Contr. Tert. Quatern. Geol. 27(2-3) 39-81 7 fig., 4 tab., 3 pls. Leiden, September 1990

A LATE OLIGOCENE (CHATTIAN B) MOLLUSCAN FAUNA FROM THE COASTAL CLIFF AT MOGENSTRUP, NORTH OF SKIVE, JUTLAND, DENMARK[1]

K.I. SCHNETLER
LANGÅ, DENMARK

and

C. BEYER
STAVANGER, NORWAY

Schnetler, K.I., & C. Beyer. A Late Oligocene (Chattian B) molluscan fauna from the coastal cliff at Mogenstrup, North of Skive, Jutland, Denmark. — Contr. Tert. Quatern. Geol., 27(2-3): 39-82, 7 figs, 3 tabs, 3 pls. Leiden, September 1990.

A very rich Late Oligocene molluscan fauna from a coastal cliff at Mogenstrup, North of Skive, Jutland, Denmark, was studied. A summary of the Late Palaeogene sedimentary sequence in NW Jutland is given, the locality and the section exposed are described. Lithostratigraphical, magnetostratigraphical and biostratigraphical correlations are suggested. A list of the molluscan species is given, comparisons with other Danish and German Late Oligocene localities are made, and palaeoecological interpretations are suggested. In the systematic part the subgenus *Andersondrillia* subgen. nov. is introduced within the genus *Microdrillia*. Several taxa are discussed and the following new species and subspecies are described: *Limopsis (Pectunculina) lamellata chattica* subsp. nov., *Limopsis (Pectunculina) vonderhochti* sp. nov., *Collonia (Collonia) troelsi* sp. nov., *Lepetella helgae* sp. nov., *Lepetella jytteae* sp. nov., *Tubiola subangulata* sp. nov., *Cerithiopsis* (s. lat.) *antonjansei* sp. nov., *Laiocochlis (Laiocochlis) supraoligocaenica* sp. nov., *Triforis (Trituba) sorgenfreii* sp. nov., *Cirsotrema (Opaliopsis) subglabrum* sp. nov., *Searlesia ravni* sp. nov., *Angistoma brueckneri danica* subsp. nov., *Clavatula mogenstrupensis* sp. nov., *Microdrillia (Microdrillia) ingerae* sp. nov., *Microdrillia (Andersondrillia) brejningensis* sp. nov., *Pleurotomella (Pleurotomella) rasmusseni* sp. nov., *Rimosodaphnella lappanni* sp. nov. and ? *Actaeopyramis* (s. lat.) *pseudopunctata* sp. nov.

Key-words — Mollusca, Late Oligocene, Chattian B, new taxa, lithostratigraphy, magnetostratigraphy, biostratigraphy, palaeoecology, Denmark.

K.I. Schnetler, Fuglebakken 14, Stevnstrup, DK-8870 Langå, Denmark; C. Beyer, CB-Magneto, P.O. Box 7015, Jorenholmen, N-4004 Stavanger, Norway.

CONTENTS

[1] This study was supported by the Danish National Science Research Council through grant 91-3204.

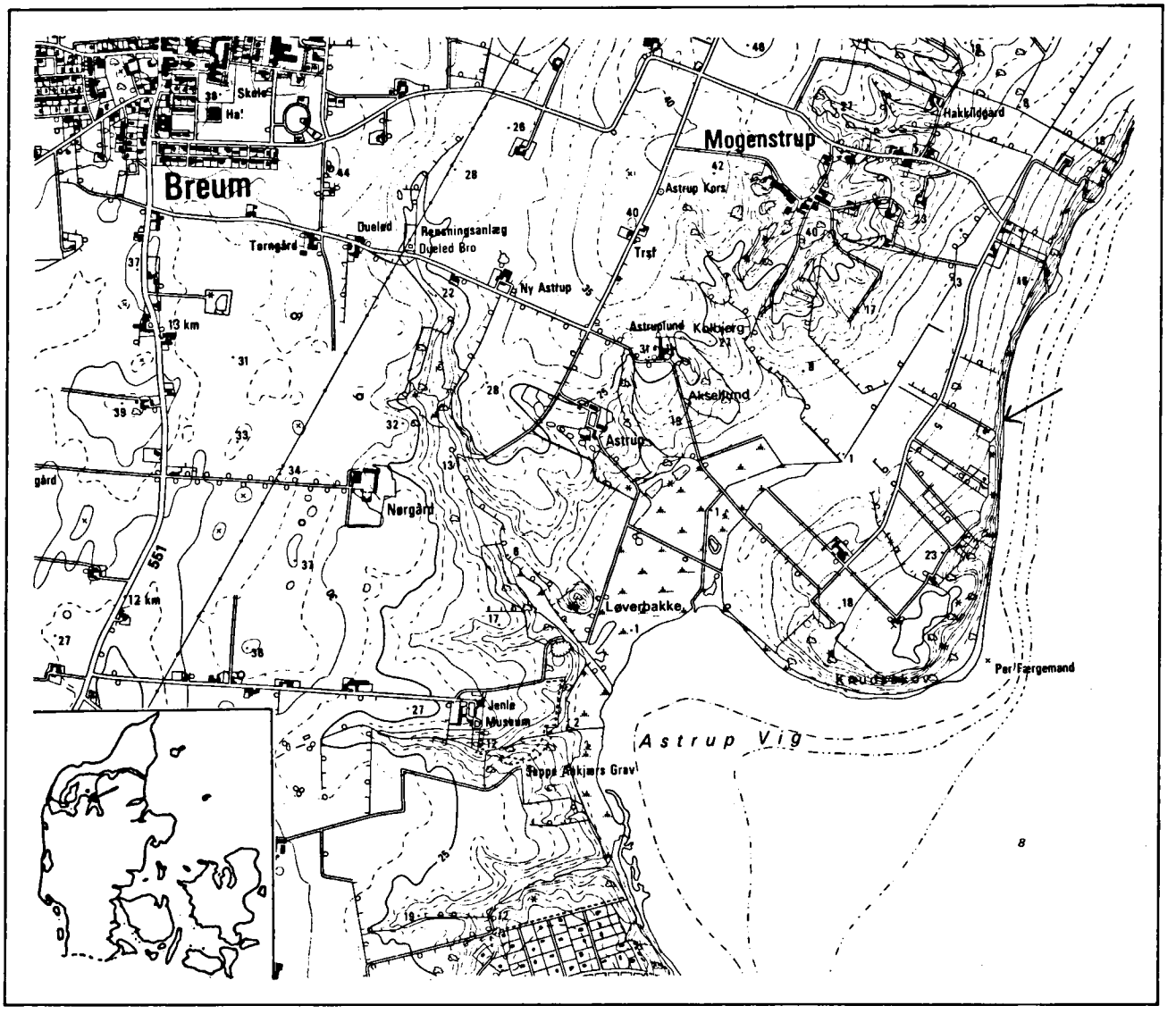


Fig. 1 Location of the Mogenstrup section. Part of the 1:25,000 map-sheet 12/6 III SV Hvalpsund (C). Kort- og Matrikelstyrelsen (A84-90). (Author: Schnetler).

Dansk sammendrag

En Øvre Oligocæn molluskfauna fra Mogenstrup, nord for Skive, Jylland, Danmark. Fra en kystklint nord for Skive er en meget rig Øvre Oligocæn molluskfauna indsamlet. Denne fauna er bemærkelsesværdig ved at indeholde en lang række arter, der aldrig tidligere er fundet i danske aflejringer fra denne periode, ligesom en del arter, der er yderst sjældne på andre lokaliteter, her er hyppige. I det foreliggende arbejde beskrives lokaliteten, og der gives en oversigt over den Øvre Oligocæne lagserie i NV Jylland. Litho-, magneto- og biostratigrafiske korrelationer foreslås, og en tolkning af aflejringsmiljøet gives. Pectiniderne indicerer en Chattian B alder. Faunalisten indeholder 197 arter. I den systematiske del diskuteres en række arter, og på tre plancher afbildes en række karakteristiske arter. Inden for slægten *Microdrillia* opstilles den nye underslægt *Andersondrillia*. Følgende nye arter og underarter introduceres: *Limopsis (Pectunculina) lamellata chattica* subsp. nov., *Limopsis (Pectunculina) vonderhochti* sp. nov., *Collonia (Collonia)* troelsi sp. nov., *Lepetella helgae* sp. nov., *Lepetella jytteae* sp. nov., *Tubiola subangulata* sp. nov., *Cerithiopsis* (s.lat.) *antonjansei* sp. nov., *Laiocochlis (Laiocochlis) supraoligocaenica* sp. nov., *Triforis (Trituba) sorgenfreii* sp. nov., *Cirsotrema (Opaliopsis)*

subglabra sp. nov., *Searlesia ravni* sp. nov., *Angistoma brueckneri danica* subsp. nov., *Clavatula mogenstrupensis* sp. nov., *Microdrillia (Microdrillia) ingerae* sp. nov., *Microdrillia (Andersondrillia) brejningensis* sp. nov., *Pleurotomella (Pleurotomella) rasmusseni* sp. nov., *Rimosodaphnella lappanni* sp. nov. og ? *Actaeopyramis* (s.lat.) *pseudopunctata* sp. nov. Faunasammensætningen indicerer aflejring på lavere vand end de øvrige kendte danske Øvre Oligocæne faunaer. Faunaen viser, især for en række sjældnere arters vedkommende, affinitet til faunaer fra Vejle Fjord området og til faunaen fra Glimmerode, Vesttyskland. Ud fra en palæoøkologisk tolkning foreslås et sublittoralt aflejringsmiljø.

Introduction (authors: Schnetler and Beyer)

The Mogenstrup section is located in NW Jutland, Denmark, on the east coast of Salling, approximately 1 km South of the small village of Mogenstrup (UTM coordinates: NH 074 814, Fig. 1). A locality near Hakkildgård, approximately 1 km North of the Mogenstrup section, was already mentioned by Ravn (1906, 1907). In his extensive work on the molluscan faunas from the Oligocene and Miocene Formations that author considered the sediments to be of Middle Miocene age, but later (Ravn, 1924) this age assignment was questioned. Subsequently, stratigraphic work was done in other localities in the area (*e.g.* Sorgenfrei, 1940; Rasmussen, 1961; Kristoffersen, 1972; Lieberkind, 1977), and a Late Oligocene or Early Miocene age for comparable sediments suggested. Since the publication of Ravn's papers, however, the outcrops at Mogenstrup had not been studied until 1987, in which year they were included in a facies analysis of the Late Oligocene sedimentary sequence in NW Jutland (Beyer, 1987). That paper included a palaeomagnetic study, the results of which suggest a Late Chattian age for this sequence.

During field work along the coast North of Skive a thin glauconitic sand layer was discovered in the coastal cliff at Mogenstrup. This sand was very rich in fossils, especially molluscs and spines of the echinoid '*Cidaris*' sp. The present paper is the result of a study of the molluscan fauna, which was found to comprise 197 taxa, 89 of which are recorded from the Danish Late Oligocene for the first time.

The molluscan assemblage is distinctly different from all known Danish Late Oligocene faunas, but does show affinities with unpublished assemblages from the Vejle Fjord area, especially with regard to a number of characteristic species. The assemblage also shows affinities with the very rich fauna from Glimmerode, F.R.G. (R. Janssen, 1978a, b; 1979a, b).

The Late Oligocene sedimentary sequence in NW Jutland (author: Beyer)

The Late Oligocene sedimentary sequence in NW Jutland consists of the fine-grained Branden Formation underlying a coarser grained sequence, which outcrops at several localities in the area.

These coarser sediments (Fig. 2a) comprise an up to *c.* 120 m thick sequence of shallow-marine deposits, overlain by Miocene quartz sands of fluvial origin. The Late Oligocene part may be divided into six facies types (indicated by letters F to A, from top to bottom):

F - Seven metres of alternating mud, silt and sand deposited in a storm-dominated tidal-flat environment.

E - Well-sorted, fine-grained sand, deposited in near-shore, beach and back-barrier environments. The thickness is up to 20 m.

D - Lagoonal and protected bay deposits consisting of black, homogeneous, organic mud with horizons of spherical calcite concretions. The thickness of this facies varies from a a few metres to about 60 m.

C - Shallow-bay and shelf sediments consisting of chamositic mud, probably deposited close to a river mouth. This facies is found only in the western part of the area (Fig. 5) where it reaches a thickness of 8 m.

B - Shelf sediments consisting of a glauconitic silt with layers of siderite concretions in the uppermost metre. The thickness varies from less than 1 m to 8 m.

A - Laminated silt, rich in diatoms, deposited in an anoxic environment, possibly an upwelling zone. The thickness is less than one metre.

The sequence comprises at least three major hiatuses as indicated in Fig. 2a. At least two transgressions occurred during the time of deposition. During the first one, mainly fine-grained material was deposited (facies A and B). After a regression a minor transgression occurred. This transgression saw the introduction of coarser material into the area, leading to the establishment of a barrier-

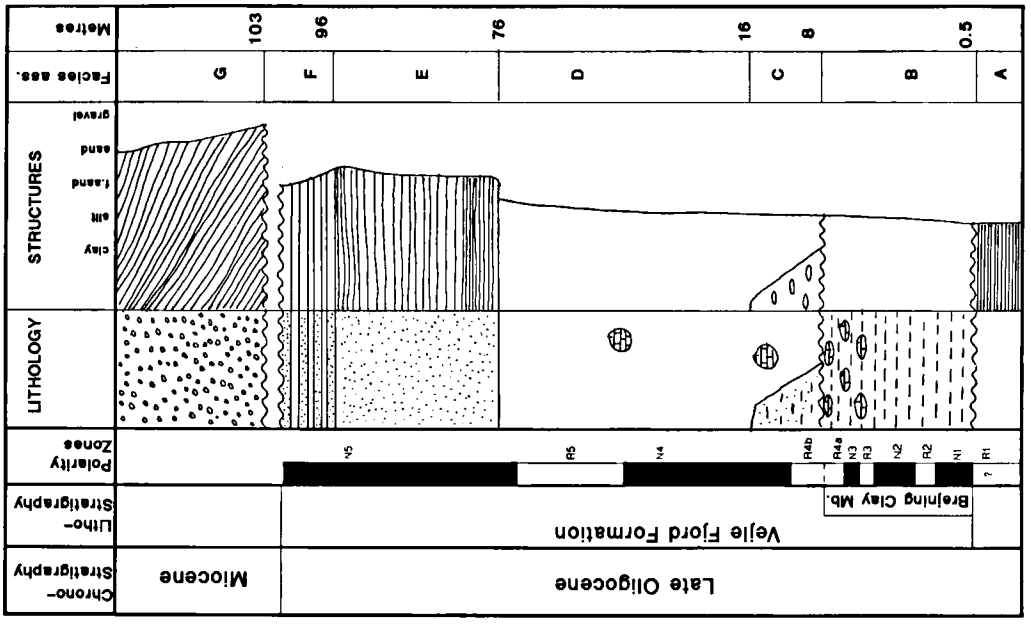


Fig. 2a. Composite lithological column illustrating the Late Oligocene sequence in NW Jutland. Thicknesses which are highly variable in the area, are shown with maximum values (author: Beyer).

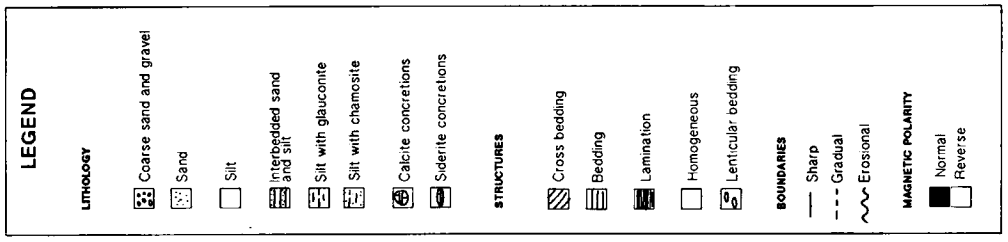


Fig. 2b. Legend to Figs 2a and 4 (author: Schnetler).

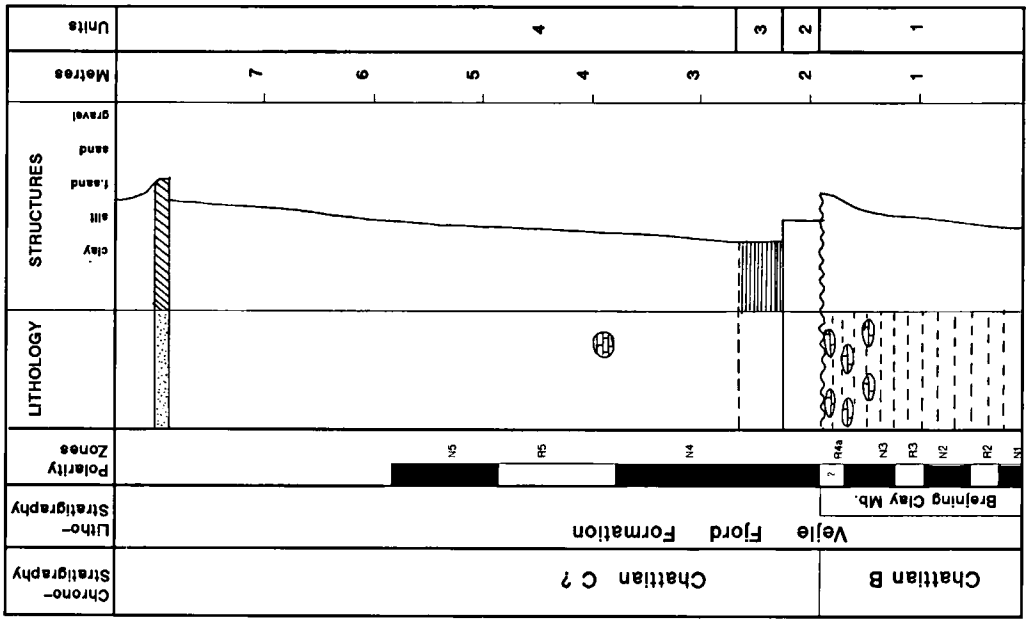


Fig. 3. Sedimentary sequence at Mogenstrup (see Fig. 1 for location and Fig. 2b for legend) (author: Beyer).

lagoon complex (C, D, E, and F), which was partly destroyed during a subsequent regressive period. This sequence rests on the Late Oligocene Branden Formation in the eastern part of the area (Fig. 2), while a primary boundary to the Palaeocene/Eocene Fur Formation is seen further to the West, where burrows extend from the Oligocene sediment down into the Fur Formation.

The deposition and preservation of this sequence was partly influenced by halokinesis. The sediments are solely found in depressions around salt structures and the thicknesses of the various facies vary greatly over short distances.

Palaeotopography was probably influenced by synsedimentary halokinesis, with deposition mainly occurring in the subsiding areas between the salt structures. Erosion on top of these structures may have removed part of the sequence while subsidence between the structures led to a high preservation potential in these areas.

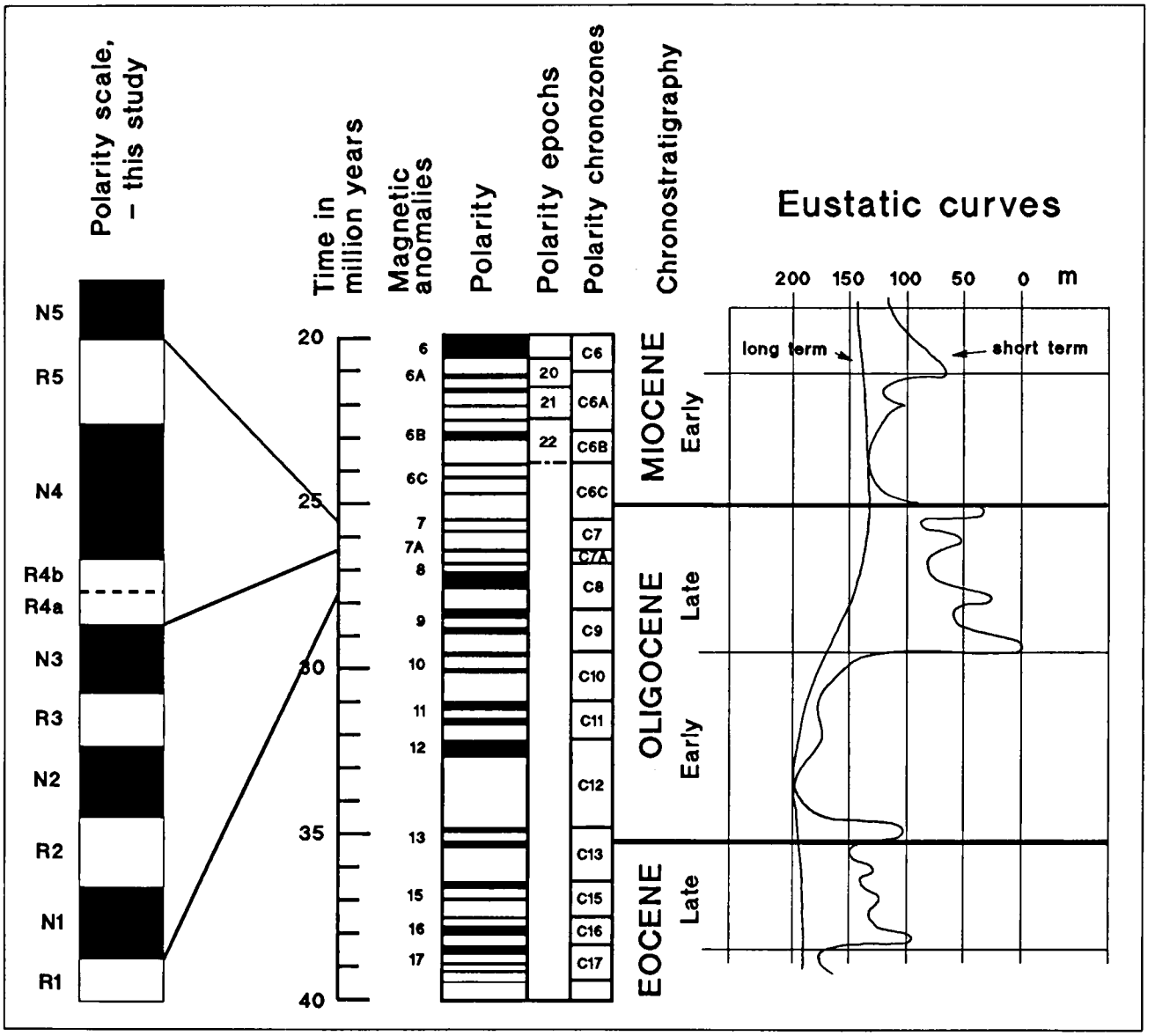


Fig. 4. Suggested correlation of the Danish Late Oligocene with the established sequence stratigraphy of Haq, Hardenbol & Vail (1987). It should be noted that the short term changes in global sea level are not directly reflected in the Danish sedimentary facies associations: the shallow marine sequence originated in a period of relatively high global sea level, thus indicating that sedimentation was influenced by subsidence of the local basin rather than by changes in global sea level (author: Beyer).

