements: The following are the dimensions of 5 specimens from Gram, now at D.G.U.:

	Length mm.	Breadth mm.	Apertural height mm.
1)	66	34	35
2)	58	37	36
3)	56	31	?
4)	58	38	36
5)	27	15	17

Distribution:

North Sea Basin. Miocene. Denmark: u. (Ravn). North Germany: u. (Beyrich, v. Koenen).

Genus: Sipho, (Klein 1753) Bruguière 1792.

Subgenus: *Sipho* s.s. (Typus: *S.* (*S.*) *gracilis* (Da Costa)).

35. Sipho (Sipho) distinctus (Beyrich 1856).

(Plate VI, fig. 3a, b).

1856. *Fusus distinctus*; Beyrich, Conchylien; p. 275, pl. 20, f. 9–10.
1872. *Fusus distinctus* Beyrich; v. Koenen, Mioc. Nordd. I; p. 179.
1907. *Fusus distinctus* Beyrich; Ravn, Jylland; p. 334, pl. VI, f. 14.
1925. *Aquilofusus* (*Eurydike*) *distinctus* Beyr.; Kautsky, Hemmoor; p. 128.
1930. *Aquilofusus* (*Eurydike*) *distinctus* Beyr.; Staesche, Zur Gliederung; p. 67.
1952. *Sipho distinctus* (Beyrich); Hinsch, Leit. Moll.; p. 162, pl. B, f. 4–6.

Original diagnosis: First described by BEYRICH. Diagnosis by HINSCH, 1952: "*Ein ziemlich schlanker Sipho mit zwei Primärspiralen, die ihr Hervorragen meist lange bewahren. Nucleus nicht gebläht.*"

Type material: BEYRICH's types are in the Mineralogical Museum, Copenhagen. Type locality: Morsum Kliff.

Material: Gram (D.G.U., 265 shells; M.M., 151 shells). Spandetgaard (M.M., 101 shells). Ravning (D.G.U., 18 shells).

Description: See descriptions by BEYRICH, RAVN and HINSCH.

Relation to other species: The present species bears rather close resemblance to *Sipho gracilis* (DA COSTA), though the latter has only 4–5 faint spirals on the upper whorls and numerous, almost obliterated spirals on the later ones (material in D.G.U.).

Regarding KAUTSKY's subgenus: *Eurydike* (1925, p. 118), to which *S. distinctus* has been referred, see HINSCH, l.c., p. 162.

Measurements: The largest measured shell from Gram (D.G.U.) has the following dimensions: Length 40 mm., breadth 14 mm. and apertural height (including canal) 18 mm.

Distribution:

North Sea Basin. Miocene. Denmark: u. (RAVN). North Germany: u. (BEYRICH, v. KOENEN, HINSCH). Pliocene: Morsum Kliff, Sylt (according to GRIPP, 1922, p. 189).

FAMILIA: NASSIDAE

Genus: Nassa, (Martini 1774 part.) Lamarck 1799.

Subgenus: *Telasco* H. & A. ADAMS 1853 (Typus: *N.* (*T.*) *cuvieri* PAYRAUDEAU).

36. Nassa (Telasco) bocholtensis (Beyrich 1854).

(Plate VI, fig. 5a, b).

1854. *Buccinum Bocholtense*; BEYRICH, Conchylien; p. 136, pl. 8, f. 1.
1872. *Nassa Bocholtensis* BEYRICH; v. KOENEN, Mioc. Nordd. I; p. 191.
1907. *Nassa bocholtensis* BEYRICH; RAVN, Jylland; p. 316, pl. V, f. 5.
1925. *Nassa* (?*Uzita*) *Bocholtensis* BEYR.; KAUTSKY, Hemmoor; p. 104.
1944. *Nassa* (*Telasco*) *bocholtensis* (BEYR.); VOORTHUYSEN, Mioz. Gastrop.; p. 101, pl. 11, f. 21–24.
1952. *Nassa* (*Hima*) *bocholtensis* BEYR. sp.; GLIBERT, Mioc. Belg. II; p. 106, pl. VIII, f. 8.

Original diagnosis: First described by BEYRICH, without a diagnosis proper.

Type material: Not used. The whereabouts of BEYRICH's type is unknown to me.

Material: Gram (D.G.U., 68 shells; M.M., 10 shells). Spandetgaard (M.M., 6 shells).

Description: See descriptions by Beyrich and Ravn.

Relation to other species: *N.* (*T.*) *bocholtensis* may sometimes be mistaken for *N.* (*T.*) *turbinella* (Brocchi), as to which see Voorthuysen.

Distribution:

North Sea Basin. Miocene. Denmark: u. (Ravn). North Germany: m. (Kautsky), u. (Beyrich, v. Koenen, Staesche). Holland: m. (Voorthuysen). Belgium: Anversien (Glibert).

37. Nassa (Telasco) syltensis (Beyrich 1854).

(Plate VI, fig. 4a, b).

1854. *Buccinum Syltense*; Beyrich, Conchylien; p. 139, pl. 8, f. 4.
1872. *Nassa Syltensis* Beyrich; v. Koenen, Mioc. Nordd. I; p. 194.
1907. *Nassa syltensis* Beyrich; Ravn, Jylland; p. 317, pl. V. f. 6.
1944. *Nassa* (*Telasco*) *syltensis* (Beyrich); Voorthuysen, Mioz. Gastrop.; p. 104, pl. 12, f. 3–5.

Original diagnosis: First described by Beyrich, without a diagnosis proper.

Type material: Beyrich's types are in the Mineralogical Museum, Copenhagen. Type locality: Morsum Kliff.

Material: Gram (D.G.U., 26 shells; M.M., 5 shells). Spandetgaard (M.M., 5 shells).

Description: See descriptions by Beyrich and Ravn.

Relation to other species: *N.* (*T.*) *syltensis* seems to come very close to *N.* (*T.*) *holsatica* (Beyrich), but the shells of the latter species are much smaller and have an almost equally vigorous spiral and rib sculpturing.

Distribution:

North Sea Basin. Miocene. Denmark: u. (Ravn). North Germany: u. (Beyrich, v. Koenen, Staesche). Holland: m. (Voorthuysen).

Subgenus: *Uzita* H. & A. Adams 1853 (Typus: *N.* (*U.*) *miga* (Bruguière)).

38. Nassa (Uzita) prismatica (Brocchi 1814).

(Plate VII, fig. 1a, b).

1814. *Buccinum prismaticum*; Brocchi, Conch. subapp. II; p. 337, pl. V, f. 7.
1856. *Buccinum prismaticum* Brocchi; M. Hoernes, Wiener Becken I; p. 146, pl. 12, f. 13–14.

1872. *Nassa limata* CHEMN.; v. KOENEN, Mioc. Nordd. I; p. 196.
1914. *Nassa limata* CHEMN.; HARMER, Plioc. Moll.; p. 69, pl. 4, f. 1–2.
1925. *Nassa (Uzita) prismatica* BROCCHI; KAUTSKY, Hemmoor; p. 103, pl. 8, f. 1.
1939. *Nassa (Uzita) prysmatica* BROCC. sp. var.; MONTANARO, Studi monogr.; p. 123, pl. VIII, f. 44–46.
1944. *Nassa (Uzita?) prismatica* (BROCCHI); VOORTHUYSEN, Mioz. Gastrop.; p. 91, pl. 10, f. 8–12.
1952. *Nassa (Hima) prysmatica* BROCC. sp.; GLIBERT, Gastr. Mioc. Moyen; p. 344, pl. X, f. 9.

Original diagnosis: BROCCHI, 1814: "*Testa ovato-oblonga, longitudinaliter costata, striis transversis crebris, elevatis, labro columellari superne uniplicato, basi reflexa, emarginata.*"

Type material: Not used. BROCCHI's type presumably in the Museo civico di Storia Naturale in Milan.

Material: Gram (D.G.U., 1 shell; M.M., 1 shell).

Description: The one complete shell in the material has eight whorls. The apex is rather pointed. The protoconch consists of 2–3 whorls which are quite smooth. On the succeeding whorls is a sculpturing of 10–11 spirals which are flat and wider than their interstices, as well as 17–20 axial ribs; the latter are narrower than their interstices and on the younger whorls are not particularly prominent.

Remarks: A shell of *N. prismatica* from the intermediate zone between Pliocene and Quaternary at Monte Mario, Rome (D.G.U. collection, leg. V. NORDMANN and CERULLI-IRELLI) has the same characters as the Gram shell, except that on the Monte Mario specimens the axial ribs are coarser.

Some authors consider the species to be identical with the Quaternary and recent *N. limata* CHEMNITZ (see GIGNOUX, 1913, p. 509).

Distribution:

North Sea Basin. Miocene. North Germany: m. (KAUTSKY), u. (v. KOENEN). Holland: m. (VOORTHUYSEN).—Pliocene. Belgium: Scaldisien (NYST). England: Coralline Crag. Waltonian (WOOD, HARMER).

Atlantic Region. Loire Basin: Miocène Moyen (GLIBERT).

Mediterranean Region. Italy: Pliocène, Quaternaire (Calabrien, Sicilien, Couches à Strombes (GIGNOUX, 1913)).

Vienna Basin: Grunder Schichten, 2. Mediterranstufe (KAUTSKY).

(The recent *N. limata* is found in the Mediterranean and in the Atlantic at Madeira and the Canary Islands (WEINKAUFF, 1868)).

FAMILIA: FASCIOLARIIDAE

Genus: Aquilofusus, Kautsky 1925 (Typus: A. waeli (Nyst)).

39. Aquilofusus semiglaber (Beyrich 1856).

(Plate VII, fig. 2a, b).

1856. *Fusus semiglaber*; BEYRICH, Conchylien; p. 269, pl. 19, f. 9.
1872. *Fusus semiglaber* BEYRICH; v. KOENEN, Mioc. Nordd. I; p. 43.
1874. *Fusus semiglaber* BEYRICH; MØRCH, Forst. i Tert.; p. 286.
1907. *Fusus semiglaber* BEYRICH; RAVN, Jylland; p. 329, pl. VI, f. 8.
1952. *β-Aquilofusus semiglaber* (BEYRICH); HINSCH, Leit. Moll.; p. 165, pl. B, f. 7–8.

Original diagnosis: First described by BEYRICH. Diagnosis by HINSCH: "*Ein relativ schlanker β-Aquilofusus mit nur zwei Primärspiralen. Die Rippen verlöschen auf den jüngeren Umgängen.*"

Type material: BEYRICH's types are in the Mineralogical Museum, Copenhagen. Type locality: Spandetgaard.

Material: Gram (D.G.U., 654 shells; M.M., 236 shells). Spandetgaard (D.G.U., 1 shell; M.M., 132 shells). Ravning (D.G.U., 58 shells; M.M., 1 shell).

Description: See descriptions by BEYRICH, RAVN and HINSCH.

Relation to other species: According to HINSCH, the present species is distinguishable from *Aquilofusus eximius* (BEYRICH) by the fact that the axial ribs disappear on the younger whorls. A large material of *Aquilofusus* shells from the sediments at Esbjerg Brickworks' old pit and the beach outside the works shows rich variation in the number of axial ribs and spirals; there is also every kind of transition between forms with axial ribs on the younger whorls and those on which these ribs quickly disappear. Having regard to this material it is difficult to draw any definite line between *A. semiglaber* and *A. eximius*.

Remarks: *A. semiglaber* is one of the most commonly occurring gastropods in the Gram clay at Gram. The *Aquilofusus* material from Ravning and Spandetgaard agree exactly with that from Gram and reveals similar constancy in the sculptural features. It is scarcely open to doubt that these are completely concordant populations at the three localities.

Measurements: HINSCH has taken measurements and worked out variation statistics on 423 shells from Gram, see HINSCH, 1952, p. 166–167.

Distribution:

North Sea Basin. Miocene. Denmark: u. (RAVN). North Germany: u. (BEYRICH, v. KOENEN, HINSCH).

40. Aquilofusus puggaardi (Beyrich 1856).

(Plate VII, fig. 3).

1856. *Fusus Puggaardi*; BEYRICH, Conchylien; p. 270, pl. 21, f. 2–3.
1872. *Fusus Puggaardi* BEYRICH; v. KOENEN, Mioc. Nordd. I; p. 40.
1874. *Fusus Puggaardi* BEYRICH; MØRCH, Forst. i Tert.; p. 287.
1907. *Fusus Puggaardi* BEYRICH; RAVN, Jylland; p. 330, pl. VI, f. 6.
1933. *Fusus (Aquilofusus) puggaardi*; GRIPP, Hamburg; pl. V, f. 9.
1952. *γ-Aquilofusus puggaardi* (BEYRICH); HINSCH, Leit. Moll.; p. 168, pl. B, f. 12–13.

Original diagnosis: First described by BEYRICH 1856. Diagnosis by HINSCH, 1952: "*Ein γ-Aquilofusus mit drei bis vier Primärspiralen. Die Rippen verlöschen bei einem Windungsdurchmesser von 7 bis 8 mm. Die Spiralskulptur ist nicht sehr kräftig.*"

Type material: BEYRICH's types are in the Mineralogical Museum, Copenhagen. Type locality: Morsum Kliff.

Material: Gram (D.G.U., 38 shells; M.M., 14 shells).

Description: See descriptions by BEYRICH, RAVN and HINSCH.

Relation to other species: *A. puggaardi* is very like *Fusus imperspicuus* (WOOD) from England's Pliocene, as HINSCH has pointed out. Comparative material of that kind has not been available, but according to WOOD's and HARMER's illustrations the only difference seems to be that *F. imperspicuus* has more vigorous spiral sculpturing on all the whorls.

The same applies to certain specimens from Maade Brickworks, which further underlines the close relationship of the two forms.

On *F. imperspicuus* see S. V. WOOD, Crag I; 1848; p. 50, pl. VI, fig. 12 and 1st supplement to Crag, 1872, p. 29, pl. II, fig. 4, as well as HARMER, Plioc. Moll., 1916, p. 360, pl. XXXVIII, figs. 17–18.

Remarks: HINSCH had a larger material (52 specimens in all) from Gram, on which he took measurements and made variation-statistical calculations; see HINSCH, p. 168.

The very similar *Fusus imperspicuus* (S. V. WOOD) has been found in England's Pliocene and Quaternary (Coralline Crag, Waltonian, WOOD, HARMER).

Distribution:

North Sea Basin. Miocene. Denmark: u. (RAVN). North Germany: u. (BEYRICH, v. KOENEN, HINSCH). Holland: u. (GRIPP, 1940, Tertiärf. in Niedersachsen, p. 29).

FAMILIA: MITRIDAE

Genus: Uromitra, Bellardi 1887 (Typus: U. cupressina (Brocchi)).

41. Uromitra cimbrica (Oppenheim in Kautsky 1925).

(Plate VII, fig. 4).

1854. *Mitra Borsoni* BELLARDI; BEYRICH, Conchylien; p. 99, pl. 5, f. 13.
1872. *Mitra Borsoni* BELLARDI; v. KOENEN, Mioc. Nordd. I; p. 119.
1907. *Mitra Borsoni* BELLARDI; RAVN, Jylland; p. 336, pl. VI, f. 19.
1925. *Turricula (Uromitra) cimbrica* OPPENH.; KAUTSKY, Hemmoor; p. 131.
1952. *Uromitra cimbrica* OPPENH.; HINSCH, Leit. Moll.; p. 169, pl. C, f. 3.
1952. *Vexillum (Uromitra) cimbricum* OPPENH.; GLIBERT, Mioc. Belg. II; p. 115, pl. VIII, f. 17.

Original diagnosis: Not given by OPPENHEIM and KAUTSKY. Diagnosis by HINSCH, 1952: "*Eine gedrungene Uromitra mit kräftigem, ziemlich kompaktem Nahtband. Die Umgänge sind stark stufenförmig gegeneinander abgesetzt. Die Spiralbänder vor dem Nahtband sind schwach*".

Type material: Not used. HINSCH's neotype from Gram is in the Geologisches Staatsinstitut in Hamburg (Typenkatalog No. 186).

Material: Gram (M.M., 10 shells).

Description: See descriptions by RAVN, KAUTSKY and HINSCH. All the Gram shells lack the protoconch.

Remarks: This species was formerly (BEYRICH, v. KOENEN, RAVN) identified with the Italian *Mitra borsoni* BELLARDI. In 1916 OPPENHEIM (p. 402) demonstrated that the Miocene form in the North Sea Basin is not identical with *M. borsoni* and named it *M. cimbrica* in an unpublished MS. In 1925 KAUTSKY employed the new species name in the material from Hemmoor. HINSCH in 1952 divided the species into two new ones: *U. wirtzi* HINSCH and *U. cimbrica* (l. c., p. 169).

All the shells from Gram agree with *U. cimbrica* according to HINSCH.

Measurements: Two specimens have the following dimensions:

	Length	Breadth
1)	15.8 mm.	6.5 mm.
2)	16.4 -	6.0 -

Distribution:

North Sea Basin. Miocene. Denmark: u. (RAVN). North Germany: m. (KAUTSKY), u. (v. KOENEN, BEYRICH, HINSCH). Belgium: Anversien (GLIBERT).

FAMILIA: CANCELLARIIDAE

Genus: Cancellaria, Lamarck 1799.

Subgenus: *Narona* H. & A. ADAMS 1854 (Typus: *C.* (*N.*) *clavatula* SOWERBY).

42. Cancellaria (Narona) calcarata (Brocchi 1814).

(Plate VII, fig. 7).

1814. *Voluta calcarata*; BROCCHI, Conch. subapp. II; p. 309, pl. III, f. 7.
1856. *Cancellaria calcarata* BROCCHI; M. HOERNES, Wiener Becken I; p. 322, pl. 35, f. 5.
1856. *Cancellaria calcarata* BROCCHI sp.; BEYRICH, Conchylien; p. 333, pl. 28, f. 3a–c.
1872. *Cancellaria calcarata* BROCCHI sp.; v. KOENEN, Mioc. Nordd. I; p. 165.
1894. *Cancellaria calcarata* BROCCHI sp.; SACCO, I Molluschi XVI; p. 32, pl. II, f. 41 (sundry varieties ibid. p. 33–34, pl. II, f. 41–48).
1925. *Sveltia* (*Calcarata*) *calcarata* BROCCHI *var. mioparva* SACCO; KAUTSKY, Hemmoor; p. 138.

Original diagnosis: BROCCHI, 1814: "*Testa ovato-acuta, oblique costata, anfractubus scalariformibus carinatis, carina spinis compressis subfornicatis coronata, columella biplicata, basi integra, apertura angulari.*"

Type material: Not used. BROCCHI's types are presumably preserved in the Museo civico di Storia Naturale in Milan.

Material: Gram (D.G.U., 1 shell—leg. H. ØDUM, 1926).

Description: The solitary specimen is very imperfect, consisting of the last whorl and fragments of the foregoing one.

The sculpturing of the shell is very characteristic (see BEYRICH). The whorls are angular in contour. From the upper suture the whorl runs outwards almost at right angles and forms an edge, the following part sinking abruptly downwards at a right angle to the lower suture. On the last whorl the region between edge and upper suture is slightly oblique. Below the edge the whorl slopes inwards, so that the surfaces above and below the edge form a right angle. A new edge forms in continuation of the upper suture of the youngest whorl and terminates at the outer apertural margin about half way between the foregoing edge and the lowest termination of the shell. The area below this edge again slopes strongly inwards. On the whorls are eight angular axial ribs which at their intersection of the edges are drawn out into spines. The ribs are slightly oblique and curved and are to be seen, though much fainter, right down to the terminal edge of the shell. There is no other sculpturing between the sculptured elements mentioned.

The aperture on this shell is trapeziform. There are two oblique folds on the columella. The umbilical fissure on the side of the columella is very narrow and almost invisible.

This shell would scarcely have been more than ½ cm. high.

Remarks: Sacco, 1894, XVI, p. 333, points out that the form illustrated by Beyrich from the North German Miocene must be regarded as a variety, which he suggests should be called *mioparva* Sacco, but without explaining the difference from the main type. Kautsky agrees with Sacco and refers to the two shells from Hemmoor under the name of *mioparva*.

The material from Gram is too small and incomplete for solving the question of the justification of this variety.

Distribution:

North Sea Basin. Miocene. North Germany: m. (Kautsky), u. (Staesche).

Atlantic Region. Bordeaux Basin: Tortonien (Cossmann & Peyrot).

Mediterranean Region. Italy: Tortoniano, Elveziano, Piacenziano, Astiano (Sacco).

Vienna Basin: 2. Mediterranstufe (Kautsky).

43. Cancellaria (Narona) rothi (Semper 1861).

(Plate VII, fig. 8a, b).

1857. *Cancellaria nodulifera*; Beyrich, Conchylien; p. 319, pl. 27, f. 3–4.
1861. *Cancellaria Rothi*; Semper, Pal. Unters.; p. 89. (non *nodulifera* Sow.).
1872. *Cancellaria Rothi* Semper; v. Koenen, Mioc. Nordd. I; p. 25.
1874. *Cancellaria Rothi* Semper; Mørch, Forst. i Tert.; p. 288.
1907. *Cancellaria Rothi* Semper; Ravn, Jylland; p. 340, pl. VI, f. 18.
1952. *Narona (β-Sveltia) rothi* (Semper); Hinsch, Leit. Moll.; p. 171.

Original diagnosis: First description in Beyrich (1857, *C. nodulifera*). First diagnosis by Hinsch, 1952: "*Eine β-Sveltia mit gerundeten Umgängen ohne deutliche Kante und Rampe. Ein vierter Spiralreifen tritt sehr früh auf.*"

Type material: Beyrich's types of *C. nodulifera* are in the Mineralogical Museum, Copenhagen. Type locality: Spandetgaard.

Material: Gram (D.G.U., 50 shells; M.M., 29 shells). Spandetgaard (M.M., 15 shells). Ravning (D.G.U., 3 shells).

Description: See descriptions by Beyrich, Ravn and Hinsch.

Relation to other species: In the Gram clay at Maade Brickworks, east of Esbjerg, there is a very similar form: *C.* (*N.*) *lyrata* (Brocchi), characterized by having angular whorls; on passing over this edge the ribs often form a small spine; on several specimens, however, the edge of the whorls is very faint and the spine on the ribs only slightly developed or entirely absent. These specimens may bear a certain similarity to

C. rothi which, however, has not the neat and fine spiral sculpturing of *C. lyrata*.

Measurements: Five shells from Gram have the following dimensions:

	Height mm.	Width mm.
1)	28.3	14.2
2)	29.1	15.2
3)	27.7	16.0
4)	29.0	14.5
5)	25.0	13.0

Distribution:

North Sea Basin. Miocene. Denmark: u. (RAVN). North Germany: u. (v. KOENEN).

Genus: Admete, Kröyer 1842.

Subgenus: *Babylonella* CONRAD.

44. Admete (Babylonella) subangulosa (S. Wood 1848).

(Plate VII, fig. 5a, b).

1848. *Cancellaria subangulosa*; WOOD, Crag I; p. 66, pl. VII, f. 20.
1856. *Cancellaria Nysti* HOERNES; M. HOERNES, Wiener Becken I; p. 305, pl. 34, f. 1.
1856. *Cancellaria pusilla* PHILIPPI sp.; BEYRICH, Conchylien; p. 323, pl. 27, f. 9; pl. 28, f. 1–2.
1861. *Cancellaria subangulosa* S. WOOD; SEMPER, Pal. Unters.; p. 99.
1867. *Cancellaria subangulosa* S. WOOD; SPEYER, Cassel; p. 179, pl. XVI, f. 10–13.
1872. *Cancellaria subangulosa* S. WOOD; S. WOOD, Suppl. Crag Moll. I; p. 47.
1872. *Cancellaria subangulosa* S. WOOD; v. KOENEN, Mioc. Nordd. I; p. 27.
1889. *Cancellaria subangulosa* S. WOOD; v. KOENEN, Unter-Oligocän; p. 101, pl. XII, f. 14.
1907. *Cancellaria subangulosa* S. WOOD; RAVN, Jylland; p. 340, pl. VI, f. 17.
1913. *Cancellaria subangulosa* S. WOOD; HARDER, Aarhus; p. 86, pl. VII, f. 8–9.
1914. *Cancellaria subangulosa* S. WOOD; GRIPP, Itzehoe; p. 26, pl. III, f. 4–6.
1918. *Admete* (*Babylonella*) *subangulosa* (S. WOOD); HARMER, Plioc. Moll. III; p. 409.
1925. *Admete* (*Babylonella*) *fusiformis* CANTR. *var. subangulosa* WOOD; KAUTSKY, Hemmoor; p. 144.
1952. *Admete* (*Babylonella*) *fusiformis* CANTR.; GLIBERT, Mioc. Belg. II; p. 131, pl. VIII, f. 18.
1952. *Admete* (*Babylonella*) *fusiformis* CANTR. *pusilla* (PHILIPPI); GÖRGES, Meeress. Kassel; p. 98, pl. 2, f. 74.

Original diagnosis: S. WOOD, 1848: "*C. Testâ minimâ, fusiformi, spirâ elevatâ, apice acuto, longitudinaliter costellatâ, transversim striatâ,*

reticulatâ; *anfractibus quinque, supernè subangulatis*; *canali brevissimâ*; *columellâ triplicatâ.*"

Type material: Not used. The whereabouts of WOOD's type is not known to me.

Material: Gram (D.G.U., 17 shells; M.M., 3 shells).

Description: The protoconch consists of 2–3 convex whorls, of which the lower 1–2 have a sculpture of numerous, fine axial ribs running from suture to suture in undulations, first with a very slight curve forward, later a strong curve backward. The curved ribs are connected together by numerous thin ribs, some straight, others directed more obliquely upward or downward, with no prolongation in the previous or next intercostal space (and see GRIPP, 1914, p. 26–27).

The other whorls are provided with a fairly pronounced ribbed structure and well-marked spirals. On the upper half of the whorls is a rounded edge. See also RAVN, 1907, p. 340.

In addition there are 3 juvenile shells which are furnished with a large protoconch of 3–4 whorls with a very pronounced sculpturing of exactly the same type as that described above. The edge on the upper half of the next whorls is much sharper on these specimens and the ribs form a kind of small spine on crossing this edge.

Whether or not this is a new species cannot of course be determined from this small material. It may be added that a juvenile shell with the same characters was found in material from a boring at Holleskov (BANKE RASMUSSEN, 1954).

Relation to other species: KAUTSKY cites *C. subangulosa* WOOD as a variety of *A. fusiformis* (CANTRAINE, 1836) according to SACCO (1894, XVI, p. 71).

Here I have named the species in conformity with v. KOENEN and RAVN. The material is too slender and poor to decide whether *A. subangulosa* can be merged with *A. fusiformis* or not.

Measurements: The largest of the shells measures 10 mm. in length and 5 mm. in width. Two others have dimensions of 6.5 mm. and 6.0 mm. long and 3.3 mm. and 3.0 mm. wide.

Distribution:

North Sea Basin. Oligocene. Denmark: u. (HARDER). North Germany: l., m., u. (v. KOENEN).—Miocene. Denmark: u. (RAVN). North Germany: l. (GRIPP), m. (KAUTSKY), u. (v. KOENEN). Belgium: Anversien (GLIBERT).—Pliocene. England: Coralline Crag (WOOD, HARMER).

A. fusiformis (CANTR.) occurs in the Italian Neogene: Tortoniano, Piacenziano, Astiano (SACCO).

FAMILIA: CONIDAE

Genus: Drillia, Gray 1838.

Subgenus: *Spirotropis* G. O. SARS 1878 (Typus: *D. (S.) carinata* (PHILIPPI)).

45. Drillia (Spirotropis) modiola (Jan 1832).

(Plate VII, fig. 6).

1832. *Fusus modiolus*; JAN, Cat. Conch. foss.; p. 10.
1848. *Pleurotoma modiola* JAN; BELLARDI, Monogr. Pleurot.; p. 596, pl. III, f. 9.
1856. *Pleurotoma modiola* JAN; M. HOERNES, Wiener Becken I; p. 366, pl. XXXIX, f. 12.
1872. *Pleurotoma modiola* JAN; v. KOENEN, Mioc. Nordd. I; p. 234.
1878. *Drillia modiola* JAN; BELLARDI, I Molluschi II; p. 129.
1881. *Pleurotoma modiola*; NYST, Conch. terr. tert.; p. 54, pl. XXVIII, f. 11.
1891. *Pleurotoma (Drillia) modiola* JAN; R. HOERN. & AUING., 1. u. 2. Mediterr.; p. 324, pl. XLI, f. 9–10.
1904. *Drillia (Spirotropis) modiola* (JAN); SACCO, I Molluschi XXX; p. 46, pl. XII, f. 41.
1907. *Pleurotoma modiola* (JAN); RAVN, Jylland; p. 356.
1933. *Pleurotoma (Spirotropis) modiola*; GRIPP, Hamburg; pl. V, f. 6.
1937. *Drillia modiola* JAN; MONTANARO, Studi monogr.; p. 153, pl. VII, f. 17.
1946. *Spirotropis (Spirotropis) modiola* (JAN); BEETS, Plioc. Pleist. gastr.; p. 100.

Original diagnosis: Given not by JAN but presumably first by BELLARDI, 1848: "*Testa turrita, solida, laevi, nitida: anfractibus acutissime carinatis, postice excavatis, antice convexis: carina et suturis simplicibus: ultimo anfractu grosse varicoso: varice aperturae opposita: labro simplici: apertura ovato-rotundata: canali brevi, recto, laeviter striato.*"

Type material: Not used. The whereabouts of JAN's and BELLARDI's types is unknown to me.

Material: Gram (D.G.U., 3 shells; M.M., 3 shells). Spandetgaard (M.M., 1 shell).

Description: See RAVN's description.

Relation to other species: The species is fairly uncommon in the Gram clay of South Jutland, but at Maade Brickworks, Esbjerg, it is common, and shells from the latter locality show that the carina of the whorls is often sharp-edged and curved slightly upwards. In this it seems to bear some resemblance to *Ancystrosyrinx corneti* (v. KOENEN) (see KAUTSKY, 1925, p. 159, pl. 11, fig. 5). In some cases the carina curved so strongly upwards that it was difficult to decide which of the species it was.

BELLARDI cites *D. (S.) carinata* (BIVONA, non PHILIPPI) as being

synonymous with *D.* (*S.*) *modiola*. The former lives in the North Atlantic in the present day (according to Thiele).

Distribution:

North Sea Basin. Miocene. Denmark: u. (Ravn). North Germany: u. (v. Koenen). Holland: u. (Molengraaf & van der Gracht).— Pliocene. North Germany: the limonite sandstone in Sylt (Gripp). Belgium: Scaldisien (Nyst). England: Coralline Crag, Red Crag (Wood, Harmer).

Mediterranean Region. Italy: Terreno miocenico, pliocenico (Bellardi).

Vienna Basin: Miozän (Hoern. & Auing.).

Genus: Turris, O. F. Müller 1766.

Subgenus: *Fusiturris* Thiele 1929

(Typus: *T.* (*F.*) *undatiruga* (Bivona)).

46. Turris (Fusiturris) helena (Semper 1861).

(Plate VIII, fig. 1a, b).

1861. *Pleurotoma Helena*; Semper, Pal. Unters.; p. 66.
1872. *Pleurotoma Helena* Semper; v. Koenen, Mioc. Nordd. I; p. 91, pl. 2, f. 8.
1874. *Pleurotoma* (*Drillia?*) *Helena* Semper; Mørch, Forst. i Tert.; p. 289.
1907. *Pleurotoma Helena* Semper; Ravn, Jylland; p. 357, pl. VII, f. 8.

Original diagnosis: Not given by Semper. First described by v. Koenen, 1872.

Type material: Not used. Both Semper's and v. Koenen's types are lost.

Material: Gram (D.G.U., 3 shells; M.M., 3 shells), Spandetgaard (M.M., 2 shells).

Description: Shell fusiform. Apex trochoid, pointed.

The protoconch consists of 3–4 smooth, convex whorls and a half whorl with a sculpturing of numerous, arcuate, narrow axial ribs.

The following whorls are mostly quite flat. On the largest of the shells there is, close under the suture, a spiral band and below this a depression. The sinus of the growth striae lies medially on the next convex part of the whorl.

Beyond numerous flat, almost obsolete spirals the adult shell has no sculpturing.

Relation to other species: Glibert (1954, p. 11) compares forms of *Turris* (*Fusiturris*) *duchasteli* forma *flexiplicata* Kautsky without axial sculpturing with *T. helena* Semper.

Material of the former species and the variety from the Jutlandic

Miocene conform very closely to *T. helena*, except that *T. duchasteli flexiplicata* has faint axial ribs following the curve of the growth lines. On the shells from Gram this axial sculpturing is almost completely effaced but there are very faint indications of axial ribs on the older whorls, whilst on the first whorl immediately after the protoconch they are actually rather vigorous. The chief difference, however, is that the shells of *T. duchasteli flexiplicata* recorded by GLIBERT are slender and almost fusiform, the Gram shells being more trochoid; but in the Mineralogical Museum there is a large, slender specimen from Gram that is much more fusiform.

Pleurotoma (Drillia) Helenae R. HOERNES & AUINGER, 1891; p. 320, pl. XXXIX, figs. 24–29, from the Miocene in the Vienna Basin is very different from *Turris Helena* SEMPER.

