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The Selandian (Paleocene) mollusc fauna from Copenhagen, Denmark: the Poul Harder 1920 collection

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Part of the map sheet 'København' (M 3130), 1:20 000, enlarged × 1.3. Copyright: Kort & Matrikelstyrelsen. Inset: Dr Poul Harder (photograph in the files of the Geological Survey of Denmark and Greenland) and three of the new gastropod species established in this bulletin. Design: Erik Morsing, Århus.

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Abstract

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A detailed study has been made of the molluscan fauna in the material collected by Poul Harder in 1920 from the classical Danish early Selandian (Late Paleocene) locality in the Lellinge Greensand at Sundkrogen (the harbour of Copenhagen). A description is also given of the now submerged locality.

The Harder collection, which has remained virtually unstudied for more than 75 years, is discussed in the interesting historical context that it was not included in the monograph on the Paleocene of Copenhagen by J.P.J. Ravn in 1939. Ravn's study was based on material collected the same year from Sundkrogen by A. Rosenkrantz, and on material collected in the thirties from other localities in the Copenhagen area. Some material collected by A. Rosenkrantz and others, but not dealt with by J.P.J. Ravn, is also included in the present study. The long-lasting controversy about publication rights relating to the Sundkrogen material is recalled.

Twenty-seven new species are introduced, viz. *Portlandia (Yoldiella) nielseni* n. sp., *Plicatula selandica* n. sp., *Laternula (Laternulina) ravni* n. sp., *Dentalium (Dentalium) sundkrogensis* n. sp., *Solariella (Solariella) ravni* n. sp., *Solariella (Solariella) hauniensis* n. sp., *Teinostoma (Teinostoma) ledoni* n. sp., *Entomope kirstineae* n. sp., *Harrisianella subglabra* n. sp., *Bittium (Bittium) oedumi* n. sp., *Cerithiopsidella (Vatopsis) rasmusseni* n. sp., *Seila (Notoseila) heilmannclauseni* n. sp., *Seila (Notoseila) anderseni* n. sp., *Thereitis weinbrechti* n. sp., *Cirsotrema (Cirsotrema) hauniensis* n. sp., *Opalia (Pliciscala) thomseni* n. sp., *Charonia (Sassia) danica* n. sp., *Siphonalia ariejansseni* n. sp., *Astyris (Astyris) lappanni* n. sp., *Streptolathyrus danicus* n. sp., *Streptolathyrus lemchei* n. sp., *Cancellaria (sensu lato) jakobseni* n. sp., *Pseudocochlespira rosenkrantzi* gen. et sp. n., *Actaeopyramis marcusseni* n. sp., *Chrysallida (Parthenina) peterseni* n. sp., *Syrnola (Syrnola) granti* n. sp. and *Cingulina harderi* n. sp. Within the Turridae, *Pseudocochlespira* n. gen. is established.

A total of 182 taxons are listed. Of these, 36 are new for the Lellinge Greensand, and 60 have not previously been recorded from Sundkrogen. The study demonstrates that several genera have their first occurrence datum in the Selandian. The Selandian mollusc fauna from Sundkrogen and elsewhere in the Copenhagen area has no equivalent in the North Sea Basin, but faunas from boulders of Selandian age from the south-eastern part of Denmark and the southern part of Sweden demonstrate affinities with the Sundkrogen fauna, whereas the fauna from the Kerteminde Marl demonstrates a lesser degree of affinity.

The palaeoenvironment is interpreted as a transgression of the Selandian Sea with erosion of the underlying Danian sediments. The near-shore environment was followed by gradually increasing water depth, resulting in deposits of fine-grained sand and finally dark clay. The dark clay was probably deposited in a deep inlet from the eastern margin of the Selandian Sea.

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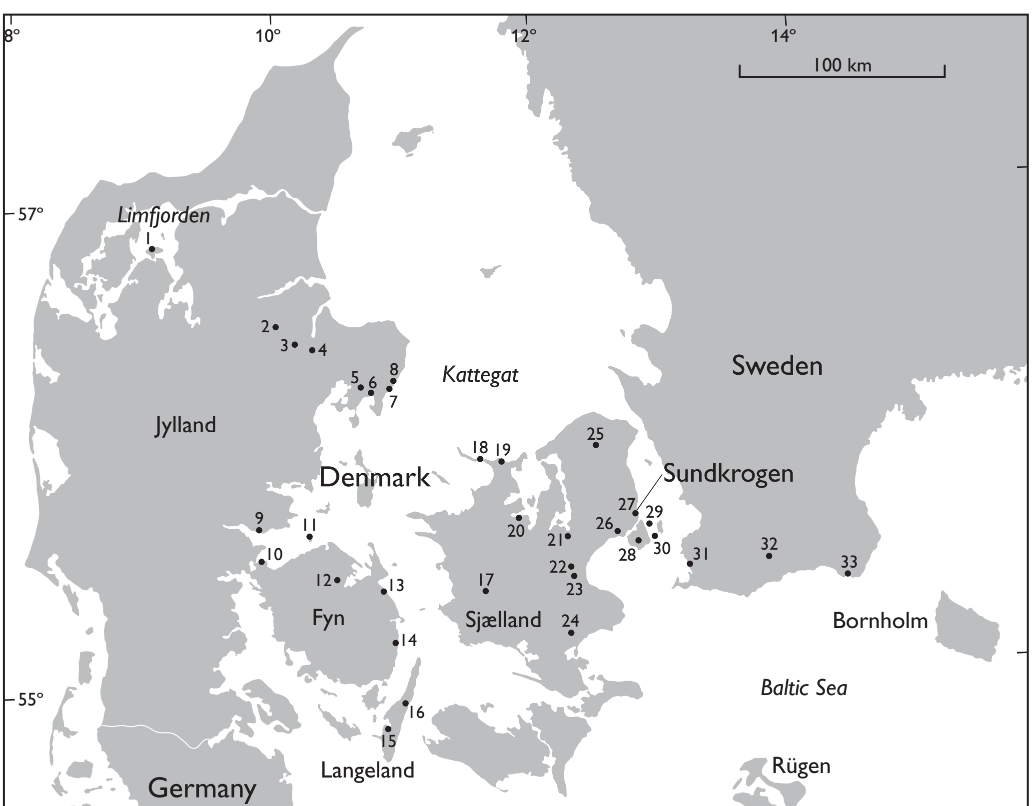
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Bornholm
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Baltic Sea
55°
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Langeland
Rügen
Germany

Introduction

The Paleocene is currently subdivided into three international stages: Danian, Selandian and Thanetian (Schmitz 1994). The Selandian Stage gained status as the international standard for the early part of the Late Paleocene Series in 1989 (Jenkins & Luterbacher 1992). It was initially proposed by Rosenkrantz (1924) to accommodate the interval from above the Danian limestone and to the base of ash-bearing strata (Mo Clay) which characterises the upper part of Holmehus, Fur and Ølst Formations. The historical stratotype area of the regional Selandian Stage is situated in eastern Denmark, with classical localities in the Copenhagen area and at the village of Lellinge (Fig. 1; Rosenkrantz 1924). Due to the absence of permanent exposures in the Copenhagen area local stratigraphic knowledge of the Selandian and Danian has been obtained primarily from shallow wells and excavations, such as harbour basins north and south of the city of Copenhagen, and from temporary road-cuts (Gry 1935; Stenestad 1976).

Rich mollusc-bearing strata of the early Selandian were recovered in the late 19th century and in the beginning of the 20th century in excavations around Copenhagen. The main localities were Vestre Gasværk and Sundkrogen; the latter is located in the now water-filled basin in the harbour north of the city (Fig. 1). The fauna from Vestre Gasværk was studied by von Koenen (1885). Part of the fauna from Sundkrogen was studied by Rosenkrantz (1920b) and Ravn (1939), and these studies paid very little attention to the material collected by Poul Harder in 1920. The Harder material was treated in a preliminary way (Harder 1922) but never investigated in detail. It is evident that Harder never allowed his collection to be studied together with other material from the Sundkrogen locality sampled the same year by Rosenkrantz (1920b). This decision was respected by Ravn (1939), who published his monograph on the basis of Rosenkrantz's collection, which included material from Sundkrogen. A bitter controversy between Harder and Rosenkrantz concerning the right to publish results from the Sundkrogen locality was the explanation for Ravn's decision. Franke (1927) published a paper on the foraminifers and ostracods from Sundkrogen and Rugård (Fig. 1), but he obviously did not study Harder's collection. The background of this controversy and its consequences for the collection are briefly outlined in this bulletin.

The main part of the material studied here – the Poul Harder 1920 collection – is part of the collections of the Geological Survey of Denmark and Greenland. With this study I wish to give this valuable collection the scientific focus it deserves, particularly in the light of the new international interest in the Selandian type area (Berggren 1994). Furthermore, I wish to bring the nearly eighty years old controversy to an amenable end.

The material has been compared with the previously published studies of Copenhagen Selandian mollusc faunas, and the study has led to the recognition of many new species. This study has also provided an opportunity to interpret the palaeoecology of the lower Selandian molluscs.

Fig. 1. Maps of north-western Europe and Denmark / southern Sweden showing localities mentioned. **Denmark**, **1**: Stolleklint; **2**: Svejstrup; **3**: Ølst; **4**: Hvalløse; **5**: Basballe; **6**: Egsmark; **7**: Holme; **8**: Rugård; **9**: Albækhoved; **10**: Røjle Klint (Holmehus); **11**: Æbelø; **12**: Gundstrup; **13**: Lundsgårds Klint; **14**: Klintholm; **15**: Kokkestræde; **16**: Longelse Sønderskov; **17**: Slagelse; **18**: Sjællands Odde; **19**: Klintebjerg; **20**: Holbæk; **21**: Roskilde; **22**: Havdrup; **23**: Lellinge; **24**: Fakse; **25**: Mårum; **26**: Vestre Gasværk; **27**: Sundkrogen; **28**: Gemmas Allé; **29**: Prøvesten; **30**: Kongedyb I and II. **Sweden**, **31**: Klagshamn; **32**: Svedala; **33**: Ystad. **Germany**, **34**: Pennigsehl; **35**: Saltzstock; **36**: Sophia Jacoba 6 and 8. **Belgium**, **37**: Mons. **Austria**, **38**: Haunsberg.

Geological setting

The Copenhagen area is situated south-west of the southern part of the Fennoscandian Border Zone (Liboriussen *et al*. 1987), also known as the Sorgenfrei–Tornquist Zone (Håkansson & Petersen 1992; Thomsen 1995). The main geological structures in Denmark and southernmost Sweden are shown in Fig. 2.

The Sorgenfrei–Tornquist Zone was inverted during the late Danian and early Paleocene causing uplift and erosion of the Danian and especially Cretaceous strata in the Border Zone and deposition in the Danish Basin during the Selandian Stage with a depocentre in Sjælland (Thomsen 1995).

Thomsen (1995) subdivided the Danian Stage in Denmark into nine nannoplanktonic zones and four sequence stratigraphic units. The uppermost of these sequences (Sequence 4) consists of chalk-sand limestone and is found in north Jylland, north Sjælland and the Copenhagen area. Sequence 4 is generally transgressive but near the Fennoscandian Border Zone it becomes regressive because of the inversion of the southern part of the Border Zone. In the Copenhagen area nannoplanktonic zones 7 and 8 are present corresponding to a NP4 age (Thomsen 1995). There is therefore a hiatus between the Danian and the Selandian deposits in the Copenhagen area in contrast to the central part of the Danish Basin where the Danian sequence is more complete.

During the Neogene an uplift took place of the Skagerrak–Kattegat Platform, the Sorgenfrei–Tornquist Zone, the Danish Basin and parts of the Ringkøbing–Fyn High (Japsen 1991, 1993; Jensen & Michelsen 1991; Jensen & Schmidt 1992). This caused the sediments in the northern Øresund region to be eroded by at least 1000 m (Thomsen 1980). Jensen & Michelsen (1991) estimate the uplift immediately south of the Fennoscandian Border Zone to be 800–1000 m.