Lithostratigraphical correlation (author: Beyer)

The sequence described is coeval with and very similar to the Late Oligocene Vejle Fjord Formation (Larsen & Dinesen, 1959) but it is clearly not directly correlative with this formation, the type locality of which is situated 200 km SE of Mogenstrup. Thus, according to standard stratigraphical procedure these two sequences should be given separate formation names. However, it is not desirable to add to the already existing confusion over Danish Late Oligocene lithostratigraphical units. That is why the name 'Vejle Fjord Formation' is also applied to the sequence described here.

Similarly, facies B will be referred to as Brejning Clay Member, because of the close lithological similarity to the Brejning Clay Member of the Vejle Fjord Formation. It seems reasonable to assume that this facies was originally very widespread.

The Vejle Fjord Formation names will not be used for the other facies, since these clearly have a very restricted geographical occurrence.

Facies D is equivalent to the Vejle Fjord Clay and facies E and F are equivalent to the Vejle Fjord Sand.

Magnetostratigraphical correlation (author: Beyer)

Based on magnetostratigraphical data, molluscan faunas and facies interpretations, Beyer (1987) suggested a Late Chattian age for most of the sequence (facies B to F) and correlated polarity zones R4b, N4, R5 and N5 with polarity chronozone C7 (Fig. 4). Polarity zones N1, R2, N2, R3, N3, and R4a may be correlated with polarity chronozones C7a and C8, which implies an age of about 27 Ma for the sediment that yielded the fauna described here.

The Mogenstrup section (author: Beyer)

The sequence outcropping at Mogenstrup (Fig. 3) can be divided into 4 units:

Unit 1
Light-greenish, clayey silt, rich in glauconite, and containing fragments of shells. In the uppermost metre three horizons of siderite concretions occur. These contain flattened horizontal burrows, indicating that compaction took place prior to cementation. The thickness of the unit is at least 2 m. The base is not visible. The fauna described in the present paper was found in the uppermost 20 cm of this unit, where green sand, consisting entirely of glauconite and containing an extremely rich fauna, is associated with the concretions.

Unit 2
This unit has a sharp lower boundary and consists of 30 cm of dark brown, clayey silt with mica and gypsum precipitations, and contains organic C (2%), pyrite (c. 2%), siderite and rhodocrosite. Vertical v-shaped cracks occur.

Unit 3
About 40 cm of light brown, silty clay with mica and jarosite precipitations, the lower boundary of which is sharp. Small horizontal burrows are visible. The sediment contains pyrite (8%), organic C (4%), and shell fragments.

Table 1. Mineralogy of the Mogenstrup sequence
Legend: Q-quartz, PL-plagioklas, KF-kalifelspar, SID-siderite, PY-pyrite, JA-jarosite, RH-rhodocrosite, GI-gibbsite, FO-fosforite, VI-vivianite, GLA-glauconite, MS-monosulfides.
For the minerals JA, RH, GI, FO no calibration samples were available and only relative vertical changes can thus be inferred from these results. The other values indicate percentage of the mineral content determined by X-ray diffraction.
The lowermost two samples are from concretions.

Metres	Q	clay	PL	KF	SID	PY	JA	RH	GI	FO	VI	GLA	MS	org. C
8.5	95	2	2	1	0	0	0	0	16	0	0	0	0	
8.4	70	24	1	2	1	1	1	0	32	24	16	0	0	
6.0	72	22	1	1	0	0	3	0	56	40	0	0	+	
4.0	70	22	2	1	2	0	2	0	24	0	0	0	+	6
3.0	70	19	2	3	0	5	0	1	0	0	0	0	+	
2.5	60	30	0	1	0	8	0	1	24	0	0	0	0	3
2.2	53	25	1	1	2	2	0	7	0	0	0	0	0	3
2.1	41	35	1	1	9	4	1	2	16	8	0	0	0	
1.8	30	11	0	1	57	1	0	0	0	0	0	0	0	
0.5	25	29	1	1	39	1	0	0	0	0	0	+	0	1

Unit 4
Six m of silt with a variable sand and clay content. Generally, grain size increases towards the top and in the uppermost part lenses of longitudinal cross-bedded sand occur. The sediment is extensively bioturbated and rich in mica and contains two horizons of scattered, spherical calcite concretions. Also minor amounts of pyrite, vivianite and siderite occur. The colour is brown but upon oxidation it changes to black within a few minutes, which is probably due to the presence of monosulfides.

Based on sedimentological analyses the Mogenstrup section can be interpreted as follows (Fig. 4; Tab. 1): Unit 1, in the uppermost part of which the fauna described here was found, is thought to have been deposited in a marine shelf environment. The depositional environment of unit 2 was oxic, indicated by the high content of rhodocrosite and the occurrence of v-shaped cracks which may indicate a supra-tidal marsh. An oxygen-deficient depositional environment is inferred for unit 3, because of the mineral assemblages (*e.g.* rich in pyrite), the facies association and burrows with a very small diameter. This may have been a shallow basin that came into existence at the start of a transgression that inundated the low-lying areas amongst the salt structures. Unit 4 was deposited in a brackish environment, probably a lagoon. This interpretation is based on the facies association, the content of monosulfides, organic C, intensive bioturbation and the occurrence of small channel deposits in the uppermost part of the unit.

The geological history of the Mogenstrup section may thus be summarized as follows. Upon deposition in a marine shelf environment (unit 1) followed a period of non-deposition and erosion (unit 2). The succeeding transgression flooded the area and gave rise to a shallow, protected marine basin (unit 3). As more sandy material was introduced into the area, barrier islands developed and the subsiding basin became a lagoon. Gradually the sedimentation rate exceeded the rate of subsidence, which led to infill of the basin with coarser material (unit 4).

Biostratigraphical correlation (author: Schnetler)

The Late Oligocene age of the section is immediately apparent from the molluscan fauna and this age determination is confirmed by a study of the otoliths. Dr P.A.M. Gaemers (Leiden, pers. comm., 1987) examined two otolith samples (one from unit 1 and one from the very fossiliferous uppermost part of unit 1); both could be assigned an early Late Oligocene age.

The biostratigraphy of the Chattian based on pectinids (R. Janssen, 1979b) can be applied to the Mogenstrup fauna since a number of stratigraphically useful species were found, *viz. Palliolum hausmanni hausmanni*, *P. limatum limatum*, *P. limatum ambignum*, *Pecten (Hilberia) bifidus bifidus* and *Pecten (Hilberia) soellingensis*. Of these only *Palliolum limatum ambignum* and *P. hausmanni hausmanni* are well preserved. *P. limatum limatum* and *Pecten (Hilberia) bifidus bifidus* are represented by a few fragments, while a single near-complete specimen of *Pecten (Hilberia) soellingensis* was collected. The pectinid fauna as a whole indicates a Chattian A/B age, most likely Chattian B, since the Chattian A species show signs of reworking, and this molluscan assemblage is probably not a biocoenosis.

The gastropod species *Hinia schlotheimi* indicates, according to R. Janssen (1979b: 162), a Chattian B or younger age. The rather frequent occurrence of this species at Mogenstrup is in agreement with the age determination suggested by the pectinids.

Two samples, one from unit 1 proper and one from the mollusc-rich upper part of unit 1 were analysed for foraminifers by Kaare Ulleberg, Norway, who concluded that both samples fall within the *Angulogerina gracilis* Zone, as does the Brejning Clay does (Ulleberg, 1987: 201) (K. Ulleberg, pers. comm.).

Material (author: Schnetler)

The molluscs were collected almost exclusively from the uppermost part of unit 1. Large samples of glauconitic sand were taken, dried and washed on a 0.5 mm mesh. The residues were hand-picked after drying and fractioning.

During collecting in the field, larger specimens of *e.g. Charonia flandrica*, *Orthosurcula regularis*, *Scaphella siemsseni* and *Boreotrophon capito* were regularly encountered, but the bulk of the material was collected by sediment processing. The molluscs are generally well preserved but pyrite disintegration causes rapid destruction of the specimens, especially in the field.

Very conspicuous among the non-molluscs are the very large number of spines of the echinoid '*Cidaris*' sp. Marginal plates of asteroids, crinoid brachials, Bryozoa and serpulids are also com-

mon. Many Anthozoa are found, especially *Ceratocyathus granulatus* (Goldfuss, 1826), *'Graphularia'* sp., and a few *Flabellum* sp. Many specimens of the brachiopod *'Terebratula'* sp. often occur in nest-like concentrations; a few specimens of *'Terebratulina'* were also collected. Teleost otoliths are common; shark teeth, especially of the genus *Pristiophorus*, however, are less common. Foraminifers and ostracods are abundant, but decapods and balanids seem to be absent.

A small molluscan fauna was collected from unit 3. The molluscs are evenly distributed over the sediment, but not very common. The following species could be identified:

Nucula (Lamellinucula) comta
Yoldia (Yoldia) glaberrima
Lentipecten (Lentipecten) corneus
Dentalium (Dentalium) geminatum
Drepanocheilus (Arrhoges) speciosus
Polinices (Euspira) helicinus
Ancilla (Ancillus) karsteni
Fusiturris selysii.

LIST OF MOLLUSCAN SPECIES (AUTHOR: SCHNETLER)

In Table 2 all molluscan species from the Mogenstrup outcrop are listed. With a few exceptions, nomenclature follows R. Janssen (1978b; 1979a, b).

In column 1, species recorded from the Danish Late Oligocene for the first time are indicated with an asterisk (*).

In column 2, the frequency of the specimens is indicated on a scale from 1 to 7:

1: ½-1 specimen
2: 2-3 specimens
3: 3-10 specimens
4: 11-40 specimens
5: 41-125 specimens
6: 126-350 specimens
7: more than 350 specimens

The number of scaphopods is estimated. Single valve of a bivalve = 1/2 specimen.

In column 3, the depository of some rare species is indicated. Abbreviations: see systematic part.

Table 2. Molluscan species from Mogenstrup (Brejning Clay Member, Vejle Fjord Formation).

	1	2	3
Bivalvia			
Leionucula peregrina (Deshayes, 1852)		2	
Nucula (Lamellinucula) comta Goldfuss, 1837		4	
Nucula (Lamellinucula) sp.	*	3	
Nuculana (Saccella) westendorpi (Nyst, 1839)		3	
Portlandia (Yoldiella) pygmaea (von Münster, 1837)		4	
Yoldia (Yoldia) glaberrima (von Münster, 1837)		3	
Acar aff. *dentiens* (Cossmann & Peyrot, 1912)	*	5	Pl. 1
Bathyarca bellula (Wiechmann, 1874)		4	
Limopsis (Limopsis) aurita (Brocchi, 1814)		6	
Limopsis (Pectunculina) lamellata chattica subsp. nov.	*	7	syst. part
Limopsis (Pectunculina) retifera Semper, 1861		6	
Limopsis (Pectunculina) vonderhochti sp. nov.	*	5	syst. part
Glycymeris (Glycymeris) obovata (Lamarck, 1819)		2	
Modiolula pygmaea (Philippi, 1843)		3	
Musculus sp.	*	3	
Arcoperna sp.		3	
Lentipecten (Lentipecten) corneus (Sowerby, 1818)		4	
Propeamussium (Parvamussium) sp.	*	4	syst. part
Palliolum (s. lat.) *venosum* (Speyer, 1864)	*	1	MNO
Palliolum (s. lat.) *limatum limatum* (Goldfuss, 1833)		3	
Palliolum (s. lat.) *limatum ambignum* (Anderson, 1958)		2	
Palliolum (s. lat.) *hausmanni hausmanni* (Goldfuss, 1833)		3	
Pecten (Hilberia) bifidus bifidus von Münster, 1835		3	
Pecten (Hilberia) soellingensis von Koenen, 1868		1	ENÅ
Limea (Notolimea) nysti (Speyer, 1864)		2	
Anomia (Anomia) ephippium (Linné, 1758)		3	
Pododesmus (Heteranomia) squamula Linné, 1758	*	2	

	1	2	3
Crassostrea cyathula (Lamarck, 1806)	*	3	
Cyclocardia (Cyclocardia) aff. *kickxi* (Nyst & Westendorp, 1839)		5	
Cyclocardia (Cyclocardia) depressa (von Koenen, 1884)		1	MNO
Astarte (Astarte) goldfussi praecursor Glibert, 1957		4	
Astarte (Astarte) gracilis gracilis (von Münster, 1837)		1	MNO
Goodallia (Goodallia) pygmaea (von Münster, 1837)		4	
Parvicardium kochi (Semper, 1861)		4	
Laevicardium (Habecardium) excomatulum Glibert & van de Poel, 1970		3	
Angulus posterus (Beyrich, 1868)		2	
Abra (Abra) bosqueti (Semper, 1861)		4	
Glossus subtransversus (d'Orbigny, 1852)	*	2	
? Coralliophaga sp.	*	1	MNO
Spaniodontella nitida (Reuss, 1867)	*	2	
Callista (Costacallista) beyrichi (Semper, 1861)	*	1	MNO
Sphenia abscisa (Wiechmann, 1879)	*	1	MNO
Corbula (Varicorbula) gibba (Olivi, 1792)		2	
Spheniopsis depressa von Koenen, 1894		1	MNO
Hiatella (Hiatella) arctica (Linné, 1767)		4	
Teredinidae gen. et sp. indet.		4	
Jouannetia (Jouannetia) aff. *neuvillei* Cossmann, 1921	*	1	MNO
Lyonsia (Lyonsia) obovata von Koenen, 1868	*	1	AJB
Thracia (Thracia) sp.		1	ISL
Poromya (Poromya) hanleyana von Koenen, 1863		3	
Cuspidaria (Cuspidaria) subcuspidata (d'Orbigny, 1852)	*	3	
Verticordia (Verticordia) aff. *punctata* Heering, 1950	*	3	
Pecchiolia sp.	*	1	AJB
Bivalvia indet.		3	
Scaphopoda			
Dentalium (Dentalium) geminatum (Goldfuss, 1841)		5	
Dentalium (Dentalium) polypleurum (Seifert, 1959)		4	
Rhabdus sp.		2	
Cadulus aff. *subfusiformis* (Sars, 1865)	*	1	MNO
Gastropoda			
Scissurella (Anatoma) koenenia R. Janssen, 1978	*	3	
Lepetella compressiuscula (Karsten, 1849)	*	3	
Lepetella helgae sp. nov.	*	2	syst. part
Lepetella jytteae sp. nov.	*	4	syst. part
Cocculina (Cocculina) dittmeri (Anderson, 1964)	*	3	Pl. 1
Astraea (Bolma) infausta (Giebel, 1852)	*	1	ENÅ
Astraea (Lithopoma) pustulosa (von Münster, 1844)	*	7	Pl. 1
Collonia (Collonia) troelsi sp. nov.	*	6	syst. part
Homalopoma (Boutillieria) simplex (Philippi, 1843)	*	3	Pl.1
Homalopoma (? Leptothyropsis) sp.	*	1	syst. part
Tubiola subangulata sp. nov.	*	3	syst. part
Tubiola sp.	*	2	syst. part
? *Skenea* sp.	*	3	syst. part
Leucorhynchia rotellaeformis (Grateloup, 1828)	*	2	
Cirsope (Cirsope) multicingulata (Sandberger, 1859)		3	
Cirsope (Pseudocirsope) subeffusa (Sandberger, 1859)	*	2	
Cingula sp.		1	MNO
Rissoa (Persephona) karsteni R. Janssen, 1978		5	
Rissoa (Persephona) punctatissima R. Janssen, 1978		4	
Alvania (Arsenia) semperi Wiechmann, 1871		4	
Alvania sp.	*	2	

	1	2	3
Ovirissoa sp.	*	1	syst. part
Turritella (Haustator) goettentrupensis (Cossmann, 1899)	*	1	MNO
Bittium sp.	*	1	MNO
Cerithiopsis (Metaxia) aff. *degrangei* (Cossmann & Peyrot, 1921)	*	2	
Cerithiopsis henckeliusii (Nyst, 1836)	*	3	
Cerithiopsis jutensis Schnetler, 1985		4	
Cerithiopsis (s. lat.) *serrula* R. Janssen, 1978		2	
Cerithiopsis (s. lat.) *daphnelloides* R. Janssen, 1978	*	3	
Cerithiopsis (s. lat.) *ariejansseni* R. Janssen, 1978	*	2	
Cerithiopsis (s. lat.) *antonjansei* sp. nov.	*	2	syst. part
Laiocochlis (Laiocochlis) supraoligocaenicus sp. nov.	*	2	syst. part
Cerithiopsida boelschei (von Koenen, 1891)		4	
Cerithiella bitorquata (Philippi, 1843)		4	
Seila (s. lat.) *angusta* Tembrock, 1964		3	
Seila (s. lat.) *koeneni* R. Janssen, 1978	*	1	MNO
Triforis (Trituba) sorgenfreii sp. nov.	*	3	syst. part
Biforina (Biforina) praeversa Gründel, 1975	*	4	
Norephora (Norephora) elatior (von Koenen, 1891)		4	
Opalia (Pliciscala) pusilla (Philippi, 1843)		1	
Turriscala (Turriscala) cf. *rudis* (Philippi, 1843)		2	
Acirsa (Plesioacirsa) leunisii (Philippi, 1843)		2	
Cirsotrema (Opaliopsis) subglabrum sp. nov.		2	syst. part
Cirsotrema (Opaliopsis) sp.1	*	1	syst. part
Cirsotrema (Opaliopsis) sp.2	*	1	syst. part
Cirsotrema (? Opaliopsis) aff. *koeneni* A.W. Janssen, 1967	*	1	syst. part
Cirsotrema (s. lat.) *crispatum* Harder, 1913		2	JHR
Amaea (Secalina) amoena (Philippi, 1843)	*	1	ISL
Architectonica sp.	*	2	
Mathilda (Mathilda) sandbergeri (Koch, 1876)		2	
Aclis (Aclis) vetusta Wiechmann, 1878		4	
Aclis (Stilbe) proneglecta R. Janssen, 1978		2	
Aclis (Graphis) hosiusi (Lienenklaus, 1891)		4	
Balcis (Balcis) ? *lamberti* (Cossmann, 1882)	*	1	MNO
Balcis alba naumanni (von Koenen, 1867)		4	
Balcis (Polygyreulima) pseudonaumanni R. Janssen, 1978		3	
Eulima (Eulima) emersa Speyer, 1870		4	
Niso (Niso) minor Philippi, 1843	*	3	
Neojanacus planatus (Speyer, 1864)	*	3	Pl. 2
Drepanocheilus (Arrhoges) speciosus (von Schlotheim, 1820)		7	
Polinices (Euspira) helicinus (Brocchi, 1814)		7	
Apiocypraea ? *humbergi* R. Janssen, 1978	*	2	syst. part
Semicassis (Echinophoria) rondeleti (Basterot, 1825)		4	
Charonia (Sassia) flandrica (de Koninck, 1837)		5	
Ficus (Ficus) concinnus (Brongniart, 1822)		3	
Pterynotus (Pterochelus) tristichus (Beyrich, 1854)	*	2	
Boreotrophon (s. lat.) *capito* (Philippi, 1843)		4	
Lyrotyphis (Eotyphis) sejunctus (Semper, 1861)		5	
Trophonopsis angustevaricata (Gripp, 1915)	*	5	syst. part
Coralliophila (Hirtomurex) kochi (Beyrich, 1854)	*	3	Pl. 2
Scalaspira (Scalaspira) elegantula aequistriata (Speyer, 1863)		4	
Scalaspira (Scalaspira) ? *waeli* (Beyrich, 1856)		1	MNO
Scalaspira (Scalaspira) sp.		5	Pl. 3
Searlesia ravni sp. nov.		3	syst. part
Exilioidea elatior (Beyrich, 1848)		2	
Parvisipho (s. lat.) *scrobiculatus* (Boll, 1851)	*	1	ISL
Coptochetus (s. lat.) *danicus* Schnetler, 1985		2	
Metula (Daphnobela) scabricula (Philippi, 1843)		4	
Pisanella subgranulata (von Schlotheim, 1820)		3	
Buccinidae *gen. et sp. indet.*	*	2	syst. part

	1	2	3
Hinia (Tritonella) schlotheimi (Beyrich, 1854)		4	
Streptochetus (Streptodictyon) cheruscus cheruscus (Philippi, 1843)		6	
Streptochetus (Streptolathyrus) soellingensis Tembrock, 1965		3	
Latirus (Pseudolatirus) sp.	*	1	syst. part
Scaphella (Scaphella) siemsseni (Boll, 1851)		4	
Ancilla (Ancillus) karsteni (Beyrich, 1856)		5	
Gibberula brevis (von Koenen, 1890)	*	4	Pl. 3
Cancellaria (Merica) evulsa postera (Beyrich, 1856)		3	
Babylonella pusilla (Philippi, 1843)		5	
Vexillum (Uromitra) hastatum (Karsten, 1849)		4	
Conomitra soellingensis (Speyer, 1864)		5	
Orthosurcula regularis (de Koninck, 1837)		5	
Acamptogenotia morreni (de Koninck, 1837)		2	
Stenodrillia obeliscus (des Moulins, 1842)		5	
Cochlespira volgeri (Philippi, 1843)		4	
Gemmula (Gemmula) laticlavia (Beyrich, 1848)		4	
Gemmula (Gemmula) trispiralis R. Janssen, 1979		5	
Gemmula (Gemmula) pseudokonincki R. Janssen, 1979	*	4	
Pleuroliria konincki (Nyst, 1845)		3	
Fusiturris duchastelii (Nyst, 1836)		6	
Fusiturris selysii (de Koninck, 1837)		4	
Fusiturris enodis R. Janssen, 1979		2	
Glibertturricula ariejansseni (Schnetler, 1987)		4	
Clavatula mogenstrupensis sp. nov.	*	2	syst. part
Cordieria plicata (Beyrich, 1848)	*	1	ISL
Bathytoma (Bathytoma) leunisii (Philippi, 1843)		5	
Asthenotoma holzapfeli (von Koenen, 1890)	*	3	
Splendrillia koeneni (Speyer, 1867)		4	
Microdrillia (Microdrillia) ingerae sp. nov.	*	3	syst. part
Microdrillia (Andersondrillia) brejningensis sp. nov.	*	4	syst. part
'*Microdrillia*' *speyeri* (Koch & Wiechmann, 1872)	*	3	Pl. 3
Boreodrillia undatella (Speyer, 1867)	*	4	
Pleurotomella anderseni Schnetler, 1987		1	MNO
Pleurotomella (Pleurotomella) margaritata R. Janssen, 1978	*	3	Pl. 3
Pleurotomella (Pleurotomella) rasmusseni sp. nov.	*	2	syst. part
Rimosodaphnella lappanni sp. nov.	*	4	syst. part
Conus (Leptoconus) semperi Speyer, 1862		4	
Hastula (Hastula) beyrichi (Semper, 1861)	*	1	MNO
Chrysallida sp.	*	1	MNO
Ebala sp.		1	MNO
Evalea kochi (Görges, 1952)		3	
Evalea incrassata (von Koenen, 1867)	*	1	ISL
Odostomia sp.		1	MNO
Syrnola (Syrnola) subcylindracea (Philippi, 1843)		5	
Syrnola (Puposyrnola) laevissima (Bosquet, 1859)	*	2	
Turbonilla (Strioturbonilla) wiechmanni Speyer, 1870	*	1	AJB
Turbonilla (Pyrgolampros) jeffreysi Koch & Wiechmann, 1872		3	
? *Actaeopyramis* (s. lat.) *pseudopunctata* sp. nov.	*	3	syst. part
Actaeon (Actaeon) punctatosulcatus (Philippi, 1843)	*	3	
Crenilabium terebelloides (Philippi, 1843)		2	
Ringicula (Ringiculina) striata (Philippi, 1843)		4	
Roxania utriculus (Brocchi, 1814)		4	
Philine (Ossiania) kochi von Koenen, 1882	*	1	MNO
Limacina hospes (Rolle, 1862)	*	4	
Limacina valvatina (Reuss, 1867)	*	3	
Clio nielseni A.W. Janssen, 1990	*	4	
Gastropoda *inc. sed.* 1	*	1	syst. part

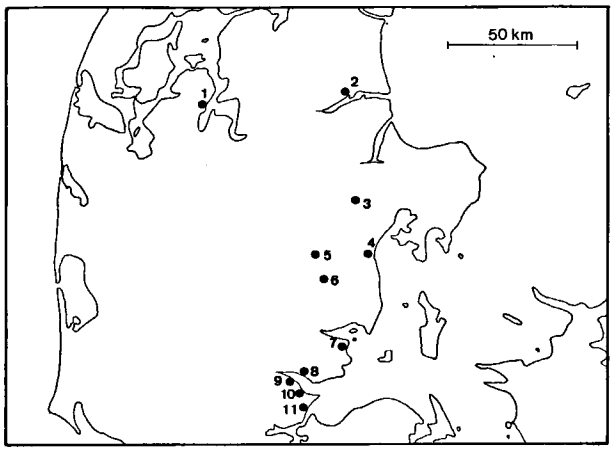


Fig. 5. Other Danish localities mentioned in this paper (author: Schnetler).

