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A LATE OLIGOCENE (CHATTIAN B) MOLLUSC FAUNA FROM THE CLAY-PIT OF GALTEN BRICKWORKS AT NØRRE VISSING, JYLLAND, DENMARK

by

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A rich Late Oligocene mollusc fauna from Nørre Vissing near Skanderborg (Jylland, Denmark) was studied. The locality and the exposed sequence are described in detail, and the litho- and biostratigraphical positions are discussed. A list of the mollusc species is given, and comparisons with other Danish and German faunas of Late Oligocene age are made.

In the systematical part discussions on several species are given and five new species are introduced, viz. *Solariella* (*Solariella*) *vissingensis* n. sp., *S.* (*S.*) *ronaldjansseni* n. sp., ? *Cirsotrema* (s. lat.) *nielseni* n. sp., *Glibertturricula ariejansseni* n. sp., and *Pleurotomella* (*Pleurotomella*) *anderseni* n. sp. The name *Nucula* (*Lamellinucula*) *harderi* n. nom. is introduced for *Nucula donaciformis* Harder, 1913 non Hall, 1847.

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Contents:

SAMENVATTING

De laat-oligocene molluskenfauna van Nørre Vissing, Jutland, Denemarken.

De vindplaats Nørre Vissing bij Skanderborg (Jutland, Denemarken) heeft de rijkste molluskenfauna opgeleverd, die uit het Deense Laat Oligoceen bekend is. Er is een sectie aanwezig, die vergelijkbaar is met de Vejle Fjord Formatie (Oligoceen/Mioceen). De grens met de door een hiaat gescheiden onderliggende Søvind Marl Formatie is goed ontsloten.

Er wordt een lithologische beschrijving van de opeenvolging gegeven, alsmede een paleo-oecologische interpretatie, en litho- en biostratigrafische correlaties. Op grond van de Pectinidae wordt unit 2 (Brejning Clay Member) tot het Chattien B gerekend. Enkele beschadigde Chattien A fossielen worden als verspoeld beschouwd.

Er worden 145 soorten mollusken genoemd. De volgende nieuwe soorten worden beschreven: *Solariella* (*Solariella*) *vissingensis* n. sp., *Solariella* (*Solariella*) *ronaldjansseni* n. sp., ? *Cirsotrema* (s. lat.) *nielseni* n. sp., *Glibertturricula ariejansseni* n. sp., and *Pleurotomella* (*Pleurotomella*) *anderseni* n. sp. Voor *Nucula donaciformis* Harder, 1913 non Hall, 1847 wordt de nieuwe naam *Nucula harderi* ingevoerd. In het systematische gedeelte worden verder diverse soorten besproken; karakteristieke soorten zijn afgebeeld op twee platen.

DANSK SAMMENDRAG

En Øvre Oligocæn molluskfauna fra Nørre Vissing, Jylland, Danmark.

Galten Teglværks lergrav i Nørre Vissing nær Skanderborg har givet den største kendte molluskfauna fra Danmark Øvre Oligocæn. På lokaliteten er sedimenter, sammenlignelige med Vejle Fjord Formationen (Oligocæn-Miocæn), blottede, og desuden er grænsen til den underliggende Søvind Marl Formation let tilgængelig.

I det foreliggende arbejde beskrives lokaliteten og lagfølgens lithologi, og litho- og biostratigrafiske korrelationer foreslås, ligesom en tolkning af palæomiljøet gives. På basis af pectiniderne henføres unit 2 (Brejning Clay Member) til Chattien B, idet nogle få dårligt bevarede pectinider, der kunne indicere en Chattien A alder, betragtes som omlejrede.

I faunalisten anføres 145 molluskarter. Disse nye arter beskrives: *Solariella* (*Solariella*) *vissingensis* n. sp., *Solariella* (*Solariella*) *ronaldjansseni* n. sp., ? *Cirsotrema* (s. lat.) *nielseni* n. sp., *Glibertturricula ariejansseni* n. sp., og *Pleurotomella* (*Pleurotomella*) *anderseni* n. sp. For *Nucula donaciformis* Harder, 1913 non Hall, 1847 foreslås det nye navn *Nucula harderi*. I den systematiske del diskuteres flere arter, og på to tavler arbildes karakteristiske arter.

INTRODUCTION (author: Schnetler)

No Danish Late Oligocene mollusc fauna has been studied since the papers of Harder (1913) and Eriksen (1937). An important material, however, has been brought together from classic and new exposures in the last ten years. The present paper is the result of a study on the mollusc fauna of Nørre Vissing, situated near Skanderborg in Jylland. This fauna yielded the largest number of mollusc species among all Danish Late Oligocene localities. The list of species comprises 145 species, 68 of which are recorded from Denmark for the first time. The clay-pit at Nørre Vissing is also interesting from a stratigraphical point of view, as the unconformity between the Eocene Søvind Marl and the Oligo-Miocene Vejle Fjord Formation is well-exposed.

LOCALITY (authors: Schnetler & Beyer)

In text-fig. 1 the geographical position of the Nørre Vissing locality is indicated. The clay-pit is situated about 1 km NNW of Nørre Vissing (about 22 km W of Århus). The UTM coordinates

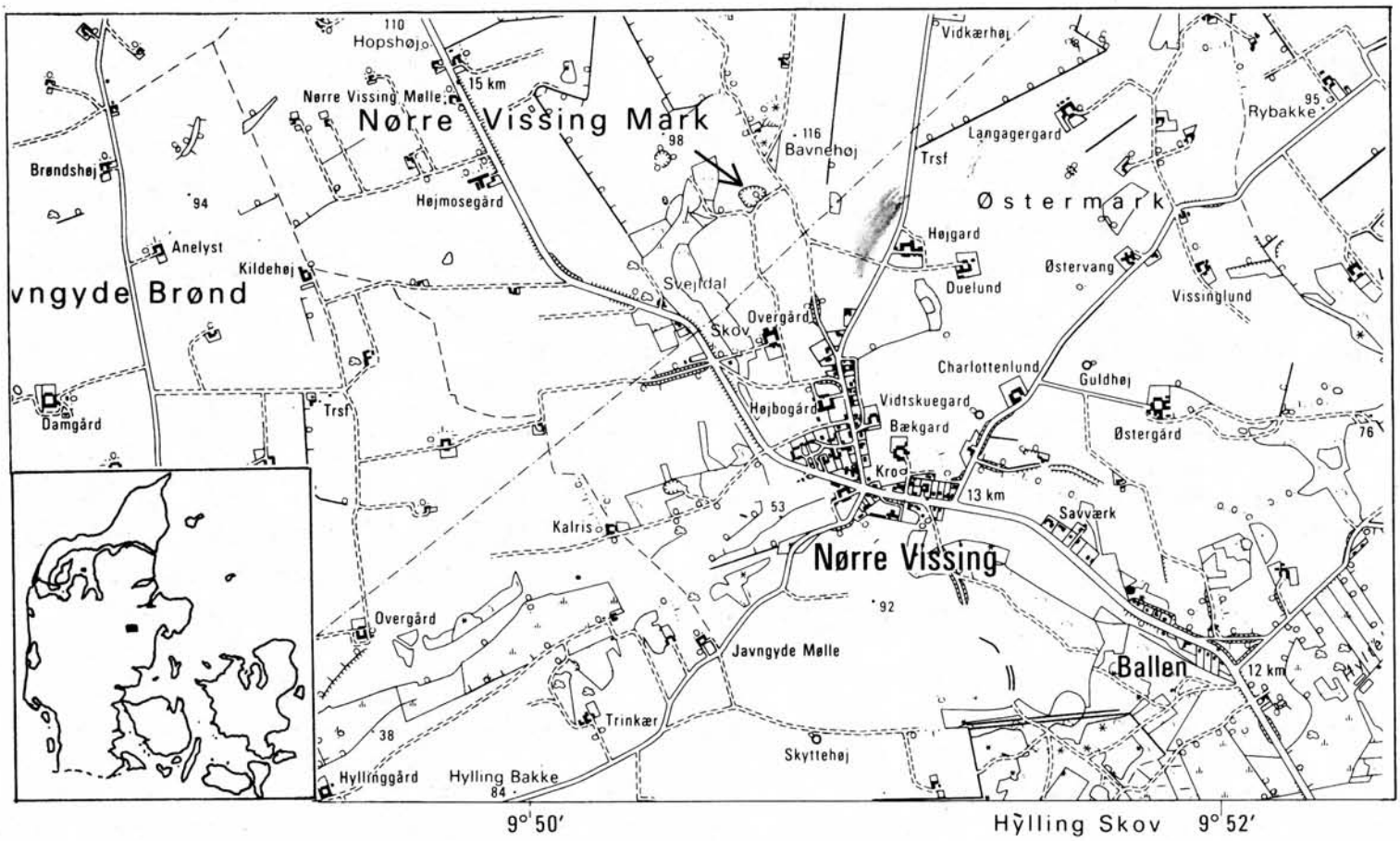

Fig. 1. Geographical situation of the clay-pit of Galten Brickworks at Nørre Vissing, Denmark. Fragment of the 1 : 25.000 map-sheet "1214 I NØ Galten". Reproduced with permission of the Geodetic Institute (A.398/86). Copyright.

(1 : 25,000 map-sheet 1214 I NØ Galten) are NH 525 212. Previous descriptions of this locality can be found in Friis & Nielsen (1979), Friis et al. (1981) and Heilmann-Clausen et al. (1985). Nørre Vissing was also mentioned in Schnetler (1985).

The clay-pit is currently worked by Galten Brickworks, which has been digging here for about 16 years. Excavation takes place only once a year, and exclusively the Søvind Marl Formation is used, from the bottom of the pit, for which purpose the Late Oligocene clay has to be removed. After completion of the excavation the Late Oligocene clay is redeposited in the excavation, in order to get the clay-pit into level again. Thus, only for a short period each year good sections are available. The Late Oligocene sediments weather quickly, partly due to a high pyrite content. In the autumns of 1985 and 1986 good sections were accessible. Smaller or greater parts of the sequence are continuously present in the western and northern fronts of the clay-pit. The sequence resembles a similar section, described by Andersen (1938) from a marl-pit at Ås (see illustration in Andersen, 1944, fig. 344). At both localities the sequence is disturbed by glacial tectonics.

LITHOLOGICAL DESCRIPTION (authors: Schnetler & Beyer)

In the northern front of the clay-pit about 12 m of Tertiary sediments are exposed, that can be subdivided into four units (compare text-fig. 2). The boundary between the Søvind Marl and the Brejning Clay was chosen as zero-level.

Unit 1 (minus 2.00-0.00 m)

Light greenish marl, weathering almost white, with calcareous concretions in a few horizons. The base of the unit is not exposed, so its total thickness is unknown. The uppermost 0.6 m are bioturbated, especially the interval minus 0.60 to minus 0.45 m, in which horizontal burrows, filled with a dark grey clay, are numerous. Many oblique burrows with a maximum diameter of about 2 cm are present in the uppermost 0.10 m. They are filled with sediment from unit 2 (dark sandy clay with faecal pellets and shell fragments). No macrofossils have been observed in unit 1. The marl belongs to the Søvind Marl Formation. It may be assigned to the calcareous nannoplankton zone NP 16 (E. Thomsen, Geological Institute, Århus; pers. comm., 1986).