Measurements: The largest shell from Gram in D.G.U. measures 11 mm. in length and 5 mm. in breadth.

Distribution:

North Sea Basin. Miocene. Denmark: u. (RAVN). North Germany: m., u. (v. KOENEN).

Subgenus: *Gemmula* WEINKAUFF 1876 (Typus: *T. (G.) gemmata* (HINDS)).

47. Turris (Gemmula) badensis (R. Hoernes 1875).

(Plate VIII, fig. 2a, b).

1856. *Pleurotoma monilis* BROCCHI; M. HOERNES, Wiener Becken I; p. 353, pl. 38, f. 14–16.
1872. *Pleurotoma rotata* BROCCHI; v. KOENEN, Mioc. Nordd. I; p. 217.
1875. *Pleurotoma Badensis;* R. HOERNES, Schlier von Ottnang; p. 357.
1907. *Pleurotoma rotata* BROCCHI; RAVN, Jylland; p. 355, pl. VIII, f. 4.
1925. *Pleurotoma Badensis* R. HOERNES; KAUTSKY, Hemmoor; p. 161, pl. 11, f. 8.
1952. *Gemmula (β-Hemipleurotoma) rotata badensis* (R. HOERNES); HINSCH, Leit. Moll.; p. 174, pl. C, f. 9.

Original diagnosis: The species was first diagnosed by M. HOERNES (1856) under the name of *Pleurotoma monilis* BROCCHI: "*P. testa fusiformi, transversim irregulariter striata; anfractibus medio carinatis, inferne stria transversa elevatiori cinctis, superne ad suturas marginatis; carina obtuse denticulata; apertura subovata; canali brevi labro intus plicato.*"

Type material: Not used. HOERNES's types are in the Naturhistorisches Museum, Vienna.

Material: Gram (D.G.U., 975 shells; M.M., 203 shells). Spandetgaard (D.G.U., 2 shells; M.M., 356 shells). Ravning (D.G.U., 5 shells; M.M., 1 shell).

Description: The protoconch consists of 5–6 relatively strongly

convex whorls, of which the upper 1–2 are smooth whereas the remaining circa 4 whorls have an axial sculpturing of thin, much elevated ribs to a number of about 17 per whorl. On the sides of these ribs strong magnification (×32 for the present examination) shows numerous, very thin, faintly elevated striae at right angles to the rib. As a rule they extend only a short distance into the intercostal spaces, but occasionally right over to the opposite rib. Quite close to the apertural suture the ribs are suddenly deflected parallel with the suture. Just below the apical suture is a faintly marked ridge or spiral.

On the other whorls the apical spiral is prominent. Below it is a fairly deep depression which aperturally is bordered by a relatively sharp, nodular carina placed relatively close above the apertural suture. The sinus of the growth striae lies on the carina.

The whorls are covered with fairly distinct spirals which in the depression are diffuse and widely spaced. On this part of the whorls their number rarely exceeds 6. On the carina the spirals lie closer and are only slightly narrower than their interspaces. To a number of 5–6 they extend both between the nodules and over them and everywhere stand out distinctly. There are mostly 2 spirals between carina and suture.

The suture between the whorls lies deep.

The area below the carina on the last whorl drops steeply down towards the canal and is covered by several spirals of which 2, lying about midway between carina and canal, are especially prominent.

Relation to other species: Shells of this species from the Upper Miocene in South Jutland were formerly (v. KOENEN, RAVN) referred to *Pleurotoma rotata* (BROCCHI). Later, KAUTSKY (l.c.) identified the form described by RAVN and v. KOENEN with *P. Badensis* R. HOERNES.

However, TH. SORGENFREI has drawn my attention to the fact that there are two distinct forms of the *P. rotata* form group in the marine Middle Miocene of South Jutland, viz. one with axial sculpturing on almost all protoconch whorls, and another on which only the last two such whorls have this structure.

The former type of protoconch is combined with the occurrence of only two spirals on the carina and otherwise with sculpturing similar to that which, according to BELLARDI, R. HOERNES & AUINGER and KAUTSKY, is to be found on *P. rotata*. Thus the material from the South Jutlandic Upper Miocene scarcely belongs to this species.

The other type of protoconch pointed out by SORGENFREI is combined with adult whorls on which the nodular carina is not provided with spiral sculpturing, being quite smooth. This type is probably identifiable with *P. badensis*.

By the way, the latter type is rather poorly described in the literature, but KAUTSKY states that on *P. badensis* the carina is wider than on

P. rotata and has larger nodules which are almost quite smooth, but with a whole bundle of fine spirals in their interspaces.

No doubt the species in the South Jutlandic Upper Miocene compares best with *P. badensis*, even if there remains some uncertainty.

Remarks: HINSCH examined 152 shells from Gram and counted the number of tubercles (l.c., p. 174).

Distribution:

North Sea Basin. Miocene. Denmark: u. (RAVN, HINSCH). North Germany: m. (KAUTSKY), u. (STAESCHE).

Mediterranean Region. Lycia in Turkey: Miocän (OPPENHEIM, 1919, p. 105).

Vienna Basin: Schlier, 2. Mediterranstufe (HOERNES & AUINGER).

Subgenus: *Hemipleurotoma* COSSMANN 1889
(Typus: *T. (H.) denticula* (BASTEROT)).

48. Turris (Hemipleurotoma) annae (Hoernes & Auinger 1891).

(Plate VIII, fig. 3a, b).

1856. *Pleurotoma turricula* BROCCHI; M. HOERNES, Wiener Becken I; p. 350, pl. 38, f. 11.
1872. *Pleurotoma turricula* BROCCHI; v. KOENEN, Mioc. Nordd. I; p. 221.
1891. *Pleurotoma Annae*; R. HOERNES & AUINGER, 1. u. 2. Mediterr.; p. 296, pl. XXXVII, f. 19–21, 23–25.
1907. *Pleurotoma turricula* BROCCHI; RAVN, Jylland; p. 354, pl. VIII, f. 3.
1925. *Pleurotoma (Hemipleurotoma) Annae* HOERN. & AUING.; KAUTSKY, Hemmoor; p. 164, pl. 11, f. 13.
1952. *Gemmula (α-Hemipleurotoma) annae* HOERN. & AUING.; HINSCH, Leit. Moll.; p. 173, pl. C. f. 8.

Original diagnosis: First described by HOERNES & AUINGER. First diagnosis by HINSCH, 1952: "*Eine α-Hemipleurotoma mit kräftiger Knotenreihe auf dem stumpfen Kiel. Eine kräftige hintere Nahtspirale trägt auf den ersten Mittelwindungen ebenfalls eine Knotenreihe.*"

Type material: Not used. HOERNES & AUINGER's type in the Naturhistorisches Museum, Vienna.

Material: Gram (D.G.U., 265 shells; M.M., 96 shells). Spandetgaard (D.G.U., 1 shell; M.M., 352 shells). Ravning (D.G.U., 10 shells).

Description: The following may be added to RAVN's description:

The protoconch is relatively large, almost trochoid, consisting of up to 5 whorls of which the oldest 3–4 seem devoid of sculpturing, whereas the 1–1½ are provided with arcuate axial ribs. These protoconch whorls last increase somewhat considerably in breadth with age.

Regarding the nodular carina, the spirals on it are scarcely ever more than 3 in number, and as a rule they are rather wider than the spirals just above and below the carina.

Relation to other species: The Pliocene *P. turricula* (Brocchi) with which this species was first indentified, usually is without nodules on the spiral band below the apical suture and on the carina (and see Hoernes & Auinger).

Staesche identifies the North German Upper Miocene shells with *P. (H.) boreoturricula* Kautsky but without explaining why. On the relation of the latter species to *T. annae*, see Kautsky, 1925, p. 165 and Hinsch, l.c.

Remarks: Hinsch measured the apical angle of 60 shells from Gram and 29 shells from Langenfelde and found that those from the latter locality were more slender than the former.

The present species is characteristic of the molluscan fauna of the Gram clay in South Jutland and is among the commonest species there.

Distribution:

North Sea Basin. Miocene. Denmark: u. (Ravn: *P. turricula*). North Germany: m. (Kautsky), u. (Hinsch).

Vienna Basin: Schlier, Grunder Schichten, 2. Mediterranstufe (Kautsky).

Subgenus: *Crassispira* Swainson 1840
(Typus: *T. (C.) bottae* (Valenciennes)).

49. Turris (Crassispira) obeliscus (Des Moulins 1841).

(Plate VIII, fig. 4).

1841. *Pleurotoma obeliscus*; Des Moulins, Rév. Pleurot.; p. 176.
1856. *Pleurotoma obeliscus* Des Moulins; M. Hoernes, Wiener Becken I; p. 371, pl. 39, f. 20.
1872. *Pleurotoma obeliscus* Des Moulins; v. Koenen, Mioc. Nordd. I; 232.
1907. *Pleurotoma obeliscus* Des Moulins; Ravn, Jylland; p. 353, pl. VIII, f. 1.
1925. *Drillia (Crassispira) obeliscus* Des Moul. *var. borealis nov. var.*; Kautsky, Hemmoor; p. 173, pl. 11, f. 25–26.

Original diagnosis: Des Moulins. 1841: "*Pl. testâ elongatissimâ subfusiformi-cylindraceâ, striis subœqualibus transversim instructâ (incrementalibus subdecussatâ); spirâ acutissimâ; anfractibus circiter tredenis 8–10-costatis planiusculis infernè vix tumentibus supernè depresso-canaliculatis ad suturam superiorem marginatis; costis verticalibus compressis (dorso acutiusculis) antè canaliculum superiorem anfractuum desinentibus; anfractu ultimo cum caudâ brevi angustâ acuminatâ nec emarginatâ spirâ multò breviore; aperturâ minimâ angustâ utrinqué acuminatâ; columellâ rectâ.*"

Type material: Not used. The whereabouts of DES MOULINS's types is not known to me.

Material: Gram (D.G.U., 1 shell—leg. LUND; M.M., 1 shell).

Description: See descriptions by RAVN and KAUTSKY.

There is only one complete shell from Gram. The upper part of the protoconch is broken off and apart from this it has 8 whorls.

The spiral band below the suture is well marked and the depression below the latter relatively deep. The axial ribs are short and broad. On the last whorls the spiral sculpturing is very faint and blurred.

Relation to other species: On the difference between this and the very similar *Drillia Allioni* BELLARDI, which occurs in the Italian Neogene and the Miocene of the Vienna Basin, see BELLARDI (1878, I Molluschi etc. II; p. 91–94), KAUTSKY (1925, p. 173–74) and R. HOERNES & AUINGER (1891, p. 315–316).

Remarks: From illustrations and descriptions in the literature it appears that the species is very variable, not only in the matter of its sculpturing but also the slenderness of the shells.

Measurements: Height 22.0 mm., breadth 7.0 mm.

Distribution:

North Sea Basin. Oligocene. Denmark: u.? (HARDER, 1913). North Germany: u. (GÖRGES, 1952).—Miocene. North Germany: m. (KAUTSKY), u. (v. KOENEN). Holland: m. (MOLENGRAAF & VAN DER GRACHT, 1913). Belgium: Boldérien, Anversien (*Clavus* (*Crassispira*) *staringi*(BOSQUET in GLIBERT, 1954)?).

Atlantic Region. Loire Basin: Helvétien, Redonien (*Clavus* (*Crassispira*) *pseudobeliscus* (FISCHER et TOURNOUER)?). Bordeaux Basin: Helvétien, Tortonien (COSSMANN & PEYROT). Morocco: Pliocène (LECOINTRE, 1952).

Vienna Basin: 2. Mediterranstufe (KAUTSKY).

Genus: Haedropleura, (Monterosato) Bucquoy, Dautzenberg & Dollfus 1882 (Typus: H. septangularis (Montagu)).

50. Haedropleura maitreja (Semper in v. Koenen 1872).

(Plate VIII, fig. 5).

1872. *Mangilia maitreja* SEMPER; v. KOENEN, Mioc. Nordd. I; p. 250, pl. 3, f. 6.
1925. *Bela* (*Haedropleura*) *maitreja* SEMP.; KAUTSKY, Hemmoor; p. 177.
1950. *Bellaspira maitreja* (SEMPER); BEETS, Olig. u. w .mioz. Gastr.; p. 48, pl. 4, f. 28–33.

Original diagnosis: Not given by SEMPER. First described by v. KOENEN.

Type material: Not used. v. Koenen's types are lost.

Material: Gram (D.G.U., 2 shells).

Description: Neither of these two shells is intact. Their protoconch is either broken off or badly corroded and their surface is so damaged that the original shell surface remains only here and there. It can be seen that the surface was glossy and without spiral ornament; even the growth lines are only faintly visible. On almost all whorls, at any rate the early ones, are thin, sharp axial ribs running in conformity with the growth lines.

One specimen is almost fusiform and has 8–9 whorls; the other is slender, turreted and had at least 10 whorls apart from the protoconch.

Good descriptions of this species are given by Kautsky and Beets.

Relation to other species: Kautsky (l.c., p. 178) considers that the species comes very close to the Pliocene and recent *H. septangularis* (Montagu).

Measurements: One of the shells is 9.7 mm. high and 3.8 mm. wide.

Distribution:

North Sea Basin. Miocene. North Germany: m., u. (v. Koenen). Holland: m. (Beets).

Genus: Brachytoma, Swainson 1840 (Typus: B. stromboides (Sow.)).

51. Brachytoma obtusangula (Brocchi 1814).

(Plate VIII, fig. 6a, b).

1814. *Murex obtusangulus*; Brocchi, Conch. subapp. II; p. 422, pl. VIII, f. 19.
1848. *Pleurotoma obtusangula* Brocchi; Bellardi, Monogr. Pleurotome; p. 593, pl. III, f. 21.
1856. *Pleurotoma obtusangula* Brocchi; M. Hoernes, Wiener Becken I; p. 365, pl. 40, f. 7–8.
1872. *Mangelia obtusangula* Brocchi; v. Koenen, Miocän Nordd. I; p. 112.
1874. *Mangelia obtusangula* Brocchi; Mørch, Forst. i Tert.; p. 290.
1878. *Drillia obtusangulus* (Brocchi); Bellardi, I Molluschi II; p. 98.
1891. *Pleurotoma* (*d. Drillia*) *obtusangula* Brocc.; Hoern. & Auing., 1. u. 2. Mediterr.; p. 317, pl. XL, f. 13–20.
1907. *Mangilia obtusangula* Brocchi sp.; Ravn, Jylland; p. 359.
1914. *Raphitoma obtusangula* Brocchi sp.; Gripp, Itzehoe; p. 34.
1914. *Drillia obtusangula* Brocchi sp.; Cipolla, Pleurot. Altavilla; p. 116, pl. XII, f. 4.
1925. *Drillia obtusangula* Brocchi; Kautsky, Hemmoor; p. 171.
1937. *Drillia obtusangula* Brocchi; Montanaro, Studi monogr.; p. 150, pl. VII, f. 3–4.
1954. *Clavus* (*Brachytoma*) *obtusangula* Brocchi sp.; Glibert, Pleurot. Mioc. Belg. etc.; p. 25, pl. IV, f. 10.

Original diagnosis: BROCCHI, 1814: "*Testa turrita, obtuse longitudinaliter costata, transverse confertim striata, anfractubus carinatis, superne laeviusculis.*"

Type material: Not used. BROCCHI's types are presumably in the Museo civico di Storia Naturale, Milan.

Material: Gram (D.G.U., 139 shells; 5 shells). Spandetgaard (M.M., 18 shells).

Description: The protoconch, which is sharp, consists of 5 convex whorls, of which the upper 4 on their lower part have a sculpturing of irregular, oblique, very thin lines visible only at about ×24. The last protoconch whorl is provided with oblique, somewhat arcuate, narrow axial ribs already visible at ×5. Between these axial ribs and at ×24 can be seen a number of irregular, web-like lines on the lower part of the whorl.

The remainder of the shell was aptly described by RAVN.

Relation to other species: The Oligocene *Raphitoma Pfefferi* v. KOENEN (Unter-Oligocän II, p. 490, pl. XXXIII, fig. 4–6) is stated to be very similar to *B. obtusangula* BROCC.

Distribution:

North Sea Basin. Miocene. Denmark: m., u. (RAVN). North Germany: l. (GRIPP), m. (KAUTSKY), u. (v. KOENEN). Belgium: Anversien (GLIBERT).

Mediterranean Region. Italy: Elveziano, Tortoniano, Piacenziano (BELLARDI, SACCO).

Vienna Basin: 2. Mediterranstufe (KAUTSKY).

Genus: Asthenotoma, Harris & Burrows 1891.

52. Asthenotoma sp.

(Plate IX, fig. 1a, b).

1907. *Mangilia sp.*; RAVN, Jylland; p. 360.

Material: Gram (M.M., 1 shell—leg. FRIIS 1910), Spandetgaard (M.M., 1 shell).

Description: RAVN described a shell of this species from Spandetgaard.

The Gram specimen may be described as follows:

The shell slender, with a short canal. The protoconch blunt and consists of 1½ smooth and rather convex whorls.

The succeeding whorls have a relatively broad spiral band close under the suture, which forms an undulating, sunken line. The lower part of the

whorls has two prominent spirals which are crossed by up to 15 axial ribs, which are short and nodular, so that in reality a belt is formed of two rows of nodules. Immediately above the lowest suture is a relatively wide spiral.

In addition, over the entire whorl are numerous fine, elevated growth striae whose sinus is just above the upper one of the two cardinal spirals and, like the region above these spirals, is crossed by a few secondary spirals.

On the last whorl are both coarse and fine spirals right out on the lower termination of the canal.

Remarks: This seems to be a new species. As there are a number of specimens of the same kind from Maade Brickworks at Esbjerg, the question will be deferred until later.

Genus: Bathytoma, Harris et Burrows 1891 (Typus: B. cataphracta (Brocc.)).

53. Bathytoma cataphracta (Brocchi 1814).

(Plate IX, fig. 3a, b).

1814. *Murex cataphractus*; Brocchi, Conch. subapp. II; p. 427, pl. VIII, f. 16.
1848. *Pleurotoma cataphracta* Brocchi; Bellardi, Monogr. Pleurotome; p. 548, pl. I, f. 14.
1856. *Pleurotoma cataphracta* Brocchi; M. Hoernes, Wiener Becken I; p. 333, pl. 36, f. 5–9.
1872. *Pleurotoma turbida* Solander; v. Koenen, Mioc. Nordd. I; p. 81.
1878. *Dolichotoma cataphracta* (Brocchi); Bellardi, I Molluschi II; p. 230, pl. VII, f. 20.
1907. *Pleurotoma cataphracta* Brocchi sp.; Ravn, Jylland; p. 350, pl. VII, f. 12.
1925. *Bathytoma cataphracta* Brocchi; Kautsky, Hemmoor; p. 179, pl. 11, f. 33.
1952. *Bathytoma mioturbida* Kautsky; Hinsch, Leit. Moll.; p. 172, pl. C, f. 6.

Original diagnosis: Brocchi, 1814: "*Testa turrita, striis granulatis moniliformibus undequaque cincta, anfractubus bipartitis, superne excavatis, carina crenulata, labro sinu separato, cauda brevi.*"

Type material: Not used. Brocchi's types presumably preserved in the Museo civico di Storia Naturale, Milan.

Material: Gram (D.G.U., 382 shells; M.M., 171 shells). Spandetgaard (D.G.U., 1 shell; M.M., 241 shells). Ravning (D.G.U., 18 shells; M.M., 4 shells).

Description: The material from South Jutland conforms exactly to Ravn's description.

Relation to other species: Shells belonging to the *cataphracta*-group have often been entered under several species names.

The earliest of the species belonging to this group is the Eocene *Pleuro-*

toma turbida SOLANDER, presumed by BEYRICH and v. KOENEN to occur in the rocks from the Eocene to the Pliocene, a long period of existence and naturally one that has been doubted by several authors.

However, *B. cataphracta* is extremely variable and no definition of the species will ever be satisfactory without a careful variation-statistical study.

HINSCH subdivides the *cataphracta* forms in the Dano-North German "Glimmerton" into three species: *B. jugleri* (PHILIPPI), *B. mioturbida* KAUTSKY and *B. laevis* HINSCH. See HINSCH, l. c., p. 172.

Remarks: *B. cataphracta* is one of the commonest molluscs in the Gram clay of South Jutland.

Measurements: HINSCH has measured the apical angle of up to 114 specimens from Gram, see HINSCH, l. c., p. 172.

Distribution:

North Sea Basin. Oligocene. Denmark: m., u. (HARDER, 1913). North Germany: ?—Miocene. Denmark: l. (SORGENFREI), m. (RAVN), u. (RAVN). North Germany: l. (GRIPP: *P. turbida* SOL.), m. (KAUTSKY), u. (v. KOENEN: *P. turbida* SOL.). Holland: m., u. (MOLENGRAAF & VAN DER GRACHT, 1913: *D. turbida* SOL.). Belgium: Anversien (GLIBERT, 1954: *B. mioturbida* KAUTSKY).

Atlantic Region. Bordeaux Basin: Aquitanien, Burdigalien, Helvétien, Tortonien (COSSMANN & PEYROT).—Portugal: Miocène (DA COSTA, 1866).

Mediterranean Region. Rhône valley: Pliocène (FONTANNES, 1878–82).—Italy: Elveziano, Tortoniano, Piacenziano, Astiano (BELLARDI).

Vienna Basin: Grunder-schichten, 2. Mediterranstufe (KAUTSKY).—Hungarian Basin: Aquitanien (SORGENFREI, 1940).

Genus: Cythara, Schumacher 1817.

Subgenus: *Mangelia* RISSO 1826 (Typus: *C. (M.) nebula* (MONTAGU)).

54. Cythara (Mangelia) kochi (v. Koenen 1872).

(Plate VIII, fig. 7).

1872. *Mangilia Kochi*; v. KOENEN, Mioc. Nordd. I; p. 115, pl. 3, f. 8.
1907. *Mangilia Kochi* v. KOENEN; RAVN, Jylland; p. 156, pl. VIII, f. 8.

Original diagnosis: First described by v. KOENEN. No diagnosis proper.

Type material: Not used. v. KOENEN's type from Gram is lost.

Material: Gram (D.G.U., 35 shells; M.M., 1 shell).

Description: The shell is small, fusiform. Apex rather blunt.

The protoconch consists of 3–4 convex whorls, of which the last 3 are smooth, the fourth having numerous arcuate, fine axial ribs which are crossed by 4–5 faint spirals.

The succeeding whorls have a shallow depression just below the suture; a blunt edge delimits it downwards. These whorls are provided with about 13 slightly oblique axial ribs of the same width as their interspaces and extending right down to the next suture. On the last whorl they fade away before reaching the canal. The ribs are crossed by numerous fine spirals of almost the same faint volume as the growth striae. The sinus of the latter lies in the depression below the suture.

Aperture narrow, elongated. Canal short.

Remarks: This species has been found only at Gram and in a boring at Holleskov (Banke Rasmussen, 1954, p. 535).

Measurements: Two shells from Gram have the following dimensions:

Length	Breadth	Apertural height
mm.	mm.	mm.
3.8	1.9	1.7
5.3	2.5	2.5

Distribution:

North Sea Basin. Miocene. Denmark: u. (v. Koenen, Ravn).

Genus: Lienardia, Jousseaume 1884.

55. Lienardia luisae (Semper in v. Koenen 1872).

(Plate IX, fig. 2a, b).

1872. *Defrancia Luisae* Semper; v. Koenen, Mioc. Nordd. I; p. 242, pl. 3, f. 2–3.
1874. *Defrancia Luisae* Semper; Mørch, Forst. i Tert. p. 290.
1878. *Clathurella Luisae* (Semper); Bellardi, I Molluschi II; p. 253.
1904. *Clathurella Luisae* (Semper); Sacco, I Molluschi XXX; p. 51, pl. XIII, f. 32–33.
1907. *Mangilia Luisae* (Semper); Ravn, Jylland; p. 359.
1925. *Mangilia* (*Clathurella*) *Luisae* Semper; Kautsky, Hemmoor; p. 185, pl. 12, f. 9.
1937. *Mangilia* (*Clathurella*) *Luisae* (Semper); Montanaro, Studi monogr.; p. 174, pl. VIII, f. 13–15.
1950. *Glyphostoma* (*Lienardia*?) *luisae* (Semp.); Beets, Olig. u. w. mioz. Gastr.; p. 55.

Original diagnosis: Not given by Semper. First described by v. Koenen.

Type material: Not used. v. KOENEN's type must be considered lost.

Material: Gram (D.G.U., 91 shells; M.M., 8 shells). Spandetgaard (M.M., 4 shells).

Description: The material from South Jutland conforms exactly to RAVN's description. Only the following need be added regarding the protoconch:

Pointed and consists of 5–6 whorls, the upper 3–4 being smooth and fairly regularly convex. Thereafter a carina forms on the region below the middle of the whorl. The apertural area below the carina has a fine sculpturing of elevated axial striae whose course is very irregular and always somewhat oblique. No transversal connecting lines between them and they are only observable under a magnification of at least $\times 24$.

Relation to other species: The variations among the shells from South Jutland are but small. The Gram clay at Maade Brickworks, Esbjerg, has produced several specimens closely approaching SACCO's illustration of *Clathurella scalaria* JAN (*var. lugustica* SACCO) (1904, XXX, pl. XIII, figs. 28–29).

Distribution:

North Sea Basin. Miocene. Denmark: m., u. (RAVN). North Germany: m. (KAUTSKY), u. (v. KOENEN). Holland: m? (BEETS).

Mediterranean Region. Italy: Elveziano, Piacenziano (MONTANARO).

Genus: Philbertia, Monterosato 1884.

Subgenus: *Philbertia* s.s. (Typus: *P.* (*P.*) *bicolor* (RISSO)).

56. Philbertia (Philbertia) reticulata (Renieri 1804).

(Plate IX, fig. 5a, b).

1804. *Murex reticulatus*; RENIERI, Tavolo alfabetica; p. 4.
1814. *Murex echinatus*; BROCCHI, Conch. subapp. II; p. 423 and p. 663, pl. VIII, fig. 3.
1848. *Clavatula cancellata* SOW.; WOOD, Crag I; p. 61, pl. VII, f. 9.
1867. *Defrancia reticulata* REN.; JEFFREYS, Brit. Conch. IV; p. 370–ibid., V; p. 220, pl. LXXXIX, f. 3.
1868. *Defrancia reticulata* REN.; WEINKAUFF, Conch. Mittelm. II; p. 128.
1872. *Defrancia reticulata* REN.; v. KOENEN, Mioc. Nordd. I; p. 241.
1878. *Homotoma reticulata* (REN.); BELLARDI, I Molluschi II; p. 268.
1879–82. *Homotoma reticulata* REN. var.; FONTANNES, Moll. plioc. I; p. 48, pl. IV, f. 11.
1882–86. *Clathurella Cordieri* PAYRAUDEAU sp.; BUCQUOY, DAUTZENBERG, DOLLFUS, Roussillon I; p. 92, pl. XIV, f. 10–12.
1904. *Peratotoma reticulata* (REN.); SACCO, I Molluschi XXX; p. 52, pl. XIII, f. 38.
1910. *Peratotoma reticulata* REN.; CERULLI-IRELLI, Faun. malac.; p. 249, pl. XXXVI, f. 25–28.

1914. *Mangilia (Clathurella) reticulata* Renieri sp.; Cipolla, Pleurot. Altavilla; p. 143, pl. XIII, f. 13–14.
1915. *Clathurella Cordieri* Payraudeau sp.; Harmer, Plioc. Moll. II; p. 239.
1925. *Mangilia (Clathurella) reticulata* Ren.; Kautsky, Hemmoor; p. 184.
1937. *Daphnella (Bellardiella) reticulata* (Ren.); Montanaro, Studi monogr.; p. 178, pl. VIII, f. 30–31.

Original diagnosis: Not given by Renieri but by Brocchi, 1814: *Murex echinatus: "Testa turrita, anfractubus teretibus reticulatis, papilla in sectionum angulis acuta, labio intus sulcato, cauda abbreviata."*

Type material: Not used. Brocchi's types presumably preserved in the Museo civico di Storia Naturale, Milan.

Material: Gram (D.G.U., 6 shells; M.M., 1 shell).

Description: Only one of these seven shells is intact. The others are fragmentary.

The protoconch comprises 4–5 whorls, the earliest being smooth and button-formed. On the others are numerous arcuate, very fine axial ribs which become oblique on the lower part of the whorls and simultaneously are crossed by a system of ribs passing obliquely, at right angles to the first system, thus forming a fine diagonal network with rhombic meshes. The upper 4 whorls are regularly convex but on the fifth there is a sharp, serrated carina at the middle. Below this keel a spiral gradually forms and a similar one can be seen just above the lowest suture.

The next whorls have a vigorous sculpturing of relatively coarse, almost straight axial ribs (in all 12–14 per whorl) whose interspace is at least twice as wide as the ribs themselves. The ribs are crossed by 3 sharp spirals whose passage across the ribs forms a small spine. On the transition from the earliest protoconch whorl to the next whorl the uppermost spiral is seen to be a continuation of the said carina. The next-upper spiral is the continuation of the spiral below the carina on the last protoconch whorl, and the latter's spiral just above the suture continues in the third of the spirals on the whorls of the adult phase. Early on the first of the latter whorls a small elevation on the part of the ribs across the upper spiral indicates the beginning of still another spiral which becomes slightly more distinct on the later whorls.

Relation to other species: Bucquoy, Dautzenberg and Dollfus suggest Payraudeau's designation *Cordieri* instead of *reticulata*, the latter author (1826, "Catalogue discriptif des Annelides et des Mollusques de l'ile de Corse", p. 144, pl. VII, fig. 11) having given a good description of *Cordieri*.

In the difference between *C. reticulata* and *C. purpurea* (Montagu, 1803), *C. rudis* (Scacchi, 1804), *C. elegans* (Donovan, 1803) and *C. Philberti* (Michaud, 1829), see Bucquoy, Dautzenberg & Dollfus, and Bellardi (cf. also Sacco, I Molluschi, XXX, 1904, pl. XIII).

Remarks: *C. reticulata* was previously found at Gram and Spandetgaard, according to v. KOENEN. It has also been found at Holleskov (BANKE RASMUSSEN, 1954, p. 535) and at Brande Brickworks.

Measurements: The intact shell from Gram measures 6 mm. in length and 3 mm. in breadth.

Distribution:

North Sea Basin. Miocene. North Germany: m. (KAUTSKY), u. (v. KOENEN).—Pliocene. England: Coralline Crag (WOOD, HARMER). Holland: Diestien supérieur (TESCH).—Quaternary. England: Waltonian, Newbournian (WOOD, HARMER).

Mediterranean Region. Italy: Miocene medio, Pliocene inferiore, P. superiore (BELLARDI). The transition between Pliocene and Quaternary at Monte Mario, Rome (CERULLI-IRELLI).

Genus: Acamptogenotia, Rovereto 1899 (Typus: A. intorta (Brocchi)).

57. Acamptogenotia intorta (Brocchi 1814).

(Plate X, fig. 1a, b).

1814. *Murex intortus*; BROCCHI, Conch. supp. II; p. 427, pl. VIII, f. 17.
1837. *Pleurotoma Morreni*; DE KONINCK, Coq. foss. de Basele etc.; p. 21, pl. 1, f. 3,
1843. *Pleurotoma Morreni* DE KONINCK; NYST, Coq et polyp.; p. 510, pl. 40. f. 6.
1848. *Pleurotoma intorta* BROCCHI; BELLARDI, Monogr. Pleurotome; p. 544, pl. I, f. 13.
1848. *Pleurotoma intorta* BROCCHI; S. WOOD, Crag I; p. 53, pl. 6, f. 4.
1856. *Pleurotoma intorta* BROCCHI; M. HOERNES, Wiener Becken I; p. 331, pl. 36, f. 1–2.
1872. *Pleurotoma intorta* BROCCHI sp.; v. KOENEN, Mioc. Nordd. I; p. 233.
1878. *Pseudotoma intorta* (BROCCHI); BELLARDI, I Molluschi II; p. 214, pl. VII, f. 10.
1881. *Pleurotoma intorta* BROCCHI sp.; NYST, Conch. terr. tert.; p. 47, pl. III, f. 11.
1890. *Pseudotoma Morreni* DE KONINCK; v. KOENEN, Unter-Oligocän, II; p. 480, pl. XXX, f. 1–2.
1907. *Pleurotoma intorta* BROCCHI sp.; RAVN, Jylland; p. 343, pl. VII, f. 4.
1925. *Genotia (Pseudotoma) Morreni* DE KONINCK; KAUTSKY, Hemmoor; p. 147, pl. 10, f. 20–21.
1954. *Acamptogenotia straeleni*; GLIBERT, Pleurotomes; p. 23, pl. IV, f. 9.

Original diagnosis: BROCCHI, 1814: "*Testa turrita, reticulatim striata, anfractubus bipartitis superne excavatis, carina nodosa, labro sinu separato, cauda brevissima.*"

Type material: Not used. BROCCHI's types presumably preserved in the Museo civico di Storia Naturale, Milan.

Material: Gram (D.G.U., 9 shells; M.M., 5 shells). Spandetgaard (M.M., 7 shells).

Description: See Ravn's description of the species.