SYSTEMATIC PART (AUTHOR: SCHNETLER)

Danish localities mentioned in this section are shown in Fig. 5.

The depositories of the material are indicated by abbreviations:

AHF	-	Coll. S.B. Andersen and H.C. Hansen, Fredericia, DK.
AJB	-	Coll. A.C. Janse, Brielle, NL.
DGU	-	Coll. Geological Survey of Denmark, Copenhagen, DK.
ENÅ	-	Coll. E. Nielsen, Århus, DK.
FHK	-	Coll. F. von der Hocht, Kerpen-Balkhausen, F.R.G.
ISL	-	Coll. K.I. Schnetler, Langå, DK.
JHR	-	Coll. J. Hillersborg, Randers, DK.
LJL	-	Coll. L.B. Jørgensen, Lime, DK.
MGUH	-	Coll. Geological Museum, University of Copenhagen, DK.
MNO	-	Coll. M.S. Nielsen, Odense, DK.
RGM	-	Coll. National Museum of Natural History (formerly: Rijksmuseum van Geologie en Mineralogie), Leiden, NL.
RLO	-	Coll. R. Lechner, Odense, DK.
SMF	-	Coll. Forschungsinstitut Senckenberg, Frankfurt am Main, F.R.G.
WLH	-	Coll. W. Lappann, Heiligenhaus-Isenbügel, F.R.G.

Limopsis (Pectunculina) lamellata chattica subsp. nov.

Pl. 1, Figs 2a-b, 3a-b

Locus typicus — Coastal cliff at Mogenstrup, North of Skive, Jutland, Denmark (Fig. 1).

Stratum typicum — Glauconitic sand, Brejning Clay Member of the Vejle Fjord Formation, Late Oligocene (Chattian B).

Derivatio nominis — This new subspecies of *Limopsis lamellata* is named after its occurrence in the Chattian stage of the Oligocene.

Holotype — Pl. 1, Figs 2a-b, (coll. MGUH 20 023) (leg. K.I. Schnetler).

Description — The shell is small, equivalve and rather convex with a somewhat obliquely ovate to subcircular outline. It is slightly inequilateral, and the orthogyrate, dorsally projecting umbo has a slightly prosocline position. The hinge line is straight, the anterior and posterior dorsal margins are of almost the same length. The transition of the anterior dorsal margin into the convex anterior margin is gradual; the posterior dorsal margin and the posterior margin together form an obtuse angle. The posterior margin is more or less convex. The transitions of both the anterior and the posterior margin into the convex ventral margin are also gradual.

The cardinal area is flat and triangular with a rather small triangular resilifer below the umbo. The dentition is divided into two series of teeth by an edentulous gap below the umbo. The anterior series consists of three to four teeth which are aligned almost dorso-ventrally. The anterior series is straight. The arched posterior series also consists of three to four teeth which are placed obliquely.

The sculpture consists of flat concentric ribs which are distributed somewhat irregularly. The spaces between these ribs are much wider than the ribs and finer ribs are visible in the interspaces. The radial ribs are weaker and the sculptural components together form a more or less reticulate ornamentation.

The shell margin has a fine crenulation which corresponds to the radial ribs. The crenulae are fairly regular in strength. The pallial line and the adductor scars are not very distinct. The anterior impression is small and rounded, the posterior one is larger and rounded trapezoidal.

Measurements — Most specimens have a height of about 2 mm. The maximum height is *c.* 3 mm.

Paratypes — Mogenstrup (coastal cliff): 1/2 specimen (Pl. 1, Figs 3a-b) (leg. K.I. Schnetler; coll. MGUH 20 024); 3/1 and 300/2 specimens (leg./coll. ISL); 1/1 and 48/2 specimens (leg./coll. JHR); 7/2 specimens (leg./coll. LJL); 11/2 specimens (leg./coll. ENÅ); 2/2 specimens (leg. K.I. Schnetler, coll. MNO); 1/1 and 32/2 speci-

mens (leg./coll. ACJ); 292/2 specimens (leg./coll. MNO); 5/2 specimens (leg. K.I. Schnetler; coll. RGM 229 789); 5/2 specimens (leg. K.I. Schnetler; coll. SMF 308 405).

Hadsten (road excavation): 1/2 specimen (leg./coll. ISL).

Brejning (beach exposure): 40/2 specimens (leg./coll. MNO); 3/2 specimens (leg./coll. ISL).

Bøgeskov (coastal cliff): 2/2 specimens (leg./coll. MNO).

Discussion — The new subspecies and *L. lamellata* Lehmann, 1885 s. str. are very close with regard to size, outline, convexity and sculpture. However, judging from the numerous available specimens of the new subspecies and specimens of *L. lamellata* s.str. from the Miocene of Dingden (type locality!), Twistringen (F.R.G.), and Winterswijk-Miste (The Netherlands) (coll. ISL) a number of features seem to be different in the Danish material.

In *L. lamellata* s.str. the cardinal area is higher with a more projecting and stronger umbonal region and a larger resilifer. The number of teeth in *L. lamellata* s.str. in the anterior and posterior series is 4-6 and these teeth are somewhat stronger. Furthermore, the sculpture on the Miocene form is generally stronger, especially the concentric ribs, and finally its maximum size is about 5 mm. Although not very obvious, these differences seem to be constant. Because of the difference in age I prefer to treat the Danish material as a stratigraphical subspecies of *L. lamellata*. The nominal subspecies is widely distributed in the Middle Miocene of the North Sea Basin (Hemmoorian and Reinbekian).

Limopsis (Pectunculina) vonderhochti sp. nov.
Pl. 1, Figs 4-7

?1884 *Limopsis Goldfussi* Nyst — von Koenen, *in* Speyer & von Koenen, pl. 31, figs 9-10 (non Nyst).
?1937 *Limopsis Goldfussi* Nyst — Eriksen, p. 141 (non Nyst ?).
1941 *Limopsis Goldfussi* Nyst — Görges, p. 160 (partim, non Nyst).
1952 *Limopsis Goldfussi* Nyst — Görges, p. 17 (non Nyst).
1979b *Limopsis (Pectunculina) retifera* Semper, 1861 — R. Janssen, p. 30, pl. 1, fig. 16 (partim, non Semper).

Locus typicus — Coastal cliff at Mogenstrup, North of Skive, Jutland, Denmark (Fig. 1).

Stratum typicum — Glauconitic sand, Brejning Clay Member of the Vejle Fjord Formation (Late Oligocene, Chattian B).

Derivatio nominis — The species is named after Mr Fritz von der Hocht, geologist, Kerpen-Balkhausen, F.R.G.

Holotype — Pl. 1, Figs 4a-b, (coll. MGUH 20 025) (leg. K.I. Schnetler).

Description — The shell is equivalve with a rounded-ovate, slightly oblique outline, inequilateral. The slightly opisthogyrate umbo has a prosocline position; it projects only slightly beyond the dorsal margin. The shell is strongly convex, with the maximum convexity at about 2/3 of the shell height. The convexity is less obvious in juvenile specimens.

The hinge line is straight. The length of the anterior dorsal margin is about two thirds of that of the posterior dorsal margin, and these margins are almost in line. Both the anterior and the posterior margins are almost straight in their dorsal parts. The transitions into the ventral margin are gradual, posteriorly with a somewhat stronger curvature than anteriorly.

The cardinal area is flat and subtriangular, and provided with a fine striation parallel to the hinge line. The rather large resilifer is placed below the umbo. Its outline is that of a right-angled triangle with the shorter cathetus placed anteriorly. The resilifer is provided with a striation similar to that of the cardinal area. The dentition is divided into two series of teeth by an edentulous gap below the umbo. The anterior series consists of 4-6 teeth which are aligned almost dorso-ventrally. The posterior, slightly arched series consists of 4-8 more obliquely placed teeth, the posterior 2-3 of which are almost parallel to the hinge line. The number of teeth is variable, but in all cases the posterior row of teeth is longer than the anterior one. Adult specimens with 4-5 anterior and 5-6 posterior teeth are most frequent.

The sculpture is dominated by numerous concentric riblets which follow the growth lines. The number of these riblets is about one hundred on specimens with a height of 10 mm. The concentric sculpture elements frequently alternate in strength. The radial sculpture is much weaker and almost exclusively visible in between the concentric ribs, giving the interspaces a serrated appearance.

The inner shell margin has a coarse crenulation on the anterior part of the ventral margin. This crenulation consists of 4-6 coarse knobs which are elongated in dorsal direction as radiating ribs on the inner shell surface. In the available material

these ribs are somewhat variable in strength. The remaining part of the ventral margin is usually smooth, but in a few shells additional knobs are indicated, especially near the transition into the posterior margin. The crenulations do not correspond with the radial ribs on the outside of the shell.

The pallial line and the adductor scars are not very distinct. A well-developed myophore is situated below the anterior part of the hinge. The anterior adductor scar is subovate and much smaller than the rounded-trapezoidal posterior one.

Range of variation — The Danish material demonstrates a rather wide range of variation with regard to the convexity. The width/height ratio varies from 0.33 to 0.46, this figure being higher in larger specimens.

The Danish material was compared with specimens from the German localities Ahnetal (coll. SMF), Krefeld-Linn (coll. WLH) and Meerbusch-Osterath (coll. FHK). Those from Ahnetal and Krefeld-Linn demonstrate a lesser degree of convexity (length/height ratio 0.27-0.35). Also the crenulation of the anterior ventral margin is coarser, with the knobs situated more posteriorly. In addition, the sculpture is more accentuated.

From Meerbusch-Osterath a sample of 38/2 and 1/1 specimens was available. This population agrees more closely with the Danish material. The length/height ratio varies from 0.28 to 0.39, and the crenulation of the anterior ventral margin and the external sculpture are rather similar to the Danish specimens.

The differences in the length/height ratios may be the result of local environmental influences and therefore I confidently refer the German populations to the new species.

Paratypes — Mogenstrup, coastal cliff: 1/2 specimen (Pl. 1, Fig. 5a-b) (leg. K.I. Schnetler; coll MGUH 20 026); 69/2 specimens and 21 fragments (leg./coll. ISL); 20/2 specimens (leg./coll. JHR); 5/2 specimens (leg./coll. LJL); 1/2 specimen (leg. K.I. Schnetler; coll. MNO); 2/2 specimens (leg. K.I. Schnetler; coll.RGM 229 790); 2/2 specimens (leg. K.I. Schnetler; coll. SMF 308 406); 1/2 specimen, leg. K.I. Schnetler, coll. WLH; 3/2 specimens and 2 fragments (leg./coll. AJB), 86/2 specimens (leg./coll. MNO), 2/2 specimens (coll. FHK, leg. K.I. Schnetler).

Brejning (beach exposure): 1/1 and 5/2 specimens (leg./coll. MNO); 2/2 specimens (leg./coll. ISL); 1/2 specimen (leg./coll. RLO); 1/2 specimen (leg./ coll. AHF).

Kirstinebjerg Skov (beach exposure): 1/2 specimen (leg./coll. ISL).

Krefeld-Linn (water well) (Chattian A and B): 1/2 specimen, Pl. 1, Fig. 6a-b, (leg. WHL, coll. SMF 309 204), 7/2 specimens (leg.coll. FHK).

Krefeld-Linn ('Maizena' water well) (Chattian A): 1/2 specimen, (leg./coll. FHK).

Krefeld (borehole GLA-1): 1/2 specimen (Chattian A), (leg./coll. FHK); 1/2 specimen (Chattian B), (leg./coll. FHK).

Matzerath(Schacht S.J. 8): 1/2 specimen (310.5-312.5 m) (leg./coll. FHK); 7/2 specimens (330-332 m); 1/1 + 1/2 specimen (328-330 m) (both leg./ coll. FHK).

Dalheim (borehole 50/19): 1/2 specimen (Chattian A) (leg./coll. FHK); 1/2 specimen (Chattian B) (leg./coll. FHK).

Meerbusch-Ilverich (water well): 1/1 and 1/2 specimens (Chattian A) (leg./coll. FHK); 4/2 specimens (Chattian B) (leg./coll. FHK).

Meerbusch-Osterath (water well): 1/1 and 38/2 specimens (Chattian A + B) (leg./coll. FHK).

Willich (water well): 2/2 specimens (Chattian A) (leg./coll. FHK).

Neukirchen-Vluyn (Schacht 5): 1/2 specimen (Chattian A) (leg./coll. FHK).

Wittlaer-Bockum (water well): 1/2 specimen (Chattian A) (leg./coll. FHK).

Moers-Kapellen (Kieswerk): 2/2 specimens (Chattian B) (leg./coll. FHK).

Moers-Rumeln (Schacht Rumeln): 1/1 and 3/2 specimens (Chattian A) (leg./coll. FHK); 3/2 specimens (coll. SMF); 5/2 specimens (leg./coll. AJB).

Ahnetal: 3/1 and 9/2 specimens (coll. SMF 308 407) (leg. J. Görges; coll. SMF 308 408).

Niederkaufungen: 1/2 specimen (coll. SMF 308 409).

Discussion — This large *Limopsis* species has previously often been referred to *L. goldfussi* (Nyst, 1845), a species restricted to the Rupelian. A specimen of *L. goldfussi* was found by Harder (1913: 52, pl. 3, fig. 18a-c) in the Middle Oligocene fine sand at Århus. This specimen cannot be referred to *L. retifera* Semper, 1861, as was assumed by R. Janssen (1979: 30).

The new species differs from *L. goldfussi* by the lower number of teeth in the posterior series, a different outline, a crenulated margin, a different sculpture and a more convex shell. R. Janssen (1979: 30, pl. 1, fig. 16) included specimens of the new species in *L. retifera*, from which it differs by

several features: *L. retifera* has a regularly crenulated margin, consisting of numerous fine denticles, which are almost equal in strength and correspond with the radial sculpture on the outside of the shell. In the new species the posterior series of hinge teeth is always the longer, while in *L. retifera* the anterior series is. In the new species the sculpture is dominated by the concentric ribs, while in *L. retifera* the sculpture is more cancellate. Finally, the new species is generally larger than *L. retifera*, the auricles are less distinct and the shell is more equilateral than that of *L. retifera*. The new species differs from the Miocene *L. anomala* auct. (non von Eichwald, 1830 ?) by having more convex valves, a coarser sculpture with more widely spaced concentric elements. The coarse knobs on the inner ventral margin are placed more posteriorly in *L. anomala* and the entire ventral margin is crenulate. The resilifer in *L. anomala* has an acute-angled triangular outline, while the outline of the resilifer in the new species is right-angled triangular.

Propeamussium (Parvamussium) sp.

Remarks — A rather limited material, consisting of 11 defective valves and fragments, is available. Mr A.C. Janse (pers. comm., 1988) noted that on the fragments in his collection from Mogenstrup the number of radial ribs on the inner side of the shell differs, in comparison to *P. pygmaeum* (von Münster, 1835) from the German and Danish Late Oligocene. The Mogenstrup specimens all have 11 radial ribs on the inside of both the left and right valve, while specimens of *P. pygmaeum* show 15-17 ribs on the right valve and 12-14 on the left one (see also R. Janssen, 1978a: 48).

The sculpture on the outside of the right valve is rather similar to that of *P. pygmaeum*. The left valve has a cancellate sculpture, consisting of about 35 concentric ribs and numerous fine radial lines.

Apparently, there are consistent differences between the Mogenstrup material and *P. pygmaeum*. More and better preserved material is needed for a proper interpretation of the Mogenstrup form. Mr A.C. Janse (pers. comm., 1989) referred to two taxa that might be related: *P. duodecemlamellatum* (Bronn, 1831), from the Early Pliocene of Italy and *P. duodecemlamellatum bronni* (Mayer, 1861) from the Middle Oligocene of Hungary.

Lepetella helgae sp. nov.
Pl. 1, Fig. 9a-b.

Locus typicus — Coastal cliff at Mogenstrup, North of Skive, Jutland, Denmark (Fig. 1).
Stratum typicum — Glauconitic sand, Brejning Clay Member of the Vejle Fjord Formation, Late Oligocene (Chattian B).
Derivatio nominis — This new species is named after my daughter, Helga Lund Schnetler.
Holotype — Pl. 1, Fig. 9a-b, (coll. MGUH 20 028) (leg. M.S. Nielsen).
Description — The shell is small and cap-shaped. The apex is highly elevated and situated precisely above the posterior apertural margin. The protoconch resembles a small button.

The aperture is almost circular. In lateral view the anterior outline of the shell is convex, whereas the posterior outline is almost straight. There is no external sculpture. The growth lines are well marked, concentric and somewhat variable in strength.

On the inside of the shell the horseshoe-shaped muscular impression is fairly distinct.
Paratypes — Mogenstrup (coastal cliff): 1 specimen (leg./coll. MNO).
Discussion — The new species is related to the very variable species *L. compressiuscula* (Karsten, 1849). In *L. compressiuscula*, however, the shell is distinctly compressed laterally and the apex is situated above the centre of the elliptical aperture. *L. compressiuscula* is also relatively less elevated.

Lepetella jytteae sp. nov.
Pl. 1, Fig. 10a-b

Locus typicus — Coastal cliff at Mogenstrup, North of Skive, Jutland, Denmark (Fig. 1).
Stratum typicum — Glauconitic sand, Brejning Clay Member of the Vejle Fjord Formation, Late Oligocene (Chattian B).
Derivatio nominis — This species is named after Mrs Jytte Hillersborg, who found and donated the holotype.
Holotype — Pl. 1, Fig. 10a-b (coll. MGUH 20 029) (leg. JHR).
Description — The shell is rather large and cap-shaped. The aperture is suboval, with its greatest width in the anterior part. The shell height equals about half the greatest diameter of the aperture. The apex is situated at about five sixths of the shell

length. The anterior outline (lateral view) is convex, while the posterior part is almost straight.

The protoconch is button-shaped and smooth. On the juvenile shell numerous growth-lines are visible, indicating that it had an almost circular aperture. About three millimetres from the protoconch a rather strong concentric sculpture appears, consisting of strong ribs, separated by interspaces of almost equal strength. On the largest available specimen about 20 such ribs are present. The concentric ribs are crossed by weaker radial ribs, the number of which increases towards the apertural margin, because secondary radial ribs appear in between the primary ones. The radial ribs are rather prominent on the adapical side of the concentric ribs, but are also visible in the interspaces.

On the inside of the shell the horseshoe-shaped muscular impression is fairly distinct.

Paratypes — Mogenstrup (coastal cliff): 25 specimens (leg./coll. MNO); 2 specimens (coll. ISL, leg. MNO).

Remarks — This rather large *Lepetella* species differs from congeners by its strong sculpture.

Collonia (Collonia) troelsi sp. nov.
Pl. 2, Fig. 2a-c

Locus typicus — Coastal cliff at Mogenstrup, North of Skive, Jutland, Denmark (Fig. 1).

Stratum typicum — Glauconitic sand, Brejning Clay Member of the Vejle Fjord Formation, Late Oligocene (Chattian B).

Derivatio nominis — The species is named after my son, Troels Lund Schnetler.

Holotype — Pl. 2, Fig. 2a-c (coll. MGUH 20 030) (leg. K.I. Schnetler).