Unit 2 (0.00-1.75 m)

A sharp boundary, indicating an erosional unconformity, separates units 1 and 2. The interval 0.00-0.70 m is a homogenous, silty mud of dark brown colour (10 YR 2/2). No burrows were observed. At the base black phosphorites (maximum size about 6 cm) are frequent; some glauconite is present in the sediment. The interval 0.70-0.90 m is a green, strongly glauconitic sand with pyrite and

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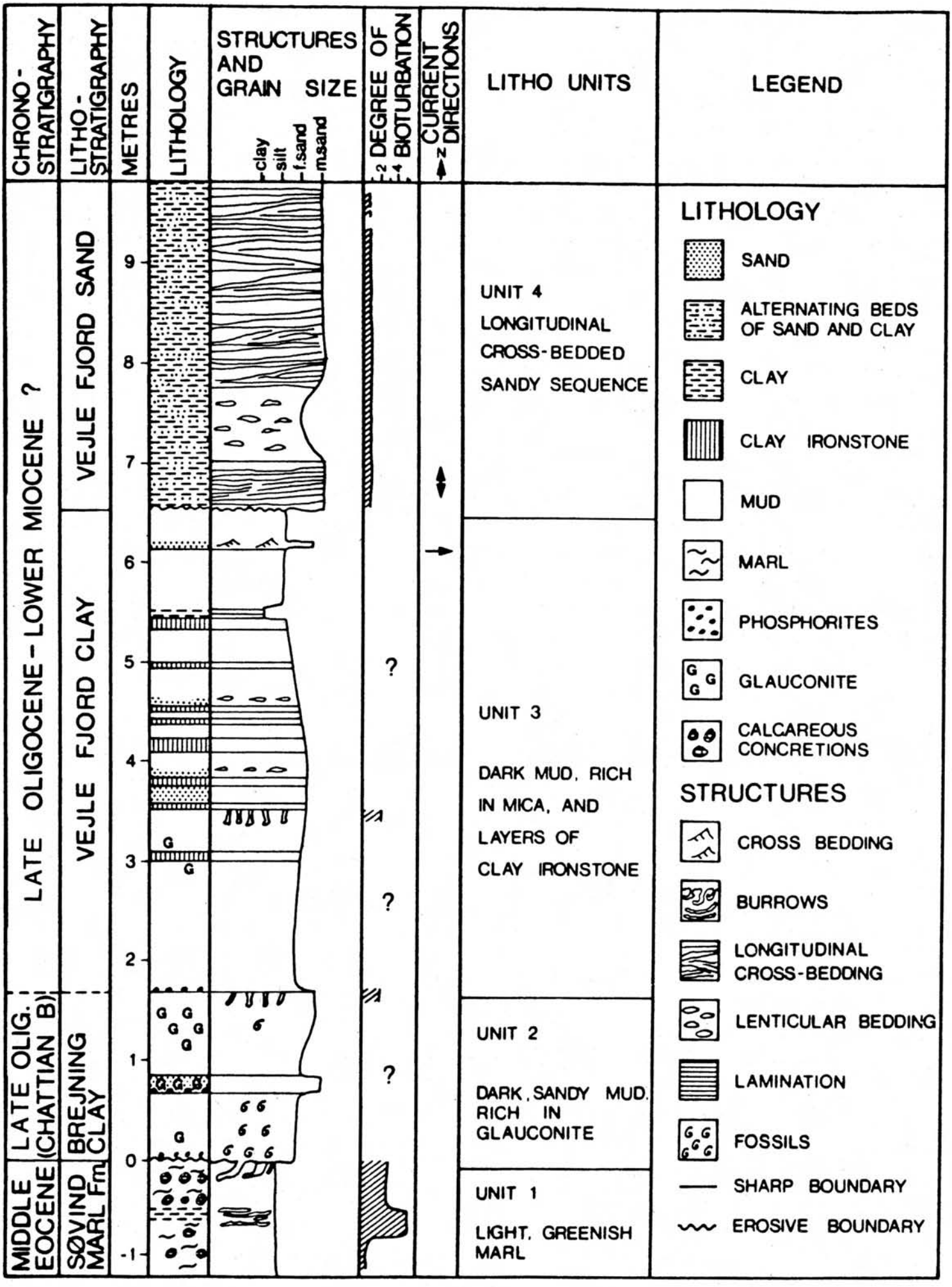
Fig. 2. Stratigraphical interpretation of the Nørre Vissing sequence (author: C. Beyer).

The term "mud" is used for poorly sorted carbonaceous fine-grained material consisting mainly of silt, but with a considerable amount of clay and fine-grained sand (estimated grain-size distribution: 60% silt, 35% clay, 5% sand). The term "glauconite" is used for greenish sand grains, some of which might possibly be chamosite.

Degree of bioturbation: the scale of Reineck & Singh (1980) is used.


CHRONO-STRATIGRAPHY
LITHO-STRATIGRAPHY
METRES
LITHOLOGY
STRUCTURES AND GRAIN SIZE
clay
silt
f.sand
m.sand
DEGREE OF BIOTURBATION
CURRENT DIRECTIONS
LITHO UNITS
LEGEND
LATE OLIGOCENE - LOWER MIOCENE ?
VEJLE FJORD SAND
VEJLE FJORD CLAY
LATE OLIG. (CHATTIAN B)
BREJNING CLAY
MIDDLE EOCENE
SØVIND MARL Fm
UNIT 4
LONGITUDINAL CROSS-BEDDED SANDY SEQUENCE
UNIT 3
DARK MUD, RICH IN MICA, AND LAYERS OF CLAY IRONSTONE
UNIT 2
DARK, SANDY MUD, RICH IN GLAUCONITE
UNIT 1
LIGHT, GREENISH MARL
LITHOLOGY
SAND
ALTERNATING BEDS OF SAND AND CLAY
CLAY
CLAY IRONSTONE
MUD
MARL
PHOSPHORITES
GLAUCONITE
CALCAREOUS CONCRETIONS
STRUCTURES
CROSS BEDDING
BURROWS
LONGITUDINAL CROSS-BEDDING
LENTICULAR BEDDING
LAMINATION
FOSSILS
SHARP BOUNDARY
EROSIVE BOUNDARY

phosphorites, overlain from 0.90 to 1.70 m by a silty mud with upwards increasing glauconite content. From 1.70 to 1.75 m a glauconitic sand is present with rather small phosphorites (1-2 cm) and pyrite-filled burrows. Macrofossils are common in unit 2, but for the greater part irregularly distributed in pockets. The molluscan fauna treated in this paper originates especially from the interval 0.00-0.70 m, in which large specimens of e.g. *Drepanocheilus speciosus, Fusiturris selysii, F. enodis, F. duchastelii, Orthosurcula regularis, Nucula comta* and *Lentipecten corneus* have been collected. Especially the gastropod *Drepanocheilus speciosus* is often found in pocket-like concentrations. In the interval 0.70-0.90 m thin-shelled bivalves (e.g. *Abra bosqueti*) are frequent. The number of fossils decreases upwards, where the shells often are decalcified as a result of pyrite oxidation, resulting in a preservation as casts or moulds. A single specimen of *Drepanocheilus speciosus*, however, was collected at + 1.75 m.

The molluscan fauna evidently is of Late Oligocene age. The unconformable lower boundary to the Søvind Marl (unit 1) thus represents a major hiatus, spanning the Late Eocene-Middle Oligocene. Unit 2 is referred to the Brejning Clay, a basal member of the Vejle Fjord Formation, defined by Larsen & Dinesen (1959).

Unit 3 (1.75-6.50 m)

This unit consists of silty and sandy mud, alternating with horizons of clay-ironstone. The sediment is homogenous and contains mica. The colour is brown (10 YR 2/2 and 5 YR 2/2). Burrows are present in some levels. The grain-size of the sediment is slightly coarsening upwards. In a few horizons small sand lenses occur, with fore-sets showing a current direction towards the East. The clay-ironstone occurs as irregular horizons with a maximum thickness of 15 cm. The colour is rusty brown (5 YR 4/4 and 5 YR 3/4). Fossils are absent.

Unit 4 (6.50-about 10 m)

This unit consists of mud and sand, occurring as alternating thin sand/mud layers in longitudinal cross-bedded sets and as lenticular bedding. In the cross-bedded sets some burrows are present. No fossils have been found. Together with unit 3 unit 4 shows resemblance with the Vejle Fjord Clay and the Vejle Fjord Sand members of the Vejle Fjord Formation.

The lithological descriptions given here are mainly based on observations by the present authors, but information from Dr C. Heilmann-Clausen (University of Aarhus) is also included.

LITHOSTRATIGRAPHICAL CORRELATION (author: Schnetler)

As mentioned above, the Nørre Vissing sequence is very similar to the Vejle Fjord Formation at Brejning, as described by Larsen & Dinesen (1959). A basal glauconitic clay is overlain by clayey and sandy sediments, indicating marine shelf conditions, followed by a lagoonal depositional environment (see chapter "Palaeoecological interpretations"). Similar conditions seem to have been present at Sofienlund (Christensen & Ulleberg, 1973). As the lateral development of the Vejle Fjord Clay and Sand members of the Vejle Fjord Formation is not known yet, a correlation of the Nørre Vissing units 3 and 4 is uncertain. Unit 2 can be correlated with the Brejning Clay with greater probability. The boundary with the Søvind Marl was described from Brejning (Eriksen, 1937, Larsen & Dinesen, 1959), from Ås (Andersen, 1938) and from Galgehøj (Lieberkind, 1977), (localities: see text-fig. 3). On each of these localities the Brejning Clay contains phosphorites. The glauconitic clay described by

Harder (1913) from Århus contained phosphorites too, and is most probably Brejning Clay. The sequence from Århus, as described by Harder, seems to be quite similar to the one at Nørre Vissing.

BIOSTRATIGRAPHICAL CORRELATION (author: Schnetler)

The molluscan fauna evidently is of Late Oligocene age. The Chattian biostratigraphy based on pectinids was initially developed by Hubach (1957) and Görges (1951), later elaborated by Anderson (1958, 1961) and R. Janssen (1979b). At Nørre Vissing the following stratigraphically useful species occur: *Palliolum* (s. lat.) *limatum limatum, P.* (s. lat.) *decussatum* and *P.* (s. lat.) *hausmanni hausmanni*. Well-preserved specimens of *P. hausmanni hausmanni* are found rather commonly, indicating a Chatt B age. Of *P. decussatum* only one defective valve and a few fragments were found. *P. limatum limatum* is represented exclusively by some fragments. The state of preservation of both last-mentioned species, which are characteristic for Chatt A faunas, suggests that they are reworked. Their presence indicates that sediments of Chatt A age were eroded, presumably in the local area, during the deposition of unit 2 at Nørre Vissing.

Otoliths from Nørre Vissing and Brejning have been collected by the author and Mogens S. Nielsen and were previously examined by Dr P.A.M. Gaemers, Leiden. Initially Dr. Gaemers had the opinion that the occurrence of *Gadichthys spatulatus* (Koken, 1891) at Nørre Vissing is an indication of a Late Neochattian (Late Chattian C) age, but recent developments in his study suggest that the otolith fauna rather has a Chattian B age. So there is no longer a discrepancy between the results based on molluscs and bony fish otoliths.

A small number of ostracods was collected from the Brejning Clay at Nørre Vissing: *Cytheridea pernota* Oertli & Keij, 1955; *Henryhowella asperrima* (Reuss, 1850) and *Echinocytheris* cf. *subcornuta* (Lienenklaus, 1900); identified by S.B. Andersen, Geological Institute, University of Aarhus. The two first-mentioned species suggest, according to the biozones of Lieberkind (1977) a Chattian age.

THE AGE OF THE BREJNING CLAY IN ITS TYPE LOCALITY (author: Schnetler)

Eriksen (1937), on the basis of mollusc studies, referred a glauconitic sand in the basal part of the Brejning Clay in its type locality to the Middle Oligocene, while the overlying part of the Brejning Clay was considered to be "Upper" Oligocene. The identification of some species in his list of the Middle Oligocene fauna, including the Middle Oligocene index-species *Nucula chasteli* Nyst, 1843 and "*Fusus*" *multisulcatus* Nyst, 1843 was by Eriksen considered questionable. He included in this list *Limopsis goldfussi* (Nyst, 1843), a species restricted to the Rupelian. From the higher part of the Brejning Clay Eriksen recorded a typical Late Oligocene fauna.

In 1959 Larsen & Dinesen established the Vejle Fjord Formation. They studied the sequence, described by Eriksen, in a well at Skansebakken, a few hundred meters NW of Eriksens localities, but the basal glauconitic sand was absent. Larsen & Dinesen divided the Brejning Clay and the lower part of the Vejle Fjord Clay into four biozones, based on the foraminifers. The zones 1-3 were referred to the time-interval Middle-"Upper" Oligocene. Lieberkind (1977) made a biostratigraphical subdivision of the Danish Eocene and Oligocene, based on ostracods. She considered the Brejning Clay from Brejning to be of Chattian age.

During the last five years Mogens S. Nielsen (Odense) and the senior author have collected a large mollusc material from the Brejning Clay at Brejning. Excavations were made immediately above the Søvind Marl, but until now a Middle Oligocene fauna has not been encountered. Many specimens of *Limopsis aurita* and *L. retifera* were found, but no *L. goldfussi*. According to the pectinids both Chattian A and B are present. The only species that might indicate a Middle Oligocene age, is *Astarte plicata* (Sandberger, 1861). Only two rather well-preserved specimens and some fragments were found; the identification is not yet secured.