Relation to other species: Already in 1890 (p. 483) v. Koenen expressed the opinion that shells from the South Jutlandic Upper Miocene were different from the Pliocene *A. intorta* and the Oligocene *A. morreni* (De Koninck). In 1925 Kautsky (p. 147) referred the Miocene shells to *A. morreni* and considered that the South European Pliocene shells alone belong to *A. intorta*. Glibert in 1954 (p. 23) segregated the shells from the Belgian Anversien as a separate species, *A. straeleni* Glibert.

It seems that the shells from the South Jutlandic Upper Miocene do not quite correspond to any of these species—best perhaps to *A. straeleni*. Owing to the lack of comparative material I propose to uphold Ravn's determination for the present.

Distribution:

North Sea Basin. Oligocene. Denmark: m., u. (Ravn, Harder). North Germany: l., m., u. (v. Koenen).—Miocene. Denmark: m., u. (Ravn). North Germany: l. (Gripp: *A. Bodei*), m. (Kautsky), u. (v. Koenen, Staesche). Belgium: Boldérien, Anversien (Glibert).—Pliocene. Belgium: Scaldisien, Casterlien (Nyst).—Quaternary. England: Waltonian Crag, Newbournian (Wood, Harmer).

Mediterranean Region: Italy: Pliocene inferiore (Bellardi).

Vienna Basin: ?

Genus: Conus, Linné 1758.

Subgenus: *Conospira* De Gregorio 1890 (Typus: *C. (C.) antediluvianus* Brug.).

58. Conus (Conospira) antediluvianus, Bruguière 1792.

(Plate IX, fig. 4a, b).

1792. *Conus antediluvianus*; Bruguière, Encycl. métod. I; p.637, pl. 347, f.6.
1814. *Conus antediluvianus* Bruguière; Brocchi, Conch. subapp. II; p. 291, pl. II, f. 11.
1853. *Conus antediluvianus* Bruguière; Beyrich, Conchylien; p. 19, pl. 1, f. 1.
1856. *Conus antediluvianus* Bruguière; M. Hoernes, Wiener Becken I; p. 38, pl. V, f. 2.
1872. *Conus antediluvianus* Bruguière; v. Koenen, Mioc. Nordd. I; p. 213.
1893. *Conospirus antediluvianus* (Bruguière); Sacco, I Molluschi XIII, 1; p. 39, pl. IV, f. 28–45.
1907. *Conus antediluvianus* Bruguière; Ravn, Jylland; p. 362, pl. VIII, f. 5.
1916. *Conus antediluvianus* Bruguière; Nørregaard, Esbjerg; p. 34.
1925. *Conus (Conospira) antediluvianus* Bruguière; Kautsky, Hemmoor; p. 145.

Original diagnosis: BRUGUIÈRE, 1792: "*Conus, testa conico-oblonga coronata, transversim striata, spira elevata acuta tertiam testae partem aequante, basi sulcata.*"

Type material: Not used. The whereabouts of BRUGUIÈRE's types is unknown to me.

Material: Gram (D.G.U., 214 shells; M.M., 68 shells). Spandetgaard (M.M., 392 shells). Ravning (D.G.U., 5 shells; M.M., 1 shell).

Description: See descriptions by BEYRICH and RAVN.

Relation to other species: It is probable that *Conus antediluvianus* has often been confused with other species, e.g. *C. dujardini* DESHAYES or *C. allionii* MICHELOTTI. These two latter species have many points of mutual resemblance but both differ from *C. antediluvianus* in that the keel on the whorls is not nodular or at least has only faint nodules. The present species is well defined particularly by the carina with its well-developed nodules.

Remarks: This species is among the most frequently occurring of the large molluscs in the Gram clay of South Jutland.

Distribution:

North Sea Basin. Miocene. Denmark: m., u. (RAVN). North Germany: m. (KAUTSKY), u. (BEYRICH, v. KOENEN). Holland: m., u. (MOLENGRAAF & VAN DER GRACHT). Belgium: ?

Atlantic Region: ?

Mediterranean Region. Italy: Elveziano, Tortoniano, Pliocene (SACCO).

Vienna Basin: Grunder Schichten, 2. Mediterranstufe (KAUTSKY).

OPISTHOBRANCHIA

FAMILIA: ACTAEONIDAE

Genus: Actaeon, Montfort 1810 (Typus: A. tornatilis (Linné)).

59. Actaeon sp.

Material: Gram (D.G.U., 1 shell).

Description: There is only this one small defective shell, consisting of about two whorls provided with stippled spiral grooves over the entire surface.

Determination of the species is impossible.

FAMILIA: PYRAMIDELLIDAE

Genus: Odostomia, Fleming 1817.

Subgenus: *Odostomia* s.s. (Typus: *O.* (*O.*) *plicata* (Montagu)).

60. Odostomia (Odostomia) conoidea (Brocchi 1814).

(Plate X, fig. 5).

1814. *Turbo conoideus*; Brocchi, Conch. subapp. II; p. 660; pl. XVI, f. 2.
1843. *Tornatella conoidea* Brocchi; Nyst, Coq. et polyp.; p. 428, pl. XXXVII, f. 27.
1844. *Auricula*? *conoidea* Broc.; Philippi, Enumeratio II; p. 119.
1848. *Odostomia plicata* Montagu; S. Wood, Crag I; p. 85, pl. IX, f. 3.
1853. *Odostomia conoidea* Brocchi; Forbes & Hanley, Brit. Moll. III; p. 260, pl. XCV, f. 4.
1856. *Odontostoma plicatum* Montagu; M. Hoernes, Wiener Becken I; p. 497, pl. 43, f. 26.
1867. *Odostomia conoidea* Brocchi; Jeffreys, Brit. Conch. IV; p. 127, pl. LXXIII, f. 6.
1868. *Odostomia conoidea* Brocchi; Weinkauff, Conch. Mittelm. II; p. 218.
1881. *Odostomia conoidea* Brocchi; Nyst, Conch. terr. tert.; p. 71, pl. VI, f. 2.
1882. *Odontostoma conoideum* Brocchi; v. Koenen, Mioc. Nordd. II; p. 245.
1886. *Odostomia conoidea* Brocchi sp.; Kobelt, Fauna Moll.; p. 88.
1888. *Odostomia conoidea* Brocchi; Petersen, Skalbær. Moll.; p. 75.
1892. *Odontostomia conoidea* (Brocchi); Sacco, I Molluschi, XI; p. 615.
1900–01. *Odostomia conoidea* Brocchi; Brøgger, Kristianiafeltet; p. 661, pl. XIX, f. 24.
1903–04. *Odontostomia conoidea* Brocchi sp.; Dolfuss, Cotter & Gomes, Moll. tert. Port.; p. 14, pl. XXXIV, f. 1.
1907. *Odostomia conoidea* Brocchi sp.; Ravn, Jylland; p. 299, pl. III, f. 19.
1915. *Odostomia conoidea* Brocchi; Øyen, Kvartærstudier III; p. 442.
1920. *Odostomia conoidea* Brocchi; Harmer, Plioc. Moll. II; p. 599, p. L, f. 33.
1925. *Odontostomia conoidea* Brocchi; Kautsky, Hemmoor; p. 73.
1946. *Odostomia* (*Megastoma*) *conoidea* (Broc.); Beets, Plioc. Pleist. gastr.; p. 52.
1952. *Odostomia* (*Megastoma*) *conoidea* (Broc.); Glibert, Mioc. Belg. II; p. 55, pl. IV, f. 10.

Original diagnosis: Brocchi, 1814: "*Testa conica, glabra, anfractubus planiusculis, infimo subcarinato, apertura ovali, columella uniplicata.*"

Type material: Not used. Brocchi's types are presumably in the "Museo civico di Storia Naturale" in Milan. Type locality: San Giusto, Northern Italy.

Material: Gram (D.G.U., 139 shells; M.M., 9 shells).

Description: There is nothing to be added to Ravn's description.

Relation to other species: *Odostomia fraterna* Semper from the Oligocene and Miocene of the North Sea Basin is stated to be more gracile,

with a more rounded final whorl and an internal aperture orifice close to the foregoing whorl without the umbilical fissure of *O. conoidea*.

Remarks: The species is particularly common in the silty sediments at Gram Brickworks.

Distribution:

North Sea Basin. Miocene. Denmark: m., u. (RAVN). North Germany: m. (KAUTSKY), u. (v. KOENEN). Belgium. Horizon de Houthaelen, Anversien (GLIBERT).—Pliocene. Holland: Scaldisien (TESCH). Belgium: Scaldisien, Casterlien (NYST).—Quaternary. Norway: postglacial (ØYEN, BRØGGER). Denmark: postglacial (JESSEN, 1936). England. (HARMER).

Atlantic Region. Portugal: Tortonien, Helvétien (DOLFUSS, COTTER & GOMES).

Mediterranean Region. Italy: Tortoniano, Piacenziano, Astiano (SACCO), Quaternary (and Pliocene) on Monte Mario at Rome (CERULLI-IRELLI). Algeria: Plaisancien (DE LAMOTHE).

Vienna Basin: 2. Mediterranstufe (HOERNES, KAUTSKY).

Recent occurrence: Atlantic Ocean from Canary Islands, along coasts of Spain, Portugal, France and England-Scotland to Norwegian waters (FORBES & HANLEY, JEFFREYS). In Danish waters down in the Kattegat (PETERSEN). In the Mediterranean as far as the Aegean Sea (WEINKAUFF).

Genus: Eulimella, (Forbes) Gray 1837.

Subgenus: *Eulimella* s.s. (Typus: *E.* (*E.*) *scillae* (SCACCHI)).

61. Eulimella (Eulimella) scillae (Scacchi 1836).

(Plate X, fig. 2).

1836. *Melania Scillae*; SCACCHI, Notitz. Conch.; p. 51, pl. II, f. 2.
1844. *Eulima Scillae* SCACCHI; PHILIPPI, Enumeratio II; p. 135, pl. XXIV, f. 6.
1853. *Eulimella Scillae* SCACCHI; FORBES & HANLEY, Brit. Moll. III; p. 309, pl. XCVIII, f. 5–6.
1867. *Odostomia Scillae* SCACCHI; JEFFREYS, Brit. Conch. IV; p. 169, pl. LXXVI, f. 5.
1868. *Eulimella Scillae* PHILIPPI; WEINKAUFF, Conch. Mittelm. II; p. 224.
1878. *Eulimella Scillae* SCACCHI; SARS, Moll. Reg. Arct. Norv.; p. 208, pl. 11, f. 17.
1882. *Eulimella Scillae* SCACCHI; v. KOENEN, Mioc. Nordd. II; p. 242.
1886. *Eulimella Scillae* SCACCHI; KOBELT, Fauna Moll.; p. 111.
1888. *Eulimella Scillae* SCACCHI; PETERSEN, Skalbær. Moll.; p. 73.
1892. *Eulimella Scillae* SCACCHI; SACCO, I Molluschi XI; p. 632, pl. II, f. 1.
1900–01. *Eulimella Scillae* SCACCHI; BRØGGER, Kristianiafeltet; p. 661, pl. XIX, f. 19.
1903–04. *Eulimella Scillae* SCACCHI sp.; DOLFUSS, COTTER & GOMES, Moll. tert. Port.; p. 15, pl. XXXIV, f. 19.

1914. *Eulimella Scillae* Scacchi sp.; Cerulli–Irelli, Fauna malac.; p. 430, pl. XXII, f. 46–50.

1946. *Eulimella (Eulimella) scillae* (Scacchi); Beets, Plioc. Pleist. gastr.; p. 52, pl. 3, f. 10.

Original diagnosis: I have not had access to Scacchi's work. Philippi, 1844, gives the following diagnosis: "*E. testa subulato-turrita; anfractibus laevissimis, planis, sutura profunda disjunctis; apertura tetragona; columella perpendiculari.*"

Type material: Not used. The whereabouts of Scacchi's and Philippi's types is unknown to me.

Material: Gram (D.G.U., 9 shells; M.M., 1 shell?).

Description: The apex turriculate, rather slender. Number of whorls: 10 (apart from the heterostrophe protoconch); they are flat, smooth and separated by a deep, oblique suture. The final whorl falls steeply towards the base. Rounded border in continuation of suture.

Aperture rhomboid. External aperture margin smooth, not thickened. Internal aperture margin straight, simple. No umbilicus, but a narrow fissure between aperture margin and whorl.

Remarks: A comparison between the Gram material and a recent specimen at D.G.U. showed complete uniformity except for the larger protoconch of the recent shell.

Measurements: A complete shell from Gram measures 5.7 mm. in length and 1.8 mm. in breadth. From the top to the bottom corner the aperture measures 1.7 mm.

Distribution:

North Sea Basin. Miocene. Denmark: u. (v. Koenen). North Germany: m., ? u. (v. Koenen).—Pliocene. Holland: ? (Beets)—Quaternary. Denmark: interglacial (*Turritella terebra*-zone (Nordmann)). Norway: postglacial (Øyen, Brøgger).

Atlantic Region. Portugal: Helvétien (Dolfuss, Cotter & Gomes)

Mediterranean Region. Italy: Tortoniano, Piacenziano, Astiano (Sacco), Mt. Mario (Cerulli—Irelli), Calabrien at Gravina (di Puglia) (Scacchi, Philippi).

Recent occurrence: Atlantic Ocean from Canary Islands and Madeira to Lofoten (Forbes & Hanley, Jeffreys, Sars). Empty shells found in waters around Iceland (Thorson, 1944). Inner Danish waters in Kattegat (Petersen). Mediterranean (Weinkauff).

Genus: Pyramidella, Lamarck 1799.

Subgenus: *Pyramidella* s.s. (Typus: *P.* (*P.*) *dolabrata* (LINNÉ)).

62. Pyramidella (Pyramidella) plicosa, Bronn 1838.

(Plate X, fig. 6).

1838. *Pyramidella plicosa*; BRONN, Leth. geogn. II; p. 1026, pl. 40, f. 24.
1848. *Pyramidella laeviuscula*; WOOD, Crag I; p. 77, pl. 9, f. 2.
1856. *Pyramidella plicosa* BRONN; M. HOERNES, Wiener Becken I; p. 492, pl. 46, f. 20.
1882. *Pyramidella plicosa* BRONN; v. KOENEN, Mioc. Nordd. II; p. 239, pl. 6, f. 15.
1892. *Pyramidella plicosa* BRONN; SACCO, I Molluschi, XI; p. 609, pl. I, f. 53.
1907. *Pyramidella plicosa* BRONN; RAVN, Jylland; p. 300, pl. III, f. 22.
1917. *Pyramidella plicosa* BRONN; COSSMANN-PEYROT, Conch. Néog. A. S. L. B. LXX; p. 95, pl. IX, f. 8–9.
1925. *Pyramidella plicosa* BRONN; KAUTSKY, Hemmoor; p. 72.
1940. *Pyramidella plicosa* BRONN; SORGENFREI, Klintinghoved; p. 33.
1944. *Pyramidella plicosa* BRONN; VOORTHUYSEN, Mioz. Gastrop.; p. 39, pl. 13, f. 18–20.
1952. *Pyramidella* (*Pyramidella*) *plicosa* BRONN; GLIBERT, Mioc. Belg. II; p. 62, pl. IV, f. 17.

Original diagnosis: BRONN gives no diagnosis but describes certain sculptural features in conjunction with *P. terebellata* (BROCCHI) and *P. unisulcata* DUJARD.

Type material: Not used. The whereabouts of BRONN's type is not known to me.

Material: Gram (D.G.U., 4 shells).

Description: See RAVN's description of the M.M. material from Varde.

The Gram material has only one intact specimen, having 6 whorls (including the protoconch). One fragmentary shell has 7 whorls (including the protoconch).

Relation to other species: The closely related species: *P. unisulcata* DUJARDIN and *P. conulus* SPEYER (Oligocene) may perhaps be = *P. plicosa* BRONN (cf. VOORTHUYSEN, v. KOENEN, SORGENFREI).

Measurements: The best preserved shell from Gram measures 3.2 mm. in height and 1.4 mm. in width.

Distribution:

North Sea Basin. Miocene. Denmark: l. (SORGENFREI), m. (RAVN). North Germany: m. (KAUTSKY). u. (v. KOENEN). Holland: m. (VOORTHUYSEN). Belgium: Anversien (GLIBERT).—Pliocene. Holland: Scaldisien (TESCH). Belgium: Scaldisien, Casterlien (NYST). England: *P. laeviuscula* in Coralline Crag, Lenham (WOOD, HARMER).

Atlantic Region. Bordeaux Basin: Helvétien, Tortonien (COSSMANN & PEYROT).

Mediterranean Region. Italy: Elveziano, Tortoniano, Piacenziano, Astiano (Sacco).

Vienna Basin: 2. Mediterranstufe (Kautsky). Poland: Torton (Friedberg). Hungarian Basin: Torton (Bogsch).

FAMILIA: RETUSIDAE

Genus: Retusa, T. Brown 1827.

Subgenus: *Cylichnina* Monterosato 1884 (Typus: *R.* (*C.*) *umbilicata* (Montagu)).

63. Retusa (Cylichnina) elongata (Eichwald 1830).

(Plate X, fig. 3a, b).

1830. *Bulla elongata*; Eichwald, Lith. Volh. Pod.; p. 214.
1856. *Bulla conulus* Deshayes; M. Hoernes, Wiener Becken I; p. 620, pl. 50, f. 4.
1882. *Bulla elongata* Eichwald; v. Koenen, Mioc. Nordd. II; p. 342.
1897. *Bullinella* (*Cylichnina*) *elongata* Eichwald; Sacco, I Molluschi XXII; p. 50, pl. IV, f. 13–14.
1903–04. *Bullinella* (*Cylichnina*) *elongata* Eichwald sp.; Dollfus, Cotter & Gomes, Moll. Tert. Port.; p. 23, pl. XXXVI, f. 17.
1907. *Cylichna elongata* Eichw. sp.; Ravn, Jylland; p. 366.
1925. *Bullinella* (*Cylichnina*) *elongata* Eichwald; Kautsky, Hemmoor; p. 199.
1932. *Bullinella* (*Cylichnina*) *elongata*; Cossmann & Peyrot, Conch. Néog., A. S. L. B. LXXXIV, p. 190, pl. XIII, f. 53–54.
1952. *Retusa* (*Cylichnina*) *elongata sp.*; Glibert, Mioc. Belg. II; p. 143, pl. X, f. 18.

Original diagnosis: Eichwald, 1830: "*Testa elongata, ad aperturam subtus tumida, versus apicem sensim attenuata, laevis, umbilicata, raro 2 lin. longa.*"

Type material: Not used. This species was first illustrated in F. Dubois de Montpereux ("Conchyliologie fossile et aperçu geognostique des formations du plateau Volhyni-Podolien", Berlin 1831, p. 49, pl. I, figs. 13–14) under the name of *Bulla ovulata*. The whereabouts of this and Eichwald's type is unknown to me.

Material: Gram (D.G.U., 9 shells).

Description: Nearly all our shells are fragmentary. See the descriptions in v. Koenen, Ravn and Glibert.

Relation to other species: Glibert (l.c., p. 143) points out that *R.* (*C.*) *conuloidea* (Wood) from the Pliocene of Belgium and Great Britain comes very close to *R.* (*C.*) *elongata*.

Distribution:

North Sea Basin. Miocene. Denmark: m. (Ravn). North Germany: m., u. (v. Koenen). Holland: m. (Molengraaf & van der Gracht). Belgium: Anversien (Glibert).

Atlantic Region. Bordeaux Basin: Burdigalien, Helvétien, Tortonien (COSSMANN & PEYROT).—Portugal: Helvétien, Tortonien (DOLLFUS, COTTER & GOMES).

Mediterranean Region. Italy: Elveziano, Tortoniano, Piacenziano, Astiano (SACCO).

Vienna Basin: 2. Mediterranstufe (KAUTSKY).

FAMILIA: SCAPHANDRIDAE

Genus: Cylichna, Lovén 1846.

Subgenus: *Cylichna* s.s. (Typus: *C.* (*C.*) *cylindracea* (PENNANT)).

64. Cylichna (Cylichna) cylindracea (Pennant 1777).

(Plate X, fig. 4a, b).

1777. *Bulla cylindracea*; PENNANT, Brit. Zool. IV; p. 117, pl. LXX, f. 85.
1848. *Bulla cylindracea* PENNANT; S. WOOD, Crag I; p. 175; pl. XXI, f. 1.
1856. *Bulla convoluta* BROCCHI; M. HOERNES, Wiener Becken I; p. 623, pl. 50, f. 7.
1867. *Cylichna cylindracea* PENNANT; JEFFREYS, Brit. Conch. IV; p. 415, pl. XCIII, f. 4.
1881. *Cylichna cylindracea* PENNANT; NYST, Conch. terr. tert.; p. 132, pl. VII, f. 21.
1882. *Cylichna cylindracea* PENNANT; v. KOENEN, Mioc. Nordd. II; p. 345.
1897. *Bulla cylindracea* PENNANT *var. convoluta*; SACCO, I Molluschi XXII; p. 49, pl. IV, f. 8–10.
1903–04. *Bullinella cylindracea* PENNANT *var. convoluta*; DOLLFUS, COTTER & GOMES, Moll. Tert. Port.; p. 23, pl. XXXVI, f. 16.
1907. *Cylichna cylindracea* PENNANT sp.; RAVN, Jylland; p. 367, pl. 8, f. 15.
1914. *Cylichna cylindracea* PENNANT sp.; GRIPP, Itzehoe; p. 36.
1923. *Cylichna cylindracea* PENNANT; HARMER, Plioc. Moll. II; p. 803, pl. LXIII, f. 12.
1925. *Bullinella cylindracea* PENNANT; KAUTSKY, Hemmoor; p. 193.
1940. *Bullinella cylindracea* PENNANT; SORGENFREI, Klintinghoved; p. 58, pl. VI, f. 20.
1952. *Cylichna* (*Cylichna*) *cylindracea* PENN. sp.; GLIBERT, Mioc. Belg. II; p. 145, pl. X, f. 15.

Original diagnosis: PENNANT, 1777: "*B. white, cylindric, a little umbilicated at the end. About twice the size of a grain of wheat.*"

Type material: Not used. The whereabouts of PENNANT's types is unknown to me.

Material: Gram (D.G.U., 3 shells).

Description: The only almost intact shell in the material is nearly quite smooth. The growth lines are partly visible whereas there are only sparse remains of fine spiral striae on the superior part of the shell. The edge round the depression in the top of the shell is evenly rounded and an umbilicus can be glimpsed within the depression.

Otherwise, see RAVN's description.

Measurements: This specimen is 4.4 mm. long and 2.1 mm. wide.

Distribution:

North Sea Basin. Oligocene. North Germany. ?—Miocene. Denmark: l. (SORGENFREI). North Germany: l. (GRIPP), m. (KAUTSKY), u. (v. KOENEN). Holland: m. (MOLENGRAAF & VAN DER GRACHT). Belgium: Horizon de Houthaelen, Anversien (GLIBERT).—Pliocene. England: Lenham Crag, Coralline Crag (HARMER). Holland: ? (BEETS). Belgium: Scaldisien (NYST).—Quaternary. England: Waltonian, Newbournian (HARMER).

Atlantic Region. Portugal: Helvétien, Tortonien (DOLLFUS, COTTER & GOMES).

Mediterranean Region. Italy: Elveziano, Tortoniano, Piacenziano, Astiano (SACCO).—Quaternaire (GIGNOUX).

Recent occurence: Mediterranean, Adriatic, Aegean, Atlantic from Finmark and Lofoten to Madeira and the Canary Islands (WEINKAUFF).

PTEROPODA

FAMILIA: SPIRATELLIDAE

Genus: Spiratella, Blainville 1817 (Typus: S. helicina (Phipps)).

65. Spiratella atlanta (Mørch 1874).

(Plate X, fig. 7 a, b, c).

1874. *Valvatina atlanta*; MØRCH, Forst. i Tert.; p. 298.
1882. *Spirialis atlanta* MØRCH; v. KOENEN, Mioc. Nordd. II; p. 359, pl. VII, f. 16.
1883. *Valvatella atlanta* MØRCH; FISCHER, Man. d. Conch.; p. 430.
1907. *Valvatina atlanta* MØRCH; RAVN, Jylland; p. 369, pl. VIII, f. 16.

Original diagnosis: MØRCH, 1874: "*T. forma Planorbi albi, lactea nitidissima, spira immersa; margo suturalis anfr. ultimi perpendicularis; peripheria rotundata, apertura dilatata. Diam. 1 mm. Structura et colore Vaginellae, forma spirae praecendentis.*"

Type material: MØRCH's type is in the M.M.. Type locality: Morsum Kliff, Sylt. RAVN's type from Varde, West Jutland, is in the M. M., but has now perished through weathering.

Material: Gram (D.G.U., 6 shells).

Description: See descriptions by v. KOENEN and RAVN.

Remarks: The species does not seem to have been found outside the North Sea Basin. *A. atlanta* does not seem to be identical with *Spirialis valvatina* REUSS, to judge from the literature.

Distribution:

North Sea Basin. Miocene. Denmark: m. ? (RAVN). North Germany: u. (v. KOENEN, RAVN).

List of Upper Miocene molluscs from South Jutland

+ = occurrence according to literature.
× = allied species occur according to literature.
? = occurrence dubious or probably derivatives.

		North Sea Basin								Atlantic Region		Mediterranean Region		Vienna Basin		Recent occurrence		Number of investigated shells from South Jutland		
		Oligocene		Miocene			Pliocene													
		Middle	Upper	Lower	Middle	Upper	England	Holland	Belgium	Miocene	Pliocene	Miocene	Pliocene	"Grunder Sch."	"2. Mediterr. st."	Atlantic Ocean	Mediterranean	Gram	Spandetgaard	Ravning
1	*Nucula (Nucula) georgiana* SEMPER	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	198	3	12
2	*Leda (Jupiteria) pygmaea* (MÜNSTER)	+	+	+	+	+	..	..	+	..	..	..	..	..	..	..	..	178		
3	*Yoldia (Yoldia) glaberrima* (MÜNSTER)	..	+	+	+	+	..	..	..	×	..	..	..	..	..	..	..	31		
4	*Limopsis (Limopsis) aurita* (BROCCHI)	..	+	+	+	+	+	+	+	×	..	+	+	..	..	+	..	3	2	
5	*Chlamys (Peplum) clavata* (POLI)	..	..	..	..	+	..	?	..	..	+	..	+	..	..	+	..	60	1	1
6	*Astarte (Carinastarte) reimersi* SEMPER	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	4055	310	140
7	*Cardita (Cyclocardia) orbicularis* (SOWERBY)	..	+	..	+	+	+	+	+	..	..	..	..	..	..	..	..	1		
8	*Kellyella (Kellyella) sp.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1		
9	*Isocardia (Isocardia) forchhammeri* BECK	..	..	..	+	+	..	..	..	..	..	..	..	..	..	..	..	128	4	1
10	*Thyasira (Thyasira) sp.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2		
11	*Corculum (Papillicardium) papillosum* (POLI)	..	..	×	+	+	..	+	..	..	+	+	+	+	+	+	+	19		
12	*Spisula (Spisula) subtruncata* D. C. *var. triangula* REN	..	..	..	+	+	..	+	?	+	+	+	+	+	..	×	×	2		
13	*Abra (Abra) prismatica* (MONTAGU)	..	..	+	+	+	+	+	+	..	+	×	+	..	..	+	+	8		
14	*Teredo sp.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4		
15	*Thracia (Thracia) cfr. ventricosa* PHILIPPI	..	..	+	+	+	+	?	+	..	..	×	×	..	+	..	..	2		
16	*Cochlodesma sp.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	6		
17	*Cadulus (Gadila) gadus* (MONTAGU)	..	..	..	+	+	..	..	..	..	..	+	+	..	+	..	..	numerous		
18	*Adeorbis carinatus* (PHILIPPI)	+	+	+	+	+	..	..	..	..	..	..	..	..	..	..	..	2		
19	*Turritella (Turritella) tricarinata* (BROCCHI)	..	..	..	+	+	+	?	..	..	?	+	+	..	..	×	×	658	57	
20	*Turritella (Archimediella) archimedis* BRONGNIART	..	..	..	..	+	..	..	..	..	..	+	+	+	+	..	..	25		
21	*Opalia (Pliciscala) vilandti* (MØRCH)	..	..	..	?	+	..	..	..	..	..	..	..	..	..	..	..	5		
22	*Xenophora (Xenophora) testigera* (BRONN)	..	..	..	..	+	..	..	..	..	..	+	+	+	..	..	..	4		
23	*Aporrhais alata* (EICHWALD)	..	..	..	+	+	..	..	..	..	..	..	..	..	+	+	..	2		
24	*Polynices (Lunatia) helicina* (BROCCHI)	..	..	+	+	+	+	+	..	+	+	+	+	+	+	..	..	34	9	1
25	*Polynices (Lunatia) alderi* (FORBES)	..	..	..	+	+	+	+	..	+	..	..	..	..	..	+	..	10	9	
26	*Polynices (Polynices) koeneni* (SACCO)	..	..	..	+	+	..	..	..	..	..	..	..	..	..	..	..	106	7	
27	*Polynices (Polynices) submamillaris* (D'ORBIGNY)	..	..	+	+	+	..	..	..	..	..	+	..	..	+	..	..	1		
28	*Cassidaria echinophora* (LINNÉ)	..	..	..	+	+	..	..	..	..	+	+	+	+	..	..	+	66	7	1
29	*Phalium (Semicassis) miolaevigatum* (SACCO)	..	..	..	+	+	..	?	?	+	×	+	×	+	+	..	×	94	8	1
30	*Pyrula condita* BRONGNIART	..	+	+	+	+	+	?	..	+	×	+	×	+	..	..	×	1		
31	*Murex cfr. (Tubicauda) spinicosta* BRONN	..	..	..	+	+	..	..	..	+	+	+	+	+	+	..	..	2		
32	*Trophon (Pagodula) vaginata* JAN *var. semperi* v. KOENEN	..	..	..	+	+	..	..	..	..	..	×	×	..	×	..	×	2		

List of Upper Miocene molluscs from South Jutland (continued)

+ = occurrence according to literature.
× = allied species occur according to literature.
? = occurrence dubious or probably derivatives.

		North Sea Basin								Atlantic Region		Mediterranean Region		Vienna Basin		Recent occurrence		Number of investigated shells from South Jutland		
		Oligocene		Miocene			Pliocene													
		Middle	Upper	Lower	Middle	Upper	England	Holland	Belgium	Miocene	Pliocene	Miocene	Pliocene	"Grunder Sch."	"2. Mediterr. st."	Atlantic Ocean	Mediterranean	Gram	Spandetgaard	Ravning
33	*Typhis (Cyphonochelus) fistulosus* (BROCCHI)	..	..	+	+	+	..	?	..	+	..	+	+	..	+	..	..	40		
34	*Liomesus ventrosus* (BEYRICH)	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	16	2	
35	*Sipho (Sipho) distinctus* (BEYRICH)	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	416	101	18
36	*Nassa (Telasco) bocholtensis* (BEYRICH)	..	..	..	+	+	..	?	..	..	..	..	..	..	..	..	..	78	6	
37	*Nassa (Telasco) syltensis* (BEYRICH)	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	31	5	
38	*Nassa (Uzita) prismatica* (BROCCHI)	..	..	..	+	+	+	..	+	+	+	+	+	+	+	..	×	2		
39	*Aquilofusus semiglaber* (BEYRICH)	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	890	133	59
40	*Aquilofusus puggaardi* (BEYRICH)	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	52		
41	*Uromitra cimbrica* (OPPENHEIM)	..	..	..	+	+	..	..	..	..	..	..	×	..	..	..	..	10		
42	*Cancellaria (Narona) calcarata* (BROCCHI)	..	..	..	+	+	..	..	..	+	..	+	+	..	+	..	..	1		
43	*Cancellaria (Narona) rothi* (SEMPER)	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	79	15	3
44	*Admete (Babylonella) subangulosa* (S. WOOD)	+	+	+	+	+	+	..	..	..	..	×	×	..	..	..	..	20		
45	*Drillia (Spirotropis) modiola* (JAN)	..	..	..	..	+	+	?	+	..	..	+	+	+	..	..	..	6	1	
46	*Turris (Fusiturris) helena* (SEMPER)	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	6	2	
47	*Turris (Gemmula) badensis* (R. HOERNES)	..	..	..	+	+	..	..	..	..	..	..	+	..	+	..	..	1178	358	6
48	*Turris (Hemipleurotoma) annae* (HOERNES & AUINGER)	..	..	..	+	+	..	..	..	..	..	..	..	+	+	..	..	361	353	10
49	*Turris (Crassispira) obeliscus* (DES MOULINS)	..	+	×	+	+	..	..	..	+	+	×	×	..	+	..	..	2		
50	*Haedropleura maitreja* (SEMPER)	..	..	..	+	+	..	..	..	..	..	..	..	..	..	..	..	2		
51	*Brachytoma obtusangula* (BROCCHI)	..	..	+	+	+	..	..	..	..	..	+	+	..	+	..	..	144	18	
52	*Asthenotoma sp.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	
53	*Bathytoma cataphracta* (BROCCHI)	..	..	+	+	+	..	?	..	+	+	+	+	+	+	..	..	553	242	22
54	*Cythara (Mangelia) kochi* (v. KOENEN)	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	36		
55	*Lienardia luisae* (SEMPER)	..	..	..	+	+	..	..	..	..	..	+	..	..	..	..	..	99	4	
56	*Philbertia (Philbertia) reticulata* (RENIERI)	..	..	..	+	+	+	+	..	..	..	+	+	..	..	+	+	7		
57	*Acamptogenotia intorta* (BROCCHI)	+	+	..	+	+	..	?	+	+	..	..	+	..	..	..	..	14	7	
58	*Conus (Conospira) antediluvianus* BRUGUIÈRE	..	..	..	+	+	..	?	..	+	..	+	+	+	+	..	..	282	392	6
59	*Actaeon sp.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1		
60	*Odostomia (Odostomia) conoidea* (BROCCHI)	..	..	..	+	+	+	+	+	+	..	+	+	..	+	+	+	148		
61	*Eulimella (Eulimella) scillae* (SCACCHI)	..	..	..	+	+	..	?	..	+	..	+	+	..	..	+	+	10		
62	*Pyramidella (Pyramidella) plicosa* BRONN	..	..	+	+	+	×	+	+	+	+	+	+	..	+	..	..	4		
63	*Retusa (Cylichnina) elongata* (EICHWALD)	..	..	..	+	+	..	..	..	+	..	+	+	..	+	..	..	9		
64	*Cylichna (Cylichna) cylindracea* (PENNANT)	..	..	+	+	+	+	+	+	+	+	+	+	..	+	+	+	3		
65	*Spiratella atlanta* (MØRCH)	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	6		

AGE OF THE MOLLUSCAN FAUNA FROM GRAM AND THE OTHER SOUTH JUTLAND LOCALITIES

Gram Brickworks is undoubtedly the best locality for studying the molluscan fauna in the Gram clay of South Jutland. All the species described in the foregoing palaeontological section were found there. All the species from Ravning and Spandetgaard contained in the Danish museums are also known from Gram, as will be seen from the list of fossils on page 106–107, where an indication is also given of the number of specimens in Danish collections from the three localities.