Description — The shell is small, rather thin-walled and wider than high, juvenile specimens very much so. The protoconch consists of three quarters of a whorl, the nucleus being relatively large and slightly depressed. The boundary with the teleoconch is sharp and indicated by an almost orthocline radial furrow.

In the largest specimen the teleoconch consists of two convex whorls, rapidly increasing in diameter, and separated by deep sutures. The last whorl equals about nine tenths, the height of the aperture about six tenths of the total shell height. The periphery is regularly convex. The base of the shell is provided with a rather narrow umbilicus, which is separated from the base by two close-set spiral ribs. In the umbilicus about four weaker spiral ribs are visible. The aperture is subcircular with a sharp labrum. The columella is concave, with a somewhat thickened inner lip demarcating the umbilicus. A vertical impression is visible on the columella, which most probably indicates the position of the operculum.

The whorls have a glossy appearance. An extremely fine spiral furrow is present near the adapical suture. Prosocline growth-lines are rather distinct. On the largest specimen two former apertures are visible as rather prominent prosocline lines.

Paratypes — Mogenstrup (coastal cliff): 3 specimens (leg./coll. ISL); 25 specimens (coll. ISL/leg. MNO); 200 specimens (leg./coll. MNO).

Discussion — The new species differs from *Collonia (C.) minima* (Philippi, 1843) by several features, although juvenile specimens at first look rather similar to this species. The protoconch of *C. minima* comprises one whorl, the nucleus is rather small and the transition to the teleoconch is not sharp. In *C. minima* the whorls increase more gently in diameter. On its base a sharp furrow is present close to the demarcating spiral rib. This spiral, as well as those within the umbilicus, are coarser in *C. minima*. Adapically, its aperture adapically has a sharper edge, and it is generally smaller than the new species.

Homalopoma (? Leptothyropsis) sp.
Pl. 1, Figs 12a-c.

Description — A rather limited material, consisting of a single defective shell and seven fragments of the same specimen, was collected (leg. E. Nielsen, Århus). Unfortunately, the protoconch is missing, and the state of preservation is rather poor, for which reasons it has not been possible to make a final interpretation of the material.

The shell is rather small, trochiform, about as high as wide. The defective specimen consists of only 1 3/4 whorls, which are moderately convex and separated by deep sutures. They increase very rapidly in diameter.

The body whorl equals about five sixth of the (estimated) total shell height; the aperture is about half as high as the complete shell. The base is only slightly convex, with a rather wide umbilicus, surrounded by a distinct spiral rib. The aperture is oval, the labrum is broken. The columella is concave, and the inner lip has a rather thick callus.

The spiral sculpture on the middle whorls consists of a thin, sharp spiral carina, which is project-

ing and situated immediately above the abapical suture. On the base of the shell three further, similar spirals are present. The four spirals are regularly spaced with concave interspaces. The distance between the lowermost of these spirals and the umbilical spiral is distinctly larger. On the largest fragment two secondary spirals develop between the two adapical spirals.

The radial sculpture consists of about 30 prosocline folds, separated by somewhat narrower interspaces. Towards the upper suture these folds are slightly accentuated, gradually becoming weaker and less well-defined downwards, and they disappear between the two adapical spirals. The radial sculpture forms small projections on the spirals. Distinct prosocline growth lines are present. From the upper suture they run slightly undulating downwards, especially well visible on the radial folds. Also between the spirals they are distinct.

Remarks — The shell seems to be rather similar to *Homalopoma (Lepthothyropsis) philipiana* Dall (see Wenz, 1938: 341, fig. 799) in general outline, but additional material is needed.

Tubiola subangulata sp. nov.
Pl. 1, Fig. 14

Locus typicus — Coastal cliff at Mogenstrup, North of Skive, Jutland, Denmark (Fig. 1).

Stratum typicum — Glauconitic sand, Brejning Clay Member of the Vejle Fjord Formation, Late Oligocene (Chattian B).

Derivatio nominis — L. *subangulata* (= near-angular). The species is named after the obtusely angular whorls.

Holotype — Pl. 1, Fig. 14; (coll. MGUH 20 032) (leg. M.S. Nielsen).

Description — The shell is very small and relatively thick-walled, about 1½ times as wide as high. It consists of about three convex whorls which rapidly increase in diameter. The protoconch consists of half a whorl only. The rather voluminous and inflated nucleus has a very finely granulated surface. The boundary with the teleoconch is only indicated by the appearance of a spiral rib on the adapical part of the first post-embryonic whorl. The body whorl equals about seven eighths of the total shell height.

The base of the shell is slightly convex and demarcated from the deep and rather wide umbilicus by a spiral rib. In the umbilicus one further spiral is visible. The aperture is almost circular; the labrum is not thickened, but the columellar part of the inner lip is slightly consolidated.

The dominant sculptural element is a rather strong spiral rib, lying at a short distance from the upper suture and dividing the whorl into two parts: a flat adapical ramp, and a lower part which adapically is almost flat, and becomes slightly convex below. The two parts of the whorl together form an obtuse angle. The transition into the base is regularly rounded. The growth lines are barely visible, but almost orthocline.

Paratypes — Mogenstrup (coastal cliff): 2 specimens (leg./coll. MNO); 1 specimen (leg. M. S. Nielsen; coll. ISL).

Discussion — The species differs from the rather similar *Tubiola* sp. 1 (A.W. Janssen, 1984: 128, pl. 6, fig. 3a-b) by having more angular whorls. *Daronia dingdensis* Anderson, 1964 has a concave adapical ramp and a demarcating carina which projects beyond the ramp. Below this carina the whorl is slightly concave, changing downwards to strongly convex. Its apex projects only slightly over the last whorl.

Tubiola sp.
Pl. 2, Fig. 1

Description — The shell is very small and consists of 2 3/4 moderately convex whorls which are separated by deep, almost canaliculate sutures. The shell is almost as high as wide. The protoconch comprises slightly more than half a whorl, and is clearly separated from the teleoconch by a radial orthocline rib, and by a difference in colour. The nucleus is relatively large.

The body whorl equals about seven eighths of the total shell height. The periphery is regularly convex with a gradual transition into the base. The rather deep, but not very wide umbilicus is separated by a distinct spiral rib which is granulated by the growth lines. One additional spiral rib is visible in the umbilicus.

The aperture is almost circular, and neither labrum nor inner lip are thickened. The shell's surface is smooth and glossy, with rather weak almost orthocline growth lines.

Material — Mogenstrup (coastal cliff): 2 specimens (leg./coll. MNO), 1 specimen (Pl. 2, Fig. 1) (leg. MNO, coll. MGUH 20 033).

Discussion — The shell differs from *Tubiola* sp. 2 from the Hemmoorian of Winterswijk-Miste

(A.W. Janssen, 1984: 128, pl. 6, fig. 8) by having a lower apex and a less concave columella.

? **Skenea** sp.
Pl. 2, Figs 3a-b

Description — Only five juvenile specimens are available. The shell is very small and planispiral. The protoconch consists of half a whorl, the nucleus is voluminous. The transition into the teleoconch is sharp and demarcated by a radial rib.

The teleoconch consists of 3/4 convex whorl only. It has a very convex periphery, and an almost flat adapical part, which is separated from the lower part of the whorl by a spiral. The transition into the convex base is gradual. The umbilicus is wide and demarcated by a spiral rib. The aperture is subcircular and the labrum is broken. Through the umbilicus the base of the nucleus is visible.

The sculpture consists of very fine, thread-like spiral riblets. A spiral near the adapical suture in particular is rather distinct, while those on the periphery are weaker. On the base the spiral demarcating the wide umbilicus is very distinct. The growth lines are opisthocline near the adapical suture.

Remarks — The material shows a stronger spiral sculpture than does ? *Skenea* sp. (A.W. Janssen, 1984: 129, pl. 6, fig. 9a-b).

Ovirissoa sp.

Description — The only specimen found is very immature and shows no teleoconch sculpture. Yet, the apical angle would indicate that the specimen is more closely related to *O. gottscheana* (von Koenen, 1882) than to *O. westfalica* (A.W. Janssen, 1967), which has a distinctly wider apical angle.

Cerithiopsis (s. lat.) **antonjansei** sp. nov.
Pl. 2, Fig. 9.

Locus typicus — Coastal cliff at Mogenstrup, North of Skive, Jutland, Denmark (Fig. 1).

Stratum typicum — Glauconitic sand, Brejning Clay Member of the Vejle Fjord Formation, Late Oligocene (Chattian B).

Derivatio nominis — This species is named after my friend Anton C. Janse, Brielle, The Netherlands.

Holotype — Pl. 2, Fig. 9, (coll. MGUH 20 040) (leg. M.S. Nielsen).

Description — The shell is rather small and slender turriculate; about three times as high as wide. The last whorl equals slightly less than one third of the total shell height.

The protoconch consists of four and a half moderately convex whorls which are separated by rather distinct sutures. The nucleus is small. From the second protoconch whorl onwards the whorls are provided with a radial sculpture, consisting of numerous fine riblets. Initially these riblets are almost orthocline, but they become slightly opisthocline on the last protoconch whorls. A spiral sculpture consisting of five or six spiral threads is present on the last two and a half protoconch whorls. These spirals are situated on the abapical part of the whorl and, although they increase in strength in abapical direction, they remain weaker than the spiral ribs. The two sculptural elements together result in a reticulate ornament of the abapical part of the whorl. The transition to the teleoconch is sharp and opisthocline.

The teleoconch consists of five and a half whorls in the largest specimen. These whorls are convex and separated by deep sutures. The last whorl equals slightly less than one third of the total shell height, the aperture with the siphonal canal about one fourth. The aperture is rounded-oval, the labrum is broken and the columella is concave. The two prominent spiral ribs (see below) cause an angular periphery. The base is almost flat.

The spiral sculpture starts immediately behind the boundary with the protoconch with three spirals, of which the adapical one is thread-like and situated immediately below the suture. This spiral does not increase in strength on the following whorls, but it gradually becomes more distant from the adapical suture. The two abapical spirals are prominent, especially the upper one, which is placed on the centre of the whorl. The lowermost spiral lies at a short distance above the abapical suture. In-between the spirals the whorl is concave, especially so between the two lower spirals. A rather weak spiral rib, demarcating the base of the whorl, is only visible on the last whorl. Close to this demarcating spiral a weaker spiral rib is present on the base.

The radial sculpture consists of slightly opisthocline ribs which are much narrower than the spaces between them. The number of these ribs is 15 on the first post-embryonal whorl and 14 on the body whorl. At the points of intersection of the radial ribs and the two stronger spirals acute knobs

occur, which are most prominent on the upper one of these two spirals. The adapical spiral rib continues across the radial ribs, without knobs being formed. In-between the radial sculpture rather weak opisthocline growth lines are visible.

Paratypes — Mogenstrup (coastal cliff): 1 specimen (leg./coll. MNO); 1 specimen (leg./coll. JHR).

Kirstinebjerg skov (beach exposure); 1 specimen (leg./coll. ISL).

Remarks — The new species differs from the numerous other species of the genus *Cerithiopsis* from the North Sea Basin by the glossy appearance of the whorls which is caused by the rather narrow spiral and radial sculpture. The protoconch of the new species resembles that of *Cerithiopsis* (s. lat.) *serrula* R. Janssen, 1978, but differs in the number of spiral threads (five to six in the new species, but only two in *C. serrula*). Furthermore, the teleoconch sculpture is much coarser in *C. serrula*. There seems to be no closely related species in the North Sea Basin.

Laiocochlis (Laiocochlis) supraoligocaenica sp. nov.
Pl. 2, Fig. 8

Locus typicus — Coastal cliff at Mogenstrup, North of Skive, Jutland, Denmark (Fig. 1).

Stratum typicum — Glauconitic sand, Brejning Clay Member of the Vejle Fjord Formation, Late Oligocene (Chattian B).

Derivatio nominis — This species is named after its occurrence in the Late Oligocene, because this chronostratigraphic unit is often referred to as 'Upper' Oligocene.

Holotype — Pl. 2, Fig. 8, (coll. MGUH 20 039) (leg. M.S. Nielsen).

Description — Only two juvenile specimens were collected. The shell is turriculate, small and sinistral. The last whorl present comprises about half the total shell-height.

The relatively large protoconch consists of about 2½ convex whorls which are separated by deep sutures. The nucleus is large and inflated. The sculpture of the larval shell consists of a group of four inequidistant spiral bands, lying alongside the adapical suture, and about 15 very delicate spiral grooves on the remaining part of the whorl. The upper spiral bands are separated by extremely narrow grooves. A radial sculpture, consisting of about 13 rather strong, almost orthocline ribs, is present after ¾ protoconch whorl. The transition to the teleoconch is not very distinct, but indicated by the disappearance of the spiral sculpture and a change from a light to a darker colour.

Even the largest specimen has only one and a half teleoconch whorls. They are moderately convex and separated by deep sutures. The flat base is demarcated by a spiral rib. The labrum is broken, and the inner lip is not very well defined. The siphonal canal is rather short and wide, slightly turned backwards.

The spiral sculpture on the teleoconch consists of two smooth spiral ribs, accompanying the upper and the lower suture respectively, the shell's surface in between these spirals is smooth, except for about ten fine spiral furrows. The radial sculpture consists of about 12 strong almost orthocline ribs per whorl which run between the two spiral ribs without crossing them. Growth lines are visible, on the base they are prosocyrt. In the available juvenile specimens the base has no further sculpture.

Paratypes — Mogenstrup (coastal cliff): 1 specimen. (leg./coll. MNO).

Discussion — The outline and sculpture of the protoconch agree with the description and illustration in Gründel (1980: 251, fig. 35) of the protoconch of the genus *Laiocochlis* Dunker & Metzger, 1874. In NW Europe this genus is represented by four species in the Lutetian of the Paris Basin (Cossmann, 1889: 41, pl. 2, figs 20-23), by the Pliocene species *L. woodi* van Regteren Altena, 1954 (= *Cerithium granosum* Wood, 1848, non Borson) and by the Pliocene and Recent species *L. sinistrata* (Nyst, 1835) (see Gründel, 1980: 251, erroneously cited as *L. sinistria* Nyst). None of these, however, seems to be related to the new species. Except for the Eocene *L. passyi* (Deshayes), which has smooth teleoconch whorls, all these species have a strong spiral ornament and a weaker or completely lacking radial ornament.

The new species is the first representative of the genus *Laiocochlis* to be reported from the Late Oligocene of the North Sea Basin. In the Oligocene (Rupelian) of the Aquitaine Basin (SW France) the species *Laiocochlis lesbarritzensis* Vergneau, 1963 occurs. A lot consisting of 23 specimens from the locality Gaas (Lagouarde) was kindly sent on loan to me by Dr P. Lozouet (Muséum national d'Histoire naturelle, Paris). The French species differs from the present one by its much smaller protoconch and relatively smaller nucleus. A radial sculpture is absent. On the teleo-

conch three primary spirals are present which are stronger than the radial sculpture. Obviously *L. lesbarritzensis* is not closely related to *L. supraoligocaenica*.

Triforis (Trituba) sorgenfreii sp. nov.
Pl. 2, Figs 5-7

1978b *Triforis (Trituba)* aff. *raulini* Cossmann & Peyrot 1921 — R. Janssen, p. 171 (*partim*).
?1978b *Triforis (Trituba)* aff. *raulini* Cossmann & Peyrot 1921 — R. Janssen, p. 171, pl. 12, fig. 51

Locus typicus — Coastal cliff at Mogenstrup, North of Skive, Jutland, Denmark (Fig. 1).
Stratum typicum — Glauconitic sand, Brejning Clay Member of the Vejle Fjord Formation, Late Oligocene (Chattian B).
Derivatio nominis — This species is named in honour of the late Professor Dr Th. Sorgenfrei (Copenhagen), who contributed substantially to the knowledge of Tertiary molluscs.
Holotype — Pl. 2, Fig. 5, (coll. MGUH 20 038) (leg. M.S. Nielsen).
Description — At Mogenstrup a rather limited material consisting of five fragmentary shells and one juvenile individual with its protoconch preserved was collected. The juvenile specimen is designated holotype here, since it demonstrates the typical teleoconch sculpture on the two preserved teleoconch whorls. Additional material from Kirstinebjerg Skov, consisting of three fragmentary shells and three fragments, was also used for the following description.

The dextral shell is rather small, turriculate to cylindrical and slender, about four times as high as wide. The shell is very fragile because of the high number of whorls, for which reason only fragmentary or juvenile shells could be collected. A reconstruction of the fragments suggest a shell height of up to 20 mm for adult specimens.

The protoconch comprises about six low and moderately convex whorls. These whorls are separated by deep sutures. The nucleus is small. The last protoconch whorl equals about one third of the total protoconch height. The last five larval whorls are provided with a radial sculpture, consisting of numerous thread-like riblets which run from one suture to the other. On the second protoconch whorl these riblets are almost orthocline, but on the last protoconch whorl they become opisthocyrt. At the same time a spiral rib appears above the the abapical suture. The adapical parts of the riblets are united by a further spiral rib, below which the radial riblets are somewhat weaker, forming an angle of about 30° with the abapical suture. The number of riblets is about 24 on the penultimate protoconch whorl and it decreases to about 20 on the last whorl. The transition to the teleoconch is sharp and opisthocline. The largest available specimen comprises 6½ teleoconch whorls which are low and separated by distinct sutures. These sutures are almost straight. The last whorl equals less than ¾ of the total shell height. The aperture is rounded rectangular. The siphonal canal is broken in all available specimens, but seems to be directed obliquely backwards. The base is flat and provided with numerous prosocyrt growth lines.

The spiral sculpture consists of two rather strong ribs, the adapical one being situated at about three fourths of the height of the whorl, the abapical one at about one fourth of this height. The spirals are much narrower than their interspaces. Between the two spirals the shell wall is concave. A third weak spiral is situated very close to the lower suture, but is usually covered by the next whorl. On the body whorl this spiral demarcates the base of the shell.

The radial sculpture consists of about 14-18 opisthocline ribs. At their points of intersection the spiral and radial sculpture elements form solid knobs. These knobs are almost equal in strength on the two spirals. The abapical knobs almost touch the suture. The spiral demarcating the base is smooth. Opisthocline growth lines are especially well visible on the concave part of the whorl and on the base, which is otherwise smooth.
Paratypes — Mogenstrup (coastal cliff): 1 defective specimen; Pl. 2, Fig. 6, (coll. MGUH 20 037) (leg. K.I. Schnetler); 1 defective specimen (leg./coll. ISL); 1 defective specimen (leg./coll. MNO); 2 defective specimens (leg./coll. JHR).

Kirstinebjerg Skov (beach exposure): 1 defective specimen, Pl. 2, Fig. 7 (coll. MGUH 20 038 (leg. K.I. Schnetler); 2 defective specimens, 3 fragments (leg./coll. ISL).

Freden: 1 specimen (coll. SMF 309 205), mentioned in R. Janssen, 1978b, p. 171 (erroneously two specimens were mentioned there).

Volpriehausen: ? 2 specimens (one of which illustrated in R. Janssen, 1978b, pl. 12, fig. 51) (leg. A. von Koenen, coll. Geologisch-Paläontologisches Institut, Göttingen).

Krefeld-Linn (water well): 2 defective specimens (leg./coll. WLH).

Discussion — The protoconch sculpture of the new species shows a similar development as in *Triforis (Trituba)* aff. *bitubulatus* Baudon, 1856 from the Hemmoorian of Winterswijk-Miste in The Netherlands (see A.W. Janssen, 1984: 160, pl. 7, fig. 6), but it differs by having a higher number of radial riblets. Furthermore, in the new species the protoconch whorls have their greatest convexity about halfway between the sutures, whereas it is situated more abapically in the species from Winterswijk-Miste. The teleoconch whorls of the new species have a smooth peripheral spiral, in the species from Miste this spiral is provided with knobs. In other features the two species are rather similar.

I have compared the Danish material with topotypical specimens of *Triforis (Trituba) raulini* Cossmann & Peyrot, 1921 from Peyrehorade-Peyrère (France), kindly sent on loan to me by Mr A.W. Janssen (coll. RGM), and with two such topotypes in coll. ISL (leg. R. Janssen). The protoconch in the French species consists of three whorls only. Its nucleus is relatively large, the whorls are highly convex, especially so the second and the third, and provided with a collabral sculpture. On the initial protoconch whorl 12 rather weak orthocline ribs are present, which number increases to 16 on the following whorls. The radial sculpture becomes stronger downwards, on the last half protoconch whorl the ribs become opisthocline.

The teleoconch of *T. raulini* differs in several respects. The Danish species has relatively higher whorls and the two spirals are further apart. The two rows of knobs are almost equal in strength in the Danish species, while in the French form the abapical knobs are stronger and also more pointed. Finally, the peripheral spiral of the Danish species is smooth, while the corresponding spiral in the French species has distinct knobs, causing a more undulated suture. Thus, the new species demonstrates a closer relationship to the species from Winterswijk-Miste than to the one from Peyrehorade.

From the German Late Oligocene R. Janssen (1978b: 172, pl. 12, fig. 51) illustrated a specimen from Volpriehausen, indicated as *Trifora (Trituba)* aff. *raulini* Cossmann & Peyrot, 1912. This specimen might be conspecific with *T. sorgenfreii*, but the specimen was not yet available for study. I have compared a rather defective specimen (about two teleoconch whorls) from Freden (coll. SMF 309 205), mentioned in R. Janssen (1978b: 171; two specimens were mentioned erroneously), kindly loaned to me by Dr Janssen. This specimen agrees with the Danish material and consequently it is referred to the new species.

Cirsotrema (Opaliopsis) subglabrum sp. nov.
Pl. 2, Fig. 10

1987 *Cirsotrema (Opaliopsis)* sp. — Schnetler, *in* Schnetler & Beyer, p. 211, pl. 1, fig. 12.