According to Dr Gaemers the otolith fauna from Brejning is still insufficiently known. Its age is beyond any doubt Chattian, and there are certain indications that the Brejning fauna is not younger than Chattian B.

Summarizing I may conclude that the age of the basal part of the Brejning Clay in the type locality is still uncertain, but several studies seem to indicate a Chattian age. A renewed study of the mollusc material collected by Eriksen would be desirable, but unfortunately the whereabouts of this material are not known. The higher parts of the Brejning Clay are equally of Late Oligocene age.

MATERIAL (author: Schnetler)

Several hundredweights of sediment were collected in the Nørre Vissing clay-pit by S.B. Andersen, M.S. Nielsen and the senior author. The clay cannot be washed in the field, so samples had to be transported and dried. After careful washing on a 0.5 mm mesh the residues were sorted out. More than 4,000 specimens were identified, the greater part originating from excavations made by the senior author during the years 1983-1985. In 1985 Schnetler stated that the mollusc fauna comprises about 85 species, but this number has since been increased to 145. Apart from the washing of sediment samples, the surface of the clay-pit has been examined systematically to collect larger specimens; the combination of these collection methods presumably has given a quite complete impression of the mollusc fauna.

The molluscs from unit 2 are often well-preserved, but pyrite desintegration quickly destroys specimens in open air, and in many cases in collections, too. As a rule smaller species are complete, whereas larger species usually are crushed. Immediate consolidation in the field can save specimens of e.g. *Ficus concinnus, Tellina postera, Nucula comta* and other fragile species. Thin-shelled bivalves are often preserved on moulds of pyrite.

Non-molluscs have not been especially studied. Many bony fish otoliths have been collected, whereas shark teeth are less common. Furthermore, echinoderms (*Echinocyamus*, spatangids and spines of "*Cidaris*"), asteroids (one marginal plate), crinoids (one arm plate), Bryozoa and serpulids are represented. Decapods are very rare, but a rather large number of gastropods demonstrates apertural damages, or repairs, presumably made by decapods (Pl. 2, Fig. 18). Pl. 2, Fig. 13 shows an unrepaired apertural damage. Brachiopods are represented by large specimens of "*Terebratula*" *grandis* Blumenbach, 1803 and two specimens of "*Discina*". In the smaller fractions ostracods and foraminifers are found rather rarely.

The number of mollusc species is high, when compared with the classical faunas from Århus and Cilleborg (respectively 87 and 48 species). Ravn processed clay from Cilleborg, but the greater part of his molluscs was collected by the labourers in the clay-pit. Harder did not describe his collecting

Fig. 3. Danish localities mentioned in this paper. 1. Vilssund (former clay-pit); 2. Lyby Strand (coastal cliff); 3. Ny Skovbo (former clay-pit); 4. Cilleborg (former clay-pit); 5. Ølst (clay-pit of "FIBO"); 6. Sofienlund (former clay-pit); 7. Åby Mark (former excavation in a slope); 8. Århus (railway-excavation); 9. Nørre Vissing (clay-pit of Galten Brickworks); 10. Skanderborg (motorway-excavation); 11. Ås (former marl-pit); 12. Galgehøj (former marl-pit); 13. Jensgård (coastal cliff); 14. Fakkegrav Badehotel (coastal cliff); 15. Brejning (beach exposure); 16. Bøgeskov (coastal cliff); 17. Kirstinebjerg Skov (beach exposure).

techniques in the clay from Århus, but presumably no sediment was processed. In the faunas from these two localities the larger species are therefore undoubtedly overrepresented.

LIST OF MOLLUSC SPECIES (author: Schnetler)

In table 1 all mollusc species, found in unit 2 at Nørre Vissing, are listed. Taxonomy is based mainly on R. Janssen (1978b, 1979a, b). In column 1 species recorded for the first time from the Late Oligocene of Denmark are indicated with an asterisk (*). In column 2 the frequency of the species is indicated with a scale from 1 to 7, meaning:

½-1	specimen -1
2-3	specimens -2
4-10	specimens -3
11-40	specimens -4
41-125	specimens -5
126-350	specimens -6
351-1000	specimens -7

The numbers of scaphopods are estimated; one valve of a bivalve = ½ specimen.

In column 3 the depository is indicated for some rare species, for abbreviations see systematical part. Furthermore, species treated in the systematical part, and species, illustrated on Plates 1 and 2, are indicated.

SYSTEMATICAL PART (author: Schnetler)

The depository of material is indicated with the following abbreviations:

AJB	Coll. A.C. Janse, Brielle, The Netherlands
DGU	Collections of the Geological Survey of Denmark, Copenhagen, Denmark
MGUH	Collections of the Geological Museum, University of Copenhagen, Denmark
ISL	Coll. K.I. Schnetler, Langå, Denmark
MNO	Coll. M.S. Nielsen, Odense, Denmark
RGM	Collections of the National Museum of Geology and Mineralogy, Leiden, The Netherlands
SMF	Collections of Forschungsinstitut Senckenberg, Frankfurt/Main, F.R.G.
WLH	Coll. W. Lappann, Heiligenhaus-Isenbügel, F.R.G.

Danish localities mentioned in this chapter are indicated in text-fig. 3.

Nucula (Lamellinucula) harderi nom. nov.

Pl. 1, Fig. 1.

? 1886 *Nucula Chastelii* Nyst - von Koenen, p. 92 (non Nyst ?).
? 1907 *Nucula Chasteli* Nyst - Ravn, p. 50 (non Nyst?).
1913 *Nucula donaciformis* n. sp., Harder, p. 49, pl. 3, figs 10a-e, 11 (non Hall, 1847).
1979b *Nucula (Lamellinucula) donaciformis* Harder, 1913 [nom. präokk.] - R. Janssen, p. 16.

Table 1. Mollusc species from Nørre Vissing, clay-pit of Galten Brickworks, Denmark (Brejning Clay Member, Vejle Fjord Formation, Chattian B)

1. * indicates that the species was not previously recorded from the Late Oligocene of Denmark
2. frequency code (see text)
3. notes (see text)

	1	2	3
Nucula (Nucula) schmidti Glibert, 1955	*	2	ISL, AJB
Nucula (Lamellinucula) comta Goldfuss, 1837		4	
Nucula (Lamellinucula) harderi nom. nov.		3	syst. part
Nucula (Leionucula) peregrina Deshayes, 1860	*	3	
Nucula (Saccella) westendorpi (Nyst, 1839)		4	
Portlandia (Yoldiella) pygmaea (von Münster, 1837)		4	
Yoldia (Yoldia) glaberrima (von Münster, 1837)		4	
Yoldia (Yoldia) strucki (Wiechmann, 1878)		2	ISL
Bathyarca bellula (Wiechmann, 1874)	*	3	pl. 1
Limopsis (Limopsis) aurita (Brocchi, 1814)		5	
Limopsis (Pectunculina) retifera Semper, 1861	*	3	
Glycymeris (Glycymeris) obovata (Lamarck, 1819)		3	
Arcoperna sp.	*	2	ISL, AJB
Modiolula pygmaea (Philippi, 1843)	*	2	ISL
Lentipecten (Lentipecten) corneus (Sowerby, 1818)		4	
Propeamussium (Parvamussium) pygmaeum (von Münster, 1835)	*	4	
Palliolum (s. lat.) *limatum limatum* (Goldfuss, 1833)	*	2	ISL, AJB
Palliolum (s. lat.) *decussatum* (von Münster, 1833)	*	2	ISL, AJB
Palliolum (s. lat.) *hausmanni hausmanni* (Goldfuss, 1835)		3	
Anomia (Anomia) ephippium Linné, 1758		3	
Limaria (Limatulella) sandbergeri (Deshayes, 1861)	*	1	AJB
Limea (Notolimea) nysti (Speyer, 1861)	*	2	ISL, AJB
Pycnodonte (Pycnodonte) callifera (Lamarck, 1819)	*	3	
Gonimyrtea droueti schloenbachi (von Koenen, 1868)		3	
Thyasira (Thyasira) flexuosa (Montagu, 1803)		2	
Cyclocardia (Cyclocardia) grossecostata (von Koenen, 1884)	*	1	AJB
Cyclocardia (Cyclocardia) aff. *kickxi* (Nyst & Westendorp, 1839)		5	syst. part
Cyclocardia (Cyclocardia) depressa (von Koenen, 1884)	*	2	ISL, MNO
Astarte (Astarte) gracilis gracilis von Münster, 1837		3	
Astarte (Astarte) goldfussi praecursor Glibert, 1957		4	
Astarte (s. lat.) sp.	*	3	syst. part
Astarte (Astarte) pygmaea von Münster, 1837		4	
Digitaria koeneni (Speyer, 1866)	*	3	
Grotriana semicostata Speyer, 1860	*	2	ISL, MNO
Parvicardium kochi Semper, 1861		3	
Laevicardium (Habecardium) excomatulum Glibert & van de Poel, 1970		4	
Ensis hausmanni (Goldfuss, 1841)	*	1	ISL
Tellina (Peronidia) postera Beyrich, 1868	*	3	
Abra (Abra) bosqueti (Semper, 1861)		4	
Pygocardia cyprinoides (Sandberger, 1861)		2	ISL
Callista (Costacallista) beyrichi (Semper, 1861)	*	2	AJB
Callista (Costacallista) reussi (Speyer, 1866)		3	
Corbula (Caryocorbula) rugulosa von Koenen, 1884		3	
Corbula (Varicorbula) gibba (Olivi, 1792)		2	
Spheniopsis depressa von Koenen, 1894	*	3	

	1	2	3
Hiatella (Hiatella) arctica (Linné, 1767)		3	
Panopea (Panopea) angusta Nyst, 1836	*	3	
Teredinidae gen. et sp. indet.		*2*	
? *Aspidopholas* sp.	*	1	ISL
Thracia sp.		2	ISL, MNO
Poromya (Poromya) hanleyana von Koenen, 1863		2	ISL, AJB
Cuspidaria sp.	*	2	ISL, AJB
Cardiomya (Cardiomya) kochii (Philippi, 1843)		3	
Dentalium (Dentalium) geminatum Goldfuss, 1841		5	
Dentalium (Dentalium) polypleurum Seifert, 1959		3	
Rhabdus sp.	*	3	
Dischides rhenanus R. Janssen, 1978	*	4	
Solariella (Solariella) vissingensis sp. nov.	*	6	syst. part
Solariella (Solariella) ronaldjansseni sp. nov.	*	4	syst. part
Solariella (Solariella) sp.	*	3	syst. part
Calliostoma (Ampullotrochus) serratocostatum (Speyer, 1869)	*	2	ISL
Cirsope (Cirsope ?) *multicingulata* (Sandberger, 1859)	*	2	ISL
Cingula sp.	*	2	ISL, MNO
Rissoa (Persephona) karsteni R. Janssen, 1978	*	3	
Rissoa (Persephona) punctatissima R. Janssen, 1978	*	1	AJB
Alvania (Arsenia) semperi Wiechmann, 1871	*	4	
Alvania sp.	*	1	AJB
Cerithiopsis jutensis Schnetler, 1985		1	AJB
Cerithipsis (s. lat.) *serrula* R. Janssen, 1978	*	1	ISL
Cerithopsida boelschei (von Koenen, 1891)	*	2	pl. 1
Cerithiella (Cerithiella) bitorquata (Philippi, 1843)	*	4	
Seila (s. lat.) *angusta* Tembrock, 1964	*	1	ISL
Triphora (Norephora) elatior (von Koenen, 1891)		3	
Acirsa (Plesioacirsa) leunisii (Philippi, 1843)	*	3	
Opalia (Pliciscala) pusilla (Philippi, 1843)		3	
Turriscala (Turriscala) rudis (Philippi, 1843)		3	
Cirsotrema (s. lat.) *crispatum* Harder, 1913		1	ISL
? *Cirsotrema* (s. lat.) *nielseni* sp. nov.	*	3	syst. part
Cirsotrema (Opaliopsis) sp.	*	1	syst. part
Mathilda (Mathilda) sandbergeri (Koch, 1876)		2	
Aclis (Aclis) vetusta Wiechmann, 1874	*	1	MNO
Aclis (Stilbe) proneglecta R. Janssen, 1978	*	1	ISL
Aclis (Graphis) hosiusi (Lienenklaus, 1891)	*	4	
Balcis (Balcis) alba naumanni (von Koenen, 1867)	*	2	
Balcis (Polygyreulima) pseudonaumanni R. Janssen, 1978	*	2	
Eulima (Eulima) emersa Speyer, 1870	*	2	
Tugurium (Trochotugurium) scrutarium (Philippi, 1843)	*	2	ISL
Drepanocheilus (Arrhoges) speciosus (von Schlotheim, 1820)		7	
Polinices (Euspira) helicinus (Brocchi, 1814)		6	
Lunatia dilatata (Philippi, 1843)	*	3	
Phalium (Echinophoria) rondeleti (de Basterot, 1825)		4	
Charonia (Sassia) flandrica (de Koninck, 1837)		3	
Ficus concinnus (Beyrich, 1854)		4	
Pterynotus sp. indet.	*	1	AJB
Boreotrophon (s. lat.) *deshayesi* (Nyst, 1836)		4	
Lyrotyphis (Lyrotyphis) cuniculosus (Nyst, 1836)		3	