In the description of *Astarte reimersi* it was stated that the populations of this species in the three localities displayed the same relative variations. I have been unable to complete my variation-statistical studies of other species, but direct visual comparison reveals such close agreement and such slight mutual variation that it is really superfluous to express it numerically. Some variation statistics will be found in HINSCH (1952).

The molluscan faunas from Gram, Ravning and Spandetgaard are so much alike on all points that they must be elements of the same fauna. This probability in turn seems to embody adequate reason for the assumption that the molluscan faunas in the three localities are of the same age.

What the position is for the other exposed fossiliferous localities, Storlund and Tornskov, can scarcely be discussed in this context, because only one shell has been available to me from Storlund and none at all from Tornskov. For these two localities I shall therefore confine myself to a reference to the description of the localities on pages 21 and 25.

Thus we have the three localities Gram, Ravning and Spandetgaard; but as the fauna from the last two places may be regarded merely as a poorer representation of the corresponding much richer Gram fauna, it will be most convenient and equally appropriate to confine the following faunistic discussion to the molluscan fauna from Gram.

With regard to the fauna from Gram, it is well to remember that there are two types of fossiliferous sediments in the Gram Brickworks pit:

Gram clay and argillaceous mica-silt (Gram silt). I regret to say that I recognized this circumstance so late that I am unable except quite occasionally to state the type of sediment from which the various species came.

However, some indication is provided by the following list of collections in the silty sediments made on August 8th–30th, 1952:

		shells
1.	*Nucula* (*Nucula*) *georgiana* SEMPER	17
2.	*Leda* (*Jupiteria*) *pygmaea* (MÜNSTER)	74
3.	*Yoldia* (*Yoldia*) *glaberrima* (MÜNSTER)	24
4.	*Astarte* (*Carinastarte*) *reimersi* SEMPER	5
5.	*Corculum* (*Papillicardium*) *papillosum* (POLI)	10
6.	*Abra* (*Abra*) *prismata* (MONTAGU)	4
7.	*Teredo sp.*	fragments
8.	*Cadulus* (*Gadila*) *gadus* (MONTAGU)	5
9.	*Odostomia* (*Odostomia*) *conoidea* (BROCCHI)	99
10.	*Eulimella* (*Eulimella*) *scillae* (SCACCHI)	1
11.	*Aporrhais alata* (EICHWALD)	1
12.	*Polynices spp.* (small shells)	81
13.	*Murex cf.* (*Tubicauda*) *spinicosta* BRONN	3
14.	*Trophon* (*Pagodula*) *vaginata* JAN *var. semperi* V. KOENEN	1
15.	*Typhis* (*Cyphonochelus*) *fistulosus* (BROCCHI)	10
16.	*Sipho* (*Sipho*) *distinctus* (BEYRICH)	2
17.	*Nassa* (*Telasco*) *bocholtensis* (BEYRICH)	3
18.	– (–) *syltensis* (BEYRICH)	2
19.	*Cancellaria* (*Narona*) *rothi* (SEMPER)	3
20.	*Admete* (*Babylonella*) *subangulosa* (S. WOOD)	12
21.	*Turris* (*Gemmula*) *badensis* (R. HOERNES)	83
22.	– (*Hemipleurotoma*) *annae* HOERNES & AUINGER	11
23.	*Brachytoma obtusangula* (BROCCHI)	16
24.	*Bathytoma cataphracta* (BROCCHI)	4
25.	*Cythara* (*Mangelia*) *kochi* (V. KOENEN)	22
26.	*Lienardia luisae* (SEMPER)	5
27.	*Philbertia* (*Philbertia*) *reticulata* (RENIERI)	2
28.	*Conus* (*Conospira*) *antediluvianus* BRUGUIÈRE	11
29.	*Actaeon sp.*	1
30.	*Retusa* (*Cylichnina*) *elongata* (EICHWALD)	1
31.	*Bullinella cylindracea* (PENNANT)	1
32.	*Spiratella atlanta* (MØRCH)	1

From earlier collections, however, I remember having found the following additional species in these sediments:

33.	*Spisula* (*Spisula*) *subtruncata* DA COSTA *var. triangula* RENIERI	1
34.	*Adeorbis carinatus* (PHILIPPI)	2
35.	*Opalia* (*Pliciscala*) *vilandti* (MØRCH)	several

These supplementary specimens scarcely complete the list, but at any rate these 35 species were found. It is also to be observed that the following 6 or more specimens are among those with the highest frequencies in the silty sediments:

Leda (*Jupiteria*) *pygmaea*, *Odostomia* (*Odostomia*) *conoidea*, *Turris* (*Gemmula*) *badensis*, *Polynices spp.*, *Yoldia* (*Yoldia*) *glaberrima* and *Cythara* (*Mangelia*) *kochi*.

I know definitely that the following species were found only in this type of sediment: *Adeorbis carinatus* and *Actaeon sp.*

In the Gram clay, whence probably the great majority of the fossils examined came, the following 19 forms were the most common: *Nucula* (*Nucula*) *georgiana*, *Chlamys* (*Peplum*) *clavata*, *Astarte* (*Carinastarte*) *reimersi*, *Isocardia* (*Isocardia*) *forchhammeri*, *Turritella* (*Turritella*) *tricarinata*, *Polynices* (*Lunatia*) *helicina*, *Polynices* (*Polynices*) *koeneni*, *Cassidaria echinophora*, *Phalium* (*Semicassis*) *miolaevigatum*, *Sipho* (*Sipho*) *distinctus*, *Nassa* (*Telasco*) *bocholtensis*, *Aquilofusus semiglaber*, *Cancellaria* (*Narona*) *rothi*, *Turris* (*Gemmula*) *badensis*, *T.* (*Hemipleurotoma*) *annae*, *Brachytoma obtusangula*, *Bathytoma cataphracta*, *Lienardia luisae* and *Conus* (*Conospira*) *antediluvianus*.

It will be seen that *Turris badensis* alone is among the commonest forms in both types of sediment. It would thus seem that there is a slight difference in the faunistic characters, though in all probability it is due merely to the change of environment. It may be that *Leda pygmaea*, *Yoldia glaberrima* and *Odostomia conoidea* had a predilection for a more sandy bottom.

There is nothing in the difference between the faunas to suggest a difference in age.

If the silty sediments overlie the Gram clay, as seems to be the case from the wall in the brickworks pit, the silt must of course be the later; but even so, there does not seem to be such a difference as to register in the molluscan fauna.

For the present, then, we must assume that the members of the Gram fauna are contemporaneous, and that the differences may be ascribed to the variation of environments.

The question of the geological age of the Gram fauna was settled some

time ago, in so far as SEMPER (1861, p. 89, under *Cancellaria Rothi* SEMPER), RAVN (1907) and HINSCH (1952) all determined it as Upper Miocene. According to the current subdivision of the North Sea Basin's marine Neogene it will still be most natural to call these sediments Upper Miocene, as will be clear from the list of fossils.

In recent decades, having regard to the often great thickness of the "Glimmerton" in Northwest Germany, especially in the Hamburg area the possibility has been considered of a stratigraphic subdivision of the Upper Miocene. I shall revert to this later. First I propose to discuss the corresponding North German (and Dutch) molluscan faunas and the relative position of the Gram fauna.

RELATION OF THE GRAM FAUNA TO OTHER MARINE NEOGENE MOLLUSCAN FAUNAS

I. THE NORTH SEA BASIN

A. Upper Miocene.

Introductory Remarks.

Sediments of a character similar to that of Gram are found in many places in Jutland, Schleswig-Holstein, Western Mecklenburg and Northern Niedersachsen. In Northwest Germany and in Holland they are replaced by greensand. The fauna in these sediments shows that the age is Upper Miocene in the same sense as in Denmark and in Germany. The approximate range of the Upper Miocene Sea in the North Sea Region is best shown on the map fig. 10 (p. 118), which shows the hypothetic situation of the supposed coastline and the principal fossiliferous localities included in the list of fossils p. 113–117.

In England and Belgium no sediments have been found capable of being correlated with the Dano-North German Upper Miocene. In Holland there is the greensand already mentioned, but in Germany the chief sediments are mica-clay and, here and there, mica-sand too.

Detailed examinations of the molluscan fauna in the mica-clay were actually first begun by R. A. PHILIPPI, whose first descriptions of *Astarte* and *Fusus* species from the mica-clay at Lüneburg are contained in VOLGER's "Dissertatio de agri Luneburgici" etc., 1845. The descriptions were repeated and extended in German, accompanied by illustrations, in a work by PHILIPPI published 1846–47.

It is probable that BEYRICH at that time was already engaged on the preparations for his monograph on North Germany's Tertiary molluscs, and at about the same time SEMPER would be commencing his collections at a large number of mica-clay localities, especially north of the Elbe. The expression "Nordalbingischer Glimmerton", which often appears in the early German literature, originated with SEMPER. As I have already said, v. KOENEN's work on the gastropods and scaphopods of the North German Miocene was the only systematic examination of all the available material of these two faunistic groups until RAVN in 1907 analysed the

Danish collections. Apart from all these works, a large number of fossil lists have been published in various German map-sheet descriptions and articles.

A collective picture of the molluscan fauna in Upper Miocene mica-clay was given by STAESCHE in 1930. I have revised the fossil list from that paper on page 113–117, in an endeavour to place the names according to the system employed in the palaeontological section of the present work. Moreover, I have gone through all the printed sources for a collective list of fossils for the North German Upper Miocene, including even rare and perhaps doubtful species in order to make the following list of the Upper Miocene fauna of the North Sea Basin as complete as possible. Obviously, a list of this kind will be faulty here and there, but the general impression should be a basis sufficient for the following discussion on the possibility of a more detailed stratigraphic subdivision of the North German and South Jutlandic Upper Miocene.

	List of Upper Miocene molluscs from North Germany and Gram	Gram	Morsum Kliff	Breklum	Blunk	Schmalfeld	Lieth	Ütersen	Langenfelde	Teufelsbrück	Heiligengeistfeld	Elbtunnel	Fresenmoor	Reinbek	Gühlitz	Lüneburg	Nordlohne
1	*Nucula* (*Nucula*) *georgiana* SEMPER	+	+	+	+	cf.	+	..	+	+	+	+	..	..	..	+	..
2	*Leda* (*Jupiteria*) *pygmaea* (MÜNSTER)	+	..	+	..	..	..	..	+	..	..	..	..	..	..	+	..
3	*Yoldia* (*Yoldia*) *glaberrima* (MÜNSTER)	+	+	..	..	..	..	..	+	..	..	+	..	..	..	+	..
4	*Arca* (*Arca*) *diluvii* LAMARCK	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..
5	*Arca* (*Arca*) *latesulcata* NYST	..	..	..	..	..	+	..	+	..	..	+	..	..	..	..	..
6	*Arca* (*Cucullaea*) *pectuncoloides* SCACCHI	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..
7	*Limopsis* (*Limopsis*) *aurita* (BROCCHI)	+	..	..	..	..	+	..	+	+	..	..	..	..	..	+	..
8	*Pecten* (*Pseudamussium*) *gerardi* NYST	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..
9	*Chlamys* (*Aequipecten*) *opercularis* (LINNÉ)	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..
10	*Chlamys* (*Pallium*) *tigrina* (MÜLLER)	..	..	..	..	..	..	..	..	..	..	+	..	..	..	+	..
11	*Chlamys* (*Peplum*) *clavata* (POLI)	+	..	+	..	..	..	..	+	..	..	+	..	..	..	..	+
12	*Astarte* (*Carinastarte*) *vetula* PHILIPPI	..	..	cf.	+	..	..	..	+	+	..	cf.	..	+	+	+	..
13	*Astarte* (*Carinastarte*) *reimersi* SEMPER	+	+	..	..	..	..	+	..	..	..	..	+	..	..	..	..
14	*Astarte* (*Carinastarte*) *rollei* SEMPER	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..
15	*Astarte* (*Laevastarte*) *fusca* (POLI)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+
16	*Astarte* (*Astarte*) *syltensis* RAVN	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..
17	*Astarte* (*Ashtarotha*) *anus* PHILIPPI	..	..	..	..	..	+	..	+	+	..	..	..	+	..	+	..
18	*Astarte* (*Nicania*) *radiata* NYST & WESTENDORP	..	..	+	..	..	+	..	+	+	..	+	..	+	..	+	..
19	*Astarte* (*Nicania*) *corbuloides* JONKAIRE	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..
20	*Cardita* (*Cyclocardia*) *orbicularis* (SOWERBY)	+	..	..	..	..	+	..	..	..	..	+	..	+	+	+	..
21	*Cardita* (*Cyclocardia*) *bella* (SEMPER)	..	..	+	..	..	..	..	+	+	..	+	..	..	..	..	..
22	*Cardita* (*Cyclocardia*) *chamaeformis* (SOWERBY)	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..
23	*Cardita* (*Megacardita*) *laevicosta* LAMARCK	..	..	..	..	..	..	..	..	..	+	..	..	+	..	+	..

	List of Upper Miocene molluscs from North Germany and Gram (continued)	Gram	Morsum Kliff	Breklum	Blunk	Schmalfeld	Lieth	Ütersen	Langenfelde	Teufelsbrück	Heiligengeistfeld	Elbtunnel	Fresenmoor	Reinbek	Gühlitz	Lüneburg	Nordlohne
24	*Isocardia* (*Isocardia*) *forchhammeri* BECK	+	+	+	..	..	+	+	+	+	+	+	..	+	..	+	..
25	*Cyprina rustica* (SOWERBY)	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..
26	*Thyasira* (*Thyasira*) *flexuosa* (MONTAGU)	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..
27	*Phacoides* (*Lucinoma*) *borealis* (LINNÉ)	..	+	..	..	..	..	..	..	..	..	+	..	..	..	..	..
28	*Corculum* (*Papillicardium*) *papillosum* (POLI)	+	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..
29	*Venus* (*Chione*) *multilamella* (LAMARCK)	..	..	..	..	..	+	+	+	+	..	+	..	..	..	..	..
30	*Spisula* (*Spisula*) *subtruncata* DA COSTA *var. triangula* RENIERI	+	+	..	..	..	..	..	..	..	..	cf.	..	..	..	..	..
31	*Abra* (*Abra*) *prismatica* (MONTAGU)	+	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..
32	*Saxicava* (*Saxicava*) *arctica* (LINNÉ)	..	..	..	..	..	..	..	+	+	..	..	..	..	..	..	..
33	*Aloidis* (*Varivorbula*) *gibba* (OLIVI)	..	..	..	..	..	..	..	+	+	..	..	..	..	..	..	..
34	*Thracia* (*Thracia*) *ventricosa* PHILIPPI	cf.	+	..	..	..	..	..	..	..	..	+	..	..	..	..	..
35	*Cuspidaria* (*Cuspidaria*) *rostrata* (SPENGLER)	..	..	..	..	..	..	..	+	..	..	..	..	+	..	..	..
36	*Cadulus* (*Gadila*) *gadus* (MONTAGU)	+	+	..	..	..	+	..	+	..	..	+	..	..	..	+	..
37	*Dentalium* (*Antalis*) *vitreum* SCHRÖTER	..	..	..	..	..	..	..	+	+	..	+	..	..	..	..	..
38	*Dentalium* (*Antalis*) *novemcostatum* L. *var. mutabilis* DOD	..	..	..	..	..	+	..	+	+	..	+	..	..	+	..	..
39	*Dentalium* (*Antalis*) *badense* PARTSCH	..	+	+	+	+	+	..	+	+	..	+	..	+	+	+	..
40	*Calliostoma* (*Ampullotrochus*) *millegranus* (PHILIPPI)	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..
41	*Teinostoma* (*Solariorbis*) *pulchralis* (WOOD)	..	+	..	..	..	..	..	+	..	..	..	..	..	..	..	..
42	*Circulus praecedens* (v. KOENEN)	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..
43	*Assiminea conoidea* v. KOENEN	..	..	..	..	..	..	..	+	..	..	+	..	..	..	..	..
44	*Assiminea Gottscheana* v. KOENEN	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..
45	*Adeorbis carinatus* (PHILIPPI)	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
46	*Turritella* (*Haustator*) *marginalis* (BROCCHI)	..	..	..	..	..	+	..	..	..	..	..	..	..	..	+	..
47	*Turritella* (*Haustator*) *triplicata* (BROCCHI)	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..
48	*Turritella* (*Zaria*) *subangulata* (BROCCHI)	..	..	..	..	+	+	+	+	+	..	+	..	..	+	+	..
49	*Turritella* (*Turritella*) *tricarinata* (BROCCHI)	+	+	+	..	..	+	..	+	+	..	+	..	..	..	..	..
50	*Turritella* (*Archimediella*) *archimedis* BRONGNIART	+	+	..	..	..	..	..	..	+	..	..	..	..	..	..	..
51	*Bittium* (*Bittium*) *spina* (PARTSCH)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..
52	*Opalia* (*Pliciscala*) *vilandti* (MØRCH)	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
53	*Scala* (*Spiniscala*) *frondicula* (WOOD)	..	..	..	..	..	..	..	+	..	..	+	..	..	+	..	..
54	*Scala holsatica* (v. KOENEN)	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..
55	*Scala gosseleti* (v. KOENEN)	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..
56	*Strombiformis* (*Subularia*) *subulata* (DONOVAN)	..	+	..	..	..	..	..	..	..	..	+	..	..	..	..	..
57	*Melanella* (*Acicularia*) *eichwaldi* (HÖRNES)	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..
58	*Melanella* (*Polygurculima*) *flexuosa* (v. KOENEN)	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..
59	*Xenophora* (*Xenophora*) *testigera* (BRONN)	+	+	+	..	..	..	..	+	..	..	+	..	..	..	+	..
60	*Aporrhais alata* (EICHWALD)	+	+	+	..	+	+	+	+	+	..	+	..	+	+	+	..
61	*Polynices* (*Lunatia*) *helicina* (BROCCHI)	+	+	+	..	..	+	+	+	+	..	+	..	+	+	+	..
62	*Polynices* (*Lunatia*) *alderi* (FORBES)	+	+	..	..	..	..	..	+	..	..	+	..	..	+	+	..
63	*Polynices* (*Polynices*) *koeneni* (SACCO)	+	+	..	..	..	..	..	+	..	..	+	..	..	..	+	..

	List of Upper Miocene molluscs from North Germany and Gram (continued)	Gram	Morsum Kliff	Brekum	Blunk	Schmalfeld	Lieth	Ütersen	Langenfelde	Teufelsbrück	Heiligengeistfeld	Elbtunnel	Fresenmoor	Reinbek	Gühlitz	Lüneburg	Nordlohne
64	*Polynices (Polynices) submamillaris* (D'orbigny)..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
65	*Sigaretus (Sigaretotrema) michaudi* Michelotti...	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..
66	*Erronea (Zonaria) amygdalum* (Brocchi).....	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..
67	*Cassidaria echinophora* (Linné).....	+	+	+	+	+	+	..	+	+	+	+	..	..	..	+	..
68	*Phalium (Semicassis) miolaevigatum* (Sacco).....	+	+	+	..	+	+	+	+	+	..	+	+	+	+	+	..
69	*Phalium (Semicassis) rondeleti* (Basterot).....	..	+	..	..	..	..	..	..	..	..	..	..	+	..	+	..
70	*Pyrula simplex* Beyrich.....	..	+	..	..	..	..	..	+	..	..	+	..	..	..	..	..
71	*Pyrula condita* Brongniart.....	+	+	..	..	..	..	..	+	+	..	+	..	..	+	+	..
72	*Murex octonarius* Beyrich.....	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..
73	*Murex imbricatus* Brocchi.....	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..
74	*Murex (Tubicauda) spinicosta* Bronn.....	cf.	..	+	..	+	+	..	+	..	..	+	..	..	..	+	..
75	*Trophon (Pagodula) vaginata* Jan *var. semperi* v. Koenen.....	+	..	+	..	..	..	..	+	..	..	+	..	..	..	+	..
76	*Typhis (Cyphonochelus) fistulosus* (Brocchi).....	+	..	+	..	..	..	..	+	..	..	+	..	..	..	+	..
77	*Typhis (Typhis) horridus* (Brocchi).....	..	+	..	..	..	..	..	..	..	..	..	..	..	+	..	..
78	*Pyrene (Mitrella) scripta* (Linné).....	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..
79	*Pyrene (Atilia) nassoides* (Grateloup).....	..	+	..	..	..	..	..	+	..	..	..	..	..	..	+	..
80	*Liomesus ventrosus* (Beyrich).....	+	+	..	..	..	..	..	+	..	..	+	..	..	..	..	..
81	*Sipho (Sipho) distinctus* (Beyrich).....	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
82	*Sipho (Sipho) gregarius* (Philippi).....	..	..	..	..	..	+	..	..	..	..	..	..	..	+	+	..
83	*Sipho (Sipho) solitarius* (Philippi).....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..
84	*Exilia contigua* (Beyrich).....	..	..	..	..	..	+	..	..	..	..	..	..	..	..	+	..
85	*Nassa (Amycla) facki* v. Koenen.....	..	+	..	..	..	..	cf.	+	+	..	+	..	..	..	+	..
86	*Nassa (Telasco) bocholtensis* (Beyrich).....	+	+	..	..	..	..	..	+	..	..	..	..	..	+	+	..
87	*Nassa (Telasco) syltensis* (Beyrich).....	+	+	..	..	..	+	..	..	+	..	..	..	..	..	+	..
88	*Nassa (Telasco) holsatica* (Beyrich).....	..	..	+	..	..	+	..	+	..	..	+	..	..	..	+	..
89	*Nassa (Uzita) prismatica* (Brocchi).....	+	+	+	..	..	+	..	..	..	..	..	..	..	..	+	..
90	*Aquilofusus eximius* (Beyrich).....	..	+	+	+	+	+	+	+	+	+	+	..	+	+	+	+
91	*Aquilofusus luneburgensis* (Beyrich).....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..
92	*Aquilofusus semiglaber* (Beyrich).....	+	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..
93	*Aquilofusus glabriculus* (Beyrich).....	..	..	..	..	..	..	..	..	..	..	..	..	+	..	+	..
94	*Aquilofusus puggaardi* (Beyrich).....	+	+	+	+	..	..	..	+	..	..	+	+	..	..	+	..
95	*Aquilofusus tricinctus* (Beyrich).....	..	..	..	..	..	..	..	+	..	..	+	..	+	+	+	..
96	*Streptochetus sexcostatus* (Beyrich).....	..	..	..	..	..	+	..	..	+	..	..	..	..	..	..	..
97	*Lathyrus (Dolicholathyrus) rothi* (Beyrich).....	..	+	+	..	+	+	cf.	+	+	..	+	..	..	..	+	..
98	*Ancilla (Ancilla) obsoleta* (Brocchi).....	..	..	..	..	+	..	..	..	+	..	..	..	..	..	..	..
99	*Uromitra cimbrica* (Oppenheim).....	+	+	+	..	..	+	..	+	+	..	+	+	..	+	+	..
100	*Mitra (Cancilla) orientalis* Oppenheim.....	..	..	..	..	..	..	..	+	..	..	+	..	..	..	..	..
101	*Scaphella (Schaphella) bolli* (Koch).....	..	+	+	..	..	..	..	+	+	..	+	..	..	..	+	..
102	*Cancellaria (Cancellaria) cancellata* (L.) *var. praecedens* Beyr.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..
103	*Cancellaria (Trigonostoma) aperta* Beyrich.....	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..
104	*Cancellaria (Trigonostoma) spinifera* Grateloup..	..	..	..	..	..	..	..	+	..	..	+	..	..	..	+	..

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105	*Cancellaria* (*Narona*) *calcarata* (BROCCHI)	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
106	*Cancellaria* (*Narona*) *varicosa* (BROCCHI)	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
107	*Cancellaria* (*Narona*) *rothi* SEMPER	+	.	.	.	.	.	.	+	.	.	+	+	.	.	.	.
108	*Cancellaria* (*Narona*) *lyrata* (BROCCHI)	.	.	+	.	+	.	.	+	+	.	.	.	+	+	+	.
109	*Cancellaria* (*Narona*) *jonkairiana* (NYST)	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
110	*Cancellaria* (*Narona*) *parvula* BEYRICH	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.
111	*Admete* (*Babylonella*) *subangulosa* (S. WOOD)	+	+	+	.	.	+	.	+	+	.	+	.	.	+	+	.
112	*Admete* (*Bonellitia*) *evulsa* (SOLANDER)	.	+	.	.	.	.	.	+	.	.	.	.	.	+	+	.
113	*Admete* (*Bonellitia*) *serrata* (BRONN)	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
114	*Drillia* (*Spirotropis*) *modiola* (JAN)	+	+	+	.	.	.	+	+	.	.	+	.	.	.	+	.
115	*Drillia* (*Cymatosyrinx*) *selenkae* (v. KOENEN)	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
116	*Ancystrosyrinx corneti* (v. KOENEN)	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
117	*Clavatula* (*Turricula*) *steinvorthi* (SEMPER)	.	.	.	.	.	.	.	+	.	.	.	.	+	+	+	.
118	*Clavatula* (*Turricula*) *dimidiata* (BROCCHI)	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
119	*Turris* (*Fusiturris*) *duchasteli* (NYST)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
120	*Turris* (*Fusiturris*) *duchasteli* (NYST) *var. flexiplicata* NYST	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
121	*Turris* (*Fusiturris*) *helena* (SEMPER)	+	+	.	.	+	.	+	.	.	.	.	.	+	+	.
122	*Turris* (*Gemmula*) *badensis* (R. HOERNES)	+	+	+	.	+	+	+	+	+	+	+	+	+	+	+	+
123	*Turris* (*Gemmula*) *zimmermanni* (PHILIPPI)	.	.	.	.	.	+	.	+	+	.	.	.	.	+	+	.
124	*Turris* (*Hemipleurotoma*) *annae* (HOERNES & AUINGER)	+	+	+	.	+	+	.	+	+	.	+	+	+	+	+	.
125	*Turris* (*Hemipleurotoma*) *inermis* (PARTSCH)	.	.	.	.	.	.	.	+	.	.	+	.	.	.	+	.
126	*Turris* (*Crassispira*) *obeliscus* (DES MOULINS)	+	+	+	.	.	+	+	+	.	.	.	.	.	.	.	.
127	*Turris* (*Crassispira*) *serratula* (BELLARDI)	.	.	cf.	.	.	.	.	+	.	.	.	.	.	.	+	.
128	*Haedropleura maitreja* (SEMPER)	+	.	.	.	.	.	.	+	.	.	+	.	.	.	+	.
129	*Brachytoma obtusangula* (BROCCHI)	+	+	+	.	.	+	.	+	+	.	+	.	.	+	+	.
130	*Asthenotoma* (*Asthenotoma*) *pannus* (BASTEROT)	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
131	*Asthenotoma* (*Aphanitoma*) *labellum* (BORSON)	.	.	.	.	.	+	.	+	+	.	.	.	.	.	+	.
132	*Bathytoma cataphracta* (BROCCHI)	+	+	+	+	+	+	+	+	+	.	+	+	+	+	+	.
133	*Cythara* (*Mangelia*) *karsteni* (v. KOENEN)	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
134	*Cythara* (*Mangelia*) *harpula* (BROCCHI)	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
135	*Cythara* (*Mangelia*) *hispidula* (JAN)	.	.	.	.	.	.	.	+	.	.	.	.	.	+	+	.
136	*Cythara* (*Mangelia*) *mio roemeri* (KAUTSKY)	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
137	*Cythara* (*Mangelia*) *kochi* (v. KOENEN)	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
138	*Lienardia luisae* (SEMPER)	+	+	+	.	.	.	.	+	.	.	+	.	.	+	+	.
139	*Lienardia mariae* (SEMPER)	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.
140	*Philbertia* (*Philbertia*) *reticulata* (RENIERI)	+	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.
141	*Philbertia* (*Teres*) *anceps* (EICHWALD)	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
142	*Genota ramosa* (BASTEROT) *var. parvicarinata* KAUTSKY	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
143	*Acamptogenotia intorta* (BROCCHI)	+	+	+	+	+	+	+	+	.	.	+	.	+	+	+	.
144	*Conus* (*Conospira*) *antediluvianus* BRUGUIÈRE	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	.

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145	*Terebra (Terebra) hörnesi* BEYRICH	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..
146	*Terebra (Terebra) forchhammeri* BEYRICH	..	+	..	..	..	..	..	..	..	..	+	..	..	..	..	..
147	*Actaeon semistriatus* (FÉRUSSAC)	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..
148	*Actaeon inflatus* (BORSON)	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..
149	*Chrysallida (Pyrgulina) pygmaea* (GRATELOUP)	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..
150	*Odostomia (Odostomia) conoidea* (BROCCHI)	+	+	..	..	..	..	..	+	..	..	+	..	..	..	..	..
151	*Eulimella (Eulimella) neumayri* (v. KOENEN)	..	..	..	..	..	..	..	..	..	..	+	..	..	+	..	..
152	*Eulimella (Eulimella) scillae* (SCACCHI)	+	+	..	..	..	..	..	+	..	..	..	..	..	..	..	..
153	*Turbonilla (Turbonilla) gastaldi* SEMPER	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..
154	*Turbonilla (Turbonilla) pseudocostellata* SACCO	..	..	..	..	..	..	..	+	..	..	+	..	..	..	..	..
155	*Turbonilla (Turbonilla) terebellum* PHILIPPI	..	..	..	..	..	..	..	+	..	..	+	..	..	..	..	..
156	*Turbonilla (Turbonilla) facki* v. KOENEN	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..
157	*Turbonilla (Turbonilla) gracillima* KOCH & WIECHMANN	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..
158	*Turbonilla (Pyrgolampros) pseudoterebralis* SACCO	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..
159	*Pyramidella (Pyramidella) plicosa* (BRONN)	+	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..
160	*Ringicula (Ringiculina) auriculata* (MÉNARD)	..	..	+	..	..	..	..	+	..	..	+	..	..	..	+	..
161	*Retusa (Cylichnina) elongata* (EICHWALD)	+	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..
162	*Volvula acuminata* (BRUGUIÈRE)	..	+	..	..	..	..	..	+	..	..	..	..	..	..	..	..
163	*Cylichna (Cylichna) cylindracea* (PENNANT)	+	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..
164	*Sabatia (Damoniella) utricula* (BROCCHI)	..	+	..	..	..	..	..	..	..	..	+	..	..	..	..	..
165	*Scaphander (Scaphander) lignarius* (L.) *var. grateloupi* MICHELOTTI	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..
166	*Spiratella valvatina* (REUSS)	..	..	..	..	..	..	..	+	..	..	..	..	..	+	..	..
167	*Spiratella atlanta* (MØRCH)	+	+	..	..	..	..	..	+	..	..	+	..	..	..	+	..
168	*Spiratella rostralis* (EYD. & SOUL.)	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..

The localities, and the printed sources of our knowledge of them, are referred to below. This information forms a necessary supplement to the list of fossils and a further foundation for the stratigraphical discussion. Unfortunately most of the fossil material on which the identifications were based were lost during the Second World War; and as moreover all the localities concerned, with the exception of Morsum Kliff, are now inaccessible, it is no longer possible to verify the determinations as regards most of the species.