The deposition of the Lellinge Greensand is associated with a sudden change from biogenic limestone to mainly siliciclastic deposits: Danian carbonates overlain by Selandian clastics reflect a major change in the geotectonic evolution of the NE Atlantic that caused palaeogeographical changes in late Danian time

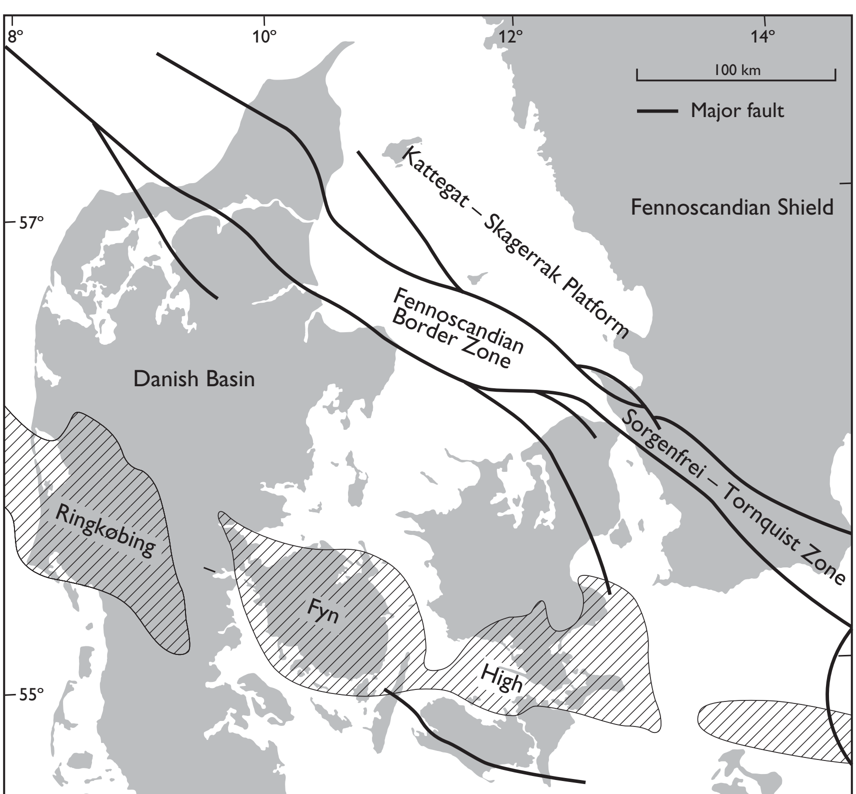

Fig. 2. Map of Denmark and southern Sweden showing the main structural units.

(Ziegler 1990). As a result of this the North Sea was separated from the Tethys Ocean and from the Atlantic Ocean. The North Sea was connected only to a cool epicontinental sea between Norway and Greenland, which was in turn connected to arctic seas to the north.

Regional Selandian stratigraphy

The clastic to fine-clastic deposits of the regional Selandian Stage are grouped into the Lellinge Greensand (Johnstrup 1876; Gry 1935; Stenestad 1976), the Kerteminde Marl (Dinesen *et al.* 1977), the Æbelø Formation (Bøggild 1918; Heilmann-Clausen 1995) and the Holmehus Formation (*pars*) (Heilmann-Clausen *et al.* 1985; Heilmann-Clausen 1995). The Selandian sediments overlie the Danian Limestone Group (*sensu* Sorgenfrei 1957) or Danian Limestone (*sensu* Michelsen *et al.* 1994) with a regional unconformity and are in turn overlain conformably by the late Paleocene (i.e. late Selandian – Thanetian) Holmehus Formation (*pars*) (Michelsen *et al.* 1996).

Lellinge Greensand

The Lellinge Greensand, the basal unit of the Selandian Stage, has its type locality at Skovhus Vænge near Lellinge (Fig. 1; Johnstrup 1876; Gry 1935; Sorgenfrei 1957; Stenestad 1976; Dinesen *et al.* 1977). The transgressive Lellinge Greensand overlies the Danian København Limestone (Stenestad 1976) of the Danian Limestone Group (*sensu* Sorgenfrei 1957) along a regional unconformity (Gry 1935; Stenestad 1976). A basal conglomerate containing abundant reworked Danian fossils was referred to as 'Ekinodermkonglomerat' (Grönwall 1904) and 'Øvre Crania Kalk' (Upper Crania Limestone) by Rosenkrantz (1920a). At all places where it is observed, the upper boundary of the Lellinge Greensand is diachronous and conformable. To the west of Sjælland, the sediments of the Lellinge Greensand grade laterally into the contemporaneous deposits of the Kerteminde Marl and are conformably overlain by the younger part of that formation.

The greensand deposits from the Copenhagen area were described by Rosenkrantz (1920a, 1920b, 1924, 1930), Gry (1935) and Stenestad (1976). The latter considered the eastern and central part of Sjælland including Copenhagen as the type area for these deposits. Specifically, the 5.95 to 10.17 m below sea level interval in the 1930 excavation at Vestre Gasværk (Fig. 1; Rosenkrantz 1930) was selected by Stenestad (1976) as the reference section.

The sediments of the Lellinge Greensand are rich in glauconite and have been referred to as calcareous greensand, fine greensand, clayey greensand and glauconitic marl (Gry 1935). Where locally cemented by calcite the sediments are known as greensand limestone, and where cemented subordinately by chert as flinty greensandstone or flinty greensand limestone (Gry 1935).

A distinctive facies within the formation, referred to as dark or intermediate marl by Gry (1935), consists of fossiliferous black clay with framboidal pyrite; foraminifers and nannoplankton make up the calcareous content of the matrix. This marl is known from localities at Lellinge (Gry 1935), in the Copenhagen area (Ravn 1939) and from a borehole at Mårum (Fig. 1; Gry 1935). The dark clay, although thin in the recently exposed sequence at Gemmas Allé on the island of Amager (Fig. 1; S.L. Jakobsen and M.S. Nielsen, personal communication 1994), may obtain a maximum thickness of *c.* 2.5 m. Dinesen *et al.* (1977) suggested that the dark clay should be considered a separate formation.

The Lellinge Greensand was encountered in many boreholes on Sjælland (Fig. 1; Gry 1935; Andersen 1944; Dinesen *et al.* 1977) where the thickness varies from about 30 m at Roskilde and Holbæk (Fig. 1; Andersen 1944) to about 10 m at Havdrup (Fig. 1; Sorgenfrei & Larsen 1972). On Sjællands Odde to the north-west only about 1 m of greensand was found (Fig. 1; Gry 1935). The maximum thickness in the Copenhagen area is more than 6 m but its original thickness cannot be determined accurately because the upper boundaries of all known occurrences are eroded (Gry 1935; Stenestad 1976).

Kerteminde Marl

The Kerteminde Marl was investigated first by Johnstrup in 1886 (see Ussing 1899, p. 119, 1904, p. 334). Ussing (1899) introduced the formation under the name 'Kerteminde Clay', but later (Ussing 1904) emended the name to Kerteminde Marl. Gry (1935) described this formation from a large number of localities in Jylland, on Fyn and on Sjælland. Lundsgårds Klint, south of Kerteminde on Fyn, is used as the type locality (Heilmann-Clausen 1995, p. 78; Fig. 1). Furthermore, the formation has been found in several borings (Gry 1935; Andersen 1944; Thomsen 1995).

The typical rock type is a monotonous, light grey silty marl, sometimes with slightly silicified layers. The marl contains pyrite and has been homogenised by strong bioturbation (Heilmann-Clausen 1995). At localities in Jylland (Hvalløse, Svejstrup), on Fyn (Klintholm) and on Sjælland (Fig. 1) sandy, glauconitic layers occur, forming the basal conglomerate with reworked Danian fossils, for which reason these layers have been compared to the basal part of the Lellinge Greensand (Ødum 1926; Rasmussen 1967; Heilmann-Clausen 1995). Layers of a dark marl have been encountered at the localities at Holme (Fig. 1; Gry 1935), Basballe and Egsmark (Fig. 1; Dinesen *et al.* 1977) and these layers have been compared to the dark clay from the Copenhagen area (Rasmussen 1967; Dinesen *et al.* 1977). Gry (1935), however, in his description of the sequence at Holme states that the dark marl has a high pyrite content but contains only few fossils. It is thus considered by the present author as dissimilar to the dark marl from the Selandian deposits in the Copenhagen area.

The Kerteminde Marl has a chalk content of about 50%, consisting mainly of reworked nannofossils, presumably derived from Cretaceous deposits on the Fennoscandian Shield and in the Fennoscandian Border Zone because of the inversion during the late Danian to the early Selandian time (Heilmann-Clausen 1995; Thomsen 1995).

Æbelø Formation

The succession of clay deposits at Østerhoved Spids on the island of Æbelø (Fig. 1) was described by Bøggild (1918), who referred the strata to the 'Æbeløformationen'. Dinesen *et al.* (1977) and Heilmann-Clausen (1985) in providing additional description of the sediments, referred them to an unnamed unit. Later, the Æbelø Formation is used consistently in a formal sense and Østerhoved Spids on Æbelø is referred to as the type locality (e.g. Heilmann-Clausen 1995; Michelsen *et al.* 1996).

The sediments of the Æbelø Formation are noncalcareous to medium calcareous clays and have a darker colour than the sediments of the Kerteminde Marl. The formation contains numerous silicified and hardened calcitic horizons giving the sediments of the Æbelø Formation a superficial resemblance to the Ølst Formation (see Heilmann-Clausen *et al.* 1985); this feature led Bøggild (1918) to interpret the layers on Æbelø as a special facies of the ash-bearing series known from the Limfjorden area (Fig. 1).

Holmehus Formation

The formation is described by Heilmann-Clausen *et al.* (1985) with the type locality on the Røjle peninsula (i.e. Røjle Klint of Fig. 1). Previously, Dinesen *et al.* (1977) described the unit as 'Holmehus Clay'.

The clay is non-calcareous, greenish, brownish or dark reddish and very fine grained. It contains lenticular sideritic or phosphatic concretions. The bedding is indistinct, and burrows of the *Zoophycos* type are present. A single bioturbated, volcanic ash layer is present. The main localities with exposures in the Holmehus Formation are Albækhoved, Æbelø, Ølst and Stolle Klint (Fig. 1).

Age of the Selandian formations

The youngest Danian strata in the Copenhagen area are nannoplankton zones 7 and 8 *sensu* Thomsen (1995), and a hiatus of unknown extent is developed. The Danian–Selandian transition is more complete or perhaps more conformable in central Denmark where nine zones are developed (Thomsen 1995).

Hansen (1968) correlated the foraminifer fauna from the Lellinge Greensand with Zone P3 in the international zonation of planktonic foraminifers. Heilmann-Clausen (1994) referred the earliest Selandian Stage to the *Cerodinium speciosum* dinoflagellate Zone in the biozonation scheme established by Powell (1992) for the North Sea. This zone corresponds to the transition from the calcareous nannoplankton zone NP4 to NP5 (Heilmann-Clausen 1994, 1995). The base of the Lellinge Greensand is placed within the Chronozone C26r (Berggren 1994) and corresponds then with the TA1–TA2 onlap cycle of Haq *et al.* (1988). E. Thomsen (personal communication 1997) investigated calcareous nannofossils in six samples from Sundkrogen and correlated the section at Sundkrogen with the uppermost part of the Lellinge Greensand at Lellinge. He found a somewhat similar flora in the Havdrup borehole 6–7 m above the base of the Selandian. The ages of the Lellinge Greensand and the lower Kerteminde Marl appear to be the same (Thomsen 1995) with the latter being contained within the *Cerodinium speciosum* dinoflagellate Zone. Hence the younger part of the Kerteminde Marl is not much younger than the Lellinge Greensand. Thomsen (1994) noted that a short interval in the Kerteminde Marl is characterised by reworked upper Cretaceous nannofossils in abundance; this is useful for local correlation.

The overlying Æbelø Formation is correlated with the *P. pyrophorum* dinoflagellate Zone of Powell (1992) (= Viborg Zone 3 *sensu* Heilmann-Clausen 1985). The dinocyst species *Alisocysta margarita* is characteristic of the unit. The Æbelø Formation is thus constrained to NP5 calcareous nannoplankton Zone and corresponds to Zone P3 of the international planktonic foraminifera zonation.