	1	2	3
Lyrotyphis (Eotyphis) sejunctus Semper, 1861		4	
Scalaspira (Scalaspira) elegantula aequistriata (Speyer, 1863)	*	3	
Scalaspira (Scalaspira) waelii (Beyrich, 1856)		4	
Angistoma brueckneri (Beyrich, 1856)		3	syst. part, pl. 2
Exilioidea elatior (Beyrich, 1848)		4	pl. 2
Metula (Daphnobela) scabricula (Philippi, 1847)		3	pl. 2
Coptochetus (s. lat.) *danicus* Schnetler, 1985		3	syst. part
Pisanella subgranulata (von Schlotheim, 1820)		3	
Streptochetus (Streptodictyon) cheruscus cheruscus (Philippi, 1843)		4	
Streptochetus (Streptolathyrus) ? *soellingensis* Tembrock, 1965	*	1	AJB
Scaphella (Scaphella) siemssenii (Boll, 1851)		3	
Ancilla (Ancillus) karsteni (Beyrich, 1853)		3	
Cancellaria (Merica) evulsa postera Beyrich, 1856		4	
Unitas granulata (Nyst, 1845)		3	
Babylonella pusilla (Philippi, 1843)		4	
Vexillum (Uromitra) hastatum (Karsten, 1849)		4	
Conomitra soellingensis (Speyer, 1864)	*	4	syst. part
Orthosurcula regularis (de Koninck, 1837)		4	
Acamptogenotia morreni (de Koninck, 1837)		4	
Stenodrillia obeliscus (des Moulins, 1842)		4	
Cochlespira volgeri (Philippi, 1843)		2	ISL
Gemmula (Gemmula) laticvlavia (Beyrich, 1848)		4	
Gemmula (Gemmula) trispiralis R. Janssen, 1979		4	
Pleuroliria koninckii (Nyst, 1845)		4	
Fusiturris duchastelii (Nyst, 1836)		6	
Fusiturris selysii (de Koninck, 1837)		5	
Fusiturris enodis R. Janssen, 1978		4	
Glibertturricula ariejansseni sp. nov.	*	4	syst. part
Bathytoma (Bathytoma) leunisii (Philippi, 1843)		4	
Splendrillia koeneni (Speyer, 1867)		1	ISL
Amblyacrum roemeri (von Koenen, 1867)	*	1	ISL
Pleurotomoides naumanni (Speyer, 1867)	*	4	syst. part
Pleurotomella (Pleurotomella) anderseni sp. nov.	*	3	syst. part
Conus (Leptoconus) semperi Speyer, 1862		1	ISL
Actaeopyramis cf. *elatus* (von Koenen, 1882)	*	2	ISL
Odostomia (Evalea) kochi (Görges, 1952)	*	1	
Pyramidellidae sp. indet.	*	1	syst. part
Syrnola (Syrnola) subcylindrica ((Philippi, 1843)		3	
Turbonilla (Pyrgolampros) jeffreysi Koch & Wiechmann, 1872		3	
Turbonilla sp.	*	2	AJB
Actaeon (Actaeon) philippi (Koch, 1868)		2	
Crenilabium terebelloides (Philippi, 1843)	*	2	
Acteocina sp.	*	1	MNO
Ringicula (Ringiculina) striata Philippi, 1843		4	
Cylichna sp. indet.	*	2	AJB, MNO
Cylichna sp. R. Janssen, 1979	*	1	AJB
Roxania (Roxania) utriculus (Brocchi, 1814)		3	
Scaphander lignarius distinctus Koch, 1876	*	1	AJB
Philine (Philine) kochi von Koenen, 1882	*	2	

Remarks — As stated by R. Janssen (1979b) the name *donaciformis* Harder, 1913 is preoccupied by *donaciformis* Hall, 1847. I therefore introduce the new name *harderi* in honour of Dr Poul Harder, who first described this species. I am indebted to Dr R. Janssen (SMF) for his very kindly leaving it to me to rename this species.

In 1913 Harder described the species from the classical locality Århus. The clay-pit at Nørre Vissing has yielded six specimens, the motorway-excavation at Skanderborg (1976) one specimen and a coastal cliff exposure at Fakkegrav Badehotel on the northern coast of the Vejle Fjord another three specimens. I compared my specimens from Nørre Vissing and Skanderborg with the syntypes in the Harder collection (DGU) and found them to be identical.

Unfortunately pyrite desintegration has damaged the specimen illustrated by Harder (pl. 3, figs 10a-e). The remaining syntypes are preserved as internal casts, with greater or smaller parts of the shells preserved, and some fragments. The small, complete specimen mentioned by Harder has a smooth ventral margin and must be referred to *Nucula peregrina* Deshayes, 1860. Harder stated that a specimen, referred to *Nucula chasteli* Nyst, 1843 by von Koenen (1886) and Ravn (1907), should be referred to *donaciformis*. Unfortunately it has not been possible to locate this specimen in MGUH. Judging from the measurements given by Ravn this specimen has not the elongated form of *donaciformis*.

Fig. 1. *Nucula (Lamellinucula) harderi* nom. nov.; × 4.
Coll. MGUH 17 600.

Fig. 2. *Bathyarca bellula* (Wiechmann, 1874); × 10.
Coll. MGUH 17 601.

Fig. 3-4. *Cyclocardia (Cyclocardia)* aff. *kickxi* (Nyst & Westendorp, 1839); × 3.5.
Coll. MGUH 17 602 and 17 603.

Fig. 5-6. *Astarte* (s. lat.) sp.; × 6.
Coll. MGUH 17 604 and 17 605.

Fig. 7. *Solariella (Solariella) vissingensis* sp. nov.; × 10.
Holotype; coll. MGUH 17 606 (leg. M.S. Nielsen).

Fig. 8a-b. *Solariella (Solariella) vissingensis* sp. nov.; × 15.
Paratype: coll. MGUH 17 607 (leg. K.I. Schnetler).

Fig. 9a-c. *Solariella (Solariella) ronaldjansseni* sp. × 7.
Holotype; coll. MGUH 17 608 (leg. J. Hillersborg).

Fig. 10a-b. *Solariella (Solariella) ronaldjansseni* sp. nov.; × 20.
Paratype; coll. MGUH 17 609 (leg. K.I. Schnetler).

Fig. 11. *Solariella (Solariella) ronaldjansseni* sp. nov.; × 10.
Paratype; coll. MGUH 17 610 (leg. M.S. Nielsen).

Fig. 12a-b. *Solariella (Solariella)* sp.; Fig. 12a × 10; Fig. 12b × 7. Coll. MGUH 17 611.

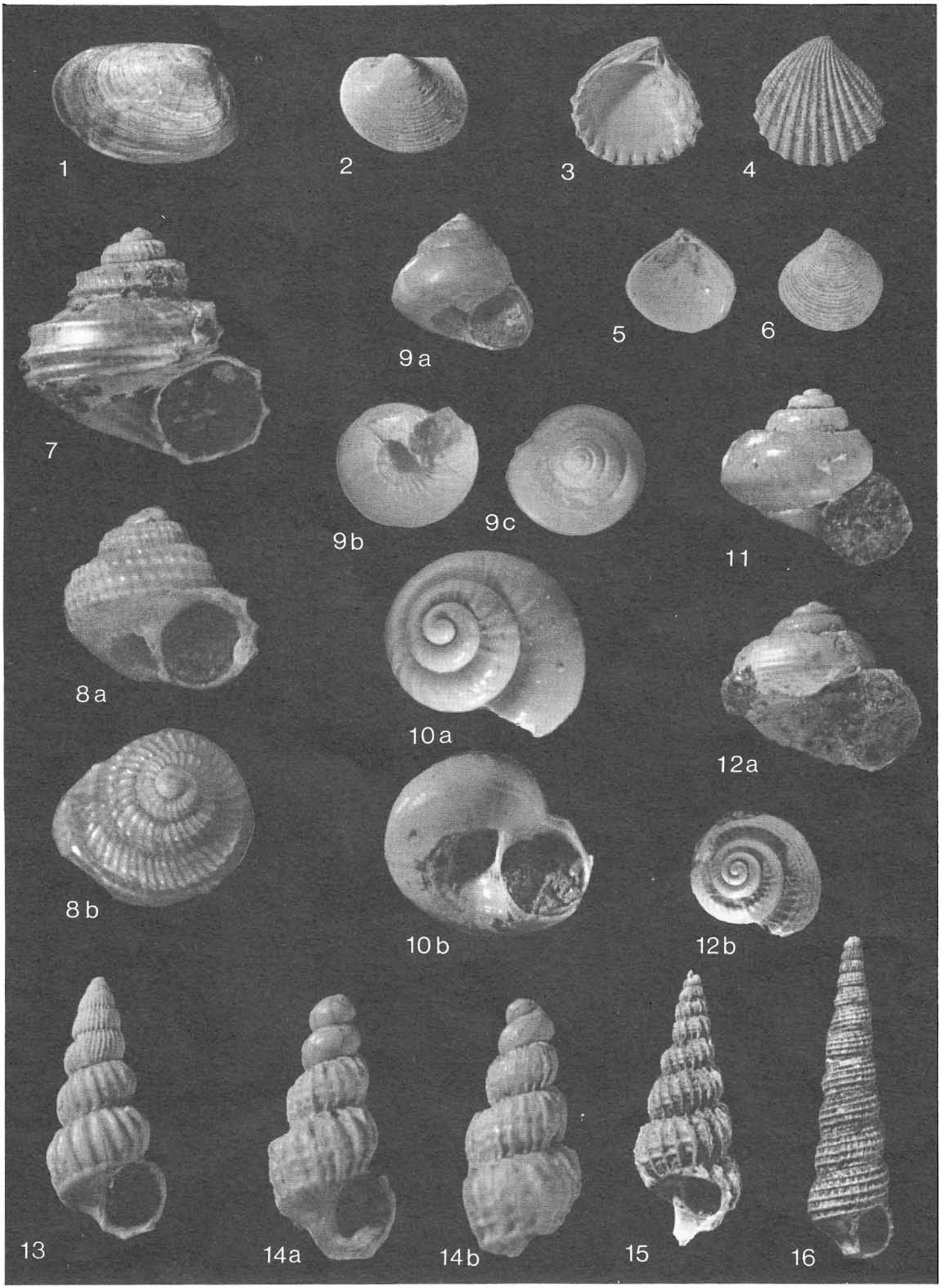
Fig. 13. *Cirsotrema (Opaliopsis)* sp.; × 20.
Coll. MGUH 17 612.

Fig. 14a-b. ? *Cirsotrema* (s. lat.) *nielseni* sp. nov.; × 20.
Holotype; coll. MGUH 17 613 (leg. M.S. Nielsen).

Fig. 15. ? *Cirsotrema* (s. lat.) *nielseni* sp. nov.; × 5.
Paratype; coll. MGUH 17 614 (leg. K.I. Schnetler).

Fig. 16. *Cerithiopsida boelschei* (von Koenen, 1891); × 5.
Coll. MGUH 17 615.