Locus typicus — Nørre Vissing, clay-pit of Galten Brickworks, Jutland, Denmark.
Stratum typicum — Brejning Clay Member of the Vejle Fjord Formation, Late Oligocene (Chattian B).
Derivatio nominis — (L.) *subglabrum* = almost smooth.
Holotype — Schnetler, *in* Schnetler & Beyer, 1987, pl. 1, fig. 12, (coll. MGUH 17 612).
Description — Since my first description of this species additional material has been collected, consisting of three defective shells and a protoconch from Mogenstrup, and a juvenile specimen with its protoconch preserved from Kristinebjerg Skov. The new material matches the specimen from Nørre Vissing perfectly. The largest specimen from Mogenstrup consists of 3½ teleoconch whorls, including the transition from the protoconch to the teleoconch. The number of radial ribs is about 20 on the last whorl. A very fine spiral ornament, consisting of eight spiral bands, separated by delicate spiral grooves, is faintly discernible. For a more detailed description the reader is referred to the above-mentioned paper.
Paratypes — Mogenstrup (coastal cliff): 1 defective specimen (Pl. 1, Fig. 13) (leg. J. Hillersborg; coll. MGUH 20 041); 2 defective specimens (leg./coll. JHR); 1 juvenile specimen (protoconch only) (leg./coll. MNO). Kirstinebjerg Skov (beach exposure) — 1 specimen (leg./coll. ISL).

Cirsotrema (? Opaliopsis) aff. **koeneni**
A.W.Janssen, 1967
Pl. 2, Fig. 11

Description — At Mogenstrup a single specimen was found, consisting of two protoconch whorls and 4 3/4 teleoconch whorls.

The shell is slender turriculate, about three times as high as wide. The last whorl equals about one third of the total shell height. The preserved protoconch whorls are slightly convex and sepa-

rated by deep sutures. They increase gradually in diameter. The whorls are provided with about 30 opisthocline radial riblets. The transition to the teleoconch appears to be sharp.

The teleoconch consists of 4 3/4 convex, somewhat angular whorls which are separated by deep sutures. The shell has a smooth basal disc, the aperture is rounded oval, the labrum is broken and the inner lip is concave. The callus is thin. The spiral sculpture is visible from the second teleoconch whorl onwards. It consists of three spiral ribs, of which the adapical one is the strongest. This rib is situated at about two thirds of whorl height. The three spirals are regularly spaced. A further, smooth spiral demarcates the basal disc, it is partly covered by the subsequent volution, but visible on all teleoconch whorls. No secondary spirals are inserted. The radial sculpture consists of about 16 ribs which are stronger than the spirals. They are almost as wide as their interspaces. On the first teleoconch whorl the radial ribs are opisthocline, but they gradually become almost orthocline on the younger whorls. At the points of intersection between the two sculptural elements rounded knobs form, most prominently on the adapical spiral rib.

Remarks — The Late Oligocene specimen described here differs from the Miocene *C. koeneni* by having three primary spirals instead of two.

Cirsotrema (Opaliopsis) sp. 1
Pl. 2, Fig. 12

Description — A single specimen was collected at Mogenstrup. The protoconch and the first teleoconch whorls are missing and the aperture is very poorly preserved. The shell is slender turriculate, about four times as high as wide. The whorls expand regularly in diameter. The specimen consists of 4 3/4 whorls which are separated by deep, slightly undulating sutures. The height of the body whorl measures about one third of the total shell height. The flat basal disc is demarcated by a smooth spiral rib which is thickened in adapical direction in between the radial ribs. The aperture is rounded-oval, the labrum and the abapical part of the aperture are broken off. A further spiral lies at the transition from the base to the canal.

At about three quarters of their height the whorls show a faint angulation. Above this angulation, in the adapical part of the whorls, a number of very delicate, close-set spiral threads can be noted. On the lower part of the whorls about ten extremely fine spirals are discernible. The spiral rib demarcating the basal disc is visible in the suture.

The radial sculpture consists of 18-20 prominent, almost orthocline ribs which run across the whorls from one suture to the other. These ribs are almost as wide as their interspaces. In-between the ribs growth lines are visible. On the adapical part of the whorls they cross the delicate spiral threads, resulting in a fine granulation (magnification × 50).

Remarks — The shell has an overall *Turbonilla*-like appearance because of the slender outline, the radial sculpture and the weak spiral sculpture. *Opalia (Pliciscala) pusilla* (Philippi, 1843) (see R. Janssen, 1978b, pl. 12, fig. 57) from the Lower Rhine area, F.R.G., has a rather similar radial sculpture, but no spiral on the base at the transition from the base to the canal. *Cirsotrema (Opaliopsis) turbonillaeforme* A.W. Janssen, 1967 is quite similar in many respects, but differs by its lower number of radial ribs (14 instead of 18-20 ribs per whorl).

Cirsotrema (Opaliopsis) sp. 2.
Pl. 2, Fig. 13

Description — A single protoconch was found which differs from *Cirsotrema (Opaliopsis) subglabra* sp. nov. The specimen comprises five moderately convex whorls, separated by deep sutures. The nucleus is relatively large and inflated. The last three whorls have a very fine radial sculpture, consisting of numerous flexuous riblets (about 60 on the penultimate whorl). In between this radial sculpture numerous extremely fine spiral grooves are suggested. The base of the shell is convex. The aperture is rounded oval, the inner lip somewhat thickened.

Remarks — I refer this larval shell to *Cirsotrema (Opaliopsis)* on account of its similarity to the protoconchs of *C. (O.) subglabrum* sp. nov., as described above, and of *C. (O.) turbonillaeforme* A.W. Janssen, 1967 from the Reinbekian of Dingden. In fact, it cannot be excluded that the present specimen does belong to the same species as *Cirsotrema (Opaliopsis)* sp. 1, the protoconch of which is unknown. This assumption seems to be supported by the very weak teleoconch sculpture of the last-named species.

Apiocypraea (Apiocypraea)
cf. **humbergi** R. Janssen, 1978
Pl. 3, Fig. 4a-b

Description — A rather limited material, consisting of one protoconch, one juvenile shell with half a teleoconch whorl preserved and one isolated labrum, is available.

The protoconch is conical and comprises about five moderately convex whorls which are separated by rather shallow sutures. The nucleus is relatively large and inflated, the following whorls are provided with a cancellated sculpture, produced by numerous fine opisthocline and prosocline thread-like riblets. The transition to the teleoconch cannot be studied on the juvenile specimen.

The sculpture on the preserved half teleoconch whorl consists of ribbon-like spiral ribs which are narrower than their interspaces. Secondary spirals develop rapidly. The radial sculpture consists of prosocyrt riblets which are weaker than the spiral ribs. The combination of the two sculptural elements results in a reticulate ornament. The radial sculpture disappears soon in apertural direction.

The isolated labrum lacks its adapical part. The outline of the labrum, its size, and also the number and the shape of the teeth, agree very well with the description and illustration of *Apiocypraea (A.) humbergi* in R. Janssen (1978b: 197, pl. 14, fig. 86). The protoconch closely resembles the description and illustration of the species *A. (A.) subphysis septemtrionalis* (Schilder, 1929) from the Hemmoorian of Winterswijk-Miste, The Netherlands (A.W. Janssen, 1984: 193, pl. 82, fig. 2). I therefore refer the Danish material, with a query, to *A. humbergi*.

Trophonopsis (Pagodula) angustevaricata
(Gripp, 1912)
Pl. 2, Fig. 14a-b

1912 *Murex angustevaricata* nov.sp., Gripp, *in* Koch, Gripp & Franke, p. 22, fig. 4.
1963 *Trophonopsis (Pagodula) semperi angustevaricata* (Gripp, 1912) — Tembrock, p. 314, pl. 5, fig. 6.
1968 *Trophonopsis semperi* (Koenen, 1872) — Rasmussen, p. 125 (partim, non von Koenen).

Description — The shell is slender and fusiform; its height equals about 2½ times the width (estimated, because the siphonal canal is broken in all specimens).

The protoconch is paucispiral and consists of two whorls, separated by deep sutures. The nucleus is large and vesicular. On the last ¾ whorl five orthocline radial ribs are present. The boundary with the teleoconch is sharp and marked by a slightly flexuous radial rib. The protoconch surface shows an extremely delicate microsculpture, consisting of about 20 spiral furrows per whorl. This microsculpture is visible on well-preserved specimens only.

The largest specimen available has 3 3/4 teleoconch whorls which are angular because of a ring of projecting spines placed just above mid-whorl. The adapical part of the whorl is almost flat, whereas the lower part is slightly convex. The base of the body whorl is regularly constricted. The columella is slightly flexuous, the aperture is rounded-oval and constricted below to the long, narrow and straight siphonal canal. The inner lip is simple, smooth and well defined; the labrum is somewhat thickened.

The spiral sculpture starts with three weak spirals, the upper one of which is the strongest. The spirals are separated by much narrower interspaces. On the body whorl five spirals are present below the strong adapical one.

The radial sculpture consists of laminate ribs which are almost orthocline. On the first teleoconch whorl there are 15 such ribs, increasing to 18 to 20 on the body whorl. At the points of intersection with the spirals the ribs become crispate. On the strong upper spiral spines are formed that project somewhat in adapical direction. On the base a similar sculpture is present, but it becomes gradually weaker downwards. In-between the radial sculpture fine, slightly flexuous growth lines are visible.

Remarks — I compared the fairly rich material from Mogenstrup with specimens of the genus *Trophonopsis* from a number of localities. From the Danish Late Oligocene I studied material from Skanderborg (1 specimen, coll. ISL) and Brejning (2 specimens, coll. ISL, and 2 specimens, coll. MNO). These lots seem to agree with the material from Mogenstrup with regard to the protoconch (worn on the two specimens from Brejning). The number of radial ribs is lower on the Brejning specimens (10 to 12 ribs, but 18 on those from Mogenstrup). In addition, these ribs are opisthocline abapically. Thus, the Brejning material probably does not belong to *Trophonopsis angustevaricata*, but seems to be closer to *T. semperi*

(von Koenen, 1872) (compare Tembrock, 1963, pl. 5, fig. 5).

From the Danish Late Miocene one specimen of *Trophonopsis semperi* from Gram was studied (coll. ISL). Its protoconch differs from the Mogenstrup form by having a smaller nucleus, a slightly angular last whorl and a microsculpture consisting of prosocline radial threads and spirals that cross the radials at right angles (Rasmussen, 1968: 123). On the specimens from Mogenstrup the microsculpture consists of spiral furrows only. On the teleoconch of the Gram specimen the angulation of the whorl is situated on the middle of the whorl, and there are only two spirals present. The number of radial ribs is about 12 on the shell from Gram and the spines are projecting more adapically than in the Mogenstrup material. From Måde (Danish Gram Clay, Late Miocene) Rasmussen (1968: 124) mentioned a large specimen having only eight or nine radial ribs.

Rasmussen (1968: 125) united *T. semperi semperi* (von Koenen, 1872) and *T. semperi angustevaricata* (Gripp, 1912) since the number of spirals was variable in his material from Gram. In my opinion *T. semperi* and *T. angustevaricata* should be considered two separate species because of the difference in protoconch and the considerably higher number of radial ribs on the specimens from Mogenstrup.

Tembrock (1963: 314) treated *T. angustevaricata* as a subspecies of *T. semperi* and stated that both occur in the 'Upper Miocene' of Lüneburg, F.R.G. This course of action does not comply with the present-day subspecies concept and seems to confirm that *T. semperi* and *T. angustevaricata* are separate species.

The specimens from Brejning seem to belong to *T. semperi* and thus *T. semperi* and *T. angustevaricata* are present in the North Sea Basin from the Late Oligocene to the Late Miocene.

Searlesia ravni sp. nov.
Pl. 2, Figs 16, 17a-b

1907 *Fusus* aff. *Koninckii* Nyst — Ravn, p. 119, pl. 5, fig. 14a-b.
1987 *Angistoma brueckneri* (Beyrich, 1856) — Schnetler, *in* Schnetler & Beyer, p. 213 (partim, non Beyrich, non pl. 2, fig. 3 = *Angistoma brueckneri danica* subsp. nov.).

Locus typicus — Cilleborg (former clay-pit), Jutland, Denmark.
Stratum typicum — Glauconitic clay, Late Oligocene (Chattian A).

Derivatio nominis — This new species is named in honour of the late Dr J.P.J. Ravn, who was the first to describe this species.
Holotype — Ravn, 1907, pl. 5, fig. 14a-b (coll. MGUH 505).
Description - The shell is large, fusiform and rather thick-walled. The height equals two times the diameter, the last whorl about three quarters of the total shell-height, and the aperture and the canal slightly more than half of the total shell height.

The adult shell may have up to eight whorls, but no complete specimen was found. On one defective shell the protoconch is present, but it is rather poorly preserved. It consists of two relatively large whorls, of which the first one is flattened and dome-shaped, while the second one is more convex. These whorls are separated by deep sutures, the nucleus is large and apparently vesicular. The second protoconch whorl is provided with a spiral ornament, consisting of about 11 weak spiral bands. The transition to the teleoconch is distinct and marked by five very close-set orthocline growth lines. Immediately behind this boundary the radial ribs occur, and the number of spiral bands increases markedly on the first teleoconch whorl.

The teleoconch consists of up to about seven whorls which are moderately convex and separated by deep sutures. The presence of radial ribs (see below) makes the suture line undulate on the first teleoconch whorls.

The aperture is oval and constricted into the well-defined siphonal canal which is relatively short and somewhat twisted backwards. The labrum is strongly and regularly thickened, both interiorly and exteriorly. Exteriorly the apertural margin is abruptly constricted. The inner lip is well defined, and the columella is smooth, slightly thickened at the transition to the canal. A solid, rounded parietal tooth is present. The transition to the base with the canal is gradual and slightly concave.

The spiral sculpture of the teleoconch starts with 22-23 flat spiral bands which are separated by narrow furrows. The number of these spirals is constant, but on the body whorl a generation of secondary spirals develops. The adapical 3-4 primary spiral bands are weaker than the lower ones. The base and the canal have a similar spiral ornament.

The radial sculpture consists of 16 radial ribs on the first teleoconch whorl, decreasing to 13-15 on

the last whorl. These ribs are about as wide as their interspaces. On the younger whorls the radial sculpture gradually becomes weaker, and on the penultimate whorl it fades completely. Weak, almost orthocline growth lines are visible. Below the adapical suture they are slightly curved backwards.
Paratypes — Mogenstrup (coastal cliff): 1 specimen (Pl. 2, Fig. 16a-b, (coll. MGUH 20 047, leg. S.B. Andersen); 1 specimen (Pl. 2, Fig. 15) (coll. MGUH 20 046, leg. K.I. Schnetler); 1 specimen (leg./coll. ISL); 1 specimen (leg./coll. MNO).

Brejning (beach exposure); 1 specimen (leg./coll. MNO).
Discussion — I have recently discussed the Danish material of the genus *Angistoma* and pointed out some differences between the German *A. brueckneri* (Beyrich, 1856) and the Danish material (Schnetler, *in* Schnetler & Beyer, 1987: 213). More material is available now, and it seems justified to separate the Danish material from Cilleborg, Brejning and Mogenstrup from *A. brueckneri*. The specimens from Århus, Nørre Vissing and Fakkegrav Badehotel, however, should be treated as a geographical subspecies of *A. brueckneri*. In my opinion the new species is better referred to *Searlesia*, in view of its protoconch, spiral sculpture and aperture.

Searlesia ravni sp. nov. differs from typical *A. brueckneri* by a considerably higher number of spiral bands which are rather equal in strength, by the absence of knobs on the columella and the presence of a solid parietal tooth. The whorls are more regularly convex and the shell attains a larger size. Finally the protoconchs are very different: *A. brueckneri* has a relatively small, multispiral protoconch, whereas in *Searlesia ravni* the larval shell is large and consists of only two whorls.

The specimens from Århus (Harder, 1913, p. 78, pl. 6, figs 9-10), from Nørre Vissing (Schnetler, *in* Schnetler & Beyer, 1987, p. 213, pl. 2, fig. 3) and from Fakkegrav Badehotel (coll. MNO) agree with the German species *A. brueckneri* in size and general outline, and in the absence of a parietal tooth. Unfortunately, no Danish specimen has its protoconch preserved. They have slightly angular whorls with about 16 spiral bands of almost equal strength and two denticles on the columella, whereas the German specimens have non-angular whorls with about 6 to 9 spiral bands, somewhat variable in strength, and four denticles on the columella. Thus, the Århus, Nørre Vissing and Fakkegrav specimens show a number of differences with as well as similarities to typical *A. brueckneri*, for which reasons I treat this material as a geographical subspecies of *A. brueckneri*.
Affinities with some other species of the 'Fusus' *group* — The Rupelian '*Fusus*' *koninckii* Nyst, 1845 (sensu Beyrich) has more angular and more convex whorls, and radial ribs on the adapical part of all whorls. Its size, aperture and parietal tooth are similar to *Searlesia ravni* sp. nov., which seems to be closely related. In my opinion '*Fusus*' *koninckii* should also be considered to belong to the genus *Searlesia*, rather than to *Euthria*, as was suggested by R. Janssen (1979a: 290). Species of *Euthria* have a concave subsutural depression without distinct spiral sculpture, no parietal tooth and a longer, narrow siphonal canal.

Angistoma feldhausi (Beyrich, 1856) from the German Middle Oligocene (Neustadt-Magdeburg) has 10-13 spirals, 3-4 denticles on the columella and is smaller than *Searlesia ravni* sp. nov.

Searlesia mitgaui (von Koenen, 1867) from the German Late Oligocene (Söllingen) has radial ribs on all whorls and two generations of secondary spirals that do not reach the strength of the primary ones. On the inner lip two weak denticles are present, that is, on the parietal wall and at the transition to the canal.

For the material from Århus, Nørre Vissing and Fakkegrav Badehotel I here introduce the name *Angistoma brueckneri danica* subsp. nov., and designate the specimen illustrated by Schnetler (*in* Schnetler & Beyer, 1987, pl. 2, fig. 3; coll. MGUH 17 618) holotype. The following paratypes are available: Århus (former railway excavation) - 1 specimen, coll. D.G.U. (leg. P. Harder); Nørre Vissing (clay-pit of Galten Brickworks) - 1 specimen (leg./coll. ISL), 1 specimen (coll. MNO, leg. K.I. Schnetler) 2 specimens (leg./coll. MNO); Fakkegrav Badehotel (coastal cliff) - 1 specimen (leg./coll. MNO).

Buccinidae *gen. et sp. indet.*
Text-Fig. 6

Description — Only two defective juvenile specimens are available (leg. M.S. Nielsen). In the better one of these the protoconch and the first teleoconch whorl are preserved. The second specimen, demonstrating a part of the second teleoconch whorl, is very defective because of a split parallel to the axis of the shell.

The protoconch comprises 1¾ whorls, separated by a deep suture. The nucleus is large, globular and slightly vesicular. On the last half protoconch whorl fine, irregularly distributed, almost orthocline growth-lines are present, crossed by some ten very delicate spiral furrows, which are merely suggested. These furrows are most prominent on the upper part of the whorl. The transition to the teleoconch is gradual, indicated by about 15 close-set growth-lines.

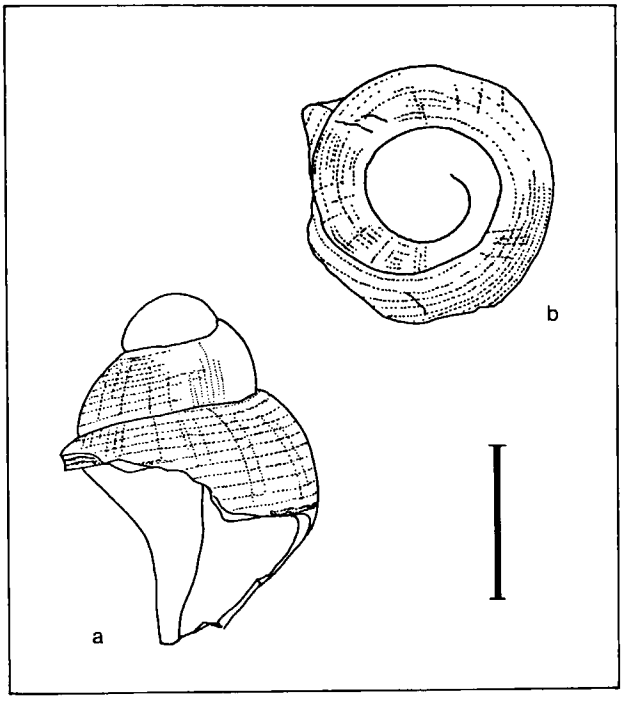


Fig. 6. Buccinidae sp., Mogenstrup; a: frontal view, b: apical view. Coll. MGUH 20 276 (A.W. Janssen del., 1990; bar length is 1 mm).

The preserved teleoconch whorls are moderately convex and separated by a deep, almost canaliculate suture. The aperture is ovoid, abapically passing into a short, rather wide and oblique siphonal canal.

The spiral sculpture consists of about ten primary spiral bands, which are separated by narrower furrows. The adapical spiral is somewhat more prominent. A radial sculpture is absent, except for weak orthocline growth-lines.

Discussion — The features of protoconch and teleoconch agree rather well with the description and illustration of *Liomesus rarus* (Beyrich) (see Beyrich, 1856: 250, pl. 17, figs 6a-b). I compared the present material with a specimen of this species from Brejning and with two specimens of *L. ventrosus* (Beyrich, 1856) from Gram, both samples from my private collection. All these specimens are full-grown and therefore their apical parts are worn. The Mogenstrup material seems to agree best with *L. rarus* with regard to the convexity of the whorls and the number of primary spirals. On the Brejning specimen the number of spirals is 12, while the specimens of *L. ventrosus* from Gram have only 7 primary spirals. The very juvenile state of the material, however, prevents a final interpretation.

Dr R. Janssen (SMF) kindly examined the illustrated specimen. In his opinion it cannot be referred to *Liomesus rarus* (pers. comm., 1990), which differs by a much larger protoconch (diameter 2.5 mm), which is flat and dome-like. Furthermore the spiral sculpture of that species is much coarser.

Latirus (Pseudolatirus) sp.
Pl. 3, Fig. 2

Description — One juvenile specimen, consisting of the protoconch and one teleoconch whorl, was collected at Mogenstrup (leg./coll. JHR). In addition, four juvenile specimens are known from Kirstinebjerg Skov (leg./coll. ISL).

The shell is fusiform, about three times as high as wide. The height of the body whorl is about six tenths of the total shell height.

The protoconch is conical, it comprises 4-4½ moderately convex whorls which are separated by deep sutures. The nucleus is small. The whorls are smooth and glossy, except for the last half whorl, on which opisthocyrt growth lines are rather distinct and three rather weak spiral ribs appear. The adapical one of these is the weakest. A further fine spiral is present on all protoconch whorls in the abapical suture. Immediately in front of the boundary with the teleoconch 2 or 3 slightly opisthocline radial ribs are present. The transition to the teleoconch is gradual.