The Holmehus Formation is included in the *P. pyrophorum* and *A. margarita* dinoflagellate Zones (= Viborg Zones 3 and 4 *sensu* Heilmann-Clausen 1985). The latter is defined by the first appearance of *Deflandrea denticulata* and corresponds with NP6–NP8 calcareous nannoplankton Zones and approximately with foraminifera Zone P4. The Holmehus Formation corresponds largely to Thanetian Substage of the Paleocene Series (Heilmann-Clausen 1994, 1995).

Historical background and previous work

In August 1920, the Mineralogical Museum (now Geologisk Museum) of the University of Copenhagen received information from the engineer G. Monberg that the excavations in the harbour of Copenhagen at Sundkrogen (Figs 1, 2) had exposed a dark to black clay with abundant fossils. The locality was subsequently visited by the palaeontologist J.P.J. Ravn who confirmed the rich fossiliferous nature of the clay and determined the beds to be of Paleocene age. He allowed Alfred Rosenkrantz, at that time a student of the Technical University of Denmark and working for the Museum, to collect samples and fossils at Sundkrogen. Rosenkrantz, however, only collected in the fine greensand and the dark clay – the two upper layers of the exposed section. He published his findings in a short preliminary paper (Rosenkrantz 1920b) but obviously intended a more extensive study of the locality and the fossils. He stated (1924, p. 9) that he had never observed the glauconitic greensand in the western part of the excavated canal at Sundkrogen which was only accessible for a short time.

In the Sundkrogen material studied by the present author there is material collected by Hilmar Ødum who at that time worked as an assistant for Geological Survey of Denmark, and a single specimen collected by Henning Lemche, at that time a high-school student. No information about these two collectors' work is available, except for a remark on a label in the Ødum material, stating that the washed and sieved material was given to Rosenkrantz. We may assume that Ødum and Lemche worked for the Mineralogical Museum together with Rosenkrantz, since Ravn (1939) established *Mathildia lemchei* and *Basilissa ødumi* amongst other new species.

Ravn (1939) states that Harder was also informed of the excavation work at Sundkrogen by G. Monberg, but at a later date. Poul Harder was employed at the Geological Survey of Denmark until 1916, when he became a lecturer at the Technical University of Denmark. No statements were made in Harder's (1922) study concerning the time at which he received this information. However, we know that he did not observe the excavations described by Rosenkrantz. Harder collected bulk samples from the rock debris derived from the excavation for the quay wall and the harbour basin at Sundkrogen (series 1, 2 and 3). An isolated outcrop of dark clay from which Harder recovered *in situ* samples for his series 4 was found in the harbour basin. His collection was made in the last months of 1920 and he carefully described the collecting of samples that he later washed and sieved. Rosenkrantz did not mention this part of the clay until his 1924 paper, but since material from that outcrop was studied by Ravn (1939) we may assume that Rosenkrantz also collected samples there. Ravn (1939) considered this part of the clay an isolated glacial floe, which he named 'le lambeau'. Rosenkrantz never sampled the glauconitic greensand. Harder's material consequently contains the most complete series of samples from Sundkrogen. Harder (1922) considered the Paleocene sequence at Sundkrogen as one big glacial transported floe, similar to the classical locality Vestre Gasværk (von Koenen 1885), whereas Rosenkrantz interpreted the Danian Limestone to be in place at both localities and the Selandian strata to be in primary contact at both localities. Yet Harder (1922), Rosenkrantz (1924) and Ravn (1925) all concluded that the exposed Selandian sequence at Sundkrogen represented the original stratigraphical order. Later Gry (1935) and Stenestad (1976) used data from several borings and excavations to show that the Paleocene deposits outcrop over most of the Copenhagen area and occur in the subsurface to the north and south of the centre of the city. The Selandian deposits were removed by glacial erosion from the high parts of the area. In faulted areas the Selandian deposits lie in tectonic depressions and have been protected from glacial erosion.

Harder (1922) noted that many specimens of the non-molluscan faunal elements are worn and greenish in colour, probably caused by glauconite. He also stated that many of the non-molluscs are well known from the Danian deposits found underlying the Selandian sediments from Sundkrogen. Based on these observations, Harder concluded that the entire fauna was of the same age, and he interpreted the lowermost deposits at Sundkrogen as a local facies of the Danian Limestone Group. In contrast, Rosenkrantz (1924) interpreted the greater part of the non-molluscs as reworked Danian specimens; a view that was also supported by Ravn (1939).

A description of the bryozoans from Sundkrogen was published by Berthelsen (1962).

The monopoly discussion

A small walnut chest of drawers in the collections of the Geological Survey of Denmark and Greenland is a symbol of a very bitter priority discussion in Danish geology back in the early 1920s. Poul Harder and Alfred Rosenkrantz (at that time a student, but later professor) both collected fossils from the Paleocene in the Copenhagen area, including Sundkrogen. Both maintained the exclusive right to publish on the Sundkrogen locality and the discussion led to personal consequences for both scientists. As mentioned in the introduction, one result of this controversy was that only the Rosenkrantz material was treated in Ravn's (1939) study of the Paleocene of Copenhagen. The material collected by Harder has remained virtually unstudied since then, influenced only by the ravages of time.

According to the literature it seems clear that Rosenkrantz was the first to collect material at Sundkrogen (see Rasmussen 1988) and Harder never denied this. A month after first collecting, Rosenkrantz had a preliminary paper in press (1920b). Without doubt Rosenkrantz thought that this paper was sufficient to guarantee a monopoly for further studies and publications on the locality and its fauna. Harder, however, did not respect this viewpoint and his 1922 paper only briefly mentions the work of Rosenkrantz. Harder (1922) does contain a review of the literature on the Paleocene of Denmark with descriptions of the localities, especially Vestre Gasværk and, naturally of course, Sundkrogen. The article did not include a faunal list and contained only remarks on the fossil content in the various samples. These remarks have been important for the present author in deciphering the label code for Harder's collection (see p. 18). Harder obviously intended a thorough study of the fauna and his paper seems to be an attempt to contest Rosenkrantz's assumed monopoly of the locality.

As might be expected, Harder's 1922 paper initiated a discussion on the monopoly of the Sundkrogen locality; a controversy that was published in the Bulletin of the Geological Society of Denmark in 1923 and 1924 (DGF 1923, 1924). The Geological Society generally tended to sympathise with Rosenkrantz and the encounter came to have severe personal and scientific consequences for both scientists. Harder resigned his membership of the society and never published on geology again. Before his relatively early death in 1931 he informed Ravn, who was at that time working on a monograph on the Paleocene of Copenhagen (i.e. the Selandian deposits), that he did not want his material from Sundkrogen to be studied together with other material. Ravn respected this wish. Rosenkrantz abandoned his intended study of the Sundkrogen material and placed the material and that of other localities in Copenhagen at the disposal of Ravn, who published in 1939.

In his later years Rosenkrantz renewed his interest in Paleocene (Selandian and Danian) molluscs. He intended a treatment of molluscs of that age from both Denmark and Greenland, including molluscs from Fakse (Fig. 1, **24**). He supervised numerous drawings of specimens, and several of these carry remarks on taxonomy. The collections in the Geological Museum of the University of Copenhagen show that Rosenkrantz kept material from these periods together, arranged in a series of registration numbers. The Paleocene molluscs from West Greenland were published much later by Kollmann & Peel (1983), a work referred to in this bulletin (p. 30).

The present study: significance

A modern study of Harder's collection is important for several reasons. Firstly, Harder sampled the complete section at Sundkrogen, whereas Rosenkrantz only sampled the two upper layers (the fine greensand and the dark clay or marl). Therefore, it was to be expected that Harder's collection would not only yield further important information but that a study would contribute to the correlation of Sundkrogen with other Paleocene exposures in the Copenhagen area. Secondly, the recent excavations on the island of Amager (i.e. Gemmas Allé, see Fig. 1, **28**) for the Øresund tunnel increased interest in the undescribed material. But the study was not at all straightforward since a major challenge for the author was to decipher the labelling of the material (see p. 18). As it became evident that Ravn (1939) had not included all the material collected by Rosenkrantz (1920b) the neglected material has also been included in the present study.

The Sundkrogen locality

The name Sundkrogen was used previously for that part of the harbour of Copenhagen now named 'Orientbassinet' (Figs 3, 4). Extensive excavations to build the harbour were carried out during the summer and autumn of 1920 under the supervision of the engineer N.C. Monberg for the Harbour of Copenhagen. The depth of this part of the harbour was 3.8–4.0 m and in the last months of 1919, before draining, the mud was removed to a depth of 4.5 m. Draining was then achieved by digging a canal, making a dam and pumping out the water. Excavation for construction of the quay wall reached a depth of 10.0 m, and was later increased to 11.5 m. About 0.5 m of greensand was observed in this excavation (letter from engineer N.C. Monberg to Harder dated 30 January 1922, now in the files of the Geological Survey of Denmark and Greenland).

Harder's concept of the sedimentary sequence in Sundkrogen is shown in Fig. 5. The estimated positions of his sample series are indicated with numbers 1 to 4. Thus series 1 was sampled approximately 5 m above the base of the Selandian deposits and series 2, 3 and 4 approximately 3 m, 3.5 m and 4.25 m higher, respectively. Harder (1922) stated that the excavated sediments changed from glauconitic greensand in the western part of the excavation to a dark clay in the eastern part. Harder's interpretation of the sedimentary sequence was based on his observations of the excavated sediments at the canal and the sequences found in two boreholes (1 and 2 on Fig. 4, I and II on Fig. 5). Harder (1922) stated that the section exposed at Sundkrogen had a thickness of about 6.5 m and he described the lithology of the sediments from top to bottom as follows:

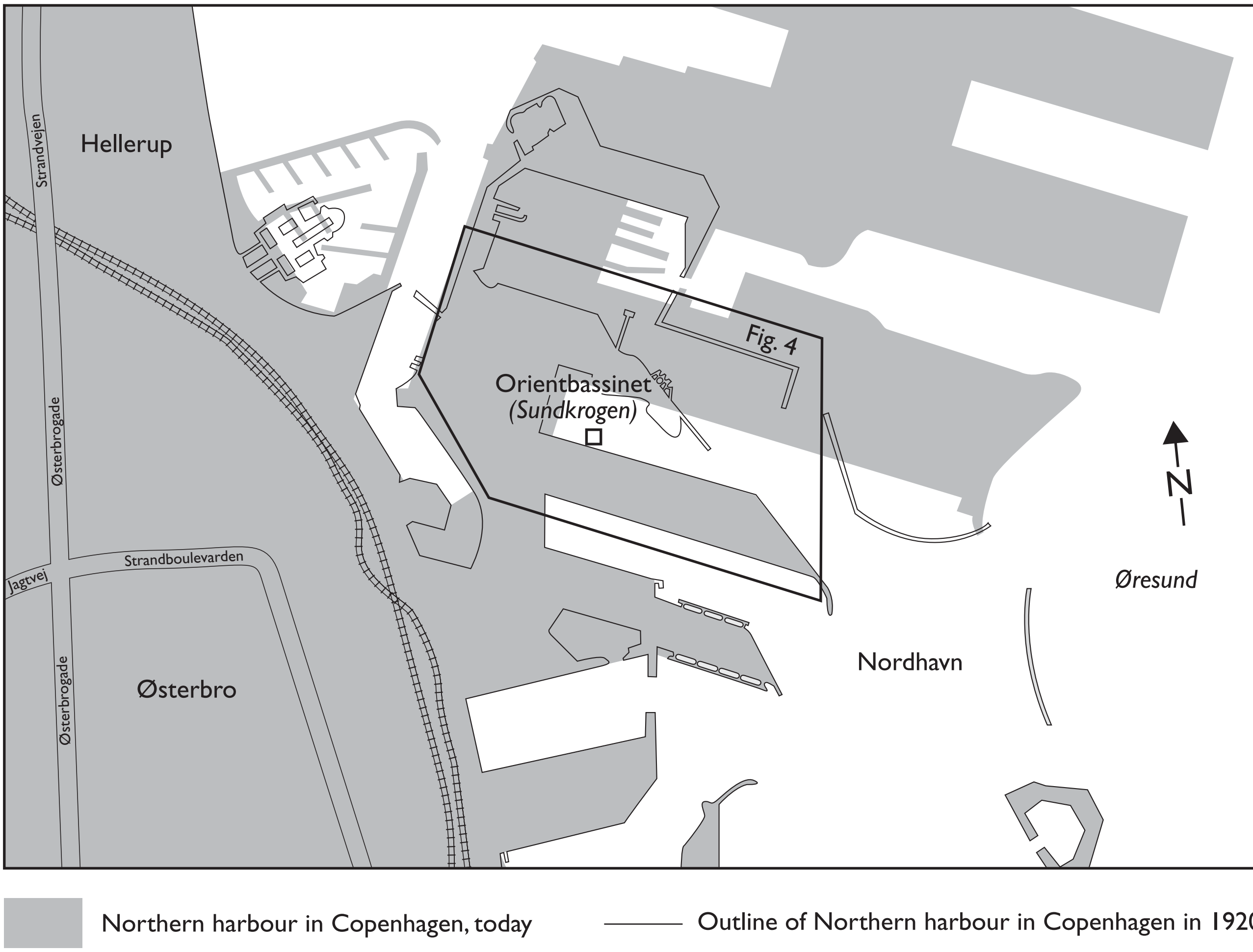

Fig. 3. Location of the now submerged locality Sundkrogen (now Orientbassinet) in the harbour of Copenhagen. The present-day harbour and that from 1920 are indicated.