Localities: Fig. 5-6, 9a-c: Coastal cliff at Jensgård (UTM coordinates NG 664 851).
All other Figs.: Nørre Vissing, clay-pit of Galten Brickworks.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R. Janssen (1979: 16) suggested that *N. donaciformis* might be an extreme form of *N. comta*. I have compared my *harderi* material with specimens of *N. comta* from Danish faunas and two German localities (Wilhelmshöhe and Glimmerode), kindly lent to me by Dr R. Janssen (SMF). *N. comta* shows some variability in shell-form and ornamentation. The number of radial ribs varies from 56 to 74. The shape varies from triangular to more elongate, with the ventral margin always convex. The variability of the length/height-ratio appears from these values: Wilhelmshöhe: 1.12-1.22; Glimmerode: 1.25-1.42; Lyby Strand (Denmark): 1.17-1.32.

N. harderi has to be considered an independent species, characterised by an elongated shell-form (length/height-ratio 1.40-1.48), parallel posterior ventral and anterior dorsal margins, the almost rectilinear part of the ventral margin and a number of radial ribs of about 95-110. Furthermore, the shell of *harderi* is distinctly more thin-walled than that of *N. comta*. Finally, no transitional forms between *N. comta* and *N. harderi* have been found.

Cyclocardia (Cyclocardia) aff. **kickxi** (Nyst & Westendorp, 1839)
Pl. 1, Figs 3-4.

Remarks — In Danish literature this species was always referred to *C. tuberculata* (von Münster, 1837). R. Janssen (1979b: 79) stated that the name *tuberculata* was preoccupied and he used the name *grossecostata* (von Koenen, 1884) instead. The material from Nørre Vissing agrees completely with specimens from Århus (Harder, 1913) and Cilleborg (Ravn, 1907), and also with material from several other Danish localities. From Mr A.C. Janse, Brielle I received specimens from Rumeln (Lower Rhine area, F.R.G.), which agree very well too.

On the average the species has 18-19 ribs, separated by interstices of the same width. Typical specimens of *C. grossecostata* have lesser ribs, that are wider than their interspaces, and less convex valves. From the Danish locality Jensgård a typical population of *C. grossecostata* was collected.

From the Danish Middle Oligocene Ravn (1907: 62, pl. 1, fig. 22) and Harder (1913: 55, pl. 4, figs 1-4) described and illustrated a form as *C. kickxi*. According to Mr A.W. Janssen (pers. comm., 1987) this form most probably is identical with *C. depressa*. It is rather common in the Viborg Formation (of ? Early-Middle Oligocene age).

Astarte (s. lat.) sp.
Pl. 1, Figs 5-6.

Remarks — A small number of rather badly preserved specimens were collected. A large population of this species is present at Jensgård, and the species was furthermore recognized in material from Rumeln (leg. A.C. Janse). All specimens have a smooth and sharp ventral margin, and a concentric ornamentation, consisting of about 30 ribs. Further studies are necessary for a final interpretation of this form.

Solariella (Solariella) vissingensis sp. nov.
Pl. 1, Figs 7, 8a-b.

Locus typicus — Nørre Vissing, clay-pit of Galten Brickworks (text-fig. 1).

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

Derivatio nominis — named after the type locality.

Holotype — Pl. 1, Fig. 7, coll. MGUH 17 606 (leg. M.S. Nielsen).

Description — The shell is rather small (height up to six mm) and fragile with the outer cross-lamellar shell-layer easily splitting off from the nacreous inner shell-wall, for which reason larger specimens are very rare.

The shell is trochiform. Small specimens are considerably wider than high, while adult specimens are almost equally high as wide. The height of the aperture equals about 2/5 of the total shell-height.

The shell comprises about five whorls, of which 1¼ whorls belong to the protoconch. The nucleus is rather voluminous, slightly depressed and provided with three very fine, thread-like spiral lines, which are ascending obliquely; they continue as the primary spirals on the teleoconch. The two adapical spirals have the widest interspace, and the entire protoconch has a very fine granulation (magnification × 50). These features are obvious on well-preserved shells only. The transition to the teleoconch is abrupt.

The teleoconch comprises about four whorls, quickly increasing in diameter and separated by deep sutures. The body whorl equals about 2/3 of the total shell-height. The spira has a gradated profile because of the accentuated spiral sculpture. The base of the adult shell is rather convex, with six fine spirals. In juvenile specimens the base is more convex. The umbilicus is wide and deep, surrounded by two strong spirals, granulated to a higher or lesser degree by the radial sculpture. Internally the umbilicus has two to three weaker spirals. The aperture is oval, labrum broken in all specimens.

Of the three spirals the two adapical ones are more widely spaced. The adapical spiral, situated at about 1/3 of the whorl height, demarcates an almost flat subsutural plane. Below the shell-wall descends obliquely to the second spiral, which is situated on the middle of the whorl. The two adapical spirals are stronger than the third one; the spaces between the three spirals are concave.

On the first ¼-½ whorls only spirals are seen, but then radial ribs appear. These are prosocline and considerably narrower than the spaces between them. The number of radial ribs is about 25-35 per whorl. In larger specimens the radial sculpture often weakens on the younger whorls. The combination of radial and spiral sculpture results in a rhombic reticulation, with small granules on the intersections, most prominently on the two adapical spirals.

Variability — The number of radial ribs is somewhat variable.

Paratypes — Nørre Vissing, clay-pit of Galten Brickworks - 1 specimen (Pl. 1, Fig. 8a-b) (leg. K.I. Schnetler; coll. MGUH 17 607); 83 specimens (leg./coll. ISL); 60 specimens (leg./coll. MNO); 9 specimens (leg./coll. AJB); 4 specimens (leg. K.I. Schnetler; coll. WLH); 3 specimens (leg. K.I. Schnetler; coll. SMF 306 376); 2 specimens (leg. K.I. Schnetler; coll. RGM 229 351).
Ølst, clay-pit of "FIBO" - 3 specimens (leg./coll. ISL); 15 specimens (leg./coll. MNO).

Discussion — This species differs from all other *Solariella* species from the Oligocene and Miocene of the North Sea Basin by details of ornamentation and the protoconch. *Solariella suturalis* (Philippi, 1843) has four spirals, a lower spire and a coarser sculpture. From the Lower Rhine area a further, as yet undescribed *Solariella* species is known (coll. AJB; coll. WLH). This form differs from *S. vissingensis* by its lower spire and by the two carina-like spiral bands, situated immediately above the abapical

suture. Furthermore the shell-wall between the adapical suture and the edge under the adapical suture is concave. The shell has no radial sculpture, except for the edge under the adapical suture.

Solariella (Solariella) ronaldjansseni sp. nov.
Pl. 1, Figs 9a-c, 10a-b, 11.

Locus typicus — Coastal cliff at Jensgård, South of Horsens Fjord (UTM coordinates NG 664 851).

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

Derivatio nominis — this species is named in honour of Dr R. Janssen, Frankfurt/Main, F.R.G.

Holotype — Pl. 1, Figs 9a-c, coll. MGUH 17 608 (leg. J. Hillersborg).

Description — The species is very fragile with the outer shell layer easily splitting off from the inner nacreous shell-wall, for which reason adult specimens are difficult to collect. For this reason a better preserved specimen from Jensgård was chosen as holotype, instead of one from Nørre Vissing. The shell is rather small (height up to about six mm).

The shell is trochiform. Juvenile specimens are considerably wider than high, while larger specimens are almost equally high as wide. The height of the aperture equals about 2/5 of the total shell-height.

The shell consists of up to five whorls. The protoconch is paucispiral, consisting of 1¼ whorls. The nucleus is rather voluminous, slightly depressed and smooth. The transition to the teleoconch is visible, but not very distinct.

The teleoconch comprises about four convex whorls, quickly increasing in diameter and separated by deep sutures, which are almost canaliculate, because of a narrow, flat to concave adapical part of the whorl. The base is convex with about 12 irregularly distributed spiral grooves. These grooves are strongest in abaxial direction. On the base the growth-lines are prosocyrt. The umbilicus is wide and deep, surrounded by two spirals in juvenile specimens. In larger specimens the abaxial spiral is somewhat indistinct, slightly thickened and folded by the radial sculpture. The adaxial spiral is more strongly ornamented with knobs. Internally the umbilical shell-wall bears six further, coarsely granulated spirals. The aperture is oval, the labrum is broken in all specimens.

The spiral sculpture is very weak. In the concave upper part of the whorl a very fine spiral groove appears after 2¼ whorls; on the lower convex part of the whorl the spirals are almost invisible. The number of spirals here is about 12 on the holotype. The transition to the base is slightly angular, and on this transition two rather distinct spiral grooves are present. The adapical one lies immediately above the abapical suture.

The radial sculpture is also very weak. On the initial three whorls the growth-lines are regularly united to radial folds (about 30 per whorl), that disappear on the younger whorls. Prosocline growth-lines remain visible.

Variability — The strength of the radial folds is somewhat variable.

Paratypes — Jensgård - 13 specimens (leg./coll. ISL)
Nørre Vissing - 1 specimen (Pl. 1, Figs 10a-b) (leg. K.I. Schnetler; coll. MGUH 17609); 1 specimen (Pl. 1, Fig. 11) (leg. M.S. Nielsen; coll. MGUH 17 610); 17 specimens (leg./coll. ISL); 1 specimen

(leg. K.I. Schnetler; coll. SMF 306 375); 1 specimen (leg. K.I. Schnetler; coll. RGM 229 352); 1 specimen (leg. K.I. Schnetler; coll. AJB); 1 specimen (leg. K.I. Schnetler; coll. WLH); 17 specimens (leg./coll. MNO).
Ølst, clay-pit of "FIBO" - 5 specimens (leg./coll. ISL); 3 specimens (leg./coll. MNO).
Ny Skovbo (former clay-pit) - 11 specimens (leg. S.B. Andersen; coll. ISL).
Skanderborg (motorway-excavation) - 7 specimens (leg. S.B. Andersen; coll. ISL).

Discussion — *S. ronaldjansseni* is closely related to *S. straeleni* Glibert, 1952. It differs from this latter species by its higher shell-form, its weaker spiral sculpture, a different spiral ornamention of the umbilical area, more convex whorls and a narrower adapical part of the whorl.

Solariella (Solariella) sp.
Pl. 1, Fig. 12a-b.

Description — Only seven rather badly preserved specimens are available, insufficient for a final interpretation.

The shell is rather small (height up to about three mm) and, like the two *Solariella* species, described above, very fragile.

The shell is trochiform, slightly wider than high. The height of the aperture equals about half the total shell-height.

The shell comprises about four convex whorls, quickly increasing in diameter and separated by deep sutures. The protoconch consists of about 1¼ whorls with a rather small nucleus. The transition to the teleoconch is not very distinct.

The teleoconch comprises about three whorls. The body whorl equals 4/5 of the total shell-height. The base is convex, provided with six spiral bands, which are regularly spaced and separated by narrower spiral grooves. The umbilicus is wide and deep, surrounded by two further, strongly knobbed spirals. The aperture is oval, labrum broken in all specimens.

The spiral ornamentation is somewhat variable, but on most shells seven spirals are present, separated by narrower interspaces. At the intersections between the spirals and the weaker radial ribs rounded knobs are formed, most prominently on the adapical spiral.

Remarks — This species in some features reminds of *S. suturalis* (Philippi, 1843), but differs by details of the spiral sculpture. *S. suturalis* has four spirals and more distinct knobs. From *S. ronaldjansseni*, described above, it differs by having a broader subsutural zone, a stronger spiral sculpture and a wider umbilicus.

? **Cirsotrema** (s. lat.) **nielseni** sp. nov.
Pl. 1, Figs 14a-b, 15.

Locus typicus — Nørre Vissing, clay-pit of Galten Brickworks (text-fig. 1).

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

Derivatio nominis — named in honour of my dear friend Mogens S. Nielsen, non-professional geologist at Odense.

Holotype — Pl. 1, Fig. 14a-b, coll. MGUH 17 613 (leg. M.S. Nielsen).

Description — The shell is rather small (height of the largest specimen 9.6 mm), not thin-walled, but rather fragile, for which reason only two rather complete specimens have been collected.

The shell is high-conical, about 2½ times as high as wide. The height of the aperture equals about ¼ of the total height of the shell.

The shell comprises seven whorls in the largest known specimen. The protoconch is only preserved on one specimen (Pl. 1, Figs 14a-b). It is paucispiral, with two smooth convex whorls, separated by deep sutures. On the last ¼ whorls of the protoconch fine, inverted sigmoid growth-lines are present. The transition to the teleoconch is sharp.