Only one convex teleoconch whorl is present in the available specimens. The height of the rounded oval aperture is about half the total shell height. The siphonal canal is long and rather narrow. The inner lip is smooth and not very strongly protruding. A weak oblique fold is present on the columella.

The spiral sculpture of the teleoconch consists of three rather narrow spiral bands which are the continuations of the spirals on the protoconch. Below the adapical suture a weak spiral band appears on a quarter of a whorl. The radial orna-

ment comprises nine strong ribs on the first whorl which distinctly weaken downwards, on the transition to the canal. The base and the siphonal canal are provided with a similar spiral sculpture.

Discussion — The limited Danish material consists of juvenile specimens only, for which reason a specific identification is impossible. Yet, the protoconch characteristics differ from those of the Miocene North Sea Basin species *Latirus (Pseudolatirus) rothi* (Beyrich, 1856) by a number of features. The protoconch of the Danish specimens has a smaller apical angle and only two or three radial ribs on its terminal part while in *L. rothi* the complete ultimate protoconch whorl is provided with radial ribs. Furthermore, the columellar fold seems to be weaker in the Danish specimens. Sorgenfrei (1958: 232, pl. 50, fig. 157) described and illustrated the protoconch of *L. rothi* from the Arnum Formation, and he also found the radial ornament of the protoconch to be restricted to the last one third or half whorl. This feature was also noted in a sample of 20 juvenile specimens of *L. rothi* from a water well at Ny Lifstrupvej (South of Varde, Denmark). Thus, it might well be possible that a more extensive material from Denmark allows a taxonomic subdivision.

Clavatula mogenstrupensis sp. nov.
Pl. 3, Fig. 5

Locus typicus — Coastal cliff at Mogenstrup, North of Skive, Jutland, Denmark (Fig. 1).

Stratum typicum — Glauconitic sand, Brejning Clay Member of the Vejle Fjord Formation, Late Oligocene (Chattian B).

Derivatio nominis — This species is named after the type locality.

Holotype — Pl. 3, Fig. 5 (coll. MGUH 20 051) (leg. K.I. Schnetler).

Description — The shell is rather small, slender fusiform, about two and a half times as high as wide. The height of the last whorl equals slightly than half the total height, the height of the aperture is about two fifths of the total height.

The protoconch comprises about 5¾ slightly to moderately convex whorls which are separated by deep sutures. The nucleus is small and slightly heterostrophic. The protoconch whorls are smooth, except for the last one which is provided with about 18 opisthocyrt radial ribs. The last protoconch whorl is more convex and has a weak spiral ornament, consisting of two weak spiral bands above the abapical suture. These bands are separated by a rather distinct spiral furrow; four to five very weak, merely indicated spiral bands are present above the two lower ones. The transition to the teleoconch is difficult to detect, but suggested by close-set growth lines.

On the two specimens found the teleoconch consists of up to 2½ whorls which are slightly convex, having an almost flat part below the adapical suture. The whorls are separated by deep sutures. The base is strongly constricted below the periphery. The aperture is rounded-oval and rather abruptly constricted at the transition to a rather short, wide and open siphonal canal. The labrum is broken, the inner lip and the left margin of the canal are S-shaped. The callus is thin, lying deeper and thus showing traces of resorption of calcareous matter.

The spiral sculpture starts with six to seven primary spiral bands which are separated by rather deep furrows. The adapical spiral band is separated from the second one by a somewhat deeper furrow and develops into a sutural band on the second teleoconch whorl. The spiral bands number two and seven are weaker than the others. The number of spirals increases by one on each of the teleoconch whorls because of further spirals appearing from below the abapical suture. No secondary spirals are inserted. The base and the canal are provided with a similar spiral sculpture.

The radial ribs are opisthocyrt. On the first teleoconch whorl they run from one suture to the other, but on the second whorl they become weaker, especially so below the adapical suture where the sutural band is developed. The radial sculpture is rather similar to that of the well-known species *Fusiturris duchastelii* (Nyst, 1836). The number of ribs is about 18 on the last whorl. The radial ribs follow the course of the growth lines which are visible between the radial ribs, with the deepest point of the sinus situated between spiral band number three and four, as counted from the adapical suture.

Paratypes — One specimen from the type locality (leg./coll. MNO).

Discussion — The new species shows some resemblance with *C. chattica* R. Janssen, 1979, but differs by having more convex protoconch whorls and stronger opisthocyrt radial ribs on the last protoconch whorl. On the teleoconch the radial sculpture is stronger. Finally, the number of primary spirals is six to seven in the new species, whereas *C. chattica* has only five primary spirals.

Microdrillia (Andersondrillia) subgen. nov.

Diagnosis — A subgenus of *Microdrillia* showing the same protoconch features as the genus. On the teleoconch the sickle-shaped riblets on the subsutural flat or concave part of the whorl are absent. On the lower part of the whorls the combination of spiral and radial ornament results in more or less prominent knobs, especially so on the carina.
Type species — *Microdrillia (Andersondrillia) grippi* Anderson, 1964 (Miocene, North Sea Basin).
Discussion — The new subgenus resembles the genus *Asthenotoma* Harris & Burrows, 1891 and especially the species *A. obtusangula* (Brocchi, 1814) in general outline and sculpture of the teleoconch, as pointed out by A.W. Janssen (1984: 299). The protoconch, however, agrees entirely with *Microdrillia* s.str. From typical representatives of *Microdrillia* s.str., such as *M. bicingulata* (Sandberger, 1860), *M. serratula* (Bellardi, 1878) and *M. teretiaeformis* A.W. Janssen, 1972, the new subgenus differs markedly by the complete absence of the sickle-shaped riblets in the subsutural excavated part of the whorl. These species generally are also more slender and their spiral ornament is more prominent.

The new subgenus is represented in the North Sea Basin by two species, *viz. Microdrillia (Andersondrillia) grippi* Anderson, 1964 and *M. (A.) brejningensis* sp. nov. Judging from the description and illustration in Peyrot (1932: 71, pl. 7, figs 6-7) the species *M. venusta* (Peyrot, 1932), described from Late Oligocene sediments at Peyrère (SW France), probably also belongs to the new subgenus. A.W. Janssen (1984: 299) considered this taxon to be closely related to, or even conspecific with *M. grippi*.

'Microdrillia' speyeri (Koch & Wiechmann, 1872) has a teleoconch rather similar to *Microdrillia* s.str., but the paucispiral protoconch excludes a close relationship. According to A.W. Janssen (pers. comm., 1990) that species should better be referred to another, possibly new genus.
Derivatio nominis — The new subgenus is named after Professor H.-J. Anderson (Marburg, F.R.G.) for his substantial contributions to the knowledge of Tertiary molluscs.

Microdrillia (Andersondrillia) brejningensis
sp. nov.
Pl. 3, Figs 9a-b, 90

Locus typicus — Beach exposure at Brejning, South of Vejle Fjord, Jutland, Denmark.
Stratum typicum — Brejning Clay Member of the Vejle Fjord Formation, Late Oligocene (Chattian B).
Derivatio nominis — This species is named after its type locality.
Holotype — Pl. 3, Fig. 8a-b, (coll. MGUH 20 054) (leg. M. S. Nielsen).
Description — The shell is rather small and slender fusiform, about 2.8 times higher than wide. The height of the last whorl equals about two thirds of the total shell height, the height of the aperture is about half the total shell height. The largest specimen consists of about seven whorls of which 3¾ belong to the protoconch.

The protoconch is broadly conical with convex whorls which are separated by deep sutures. The nucleus is small, slightly inflated and apparently smooth. Succeeding protoconch whorls are provided with a radial sculpture which consists of fine, opisthocyrt ribs, numbering about twenty on the first whorl. The ribs run backwards below the adapical suture and form an opisthocyrt curve across the whorl. Near the abapical suture the ribs bend forwards and disappear. The radial sculpture gradually increases in strength; on the last protoconch whorl the ribs are more widely spaced and prominent. On the terminal half protoconch whorl about seven such ribs are present. Immediately below the adapical suture lies a fine spiral rib; on the middle part of the whorl a few spiral furrows are indicated. On the abapical part of the protoconch whorls an extremely fine sculpture is present, consisting of thin lines crossing the radial ribs, exclusively visible in well-preserved specimens. Immediately in front of the transition to the teleoconch several flexuous ribs are present.

The largest specimen has 3 3/4 teleoconch whorls which are carinate due to a prominent, central spiral rib. This rib divides the whorl into a distinctly concave adapical part and an almost vertical abapical part. The base is slightly convex and rather abruptly constricted to a siphonal canal of medium length. The aperture is elongated-oval with a gradual transition into the canal. The labrum is broken on all available specimens. The inner lip is smooth, the callus is thin and excavated, thus showing traces of resorption of calcareous matter.

The spiral sculpture starts with three primary spirals, of which the adapical one is the strongest. This accentuated spiral rib, or better, carina, is situated at mid-whorl, and the two other spiral ribs

are regularly distributed on the abapical part of the whorl. Immediately above the abapical suture a weak spiral rib is seen from the second teleoconch whorl onwards. The spirals are distinctly narrower than their interspaces. A large specimen from Mogenstrup shows an aberrant spiral sculpture in that the third spiral from above is completely absent. In all other features the shell agrees completely with the remaining material. In the concave subsutural part of the whorl four spiral bands are present on the first teleoconch whorl, separated by narrow furrows, but they soon disappear. On the body whorl only one very weak spiral is indicated immediately above the adapical spiral rib. No secondary spirals are inserted. The base is provided with a similar sculpture to the end of the canal, a further seven spirals are present.

The radial sculpture consists of 15-18 ribs which are narrower than their interspaces. These ribs are almost orthocline and only visible below the carina. At the points of intersection of spiral and radial sculpture knobs are formed, most prominently on the carina. The growth lines are especially well visible above the carina, where radial sculpture is absent. The rather deep sinus is situated immediately above the carina. On the base the growth lines form a very flat prosocyrt curve.

Paratypes — Brejning (beach exposure): 3 specimens (leg./coll. MNO); 1 specimen (leg. M.S. Nielsen; coll.ISL).

Mogenstrup (coastal cliff): 1 specimen, Pl. 3, Fig. 9, (coll. MGUH 20 055) (leg. K.I. Schnetler); 1 specimen (leg./coll. LJL); 5 specimens (leg./coll. ISL); 4 specimens (leg./coll. MNO); 1 specimen (leg./coll. JHR).

Discussion — This species resembles *Microdrillia grippi* Anderson, 1964, but differs by a number of features. The new species has a more slender protoconch with the radial sculpture starting immediately after the nucleus. The teleoconch has a distinct concave adapical part of the whorl without spiral sculpture. The spirals below the carina are narrower and there is no sutural spiral band. The radial sculpture consists of almost orthoclinic ribs, while *M. grippi* has prosocline ribs. The sinus in the growth lines of the new species is situated below the middle of the concave part of the whorl, while in *M. grippi* the sinus lies at mid-whorl. The shell has a glossier appearance because of the sharper sculpture, the weak radial sculpture and the absence of secondary spirals.

Microdrillia (Microdrillia) ingerae sp. nov.
Pl. 3, Figs 7a-b

Locus typicus — Coastal cliff at Mogenstrup, North of Skive, Jutland, Denmark (Fig. 1).

Stratum typicum — Glauconitic sand, Brejning Clay Member of the Vejle Fjord Formation, Late Oligocene (Chattian B).

Derivatio nominis — This species is named after my wife Inger Lund Schnetler.

Holotype — Pl. 3, Fig. 6a-b, (coll. MGUH 20 053) (leg. K.I. Schnetler).

Description — The shell is rather small, fusiform, about 2.4 times higher than wide, rather solid, the height of the aperture equals slightly less than half the total shell height.

The protoconch is broadly conical and consists of five moderately convex whorls which are separated by deep sutures. The nucleus is small and inflated. The initial one and a half protoconch whorls are smooth, the following ones are provided with a weak spiral rib above the abapical suture and with numerous narrow radial ribs which gradually increase in strength. Near the adapical suture these ribs run strongly backwards, but they become opisthocyrt on the last protoconch whorl and here about eight fine spiral grooves are indicated. An oblique microsculpture, consisting of very fine divergent lines crossing the radial ribs at more or less right angles is present in between the ribs (preserved on one shell only). In very juvenile specimens it can be seen that the base of the protoconch is demarcated by a strong, smooth spiral rib followed by a weaker spiral rib below. On the base of the protoconch the growth lines form a prosocline curve. The transition to the teleoconch is distinct but not very sharp.

The teleoconch of the largest specimen consists of three whorls which are separated by deep sutures. The body whorl equals about two thirds of the total shell height. The whorls are divided into a slightly concave adapical part and an almost flat abapical part by a carina which lies at mid-whorl. The base is constricted to a rather short canal. The callus is thin and the columella is smooth, showing traces of resorption of calcareous matter. The aperture is oval and narrows gradually into the siphonal canal.

The spiral sculpture starts with a strong carina on the middle of the whorl. Immediately below the adapical suture a relatively broad sutural band is situated and above the abapical suture a weak

spiral rib is visible. From the second teleoconch whorl onwards the carina consists of two close-set spirals. Both the sutural band and the spiral rib below the carina gradually increase in strength. A secondary spiral rib develops in the centre of the space between the carina and the adapical spiral. This secondary spiral soon becomes stronger than the abapical spiral rib. On the base and the canal a further eleven spirals are present. A generation of secondary spirals develops on the base and on the neck of the canal.

The radial sculpture is rather complex. From the carina, on which they form accentuated knobs, thickened opisthocline ribs (following the direction of the growth lines) are present, quickly diminishing in strength downwards and disappearing already near the second spiral below the carina. Their number increases from about 18 on the first teleoconch whorl to 24 to 26 on the body whorl. The growth-lines are distinct, especially so on the concave subsutural part of the whorls, where they form numerous sharp and regularly spaced, sickle-shaped riblets (curved backwards). Below the carina they are curved in an anterior direction and, gradually becoming weaker, they continue downwards in a flat prosocyrt curve.

Paratypes — Mogenstrup (coastal cliff): 4 juvenile specimens (leg./coll. ISL); 1 juvenile specimen (leg./coll. JL). 2 specimens (leg./coll. MNO); 2 juvenile specimens (leg./coll. JHR).

Kirstinebjerg Skov (beach exposure): 2 specimens (leg./coll. ISL).

Discussion — The new species is obviously closely related to *Microdrillia serratula* (Bellardi, 1878) but differs by a number of features. *M. ingerae* has a higher number of radial ribs on the protoconch. The sutural band more strongly developed, the carina is less sharp and the two spirals below the carina are rather weak. In *M. serratula* the carina is sharp and consists of one spiral only. Moreover, this species has a higher number of spiral ribs on the base and its general outline is more slender.

In *Microdrillia bicingulata* (Sandberger, 1860) the two spirals below the carina are prominent and more widely spaced. Its radial sculpture is much weaker. *M. teretiaeformis* A.W. Janssen, 1972 has a smooth carina consisting of only one spiral. *'Microdrillia' speyeri* (Koch & Wiechmann, 1872), which is also present at Mogenstrup, has a paucispiral protoconch.

Pleurotomella (Pleurotomella) rasmusseni
sp. nov.
Pl. 3, Figs 11a-b

Locus typicus — Coastal cliff at Mogenstrup, North of Skive, Jutland, Denmark (Fig. 1).

Stratum typicum — Glauconitic sand, Brejning Clay Member of the Vejle Fjord Formation, Late Oligocene (Chattian B).

Derivatio nominis — The species is named in honour of State Geologist Dr Leif Banke Rasmussen, Geological Survey of Denmark, Copenhagen, who has contributed substantially to the knowledge of the molluscs and the stratigraphy of the Danish Neogene.

Holotype — Pl. 3, Fig. 10a-b, (coll. MGUH 20 056) (leg. K.I. Schnetler).

Description — The shell is rather small and thin-walled, subfusiform, about two and a half times higher than wide. The height of the last whorl equals three fifths of the total shell height. The largest specimen has about seven whorls, of which 4¾ belong to the protoconch. This larval shell is broadly conical with convex whorls separated by deep sutures. The nucleus is small, slightly heterostrophic and provided with an extremely fine microgranulation arranged in eight spirals. The last three whorls of the protoconch have a cancellate ornament on the abapical two third of the whorl, while the abapical third of the whorl has collabral riblets only. On the last protoconch whorl a carina develops on the middle of the whorl and immediately in front of the transition to the teleoconch a spiral rib appears on both sides of the carina. On the last ¾ whorl numerous opisthocline growth lines are visible. The transition to the teleoconch is sharp but not very prominent. The diagonal sculpture fades away and a fine granulation appears at the same time (magnification × 50).

The largest specimen has 2 3/4 teleoconch whorls which are very convex and separated by deep, undulating sutures. Below the adapical suture the whorls are slightly concave. The last whorl comprises about three fifths of the total shell height. The base is convex and abruptly constricted into a rather short siphonal canal. The aperture is rounded-oval. The labrum is broken on all specimens and the columella is smooth with a well-defined inner lip. The callus is thin, showing traces of resorption of calcareous matter.

The spiral sculpture starts with three primary spirals which are continuations of the carina and the two spiral ribs on the last ¾ whorl of the protoconch. The adapical spiral rib remains weak on all whorls, whereas the middle one, being the continuation of the carina, remains the strongest. The abapical spiral increases in strength but remains weaker than the middle one. Immediately above the abapical suture a further weak spiral rib appears on a quarter of a whorl. In the upper concave part of the whorl four narrow spirals are present from the first teleoconch whorl onwards. Their number increases to seven on the body whorl. Inbetween the primary spirals a generation of secondary spirals develops from the second teleoconch whorl onwards. The base and the canal are provided with a similar spiral ornament.

The radial sculpture consists of nine to ten slightly opisthocline ribs separated by about equally wide interspaces. These ribs are almost invisible on the concave part of the whorls but prominent on the convex part. At the points of intersection of spiral and radial ornament elongated knobs form. The radial ribs gradually disappear on the base.

The growth lines are very prominent in the concave part of the whorls where together with the spiral ribs they form a regular reticulate pattern. Downwards they decrease in strength. On the base they form a very shallow prosocyrt curve. The entire teleoconch has a fine granulation between the sculptural elements. The sinus is rather shallow and has its deepest point slightly below the middle of the concave part of the whorl.

Paratypes — Mogenstrup (coastal cliff): 1 specimen (leg./coll. ISL).

Jensgård (coastal cliff): 2 specimens (leg./coll. ISL); 1 specimen (leg./coll. MNO).

Discussion — This new species is closely related to *P. mioweberi* (Nordsieck, 1972), as described and illustrated by A.W. Janssen (1984: 325, pl. 74, fig. 10; pl. 82, fig 5). I have compared the new species with material of the latter species from Gram (Late Miocene, coll. ISL) and Miste (Middle Miocene; coll. ISL). A number of differences seem to be constant. The protoconch of the new species consists of 4¾ whorls, whereas 5½ such whorls are present in *P. mioweberi*. The protoconch of *P. rasmusseni* is more broadly conical. The sculpture in the concave adapical part of the whorl is much more prominent in the new species and the sinus of the growth lines is situated more abapically than in *P. mioweberi*. The concave part of the whorls is more excavated on the new species, and finally the granulation is weaker than in *P. mioweberi*. *Pleurotomella* sp. from the German Late Oligocene (R. Janssen, 1979a: 329, pl. 18, fig. 77) differs by the absence of secondary spirals and by its more angular whorls.

Rimosodaphnella lappanni sp. nov.
Pl. 3, Fig. 13a-b

Locus typicus — Fakkegrav Badehotel (coastal cliff), North of Vejle Fjord, Jutland, Denmark

Stratum typicum — Brejning Clay Member of the Vejle Fjord Formation, Late Oligocene (Chattian B).

Derivatio nominis — This new species is named after my friend, Mr. Werner Lappann, Heiligenhaus-Isenbügel, F.R.G.

Holotype — Pl. 3, Fig. 12a-b; (coll. MGUH 20 057) (leg. M.S. Nielsen).

Description — The shell is rather small and fusiform, about 2.5 times higher than wide. The last whorl comprises three fifths, the aperture slightly less than half the total shell height.

The protoconch is high-conical and multispiral, consisting of 3½-4 moderately convex whorls which are separated by deep sutures. The whorls have their greatest width abapically. The nucleus is small and apparently smooth, while the last three whorls are provided with a diagonal sculpture. On the last half whorl of the protoconch a carina is present, lying somewhat below the middle of the whorl. On the last ¾ whorl before the transition to the teleoconch a weak spiral rib develops between the carina and the abapical suture. Immediately in front of the transition a further weak spiral occurs above the carina. These three spirals continue as the primary spirals on the teleoconch. The transition to the teleoconch is sharp, demarcated by a sigmoidal rib.

The teleoconch consists of 3 3/4 whorls which have a concave adapical and a convex lower part. The whorls are separated by deep sutures. The base of the shell is convex, but rather abruptly constricted to a relatively long siphonal canal. The callus is thin and the inner lip is not very sharply demarcated (which could indicate that the available specimens are not yet fully-grown). The aperture is oval, rather suddenly narrowed at the transition to the siphonal canal. The labrum is broken.

The spiral sculpture starts with three spirals on the convex part of the whorl which are continuations of the carina and the two spirals on the protoconch. On a quarter of a whorl a further, rather weak spiral rib appears immediately above the abapical suture. The second spiral from above is situated on the middle of the whorl. The second and third spirals are stronger than the others. On the second teleoconch whorl secondary spirals are inserted between the primary ones, and on the younger whorls two further spiral generations are present. Ultimately, the spirals become nearly equal in strength. The base and the canal are furnished with a similar sculpture. All spirals are threadlike and narrower than their interspaces. On the columella the spirals are visible below the callus. On the concave upper part of the whorls no spirals are present.

The radial sculpture is restricted to the convex part of the whorls. It starts on the first teleoconch whorl with about 14 opisthocline ribs which are about as wide as their interspaces. The number of ribs is constant on all the whorls. On the base of the body whorl the radial sculpture gradually disappears downwards. At the points of intersection of spiral and radial ornament small, elongate knobs form, most prominently on the first teleoconch whorl. On the concave adapical part of the whorls the growth lines are accentuated and form sickle-shaped riblets with a backward curvature. On the convex part of the whorls they curve forwards to opisthocline, in the same direction as the radial sculpture. An extremely fine granulation is present between the sculptural elements all over the teleoconch, especially well visible (magnification × 50) on the concave part of the whorls.