Series 4: *c.* 2.25 m clay, upwards becoming very dark brown and sticky, downwards becoming lighter brown and less sticky, with gradual transition below into:

Series 3: *c.* 0.75 m brown, clayey fine sand, downwards with gradual and rapid transition into:

Series 1, 2: *c.* 3.50 m green, clayey glauconitic sand, with increasing grain size upwards. The clay content is distinctly lower in the lower part.

Four boreholes drilled in September 1920 (A and B) and between 20 December 1920 and 13 January 1921 (I and II; Fig. 5) showed that especially the western parts of the deposits were strongly disturbed, as stated by Harder (1922) and Rosenkrantz (1924). They also showed that the fossiliferous sediments overlie consolidated greensand and the Danian Saltholm limestone (Gry 1935, fig. 12); the Saltholm limestone is now known as the København Limestone Formation (Stenestad 1976).

The material from Sundkrogen

The author received the Harder collection for study in April 1994. It originates from the Sundkrogen excavations in the harbour area north of Copenhagen (Figs 1, 3). The Geological Survey of Denmark promised, before Harder died in 1931, to take care of the collection. Franke (1927) published a paper on the foraminifers and ostracods from Sundkrogen and Rugård, but he obviously did not study the Harder collection. Except for Berthelsen (1962), the material has thus remained unstudied.

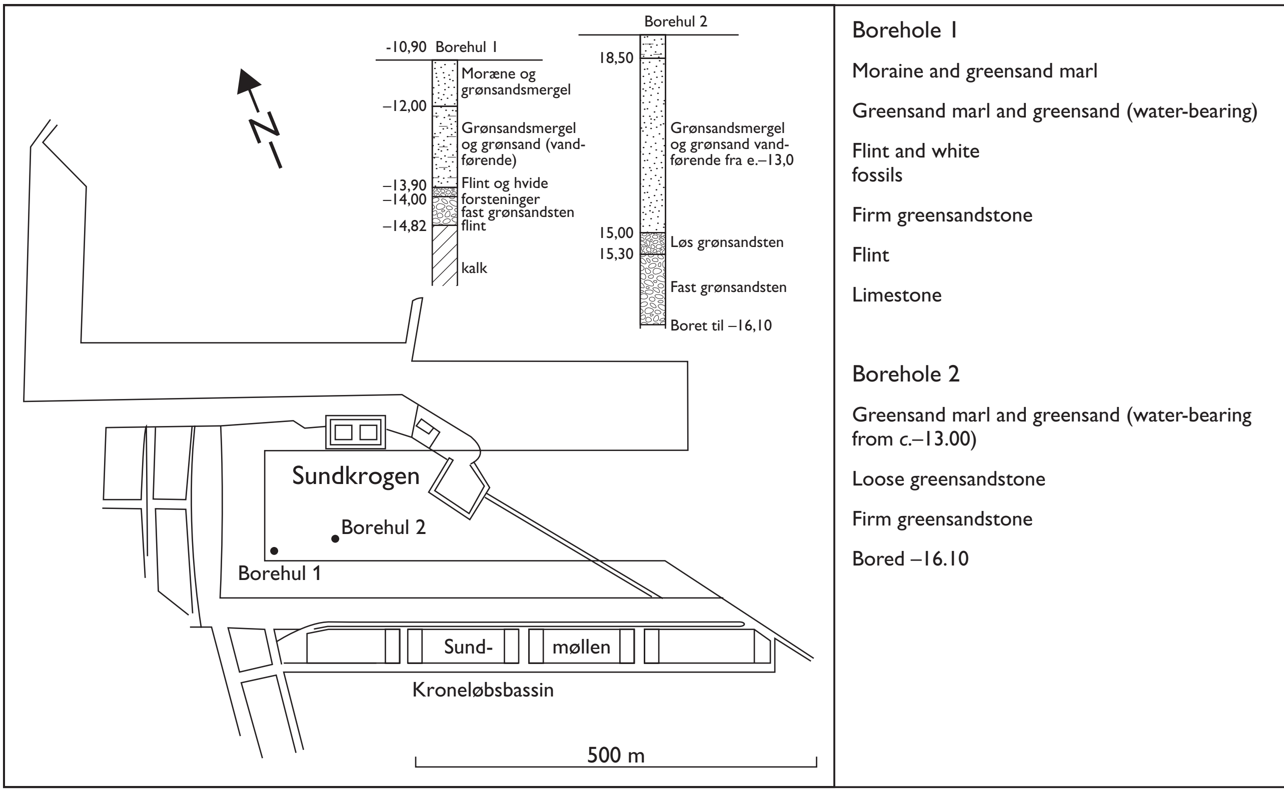

Fig. 4. Map showing the positions of boreholes 1 and 2 in Sundkrogen 1920–1921. The sections of the two boreholes were most likely drawn by the engineer G. Monberg. On the left part of the original map, Harder noted that the distance between the boreholes was 87 1/3 m. The sections are redrawn from the original material in the files of the Geological Survey of Denmark and Greenland, and shown here in slightly reduced form. Depths are in metres.

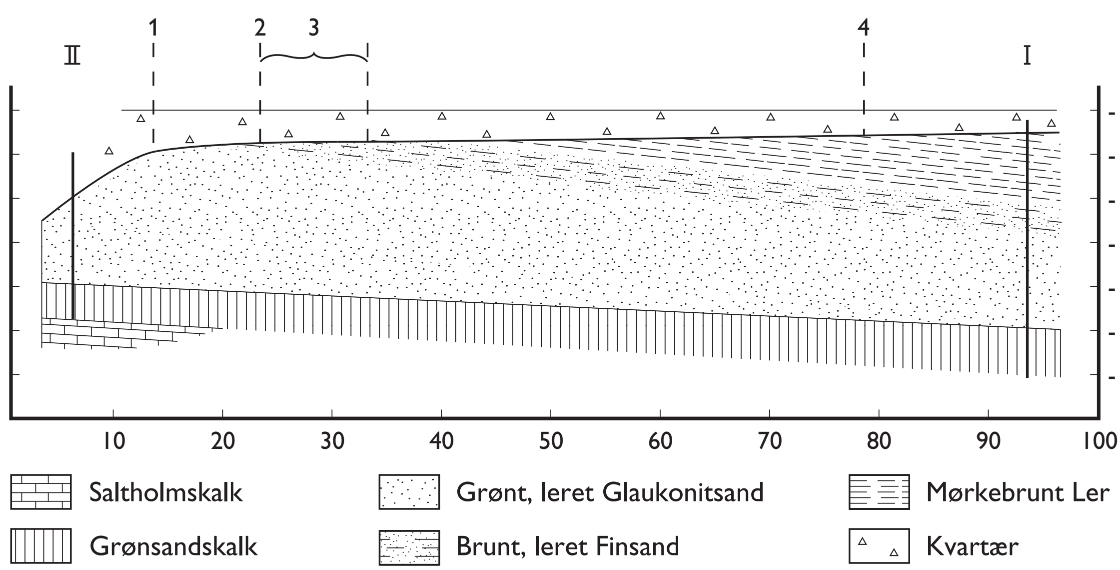

Fig. 5. Schematic profile of the Selandian sediments in Sundkrogen. Reproduced from Harder (1922) with numbers 1–4 marking the estimated stratigraphic positions of the four series of samples. I and II indicate the locations of the two boreholes, shown in Fig. 4 as boreholes 1 and 2. Numbers are in metres. The Selandian sediments discussed in this bulletin are the units between the Danian Limestone and the Quaternary. **Saltholmskalk**: Danian Limestone; **Grønsandskalk**: consolidated greensand; **Grønt, leret Glaukonitsand**: green, clayey glauconitic greensand; **Brunt, leret Finsand**: brown, clayey fine sand; **Mørkebrunt Ler**: dark brown clay; **Kvartær**: Quaternary.

The chest containing the collection has 20 drawers with species in glass tubes and matchboxes. The greater part of the material was sorted and identified by Harder. Specimens in the vials are marked with cotton-wool; in the open matchboxes are hand-written labels. A part of the material was only partly sorted, especially from the fine-grained greensand (drawer 14). Drawer 5 contains various samples labelled with series numbers.

The Harder collection also includes two wooden boxes containing material from Sundkrogen recovered by geologist Ib Marcussen in 1995. The boxes were numbered Da 130 and Da 131 and contained samples of all the sediment types originally labelled and described by Harder. Furthermore, residues from the washing and sieving are present but in several cases have been only partially organised. The greater part of the residues, however, consist of the finer fractions and thus contain only very juvenile molluscs, but do also include foraminifers and ostracods. This material, found during the present study, supplied important information on the labelling of the main part of the collection. In addition further undescribed species were found, as well as additional specimens of several of the new species.

In addition to Harder's material, box Da 131 contains fossils in clay samples collected by Hilmar Ødum in September 1920. The fossils, mainly bivalves, are still embedded in the sediment and they are therefore rather complete, whereas the bulk of Harder's fossils were recovered by processing samples. Ødum also processed samples and the residues were given to Rosenkrantz in 1921. Ødum's material is only derived from the fine-grained greensand. Nevertheless his material has contributed to the knowledge of the molluscan fauna from Sundkrogen since his residues from Sundkrogen presumably were studied by Ravn in his 1939 monograph. The present study also includes the Ødum material which yielded additional specimens of two of the new species described in this bulletin.

Table 1. Harder's series and colour identification

Series	Lithology	Cotton-wool colour
1a	Green, slightly clayey glauconitic sand, coarse-grained	lilac
1b	Green, slightly clayey glauconitic sand, coarse-grained	lilac
1c	Green, clayey glauconitic sand	green
2	Green, clayey glauconitic sand	red
3	Brown, clayey fine-grained greensand	white
4	Dark brown, sticky clay	black

Labelling of the material

Harder's material was stored in the chest of drawers without any indication of the affiliation to the sampled series (e.g. Harder 1922) and the labelling has been a puzzle. Five colours of cotton-wool were used in some sort of identification system arranged as follows:

Drawers 1, 2:	initially green, now faded to a dirty whitish
Drawers 3, 4, 8, 9:	light red (faded)
Drawer 5:	contains various samples
Drawers 6, 7:	lilac
Drawers 10–14:	white
Drawers 15–20:	black

The initial inspection showed that many vials had fallen out of the matchboxes and thus were separated from their labels. Since none of the tubes were labelled, identification is complicated, especially in cases of fragments or badly preserved specimens. Harder was a careful and systematic collector, and it may be assumed that the five colours equate with the five series of samples, but a key to the labelling code no longer exists in written form. Harder (1922) only mentions four series, but he also refers to a sample which could be assigned neither to the glauconitic greensand nor to the fine-grained greensand. He stated (1922, p. 20) that this sample was kept apart when processed. However, material from this sample has not been recovered in the present study. Within each colour the material is arranged in the same way: first he placed the gastropods, then the bivalves and scaphopods, and finally the representatives of the non-molluscs: anthozoans, echinoids, crinoids, serpulids, bryozoans, crustaceans, foraminifers and fishes.