The teleoconch consists of about six whorls, which are convex and separated by deep sutures. The body whorl equals about half the total shell-height. The flat basal disc is demarcated by a spiral on which the radial ribs cause small projections. The aperture is rounded oval. The labrum is thickened, but broken in all specimens, except the holotype.

The spiral sculpture consists of five prominent primary spirals, regularly distributed and separated by almost equally wide grooves. The middle three of them are somewhat stronger than the upper and lower spiral. Three to four weak secondary spirals develop soon between the adapical suture and the upper primary spiral. On the younger whorls fine secondary spirals become visible between the lower primary spirals as well.

The radial sculpture starts suddenly with a slightly opisthocline radial rib. On the first whorls the radial ribs are sharp and orthocline, but on the younger whorls they become slightly prosocline. The ribs are in most cases composed of two lamels, but sometimes old apertures are developed as varices with a higher number of lamels. The number of radial ribs is about 20 on each whorl. The ribs are narrower than their interspaces. At the points of intersection of the radial ribs and the primary spirals small projecting spines are present, most prominently on the adapical spiral. On the basal disc the radial ribs run slightly prosocyrt, concentrating into a thickened margin on the columellar side of the aperture.

Paratypes — Nørre Vissing, clay-pit of Galten Brickworks - 1 specimen (Pl. 1, Fig. 15) (leg. K.I. Schnetler; coll. MGUH 17 614); 2 specimens (leg./coll. ISL); 3 specimens (leg./coll. MNO). Skanderborg (motorway-excavation) - 2 specimens (leg. S.B. Andersen; coll. ISL).

Discussion — The paucispiral, smooth protoconch differs from other *Cirsotrema* species, for which reason I refer the present species with some doubt to this genus. *Cirsotrema* (s. lat.) *crispatum* Harder, 1913 is known from a number of Danish Late Oligocene localities, but only known in one fragment from Nørre Vissing. This species has a higher number of spirals, more angular whorls and very crispy radial ribs. *Cirsotrema insigne* (Philippi, 1843) has a lower number of radial ribs, which are stronger and less sharp.

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

Description — Only a single juvenile specimen is available, consisting of the protoconch and 2¾ whorls of the teleoconch.

The shell is small, highly conical, more than twice as high as its maximum diameter. The height of the aperture is about ¼ of the total shell-height.

The protoconch is highly conical, multispiral and consists of five moderately convex whorls, which are separated by rather shallow sutures. The nucleus is small and slightly depressed, probably a little worn. The last three whorls of the protoconch are provided with a radial sculpture, consisting of about 30 regularly distributed, slightly opisthocline, fine ribs. These riblets become more flexuous on the last whorl of the protoconch. The protoconch is furthermore provided with a very fine granulation. The transition to the teleoconch is sharp.

The teleoconch has convex whorls, which are separated by deep sutures. The body whorl equals about half the total shell-height. The basal disc is distinctly demarcated by a spiral rib, and on the disc only growth-lines are visible. The radial ribs on the whorls are separated from the demarcating spiral rib by a fine furrow. The aperture is obliquely oval. Two former apertures are present as varices on the teleoconch.

The radial sculpture consists of slightly prosocline ribs of almost the same width as their interspaces. The number of these ribs is about 20 on the last whorl.

Remarks — The species shows some resemblance to the Miocene *Cirsotrema (Opaliopsis) turbonillaeformis* A.W. Janssen, 1967, which has, however, a lower number of radial ribs.

Angistoma brueckneri (Beyrich, 1856)
Pl. 2, Fig. 3.

Remarks — This species was found by Harder (1913: 78, pl. 6, figs 9a-b). He stated that his species differs from the descriptions and illustrations in the literature by having only two denticles on the columella. At Nørre Vissing three specimens were found, and they agree very well with Harder's specimen. Ravn (1907: 323, pl. 5, figs 14a-b) described and figured a large specimen from Cilleborg sub nomen *Fusus* aff. *Konincki* Nyst. This specimen has no denticles on its columella. A single further specimen was later collected at Brejning (coll. MNO).

I compared the Danish material with five specimens of *A. brueckneri* from Glimmerode, F.R.G., kindly lent to me by Dr R. Janssen (Frankfurt/Main). The German material (SMF 250 767), consisting of one adult and four juvenile specimens, demonstrates a lower number of spiral bands (9 on the penultimate whorl of the adult specimen) and four denticles on the columella. The specimens from Nørre Vissing and Århus have about 16 spiral bands on the penultimate whorl, while the very large specimen from Cilleborg has 23. According to R. Janssen (1979: 290) the German material has only 6-9 spiral bands on the penultimate whorl. All Danish specimens, except from the Cilleborg and Brejning specimens, have only two denticles on the columella. I refer the Danish material to *A. brueckneri*, allthough the differences described might justify a subspecific distinction.

Coptochetus (s. lat.) **danicus** Schnetler, 1958
Pl. 2, Fig. 2.

Remarks — Since the first description of this species in 1985 six further specimens were collected at Nørre Vissing, and one specimen at Fakkegrav Badehotel (coll. MNO). Mr A.C. Janse, Brielle (pers. comm., 1986) reported two specimens from Rumeln, Lower Rhine area, F.R.G.

The new Danish material agrees very well with the type specimens. A well-preserved specimen with a rather distinct spiral sculpture is illustrated on Pl. 2, Fig. 2. It shows about 11 spiral bands on the penultimate whorl, so the number of spiral bands is constant.

From the Latdorfian of Latdorf and Calbe a/S von Koenen (1889: 205, pl. 20, figs 9a-c, 10a-b) described and illustrated *Fusus recticosta*. I have compared my material of *C. danicus* with 13 specimens of *F. recticosta* from Latdorf (from the von Koenen collection, no. 89), kindly placed at my disposal by Dr S. Ritzkowski (Göttingen). *F. recticosta* has a smaller protoconch with a more pointed nucleus, almost flat whorls, apparently without spiral sculpture and a less slender shape. A single specimen has a larger protoconch. In other features the two species are very similar, and they are evidently very closely related.

PLATE 2

Fig. 1. *Exilioidea elatior* (Bewyrich, 1848); × 10.
Coll. MGUH 17 616.

Fig. 2. *Coptochetus* (s. lat.) *danicus* Schnetler, 1985; × 10.
Coll. MGUH 17 617.

Fig. 3. *Angistoma brueckneri* (Beyrich, 1856); × 1.6.
Coll. MGUH 17 618.

Fig. 4. *Conomitra* sp.; × 7.5
Coll. MGUH 17 619.

Fig. 5. *Metula (Daphnobela) scabricula* (Philippi, 1847); × 2.4.
Coll. MGUH 17 620.

Fig. 6. *Vexillum (Uromitra) hastatum* (Karsten, 1849); × 3.2.
Coll. MGUH 17 621.

Fig. 7-8. *Conomitra soellingensis* (Speyer, 1864); × 6.5.
Coll. MGUH 17 622 and 17 623.

Fig. 9-11. *Conomitra ravni* (Harder, 1913); × 7.5.
Syntypes; coll. Harder Nrs 427, 429 and 428 respectively (coll. DGU).

Fig. 12. *Glibertturricula ariejansseni* sp. nov.; × 4.5.
Holotype; coll. MGUH 17 624 (leg. K.I. Schnetler).

Fig. 13. *Glibertturricula ariejansseni* sp. nov.; × 4.5.
Paratype; coll. MGUH 17 625 (leg. K.I. Schnetler).

Fig. 14. *Pleurotomoides naumanni* (Speyer, 1867); × 5.
Coll. MGUH 17 626.

Fig. 15a-b. *Pleurotomella (Pleurotomella) anderseni* sp. nov.; × 5.
Paratype; coll. MGUH 17 627 (leg. S.B. Andersen).

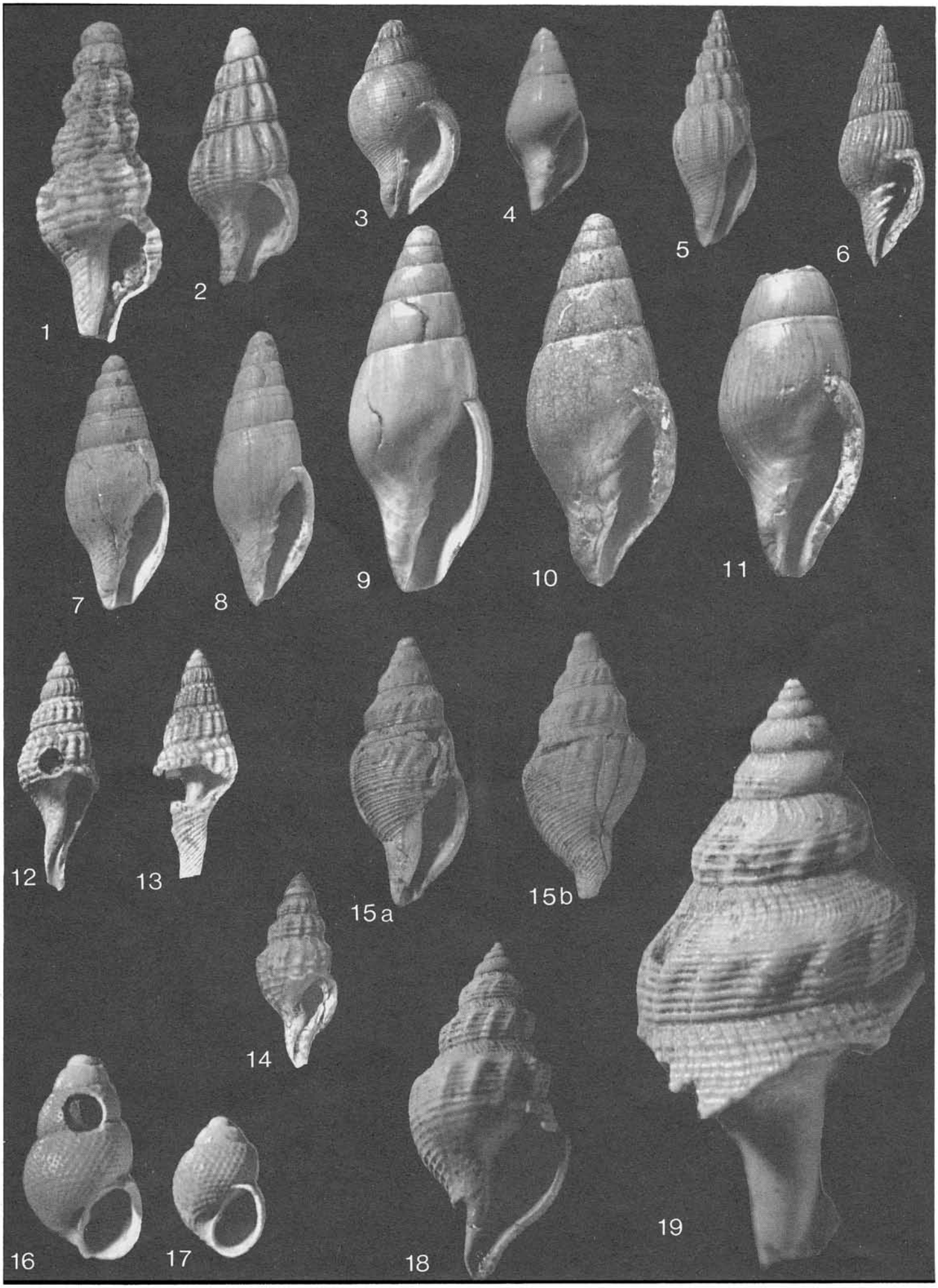
Fig. 16. Pyramidellidae sp. indet.; × 20.
Coll. MGUH 17 628.

Fig. 17. Pyramidellidae sp. indet.; × 20.
Coll. MNO.

Fig. 18. *Pleurotomella (Pleurotomella) anderseni* sp. nov.; × 10.
Holotype; coll. MGUH 17 629 (leg. K.I. Schnetler).

Fig. 19. *Pleurotomella (Pleurotomella) anderseni* sp. nov.; × 20.
Paratype; coll MGUH 17 630 (leg. M.S. Nielsen).