The Principal Fossil-Localities in North Germany:

Morsum Kliff, Sylt. (The molluscan fauna is referred to by BEYRICH, 1850, 1853–57—FORCHHAMMER, 1828—GOTTSCHE, 1885—GRIPP, 1915,

LOCALITIES WITH FOSSILIFEROUS UPPER MIOCENE DEPOSITS IN SOUTH JUTLAND AND NORTHERN GERMANY

Scale
10 0 50 100 km

GEOLOGICAL SURVEY OF DENMARK 1956. L.B. RASMUSSEN

Fig 10.

1922, 1933, 1940a—HINSCH, 1952—KARSTEN, 1857—v. KOENEN, 1872, 1882—MEYN, 1848, 1876—MØRCH, 1874—RAVN, 1907—SEMPER, 1856, 1861—STAESCHE, 1930—WIRTZ, 1949—Sediments and stratification are described by DIETZ & HECK 1952—GAGEL, 1905a, b, 1911—STOLLEY, 1900–01, 1905, 1929, 1935, 1938—WETZEL, 1931, 1937—WIRTZ & ILLIES 1951). Dislocated cliff with complicated stratification (see especially WIRTZ & ILLIES, 1951, p. 73–83, section of cliff, ibid. p. 74, Abb. 1).

Rocks: mica-clay and silty sediments (see Staesche, 1930, p. 62–63). This series overlain by Pliocene limonite-sandstone with remnants of fauna. Fauna distribution in Upper Miocene given by Staesche, 1930, p. 62–69.—The list of fauna also contains the following dubious forms: ?*Cancellaria spinifera* Grat., ?*C. acutangularis* Lam., ?*Fusus lüneburgensis* Phil., (v. Koenen, 1872, 1882)—*Trochus sp.* (Meyn, 1876)—*Pecten sp.* (smooth form) (Ravn, 1907).

Breklum (South Schleswig). (Locality description and fossil list in Struck, 1908, p. 54–55). Brickworks pit. Rock: mica-clay, probably in secondary position.

Blunk (at Muggesfelde in Holstein). (Description and fossil list in Gottsche & Wibel, 1876). Brickworks pit. Collections by Semper in 1870. No other information.—Supplement to list of fossils: *Pecten (Neithea) sp.* (Gottsche & Wibel, 1876).

Schmalfeld (Holstein). (Locality description and fossil list in Struck 1908, p. 51–52). Brickworks pit. Rock: mica-clay. Supplement to fossil list: *Natica sp.*, *Astarte sp.* (Struck, 1908).

Lieth (Holstein). (Locality and fauna descriptions in Semper, 1856, 1861—Gottsche & Wibel, 1876). Brickworks pit. The fossils were found in sand mixed with black clay (see Semper, 1861, p. 35) and were partly rolled. No particulars of rocks or stratification.—Supplement to list of fossils: *Fusus ? semiglaber* Beyr., *Turritella sp. nova*, *Pectunculus sp.*, *Astarte radiata* Nyst & West., *var.* (*Steinvorthi* Semp.), *Astarte sp. 1*, *Astarte sp. 2.*, *Pleurotoma turricula* Brocc. var. *laeviuscula* v. Koenen. (Gottsche & Wibel, 1876).

Ütersen (Holstein). (Fossil list in Wolff, 1913b, 1914a, p. 502–506. Also mentioned in S. Thiele, 1941, p. 107–108). Two borings: mica-clay and -sand. Supplement to fossil list: *Nucula sp.*, *Tellina ?*, *Nassa sp.*, *Xenophora Deshayesii* Mich. (Wolff, 1913b).

Langenfelde (near Hamburg). (Molluscan fauna mentioned by v. Koenen, 1872, 1882—Gottsche & Wibel, 1876—Gripp, 1920, 1933. Further information on the locality in Gottsche, 1901). Two brickworks pits. Rock: mica-clay, underlain by greenish-grey, sticky clay ("Töpferthon") or fossiliferous Middle Miocene mica-clay ("Dingden—Reinbek—stufe"). The stratification is disturbed by a salt dome.—Supplement to fossil list: *Fusus ? semiglaber* Beyr., *Nassa ? turrita* Bors., *Nassa sp.*, ? *Cerithium Genei* Mich., *Scalaria ? Gosseleti* v. Koenen, *Capulus sp.*, *Spirialis ? rostralis* Eyd. & Soul., *Anomia sp.*, *Pecten 5 sp.*, *Modiola sp.*, *Cardium sp.*, *Astarte radiata* Nyst & West., *var.* (*Steinvorthi* Semp.), *Astarte sp.*, *Syndosmya sp.*, *Teredo* and *Teredina* (Gottsche & Wibel, 1876).

Teufelsbrück (on the Elbe west of Hamburg). (Occurrence mentioned by Semper, 1856, 1861—Gottsche & Wibel, 1876). Fossils collected loose on the river bank. Their state of preservation suggests that they

came from mica-clay.—Supplement to fossil list: *Turritella sp. nova* (GOTTSCHE & WIBEL, 1876),

Heiligengeistfeld (Hamburg). (Description and fossil list in GOTTSCHE & WIBEL, 1876). Excavation for sewers. Rock: mica-clay. No mention of stratification. Supplement to fossil list: *Fusus Klipsteini* MICH., *Turritella sp. nova* (GOTTSCHE & WIBEL, 1876).

Elbtunnel (Hamburg). (Description and fossil list in E. HORN, 1912 —WOLFF, 1914b). Excavation shafts during construction of Elbtunnel in Hamburg. Rock: mica-clay, presumably in situ. Underlying strata apparently of mica-sand with lignite.—Supplement to fossil list: *Anomia cf. Goldfussi* DECH., *Modiola cf. longa* BRONN (SACCO), *Nucula sp.*, *Arca cf. saxonica* v. KOENEN, *Leda cf. nana* v. KOENEN, *Erycina ? cf. curta* v. KOENEN, *Psammobia sp.*, *Teredo sp.*, *Adeorbis sp.*, *Rissoa cf. striata* MONT., *Rissoa cf. flexuosa* v. KOEN., *Turbonilla sp.*, *Nassa turrita* BORS., *Bulla sp.1*, *Bulla sp. 2*, *Philine cf. undulata* v. KOENEN (E. HORN, 1912).

Fresenmoor (Niedersachsen). Description and reference in SCHROEDER, 1906, p. 9 — HINSCH, 1952, p. 145). Clay pit. Rock: dark silty mica-clay in secondary position.

Reinbek (east of Hamburg). (Molluscan fauna mentioned by GOTTSCHE, 1878—WOLFF, 1913a.—GOTTSCHE & WIBEL, 1876.—Locality described by ZIMMERMANN, 1847, pp. 232 and 240. Railway cutting. Brickworks pit (in Wohltorf). Rock: mica-clay, underlain by "alum earth" and sandstone impregnated with ferric oxide ("Dingden-Reinbekstufe"), probably in situ.—Supplement to fossil list: *Nucula sp.*, *Astarte sp.*, *Voluta sp.*, *Fusus sp.* ("Gruppe des *eximius*, jüngere Windungen glatt"). (WOLFF, 1913a).

Gühlitz (West Mecklenburg). (Fossil list and description in BEYRICH, 1853–57—SCHULTE, 1905—STAESCHE, 1930). Brickworks pit. Rock: dark, micaceous clay. Stratification inadequately described.—Supplement to fossil list: *Pecten sp.*, *Leda sp.*, *Mactra sp.*, *Cardium sp.* (SCHULTE, 1905). *Aquilofusus lategradatus* (KAUTSKY, 1925).

Lüneburg (Niedersachsen). (Reference to locality and fauna in VOLGER, 1845—PHILIPPI, 1851—BEYRICH, 1853–57—SEMPER, 1861—v. KOENEN, 1872, 1882—MÜLLER, 1904—WOLLEMANN, 1906—STAESCHE, 1930—HINSCH, 1952). Several brickworks pits, especially at Kaltenmoor, southeast of the town and at Ochtmissen to the northwest. Rocks: mica-clay (uppermost) and sticky clay with phosphorites (below), both with marine fauna. The gastropods most prominent in the mica-clay and the pelecypods in the sticky clay (according to MÜLLER, 1904, p. 16).—Supplement to fossil list: *Tritonium enode* BEYR. (not from mica clay ?—v. KOENEN, 1872), *Scalaria cf. pseudoscalaris* BROC. (v. KOENEN, 1872), *Pecten sp.* (MÜLLER, 1904), *Pecten bellicostatus* WOOD (WOLLEMANN, 1906, p. 21).

Nordlohne (Süd-Oldenburg). (Mentioned in GRIPP, 1940b, p. 28).

Brickworks pit. Rock: greensand in secondary position. No complete fauna list published.

Unlike Staesche (1930, p. 71–73), I have elected to list the forms for each locality separately instead of lumping several find-spots together under collective terms such as "Sonst. Fundpunkte bei Hamburg", "Nordschleswig", etc. By this means it should be possible to avoid error. The Mecklenburg localities are omitted from the list because there is a great probability that both Middle and Upper Miocene mica-clay occurs there, and that consideration has not been or could not be given to different horizons. It is possible that the sediments looked so alike that horizontal collecting was difficult or impossible. Later I shall give a list of forms recorded in the literature as found at the Mecklenburg localities, with my comments (p. 128–129).

Characterizing Molluscs in the Upper Miocene.

On the list p. 113–117 it is conspicuous that some species are represented in all, or nearly all localities, viz.:

Astarte vetula—or *A. reimersi.*
Isocardia forchhammeri.
Dentalium badense.
Aporrhais alata.
Polynices helicina.
Cassidaria echinophora.
Phalium miolaevigatum.
Sipho distinctus.
Aquilofusus eximius—or *A. semiglaber.*
Turris badensis.
– *annae.*
Bathytoma cataphracta.
Acamptogenotia intorta.
Conus antediluvianus.

It is also striking that at the few places where *Aquilofusus eximius* has not been found, *A. semiglaber* occurs instead, and that where *Astarte vetula* is absent, *Astarte reimersi* seems to take its place. This is most interesting and must be borne in mind during the stratigraphical discussion later. It is scarcely accidental and I have therefore ventured to place these forms side by side in the list of those species which seem to occur in practically all fossiliferous localities.

With the exception of *Dentalium badense*, all these species have been found at Gram. Moreover, they are forms which mostly occur in large individual numbers.

A comparison with the list of fauna on p. 106–107 shows that whereas

most forms are also known from the Middle Miocene of the North Sea Basin, three species (or their "substitutes") have been found only in the Upper Miocene within the region, viz.:

Sipho distinctus.
Aquilofusus eximius—or *A. semiglaber.*
Astarte vetula—or *A. reimersi.*

It is true that *Sipho distinctus* has been found in the Pliocene limonite sandstone in Sylt, but the other two have only been encountered definitely in the Upper Miocene sediments and therefore for the present may serve as "index fossils" in the North Sea Basin.

Accordingly, there can be no doubt of the Gram fauna's close association and age-connection with the North German "Glimmerton".

Biostratigraphical Discussion.

The Subdivision of the Deposits in North Germany. According to GRIPP (1920, p. 16–18), the thickness of the mica-clay in the Hamburg region approximates values close up to 250 metres in places. Though this is doubtless an uncommon maximum, we know from elsewhere in North Germany that the thickness is very considerable, often over 100 m. Consequently it will be advisable a priori to assume a certain difference in the composition of the fauna in the lower and the upper strata respectively.

At several places in Holstein (Langenfelde, Reinbek, etc.) Upper Miocene mica-clay has been observed directly underlain by Middle Miocene mica-clay or -sand. Thus there is good reason for assuming that these are the earliest "Glimmerton" deposits.

In the island of Sylt, Morsum Kliff has limonite sandstone overlying mica-clay. It is possible, however, that there is a basal conglomerate between the two sediments. If this conglomerate does not represent an exceedingly vigorous erosion, the underlying mica-clay may therefore be assumed to represent a late phase of the mica-clay complex. The fauna of the limonite sandstone was studied by GRIPP (1922) and WIRTZ (1949) and is unquestionably Pliocene.

By comparing the molluscan fauna in the "lower" and the "upper" mica-clay, German geologists have suggested a certain faunistic difference. The first to visualize this difference was GRIPP, though SEMPER does mention once or twice (1861, p. 35 under *Mitra Borsoni* BELL. and p. 42 under *Astarte vetula* PHIL.) that some species were frequent in one place and totally absent in another.

In a work dated 1919, however, GRIPP admits, concerning the faunistic difference between Lüneburg-Gühlitz and Schleswig-Holstein localities (1919, p. 28): "Leider können wir heute noch nicht übersehen, ob diese

faunistichen Unterschiede auf zeitlichen oder faziellen Verschiedenheiten beruhen".

Differences between the faunas at Hamburg and in Schleswig are indicated by the same author in 1922 (p. 198):

"Hiermit steht in Einklang, dass die Fauna des Glimmertons verschieden ist, je nachdem, ob sie Aufschlüssen im tieferen oder höheren Teil der Ablagerung entstammt. Es ist z. B. der Nordschleswiger Glimmerton nicht nur ausgezeichnet durch einige Astarten und den *Fusus semiglaber*, sondern es fehlen hier von Arten, die im Glimmerton bei Hamburg häufig sind, *Murex spinicosta* und *Pleurotoma Steinvorthi* vollkommen und *Fusus crispus* Bors. (= *F. Rothi* Beyr.) ist nur in einem einzigen Exemplar von Sylt bekannt und in einem fraglichen Stück von Gramm. Erst von Brecklum an südlich kommen in dem dort anstehenden tieferen Glimmerton *Fusus crispus* und *Murex spinicosta* ständig vor".

A very thorough study of the differences between the faunas of the various localities (or locality groups) was made by Staesche in 1930 and resulted in the subdivision of the Upper Miocene mica-clay in North Germany and South Jutland into three zones. The basis was, firstly, the regular occurrence of some species in some localities and their complete absence in others, and the percentages of the species known from Middle Miocene sediments and from Pliocene.

Staesche's subdivision is as follows (1930, p. 84):

"1. Die Gühlitz-Mecklenburger Stufe, als obermiozän erwiesen durch das Auftreten der Glimmerton-Fusiden, von den höheren Stufen unterschieden durch *Murex octonarius*, *Aquilofusus festivus* und *Trigonostoma aperta*. 90% und mehr mittelmiozäner, etwa 22.5% pliozäner Formen. Hierher gehören Gühlitz und die mecklenburgischen Fundorte, in der Hamburger Gegend die tiefsten, fossilarmen Schichten des Glimmertons.

2. Die Langenfelder Stufe, charakterisiert .... besonders durch *Murex spinicosta*, *Dolicholathyrus rothi*, *Aquilofusus glabriculus*, *meyni*, *gregarius* und *Surcula steinvorthi*. Ca. 83.5% mittelmiozäner, 28–32% pliozäner Formen. Hierher gehören die reichen Faunen der Hamburger Gegend sowie Lüneburg.

3. Die Sylter Stufe. Leitfossilien: *Aquilofusus semiglaber*, *Astarte reimersi*, häufig die in der Langenfelder Stufe seltene *Buccinopsis dalei*. Rund 81% mittelmiozäner, 35% pliozäner Formen. Vorkommen: nur Nordschleswig, Sylt, Jütland."

In 1933 and in 1940 Gripp made a somewhat more cautious subdivision of the Upper Miocene mica-clay than Staesche (see Gripp, 1933, p. 93–94, and 1940 p. 145) into "older" and "younger":

"Jüngerer Glimmerton. Sylt und Nordschleswig, Bohr. bei Pinne-

berg mit *Astarte rollei*, *A. reimersi*, *A. syltensis*, *Aquilofusus semiglaber*.

Älterer Glimmerton. Hamburg, Langenfelde, Wohltorf bei Reinbek, Lüneburg mit *Astarte vetula*, *A. anus*, *Pleurotoma steinvorthi*.

Sandige Übergangsschicht. Geschiebe von Bahrenfeld, Rissen und Halstenbek mit Leitformen des Glimmertons neben solchen der Reinbeker Stufe".

In 1941 S. THIELE deals with the stratigraphy of the "Glimmerton" in a work on the Miocene and Pliocene in Schleswig-Holstein. Here (1941, p. 110–111) he expresses the belief "dass keine grundsätzlichen Bedenken bestehen können, das Nebeneinanderauftreten der mittel- und obermiocänen Leitfossilien an den mecklenburgischen Fundpunkten und in Gühlitz dadurch zu erklären, dass hier neben eindeutigem Obermiocän auch Mittelmiocän (Reinbeker Stufe) in völlig gleicher Fazies (Kummerer Ton) ansteht, deren Faunen deshalb auch bisher nicht getrennt aufgesammelt worden sind". Therefore THIELE considers that STAESCHE's "Gühlitz-Mecklenburger Stufe" is non-existent. But he does believe it possible to distinguish a separate basic stratum of the "Langenfelder-Stufe", characterized by the mass occurrence of *Astarte vetula*, "die überall dort gefunden wurde, wo die Basisschichten des Obermiocäns angeschnitten waren (Reinbek, Langenfelde, Kiel, Mecklenburg)", so that the division of the Upper Miocene mica-clay into zones is as follows:

Latest:	"Sylter Stufe
	Langenfelder Stufe
Earliest:	Basisschichten".

Latest of all W. HINSCH (in 1952) took the problem up for examination. He studied the variation of specially selected dominant species ("Leitende Molluskengruppen") in each given locality and thereafter compared the populations. The difference between these populations, HINSCH considers, is governed by their different geological age ("historische Rassen") and is therefore suitable for employment in the stratigraphical evaluation. He sets up the following units:

Latest:	"Sylter Stufe,
	Grammer Stufe,
Earliest:	Langenfelder Stufe",

and also divides the last one into two sub-groups, a lower one: "Lüneburger Unterstufe" and an upper one: "Langenfelder Unterstufe".

As HINSCH's suggested subdivision is the latest and most thoroughly motivated I shall reproduce it in greater detail. The character fossils are distributed as follows (HINSCH, 1952, p. 180–182):

1. "Langenfelder Stufe

Chlamys (*Peplum*) *clavata* ("erstes Auftreten")
Astarte (*Carinastarte*) *vetula*
– (*Ashtarotha*) *omalii* ("erstes Auftreten")
– (*α-Nicania*) *corbuloides*. ("erstes Auftreten")
– (*α-* –) *gracilis*
– (*α-* –) *radiata* ("letztes Auftreten")
– (*Laevastarte*) *fusca forma magdalenae* ("erstes Auftreten")
Cardita laevicosta ("letztes Auftreten")
Venus (*Dosina*) *multilamella* ("letztes Auftreten")
Bittium spina ("letztes Auftreten")
Pagodula vaginata ("letztes Auftreten")
Sipho gregarius ("nur Lüneburger Unterstufe")
– *distinctus* ("mit Anklängen an *Sipho gregarius*")
– *solitarius* ("nur Lüneburger Unterstufe")
β-Aquilofusus luneburgensis
γ-Aquilofusus puggaardi ("erstes Auftreten")
δ-Aquilofusus glabriculus ("nur Lüneburger Unterstufe")
Narona (*β-Sveltia*) *lyrata parvicarinata*
Uromitra wirtzi
Bathytoma jugleri
Surcula steinvorthi ("letztes Auftreten")
Gemmula (*α-Hemipleurotoma*) *annae* ("schlankere Form")
– (*β-Hemipleurotoma*) *zimmermanni* ("letztes Auftreten")
– (*β-* –) *rotata badensis* ("mit dichteren Knoten")".

(Occurrence: "a) Lüneburger Unterstufe: Lüneburg. Vielleicht gehören hierher einige mecklenburgische Lokalitäten und die Basisschichten Thiele's.

b) Langenfelder Unterstufe: Langenfelde, Elbtunnel, Wohltorf, Lieth.")

2. "Grammer Stufe

Astarte (*Carinastarte*) *reimersi*
Murex (*Tubicauda*) *spinicosta* ("letztes Auftreten")
Liomesus fossulatus grippi
Sipho distinctus
Streptochetus sexcostatus ("letztes Auftreten")
β-Aquilofusus semiglaber
Uromitra cimbrica
Narona (*β-Sveltia*) *rothi*

Bathytoma mioturbida ("erstes Auftreten")
Gemmula (*α-Hemipleurotoma*) *annae*
– (*β-* –) *rotata badensis* ("mit weiten Knoten")".

(Occurrence: "Gramm, Fresenmoor, Esbjerg, Storlund, Spandetgaard und andere südjütländische Lokalitäten").

3. "Sylter Stufe

Astarte (*Carinastarte*) *rollei*
– (*Astarte*) *syltensis* ("erstes Auftreten")
Polinices hemiclausa ("erstes Auftreten")
Aporrhais pespelicani ("erstes Auftreten")
Liomesus ventrosus
Sipho distinctus ("letztes Auftreten")
β-Aquilofusus eximius
Gemmula (*α-Hemipleurotoma*). ("Zwischenform der Arten *annae* und *turrifera* in der Sylter Stufe")".

(Occurrence: "Typuslokalität ist das Morsum Kliff. Ferner gehört hierher die Abt. III der Dammbaugrube Nösse").

Remarks on the Subdivision applied in North Germany. To these suggestions I would make the following remarks:

The sediments underlying the South Jutlandic exposed occurrences Gram, Spandetgaard and Ravning are not accessible, and the borings made in the vicinity down into these strata have not supplied any macrofossils. The molluscan fauna studied in the present work does not seem to have been collected in sediments near to the base of the mica-clay. The overlying strata on all the localities consist of Quaternary deposits, wherefore there is no reason for assuming that this molluscan fauna came from sediments in the vicinity of the upper part of the mica-clay. As a result then, there is nothing in the stratification of these localities to provide a hint as to where in the stratigraphic column of the mica-clay series as a whole the fossils came from.

This means that in any attempt to place the Gram fauna chronologically in relation to the other Upper Miocene faunas known from the North Sea Basin, there is no other course open than to compare them one with the other—which is exactly what has already been tried by German geologists as described above. This however cannot be done without first making a critical examination of these attempts at subdivision.

The first thing one observes is that in the North German region not a single complete section is known (or at any rate published) in which

fossiliferous mica-clay has been found with underlying fossiliferous Middle Miocene and simultaneously overlying fossiliferous Pliocene. Consequently the expedient had to be resorted to of piecing the sections together from several, often mutually remote, localities. This in itself embodies wide possibilities of error.

As regards most localities, the molluscan fauna as we know it from these exposed sections, forms only a small representation and has often been procured on brief, fortuitous excursion visits. Two localities alone, Langenfelde and Morsum Kliff, have been visited so often that a reliable impression has gradually been built up of which species are abundant at these places. At the same time a number of rare species have been discovered, thus bringing the total number of species up rather high.

In order to apply the percentile Middle Miocene share of the molluscan fauna in the age discussion as Staesche did, there must be a large and stable material assembled over a long collecting period, for it is necessary to ensure that practically all species present in the deposit are represented in the collections. And even then there is some uncertainty, for it often happens that hitherto unknown species turn up later and at once give rise to changes in the percentages. Thus in any case one must not attach too much importance to these percentages. It must also be remembered that in the main the Middle Miocene molluscan fauna comes from very sandy sediments, whereas the Upper Miocene is mostly from clayey beds.

Staesche's percentages for the Middle Miocene share of the faunas from the "Langenfelder Stufe": 83.5, and "Sylter Stufe": 81, lie so close together that the finding of merely a few new species will reverse the proportions. The same applies to the Pliocene percentages.

The "Gühlitz-Mecklenburger Stufe" of Staesche. Like S. Thiele, I am bound to consider the "Gühlitz-Mecklenburger Stufe" as being uncertain. The list of fossils p. 128–129 contains all the species named in the literature from Gühlitz, Kummer, Hohenwoos and Bockup. The last three were described by Metzmacher (1903, 1917). As indicated on p. 121 both Upper and Middle Miocene sediments were exposed in the sections. Furthermore, the Upper Miocene mica-clay was almost as dark in colour as the clay ("alum earth") immediately overlying the sandstone ("Reinbek-Dingden-stufe"). Thus there were good chances that fossils from both dark strata would be mixed together in the collections and that any difference in the faunas would be concealed.

Quite remarkable was the finding of the following species not known in other mica-clay localities: *Murex inornatus*, *Fusus festivus*, *Pleurotoma interrupta*, *Pl. pannoides*, *Borsonia uniplicata*, *Limopsis lamellata*, *Astarte concentrica* and *Cardium subturgidum*.

In theory some of these species might well occur in the mica-clay, but

List of the Molluscan Fauna from the Mica-Clay of Mecklenburg.

(Following the nomenclature of v. KOENEN 1872—82).

Molluskfaunaen i glimmerleret i Mecklenburg.

		Gühlitz	Kummer	Hohenwoos	Bockup
1	*Murex octonarius* BEYR.	+	+	+	+
2	*Murex inornatus* BEYR.			+	
3	*Trophon Semperi* v. KOEN.		+		
4	*Tiphys horridus* BROC.	+	+		
5	*Cancellaria evulsa* SOL.	+	+	+	
6	*Cancellaria subangulosa* WOOD.	+	+		
7	*Cancellaria lyrata* BROC.	+	+	+	
8	*Cancellaria aperta* BEYR.	+			
9	*Cancellaria scalaroides* WOOD.	+			
10	*Fusus crispus* BORSON		+	+	
11	*Fusus festivus* BEYR.		+	+	
12	*Fusus tricinctus* BEYR.	+	+	+	+
13	*Fusus eximius* BEYR.	+	+	+	+
14	*Fusus Meyni* SEMP.	+			
15	*Fusus gregarius* PHIL.	+	+	+	
16	*Fusus distinctus* BEYR.	+	+	+	+
17	*Nassa Bocholtensis* BEYR.	+	+		
18	*Cassis saburon* BRUG.	+	+	+	
19	*Conus antediluvianus* BRUG.	+	+	+	
20	*Pleurotoma turbida* SOL.	+	+	+	+
21	*Pleurotoma rotata* BROC.	+	+	+	
22	*Pleurotoma rotata* BROC. *var. complanata* v. KOEN.	+			
23	*Pleurotoma turricula* BROC.	+	+	+	+
24	*Pleurotoma turricula* BROC. *var. laeviuscula* v. KOEN.	+			
25	*Pleurotoma porrecta* S. WOOD.		+	+	
26	*Pleurotoma Steinvorthi* SEMPER	+	+	+	+
27	*Pleurotoma interrupta* BROC.		+	+	
28	*Pleurotoma intorta* BROC.	+	+	+	+
29	*Pleurotoma anceps* EICHW.		+	+	
30	*Pleurotoma cf. festiva* DOD.		+		
31	*Pleurotoma pannoides* v. KOEN.		+		
32	*Pleurotoma Helena* SEMP.	+			
33	*Pleurotoma Selenkae* v. KOEN.	+	+	+	
34	*Defrancia Luisae* SEMP.	+			
35	*Mangelia obtusangula* BROC.	+	+	+	
36	*Mangelia hispidula* JAN.	+			
37	*Borsonia uniplicata* NYST.		+	+	
38	*Mitra Borsoni* BELL.	+	+	+	+
39	*Ficula reticulata* LAM.	+			
40	*Natica helicina* BROC.	+	+	+	

		Gühlitz	Kummer	Hohenwoos	Bockup
41	*Natica Alderi* Forbes	+	+	+	
42	*Turbonilla spec.*			+	
43	*Aporrhais alata* Eichw.	+	+	+	
44	*Eulima subulata* Don		+		
45	*Turritella subangulata* Broc.	+	+	+	
46	*Assiminea cf. Gottscheana* v. Koen.		+		
47	*Dentalium badense* Partsch	+	+	+	+
48	*Dentalium mutabile* Dod.	+			
49	*Cadulus subfusiformis* Sars		+	+	
50	*Ringicula auriculata* Mén.			+	
51	*Spirialis valvatina* Reuss		+	+	
52	*Spirialis Koeneni* Kittl				
53	*Pecten cf. tigerinus* Müll.		+	+	
54	*Arca diluvii* Lmk.	+			
55	*Limopsis lamellata* Lehmann		+	+	
56	*Yoldia Philippina* Nyst		+	+	
57	*Leda spec.*			+	
58	*Cardita chamaeformis* Sow.		+	+	+
59	*Cardita orbicularis* Sow.	+			
60	*Astarte vetula* Phil.	+	+	+	
61	*Cardium subturgidum* D'orb.		cf.	+	
62	*Isocardia cf. lunulata* Nyst		+	+	+
63	*Neaera sp.*		+		

here their numbers are so large and their Middle Miocene character so obvious that one is justified in doubting that they all came from the mica-clay.

As it was these very species (together with *Cancellaria* (*Trigonostoma*) *aperta* from Gühlitz) which Staesche indicated (see p. 123) as character fossils for the "Gühlitz-Mecklenburger Stufe", the basis for the maintenance of that zone is thus eliminated, especially when Staesche's "percentage method" must also be rejected. And by the way, the high Middle Miocene percentile share, 90, was arrived at by the presence of these particular species.

Thiele's "Basisschichten" (see p. 124), which is characterized exclusively by the many shells of *Astarte vetula*, is scarcely capable of stratigraphical application. The mass occurrence of a single species is the result of purely local oecological conditions.

Stratigraphical Applicability of the Species. It is well known that fairly uncommon species are not very applicable as character fossils. Staesche, Gripp and Hinsch all indicate some which, at any rate ac-

cording to the information available in the literature, do not seem to be common, such as the occurrence of *Bittium spina*, *Surcula steinvorthi*, *Venus multilamella* and *Cardita laevicosta* in the "Langenfelder Stufe" in sensu STAESCHE and HINSCH (and "Älterer Glimmerton" in sensu GRIPP). There is no reason e.g. why these somewhat rare species may not crop up later in localities otherwise placed to the "Sylter Stufe" of STAESCHE.

Matters are quite different as regards species which dominate by their large individual numbers. These provide profitable opportunities for examining the variations within the different populations and HINSCH deserves well for having completed valuable studies in this field. The following genera come into question: *Astarte*, *Liomesus*, *Sipho*, *Aquilofusus*, *Uromitra*, *Cancellaria* (*Narona*), *Bathytoma* and *Turris* (*Gemmula*).

The problem, however, is whether the differences between these populations are the result of oecological conditions, differences in age or other factors.

Unfortunately we know but little about the influence of environment on the populations and still less about the time factors.

We have only little information regarding the facies in the North German mica-clay localities (cf. the survey of the North German occurrences, p. 117–121). For this reason we cannot simply assume that the facies are so uniform that their influence on the populations may be ignored and leave us with the time factor alone to be considered.

As regards the Gram locality I may merely recall that there are two groups of sediments, one more clayey and one more silty—apparently a difference of only small consequence on the whole. Nevertheless each sediment group is characterized by its particular dominating species, cf. p. 110.

Comparison between the Faunas at Gram and a Locality at Maade. In this discussion it is useful to include the fauna from a somewhat different, more distinctly clayey facies at Maade Brickworks, east of Esbjerg. Several species occur there but not at Gram. In the following I shall merely name those of which many specimens have been found, it being the intention to analyse the molluscan fauna from this locality in more detail on a later occasion. As it happens, GOTTSCHE (see GOTTSCHE & WIBEL, 1876) enumerated the species from the Langenfelde fauna that were found with many specimens, so that I am able to place the two lists side by side in order to demonstrate also the similarities between the Langenfelde and Maade faunas.

Langenfelde:	Maade:
	Nucula georgiana
Leda pygmaea	*Leda pygmaea*
Limopsis aurita	*Limopsis aurita*

Chlamys clavata	*Chlamys clavata*
	Astarte reimersi
Astarte radiata	*Astarte radiata*
Cardita orbicularis	*Cardita orbicularis*
Isocardia forchhammeri	*Isocardia forchhammeri*
Dentalium badense	*Dentalium badense*
Turritella subangulata	*Turritella subangulata*
Turritella sp. nov.	*Turritella tricarinata*
Xenophora testigera	*Xenophora testigera*
Aporrhais alata	
Polynices helicina	*Polynices helicina*
Cassidaria echinophora	*Cassidaria echinophora*
Phalium miolaevigatum	
	Typhis fistulosus
Sipho distinctus	*Sipho distinctus*
Nassa holsatica	*Nassa holsatica*
Aquilofusus luneburgensis	*Aquilofusus luneburgensis*
	Aquilofusus puggaardi
Lathyrus rothi	*Lathyrus rothi*
	Uromitra wirtzi
Scaphella bolli	*Scaphella bolli*
Cancellaria lyrata	*Cancellaria lyrata*
	Drillia modiola
Turris badensis	*Turris badensis*
Turris annae	*Turris annae*
Brachytoma obtusangula	*Brachytoma obtusangula*
Bathytoma cataphracta	*Bathytoma cataphracta*
	Lienardia luisae
Acamptogenotia intorta	*Acamptogenotia intorta*
Conus antediluvianus	*Conus antediluvianus*

The resemblance of the one fauna to the other is remarkably close. Of *Phalium miolaevigatum* only 1–2 shells were found at Maade, and of *Aporrhais alata* 4–5, and therefore they cannot be said to be quite common there; but otherwise the degree of similarity is very high. The Maade material has not yet been finally surveyed, but even now it may be said that the populations of the following genera agree completely with the corresponding Langenfelde populations as known to us through Hinsch: *Sipho*, *Aquilofusus*, *Uromitra*, *Cancellaria* (*Narona*), *Bathytoma* and *Turris* (*Gemmula*). The only point on which the two do not conform is the *Astarte* populations. None of the Langenfelde *Astartes* (except *A. radiata)* have been found at Maade, and vice versa.