As mentioned above, samples and residues from Sundkrogen labelled and described by Harder occupy two boxes. The labelling of the samples indicates that Harder subdivided series 1 into three parts, viz. 1a, 1b and 1c. Furthermore, two labels on this material indicate that series 1c was marked with green cotton-wool and series 2 with red cotton-wool. According to the label information, the best interpretation is that these different series can be matched with the cotton-wool colours as shown in Table 1.

The fauna from Sundkrogen

State of preservation

The sediments from Sundkrogen contain pyrite, especially the dark clay (Harder 1922; Rosenkrantz 1924; Gry 1935). The present state of preservation shows that various stages of pyrite disintegration have occurred in the mollusc material from all sediment types. In spite of the pyrite contents the bulk of the material is well preserved and therefore suitable for the study. Several fragments are worn or green-coloured, especially the bivalve fragments from the glauconitic greensand (series 1a, 1b and 1c). Harder (1922) observed that the bivalve genera *Astarte* and *Pectunculus* (*Glycymeris*) in particular were worn and green-coloured.

Many gastropods have a characteristic sculpture that allows identification of fragments, but in many cases a final interpretation of fragments is not possible.

Harder (1922) noted that many specimens of the non-molluscan faunal elements were worn and greenish in colour, probably caused by glauconite. This study has confirmed almost all statements concerning the preservation of the non-molluscs made by Harder (1922) and they are generally considered as reworked, with a few exceptions (see this page and p. 23).

List of molluscs from Sundkrogen

The molluscan fauna from the Selandian at Sundkrogen is listed in Table 2, pp. 20–22. The succession in the present study differs from that in Ravn (1939) (see p. 20) and for comparison the serial numbers in Ravn (1939) are given in the column 'Ravn'. Species indicated with an asterisk (*) are new for Sundkrogen, those with two asterisks (**) are new for the Lellinge Greensand.

In this study one valve of a bivalve species with the umbo preserved is counted as ½ specimen, while a shell of a gastropod species with the protoconch preserved is counted as one specimen. In many cases the number of specimens is estimated, especially for many bivalve species and the scaphopods. Thus the bivalves in the lower series are most likely under-represented in Table 2. The dark clay contains many juvenile specimens, especially of Naticidae and Pleurotomidae, and for such specimens identification at the species level is not possible. In most cases correct identification of juvenile Turrids is not possible. Thus the number of specimens and the frequency of the species are not accurate. In Table 2 the series are indicated as 1a-b, 1c, 2, 3 and 4.

Finally, it should be emphasised that some of the residues have not been completely picked. Only rare species are isolated, and therefore the numbers given for the common to abundant species in Table 2 are too low.

Non-molluscs from Sundkrogen

The Sundkrogen residues, in particular the glauconitic greensand (series 1a, 1b, 1c and 2), have a very high number of specimens belonging to other faunal groups.

The brachiopods are represented by *Carneithyris lens*, *Crania tuberculata*, *Isocrania posselti*, *Terebratulina? striata* and *Argyrotheca scabricula*. Only the last-mentioned species is known from the Paleocene at Vestre Gasværk, but the state of preservation suggests that the specimen is reworked from the Danian.

The echinoids are represented by fragments of *Echinocorys* sp., spines of *Phymosoma* sp. and *'Cidaris'* sp. and a few specimens of a *Salenia* species. In the fine-grained glauconitic greensand and dark clay, spines of *Palaeodiadema* sp. and fragments and spoon-shaped spines of a spatangoid, are abundant with a state of preservation that indicates these echinoids were a part of the original biocoenosis.

Numerous crinoids of the genera *Isselicrinus* and *Bourgueticrinus* are present in the glauconitic greensand. A few specimens of the first genus seem to be a part of the original Selandian fauna.

Numerous tubes of *Ditrupa* and *Serpula* seem to be reworked. A few plates of the cirriped *Scalpellum* sp. and rare fragments of decapods have been found.

Many specimens of ostracods were found by the present author, especially in the residues from the dark marl. Franke (1927), in a study of the foraminifers and ostracods from Rugård and Sundkrogen, stated that the ostracod fauna was represented by few species and specimens. He concluded that the foraminiferal faunas from different layers were similar, and that there was no basis for a biostratigraphical subdivision of the sequence at Sundkrogen. Harder (1922) stated that the

Table 2. Number of mollusc specimens from Sundkrogen

	Species	Ravn	Series					Total
			1a-b	1c	2	3	4	
**	*Leionucula* sp.			1	1			2
	Nucula densistria von Koenen 1885	1	7	5	5	4	20	41
*	*Nucula? subaequilatera* von Koenen 1885	2	4	6	6	1	1	18
	Nuculana crassistria (von Koenen 1885)	4	60	90	50	90	1300	1590
	Nuculana symmetrica (von Koenen 1885)	5					2	2
	Nuculana ovoides (von Koenen 1885)	6	15	5	2	20	10	52
**	*Portlandia (Yoldiella) nielseni* n.sp.						41	41
*	*Cucullaea dewalquei* von Koenen 1885	7	10	8	10	7	1	36
	Barbatia praescabra (von Koenen 1885)	8	200	180	225	600	26	1231
	Nuculina glabra Ravn 1939	14	1			2		3
	Arcopsis limopsis (von Koenen 1885)	10	10	10	6	5	12	43
	Glycymeris corneti (von Koenen 1885)	12	150	60	100	47	1	358
	Limopsis monbergi Ravn 1939	13	16	13	14	16	2	61
	Modiolus sp.	46	35	7	6	5	2	55
	Crenella sphaericula von Koenen 1885	47	6	10	8	8	2	34
**	*Arcoperna?* sp.				1		1	
	Avicula sp.	38						2
	Pinna sp.	39		5	1	1	1	8
	Propeamussium bisculptum (von Koenen 1885)	41	3	2	4	8		17
	Propeamussium hauniense Ravn 1939	42	3	5	1	11	1	21
	Chlamys palaeocaenica (Staesche 1937)	43		1	1	1	2	5
**	*Plicatula selandica* n. sp.		1					1
*	*Lima geinitzi* (von Hagenow 1842)	40	2	3	1	2		8
*	*Ostrea* sp.	44	122	75	160	169	1	527
	Exogyra canaliculata (Sowerby 1813)	45	13	11	9	12	1	46
	Lucina lepis von Koenen 1885	20	8	15	12	2		37
	Lucina planistria von Koenen 1885	21	7	2	2	6	1	18
*	*Lucina (Phacoides)* sp.	22	2		2	2		6
	Astarte trigonula von Koenen 1885	16	185	120	1	73	32	1511
	Crassatella hauniensis Ravn 1939	17		1	1	1		3
	Crassatella groenwalli Roedel 1935	18	1	1		5		7
	Crassatella subplana Ravn 1939	19	6	5	8	5	1	25
	Venericardia roedeli Ravn 1939	15	22	35	25	24	3	109
	Loxocardium cf. *tenuitesta* (Cossmann 1908)	23	1	1	1	2		5
**	*Protocardia semidecussata* (von Koenen 1885)	24		2	3	1		6
	Tellina sp.	28	1	3	4	2	4	14
*	*Tellina* n. sp. von Koenen 1885		1					1
	Gari sp.	30		1		1		2
	Cytherea sp.	25		30	17	17	2	66
	Circe angelini (von Koenen 1885)	27	1	11	2	3	1	18
**	*Veniella* cf. *ciplyensis* Vincent 1930		1		1	1		3
	Corbula koeneni Cossmann 1908	34	35	25	45	35	2	147
	Teredinidae indet.	37	1	1	2	2	1	7
	Pholadomya margaritacea (Sowerby 1823)	31	8		4			12
**	*Laternula (Laternulina) ravni* n. sp.	32	6	13		3	9	31
	Lyonsia sp.	35		3		1	2	6
**	*Lyonsia baltica* Roedel 1935		1			1		2
**	*Thracia* sp.			1			1	2
**	*Cuspidaria* sp.		3	1	1	2		7
	Verticordia granulosa Ravn 1939	33	3	2	5	5	5	20
	Bivalvia gen. et spec. indet.					1		1
	Dentalium rugiferum von Koenen 1885	49	35	15	30	25	2	107
**	*Dentalium sundkrogensis* n. sp.	(49)	43	200	189	336	5475	6243
	Dentalium undiferum von Koenen 1885	50	80	75	60	300	250	725
**	*Dentalium* sp.				1	2		3
	Siphonodentalium intumescens (von Koenen 1885)	51				2	150	152
	Emarginula sp.	53			1			1
	Patella subglabra Ravn 1939	61				5	5	
	Acmaea poulseni Ravn 1939	62				2		2
*	*Solariella (Solariella) ravni* n. sp.	56			2	1		3
**	*Solariella (Solariella) hauniensis* n. sp.						2	2
**	*Solariella?* sp.					1		1

Table 2 (*continued*)

			Series					
	Species	Ravn	1a-b	1c	2	3	4	Total
*	*Teinostoma ledoni* n. sp.	59	4			7		11
*	*Lacuna (Pseudocirsope) ovalis* von Koenen 1885	64	1			1		2
**	*Entomope kirstineae* n. sp.						9	9
	Alvania hauniensis Ravn 1939	70	3	12	23	27	413	478
*	*Cyclostrema denselineatum* Ravn 1939	60			1	3		4
	Architectonica koeneni (Ravn 1939)	63	1	2	4	4	7	18
	Pseudomalaxis pingeli (Mørch 1874)	54			3	14	26	43
	Pseudomalaxis groenwalli (Ravn 1939)	55			1			1
	Acrocoelum gracilis (von Koenen 1885)	88	60	152	250	425	245	1132
	Acrocoelum obtusa (von Koenen 1885)	89	9	7	30	96		142
	Mathilda (Fimbriatella) quadricincta Ravn 1939	90				1	1	2
	Mathilda (Fimbriatella) carinata Ravn 1939	91		1	1	12	8	22
	Mathilda lemchei Ravn 1939	92	8	8	16	18	6	56
	Bayania obtusata (von Koenen 1885)	82	10	2	19	8	30	69
	Haustator nana (von Koenen 1885)	80	358	1820	1750	16300	20100	40328
	Haustator suessi (von Koenen 1885)	81	10	19	18	48	8	103
*	*Metacerithium hauniense* (von Koenen 1885)	93	3	1	3	1		8
**	*Harrisianella subglabra* n. sp.				1	2		3
**	*Bittium (Bittium) oedumi* n. sp.		2					2
	Cerithiopsis hauniensis Ravn 1939	95	4		6	20		30
	Cerithiopsis grewingki (von Koenen 1885)	94		1			1	2
	Cerithiopsis similis (Ravn 1939)	97	3	1	2	4	1	11
**	*Cerithiopsidella (Vatopsis) rasmusseni* n. sp.		2			1		3
	Cerithiella (*sensu lato*) *monbergi* (Ravn 1939)	96	6	1	14	24	20	65
**	*Seila (Notoseila) heilmannclauseni* n. sp.		3		2	2		7
**	*Seila (Notoseila) anderseni* n. sp.		4					4
**	*Thereitis weinbrechti* n. sp.					7	15	22
**	*Biforina (Oriforina)* sp.				3	1		4
	Eucycloscala crassilabris (von Koenen 1885)	72	20	40	77	200	680	1017
	Acirsa (Hemiacirsa) elatior (von Koenen 1885)	78	3	1	5	14		23
	Acrilla gryi Ravn 1939	75	2		8	12	3	25
	Acrilla fenestrata Ravn 1939	76		9	6	5		20
	Acrilla bruennichi Ravn 1939	77			5	4	5	14
	Coniscala johnstrupi (Mørch 1874)	71	3		5	10	15	33
	Cerithiscala poulseni (Ravn 1939)	73	5	8	23	221		257
	Cerithiscala hauniensis (Ravn 1939)	74	25	40	66	115		246
**	*Cirsotrema (Cirsotrema) hauniensis* n. sp.		1					1
**	*Opalia (Pliciscala) thomseni* n. sp.						1	1
**	*Scaliidae* indet.		1		1			2
	Aclis (Graphis) densestriatus Ravn 1939	79	1			15	7	23
	Polygyreulima solidula (von Koenen 1885)	87	1	1	4	4	12	22
	Aporrhais gracilis von Koenen 1885	98	3	4	3	8	2060	2078
*	*Calyptraea* sp.	65	3	2		4		9
	Xenophora sp.	58	6	5	5	6	2	24
	Lunatia detracta (von Koenen 1885)	66		1	6	4	203	214
	Lunatia detrita (von Koenen 1885)	67		8	8	1	44	61
	Tectonatica lindstroemi (von Koenen 1885)	68	42	39	147	240	199	667
	Naticidae indet.		75	144	75	430	694	1418
*	*Amauropsella decussata* (von Koenen 1885)	69					2	2
*	*Sycostoma striata* (von Koenen 1885)				1		1	2
	Cassidaria elongata von Koenen 1885	101		6	5	10	1	22
	Charonia (Sassia) bjerringi (Ravn 1939)	102			1	1	3	5
**	*Charonia (Sassia) danica* n. sp.		1	1	1		4	7
	Murex (*sensu lato*) *nanus* Ravn 1939	109		1	2	2	4	9
	Urosalpinx pyruloides (von Koenen 1885)	110	1	2	1	15	3	22
*	*Tritonidea rosenkrantzi* Ravn 1939	106		1	1			2
	Siphonalia hauniensis Ravn 1939	107	5		35	11	53	104
**	*Siphonalia ariejansseni* n. sp.		11	14	2	44	1	72
	Astyris (Astyris) lappanni n. sp.	117		1	10	16	4	31
*	*Pseudoandonia crispata* (Ravn 1939)	114	1					1
	Suessionia densestriata (von Koenen 1885)	103	9	10	37	132	62	250
	Suessionia canalifera (Ravn 1939)	104	139	207	340	917	830	2433