Localities: Fig. 4: Glimmerode/Niederhessen (F.R.G.).
Fig. 9-11: Railway excavation at Århus (Harder, 1913).
Fig. 17: Kirstinebjerg Skov, Trelde Næs (UTM coordinates NG 505 616).
All other Figs.: Nørre Vissing, clay-pit of Galten Brickworks.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Conomitra soellingensis (Speyer, 1864)
Pl. 2, Figs 7-8.

Remarks — This species occurs abundantly at Nørre Vissing, but it is very rare at other Danish localities. Ravn (1909: 334, 336) mentioned a *Mitra* sp. from the localities Åby Mark and Vilssund. These specimens are not well-preserved, but they seem to belong to *C. soellingensis* because of the presence of two subsutural spiral grooves. In material from Sofienlund I found five specimens (coll. MGUH), and at Skanderborg three further specimens were collected (coll. ISL). I compared the Danish material with specimens from Rumeln (SMF 250 811) and Söllingen (SMF 251 677). The German material has more gradated whorls. The spiral sculpture is stronger on the specimens from Söllingen, but rather weak on the specimens from Rumeln (described as *Mitra Rhenana* by Görges, 1941). In my opinion, however, the Danish material should not be distinguished specificly from *C. soellingensis*.

From Århus Harder (1913: 84, pl. 7, figs 2-3) described and illustrated *Mitra Ravni*, which was found in three specimens. I have compared my material of *C. soellingensis* with Harder's syntypes (coll. DGU). Harder illustrated two specimens: nrs 427 (pl. 7, figs 2a-c) and 428 (pl. 7, fig. 3). The third specimen (nr 429) was not illustrated. Nr 427 is very well-preserved, whereas nr 428 lacks the first whorls. Nr 429 has a damaged aperture and is worn. The three specimens undoubtedly belong to one species. They differ from *C. soellingensis* by their almost invisible spiral sculpture. In specimen nr 427 two extremely weak spiral grooves are present below the adapical suture. In shell nr 428 these spiral grooves are more distinct, whereas in nr 429 no spiral grooves are visible. No other spirals are present, not even on the transition of the body whorl to the siphonal canal. Furthermore, in Harder's shells the last whorl is slightly angular at the transition to the base. All specimens from Nørre Vissing have a rather distinct spiral sculpture; at least the adapical spiral grooves are always present, and in several specimens weaker spirals can be observed on the remaining part of the whorl. On the neck of the siphonal canal all specimens have rather distinct spirals.

From Glimmerode (F.R.G.) R. Janssen (1979: pl. 17, fig. 49) illustrated a shell sub nomen *Conomitra ravni*, which in my opinion is not identical with *C. ravni* (Harder, 1913). I compared Harder's syntypes with specimens of the Glimmerode *Conomitra* (SMF 250 795 and material in coll. ISL). The Glimmerode material differs from the genuine *C. ravni* by a more pointed protoconch with a smaller nucleus, no spirals on the whorls, but spirals on the neck of the siphonal canal. The whorls are relatively higher and finally the Glimmerode species is smaller than *C. ravni* from Århus. On Pl. 2 Harder's syntypes (Figs 9-11) and a specimen from Glimmerode (Fig. 4) are illustrated.

Glibertturricula ariejansseni sp. nov.
Pl. 2, Figs 12-13.

? 1866 *Pleurotoma Duchasteli* Nyst var. *granulata* Sp., Speyer, p. 193, pl. 21, figs 1a-b.
1913 *Pleurotoma Duchasteli* Nyst var. *granulata* Speyer - Harder, p. 95, pl. 7, fig. 35.

Locus typicus — Nørre Vissing, clay-pit of Galten Brickworks (text-fig. 1).

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

Derivatio nominis — named in honour of Mr A.W. Janssen, RGM, Leiden, who first discovered the species.

Holotype — Pl. 2, Fig. 12, coll. MGUH 17 624 (leg. K.I. Schnetler).

Description — The full-grown shell is medium-sized (height up to about 22 mm), rather thick-walled and slender fusiform, about three times as high as wide. The height of the aperture equals about half the total shell-height in smaller specimens, but about 2/5 in full-grown shells.

The shell comprises up to 11 whorls, of which five belong to the protoconch. The protoconch is high-conical, with moderately convex whorls. The small nucleus and the first whorl of the protoconch are separated from the remaining larval whorls by a somewhat deeper suture. The first three protoconch whorls are smooth, except for a very fine granulation, which covers the entire protoconch (magnification × 50). Then radial sculpture appears on the fourth whorl as slightly opisthocline thread-like ribs, 14-18 (usually 16) on the last protoconch whorl. These ribs are strongest towards and slightly thickened immediately above the abapical suture. On the last protoconch whorl four broad and weak spiral bands appear gradually.

The transition into the teleoconch is not very distinct, but sometimes growth-lines are prominent and close-set here. On the teleoconch the microsculpture of the protoconch disappears.

The teleoconch consists of up to six whorls, slowly and gradually increasing in diameter. They are almost flat to slightly angular, as the second adapical spiral band projects a little, compared with the first one. The whorls are separated by distinct sutures. The last whorl equals about 2/3 of the total shell-height. The inner lip is well-defined, the labrum is broken in all available specimens. The base of the shell is gradually constricted, but convex at the place of the apertural periphery. The siphonal canal is rather long and almost straight.

The spiral sculpture consists of four primary spiral bands, which are the continuation of the spirals on the protoconch. In almost all shells a weak spiral rib is present immediately above the abapical suture. Secondary spirals develop in between the primary spiral bands, but they usually remain weaker.

The radial sculpture consists of about 16 ribs on the first teleoconch whorl, increasing to 20-24 on the last whorl of adult shells. The flexuous radial ribs are opisthocyrt and rather prominent abapically. At the intersections of the radial and spiral sculpture elements more or less coarse knobs are formed, most prominently on the two adapical spirals, where the radial ribs are disintegrated into two rows of knobs. On larger shells the radial sculpture often becomes weaker in apertural direction. On the base of the shell the radial sculpture tends to disappear.

The growth-lines are well-visible, they have a distinct sinus, lying on the second adapical spiral band, or in the space between the second and third spiral band. They show a stronger opisthocyrt curvature on the abapical part of the whorl than the radial ribs.

Variability — The new species shows a rather wide range of variability. The number of primary spiral bands is four in all shells, except three having five primary spiral bands instead. On many shells the adapical spiral forms a subsutural band. In some shells the adapical and the abapical spiral bands are distinct, with an almost smooth middle part of the whorl. In other specimens the two adapical spirals are strong, whereas the lower two are of the same strength as the accompanying secondary spirals. This is often occurring in spiral band number three, which gives the impression that it is disintegrated into three fine spiral riblets. In most shells, however, the four primary spiral bands are prominent all over the whorls, while the secondary spirals are considerably weaker. The spiral rib overlying the abapical suture is relatively weaker. The number and strength of the radial ribs are variable, and the knobs may be more or less accentuated.

Paratypes — Nørre Vissing, clay-pit of Galten Brickworks - 1 specimen (Pl. 2, Fig. 13) (leg. K.I. Schnetler; coll. MGUH 17 625); 25 specimens (leg./coll. ISL); 2 specimens (leg. K.I. Schnetler; coll. RGM (229 353); 2 specimens (leg. K.I. Schnetler; coll. SMF 306 377); 2 specimens (leg. K.I. Schnetler; coll. WLH); 2 specimens (leg. K.I. Schnetler; coll. AJB); 3 specimens (leg./coll. AJB); 10 specimens (leg./coll. MNO).
Skanderborg (motorway-excavation) - 30 specimens (leg. S.B. Andersen; coll. ISL); 2 specimens (leg. S.B. Andersen; coll. RGM 229 354); 2 specimens (leg. S.B. Andersen; coll. SMF 306 378).
Århus (railway-excavation) - 8 specimens (leg. P. Harder; coll. DGU); 2 specimens (leg. H. Ødum; coll. DGU).
Kirstinebjerg Skov (beach exposure) - 11 specimens (leg./coll. ISL); 1 specimen (leg. K.I. Schnetler; coll. RGM 229 355); 1 specimen (leg. K.I. Schnetler; coll. SMF 306 379); 1 specimen (leg. K.I. Schnetler; coll. AJB); 8 specimens (leg./coll. MNO).
Ølst, clay-pit of "FIBO" - 4 specimens (leg./coll. ISL); 4 specimens (leg./coll. MNO).
Sofienlund (former clay-pit) - 1 specimen (leg. K. Brünnich Nielsen; coll. MGUH).
Ny Skovbo (former clay-pit) - 2 specimens (leg. S.B. Andersen; coll. RGM 227 779); 12 specimens (leg. S.B. Andersen; coll. ISL).
Bøgeskov (coastal cliff) - 1 specimen (leg./coll. MNO).
Krefeld-Linn (water drilling) - 5 specimens (leg. W. Lappann; coll. SMF 306 380); 5 specimens (leg. W. Lappann; coll. RGM 229 356); 78 specimens (leg./coll. WLH); 46 specimens (leg. W. Lappann; coll. ISL).
Krefeld-Gellep (harbour extension) - 9 specimens (leg. F. von der Hocht; coll. RGM 229 357).
Krefeld, Kempener Feld (water drilling) - 1 specimen (leg. F. von der Hocht; coll. RGM 229 358).
Rumeln, mine shaft Diergardt VI - 1 specimen (leg. A.W. Janssen; coll. RGM 229 359); 3 specimens (leg. A. Zilch; coll. SMF 306 381); 11 specimens (leg./coll. AJB).
Erkelenz, K 3 boring for mine shaft Sophia Jacoba - 24 specimens (coll. AJB); 2 specimens (coll. ISL).
Ahnetal - 1 specimen (leg. J. Görges; coll. SMF 251 081).
Ahnetal, Brandkopf - 5 specimens (leg. M. van den Bosch; coll. RGM 229 360).
Zierenberg bei Kassel - 2 specimens (leg. J. Görges; coll. SMF 306 382).
Niederkaufungen - 1 specimen (leg./coll. ISL).
Glimmerode - 1 specimen (leg. M. van den Bosch; coll. RGM 229 361).
Sternberger Gestein - 1 specimen (leg. J. Görges; coll. SMF 306 384).

Remarks — The new species differs from the type species, *G. vervoeneni* Cadée & Janssen, 1985, by several features. On the last whorl of the protoconch 16 radial ribs are present, and only four weak spiral bands, whereas *G. vervoeneni* has about 20 radial ribs and 7 spiral bands. In all other features the protoconchs of the two species are similar. On the teleoconch whorls of the new species no carina is present, and consequently a concave adapical part is absent. The number of spiral bands on the new species is not as high as in *G. vervoeneni* (4-5 primary spiral bands in *G. ariejansseni* and 7-8 in *G. vervoeneni*).

G. vervoeneni was confused with *Fusiturris selysii*, and according to literature it seems that *G. ariejansseni* similarly has been confused with *Fusiturris duchastelii*. Harder (1813: 95, pl. 7, fig. 35) mentioned and figured the new species sub nomen *Pleurotoma Duchasteli* var. *granulata* Speyer and he mentioned 5 further specimens of this form. In his material of *Fusiturris duchastelii* (coll. DGU). I found 8 specimens of *G. ariejansseni*, including the figured specimen. I found further 2 specimens in coll. DGU (leg. H. Ødum).

Speyer (1866: 193, pl. 21, figs 1a-b) described and illustrated a form of *Fusiturris duchastelii,* characterised by flat whorls, a low number of spirals, and spirals and radial ribs of almost the same strength, thus resembling strongly *G. ariejansseni*. The identity can, however, only be secured by a direct comparison of Speyer's specimen (most probably housed in the Zentrales Geologisches Institut, East Berlin).

Glibertturricula ariejansseni and *Fusiturris duchastelii* at first glance resemble each other closely in general shape and sculpture, and considering the wide range of variability of *F. duchastelii* it is no wonder that the two species were confused. The new species, however, differs from *F. duchastelii* by a number of features: the protoconch is microgranulated, the spiral sculpture is generally coarser, the sinus of the growth lines is placed adapically of the middle of the whorl, the aperture is relatively longer, and finally, the new species generally is smaller than *F. duchastelii*.

Glibertturricula ariejansseni has a wide geographical distribution in the Danish and NW German parts of the North Sea Basin. In Denmark the species is known exclusively from localities, assigned to Chattian B, whereas it is known from several German localities, assigned to Chattian A (and from the Chattian B locality Krefeld-Gellep).