Paratypes — Mogenstrup (coastal cliff): 15 specimens (leg./coll. ISL); 13 specimens (leg./coll. MNO); 1 specimen (leg. ISL/coll. WLH); 1 specimen (leg. ISL/coll. SMF 308 411); 1 specimen (leg. ISL/coll. RGH 229 791).

Kirstinebjerg Skov (beach exposure): 1 specimen (leg./coll. MNO).

Discussion — The new species differs from *Rimosodaphnella* sp. [described and illustrated *sub nomina Philbertia sinuosula* Sorgenfrei, 1958 by Anderson (1964: 312, pl. 42, figs 268, 268a) from the Miocene of Dingden, F.R.G.] by the development of the primary spirals. In the species described by Anderson, the carina on the last protoconch whorl develops into the uppermost primary spiral of the teleoconch, whereas in the new species this carina continues as the second spiral. Furthermore, the German species has a somewhat more thick-set outline, a more broadly conical protoconch, a wider concave zone, a less sharp sculpture and is generally larger.

? **Actaeopyramis** (s. lat.)
pseudopunctata sp. nov.
Pl. 3, Figs 14-15

Locus typicus — Water well at Krefeld-Linn, Nordrhein-Westfalen, F.R.G.

Stratum typicum — Grafenberg Sands, Late Oligocene (Chattian A or B).

Derivatio nominis — The species is named after its very distinctive sculpture (*pseudopunctata* = falsely punctate).

Holotype — Pl. 3, Figs. 15 (coll. MGUH 20 059) (leg. F. von der Hocht).

Description — At Mogenstrup six juvenile specimens were collected. An adult specimen from Krefeld-Linn is designated holotype.

The shell is very small and rather thick-walled, ovoid-conical. In juvenile specimens the height equals about 1.3 times the width. In the presumably adult holotype the shell height is about 1.9 times the width. The height of the aperture equals about one third of the total shell height. The adult specimen comprises about four whorls, one of which belongs to the heterostrophic protoconch, of which only the terminal 3/4 whorl is visible, projecting only slightly above the teleoconch. The transition to the teleoconch is sharp and slightly prosocline.

The three teleoconch whorls are slightly to moderately convex and separated by deep, somewhat canaliculate sutures. The body whorl equals about 6/10 of the total shell height. The base is convex, the umbilicus is rather narrow. The aperture is oval, with a regularly rounded lower margin. The labrum is sharp-edged with a gradual transition into the columellar part. The columella is concave and bears a rather weak, oblique fold opposite the umbilicus.

The spiral sculpture starts immediately after the boundary with the protoconch and consists of nine to ten ribbon-like spirals which are separated by narrower furrows. A weak subsutural ramp is demarcated by the adapical spiral band; on this ramp two very fine spiral furrows are visible. The base of the shell has a similar spiral sculpture.

The radial sculpture consists of about 30 opis-

thocline, flat riblets which are weaker than the spiral bands. The combination of the two sculptural elements results in a pattern of almost punctate appearance. The depressions are elliptical, having their greatest diameter in the direction of the spirals. The growth lines are very fine and can be observed on a few specimens only. They are almost orthocline and appear to have a very flat sinus under the adapical suture.

Paratypes — Mogenstrup (coastal cliff): 1 specimen (Pl. 3, Fig. 14) (coll. MGUH 20 058, leg. M.S. Nielsen); 4 specimens (leg./coll. MNO); 1 specimen (leg. M.S. Nielsen, coll. ISL).

Discussion — I refer the new species to the genus *Actaeopyramis* (s. lat.) with some hesitation, since the sculpture is somewhat untypical. In *Actaeopyramis* the spirals are smooth and projecting, and in the interspaces the radial lamellae give rise to a punctation. Moreover, the growth lines are prosocline. The general outline of the new species corresponds well to the genus *Actaeopyramis*, so do the shape of the protoconch and the aperture, but it closely resembles the species referred to as Pyramidellidae indet. and described from Nørre Vissing (Schnetler, *in*: Schnetler & Beyer, 1987: 220, pl. 2, figs 16-17). From this form the new species differs by its weaker subsutural ramp, less convex whorls and a less regular punctate sculpture. In all other features the two species appear closely related. They should probably be united in a new genus. Introduction of such a new genus is deferred to another occasion.

Gastropoda *inc. sed.*
Text-Fig. 7

Description — Only a single (? juvenile) specimen is available (leg./coll. M.S. Nielsen). The shell is very small and discoidal, 2.8 times wider than high. The protoconch consists of 1¾ whorls which are separated by a distinct suture. The nucleus is small. The transition to the teleoconch is sharp, demarcated by a distinct, slightly flexuous rib.

The teleoconch consists of somewhat more than 1¾ whorls, slowly expanding in diameter and circular in transverse section, separated by a distinct suture. The upper junction of the whorls lies on the periphery of the preceding whorl, the lower one touches below the periphery, which results in concave upper and lower sides of the shell. The transition into the base is gradual. The aperture is subcircular, the labrum is broken. The umbilicus is wide and open, very much shaped like the concave apical side of the shell. The base of the nucleus is visible in the umbilicus.

The spiral sculpture consists of barely visible furrows. On the upper side of the whorl one furrow can be seen, on the periphery three, and on the base two. The growth lines are sometimes visible as sigmoidal lines, especially so on the periphery.

Comparison with other Late Oligocene faunas (author: Schnetler)

Danish Late Oligocene molluscan faunas were published by Ravn (1907, 1909), Harder (1913), Madsen (1918), Eriksen (1937) and Schnetler & Beyer (1987). These faunas are characterised by a high frequency of species like *Drepanocheilus (Arrhoges) speciosus*, *Polinices helicinus* and *Fusiturris*

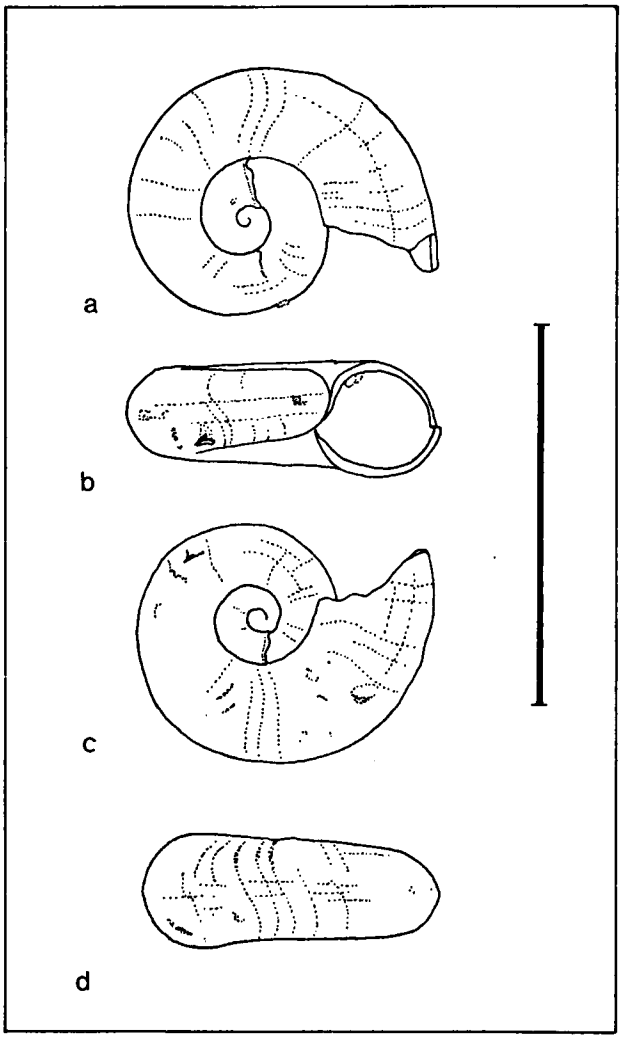


Fig. 7. Gastropoda *inc. sed.*, Mogenstrup; a: apical view, b: frontal view, c: umbilical view, d: lateral view. Coll. MGUH 20 275 (A.W. Janssen del., 1990; bar length is 1 mm.

duchastelii. Other very common species are *Nucula comta*, *Limopsis aurita*, *Cyclocardia* aff. *kickxi* and *Gemmula* spp. In comparison to the Århus fauna (Harder, 1913) the following species are absent at Mogenstrup:

Nucula harderi Schnetler, *in* Schnetler & Beyer, 1987
Emarginula punctulata Philippi, 1843
Unitas granulata (Nyst, 1845)
Conomitra ravni (Harder, 1913)
Microdrillia bicingulata (Sandberger, 1860).

In comparison to the recently described fauna from Nørre Vissing (Schnetler & Beyer, 1987) the following characteristic species are absent:

Nucula harderi Schnetler, *in* Schnetler & Beyer, 1987
Solariella spp.
Unitas granulata
Pleurotomoides naumanni (Speyer, 1867).

The faunas from Nørre Vissing and Mogenstrup have 97 species in common, but frequencies of common species differ. A fairly large number of species found at Mogenstrup is absent at Nørre Vissing, *e.g.*:

Limopsis lamellata chattica
Limopsis vonderhochti
Acar aff. *dentiens*
Pecten bifidus bifidus
Pecten soellingensis
Astraea pustulosa
Cocculina dittmeri
Cirsope subeffusa
Triforis sorgenfreii
Neojanacus planatus
Trophonopsis angustevaricata
Pterynotus tristicus
Coralliophila kochi
Gibberula brevis
Microdrillia spp.
Pleurotomella margaritata
Pleurotomella rasmusseni
Rimosodaphnella lappanni
pteropods.

Many of these species are extremely rare in the Brejning Clay of localities in the Vejle Fjord area [Brejning, Fakkegrav Badehotel, Bøgeskov, Kirstinebjerg Skov, Jensgård and Skanderborg (glacial flow)], or even absent from other Danish Late Oligocene localities (*e.g.* Århus, Cilleborg and Nørre Vissing). Thus, these rare species point out certain affinities with the faunas from the Vejle Fjord area, rather than with the faunas from Århus, Cilleborg and Nørre Vissing.

When compared to the German Late Oligocene faunas the Mogenstrup association shows affinities with those from the Lower Rhine area, Glimmerode, Freden and the Sternberger Gestein. Associations described from Söllingen, Niederkaufungen, Ahnetal and Doberg, however, appear to be different.

The fauna from the Lower Rhine area has 110 species in common with Mogenstrup, among which are the following characteristic species:

Limopsis aurita
Limopsis vonderhochti
Lepetella compressiuscula
Cirsope multicingulata
Cirsotrema crispatum
Conomitra soellingensis
'Microdrillia' speyeri.

Moreover, *Emarginula* spp. (except *E. punctulata* Philippi, 1843) are absent from both faunas. Obvious differences are the absence of *Astraea* spp. and the lower diversity of the Cerithiopsidae in the Lower Rhine area.

The fauna from Glimmerode has 105 species in common with the Mogenstrup association, among which are:

Acar aff. *dentiens*
Astraea spp.
Scissurella koeneniana
Gibberula brevis
Cerithiopsidae
Muricidae.

At Glimmerode the following species which are common at Mogenstrup, are missing:

Limopsis aurita
Limopsis vonderhochti.

Additionally, the Mogenstrup fauna did not yield any Amphineura or *Emarginula* spp.

The fauna from Freden has 100 species in common with Mogenstrup, among which are:

Limopsis aurita
Astraea pustulosa
Cirsope subeffusa.

The following species from Mogenstrup are missing at Freden:

Limopsis vonderhochti
almost all Cerithiopsidae
'*Microdrillia*' *speyeri.*

An obvious difference is the presence of *Emarginula* spp. in the Freden fauna.

The fauna from the typical 'Kasseler Meeressand' (Niederkaufungen and Ahnetal) has 80 species in common with Mogenstrup, among which are:

Exilioidea elatior
Metula scabricula
Streptochetus soellingensis
Conomitra soellingensis.

Emarginula spp. are absent from both faunas. In comparison to the Mogenstrup fauna, a large number of species are absent, *e.g.:*

Acar aff. *dentiens*
Limopsis aurita
Palliolum hausmanni hausmanni
Astraea pustulosa
Cirsope spp.
Rissoa spp.
almost all Cerithiopsidae.

The fauna from Söllingen has 75 species in common with Mogenstrup, among which are:

Acar aff. *dentiens*
Scissurella koeneniana
Astraea pustulosa
Pterynotus tristrichus.

Among the many Mogenstrup species that do not occur at Söllingen the following may be mentioned:

Limopsis aurita
Limopsis vonderhochti
Rissoa spp.
Triphoridae
Ancilla karsteni
Vexillum hastatum
Gemmula trispiralis
Turbonilla spp.

Emarginula spp. are present in the Söllingen fauna.

The Doberg fauna has 68 species in common with Mogenstrup: *e.g.:*

Acar aff. *dentiens*
Astraea spp.

The following species, common at Mogenstrup, are absent from the Doberg fauna:

Limopsis aurita
Limopsis vonderhochti
Rissoa spp.
many Cerithiopsidae
Muricidae, except *Lyrotyphis cuniculosus* (Nyst, 1836)
Vexillum hastatum
Conomitra soellingensis
Gemmula trispiralis
Gemmula pseudokonincki.

The Doberg fauna comprises a large number of bivalve species, especially Pectinidae. *Emarginula* spp. are also present.

The 'Sternberger Gestein' fauna has 100 species in common with Mogenstrup. As this fauna originates from boulders of different ages (Chattian A, B and C) further analyses were not made.

Palaeoecological interpretations (author: Schnetler)

In unit 1 molluscs are generally not very common and regularly distributed in the sediment. In the uppermost part of unit 1 molluscs and other fossils are abundant. The molluscan assemblage is most probably not a biocoenosis, as the fossils are concentrated in a thin horizon which has a sharp lower boundary; *Fusiturris duchastelii*, *Gemmula* spp., *Polinices helicinus* and *Streptochetus cheruscus* are found almost exclusively as juvenile specimens. However, of many molluscs both juvenile and adult specimens are found, *e.g.* the gastropods *Astrea pustulosa* (dominant), *Lyrotyphis sejunctus*, *Hinia schlotheimi*, *Charonia flandrica* and the bivalves *Limopsis* spp.

The abundant occurrence of *Astraea pustulosa* is very conspicuous. According to R. Janssen

(1978a: 161) the genus *Astraea* suggests littoral conditions. This is also suggested by the occurrence of *Alvania semperi*, *Cirsope* spp., *Gibberula brevis* and *Vexillum hastatum*. The common species *Fusiturris duchastelii* and *Polinices helicinus* seem to be rather facies independent since they are common in all facies.

Table 3. Frequencies of bivalve and gastropod species.

	number of specimens	%
Bivalvia		
1. *Limopsis lamellata chattica*	155	24.8
2. *Limopsis retifera*	135	21.6
3. *Limopsis aurita*	62	9.9
4. *Cyclocardia* aff. *kickxi*	48	7.7
5. *Limopsis vonderhochti*	41	6.5
6. *Astarte goldfussi praecursor*	17	2.7
7. Teredinidae gen. et sp. indet.	14	2.2
8. *Portlandia pygmaea*	11	1.8
9. *Acar* aff. *dentiens*	11	1.8
10. *Bathyarca bellula*	10	1.6
Gastropoda		
1. *Collonia troelsi*	229	12.7
2. *Astraea pustulosa*	201	11.2
3. *Fusiturris duchastelii*	200	11.1
4. *Polinices helicinus*	131	7.3
5. *Streptochetus cheruscus*	127	7.1
6. *Lyrotyphis sejunctus*	68	3.8
7. *Drepanocheilus speciosus*	63	3.5
8. *Stenodrillia obeliscus*	53	2.9
9. *Gemmula trispiralis*	46	2.6
10. *Orthosurcula regularis*	40	2.2

The gastropod species *Charonia flandrica*, on the other hand, would indicate deeper water and the occurrence of *Cocculina dittmeri* might even indicate rather deep water. The genus *Cocculina* and related forms live on waterlogged wood (Marshall, 1985) at depths below 150 m together with '*Teredo*' sp., and since '*Teredo*' sp. is rather common at Mogenstrup this might indicate deeper water.

Very remarkable is the high diversity of Muricidae and Cerithiopsidae, since representatives of these groups are very rare at other Danish Late Oligocene localities, *e.g.* Nørre Vissing, Arhus and Skanderborg. We may assume that, generally speaking, the gastropod assemblage indicates littoral to higher sublittoral conditions.

The bivalve assemblage is dominated by *Limopsis* spp.: species of this genus make up 63.9% of the bivalve total number of specimens. *Limopsis* is epibenthic and lives in a sublittoral environment. *L. retifera* is very often found at Mogenstrup articulated specimens, indicating low current velocities and hardly any transport. The species *Nucula* spp., *Nuculana westendorpi* and *Yoldia glaberrima* are rather rare at Mogenstrup, but very common in the clayey sediments of the Danish Late Oligocene, *e.g.* the localities Arhus, Nørre Vissing and Skanderborg. These specimens are endobenthic. The equally endobenthic species *Astarte goldfussi praecursor* and *Cyclocardia* aff. *kickxi* are rather common. Very interesting is the relatively common occurrence of *Acar* aff. *dentiens*, which is also common in the near-shore sediments at Glimmerode. In all, the bivalve assemblage indicates higher sublittoral conditions.

The abundance of spines and other remains of the regular sea-urchin '*Cidaris*' sp., of marginal plates of asteroids and of Anthozoa is very interesting, since remains of these groups are very rare at other Danish Late Oligocene localities (for instance Nørre Vissing, Århus and Skanderborg). The brachiopod '*Terebratula*' sp. is common. Serpulids are also common, but balanids are absent. Teeth of some shark species were found: *Pristiopho-*

Table 4. UTM coordinates of Danish localities mentioned in this paper

No.	Locality	Kind of outcrop	Mapsheet	Coordinates
1.	Mogenstrup	coastal cliff	1216 III SV	NH 074 814
2.	Cilleborg	former clay-pit	1216 II SØ	NH 550 784
3.	Hadsten	former road-excavation	1315 III NV	NH 650 442
4.	Århus	former railway-cut	1314 I VNØ	NH 745 235
5.	Nørre Vissing	working clay-pit	1214 I NØ	NH 525 212
6.	Skanderborg	former motorway-excavation	1214 I SØ	NH 573 120
7.	Jensgård	coastal cliff	1313 I NV	NG 664 851
8.	Fakkegrav Badehotel	coastal cliff	1213 I SØ	NG 490 711
9.	Brejning	beach exposure	1213 I SV	NG 439 696
10.	Bøgeskov	coastal cliff	1213 I SØ	NH 480 646
11.	Kirstinebjerg Skov	beach exposure	1213 II NØ	NG 505 616

rus sp., *Synodontaspis acutissima* (Agassiz, 1843) and Odontaspididae gen. et sp. indet. (F. von der Hocht, pers. comm., 1987). These species might indicate deeper water, but as the shark fauna is very limited at Mogenstrup and the state of preservation is rather poor the teeth are possibly reworked.

A number of teleost otoliths were collected (coll. ISL, AJB). This material was examined by Dr P.A.M. Gaemers (Leiden), who identified 17 species, of which *Gadichtys attenuatus* (Koken, 1891) is the most common. According to Dr Gaemers (pers. comm., 1987, 1989) the otolith fauna indicates rather deep-water (100-200 m). The two deep water genera *Diaphus* (lantern-fishes) and *Coelorinchus* (grenadier-fishes) are represented by a few specimens and all other species, except for *Colliolus* spp., indicate rather deep water. The state of preservation indicates that this material is not reworked and is thus a good indication of deposition in a sublittoral environment.

ACKNOWLEDGEMENTS

The authors are very grateful to the following persons for (information on) molluscan material in their collections: Mr Sten Bo Andersen (Fredericia, Denmark); Mr H.C. Hansen (Fredericia, Denmark); Mrs J. Hillersborg (Randers, Denmark); Mr A.C. Janse (Brielle, The Netherlands); Mr F. von der Hocht (Kerpen-Balkhausen, F.R.G.), who also supplied information on shark material; Mr A.W. Janssen (National Museum of Natural History, Leiden, The Netherlands), who also kindly examined some problematic molluscs, prepared text-figs 6 and 7, improved an earlier version of the manuscript and studied the Mogenstrup pteropods for a separate paper; Dr R. Janssen (Senckenberg Museum, Frankfurt am Main, F.R.G.), who also kindly examined some problematic molluscs; Mrs L.B. Jørgensen (Lime, Denmark); Mr W. Lappann (Heiligenhaus-Isenbügel, F.R.G.); Mrs R. Lechner (Odense, Denmark); Dr P. Lozouet (Musée national d'Histoire naturelle, Paris, France); Mrs E. Nielsen (Århus, Denmark) and Mr M.S. Nielsen (Odense, Denmark), who kindly placed his important collection from Mogenstrup at my disposal and in this way contributed substantially to this paper.

Dr P.A.M. Gaemers (National Museum of Natural History, Leiden, The Netherlands) supplied information on otolith material.

Mr K. Ulleberg (Galleberg, Norway) is kindly thanked for information on the Foraminifera zonation.

We furthermore like to thank Dr C. Heilmann-Clausen (Geological Institute, University of Århus, Denmark) for stimulating critical remarks and helpful advice.

Mr S.L. Jakobsen and Mrs M. Bjerreskov (Geological Museum, University of Copenhagen, Denmark) were very helpful with regard to the MGUH collections. Mr O.B. Berthelsen (Geological Institute, Copenhagen) is thanked for doing part of the photographic work.

Mr J.W.M. Jagt (Venlo, The Netherlands), co-editor of this periodical, kindly corrected the English text.

The substantial assistance of Mr S.B. Andersen (Geological Institute, University of Århus, Denmark) in critically reading and correcting the manuscript, providing material and, especially, for doing the photographic work, is gratefully acknowledged.

REFERENCES

Anderson, H.J., 1964. Die miocäne Reinbek-Stufe in Nord- und Westdeutschland und ihre Molluskenfauna. — Fortschr. Geol. Rheinld. u. Westf., 14: 31-368.

Beyer, C., 1987. Ø. Oligocæn-N. Miocæn i Nordvest Jylland. Faciesanalyse and magnetostratigrafi. Århus (thesis University of Århus), 165 pp. (unpublished).

Beyrich, E., 1856. Die Conchylien des norddeutschen Tertiärgebirges, 4/5. Berlin (Hertz): 177-296, pls 16-25.

Cossmann, M. 1889. Catalogue illustré des coquilles de l'Éocene des environs de Paris. — Ann. Soc. r. Malacol. Belg., 24: 3-381, 12 pls.