Table 2 (*continued*)

	Species	Ravn	Series 1a-b	1c	2	3	4	Total
	Pseudoliva koeneni Ravn 1939		1				11	12
	Fusus danicus von Koenen 1885	111	12	9	17	16	11	65
*	*Levifusus moerchi* (von Koenen 1885)	113			4	1	1	6
	Streptolathyrus? johnstrupi (von Koenen 1885)	112				1		1
**	*Streptolathyrus danicus* n. sp.					15	188	203
**	*Streptolathyrus lemchei* n. sp.					1		1
	Clavella hauniensis Ravn 1939	115					1	1
	Exilia crassistria (von Koenen 1885)	116	3	3	3	2	7	18
	Scaphella crenistria (von Koenen 1885)	122			1	2		3
	Ancilla (Sparella) flexuosa (von Koenen 1885)	123	30	30	53	140	120	373
	Volutilithes nodifer (von Koenen 1885)	121	10	3	8	15	2	38
	Kroisbachia conoidea (von Koenen 1885)	124	1		4	4	35	44
	Admetula latesulcata (von Koenen 1885)	125	22	20	50	100	388	580
	Brocchinia tricincta (von Koenen 1885)	126	5	1	12	16	3	37
	Admete curta (von Koenen 1885)	127	1					1
	Sveltella planistria (von Koenen 1885)	129			6	4	25	35
	Sveltella multistriata (Ravn 1939)	130	1	1	6	14	8	30
	Babylonella ravni (Glibert 1960)	128	73	90	184	321	708	1376
**	*Cancellaria (sensu lato) jakobseni* n. sp.				3	1		4
*	*Fusimitra densistria* (von Koenen 1885)	119	1					1
*	*Fusimitra aequicostata* (von Koenen 1885)	120				1		1
	Hemipleurotoma gryi (Ravn 1939)	131	18	18	37	48	127	248
	Hemipleurotoma danica (von Koenen 1885)	132	6	20	8	15	67	116
	Eopleurotoma selandica (von Koenen 1885)	133	6		2	3	48	59
	Pleurotomidae indet.		16		75	130	634	855
	Surcula hauniensis (von Koenen 1885)	134				4	8	12
	Surcula johnstrupi (von Koenen 1885)	135	5		10	1	8	24
	Surcula rosenkrantzi Ravn 1939	136	1	3	5	17	36	62
	Surcula torelli (von Koenen 1885)	137	11	11	39	32	116	209
	Surcula fissicosta (von Koenen 1885)	138				2	13	15
	Surcula sp. indet.					9	40	49
	Pseudocochlespira koeneni (Arkhanguelsky 1904)	139	3	2	8	17	12	42
	Pseudocochlespira boeggildi (Ravn 1939)	140	3	4	4	54	17	82
**	*Pseudocochlespira rosenkrantzi* n. sp.	(140)				2	1	3
	Genotia brevior (von Koenen 1885)	141	1		9	1	1	12
	Pseudotoma steenstrupi (von Koenen 1885)	142			3		16	19
*	*Pseudotoma inconspicua* (von Koenen 1885)	143	1					1
	Cordieria binodosa (von Koenen 1885)	144	20	15	52	40	48	175
**	*Actaeopyramis marcusseni* n. sp.					1	37	38
**	*Chrysallida (Parthenina) peterseni* n. sp.						4	4
**	*Cingulina harderi* n. sp.					2	5	7
**	*Syrnola (Syrnola) granti* n. sp.		1			16	37	54
**	*Ebala* sp.				1		1	2
	Odostomia undifera (von Koenen 1885)	84	3	13	8	303	618	945
*	*Odostomia (Cyclodostomia) obtusa* (von Koenen 1885)	85			36			36
	Odostomia (Cyclodostomia) pupaeformis (von Koenen 1885)	86					2	2
	Turbonilla beyrichi von Koenen 1885	83	19	75	67	211	489	861
	Actaeon pusillus Ravn 1939	145	2	1	19	44	146	226
	Ravniella regularis (von Koenen 1885)	146	17	20	60	300	40	437
	Retusa plicatella (von Koenen 1885)	147	60	150	28	329	565	1132
	Crenilabium elatum (von Koenen 1885)	148	15	130	40	91	495	771
	Gilbertina ultima (von Koenen 1885)	149	30	35	60	130	60	315
*	*Ringicula (Ringiculina) erratica* Roedel 1937	150	1	2	3	3		9
	Roxania clausa (von Koenen 1885)	151		2	80	2	152	236
*	*Bulla (Haminea?)* sp.	152			1		2	3
**	*Acteocina?* sp.						1	1
	Cylichna discifera von Koenen 1885	153	30	80	140	160	152	562
	Nautilus sp.	154	95 fr.	12 fr.	5 fr.	11 fr.		123 fr.
	Number of specimens		2395	4177	4836	25814	38628	75851
	Number of species		109	103	130	146	119	182

dark marl had a high frequency of a characteristic *Rheophax* species but Franke (1927) did not mention this genus. Judging from the illustration of *Clavulina parisiensis* by Franke (1927, plate 1, fig. 6) this species might be the *Rheophax* species mentioned by Harder and referred to *Pseudoclavulina anglica* by Brotzen (1948, p. 37, plate 5, figs 1, 2). Inspection of the various Sundkrogen residues, however, has confirmed Harder's observations. Specimens of the species *Clavulina parisiensis* are abundant in the residues from the dark marl (series 4), whereas they are rare or absent in other residues. Many fragments of bryozoans are present in the glauconitic greensand. Von Koenen (1885) described two species of corals, viz. *Trochocyathus calcitrapa* and *Sphenotrochus latus* from the Paleocene at Vestre Gasværk. These species are present in the material from Sundkrogen in the glauconitic greensand. Harder stated that *Trochocyathus calcitrapa* was better preserved than *Sphenotrochus latus*, and the present study confirms this observation. Yet, both species are believed to belong to the original fauna. Fragments of *Graphularia* sp. are frequent, whereas fragments of *Dendrophyllia* and other Anthozoa are very rare. A few fragments of a hydrocoral are present in the collection.

Paleocene otoliths from the Copenhagen area were studied by Koken (in: von Koenen 1885, pp. 111–116) and by Roedel (1930) from boulders in NE Germany. The otoliths from Sundkrogen and other localities in the Copenhagen area, as well as those from the Danian of Fakse have been studied by Schwarzhans (in press). The otolith faunas from the various series at Sundkrogen show no significant differences (W. Schwarzhans, personal communication 1996).

This study has confirmed almost all statements concerning the preservation and distribution of the non-molluscs made by Harder (1922). But the present author agrees with Rosenkrantz (1924) and Ravn (1939) that the bulk of non-molluscs are reworked from the underlying Danian deposits since almost all identifiable species are well known from this stage, and the content of non-molluscs decreases upwards.

Comparison with other Paleocene molluscan faunas

Denmark

The Early Paleocene (Danian) of Fakse

Previously, the Selandian fauna from Copenhagen has been compared with the well-known fauna from Fakse (Fig. 1, **24**) (Early Paleocene, Danian) that has been studied by Ravn (1902a, b, 1933) and Rosenkrantz (1960). Nielsen (1919) pointed out similarities between the small gastropods from Fakse and the gastropods from the greensand of Copenhagen. The former were collected by sieving residues of the unconsolidated corallian chalk from that part of the Fakse quarry, known as 'Ravn's nose', and this type of chalk consequently has been named 'næsekalk' (meaning = nose chalk). Harder (1922) mentioned a few species of molluscs common to the two faunas, which suggested that further studies would inevitably increase the number of species known to be common to both faunas. Ravn (1933), however, made no statements of species common to the two faunas in his study of the Fakse fauna. Ravn made a detailed comparison of the two faunas in his monograph on the Paleocene (i.e. Selandian) of Copenhagen (Ravn 1939). He found that they differed considerably because of the different facies, but he concluded that the mollusc fauna from Copenhagen has a more modern character than that from Fakse.

Other differences not mentioned by Ravn are that the family Tritoniidae is very abundant and very diverse at Fakse whereas in the Selandian fauna of Copenhagen this family is represented only by two very rare species. In the Fakse fauna the family Triphoridae is represented by five species, of which one is abundant, while only four juvenile specimens represent this family in the Selandian fauna. The family Cypraeidae is very diverse in the Fakse fauna (eight species) but is absent in the Copenhagen fauna, while the family Cancellariidae is represented by eight species in the Selandian fauna, but by only two rare species at Fakse.