A comparison between the fauna from Gram and that from Maade

shows that there are both conspicuous differences and certain similarities.

The following species, very common at Maade, have either not been found at all at Gram or in only one or two specimens:

Limopsis aurita
Astarte radiata
Cardita orbicularis
Dentalium badense
Nassa holsatica
Aquilofusus luneburgensis
Lathyrus rothi
Uromitra wirtzi
Scaphella bolli
Cancellaria lyrata.

Conversely, the following very common species at Gram are either absent or found in only one or two specimens at Maade:

Odostomia conoidea
Polynices koeneni
Phalium miolaevigatum
Nassa syltensis
Aquilofusus semiglaber
Cancellaria rothi
Admete subangulosa
Cythara kochi.

It is quite evident that some species are "replaced" by closely related forms:

Aquilofusus luneburgensis	by *A. semiglaber*
Uromitra wirtzi	– *U. cimbrica*
Nassa holsatica	– *N. syltensis*
Cancellaria lyrata	– *C. rothi*

Nevertheless the point must be underlined that among the material from Maade Brickworks are transitional forms between the species listed to the left and those to the right. Moreover, solitary specimens of all the species on the right have also been found.

Own Views. With regard to the *Astarte* populations it is a most striking fact that not a single specimen of *A. vetula*, *A. anus* etc., encountered in the basal stratum of the mica-clay in the Hamburg region has been found in Denmark. Some unpublished sections in the Miocene in Jutland go through the Upper Miocene mica-clay down into the under-

lying Middle Miocene, and although in one case the section is exposed, with very good chances of studying the transitional strata, these *Astarte* species have not been forthcoming here either.

Thus in Denmark, as in North Germany, there are localities with populations that differ from one to the other.

This means that Staesche cannot infer (on the fossil evidence) that the whole of Jutland's Upper Miocene is part of the younger phase.

Further, the objection may be raised to Hinsch's conclusion, 1952, p. 175: "dass die Unterschiede der Population durch ihr verschiedenes geologisches Alter bedingt sind", that fairly narrowly delimited, diversified "sociations" of molluscs have been found in the present day, living in the same marine region where the sediments do not differ particularly but where, on the other hand, the conditions of life: nutrition, salinity etc., cause certain species to congregate especially in one place and others of the same genus in another. I would refer to C. G. Joh. Petersen's researches in the Danish waters (1915).

Accordingly there are no sufficiently weighty reasons for dismissing the possibility that the various populations which Hinsch has demonstrated in the North German and South Jutlandic mica-clay were more or less contemporaneous. It would appear from Hinsch, 1952, p. 175, that this possibility was far from his thoughts, for he merely writes: "Diese Unterschiede könnten theoretisch durch Fazieseinflüsse bedingt sein, jedoch ist die Glimmertonfazies an allen vier Lokalitäten sehr ähnlich. Auch die geographische Breite kann nicht ausschlaggebend sein, denn die Lageskizze zeigt, dass gerade Gramm und Fresenmoor weit auseinander liegen."

As a consequence, with the evidence at hand I am unable to associate myself finally with the German subdivision of the Upper Miocene mica-clay; it is a problem that calls for treatment in the light of modern oecological and faunistic marine-biological research. It is possible that we must await the publication of zoological studies in this hitherto only superficially handled subject.

As the animal remains moreover have not come from one complete section through the mica-clay, but from several occurrences often mutually remote, the upshot of my examination of the subject must be that I have found no good and sufficient grounds in the molluscan fauna for bringing the Gram, Spandetgaard and Ravning sediments into closer correlation with other known sediments in the Upper Miocene of the North Sea Basin.

B. The remaining Miocene and the Pliocene.

As regards the other marine Miocene faunas in Northwest Europe, no discussion in detail seems to be called for, as STAESCHE (1930, p. 70) has already pointed out that a very large number of Upper Miocene species are present in the Middle Miocene, i.e. 108 of the 129 species to which he refers. As far as the Pliocene is concerned, only 34 persisted. For the Gram fauna the corresponding figures are 44 and 18 of 59 species.

Thus there is fairly close affinity with the fauna of the Middle Miocene, due quite possibly to the circumstance that the collected Pliocene fossils came exclusively from littoral sediments, which is not the case with those of the Upper Miocene. For instance, it is quite credible that several of the mica-clay species lived in deeper water some way up in the Pliocene, apparently without leaving a trace in the Crag formations or in the other known sediments. We cannot preclude the possibility that the rare finds of defective shells of *Phalium miolaevigatum*, *Pyrula condita*, *Typhis fistulosus*, *Bathytoma cataphracta*, *Acamptogenotia intorta* and *Conus antediluvianus* in the Pliocene of England, Holland and Belgium—shells which are considered to be derivatives from earlier sediments, actually were contemporary forms accidentally washed into the regions where the fauna discovered once lived.

It is evident that the South Jutlandic marine Pliocene holds a separate position in relation to the British, Dutch and Belgian. As regards Morsum Kliff, where it was long believed to be another facies of the Upper Miocene or even Middle Miocene (GOTTSCHE, 1885), the current view of its age was first documented by GRIPP in 1922. Later, ØDUM (1934) in a boring at Sæd, south of Tønder, found remnants of a similar fauna, and in 1944 HECK published the finding of still another locality of marine Pliocene at Bredstedt, between Tønder and Husum.

The sections at Bredstedt and Morsum Kliff have the following sequence:

Quaternary
Limnian-fluviatile quartz-sand
Siderite- or limonite- sandstone
Transgression conglomerate
Upper Miocene mica-clay

The fauna of the siderite- or limonite- sandstone, according to GRIPP and HECK, is characterized especially by the following Pliocene species:

Corbulomya complanata SOW.
Mactra arcuata SOW.
Nassa reticosa SOW.

Among the other fossils were the following forms which were also known from the Upper Miocene:

		Morsum Kliff	Sæd	Bred-stedt
1.	*Yoldia glaberrima*	+	+	+
2.	*Spisula subtruncata triangula*		+	+
3.	*Abra prismatica*	+		+
4.	*Dentalium vitreum*	+	+	cf.
5.	*Turritella tricarinata*			+
6.	*Polynices alderi*	+		+
7.	*Cassidaria echinophora*	+		
8.	*Phalium rondeleti*	+		
9.	*Liomesus ventrosus*	+		
10.	*Sipho distinctus*	+		
11.	*Nassa syltensis*	+	+	
12.	*Aquilofusus eximius*	var.		
13.	*Scaphella bolli*	?		
14.	*Drillia modiola*	+		
15.	*Turris badensis*		+	
16.	– *annae*	+	+	+
17.	*Acamptogenotia intorta*	+		
18.	*Conus antediluvianus*	cf.		
19.	*Volvula acuminata*	+		
20.	*Cylichna cylindracea*			+

A comparison of this list with the fossil list on page 106–107 will show that the South Jutlandic Pliocene contains some more Upper Miocene species than the Pliocene in England, Holland and Belgium.

The interpretation of this may be that the South Jutlandic Pliocene is closer in age to the Upper Miocene than the Pliocene elsewhere in the North Sea Basin.

Unfortunately, the fossils usually are in a poor state of preservation in the siderite- or limonite- sandstone, and the entire fauna in the form in which we know it today is too small to constitute a basis for farreaching conclusions.

II. REST OF EUROPE AND NORTH AFRICA

Outside the area of the North Sea Basin there are marine Neogene sediments at several places along the Atlantic coast, in the coastal regions of the Mediterranean and in the Vienna Basin. Very large molluscan faunas have been secured from these sediments and the majority have

been well studied. This is true especially of the Italian Neogene and the Vienna Basin Miocene. These researches began several years before the corresponding work was commenced in the North Sea Basin and many of the species found in the latter's Miocene and Pliocene were early identified with species in Italy and the Vienna Basin. A perusal of the fauna list on page 113–117 will often encounter the name of BROCCHI, for example, and HOERNES' large work on the molluscs of the Vienna Basin was diligently used by SEMPER, BEYRICH and v. KOENEN in their studies of the North German and South Jutlandic Upper Miocene.

It is regrettable that identification in several cases was made only through the medium of the literature and the often mediocre illustrations. Naturally this has given rise to faulty conclusions, and even today many species are determined without an opportunity of making direct comparisons with type material or even shells from the particular sediments in Italy and elsewhere. It would certainly be of vital importance—to stratigraphical adjudication as well—if direct comparisons could be made.

These weaknesses in the documentation material must be borne in mind when endeavouring to throw light on the relation between the molluscan fauna of the mica-clay and the other Neogene faunas in Europe and North Africa. In the present work I shall touch only lightly upon this subject, as I consider it preferable to postpone a more detailed examination of it until the entire Danish Upper Miocene molluscan fauna has been analyzed and every possibility of comparing with the Italian and Austrian Neogene fossil material has been utilized.

The fossil list on page 106–107 provides information with regard to certain main features in these relations:

With the Miocene in the Atlantic Region (Loire Basin, Bordeaux Basin, Portugal and Morocco bracketed together) the Gram fauna has 21 real or approximate species in common, but only 14 with the Pliocene (best known from Morocco, LECOINTRE, 1952).

As regards the Mediterranean Region the number of species is rather larger, because the thorough Italian studies are available in support. 32 real or approximate species are shared with the Italian Miocene and about 33 with her Pliocene.

The Vienna Basin Miocene seems to have 20 forms or closely related species in common with Gram.

Even under the supposition of the correctness of the identifications it seems difficult to draw other stratigraphical conclusions on this basis than those drawn earlier (GRIPP (1915), STAESCHE (1930), etc.).

Practically all the species which the Gram fauna has in common with the Miocene of these regions were, according to the literature, found in the Helvétien and Tortonien. On account of the rather large number of forms that are also common to the Pliocene, the Gram fauna and its

equivalents must be placed in the chronological interval between the Tortonian and the lower marine Pliocene.

Just in that period there was a regionally widespread regression, so that accumulation of marine sediments proceeded in only few of the areas now lying above sea level.

As a possible equivalent to the Upper Miocene of the North Sea Basin Hinsch (l.c., p. 183) suggests the North African Sahélien, which lies between the uppermost marine Miocene (Tortonien) and the lowermost marine Pliocene (Plaisancien). However, we have no definite knowledge of a single species in common with the Gram fauna in these sediments (see Stchepinsky, 1938).

Mayer-Eymayr (see Hinsch, l.c., p. 179) placed the Upper Miocene mica-clay in a new phase: Messinien, comprising all marine sediments later than the Tortonien and earlier than the Plaisancien.

However, both proposals merely emphasize what was said above, that the Northwest European Upper Miocene seems to belong between the Tortonien and the Plaisancien (= Piacentin), and in between in Europe are placed two phases known only in brackish and limnian facies, i.e. Sarmatien and Pontien; but on the more exact relation of the marine mica-clay to these two phases we lack the material for a discussion in the present context.

DANSK SAMMENDRAG

DET MARINE ØVRE MIOCÆN I SØNDERJYLLAND OG DETS MOLLUSKFAUNA

Indledning.

Det miocæne glimmerler i Sønderjylland blev opdaget af FORCHHAMMER i 1828 på øen Sild. I årene derefter blev disse aflejringer og deres forsteningsindhold undersøgt af L. MEYN (1848), E. BEYRICH (1853—57). J. O. SEMPER (1856, 1861), A. VON KOENEN (1872, 1882), O. MØRCH (1874), J. P. J. RAVN (1907), K. STAESCHE (1930) og W. HINSCH (1952).

Nærværende undersøgelse er dels en revision af det ældre materiale af mollusker og dels en bearbejdelse af de nytilkomne fund. Materialet opbevares på Universitetets Mineralogiske Museum, København og Danmarks Geologiske Undersøgelse, Charlottenlund. Det stammer fra flg. tre lokaliteter: Gram, Spandetgård og Ravning. I den ældre litteratur nævnes også Storlund og Tornskov som findesteder for glimmerler-fossiler (se kortet fig. 10, p. 118).

Lokalitetsbeskrivelser.

1. Gram. Lokaliteten består af en teglværksgrav, beliggende 800 m nord for Gram slot, ca. 1,5 km nord for Gramby og ca. 75 m vest for landevejen Gram-Rødding.

Glimmerleret ved Gram og dets molluskfauna er omtalt af MEYN (1848), SEMPER (1861), v. KOENEN (1872, 1882), MØRCH (1874), RAVN (1907) og HINSCH (1952). Foraminiferfaunaen er omtalt af CLODIUS (1922) og otolitterne af WEILER (1942).

Leret har været gravet til teglværksbrug allerede omkring 1848 (MEYN), men fast teglværksdrift synes først etableret efter 1857 (»Schulzeitung f. Schleswig-Holstein«, Jahrg. 1857).

Det ældste teglværk har ligget ca. 100 m v n v for det nuværende (se skitsen fig. 6), som blev bygget omkring 1900. Lergraven havde i 1952 det på skitsen angivne omfang. Hovedprofilets længde (AB på fig. 6, p. 17) havde i aug. 1952 en længde af ca. 185 m, og dets højde var ca. 7,5 m.

Overjorden udgøres af omkring 1,5 m moræneler. De tertiære sedimenter

fordeler sig på to hovedgrupper: 1. nederst: mørkegråt, ret fedt glimmerler (Gram-ler) og 2. derover: en stærkt vekslende lagfølge af gråt, finsandet ler og gråt, leret finsand. Overgangen mellem disse to hovedgrupper er ganske jævn. Skitsen fig. 7 (p. 18) giver et tilnærmet indtryk af sedimenttypernes fordeling i profilet.

Et profil i de finsandede sedimenter måltes i teglværksgravens nordøstlige hjørne, vinkelret på hovedprofilet:

Terrænkote: ca. +32 m.

0—1,5 m	Moræneler, sandet, stenet, forvitret, gulligt.
1,5—1,7 m	Ler, sandet, stenfrit, rustgult, med rester af planterødder, muligvis forvitret Tertiær.
1,7—2,7 m	Glimmerler, finsandet, gråt, nærmende sig til leret glimmerfinsand. De mest finsandede lag er lysegrå med rustgule, uregelmæssige partier.
2,7—3,0 m	Ler, mindre glimmerholdigt, uregelmæssigt spættet. Der findes mange grågule, fede partier og desuden mere sandprægede partier, som har en svagt grønlig farvetone. Mange valnødde-hønseægstore konkretioner af uregelmæssig form.
3,0—3,5 m	Glimmerfinsand, lagdelt, af lysegrå farve, med uregelmæssige rustgule partier. Enkelte næsten helt sorte, små uregelmæssige klumper.
3,5—5,4 m	Glimmerler, finsandet, på friske blotninger brunliggråt, med mange uregelmæssige glaukonitansamlinger. Fossilførende. Fra 4,6—5,4 m ses på sine steder tydelig lagdeling, især omkring 4,6 m, 4,8 m og 5,4 m.
5,4—6,9 m	Glimmerler, finsandet, gråt-gråbrunt, væsentlig som ovenfor. Lagdeling stedvis synlig. Fossilførende.

Lagene ligger konkordante og synes at hælde ca. 6°—8° i østlig retning.

Boreprofiler (se den engelske del, p. 13—16) fra Gram og omegn viser dels, at den fluvioglaciale erosion har fjernet nogle m af tertiæret i Gram ådal og dels, at det øvremiocæne glimmerler underlejres af kvartssand, kvartsgrus eller glimmersand, hvorfra der ikke kendes nogen fauna, bortset fra nogle dybere liggende lag ved Østergård mejeri (D.G.U. arkiv nr. 141.28). Her er der fundet en velbevaret mellemmiocæn molluskfauna, som bearbejdes af Th. Sorgenfrei. Sandsynligvis er de nævnte sedimenter under glimmerleret også mellemmiocæne.

Det øvremiocæne glimmerlers mægtighed er ved teglværket ca. 35 m. På grund af den hyppige forekomst af *Astarte reimersi* Semper foreslog P. Harder i 1913 (Ussing 1913, p. 163) betegnelsen »Astarte-ler« for dette glimmerler. Denne betegnelse er her erstattet med navnet »Gram-ler«, som jeg definerer som det ler, der går i dagen i Gram teglværks lergrav. Opadtil er det overlejret af glimmerfinsand, som jeg her betegner »Gram-finsand«. Gram-ler og Gram-finsand udgør »Gram-formationen«. Nedadtil er Gram-formationen underlejret af grus og sand, som er påvist i 36 m's dybde i boringen D.G.U. Arkiv nr. 141.24. c, der findes ganske tæt ved lergraven. Hele Gram-formationen i denne boring har en tykkelse af omkring 35 m. Gram-leret er i tør tilstand gråt—mørkegråt med brunligt skær, i våd tilstand mørkegråt, finkornet, undertiden svagt sandet, gennemgående ret hårdt og indeholder talrige svovlkisstængler. Stedvis findes i

leret isolerede, stærkt kalkholdige, ellipsoidiske konkretioner, dannede i tilknytning til en større forstening, oftest et krabbeskjold (»krabbeboller«). De finsandede sedimenters karakter ses bedst af profilbeskrivelsen p. 139.

Af dyrerester er der i Gram-leret fundet talrige foraminiferer, echinider (pigge og skalstumper af spatangider), bryozoer (*Lunulites sp.*), pelecypoder, scaphopoder, gastropoder, crustaceer, hajer, benfisk, reptiler (*Psephophorus sp.*) og cetaceer. Vedrørende de ældre undersøgelser af disse fund se den engelske del p. 19–20.

2. Storlund. Denne lokalitets beliggenhed er ikke kendt med sikkerhed. Storlund er navnet på en samling gårde og huse mellem Enderupskov og Vr. Nybøl i Gram sogn. SEMPER og v. KOENEN nævner »Storland« (= Storlund) som findested for miocæne gastropoder (se listen p. 21–22). Efter oplysninger fra stedkendte folk har der tidligere ligget et teglværk ved Storlund. Ethvert spor af lergravene synes nu forsvundne. I de danske samlinger findes kun en højre- og en venstreskal af *Astarte reimersi* SEMPER (etiketteret: *Astarte vicina* SEMPER), som Mineralogisk Museum har fået fra SEMPER's samling i det tidligere »Naturhistorisches Museum« i Hamburg.

3. Ravning. Lokaliteten ligger mellem Kongeå og Ribe-Kolding-landevejen, ca. 3 km nø for Kalvslund Kirke og 1,3 km vest for Mejlby i Ribe amt. Det tidligere teglværk er forlængst nedlagt og lergravene tilgroede. MØRCH omtalte 1874 »Mejlby teglværk« som findested for miocæne mollusker. RAVN nævnte yderligere nogle arter i 1907 (se faunalisten p. 23). A. JESSEN og V. NORDMANN samlede i 1906 yderligere materiale, der opbevares på D.G.U. Iflg. karteringsdagbogen for 1906 til kortbladet »Rødding« (opbev. på D.G.U.) fandtes der over Gram-leret senglacialt hedegrus.

4. Spandetgård. Forekomsten ligger ca. 200 m nordøst for Spandetgård, Spandet sogn, Tønder amt. Den omtales af FORCHHAMMER (1847), MEYN (1848), BEYRICH (1853—57), SEMPER (1861), MØRCH (1874), RAVN (1907) og HINSCH (1952), i alle tilfælde som findested for miocæne mollusker. GOTTSCHE (Schr. Naturw. Ver. f. Schleswig-Holstein, IX, p. 150—151, 1891) omtaler i en lille notits, at der ikke synes at forekomme lerjernstensbænke i Gram-leret ved Spandet. Teglværksdriften, som var baseret på forekomsten, blev indstillet allerede omkring 1900. I sommeren 1955 er man atter begyndt at åbne de gamle lergrave. Gram-leret overlejres her af diluvialsand. En dyb boring (D.G.U. arkiv nr. 150.17.a.—c.) ved det tæt ved lergraven liggende Spandet mejeri har iflg. mundtlige oplysninger gennemtrængt ca. 100 m Gram-ler, før den nåede ned i sand. Vedrørende de hidtil publicerede mollusker fra Spandetgård se listerne på p. 24.

5. Tornskov. Lokaliteten ligger 4 km nord for Løgumkloster, vest for vejen til Arrild, ind i østranden af Vognshøj-bakkerne, og 2—300 m syd for de gårde, der fører navnet Tornskov, i Nørre-Løgum sogn, Tønder amt. Forekomsten af stenfrit ler i Vognshøjpartiet omtales af både FORCHHAMMER (1847)

og MEYN (1848), men det synes først at være SEMPER, som erkendte, at i hvert fald noget af leret var miocænt (i et utrykt manuskript). v. KOENEN (1872, 1882) nævner Tornskov som findested for de gastropoder, der er anført p. 25–26. Forekomsten har ikke været udnyttet siden omkring 1890. I 1940 fandt TH. SORGENFREI glimmerler, stedvis med aftryk af mollusker, i den sydligste af erosionsslugterne ind i bakkedraget vest for Tornskov-gårdene.

Gastropodfaunaen, som efter v. KOENEN (1872, 1882) er anført side 25–26, afviger noget fra den, der kendes fra de øvrige sønderjydske lokaliteter. Således er forekomsten af *Cancellaria cancellata* L., *Fusus sexcostatus* BEYR., *F. festivus* BEYR. og *Mitra scrobiculata* BROC. bemærkelsesværdig. Disse arter tilhører normalt ikke glimmerlerfaunaen, men forekommer til gengæld i den underliggende Dingden-Reinbeck-etage (GRIPP 1915, 1919, 1933; KAUTSKY, 1925, p. 214). Der er da mulighed for, at også lag ældre end Gram-leret har været tilgængelig ved Tornskov. I de danske samlinger findes ikke en eneste forstening fra nærværende forekomst.

Molluskfaunaen.

Den efterfølgende omtale af molluskfaunaen fra Sønderjyllands Øvre Miocæn er gjort så kortfattet som muligt. Vedrørende synonymliste, originaldiagnose, typemateriale og udbredelse henvises til den engelske del. Det foreliggende materiales talmæssige størrelse og regionale udbredelse fremgår iøvrigt mest overskueligt af skemaet p. 114–115. For de arters vedkommende, hvor RAVN allerede (1907) har givet en god beskrivelse, er en sådan udeladt. Det er hensigten at give artsdiagnoser og beskrivelser af de fleste af arterne i et senere arbejde om Esbjerg-egnens Miocæn, idet disse arter findes i mere varieret form på lokaliteter i dette område og derfor giver anledning til en mere differentieret diagnose, end materialet fra Sønderjylland berettiger til.

Jeg har i nærværende arbejde fulgt systematikken i J. THIELE: »Handbuch der systematischen Weichtierkunde, I—II« (Jena 1931—35) så konsekvent som muligt. Pyramidelliderne er dog henført til Opisthobranchierne i overensstemmelse med de nyeste undersøgelser. (FRETTER and GRAHAM, 1949). Dybere gående nomenklatoriske spørgsmål er ikke taget op.

Pelecypoda.

1. *Nucula* (*Nucula*) *georgiana* SEMPER in RAVN, 1907. (Tavle I, fig. 1a,b).

Se RAVN's beskrivelse (1907, p. 257). Arten ligner meget den oligocæne *N. compta* GOLDF., men denne har ikke det stumpe knæk på bageste dorsalrand. *N. georgiana* hører til Gram-lerets almindeligste muslinger.

2. *Leda* (*Jupiteria*) *pygmaea* (MÜNSTER in GOLDFUSS, 1837). (Tavle I, fig. 2a, b).

Denne art omtales fra Gram af RAVN (1907, p. 261) under navnet *Portlandia Philippiana* NYST. Samme forfatter beskriver dog også (smstds. p. 260) *Portlandia pygmaea* MÜNST. sp. Der henvises til denne beskrivelse. *Portlandia Philippiana* NYST. synes blot at være de tykkere og kortere former af *Leda pygmaea*. Af nogle forfattere anses den nulevende *Leda tenuis* (PHILIPPI) at være identisk med denne art. *L. pygmaea* er ved Gram mest almindelig i de sandede sedimenter.

3. *Yoldia* (*Yoldia*) *glaberrima* (MÜNSTER in GOLDFUSS, 1837).

Arten er beskrevet af RAVN (1907, p. 261). Fra Gram foreligger kun brudstykker, hvoraf langt de fleste er fra de finsandede sedimenter.

4. *Limopsis* (*Limopsis*) *aurita* (BROCCHI, 1814). (Tavle I, fig. 3a, b).

Der henvises til RAVN's beskrivelse (1907, p. 265). — Den øvreoligocæne *L. goldfussi* NYST. adskiller sig iflg. GÖRGES (1952, p. 17) fra *L. aurita* ved at have det dobbelte antal axialribber, hvis mellemrum er meget smallere end hos sidstnævnte art. Ved Gram og Spandetgård er arten sjælden.

5. *Chlamys* (*Peplum*) *clavata* (POLI, 1795). (Tavle I, fig. 5a, b).

RAVN (1907, p. 252) har beskrevet denne art indgående. Den har ofte været henført til *C. septemradiata* MÜLLER. *C. clavata* (iflg. ROGER, 1939, p. 210) adskiller sig fra denne ved 1) sin flade eller kun lidt indtrykte ventralskal, 2) sine mere fremspringende, men mindre spidse hjørner på venstreskallen, 3) sine oftest stærkere markerede folder og 4) sin mindre åbne apikalvinkel. — *C. clavata* hører til de almindeligste muslinger ved Gram. Det er bemærkelsesværdigt, at arten ikke forekommer i aflejringer ældre end Pliocæn i Middelhavsområdet.

6. *Astarte* (*Carinastarte*) *reimersi* SEMPER in RAVN, 1907. (Tavle II, fig. 1a, b).

Beskrivelse af RAVN (1907, p. 272). Arten er langt den almindeligst forekommende i Gram-leret i Sønderjylland. Der er kun ringe mulighed for forveksling med andre arter. I det hollandsk-belgiske Pliocæn forekommer en nærstående form: *A. trigonata* NYST (Tavle II, fig. 2a, b; beskrevet af NYST, 1881, p. 195, t. XXI, f. 6 og HEERING, 1950. a, p. 73, t. I, f. 3-5,9), som adskiller sig fra *A. reimersi* ved sit høje, spidse umbonalparti, sin skarpe begrænsning af lunula og area og ved, at skalranden fra umbo til bageste hjørne danner en udspændt bue, medens vinklen mellem ventralranden og bageste dorsalrand iøvrigt er mere stump. *A. rollei* SEMPER fra Morsum Kliff på Sild (Tavle II, fig. 3a, b) er en anden nærstående form (RAVN, 1907, p. 270), som har tydeligt fladere skaller. *A. vetula* PHILIPPI (Tavle II, fig. 4a, b; se endvidere HINSCH, 1952, p. 149) har derimod stærkere hvælvet skal, dybere nedsænket lunula og area og større skallængde i forhold til skallens højde. *Astarte anus* PHILIPPI (Tavle II, fig. 5) har folder i stedet for radialribber, er mindre trekantet af omrids og har en kun svag carina. — Der er foretaget en variationsstatistisk undersøgelse i lighed med HINSCH (1952, p. 150—154). Resultatet er gengivet på kurverne p. 38—39 og skemaet p. 36–37. Værdierne er beregnet ved hjælp af formlerne p. 37 og 40, hvor M = middelværdien, x = den målte enkeltværdi, n = antallet af målte skaller, σ = standardafvigelsen, d = afvigelsen fra middelværdien (x—M), σ_M = middelfejlen på middelværdien, σ_σ = middelfejlen på standardafvigelsen. Værdierne og kurverne for populationerne fra Gram, Spandetgård og Ravning stemmer så nøje overens, at det vil være rimeligt at antage, at disse populationer er af fuldstændig samme karakter.

7. *Cardita* (*Cyclocardia*) *orbicularis* (SOWERBY, 1825).
Omtalt af RAVN (1907, p. 267) fra Gram. Materialet er ikke forøget siden da.

8. *Kellyella* (*Kellyella*) sp.
Skallen cirkelrund med midtstillet, indad- og lidt fremadkrummet umbo. Skaloverfladen glat, med svage spor af koncentriske tilvækstlinier. Skalranden glat. Foran umbo en fure mellem skalranden og den lange tand, som bagtil er fortykket og har et indhak, der passer til højreskallens tand. Arten ikke tidligere beskrevet. Der henvises til SORGENFREI's beskrivelse i et kommende arbejde om mellemmiocæne mollusker.

9. *Isocardia* (*Isocardia*) *forchhammeri* BECK in RAVN, 1907. (Tavle III, fig. 1 a,b).
Beskrivelse af RAVN (1907, p. 273). Arten afviger fra den recente *I. humana* LINNÉ = *I. cor* LINNÉ bl.a. ved at være lidt mere langstrakt, ved sin mindre buede (ofte endda helt lige) ventralrand, ved sin mindre snoede umbo og ved sin mindre skarpt afgrænsede area. Fragmenter af *I. forchhammeri* er meget almindelige i Gram-leret, men hele skaller er sjældne.

10. *Thyasira* (*Thyasira*) sp. (Tavle I, fig. 7).
Der er fundet en ubestemmelig dobbeltskal af denne slægt ved Gram.

11. *Corculum* (*Papillicardium*) *papillosum* (POLI, 1795). (Tavle I, fig. 6a,b.).
Skallen kredsformet. Overfladen dækkes af ca. 25 flade radialribber, hvis bredde tiltager mod skallens yngste del. De bærer talrige, regelmæssige, runde knuder, og deres mellemrum er lidt smallere end ribberne selv og bærer talrige tværgående striber, hvis antal forøges på skallens yngste del. De to eneste velbevarede venstreskaller har en under umbo beliggende kardinaltand, som er ret kraftig og lidt udtrykket i transversal retning. Den er bagtil begrænset af en relativ stor triangulær udhuling, bestemt til en af højreskallens kardinaltænder. Forreste lateraltand er tynd, længere, mindre fremtrædende og næsten sammenfaldende med den bageste dorsalrand. Bagtil er den furet af en svag udhulning. — Arten har stor lighed med *C. straeleni* GLIBERT (1945, p. 174, pl. XI, f. 1.) fra Belgiens Anversien, som dog synes at have flere transversalstriber pr. mm ribbemellemrum.

12. *Spisula* (*Spisula*) *subtruncata* (DA COSTA 1778), var. *triangula* (RENIERI, 1804). (Tavle II, fig. 6a,b).
Denne art er beskrevet under betegnelsen *Mactra trinacria* SEMPER af RAVN, 1907, p. 281.

13. *Abra* (*Abra*) *prismatica* (MONTAGU, 1808). (Tavle I, fig. 4).
Arten er beskrevet og afbildet af AD. S. JENSEN & R. SPÄRCK, 1934, p. 141. Fra Gram kendes kun brudstykker.

14. *Teredo* sp. (Tavle III, fig. 2).

Fra Gram foreligger flere fragmenter med en karakteristisk skulptur, der svarer til den, man finder hos en art, som vil blive beskrevet og afbildet af TH. SORGENFREI i et kommende arbejde.

15. *Thracia* (*Thracia*) cfr. *ventricosa* PHILIPPI, 1844. (Tavle II, fig. 7).

I Gram teglværks lergrav er fundet rester af en *Thracia*, som bedst kan sammenlignes med *T. ventricosa*, som er beskrevet af RAVN, 1907, p. 283 (afbild. hos RAVN, tavle II, f. 11).

16. *Cochlodesma* sp.

6 umbonalpartier fra Gram med den karakteristiske store, ovale båndplade.

Scaphopoda.

17. *Cadulus* (*Gadila*) *gadus* (MONTAGU, 1803). (Tavle III, fig. 3).

Kun brudstykker. Hos slægten *Cadulus* er den midterste del af skallen som bekendt opsvulmet, men fragmenter med tydeligt aftagende skalbredde til begge sider af en sådan opsvulmning er ikke fundet blandt materialet fra Gram.

Gastropoda.

18. *Adeorbis carinatus* (PHILLIPI, 1843). (Tavle III, fig. 4a,b,c).

Skallen fladt hvælvet, cirkelrund, bestående af 4—5 vindinger, hvis bredde tiltager stærkt, således at den yngste vinding er næsten dobbelt så bred som de andre tilsammen. Protoconchen og de ældste vindinger uden skulptur. En sådan synes først at optræde i løbet af næstsidste vinding i form af spiraler på det fladere parti under suturen. På den yngste vinding ses talrige spiraler, der dog ligger tættest og er smallest på det flade øvre parti. Midt på samme vinding en perifer carina, der afgrænser skallens basis fra den hvælvede overside. Basis domineres af en bred navle inde i hvilken de øvrige vindinger tydeligt ses. Midt mellem navlen og den perifere carina en ny, relativt svag carina. Mellemrummene mellem denne og de to nævnte komponenter udstyret med svage, flade spiraler. Tilvækstlinierne er synlige på hele skallen som regelmæssige buer. Mundingen er skævt oval. — *A. carinatus* er overvejende fundet i nordtyske mellem- og øvreoligocæne lag. Ved Gram er den hidtil kun fundet i de finsandede sedimenter.

19. *Turritella* (*Turritella*) *tricarinata* (BROCCHI, 1814). (Tavle IV, fig. 1a,b).