Pleurotomoides naumanni (Speyer, 1867)
Pl. 2, Fig. 14.

Remarks — The Danish specimens differ from German specimens by their larger and relatively wider protoconch. Most specimens have one spiral more on the abapical part of the whorl than the German material. One specimen, however, from Krefeld-Linn (coll. WLH) has a protoconch similar to the Danish specimens.

Pleurotomella (Pleurotomella) anderseni sp. nov.
Pl. 2, Figs 15a-b, 18-19

Locus typicus — Nørre Vissing, clay-pit of Galten Brickworks (text-fig. 1)

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

Derivatio nominis — named in honour of curator Søren Bo Andersen, Geological Institute, University of Aarhus.

Holotype — Pl. 2, Fig. 18, coll. MGUH 17 629 (leg. K.I. Schnetler).

Description — The shell is rather small (height up to 10 mm), rather thin-shelled, for which reason only two specimens with the body whorl preserved have been collected.

The shell is subfusiform, about 2.7 times as high as wide. The height of the aperture is almost half the total shell-height, and the body whorl equals 2/3 of the total shell-height.

The largest specimen known (Pl. 2, Figs 15a-b) consists of 8 whorls, of which 4¼ belong to the protoconch, which is conical with convex whorls, separated by deep sutures. The nucleus is small, slightly heterostrophic and it has an extremely fine microgranulation, arranged in 5 spirals. This sculpture can only be observed on well-preserved specimens, at magnification × 50. The following protoconch whorls are provided with a cancellate ornamentation on the abapical half of the whorl,

whereas the adapical half has only collobral, thread-like riblets. Immediately before the transition to the teleoconch the diagonal ornamentation fades away, and very close-set, inverted sigmoid radial ribs are developed instead. At the same time a fine granulation appears (magnification × 50) in between the sculpture elements.

The teleoconch consists of up to 3¾ angular whorls, with a flat to concave upper part and a convex lower part. The whorls are separated by deep sutures. The base of the shells is convex and regularly constricted. The aperture is rather wide, rounded oval, gradually narrowing below to form the siphonal canal, which is slightly turned to the right. The labrum is broken in all available specimens. The columella is smooth, with a rather well-defined inner lip, showing traces of resorption of calcareous matter. The callus is rather thin. The holotype shows an apertural damage repair.

On the first teleoconch whorl a spiral sculpture of 4-5 spirals is present above the abapical suture, and a not very accentuated carina developes. After about ¼ volutions the spirals are restricted to the abapical half of the whorl. From here secondary spirals develop in between the primary ones, covering the shell to the end of the siphonal canal. On the subsutural zone initially no spirals are present, but from the second whorl onwards several generations of weak spirals develop here.

The radial sculpture is only present on the abapical, convex part of the whorls. It consists of 16-18 weak, opisthocline ribs. On the body whorl and the base the radial sculpture disappears. Numerous growth-lines are visible, with the rather shallow sinus lying in the subsutural zone. On the convex part of the whorls they run opisthocline, touching the lower suture at an angle of about 75°.

Variability — The radial ribs are rather variable in strength.

Paratypes — Nørre Vissing, clay-pit of Galten Brickworks - 1 specimen (Pl. 2, Figs 15a-b) (leg. S.B. Andersen; coll. MGUH 17 627) 1 specimen (Pl. 2, Fig. 19) (leg. M.S. Nielsen; coll. MGUH 17 630); 4 specimens (leg./coll. ISL); 1 specimen (leg. S.B. Andersen; coll. ISL); 2 specimens (leg./coll. MNO).

Discussion — The present species does not seem to be closely related to any other *Pleurotomella* species, known from Late Oligocene and Miocene deposits in the North Sea Basin. From the Early Miocene Klintinghoved Clay Sorgenfrei (1940: 56, pl. 6, fig. 18) described and illustrated a similar form sub nomen *Daphnella Roemeri* (Philippi, 1943). He stated that the protoconch was provided with a diagonal ornamentation. I have compared my material of *Pleurotomella anderseni* with two specimens of the Klintinghoved form, kindly placed at my disposal by Mr F. Weinbrecht, Glücksburg, F.R.G. The material from Klintinghoved (one protoconch and one juvenile shell) shows some differences: the protoconch has less convex whorls, the spiral sculpture is weaker, the radial ribs are more orthocline and the granulation of the teleoconch is very weak. In other features the Klintinghoved form and *P. anderseni* are rather similar, and they seem to be closely related. The Klintinghoved form is certainly not identical with *Amblyacrum roemeri* (Philippi, 1843), which has a mangelioid protoconch.

Pyramidellidae sp. indet.
Pl. 2, Figs 16-17

Description — The shell is very small (height of the largest known specimen 1.8 mm) and rather thick-walled, ovoid-conical. The height of the aperture equals about 1/3 of the total shell-height.

The shell of the largest specimen consists of about 4½ whorls. The protoconch is heterostrophic,

with only the terminal 1½ whorls visible, rising only slightly above the teleoconch. On both available specimens the transition to the teleoconch is worn.

The teleoconch consists of up to three whorls, which are moderately convex and separated by deep, canaliculate sutures, caused by a slightly concave subsutural ramp. The body whorl equals about 2/3 of the total shell-height. The base is convex, and the aperture is oval, the labrum sharp-edged and regularly passing into the innerlip, which is procured with a projecting edge. This edge is separated from the base by a narrow umbilicus. The concave columella has a distinct, oblique fold.

The spiral sculpture consists of 10-11 flat, broad spiral bands, of which the upper one demarcates the subsutural ramp. The other spiral bands have approximately the same strength; they are separated by narrower furrows. On the subsutural ramp furthermore four very fine spirals are visible. The spiral sculpture continues unchanged on the base of the shell.

The radial sculpture consists of numerous opisthocline, flat riblets, somewhat weaker than the spiral bands, and equally continuing on the base. Both available shells show former apertural margins, and the radial ribs before these margins run almost in the same direction as the growth-lines. The combination of the spiral and axial sculpture results in a pattern of almost punctate appearence, with elliptical to almost circular depressions, having their largest diameter in the direction of the spirals.

The growth-lines are almosat invisible; the former apertural margins are anticipated by more distinct and close-set growth-lines. The incremental lines run almost orthocline between upper and lower suture, with only a very flat sinus, with its hindmost part lying on the second adapical spiral. On the base of the shell the growth-lines are directed towards the umbilicus.

Material — Nørre Vissing, clay-pit of Galten Brickworks - 1 specimen (Pl. 2, Fig. 17) (leg. K.I. Schnetler; coll. MGUH 17 628).
Kirstinebjerg Skov (beach exposure) - 1 specimen (leg./coll. MNO).

Remarks — There seems to be no suitable genus for this species. It reminds more or less of *Menestho*, or *Evalea*, but its peculiar sculpture is rather unique. For the time being, with only two specimens at hand, I prefer to record this form in open nomenclature. I thank Mr A.W. Janssen for valuable discussions on this subject.

COMPARISON WITH DANISH LATE OLIGOCENE FAUNAS (author: Schnetler)

In Denmark only few Late Oligocene faunas have been studied. Harder (1913) identified 87 species from Århus, 71 of which are equally known from Nørre Vissing. When compared to the Århus fauna the total absence of *Vaginella tenuistriata* Semper, 1861 and the low frequency of *Dentalium polypleurum* in the fauna from Nørre Vissing is very conspicuous. Other species, found at Århus, but absent at Nørre Vissing, are e.g. *Palliolum* (s. lat.) *limatum ambigum* (Anderson, 1958), *Goodallia laevigata* (Speyer, 1866), *Emarginula punctulata* Philippi, 1843, *Hinia schlotheimi* (Beyrich, 1854), *Conomitra ravni* and *Microdrillia bicingulata* (Sandberger, 1860).

On the other hand, species like *Propeamussium pygmaeum*, *Solariella* spp., *Cerithiella bitorquata, Conomitra soellingensis* and *Pleurotomoides naumanni* are not found at Århus. The species *Exilioidea elatior, Stenodrillia obeliscus* and *Astarte pygmaea* are distinctly more frequent at Nørre Vissing. The fauna from Århus was by Anderson (1961) considered to be of Chattian B age on the basis of the pectinids.

Ravn (1907) recorded Late Oligocene faunas, of which the most important one is the fauna from Cilleborg. From this locality he recorded 48 species, of which 37 occur also at Nørre Vissing. The following species, mentioned from Cilleborg, are not yet recorded from Nørre Vissing: *Pecten (Hilberia) soellingensis* Koenen, 1868, *Pecten (Hilberia) bifidus bifidus* von Münster, 1835, *Stenomphalus koeneni* (Görges, 1952), *Hinia schlotheimi, Asthenotoma obliquinodosa* (Sandberger, 1860), *Cordieria* sp. and *Inquisitor holzapfeli* (von Koenen, 1890). Anderson (1961), on the basis of the pectinids, assigned the Cilleborg fauna to Chattian A.

Ravn (1909) recorded smaller Late Oligocene faunas from Vilssund and Åby Mark, Andersen (1938) from Ås, and Madsen (1918) from Ny Skovbo. None of these differs much from the Nørre Vissing fauna.

Eriksen (1937) described a fauna from Brejning, including only one species not known from Nørre Vissing, viz. *Emarginula* sp. In the meantime more species are known from Brejning, among which the following have not been found at Nørre Vissing: *Inquisitor holzapfeli, Asthenotoma obliquinodosa* and *Cirsope ovulum* (Philippi, 1843).

COMPARISON WITH GERMAN LATE OLIGOCENE FAUNAS (author: Schnetler)

The molluscan faunas from a large number of German localities are published extensively by R. Janssen (1978b, 1979a, 1979b). *Drepanocheilus speciosus* does not seem to be a very common species at any German locality, but at Nørre Vissing (and various other Danish localities) this gastropod is dominant.

According to R. Janssen (1978a) the molluscan faunas of Glimmerode and Söllingen indicate near-shore or littoral environments, suggested by frequent occurrence of *Emarginula* species, rissoids and Amphineura. At Doberg also the large number of *Emarginula*'s suggest similar consitions. Such elements are very rare in the Nørre Vissing fauna, which seems to have more affinities with the faunas from the Lower Rhine area, Freden and the Sternberger Gestein.

The bivalve *Limopsis aurita* is very common at Nørre Vissing (and various other Danish localities), but seems to occur in a restricted number of German localities only (Freden, Wiepke, Volpriehausen, Krefeld, Rumeln and Sternberger Gestein).

PALAEOECOLOGICAL INTERPRETATIONS (authors: Schnetler & Beyer)

Unit 1 (the Søvind Marl): According to Heilmann-Clausen et al. (1985) the depositional environment was a rather deep shelf.

Unit 2 (the Brejning Clay): the depositional environment is interpreted as a marine, lower sublitoral situation. The abundant phosphorites and glauconite probably indicate an original high concentration of organic material in the sediment and a low rate of sedimentation.

The molluscan fauna, collected in unit 2 at Nørre Vissing seems to be rather close to the original biocoenosis. Nearly all species are found in adult specimens, and the number of juvenile specimens is rather low. Many species of bivalves are found as double-valved specimens, which indicates low current velocities and hardly any transport. Taxodont bivalves are very common, especially endoben-

thonic genera like *Nucula, Yoldia* and *Nuculana*, but also the epibenthonic genus *Limopsis*, whereas *Glycymeris* is less frequent. Other rather frequent endobenthonic genera are *Cyclocardia, Abra* and *Panopea*.

Among the gastropods many endobenthonic species are frequent. Very common species are *Drepanocheilus speciosus, Polinices helicinus, Fusiturris duchasteli*, and several other representatives of Turridae. As stated above, hardly any element in the gastropod fauna suggests littoral conditions. Rissoids are very rare, except *Alvania semperi*, and no *Emarginula* or other limpets have been found. The mollusc fauna as a whole suggests euhaline, open marine, most probably lower sublittoral conditions, with a water depth of about 70 to 100 m.

Unit 3: The environment was a relatively calm, near-shore basin with restricted circulation, possibly a lagoon. In high energy situations sand was transported from the West.

Unit 4: The sediment was probably deposited in tidal channels.

Units 3 and 4 have been deposited in an environment of a prograding coast.

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