Eriksen, K., 1937. En forelæbig meddelelse om Tertiæret ved Brejning på sydsiden af Vejle Fjord. — Bull. geol. Soc. Denmark, 9(2): 137-150.

Görges, J., 1941. Die Oberoligocänfauna von Rumeln am Niederrhein. — Decheniana, 100(A): 115-186, 3 pls.

Görges, J., 1952. Die Lamellibranchiaten und Gastropoden des Oberoligocänen Meeressandes von Kassel. — Abhandl. hess. L.-Amt Bodenforsch., 4: 134 pp, 3 pls.

Gründel, J., 1980. Bemerkungen zur Überfamilie Cerithiopsacea H.A. Adams, 1854 (Gastropoda) sowie zur Fassung einiger ihrer Gattungen. — Zool. Anz., Jena, 204(3-4): 209-264, 41 figs.

Haq, B.U., J. Hardenbol & P.R. Vail, 1987. Chronology of fluctuating sea levels since the Triassic. — Science, 235: 1156-1167.

Harder, P., 1913. De oligocaene Lag i Jaernbanegennemskaeringen ved Aarhus Station. — Danm. Geol. Unders., (2)22: 140 pp., 5 tabs, 4 figs, 9 pls.

Janssen, A.W., 1984. Mollusken uit het Mioceen van Winterswijk-Miste. Een inventarisatie, met beschrijvingen en afbeeldingen van alle aangetroffen soorten. Amsterdam (K.N.N.V., N.G.V., R.G.M.), 451 pp., 82 pls.

Janssen, A.W., 1990. Pteropod species (Mollusca, Gastropoda, Euthecosomata) from the Late Oligocene of Mogenstrup, Jylland, Denmark. — Contr. Tert. Quatern. Geol., 27(2-3): 83-92, 10 figs, 1 pl. (printed in this issue).

Janssen, R., 1978a. Die Scaphopoden und Gastropoden des Kasseler Meeressande von Glimmerode (Niederhessen). — Geol. Jb., (A)4: 3-195, 3 figs, 3 tabs, 7 pls.

Janssen, R., 1978b. Die Mollusken des Oberoligozäns (Chattium) in Nordseebecken, 1. Scaphopoda, Archaeogastropoda, Mesogastropoda. — Arch. Moll., 109(1/3): 137-227, 1 fig., pls 9-14.

Janssen, R., 1979a. Die Mollusken des Oberoligozäns (Chattium) im Nordseebecken, 2. Neogastropoda, Euthyneura, Cephalopoda. — Arch. Moll., 109(4/6): 277-376, 5 pls.

Janssen, R. 1979b. Revision der Bivalvia des Oberoligozäns (Chattium, Kasseler Meeressand).— Geol. Abhandl. Hessen, 78: 1-181, 1 fig., 4 pls.

Koch, E., K. Gripp & A. Franke, 1912. Die staatlichen Tiefbohrungen XIV, XV, XVI, XVII in den Vierlanden bei Hamburg. — Jb. Hamb. wiss. Anst. 29, 4. Beih.: 33 pp., 8 figs, 1 pl.

Kristoffersen, F. N., 1972. Oligocæn og Miocæn i Nøvling, 1. — Danm. geol. Unders., 3 (40): 63-70.

Larsen, G., & Dinesen, A., 1959. Vejle Fjord Formationen ved Brejning. Sedimenterne, Foraminiferfaunaen (Olig.-Mioc.). — Danm. geol. Unders., (2)82, 114 pp.

Lieberkind, K., 1977. Ostracodstratigrafi i Øverste Eocæn og Oligocæn i Danmark - belyst ud fra Viborg 1 boringen og enkelte daglokaliteter. Århus (thesis University of Århus), 112 pp, 23 pls. (unpublished)

Madsen, V., 1918. Om Tertiæret ved Mariager Fjord. — Danm. geol. Unders. (4)1(8): 41 pp.

Marshall, B.A., 1986. Recent and Tertiary Cocculinidae and Pseudococculinidae (Mollusca: Gastropoda) from New Zealand and New South Wales. — New Zealand Journal of Zoology, 12(1985): 505-546, 24 tabs, 14 figs.

Peyrot, A., 1932. Conchologie néogénique de l'Aquitaine, 6. — Actes Soc. linn. Bordeaux, 84: 5-128, 10 pls.

Rasmussen, L.B., 1961. De miocæne formationer i Danmark. — Danm. geol. Unders., 4(5), 45 pp.

Rasmussen, L.B., 1968. Molluscan faunas and biostratigraphy of the marine younger Miocene formations in Denmark, 2. Palaeontology. — Danm. geol. Unders., 2(92): 265 pp., 27 pls.

Ravn, J.P.J., 1906. Nogle bemærkninger om de Oligocæne og Miocæne aflejringer i Jylland. — Bull. Geol. Soc. Denmark, 12: 1-6.

Ravn, J.P.J., 1907. Molluskfaunaen i Jyllands Tertiær-aflejringer. — Kgl. Danske Vid. Selskab Skr., 7 (nat. mat.) 3(2): 180 pp., 8 pls.

Ravn, J.P.J., 1909. Om nye findesteder for Tertiærforsteninger i Danmark. - Bull. geol. Soc. Denmark, 3: 331-336.

PLATE 1

Fig. 1. *Acar* aff. *dentiens* (Cossmann & Peyrot, 1912); a: left valve, interior; b: left valve, exterior; × 10. Coll. MGUH 20 022.

Fig. 2. *Limopsis (Pectunculina) lamellata chattica* subsp. nov., holotype; a: left valve, interior; b: left valve, exterior; × 9.5. Coll. MGUH 20 023.

Fig. 3. *Limopsis (Pectunculina) lamellata chattica* subsp. nov., paratype; a: right valve, interior; b: right valve, exterior; × 9.5. Coll. MGUH 20 024.

Fig. 4. *Limopsis (Pectunculina) vonderhochti* sp. nov., holotype; a: right valve, interior; b: right valve, exterior; × 3. Coll. MGUH 20 025.

Fig. 5. *Limopsis (Pectunculina) vonderhochti* sp. nov., paratype; a: left valve, interior; b: left valve, exterior; × 3. Coll. MGUH 20 026.

Fig. 6. *Limopsis (Pectunculina) vonderhochti* sp. nov., paratype; a: left valve, interior; b: left valve, exterior; × 3. Coll. SMF 309 204.

Fig. 7. *Limopsis (Pectunculina) vonderhochti* sp. nov., paratype; a: right valve, interior; b: right valve, exterior; × 3. Coll. SMF 308 407.

Fig. 8. *Cocculina dittmeri* (Anderson, 1964); apical view; × 5. Coll. MGUH 20 027.

Fig. 9. *Lepetella helgae* sp. nov., holotype; a: lateral view; b: apical view; × 20. Coll. MGUH 20 028.

Fig. 10. *Lepetella jytteae* sp. nov., holotype; a: lateral view; b: apical view; × 2. Coll. MGUH 20 029.

Fig. 11. *Astraea (Lithopoma) pustulosa* (von Münster, 1844); apertural view; × 10. Coll. MGUH 20.030.

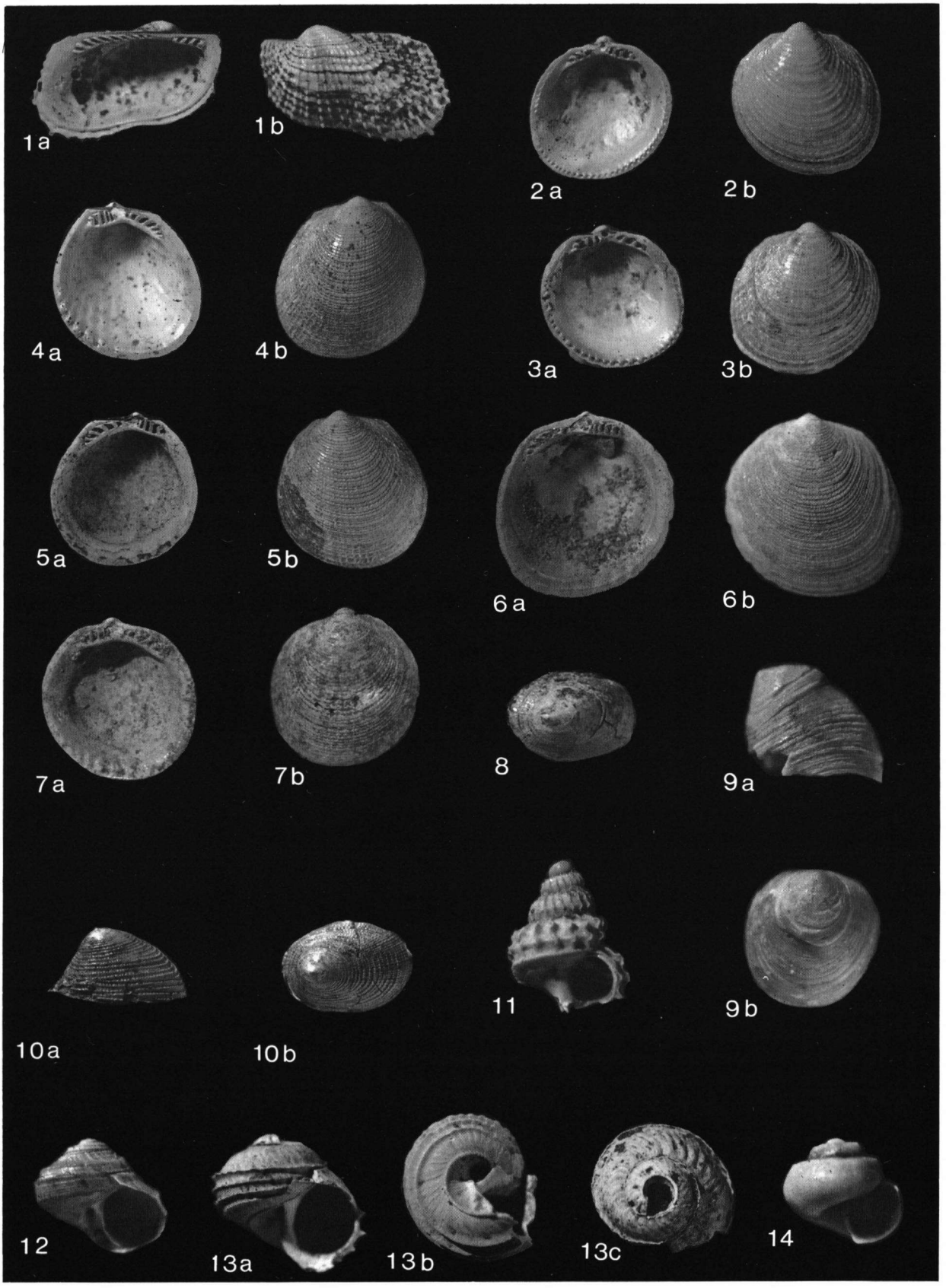
Fig. 12. *Homalopoma (Boutillieria) simplex* (Philippi, 1843); apertural view; × 10. Coll. MGUH 20 031.

Fig. 13. *Homalopoma (? Leptothyropsis)* sp.; a: apertural view; b: umbilical view; c: apical view; × 5. Coll. ENA.

Fig. 14. *Tubiola subangulata* sp. nov., holotype; apertural view; × 30. Coll. MGUH 20 032.

Fig. 6 from Krefeld-Linn, F.R.G. (water well). Fig. 7 from Ahnetal, F.R.G. All other specimens from Mogenstrup (coastal cliff), Denmark.

PLATE 1


1a
1b
2a
2b
4a
4b
3a
3b
5a
5b
6a
6b
7a
7b
8
9a
10a
10b
11
9b
12
13a
13b
13c
14

Ravn, J. P. J. 1924. Tertiær. *In*: Oversigt over Danmarks geologi (ed. V. Madsen) — Danm. geol. Unders., 5(4), 208 pp., 2 pls.

Schnetler, K.I., & C. Beyer, 1987. A Late Oligocene (Chattian B) mollusc fauna from the clay-pit of Galten Brickworks at Nørre Vissing, Jylland, Denmark. — Meded. Werkgr. Tert. Kwart. Geol., 24(3): 193-224, 3 figs, 1 tab., 2 pls.

Sorgenfrei, T., 1940. Marint Nedre-Miocæn i Klintingehoved paa Als. — Danm. geol. Unders., 2(65), 143 pp., 8 pls.

Sorgenfrei, T., 1958. Molluscan assemblages from the marine Middle Miocene of South Jutland and their environments, 1-2. — Danm. geol. Unders. (2) 79: 503 pp., 76 pls.

Speyer, O., & A. von Koenen, 1884. Die Bivalven der Casseler Tertiär-Bildungen, mit einem Vorwort und Tafel-Erklärungen von A. von Koenen. — Abhandl. geol. Spez.-Karte Preussen, 4(4): i-xii, 31 pls.

Tembrock, M.-L., 1963. Muriciden aus dem Mittel- und Oberoligocän und den Vierlandschichten des Nordseebeckens. — Paläont. Abhandl., 1: 299-351, 3 tabs, 10 pls.

Ulleberg, K., 1987. Foraminiferal zonation of the Danish Oligocene sediments. — Bull. geol. Soc. Denmark, 36: 191-202.

Wenz, W., 1938-1944. Gastropoda. Allgemeiner Teil und Prosobranchia. — Handbuch der Paläozoologie, 6: xii + 1639 pp., 4211 figs.

Manuscript received 23 October 1989, revised version accepted 3 August 1990.

PLATE 2

Fig. 1. *Tubiola* sp.; apertural view; × 30. Coll. MGUH 20 033.
Fig. 2. *Collonia (Collonia) troelsi* sp. nov., holotype; a: apertural view; b: umbilical view; c: apical view; × 20. Coll. MGUH 20 034.
Fig. 3.? *Skenea* sp.; a: apical view; b: umbilical view; × 30. Coll. MGUH 20 035.
Fig. 4. *Neojanacus planatus* (Speyer, 1864); apertural view; × 3. Coll. LJL.
Fig. 5. *Triforis (Trituba) sorgenfreii* sp. nov., holotype; apertural view; × 30. Coll. MGUH 20 036.
Fig. 6. *Triforis (Trituba) sorgenfreii* sp. nov., paratype; apertural view; × 11. Coll. MGUH 20 037.
Fig. 7. *Triforis (Trituba) sorgenfreii* sp. nov., paratype; apertural view; × 4. Coll. MGUH 20 038.
Fig. 8. *Laiocochlis (Laiocochlis) supraoligocaenica* sp. nov., holotype; apertural view; × 20. Coll. MGUH 20 039.
Fig. 9. *Cerithiopsis* (s. lat.) *antonjansei* sp. nov., holotype; apertural view; × 10. Coll. MGUH 20 040.
Fig. 10. *Cirsotrema (Opaliopsis) subglabrum* sp. nov., paratype; apertural view; × 10. Coll. MGUH 20 041.
Fig. 11. *Cirsotrema (? Opaliopsis)* aff. *koeneni* A.W. Janssen, 1967; apertural view, × 20. Coll. JHR.
Fig. 12. *Cirsotrema (Opaliopsis)* sp. 1; apertural view; × 6. Coll. MGUH 20 042.
Fig. 13. *Cirsotrema (Opaliopsis)* sp. 2; apertural view; × 30. Coll. MGUH 20 043.
Fig. 14. *Trophonopsis (Pagodula) angustevaricata* (Gripp, 1912); a: apertural view; b: dorsal view; × 5. Coll. MGUH 20 044
Fig. 15. *Coralliophila (Hirtomurex) kochi* (Beyrich, 1854); a: apertural view; b: dorsal view; × 5. Coll. MGUH 20 045.
Fig. 16. *Searlesia ravni* sp. nov., paratype; dorsal view; × 1. Coll. MGUH 20 046.
Fig. 16. *Searlesia ravni* sp. nov., paratype; a apertural view; b: lateral view; × 1. Coll. MGUH 20 047.

Fig. 7 from Kirstinebjerg Skov (beach exposure), Denmark. All other specimens from Mogenstrup (coastal cliff), Denmark.

PLATE 2

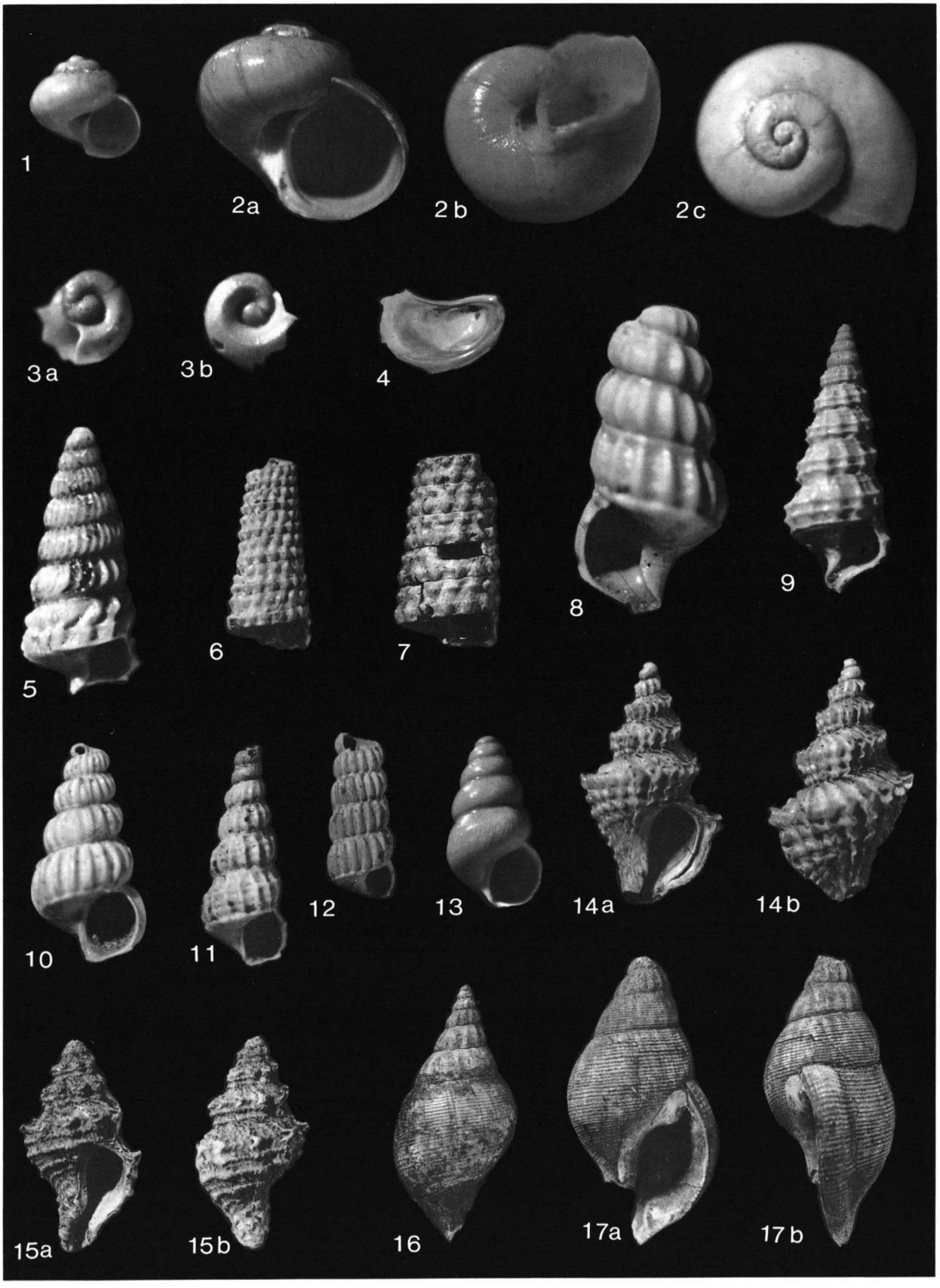


PLATE 3

Fig. 1. *Scalaspira (Scalaspira)* sp.; apertural view; × 9. Coll. MGUH 20 048.
Fig. 2. *Latirus (Pseudolatirus)* sp.; apertural view; × 11. Coll. JHR.
Fig. 3. *Gibberula brevis* (von Koenen, 1890); apertural view; × 8. Coll. MGUH 20 049.
Fig. 4. *Apiocypraea (Apiocypraea)* cf. *humbergi* R. Janssen, 1978; a: apertural view; b: dorsal view; × 10. Coll. MGUH 20 050.
Fig. 5. *Clavatula mogenstrupensis* sp. nov., holotype; apertural view; × 11. Coll. MGUH 20 051.
Fig. 6. *Babylonella pusilla* (Philippi, 1843); apertural view; × 8. Coll. MGUH 20 052.
Fig. 7. *Microdrillia ingerae* sp. nov., holotype; a: apertural view; b: dorsal view; × 8.5. Coll. MGUH 20 053.
Fig. 8. *'Microdrillia' speyeri* (Koch & Wiechmann, 1872); apertural view; × 8. Coll. LJL.
Fig. 9. *Microdrillia (Andersondrillia) brejningensis* sp. nov., holotype; a: apertural view; b: dorsal view; × 8. Coll. MGUH 20 054.
Fig. 10. *Microdrillia (Andersondrillia) brejningensis* sp. nov., paratype; apertural view; × 8. Coll. MGUH 20 055.
Fig. 11. *Pleurotomella (Pleurotomella) rasmusseni* sp. nov., holotype; a: apertural view, × 8½; b: dorsal view, × 8. Coll. MGUH 20 056.
Fig. 12. *Pleurotomella (Pleurotomella) margaritata* R.Janssen, 1978; apertural view; × 8. Coll. JHR.
Fig. 13. *Rimosodaphnella lappanni* sp. nov., holotype; a: apertural view; b: dorsal view; × 5. Coll. MGUH 20 057.
Fig. 14.? *Actaeopyramis* (s. lat.) *pseudopunctata* sp. nov., paratype; apertural view; × 34. Coll. MGUH 20 058.
Fig. 15.? *Actaeopyramis* (s. lat.) *pseudopunctata* sp. nov., holotype; apertural view, × 23. Coll. MGUH 20 059.

Fig. 9 from Brejning (beach exposure), Denmark; Fig. 13 from Fakkegrav Badehotel (coastal cliff), Denmark; Fig. 15 from Krefeld-Linn (water well), F.R.G. All other specimens from Mogenstrup (coastal cliff), Denmark.

PLATE 3