Der henvises til RAVN's beskrivelse (1907, p. 296).

20. *Turritella* (*Archimediella*) *archimedis* BRONGNIART, 1823. (Tavle IV, fig. 2).

Se RAVN, 1907, p. 296.

21. *Opalia* (*Pliciscala*) *vilandti* (MØRCH, 1874). (Tavle IV, fig. 3).
Arten er beskrevet af RAVN, 1907, p. 295 (*Scalaria Vilandti*).

22. *Xenophora* (*Xenophora*) *testigera* (BRONN, 1831). (Tavle IV, fig. 5a, b).
Skallen trochoid. Protoconchen består af 4—5 glatte vindinger, af hvilke de yngste har buede tilvækstlinier. De øvrige vindinger er forsynede med uregelmæssig overflade, men er iøvrigt flade. Ingen skulptur ud over ret udviskede spiraler på de yngste vindinger, som også bærer mere fremtrædende spiraler lige over suturen. Her findes også de for slægten karakteristiske aftryk af fremmedlegemer (molluskskaller, bryozorester o.lign.). Basis er begrænset af en skarp nedadvendt perifer kant. Iøvrigt er den forsynet med talrige tilvækstlinier, der udgår fra navlepartiet i retning vinkelret på periferien. Efter at $^2/_3$ af afstanden til denne er tilbagelagt svinger de i en stor bue bagud og forløber derefter parallelt med periferien. Omkring navlepartiet ses de svage spor af enkelte flade spiraler.

23. *Aporrhais alata* (EICHWALD, 1830). (Tavle IV, fig. 4a, b).
Der foreligger kun een hel skal fra Gram. Protoconchen er afbrudt. Skulpturen på de øvrige vindinger (ialt 6) består af spiraler og buede forhøjninger, som følger tilvækstlinierne. Disse forhøjninger bliver kraftigere på den følgende vinding, og under midten af den næstfølgende svulmer forhøjningerne op til knuder, som på den yngste vinding bliver korte og kraftige, ligesom deres mellemrum efterhånden er blevet fordoblet. På yngste vinding tælles 18 knuder, på næstyngste ca. 21. Spiralen umiddelbart over den aperturale sutur bliver efterhånden mere listeformet. På næstyngste vinding ses antydning af knudedannelse. På yngste vinding findes 3 knudebærende carinae: 1. øverst: fortsættelsen af den kraftige knuderække, 2. i midten: fortsættelsen af spiralen over den aperturale sutur og 3. nederst: en ny tilkommen køl. Disse carinae fortsætter sammen med spiralerne ud på vingen. Kølene danner her ribber, som ender i vingens hjørner. Fra den øverste af disse strækker en bræmme sig langs skallen op til den fjerde af de bevarede vindinger. Bræmmens rand er afbrækket. Inderlæben er kun ringe udbredt. Mundingen er rektangulær og ender nedadtil i en meget kort, hårtynd kanal. En rendeformet sænkning går fra mundingen mod den øverste udvækst af vingen. — Skallen fra Gram har størst affinitet til *A. alata*, men der er også træk som minder om den recente *A. pes pelecani* L., f. ex. den sekundære knuderække umiddelbart over den aperturale sutur.

24. *Polynices* (*Lunatia*) *helicina* (BROCCHI, 1814). (Tavle IV, fig. 6a, b).
Omtale hos RAVN, (1907, p. 294). Fra Øvre Miocænets øvrige *Natica*-arter adskilles nærværende art ved, at tilvækslinierne straks under suturen har retning mod umbilicus, og ved at denne er ret stor og forholdsvis tydeligt afgrænset.

25. *Polynices* (*Lunatia*) *alderi* (FORBES, 1838). (Tavle IV, fig. 8a, b).
Beskrivelse hos RAVN (1907, p. 292). Artens hovedkarakterer er følgende:

Under den apikale sutur kan forekomme en svag depression. Tilvækstlinierne går ikke straks under suturen i en lige linie i retning mod umbilicus, men er på vindingernes øverste del (i depressionen) buede, før de bliver retlinede. Umbilicus er ikke tydeligt afgrænset. Den indre mundingsrands vinkel med skallens akse er noget mindre end den tilsvarende vinkel hos *P. helicina*.

26. *Polynices* (*Polynices*) *koeneni* (SACCO, 1891). (Tavle IV, fig. 7a, b).
Beskrivelse hos RAVN (1907, p. 291, under navnet *N. plicatula* BRONN). Artens hovedkarakterer er følgende: Tilvækstlinierne danner smalle skarpe folder på partiet under den apikale sutur. Den største del af navleåbningen dækkes af en pløk, som er en udposning af den indre mundingsrand. Spiret er lavt.

27. *Polynices* (*Polynices*) *submamillaris* (D'ORBIGNY, 1852). (Tavle V, fig. 1a, b).
Beskrivelse hos RAVN (1907, p. 291, under navnet *N. Josephinia* RISSO). Artens hovedkarakterer er følgende: Lavt spir og stor og velafgrænset, halvcirkelformet umbilicus. Mundingens inderlæbe breder sig forholdsvis lidt ind ved yngste vinding og afskærer kun et lille stykke af øverste hjørne af umbilicus.

28. *Cassidaria echinophora* (LINNÉ, 1758). (Tavle V, fig. 3).
Beskrivelse hos RAVN (1907, p. 306).

29. *Phalium* (*Semicassis*) *miolaevigatum* (SACCO, 1890). (Tavle V, fig. 4).
Arten er beskrevet hos RAVN, 1907, p. 309, under navnet *Cassis saburon* (kendes kun recent), medens de i Middelhavets Pliocæn forekommende exemplarer benævnes *P.* (*S.*) *laevigatum* (DEFRANCE), og de miocæne kaldes *P.* (*S.*) *miolaevigatum*. Der synes imidlertid at være jævne overgange mellem disse former.

30. *Pyrula condita* BRONGNIART, 1823. (Tavle V, fig. 5a, b).
Der foreligger kun een skal, der mangler det meste af slutningsvindingen. Apex er meget stump, næsten flad. På vindingerne og de bevarede dele af slutningsvindingen (de øvre, flade partier) ses skulpturen at bestå af affladede spiraler, adskilte ved meget brede mellemrum, som krydses af talrige hårtynde, radiært forløbende tilvækstlinier. Derimod findes ingen sekundærspiraler mellem hovedspiralerne. Arten har været gjort identisk med den pliocæne og recente *P. reticulata* LAM.

31. *Murex* cfr. (*Tubicauda*) *spinicosta* BRONN, 1831. (Tavle V, fig. 2).
Fra Gram foreligger kun 2 juvenile skaller, som ikke kan bestemmes med sikkerhed. Protoconchens godt 5 hvælvede vindinger viser sig under stærk forstørrelse at være besat med talrige, ganske små forhøjninger, og dens afslutning mod de voksne vindinger dannes af en bladformet, buet ribbe, som en tid har udgjort mundingsranden. Skulpturen på den følgende vinding udgøres af kraftige tværribber. På den bedst bevarede af skallerne ses kun 4 sådanne. De krydses af 3 ret kraftige og 2 svagere spiraler, der begge er næsten lige kraf-

tige. Ved passagen over ribberne danner alle disse spiraler en lille tap. Den øverste af de kraftige spiraler forårsager ved passagen over tværribberne et knæk på disse, således at vindingen bliver kantet. Tappen, der dannes ved denne spirals krydsning med den sidste tværribbe på den bedst bevarede skal, er lidt udtrukket.

32. *Trophon* (*Pagodula*) *vaginata* JAN (1832) *var. semperi* v. KOENEN, 1872. (Tavle V, fig. 6).

Der foreligger to skaller fra Gram: et lille, ufuldstændigt, juvenilt exemplar og en udvokset skal, der mangler kanalen og er lidt korroderet på overfladen. Det juvenile exemplar mangler den ældste del af protoconchen og besidder kun de to nederste af dennes vindinger, der begge er stærkt hvælvede. Den øverste synes at have talrige små gruber strøet ud over hele vindingen. Den nederste er fuldstændig glat. Efter protoconchen følger en vinding med tværlameller, hvoraf den yngste er udtrukket i en opadrettet tap. — Den udvoksede skal er så ødelagt af forvitring på protoconchen og de 3—4 følgende vindinger, at skaloverfladen kun delvis er bevaret. På hver af vindingerne findes en carina omtrent på midten. Ved passagen over denne er lamellerne (ialt 11—12) trukket ud i tappe. Midt på partiet under carina'en findes en ret kraftig spiral. På det tilsvarende parti af slutningsvindingen forekommer 4 spiraler.

33. *Typhis* (*Cyphonochelus*) *fistulosus* (BROCCHI, 1814). (Tavle VI, fig. 1a,b).

Beskrivelse hos RAVN (1907, p. 321) under navnet *Tiphys Schlotheimi* BEYRICH.

34. *Liomesus ventrosus* (BEYRICH, 1856). (Tavle VI, fig. 2).

Beskrivelse hos RAVN (1907, p. 313) under navnet *Buccinopsis Dalei* SOW. sp., hvortil skallerne fra Sønderjylland tidligere henførtes.

35. *Sipho* (*Sipho*) *distinctus* (BEYRICH, 1856). (Tavle VI, fig. 3a,b).

Beskrivelse hos RAVN (1907, p. 334).

36. *Nassa* (*Telasco*) *bocholtensis* (BEYRICH, 1854). (Tavle VI, fig. 5a,b).

Beskrivelse hos RAVN (1907, p. 316).

37. *Nassa* (*Telasco*) *syltensis* (BEYRICH, 1854). (Tavle VI, fig. 4a,b).

Beskrivelse hos RAVN (1907, p. 317).

38. *Nassa* (*Uzita*) *prismatica* (BROCCHI, 1814). (Tavle VII, fig. 1a,b).

Den eneste skal (fra Gram), der foreligger, har ialt 8 vindinger. Apex er temmelig spids. Protoconchen består af 2—3 vindinger, som er fuldstændig glatte. På de flg. vindinger optræder en skulptur af 10—12 spiraler, der er flade og bredere end deres mellemrum, samt 17—20 axialribber. Disse er smallere end deres mellemrum og er på de yngre vindinger ikke særlig markerede.

39. *Aquilofusus semiglaber* (BEYRICH, 1856). (Tavle VII, fig. 2a, b).
Beskrivelse hos RAVN (1907, p. 329).

40. *Aquilofusus puggaardi* (BEYRICH, 1856). (Tavle VII, fig. 3).
Beskrivelse hos RAVN (1907, p. 330).

41. *Uromitra cimbrica* (OPPENHEIM) in KAUTSKY, 1925. (Tavle VII, fig. 4).
Beskrivelse hos RAVN (1907, p. 336) under navnet *Mitra Borsoni* BELLARDI.

42. *Cancellaria* (*Narona*) *calcarata* (BROCCHI, 1814). (Tavle VII, fig. 7).
Der foreligger kun et meget ufuldstændigt exemplar (fra Gram), bestående af sidste vinding og fragmenter af den foregående. Skallens skulptur er meget karakteristisk. Vindingerne er skarpkantede af omrids. Fra øverste sutur går vindingen næsten vinkelret udad og danner en kant, idet det følgende parti pludseligt sænker sig vinkelret ned mod nederste sutur. På sidste vinding er partiet mellem kanten og den øverste sutur svagt skrånende. Under kanten skråner vindingen indad, således at partiet over og under står vinkelret på hinanden. En ny kant dannes i fortsættelse af den yngste vindings øverste sutur og ender på den ydre mundingsrand ca. halvvejs mellem den foregående kant og skallens nederste afslutning. Partiet under denne kant skråner atter stærkt indad. På vindingerne findes 8 skarpkantede axialribber, som ved passagen over kanterne er trukket ud i tappe. Ribberne er svagt skråtstillede og buer lidt. De findes, omend betydeligt svækkede, helt ned til skallens afslutning. Mellem de nævnte skulpturelementer ses ingen yderligere skulptur. Mundingen er trapezformet. På columella ses to skrå folder. Navlespalten på siden af columella er meget snæver og næsten usynlig. Skallen har næppe været over $^1/_2$ cm høj.

43. *Cancellaria* (*Narona*) *rothi* (SEMPER, 1861). (Tavle VII, fig. 8a, b).
Beskrivelse hos RAVN (1907, p. 340).

44. *Admete* (*Babylonella*) *subangulosa* (S. WOOD, 1848). (Tavle VII, fig. 5a, b).
Beskrivelse hos RAVN (1907, p. 340).

45. *Drillia* (*Spirotropis*) *modiola* (JAN, 1832). (Tavle VII, fig. 6).
Beskrivelse hos RAVN (1907, p. 356).

46. *Turris* (*Fusiturris*) *helena* (SEMPER, 1861). (Tavle VIII, fig. 1a, b).
Beskrivelse hos RAVN (1907, p. 357). Denne art sammenlignes af GLIBERT (1954, p. 11) med *T.* (*F.*) *duchasteli forma flexiplicata* KAUTSKY. Exemplarer af denne art, hvor axialskulpturen er stærkt udvisket, har stor lighed med *T.* (*F.*) *helena*.

47. *Turris* (*Gemmula*) *badensis* (R. HOERNES, 1875). (Tavle VIII, fig. 2a,b).
Beskrivelse hos RAVN (1907, p. 355). Protoconchen består af 5—6 relativt stærkt hvælvede vindinger, hvoraf de 1—2 øverste er glatte, medens de resterende ca. 4 vindinger bærer en axialskulptur af tynde, stærkt ophøjede ribber i et antal af ca. 17 pr. vinding. På flankerne af disse ribber ser man ved stor forstørrelse (ved undersøgelsen anvendes 32×) talrige, ganske tynde, svagt ophøjede striber vinkelret på ribben. De når som regel kun et kort stykke frem i ribbernes mellemrum; undertiden når de dog helt over til den modsatte ribbe. Ribberne bøjer ganske tæt over den aperturale sutur pludseligt parallel med denne. Tæt under den apikale sutur forekommer en svagt markeret liste eller spiral. — Denne art henførtes tidligere til *Pleurotoma rotata* (BROCCHI). Senere har KAUTSKY (1925, p. 161), der kendte materialet fra Wienerbækkenet, identificeret den med *T. badensis*.

48. *Turris* (*Hemipleurotoma*) *annae* (HOERNES & AUINGER, 1891). (Tavle VIII, fig. 3a,b).
Beskrivelse hos RAVN (1907, p. 354 under navnet *P. turricula* BROC.). Protoconchen er relativ stor, nærmest trochoid og består af indtil 5 vindinger, hvoraf de ældste 3—4 synes skulpturløse, medens de 1—$1^1/_2$ yngste bærer buede axialribber. Disse protoconchvindinger tiltager ret stærkt i bredde med alderen. — Den pliocæne *Pleurotoma turricula* (BROCCHI), som den foreliggende art først blev identificeret med, er gennemgående uden knudedannelse på spiralbåndet under den apikale sutur og på carina'en.

49. *Turris* (*Crassispira*) *obeliscus* (DES MOULINS, 1841). (Tavle VIII, fig. 4).
Beskrivelse hos RAVN (1907, p. 353). Den bedst bevarede skal fra Gram har den øverste del af protoconchen afbrudt og har desuden ialt 8 vindinger. Spiralbåndet under suturen er velmarkeret, og depressionen derunder relativt dyb. Axialribberne er korte og brede. På de yngste vindinger er spiralskulpturen meget svag og udvisket.

50. *Haedropleura maitreja* (SEMPER in v. KOENEN, 1872). (Tavle VIII, fig. 5).
Der foreligger kun 2 noget korroderede exemplarer. Arten vil blive beskrevet ved en anden lejlighed.

51. *Brachytoma obtusangula* (BROCCHI, 1814). (Tavle VIII, fig. 6a,b).
Beskrivelse hos RAVN (1907, p. 359).

52. *Asthenotoma sp.* (Tavle IX, fig. 1a,b).
Denne art er muligvis ny. Materialet er kun blevet forøget med een skal fra Gram. Der henvises til RAVN's beskrivelse af *Mangilia sp.* (1907, p. 360).

53. *Bathytoma cataphracta* (BROCCHI, 1814). (Tavle IX, fig. 3a,b).
Beskrivelse hos RAVN (1907, p. 350).

54. *Cythara* (*Mangelia*) *kochi* (v. KOENEN, 1872). (Tavle VIII, fig. 7).
Beskrivelse hos RAVN (1907, p. 360).

55. *Lienardia luisae* (SEMPER in v. KOENEN, 1872). (Tavle IX, fig. 2a, b).
Beskrivelse hos RAVN (1907, p. 359).

56. *Philbertia* (*Philbertia*) *reticulata* (RENIERI, 1804). (Tavle IX, fig. 5a, b).
Kun een af de foreliggende skaller er fuldstændig. De øvrige er fragmentariske. Protoconchen består af 4—5 vindinger, hvoraf den ældste er glat og knopformet. På de øvrige findes talrige, buede, ganske tynde axialribber, som på vindingernes nederste del bliver skrå, retlinede og samtidig krydses af et system af ribber, der forløber skråt, vinkelret på det første system, således at der dannes et fint diagonalnet med rhombiske masker. De 4 øverste vindinger er regelmæssigt hvælvede, men på den femte optræder en skarp, savtakket carina på midten. Under denne carina dannes efterhånden en spiral, og en lignende ses tæt over den nederste sutur. De følgende vindinger bærer en kraftig skulptur af relativt grove, næsten lige, axialribber (ialt 12—14 pr. vinding), hvis mellemrum er mindst dobbelt så brede som ribberne selv. Disse krydses af 3 skarpe spiraler, ved hvis passage over ribberne, der dannes en lille tap. Den øverste af spiralerne ses på overgangen mellem ældste protoconchvinding og den følgende vinding at være fortsættelsen af den omtalte carina. Den næstøverste spiral danner fortsættelsen af spiralen under carina'en på sidste protoconchvinding, og denne vindings spiral tæt over suturen fortsætter i den tredie af spiralerne på det voksne stadiums vindinger. Tidligt på den første af disse antyder en lille forhøjning på det over øverste spiral liggende parti på ribberne anlægget af endnu en spiral, som træder lidt tydeligere frem på de yngre vindinger.

57. *Acamptogenotia intorta* (BROCCHI, 1814). (Tavle X, fig. 1a, b).
Beskrivelse hos RAVN (1907, p. 343).

58. *Conus* (*Conospira*) *antediluvianus* BRUGUIÈRE, 1782. (Tavle IX, fig. 4a, b).
Beskrivelse hos RAVN (1907, p. 362).

59. *Actaeon sp.*
Der foreligger kun en lille defekt og ubestemmelig skal fra Gram.

60. *Odostomia* (*Odostomia*) *conoidea* (BROCCHI, 1814). (Tavle X, fig. 5).
Beskrivelse hos RAVN, 1907, p. 299. *Odostomia fraterna* SEMPER, der angives at forekomme i Nordsøbækkenets Oligocæn og Miocæn er slankere, har en mere afrundet slutningsvinding og en indre mundingsrand, som lægger sig tæt op til den foregående vinding uden den navlespalte, som findes hos *O. conoidea*.

61. *Eulimella* (*Eulimella*) *scillae* (SCACCHI, 1836). (Tavle X, fig. 2).
Spiret tårnformet, ret slankt. Vindingernes antal 10 (foruden den heterostrofe

protoconch), flade, glatte og adskilte ved en dyb, skråt liggende sutur. Sidste vinding med stejlt fald mod basis. Afrundet kant i suturens fortsættelse. Mundingen rhombeformet. Ydre mundingsrand glat, ikke fortykket. Indre mundingsrand retlinet, simpel. Ingen umbilicus, men smal spalte mellem mundingsrand og vinding.

62. *Pyramidella* (*Pyramidella*) *plicosa* BRONN, 1838. (Tavle X, fig. 6).
Beskrivelse hos RAVN, 1907, p. 300. Ikke tidligere omtalt fra Øvre Miocænet i Danmark.

63. *Retusa* (*Cylichnina*) *elongata* (EICHWALD, 1830). (Tavle X, fig. 3a,b).
Beskrivelse hos RAVN (1907, p. 366).

64. *Cylichna* (*Cylichna*) *cylindracea* (PENNANT, 1777). (Tavle X, fig. 4a,b).
Beskrivelse hos RAVN (1907, p. 367).

Pteropoda.

65. *Spiratella atlanta* (MØRCH, 1874). (Tavle X, fig. 7a,b,c).
Beskrivelse hos RAVN (1907, p. 369).

Alderen af molluskfaunaen fra Gram og de øvrige sønderjydske lokaliteter.

Den vigtigste lokalitet for studiet af molluskfaunaen i det sønderjydske Gram-ler er utvivlsomt Gram teglværk. Samtlige de mollusker, der er beskrevet i den palæontologiske del, er fundet på denne lokalitet. Under beskrivelsen af *Astarte reimersi* er på side 142 nævnt, at populationerne af denne art fra Gram, Ravning og Spandetgård viser samme variationsforhold. For de øvrige arters vedkommende er der ikke foretaget variationsstatistik, men de viser for alle tre lokaliteter så store overensstemmelser indbyrdes, at man uden videre kan antage de pågældende populationer for identiske. Molluskfaunaerne fra de tre lokaliteter må derfor også anses for at være praktisk taget synkrone. Da der ikke findes noget materiale fra Storlund og Tornskov i de danske samlinger bortset fra 2 skaller af *Astarte reimersi* fra Storlund, kan der ikke gøres rede for molluskfaunaens variationsforhold på disse lokaliteter, hvorfor de udelades af diskussionen. Til grundlag for denne lægges iøvrigt kun faunaen fra Gram, da molluskerne fra Ravning og Spandetgård kun kan betragtes som en fattigere repræsentation for den synkrone, meget rigere Gram-fauna.

Som omtalt tidligere (side 139) findes der to sedimentgrupper ved Gram teglværk: Gram-ler og en vekslen af finsandet glimmerler og leret glimmerfinsand (Gram-finsand). Desværre er indsamlingerne fra sidstnævnte serie først sent blevet holdt ude fra fossilerne fra Gram-leret. En indsamling fra de finsandede sedimenter i august 1952 resulterede i den på side 109—110 gengivne liste. Af disse 35 arters talmæssige fordeling synes at fremgå, at flg. 6 arter hører til de almindeligste i denne serie: *Leda* (*Jupiteria*) *pygmaea*, *Odostomia* (*Odostomia*) *conoidea*, *Turris* (*Gemmula*) *badensis*, *Polynices spp.*, *Yoldia* (*Yoldia*) *glaberrima*

og *Cythara* (*Mangelia*) *kochi*. Flg. arter er med sikkerhed kun fundet i de finsandede sedimenter: *Adeorbis carinatus* og *Actaeon sp.*

I Gram-leret, hvorfra hovedmængden af de undersøgte fossiler sandsynligvis stammer, er følgende 19 former almindeligst: *Nucula* (*Nucula*) *georgiana*, *Clamys* (*Peplum*) *clavata*, *Astarte* (*Carinastarte*) *reimersi*, *Isocardia* (*Isocardia*) *forchhammeri*, *Turritella* (*Turritella*) *tricarinata*, *Polynices* (*Lunatia*) *helicina*, *Polynices* (*Polynices*) *koeneni*, *Cassidaria echinophora*, *Phalium* (*Semicassis*) *miolaevigatum*, *Sipho* (*Sipho*) *distinctus*, *Nassa* (*Telasco*) *bocholtensis*, *Aquilofusus semiglaber*, *Cancellaria* (*Narona*) *rothi*, *Turris* (*Gemmula*) *badensis*, *T.* (*Hemipleurotoma*) *annae*, *Brachytoma obtusangula*, *Bathytoma cataphracta*, *Lienardia luisae* og *Conus* (*Conospira*) *antediluvianus*.

Der er intet i faunadifferencen, der umiddelbart kan tilskrives en aldersforskel. Forekomsten af *Leda pygmaea*, *Yoldia glaberrima* og *Odostomia conoidea* i de finsandede sedimenter er måske først og fremmest faciesbetonet.

Det vil fortsat være rimeligt at betegne Gram-faunaen som øvremiocæn i lighed med SEMPER (1861, p. 89), RAVN (1907) og HINSCH (1952).

Gram-faunaens relationer til andre marine neogene molluskfaunaer.

I. Nordsøbækkenet.

A. Øvre Miocænet. Det vil være naturligst først at sammenligne Gram-faunaen med de tilsvarende faunaer fra Nordtysklands Miocæn, hvor sedimenterne i den øverste del er af samme karakter som i det danske Øvre Miocæn. De tyske geologer anvender ofte betegnelsen »Glimmerton« for denne del af det nordtyske Miocæn. I Vest-Tyskland (vestlige Niedersachsen) og i Holland erstattes disse glimmerler-sedimenter øjensynlig af grønsand.

Molluskfaunaen i det nordtyske Øvre Miocæn er opført på listen side 113–117, hvor også faunaen fra Gram er taget med. Det ses af listen, at visse arter er repræsenteret på alle, eller næsten alle, lokaliteter, nemlig de på side 121 anførte 14 former. Det er særligt påfaldende, at på de få steder, man ikke har fundet *Aquilofusus eximius* finder man i stedet *A. semiglaber*, og hvor man ikke finder *Astarte vetula* synes man i stedet at finde *Astarte reimersi*. Med undtagelse af *Dentalium badense* er alle 14 arter kendt fra Gram. De fleste er tillige kendt fra Mellem Miocænet, men tre arter er kun fundet i Nordsøbækkenets Øvre Miocæn, nemlig *Sipho distinctus* (der dog også synes fundet i den pliocæne limonitsandsten på Sild, GRIPP, 1922), *Aquilofusus eximius* eller *A. semiglaber* og *Astarte vetula* eller *A. reimersi*. Da de samtidig plejer at forekomme i stort individantal, kan de indtil videre vælges til »ledefossiler« for Nordsøbækkenets Øvre Miocæn. På grundlag af listen side 113–117 og det ovenfor anførte kan der ikke være nogen tvivl om Gram-faunaens nære tilknytning til og aldersmæssige samhørighed med det nordtyske »Glimmerton«.

Mægtigheden af dette »Glimmerton« kan i Hamburgområdet (iflg. GRIPP, 1920, p. 16—18) nå op på ca. 250 m. Selv om dette kun er et sjældent og under særlige forhold forekommende maximum, regner man dog ofte med mægtigheder på over 100 m. Det ville derfor være rimeligt at antage en vis forskel på faunasammensætningen i henholdsvis de nederste og de øverste lag. De yngste lag af »Glimmerton« antages at findes i Morsum Kliff på Sild (se GRIPP, 1922),

hvor det underlejrer den pliocæne limonitsandsten. Imidlertid findes der muligvis et basiskonglomerat indskudt mellem limonitsandstenen og glimmerleret. Da man ikke kan vide, hvor stor en sedimentafbrydelse et sådant basiskonglomerat repræsenterer, kan man ikke uden videre gå ud fra, at de øverste glimmerlerlag er det aller yngste Øvre Miocæn. Imidlertid er profilet i Morsum Kliff den eneste tilgængelige og grundigst kendte, fossilførende forekomst, hvor Øvre Miocænet direkte overlejres af Pliocænet. Man har derfor hidtil uden videre betegnet glimmerleret her som det yngste.

Ved Hamburg (Langenfelde, Reinbek etc.) finder man glimmerleret underlejret af fossilførende, mellemmiocæne aflejringer uden mellemliggende transgressionskonglomerater. Glimmerleret her kan derfor anses for at repræsentere det ældste Øvre Miocæn. En undersøgelse af faunaen i dette glimmerler og i det påståede yngste glimmerler i Morsum Kliff har derfor dannet grundlag for overvejelser over en eventuel inddeling af Øvre Miocænet på grundlag af molluskfaunaen. Disse inddelingsforsøg skyldes Staesche 1930, Gripp 1933 og 1940, S. Thiele 1941 og W. Hinsch 1952. For de tre førstnævnte forfatteres vedkommende henvises til den engelske del side 122–126, hvor man let vil finde de pågældende geologers zoneinddeling. Her skal kun anføres det nyeste af inddelingsforslagene, nemlig Hinsch', der giver følgende inddeling:

Yngst: »Sylter Stufe«
»Grammer Stufe«
Ældst: »Langenfelder Stufe«.

De pågældende mollusker, som Hinsch mener karakteriserer de forskellige zoner, findes anført i citatet side 125–126, hvor man også vil finde opført de lokaliteter, hvor man ifølge Hinsch finder disse zoner.

Betragter man de tyske inddelingsforslag kritisk, må det først understreges, at man ikke kender noget fossilførende fuldstændigt profil gennem Øvre Miocænet med både underlejrende fossilførende Mellem Miocæn og overlejrende fossilførende Pliocæn. Man har altid været henvist til at stykke erfaringerne fra isolerede enkeltforekomster sammen, hvilket naturligvis indebærer store fejlmuligheder.

En anden indvending mod de ovennævnte inddelingsforslag er, at man i for høj grad har taget hensyn til visse sjældnere forekommende arter, som anses for karakteristiske for den pågældende zone eller under-etage. Erfaringen viser ofte, at sådanne sjældnere former pludseligt dukker op i zoner eller på lokaliteter, hvor de formodedes ikke at høre hjemme. Derfor er deres anvendelse som »ledefossiler« uheldig.

Bedre er det utvivlsomt at tage overvejende hensyn til de arter, der dominerer ved deres store individantal. Her har man gode muligheder for at undersøge variationerne inden for de forskellige populationer. Det er Hinsch' fortjeneste at have gennemført værdifulde undersøgelser på dette område. Der er tale om følgende slægter: *Astarte*, *Liomesus*, *Sipho*, *Aquilofusus*, *Uromitra*, *Cancellaria* (*Narona*), *Bathytoma* og *Turris* (*Gemmula*). Det er imidlertid et problem, om disse populationers forskelligheder skyldes økologiske forhold, temperaturforhold, forskel i alder eller andre forhold. Desværre ved man ikke

meget om kårenes indflydelse på populationerne og endnu mindre om tidsfaktorens betydning.

HINSCH betragter den sidstnævnte årsag som den afgørende for populationsdifferencerne i »Glimmerton«, idet han anser faciesforskellene mellem de forskellige lokaliteter for uvæsentlige. Heroverfor kan i overenstemmelse med det foregående indvendes, at også andre forhold end alder og facies har indflydelse på populationerne.

I Danmark forekommer på en lokalitet ved Maade øst for Esbjerg en øvremiocæn molluskfauna, som i nogen grad afviger fra den ved Gram teglværk. Den minder derimod meget om faunaen fra Langenfelde ved Hamburg (se sammenligningen mellem de to faunaers almindeligste arter i den engelske del side 130–131). Muligvis er forekomsten af *Astarte reimersi* ved Maade kun knyttet til de øverste lag dersteds, hvilket gør overensstemmelserne endnu mere påfaldende, og det kan allerede nu siges at flere af populationerne stemmer overens med de fra Langenfelde, således af flg. slægter: *Aquilofusus*, *Uromitra*, *Sipho*, *Cancellaria* (*Narona*), *Bathytoma* og *Turris* (*Gemmula*). Før Maade-forekomsten er færdigbearbejdet kan noget sikkert om populationernes optræden i profilet dog ikke siges.

Foreløbig kan med sikkerhed konstateres visse afvigelser fra molluskfaunaen fra Gram. Flg. former er meget almindelige ved Maade, men er enten slet ikke fundet ved Gram eller kun fundet i 1—2 exemplarer: *Limopsis aurita*, *Astarte radiata*, *Cardita orbicularis*, *Dentalium badense*, *Nassa holsatica*, *Aquilofusus luneburgensis*, *Lathyrus rothi*, *Uromitra wirtzi*, *Scaphella bolli* og *Cancellaria lyrata*. Omvendt er flg. ved Gram meget almindelige arter enten slet ikke fundet ved Maade eller kun fundet i 1—2 exemplarer: *Odostomia conoidea*, *Polynices koeneni*, *Phalium miolaevigatum*, *Nassa syltensis*, *Aquilofusus semiglaber*, *Cancellaria rothi*, *Admete subangulosa* og *Cythara kochi*.

Ved Maade synes der at være forskel på populationerne fra profilets øverste del (hvor også *Astarte reimersi* forekommer) og de fra den nederste del (som ligner Langenfelde-faunaen mest). Når undersøgelserne her er afsluttede, vil man måske vide mere om disse populationers variationsforhold. Foreløbig er det ikke muligt at drage videre slutninger om Gram-faunaens relation til de nordtyske faunaer og til Maade-forekomstens fauna. Øvre Miocænet ved Gram er derfor ikke henført til nogen af zonerne i de tyske inddelingsforslag.

B. Det øvrige Miocæn og Pliocænet. Med hensyn til de øvrige marine miocæne faunaer fra Nordvesteuropa vil der ikke være grund til at gå i detaljer, da STAESCHE (1930, p. 70) har påpeget, at et meget stort antal af Øvre Miocænets arter allerede fandtes i Mellem Miocænet, nemlig 108 af de 129 arter han omtaler. For Pliocænets vedkommende persisterede kun 34. For Gramfaunaens vedkommende er de tilsvarende tal henholdsvis 44 og 18 af 59 arter. Der synes altså at være større affinitet til Mellem Miocænets fauna. Relationerne til de pliocæne faunaer i Nordsøbækkenet er større for det sønderjydske Pliocæns vedkommende. En liste over de øvre miocæne former, der er fundet i Sønderjyllands Pliocæn findes i den engelske del side 135. Der skal iøvrigt ikke gås nærmere ind på disse faunarelationer her.