Table 3. The molluscan fauna of Sundkrogen compared with other Paleocene faunas

No.	Species	V6	V7	K1	K2	P	G	Kl	T	Ro	Ru	Hv	Y
1	*Leionucula* sp.												
2	*Nucula densistria* von Koenen 1885	*	*				*	*		*	?	*	
3	*Nucula? subaequilatera* von Koenen 1885				?				*		?		
4	*Nuculana crassistria* (von Koenen 1885)	*	*	*	*						*	*	
5	*Nuculana symmetrica* (von Koenen 1885)	*	*	*	*	*				*			
6	*Nuculana ovoides* (von Koenen 1885)	*				?	*	*	*	*	?	*	
7	*Portlandia (Yoldiella) nielseni* n. sp.								*	?			
8	*Cucullaea dewalquei* von Koenen 1885	*		*	*			*	*	*		*	
9	*Barbatia praescabra* (von Koenen 1885)	*	*	*	*	*	*	*		*		*	?
10	*Nuculina glabra* Ravn 1939												
11	*Arcopsis limopsis* (von Koenen 1885)	*	*				*	*		*	*	*	
12	*Glycymeris corneti* (von Koenen 1885)	*	*				*			*			*
13	*Limopsis monbergi* Ravn 1939	*	*				*						*
14	*Modiolus* sp.										*		
15	*Crenella sphaericula* von Koenen 1885	*	*				*					*	
16	*Arcoperna?* sp.												
17	*Avicula* sp.									*	*		
18	*Pinna* sp.	*	*				*	*		*	*		
19	*Propeamussium bisculptum* (von Koenen 1885)	*	*	*		*	?	*			*		
20	*Propeamussium hauniense* Ravn 1939	*	*	*				*					
21	*Chlamys palaeocaenica* (Staesche 1937)	*									*		
22	*Plicatula selandica* n. sp.											*	
23	*Lima geinitzi* (von Hagenow 1842)		*	*		*	*	*		*	*	*	
24	*Ostrea* sp.	*	*				*	*					*
25	*Exogyra canaliculata* (Sowerby 1813)	*	*				*		*				*
26	*Lucina lepis* von Koenen 1885	*	*							*			
27	*Lucina planistria* von Koenen 1885						*	*		*			
28	*Lucina (Phacoides)* sp.	*							*				
29	*Astarte trigonula* von Koenen 1885	*	*	*	*		*		*	*		*	*
30	*Crassatella hauniensis* Ravn 1939									*			*
31	*Crassatella groenwalli* Roedel 1935						*			*			
32	*Crassatella subplana* Ravn 1939	*				*	*						
33	*Venericardia roedeli* Ravn 1939		*				*			*			*
34	*Loxocardium* cf. *tenuitesta* (Cossmann 1908)												
35	*Protocardia semidecussata* (von Koenen 1885)		*										
36	*Tellina* sp.						*		*	*			
37	*Tellina* n. sp. von Koenen 1885												
38	*Gari* sp.												
39	*Cytherea* sp.						*			?			
40	*Circe angelini* (von Koenen 1885)	*		*		*	*		*	*			
41	*Veniella* cf. *ciplyensis* Vincent 1930												
42	*Corbula koeneni* Cossmann 1908	*	*				*	*	*	*			*
43	*Teredinidae* indet.		*				*	*			*		
44	*Pholadomya margaritacea* (Sowerby 1823)	*	*		*			*		?	?		
45	*Laternula (Laternulina) ravni* n. sp.	*	*		*								
46	*Lyonsia* sp.												
47	*Lyonsia baltica* Roedel 1935								*	*			
48	*Thracia* sp.												
49	*Cuspidaria* sp.						*	*					
50	*Verticordia granulosa* Ravn 1939		*				*	?	*				
51	*Bivalvia* gen. et spec. indet.												
52	*Dentalium rugiferum* von Koenen 1885	*	*	*	*	*	*	*	*	*	*	*	
53	*Dentalium sundkrogensis* n. sp.	*											
54	*Dentalium undiferum* von Koenen 1885	*	*	*	*	*	*	*	*	*		*	*
55	*Dentalium* sp.												
56	*Siphonodentalium intumescens* (von Koenen 1885)	*	*	*	*	*		*			*	*	
57	*Emarginula* sp.						*	?					
58	*Patella subglabra* Ravn 1939			*		*							
59	*Acmaea poulseni* Ravn 1939		*										
60	*Solariella (Solariella) ravni* n. sp.	*											
61	*Solariella (Solariella) hauniensis* n. sp.												
62	*Solariella?* sp.												
63	*Teinostoma ledoni* n. sp.	*	*										

Table 3 (*continued*)

No.	Species	V6	V7	K1	K2	P	G	Kl	T	Ro	Ru	Hv	Y
64	*Lacuna (Pseudocirsope) ovalis von* Koenen 1885	*	*	*	*	*		?					
65	*Entomope kirstineae* n. sp.		*		*								
66	*Alvania hauniensis* Ravn 1939	*	*	*	*	*	*	*	*				*
67	*Cyclostrema denselineatum* Ravn 1939		*	*		*							
68	*Architectonica koeneni* (Ravn 1939)	*	*	*	*	*				*	*	*	
69	*Pseudomalaxis pingeli* (Mørch 1874)	*	*	*	*			?	?		*		
70	*Pseudomalaxis groenwalli* (Ravn 1939)	*	*	*		*	*						
71	*Acrocoelum gracilis* (von Koenen 1885)	*	*	*	*				*			*	*
72	*Acrocoelum obtusa* (von Koenen 1885)	*	*	*	*	*		*		*			
73	*Mathilda (Fimbriatella) quadricincta* Ravn 1939		*	*									
74	*Mathilda (Fimbriatella) carinata* Ravn 1939	*	*	*	*	*							
75	*Mathilda lemchei* Ravn 1939	*	*	*	*	*							
76	*Bayania obtusata* (von Koenen 1885)	*	*		*		*						
77	*Haustator nana* (von Koenen 1885)	*	*	*	*	*	*	*	*	*	*		*
78	*Haustator suessi* (von Koenen 1885)	*	*				*						
79	*Metacerithium hauniense* (von Koenen 1885)		*	*	*								*
80	*Harrisianella subglabra* n. sp.												
81	*Bittium (Bittium) oedumi* n. sp.												
82	*Cerithiopsis hauniensis* Ravn 1939	*					*						*
83	*Cerithiopsis grewingki* (von Koenen 1885)	*	*	*	*		*						
84	*Cerithiopsis similis* (Ravn 1939)	*	*										
85	*Cerithiopsidella (Vatopsis) rasmusseni* n. sp.												
86	*Cerithiella (sensu lato) monbergi* (Ravn 1939)	*	*	*	*								
87	*Seila (Notoseila) heilmannclauseni* n. sp.												
88	*Seila (Notoseila) anderseni* n. sp.												
89	*Thereitis weinbrechti* n. sp.			*	*								
90	*Biforina (Oriforina)* sp.												
91	*Eucycloscala crassilabris* (von Koenen 1885)	*	*	*	*	*		*				*	
92	*Acirsa (Hemiacirsa) elatior* (von Koenen 1885)	*	*		*					*	*		
93	*Acrilla gryi* Ravn 1939	*	*				*						
94	*Acrilla fenestrata* Ravn 1939	*	*				*						
95	*Acrilla bruennichi* Ravn 1939												
96	*Coniscala johnstrupi* (Mørch 1874)	*	*		*							*	
97	*Cerithiscala poulseni* (Ravn 1939)				*								
98	*Cerithiscala hauniensis* (Ravn 1939)												
99	*Cirsotrema (Cirsotrema) hauniensis* n. sp.												
100	*Opalia (Pliciscala) thomseni* n. sp.												
101	*Scaliidae* indet.												
102	*Aclis (Graphis) densestriatus* Ravn 1939	*		*	*								
103	*Polygyreulima solidula* (von Koenen 1885)	*	*		*						*		
104	*Aporrhais gracilis* von Koenen 1885	*	*	*	*	*	*	*	*	*	*	*	
105	*Calyptraea* sp.	*					*						
106	*Xenophora* sp.	*	*										
107	*Lunatia detracta* (von Koenen 1885)	*	*	*	*	*		*	*	*	*	*	
108	*Lunatia detrita* (von Koenen 1885)	*	*	*	*	*		*	*	*	*		
109	*Tectonatica lindstroemi* (von Koenen 1885)	*	*	*	*	*			*	*			
110	*Naticidae* indet.												
111	*Amauropsella decussata* (von Koenen 1885)	*											
112	*Sycostoma striata* (von Koenen 1885)	*											
113	*Cassidaria elongata* von Koenen 1885	*	*										
114	*Charonia (Sassia) bjerringi* (Ravn 1939)	*	*		?	*							
115	*Charonia (Sassia) danica* n. sp.								*				
116	*Murex (sensu lato) nanus* Ravn 1939		*	*									
117	*Urosalpinx pyruloides* (von Koenen 1885)	*	*	*	*		*		*		*		
118	*Tritonidea rosenkrantzi* Ravn 1939		*										
119	*Siphonalia hauniensis* Ravn 1939	*		*	*	*			*				
120	*Siphonalia ariejansseni* n. sp.								*				
121	*Astyris (Astyris) lappanni* n. sp.	*			*								
122	*Pseudoandonia crispata* (Ravn 1939)			*		*			*				
123	*Suessionia densestriata* (von Koenen 1885)	*	*	*	*								
124	*Suessionia canalifera* (Ravn 1939)	*	*	*	*	*			*				
125	*Pseudoliva koeneni* Ravn 1939												
126	*Fusus danicus* von Koenen 1885	*	*	*	*		*			*			

Table 3 (*continued*)

No.	Species	V6	V7	K1	K2	P	G	Kl	T	Ro	Ru	Hv	Y
127	*Levifusus moerchi* (von Koenen 1885)	*	*										
128	*Streptolathyrus? johnstrupi* (von Koenen 1885)	*	*			*							
129	*Streptolathyrus danicus* n. sp.	*		*									
130	*Streptolathyrus lemchei* n. sp.												
131	*Clavella hauniensis* Ravn 1939	*	*	*									
132	*Exilia crassistria* (von Koenen 1885)	*	*	*	*			*					
133	*Scaphella crenistria* (von Koenen 1885)	*	*										
134	*Ancilla (Sparella) flexuosa* (von Koenen 1885)	*	*	*	*	*	*	*	*		*	*	
135	*Volutilithes nodifer* (von Koenen 1885)	*	*				*	*	*		?		
136	*Kroisbachia conoidea* (von Koenen 1885)	*	*	*	*				*	*		*	
137	*Admetula latesulcata* (von Koenen 1885)	*	*	*	*	*			*	*			
138	*Brocchinia tricincta* (von Koenen 1885)	*	*	*	*		*						
139	*Admete curta* (von Koenen 1885)		*	*									
140	*Sveltella planistria* (von Koenen 1885)	*	*	*	*					*		*	
141	*Sveltella multistriata* (Ravn 1939)		*		*				*				
142	*Babylonella ravni* (Glibert 1960)	*	*	*	*	*	*						
143	*Cancellaria (sensu lato) jakobseni* n. sp.												
144	*Fusimitra densistria* (von Koenen 1885)		*	*							*		
145	*Fusimitra aequicostata* (von Koenen 1885)			*							*		
146	*Hemipleurotoma gryi* (Ravn 1939)	*	*	*	*	*		*	*				
147	*Hemipleurotoma danica* (von Koenen 1885)	*	*	*	*	*			*				
148	*Eopleurotoma selandica* (von Koenen 1885)	*	*	*	*	*			*	*			*
149	*Pleurotomidae* indet.												
150	*Surcula hauniensis* (von Koenen 1885)	*	*	*		*		*	*	*	*		
151	*Surcula johnstrupi* (von Koenen 1885)	*	*	*	*					*			
152	*Surcula rosenkrantzi* Ravn 1939	*	*	*	*		*		*				*
153	*Surcula torelli* (von Koenen 1885)	*	*	*	*	*		*	*				
154	*Surcula fissicosta* (von Koenen 1885)	*	*	*	*	*				*			
155	*Surcula* sp. indet.												
156	*Pseudocochlespira koeneni* (Arkhanguelsky 1904)	*	*	*	*	*						*	
157	*Pseudocochlespira boeggildi* (Ravn 1939)	*	*		*			*					
158	*Pseudocochlespira rosenkrantzi* n. sp.												
159	*Genotia brevior* (von Koenen 1885)	*	*	*	*					*		*	
160	*Pseudotoma steenstrupi* (von Koenen 1885)	*	*		*	*				*			
161	*Pseudotoma inconspicua* (von Koenen 1885)	*	*						*				
162	*Cordieria binodosa* (von Koenen 1885)	*	*	*	*	*	*	*		*	*	*	
163	*Actaeopyramis marcusseni* n. sp.												
164	*Chrysallida (Parthenina) peterseni* n. sp.												
165	*Cingulina harderi* n. sp.												
166	*Syrnola (Syrnola) granti* n. sp.												
167	*Ebala* sp.												
168	*Odostomia undifera* (von Koenen 1885)	*	*	*	*	*	*			*			
169	*Odostomia (Cyclodostomia) obtusa* (von Koenen 1885)	*	*		*		*		*	*	*		
170	*Odostomia (Cyclodostomia) pupaeformis* (von Koenen 1885)	*	*		*	*			*				
171	*Turbonilla beyrichi* von Koenen 1885	*	*	*	*	*			*				
172	*Actaeon pusillus* Ravn 1939		*					*					
173	*Ravniella regularis* (von Koenen 1885)	*	*	*	*	*	*	*	*	*	*	*	
174	*Retusa plicatella* (von Koenen 1885)	*	*	*	*	*	*			*	*		
175	*Crenilabium elatum* (von Koenen 1885)	*	*	*	*	*	*	*		*			?
176	*Gilbertina ultima* (von Koenen 1885)	*	*	*	*	*		*		*		*	
177	*Ringicula (Ringiculina) erratica* Roedel 1937		*	*	*					*			
178	*Roxania clausa* (von Koenen 1885)	*	*	*	*			*		*	*		
179	*Bulla (Haminea?)* sp.		*					*					
180	*Acteocina?* sp.												
181	*Cylichna discifera* von Koenen 1885	*	*	*	*	*	*	*	*	*	*	*	
182	*Nautilus* sp.	*	*					*					
	Number of species in common	104	107	71	71	49	50	44	49	55	35	29	18
	Total number of species	107	111	71	74	49	55	65	55	76	57	31	21
	Similarity index (%)	97	96	100	96	100	91	68	89	72	61	93	86