II. Øvrige Europa og Nordafrika.

Gram-faunaens forhold til faunaen i det øvrige Europa's og Nordafrikas marine Neogen vil ligeledes blive behandlet senere, når hele den danske øvremiocæne molluskfauna er færdigbearbejdet. Her skal kun understreges, at næsten alle de arter, som Gram-faunaen har fælles med de områder, som nævnes i fossillisten side 106–107, er fundet i Helvétien og Tortonien. På grund af det ret store antal former, som også er fælles med Pliocænet, må man anbringe Gram-faunaen og dens ækvivalenter i tidsrummet mellem Tortonien og det nederste marine Pliocæn (Plaisancien). I denne periode fandt der netop en regionalt omfattende regression sted, således at akkumulation af marine sedimenter kun foregik i få af de områder, som nu ligger over havets niveau. Imellem Tortonien og Plaisancien (= Piacentin) anbringer man i Europa to etager, som kun kendes i brakvands- og limnisk facies, nemlig Sarmatien og Pontien. Det marine, nordvesteuropæiske Øvre Miocæns relation til disse to tidsafsnit er det imidlertid ikke muligt at karakterisere nærmere på grundlag af det foreliggende materiale.

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INDEX TO FOSSIL SPECIES AND GENERA

The names of species and genera used in the present paper are printed in *italics*; all synonyms in Roman types.

PLATES

Plate I.

Fig. 1. *Nucula* (*Nucula*) *georgiana* SEMPER ..... p. 28 (141)
Loc.: Ravning. Coll.: D.G.U.
Right valve. × 1.
a) Exterior b) Interior.

– 2. *Leda* (*Jupiteria*) *pygmaea* (MÜNSTER) ..... p. 29 (141)
Loc.: Gram. Coll.: D.G.U.
Right valve. × 10.
a) Exterior b) Interior.

– 3. *Limopsis* (*Limopsis*) *aurita* (BROCCHI) ..... p. 31 (142)
Loc.: Gram. Coll.: D.G.U.
Left valve. × 2.5.
a) Exterior b) Interior.

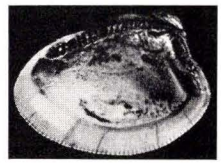
– 4. *Abra* (*Abra*) *prismatica* (MONTAGU) ..... p. 46 (143)
Loc.: Gram. Coll.: D.G.U.
Exterior of right valve. × 3.

– 5. *Chlamys* (*Peplum*) *clavata* (POLI) ..... p. 32 (142)
Loc.: Gram. Coll.: D.G.U.
Left valve. × 1.
a) Exterior b) Interior.

– 6. *Corculum* (*Papillicardium*) *papillosum* (POLI) ..... p. 43 (143)
Loc.: Gram. Coll.: D.G.U.
Left valve. × 15.
a) Exterior b) Interior.

– 7. *Thyasira* (*Thyasira*) *sp.* ..... p. 43 (143)
Loc.: Gram. Coll.: D.G.U.
Exterior of left valve. × 10.

a



b

1. Nucula georgiana (× 1).

a

b

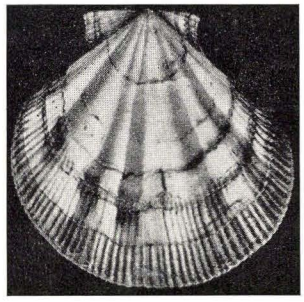
2. Leda pygmaea (× 10).

a

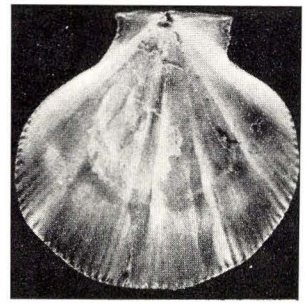
b

3. Limopsis aurita (× 2 ½).

4. Abra prismatica (× 3).



a



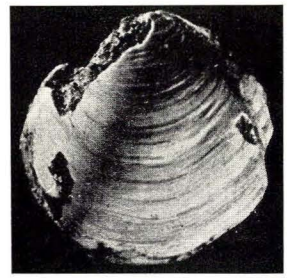
b

5. Chlamys clavata (× 1).

a

b

6. Corculum papillosum (× 15).



7. Thyasira sp. (× 10).

Chr. Westergaard phot.

Plate II.

Fig. 1. *Astarte* (*Carinastarte*) *reimersi* SEMPER . . . . . p. 34 (142)
a) Exterior of right valve. × 1.5.
Loc.: Gram. Coll.: D.G.U.
b) Interior of right valve. × 1.5.
Loc.: Storlund. Coll.: M.M.

– 2. *Astarte* (*Carinastarte*) *trigonata* NYST . . . . . p. 34 (142)
Loc.: Deurne (Belgium). Coll.: Mus. R. d'Hist. Nat. Belg., Bruxelles. No. 4147.
Right valve. × 1.5.
a) Exterior b) Interior.

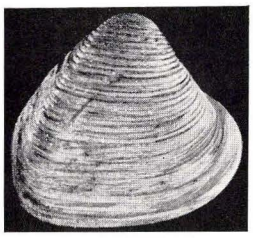
– 3. *Astarte* (*Carinastarte*) *rollei* SEMPER . . . . . p. 35 (142)
Loc.: Morsum Kliff, Sylt (Germany).
Coll.: D.G.U.
Left valve. × 1.5.
a) Exterior b) Interior.

– 4. *Astarte* (*Carinastarte*) *vetula* PHILIPPI . . . . . p. 35 (142)
Loc.: Wohltorf, Reinbek (Germany).
Coll.: D.G.U.
a) Exterior of right valve. × 1.5.
b) Interior of left valve. × 1.5.

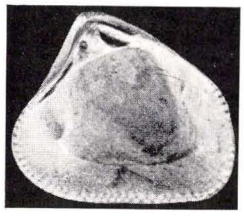
– 5. *Astarte* (*Ashtarotha*) *anus* PHILIPPI . . . . . p. 35 (142)
Loc.: Langenfelde (Germany). Coll.: M.M.
Right valve. × 1.5.
a) Exterior b) Interior.

– 6. *Spisula* (*Spisula*) *subtruncata* DA COSTA *var. triangula* RENIERI . . . . . p. 45 (143)
Loc.: Gram. Coll.: M.M.
Right valve. × 8.
a) Exterior b) Interior.

– 7. *Thracia* (*Thracia*) *cfr. ventricosa* PHILIPPI . . . . . p. 48 (144)
Loc.: Gram. Coll.: D.G.U.
Exterior of right valve. × 1.5.

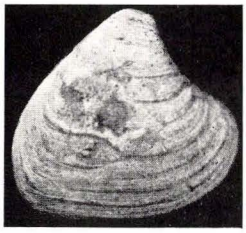


a

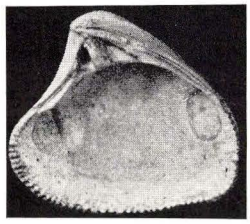


b

1. Astarte reimersi (× 1 ½).

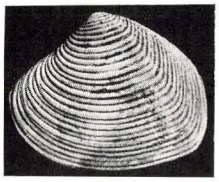


a

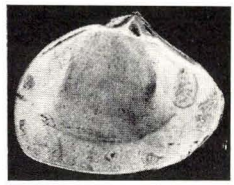


b

2. Astarte trigonata (× 1 ½).



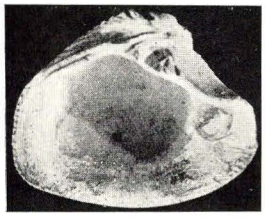
a



b

3. Astarte rollei (× 1 ½).

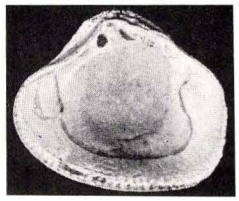
a



b

4. Astarte vetula (× 1 ½).

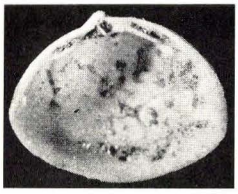
a



b

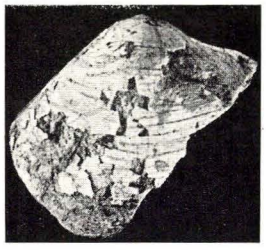
5. Astarte anus (× 1 ½).

a



b

6. Spisula subtruncata triangula (× 8).



7. Thracia cfr. ventricosa (× 1 ½).

Fig. 2. Bent Søndergaard phot., fig. 1, 3-7. Chr. Westergaard phot.

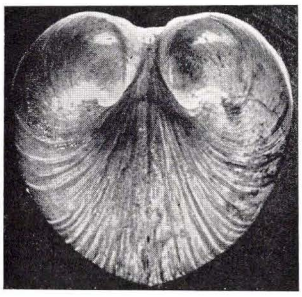
Plate III.

Fig. 1. *Isocardia* (*Isocardia*) *forchhammeri* Beck ..... p. 41 (143)
Loc.: Gram. Coll.: D.G.U.
a) Profile of double valves. × 1.
b) Exterior of right valve. × 1.

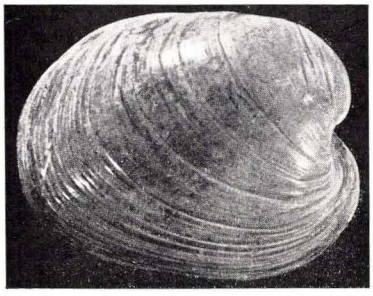
– 2. *Teredo sp.* ..... p. 48 (144)
× 10. Loc.: Gram. Coll.: D.G.U.

– 3. *Cadulus* (*Gadila*) *gadus* (Montagu) ..... p. 49 (144)
× 10. Loc.: Gram. Coll.: D.G.U.

– 4. *Adeorbis carinatus* (Philippi) ..... p. 51 (144)
Loc.: Gram. Coll.: D.G.U.
a) Apical view. × 10.
b) Basal view. × 10.
c) Apertural view. × 10.

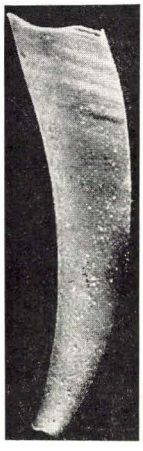


a

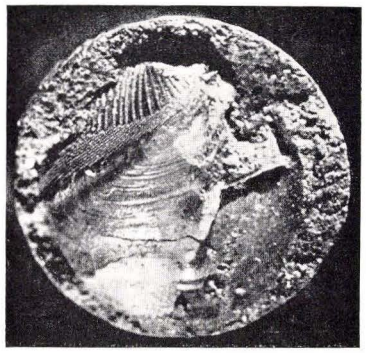


b

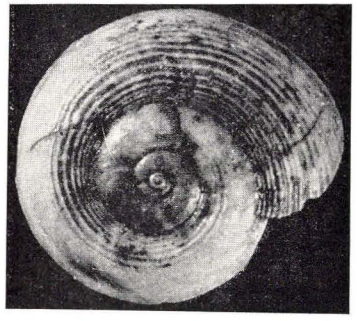
1. Isocardia forchhammeri (× 1).



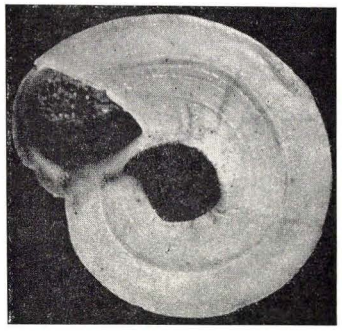
3. Cadulus gadus (× 10).



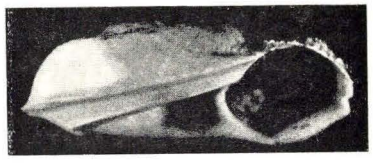
2. Teredo sp. (× 10).



a



b



c

4. Adeorbis carinatus (× 10).

Chr. Westergaard phot.

Plate IV.

Fig. 1. *Turritella* (*Turritella*) *tricarinata* (Brocchi)..... p. 52 (144)
Loc.: Gram. Coll.: D.G.U.
a) Apertural view. × 5.
b) Protoconch. × 20.

– 2. *Turritella* (*Archimediella*) *archimedis* Brongniart..... p. 53 (144)
Loc.: Gram. Coll.: D.G.U.
Apertural view. × 5.

– 3. *Opalia* (*Pliciscala*) *vilandti* (Mørch)..... p. 54 (145)
Loc.: Gram. Coll.: D.G.U.
Apertural view. × 10.

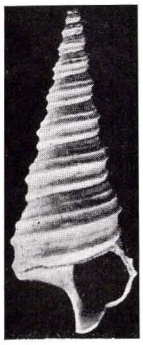
– 4. *Aporrhais alata* (Eichwald)..... p. 56 (145)
Loc.: Gram. Coll.: M.M.
a) Rear view. × 1.5.
b) Apertural view. × 1.5.

– 5. *Xenophora* (*Xenophora*) *testigera* (Bronn)..... p. 55 (145)
Loc.: Gram. Coll.: D.G.U.
a) Apertural view. × 3.
b) Basal view. × 3.

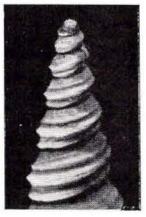
– 6. *Polynices* (*Lunatia*) *helicina* (Brocchi)..... p. 58 (145)
Loc.: Gram. Coll.: D.G.U.
a) Apical view. × 2.
b) Apertural view. × 2.

– 7. *Polynices* (*Polynices*) *koeneni* (Sacco)..... p. 60 (146)
Loc.: Gram. Coll.: D.G.U.
a) Apical view. × 2.
b) Apertural view. × 2.

– 8. *Polynices* (*Lunatia*) *alderi* (Forbes)..... p. 59 (145)
Loc.: Gram. Coll.: D.G.U.
a) Rear view. × 2.
b) Apertural view. × 2.



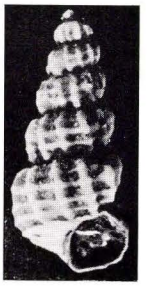
a (× 5)



b (× 20)

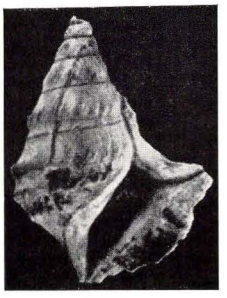
1. Turritella tricarinata.

2. Turritella archimedis (× 5).



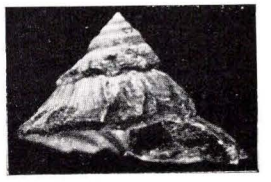
3. Opalia vilandti (× 10).

a

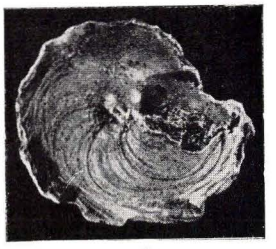


b

4. Aporrhais alata (× 1 ½).



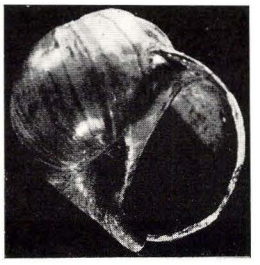
a



b

5. Xenophora testigera (× 3).

a

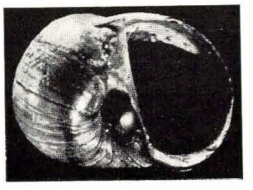


b

6. Polynices helicina (× 2).

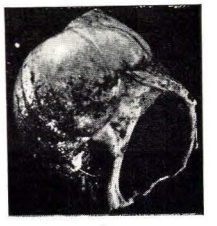
a

a



b

7. Polynices koeneni (× 2).



b

8. Polynices alderi (× 2).

Chr. Westergaard phot.

Plate V.

Fig. 1. *Polynices* (*Polynices*) *submamillaris* (D'ORBIGNY) . . . . . p. 60 (146)
Loc.: Gram. Coll.: M.M.
a) Rear view. × 2.
b) Apertural view. × 2.

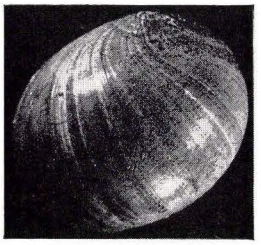
– 2. *Murex cfr.* (*Tubicauda*) *spinicosta* BRONN . . . . . p. 66 (146)
Loc.: Gram. Coll.: D.G.U.
Rear view. × 10.

– 3. *Cassidaria echinophora* (LINNÉ) . . . . . p. 61 (146)
Loc.: Gram. Coll.: D.G.U.
Apertural view. × 1.

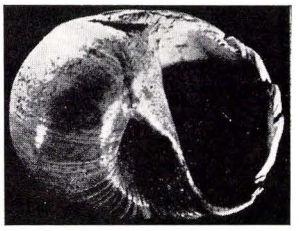
– 4. *Phalium* (*Semicassis*) *miolaevigatum* (SACCO) . . . . . p. 63 (146)
Loc.: Gram. Coll.: D.G.U.
Rear view. × 1.

– 5. *Pyrula condita* BRONGNIART . . . . . p. 65 (146)
Loc.: Gram. Coll.: D.G.U.
a) Apical view. × 1.5.
b) Apertural view. × 1.5.

– 5. *Trophon* (*Pagodula*) *vaginata* JAN *var. semperi* V. KOENEN p. 68 (147)
Loc.: Gram. Coll.: D.G.U.
Rear view. × 2.

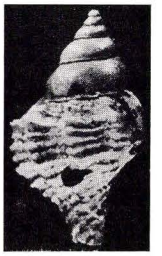


a

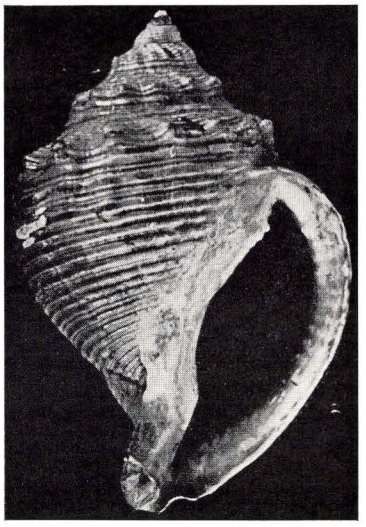


b

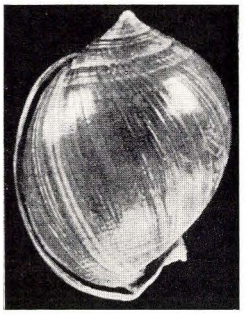
1. Polynices submamillaris (× 2).



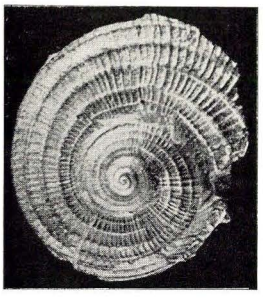
2. Murex cfr. spinicosta (× 10).



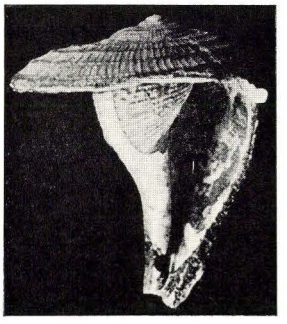
3. Cassidaria echinophora (× 1).



4. Phalium miolaevigatum (× 1).



a



b

5. Pyrula condita (× 1 ½).

6. Trophon vaginata semperi (× 2).

Chr. Westergaard phot.

Plate VI.

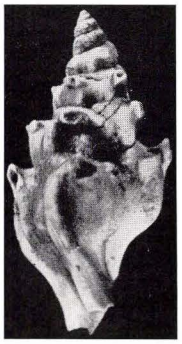
Fig. 1. *Typhis* (*Cyphonochelus*) *fistulosus* (Brocchi) ..... p. 69 (147)
Loc.: Gram. Coll.: D.G.U.
a) Rear view. × 5.
b) Protoconch. × 20.

– 2. *Liomesus ventrosus* (Beyrich) ..... p. 70 (147)
Loc.: Gram. Coll.: D.G.U.
Apertural view. × 1.

– 3. *Sipho* (*Sipho*) *distinctus* (Beyrich) ..... p. 71 (147)
Coll.: D.G.U.
a) Apertural view. × 1. Loc.: Ravning.
b) Protoconch. × 10. Loc.: Gram.

– 4. *Nassa* (*Telasco*) *syltensis* (Beyrich) ..... p. 73 (147)
Loc.: Gram. Coll.: D.G.U.
a) Rear view. × 5.
b) Protoconch. × 10.

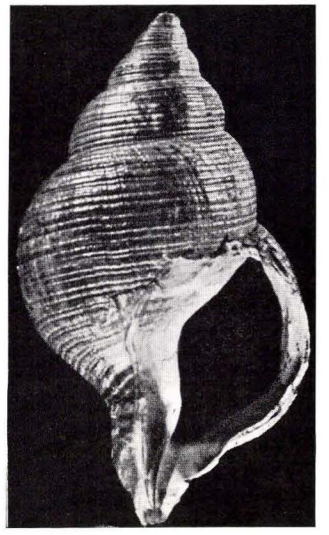
– 5. *Nassa* (*Telasco*) *bocholtensis* (Beyrich) ..... p. 72 (147)
Loc.: Gram. Coll.: D.G.U.
a) Rear view. × 5.
b) Protoconch. × 10.



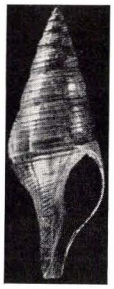
a (× 5).

b (× 20).

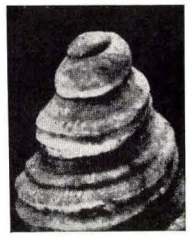
1. Typhis fistulosus.



2. Liomesus ventrosus (× 1).

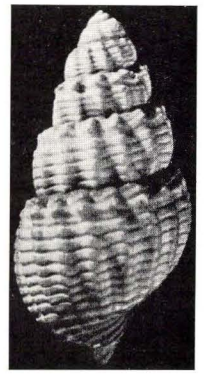


a (× 1).



b (× 10).

3. Sipho distinctus.



a (× 5).

a (× 5).

b (× 10).

4. Nassa syltensis.

b (× 10).

5. Nassa bocholtensis.

Chr. Westergaard phot.

Plate VII.

Fig. 1. *Nassa* (*Uzita*) *prismatica* (Brocchi) . . . . . p. 73 (147)
Loc.: Gram. Coll.: D.G.U.
a) Rear view. × 3.
b) Protoconch. × 10.

– 2. *Aquilofusus semiglaber* (Beyrich) . . . . . p. 75 (148)
Coll.: D.G.U.
a) Protoconch. × 10. Loc.: Gram.
b) Apertural view. × 1. Loc.: Ravning.

– 3. *Aquilofusus puggaardi* (Beyrich) . . . . . p. 76 (148)
Loc.: Gram. Coll.: D.G.U.
Apertural view. × 2.

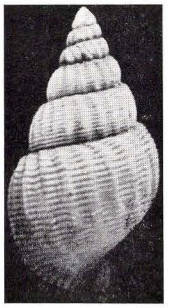
– 4. *Uromitra cimbrica* (Oppenheim) . . . . . p. 77 (148)
Loc.: Gram. Coll.: M.M.
Apertural view. × 2.

– 5. *Admete* (*Babylonella*) *subangulosa* (S. Wood) . . . . . p. 80 (148)
Loc.: Gram. Coll.: D.G.U.
a) Apertural view. × 5.
b) Protoconch. × 15.

– 6. *Drillia* (*Spirotropis*) *modiola* (Jan) . . . . . p. 82 (148)
Loc.: Gram. Coll.: D.G.U.
Rear view. × 3.

– 7. *Cancellaria* (*Narona*) *calcarata* (Brocchi) . . . . . p. 78 (148)
Loc.: Gram. Coll.: D.G.U.
Rear view. × 4.5.

– 8. *Cancellaria* (*Narona*) *rothi* (Semper) . . . . . p. 79 (148)
Coll.: D.G.U.
a) Apertural view. × 1.5. Loc.: Ravning.
b) Protoconch. × 10. Loc.: Gram.

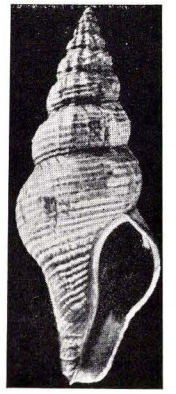


a (× 3).

b (× 10).

1. Nassa prismatica.

a (× 10).



b (× 1).

2. Aquilofusus semiglaber.

3. Aquilofusus puggaardi (× 2).

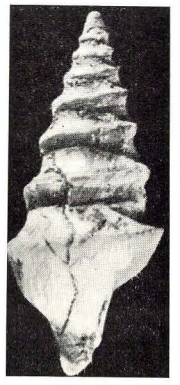
4. Uromitra cimbrica (× 2).

7. Cancellaria calcarata (× 4 ½).

a (× 5).

b (× 15).

5. Admete subangulosa.



6. Drillia modiola (× 3).

a (× 1 ½).

b (× 10).

8. Cancellaria rothi.

Chr. Westergaard phot.

Plate VIII.

Fig. 1. *Turris* (*Fusiturris*) *helena* (SEMPER) . . . . . p. 83 (148)
Loc.: Gram. Coll.: D.G.U.
a) Rear view. × 4.5.
b) Protoconch. × 10.

– 2. *Turris* (*Gemmula*) *badensis* (R. HOERNES) . . . . . p. 84 (149)
Loc.: Gram. Coll.: D.G.U.
a) Protoconch. × 15.
b) Apertural view. × 2.5.

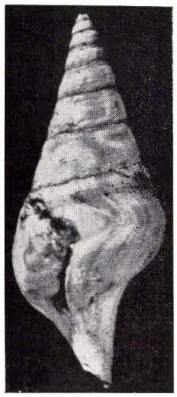
– 3. *Turris* (*Hemipleurotoma*) *annae* (HOERN. & AUING.) . . . p. 86 (149)
Loc.: Gram. Coll.: D.G.U.
a) Apertural view. × 2.5.
b) Protoconch. × 12.5.

– 4. *Turris* (*Crassispira*) *obeliscus* (DES MOULINS) . . . . . p. 87 (149)
Loc.: Gram. Coll.: D.G.U.
Rear view. × 2.5.

– 5. *Haedropleura maitreja* (SEMPER) . . . . . p. 88 (149)
Loc.: Gram. Coll.: D.G.U.
Apertural view. × 4.5.

– 6. *Brachytoma obtusangula* (BROCCHI) . . . . . p. 89 (149)
Loc.: Gram. Coll.: D.G.U.
a) Rear view. × 6.25.
b) Protoconch. × 12.5.

– 7. *Cythara* (*Mangelia*) *kochi* (v. KOENEN) . . . . . p. 92 (150)
Loc.: Gram. Coll.: D.G.U.
Rear view. × 12.5.



a (× 4 ½). b (× 10).

1. Turris helena.

a (× 15).

b (× 2 ½).

2. Turris badensis.

a (× 2 ½).

b (× 12 ½).

3. Turris annae.

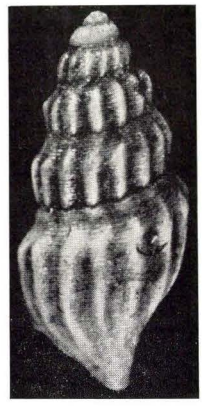
4. Turris obeliscus (× 2 ½).

5. Haedropleura maitreja (× 4 ½).

a (× 6 1/4).

b (× 12 ½).

6. Brachytoma obtusangula.



7. Cythara kochi (× 12 ½).

Chr. Westergaard phot.

Plate IX.

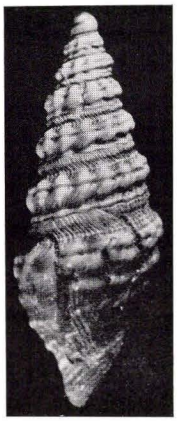
Fig. 1. *Asthenotoma sp.* ..... p. 90 (149)
Loc.: Gram. Coll.: M.M.
a) Rear view. × 6.25.
b) Protoconch. × 15.

– 2. *Lienardia luisae* (SEMPER) ..... p. 93 (150)
Loc.: Gram. Coll.: D.G.U.
a) Rear view. × 6.25.
b) Protoconch. × 12.5.

– 3. *Bathytoma cataphracta* (BROCCHI) ..... p. 91 (149)
Loc.: Gram. Coll.: D.G.U.
a) Apertural view. × 1.
b) Protoconch. × 12.5.

– 4. *Conus* (*Conospira*) *antediluvianus* BRUGUIÈRE ..... p. 97 (150)
Coll.: D.G.U.
a) Apertural view. × 1. Loc.: Ravning.
b) Protoconch. × 15. Loc.: Gram.

– 5. *Philbertia* (*Philbertia*) *reticulata* (RENIERI) ..... p. 94 (150)
Coll.: D.G.U.
a) Protoconch. × 20. Loc.: Holleskov.
b) Apertural view. × 7.5. Loc.: Gram.

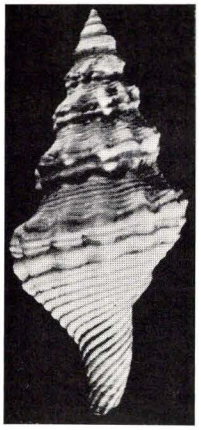


a (× 6¼).

b (× 15).

1. Asthenotoma sp.

a (× 1).



a (× 6¼).

b (× 12½).

2. Lienardia luisae.

b (× 12½).

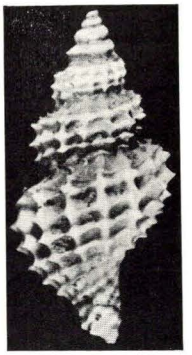
3. Bathytoma cataphracta.

a (× 1).

b (× 15).

4. Conus antediluvianus.

a (× 20).



b (× 7½).

5. Philbertia reticulata.

Chr. Westergaard phot.

Plate X.

Fig. 1. *Acamptogenotia intorta* (Brocchi) ..... p. 96 (150)
Loc.: Gram. Coll.: D.G.U.
a) Rear view. × 1.5.
b) Apertural view. × 1.5.

– 2. *Eulimella* (*Eulimella*) *scillae* (Scacchi) ..... p. 100 (150)
Loc.: Gram. Coll.: D.G.U.
Apertural view. × 10.

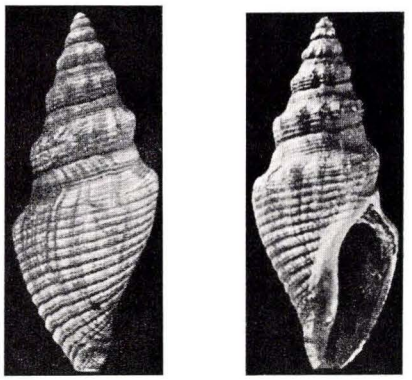
– 3. *Retusa* (*Cylichnina*) *elongata* (Eichwald) ..... p. 103 (151)
Loc.: Gram. Coll.: D.G.U.
a) Rear view. × 10.
b) Apertural view. × 10.

– 4. *Cylichna* (*Cylichna*) *cylindracea* (Pennant) ..... p. 104 (151)
Loc.: Gram. Coll.: D.G.U.
a) Rear view. × 10.
b) Apertural view. × 10.

– 5. *Odostomia* (*Odostomia*) *conoidea* (Brocchi) ..... p. 99 (150)
Loc.: Gram. Coll.: D.G.U.
Apertural view. × 10.

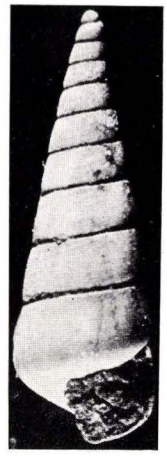
– 6. *Pyramidella* (*Pyramidella*) *plicosa* Bronn ..... p. 102 (151)
Loc.: Gram. Coll.: D.G.U.
Apertural view. × 10.

– 7. *Spiratella atlanta* (Mørch) ..... p. 105 (151)
Loc.: Gram. Coll.: D.G.U.
a) Apical view. × 10.
b) Apertural view. × 10.
c) Basal view. × 10.

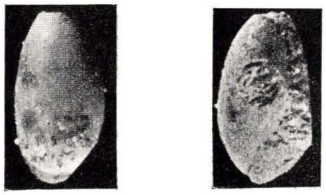


a b

1. Acamptogenotia intorta (× 1 ½).



2. Eulimella scillae (× 10).



a b

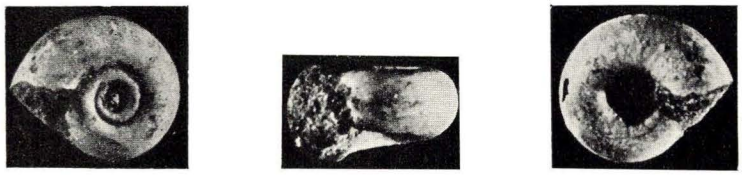
3. Retusa elongata (× 10).

5. Odostomia conoidea (× 10).

6. Pyramidella plicosa (× 10).

a b

4. Cylichna cylindracea (× 10).



a b c

7. Spiratella atlanta (× 10).

Chr. Westergaard phot.

FR. BAGGES KGL. HOFBOGTRYKKERI
KØBENHAVN

Pris 20 Kr.