The first five localites in the Copenhagen area are mentioned by Ravn (1939). For locations, see Fig. 1. **V6**: Vestre Gasværk VI; **V7**: Vestre Gasværk VII; **K1**: Kongedyb I; **K2**: Kongedyb II; **P**: Prøvesten; **G**: Gemmas Allé, Amager, excavation 1994; **Kl**: Klintebjerg (glacial boulders); **T**: A boulder from Longelse Sønderskov. G and T: material collected and identified by Mogens S. Nielsen, Odense. **Ro**: Molluscan fauna from boulders in NE Germany (Roedel 1935, 1937). **Ru**: Rugård, south of Grenå (Grönwall & Harder 1907). **Hv**: Hvalløse (Ødum 1926). **Y**: Ystad, Sweden (Brotzen 1948).

The family Aporrhaidae, absent in the Fakse fauna, is represented by the very frequent *Aporrhais gracilis* in the Selandian fauna from Copenhagen.

The Copenhagen area

Ravn (1939) concluded that the molluscan assemblages from the Selandian localities were similar and he interpreted the insignificant differences in frequencies of some species as resulting from environmental factors, rather than from differences in age. The present study confirms this conclusion, as the similarity index for the six faunas listed in Table 3 (pp. 24–26) are between 91 and 100%. It should also be noted that Grönwall (1897) described greensand boulders with a similar fauna from the Copenhagen area.

The Lellinge Greensand mollusc fauna (Selandian)

The molluscs from the Lellinge locality (Fig. 1, **23**) (i.e. the type locality for the Lellinge Greensand) are generally poorly preserved and positive species identification is difficult. Grönwall & Harder (1907, pp. 62–63) listed 13 species of which 11 (= 85%) are known from Sundkrogen. At Klintebjerg in NW Sjælland (Fig. 1, **19**) boulders of Lellinge Greensand are abundant with a higher content of molluscs and other fossils. The commonest rock type is a grey, hard, greensand limestone, but less consolidated rock types are also found. The molluscan fauna is listed by Jakobsen & Collins (1979) and by Collins & Jakobsen (1995). Sixty-five species of molluscs are known, among which are some large specimens, for example *Volutilithes nodifer*, Naticidae, *Dentalium rugiferum*, *Crenilabium terebelloides* and *Cucullaea dewalquei*. The frequency of the mollusc species differs from the fauna of the Paleocene of Copenhagen. Remarkable is the scarcity of the gastropod *Haustator nana* (only one specimen is known). The similarity index is 68%, thus confirming that the fauna differs somewhat from the contemporaneous Selandian fauna of Copenhagen.

The Kerteminde Marl mollusc fauna (Selandian)

The molluscan fauna of the Kerteminde Marl is especially known from the paper of Grönwall & Harder (1907), who described a fauna from Rugård, south of Grenå (Fig. 1, **8**). This fauna contained 57 species of molluscs, of which seven were recorded in open nomenclature. The bivalve species *Barbatia praescabra*, abundant at Sundkrogen, is absent at Rugård, as is the gastropod *Eucycloscala crassilabris*. Only four specimens and some fragments of the gastropod *Aporrhais gracilis* were found. The Kerteminde Marl is generally interpreted as a deep-water deposit that is contemporaneous or a little younger than the Lellinge Greensand. The molluscan fauna is listed in Table 3, column Ru; it differs from the greensand fauna from Copenhagen (similarity index 61%).

The Danian to Selandian transition at Svejstrup and Hvalløse (Fig. 1; **2** and **4**, respectively) in Jylland has been studied by Ødum (1926) and Thomsen & Heilmann-Clausen (1985). The Selandian is represented by marls of the Kerteminde Marl, which contains a rather badly preserved molluscan fauna (Ødum 1926). Nine species of molluscs have been recorded from Svejstrup, and 31 from Hvalløse. The Hvalløse fauna (column Hv in Table 3) has a similarity index of 93%. As the state of preservation of the molluscan fauna in the Kerteminde Marl is generally poor, we can assume that the number of species is not accurate.

On Fyn, a remarkable fauna has recently been found in boulders from a gravel-pit at Gundstrup near Odense (Fig. 1, **12**; unpublished data; M.S. Nielsen, personal communication 1995). The molluscs occur almost exclusively as external imprints in slightly consolidated sediments of the Kerteminde Marl, and thus the state of preservation allows making of casts. The fauna is characterised by large species and specimens. Several of the species are apparently undescribed and a study of the fauna is in progress by M.S. Nielsen and the present author. A gastropod related to *Kangilioptera ravni* from the Paleocene of West Greenland (Rosenkrantz 1970) is present in the material, and there are other species that also demonstrate affinities with the Greenland fauna. Four specimens of *Streptolathyrus lemchei* n. sp. all have larger dimensions than the specimen from Sundkrogen.

Selandian boulders

Fossiliferous Selandian boulders or erratic blocks have been known for many years from the south-eastern part of Denmark and especially from Fyn, Langeland and Sjælland (Fig. 1; Grönwall 1904). Grönwall (1904) divided the blocks into a number of types. One type is 'grey Paleocene rock-type' which is a glauconitic, fine-grained greensand or marl containing a macrofaunal assemblage identical to that from Vestre Gasværk in the Copenhagen area, while another boulder type was interpreted to be a lateral equivalent to the basal conglomerate from Vestre Gasværk.

An unusual brown block type is known as 'brown Eocene rock-type' (Grönwall 1904) or 'reddish brown *Turritella* sandstone' (Andersen & Heilmann-Clausen 1984). Blocks of this type are widespread and are known from Sweden, Denmark and northern Germany; a summary is given in Andersen & Heilmann-Clausen (1984) who interpret the blocks as a lateral equivalent facies to the Lellinge Greensand representing deposition in a shallow water setting. It is possible that the blocks originate from a sequence that is *in situ* at the bottom of the Baltic Sea between south-eastern Sweden, Bornholm and Rügen in North Germany (Fig. 1; Grönwall 1904; Andersen & Heilmann-Clausen 1984). The block type shares several species with the Vestre Gasværk fauna (Grönwall 1904), including the small *Haustator nana*, but the associated gastropod species *Turritella imbricataria* is known from Eocene strata in the Paris Basin. Hence Grönwall tentatively concluded that this boulder could be younger than the Paleocene strata of Copenhagen.

Andersen & Heilmann-Clausen (1984) studied a couple of samples of this particular 'reddish brown *Turritella* sandstone' containing large, current-oriented specimens of *Turritella*, and the dinocyst flora obtained from these blocks correlates with the dinocyst flora that is typical of the Lellinge Greensand. Preliminary studies of boulders with *Turritella* species carried out by M.S. Nielsen and the present author indicate that the boulders with the large *Turritella* species contain a poor fauna, whereas boulders with *Haustator nana* generally have a rich fauna. In Table 3, column T, the fauna of a boulder of the latter type is listed, with a similarity index of 89%.

Southern Sweden

Brotzen (1948) described boreholes and boulders from the Swedish Paleocene. Of particular note is a greenish, sandy clay with glauconite from a borehole at Gjuteri AB at Ystad (Fig. 1, **33**) that contained a rich fauna, comparable to that of the Lellinge Greensand at Copenhagen. This fauna, listed in Table 3, column Y, has a similarity index of 86%. Brotzen distinguished between two types of boulders with *Turritella* from the Ystad area: one type with *Turritella* and *Cerithium* and another with abundant *Turritella nana*.

Gustafsson & Norling (1973) described the foraminifer fauna from boreholes in the Svedala area, about 20 km south-east of Malmö, Sweden (Fig. 1, **32**) and also mentioned the presence of otoliths, bivalves and gastropods, mainly *Turritella* species (1973, p. 260). Brotzen (1962, p. 166) stated that a rich molluscan fauna, together with the coral *Sphenotrochus latus*, a species very common in the Selandian deposits in the Copenhagen area, were found in a borehole west of Ystad. Bergström *et al*. (1982, p. 19) correlated part of the section found in these boreholes with the Lellinge Greensand.

Northern Germany

Paleocene faunas are known from several localities and from loose blocks in northern Germany. The Paleocene of the region is well known, particularly through the works of Anderson (1972, 1973, 1974, 1975, 1976, 1977, 1982) and Müller & Strauch (1991).

At Pennigsehl (Fig. 1, **34**) a glacial floe yielded seven species of molluscs (Anderson 1977) that show affinities with the fauna of the Selandian of Copenhagen.

Roedel (1935, 1937) studied the molluscan fauna from Paleocene boulders ('aschgrauer Paläozän-Geschiebe') of NE Germany. This fauna, listed in column Ro of Table 3, has a similarity index of 72% to the Selandian fauna of Copenhagen.

Other German faunas show closer affinities with the middle Danian fauna from Calcaire de Mons in Belgium (Fig. 1, **37**). From Salzstock south of Hannover (Fig. 1, **35**), Anderson (1972) described a fauna of 12 molluscs, of which only *Volutilithes nodifer* is known from the greensand of Copenhagen while six species are in common with the Calcaire de Mons. From the mine shaft Sophia Jacoba 6 (Fig. 1, **36**), Anderson (1973, 1974, 1975) described a rather rich fauna (46 bivalves, four scaphopods and 39 gastropods) of which only ten species are shared with the Copenhagen fauna, whereas 48 species are also common to the fauna from Calcaire de Mons. Müller & Strauch (1991) recorded a rich Paleocene fauna in the mine shaft Sophia Jacoba 8 (Fig. 1, **36**) (65 bivalves, three scaphopods and 48 gastropods); a fauna that demonstrates the same affinity with the fauna from the Calcaire de Mons.

Anderson (1974) refers the Paleocene faunas from the greensand of Copenhagen, northern Germany and Ukraine to the Montian Stage and interprets the fauna from Copenhagen as a deep-water fauna, whereas faunas from the Calcaire de Mons, northern Germany and Ukraine represent more near-coastal faunas. Martini (1977) referred the Paleocene Hückelhofener Schichten and the Paleocene from Pennigsehl to the calcareous nannoplankton zone NP4. Anderson (1982) correlates the German Hückelhofener Schichten and Pennigsehler Schichten and the Montian of Belgium and France with the Danish Lellinge Greensand and Kerteminde Marl formations. Müller & Strauch (1991) refer the Hückelhofener Schichten to the Montian. As the Montian has been correlated with the middle Danian (Bignot 1993) the stratigraphic position of the German Paleocene is uncertain (late Danian or early Selandian).

The Calcaire de Mons fauna (Montian/Danian), Belgium

The classical fauna from the Calcaire de Mons (Fig. 1, **37**) (Montian, i.e. Middle Danian according to Bignot 1993, p. 51) was first studied by Briart & Cornet (1870, 1873, 1877, 1887) and Cossmann (1908, 1915, 1924). Glibert (1973) revised the gastropods and Glibert & van de Poel (1973) the bivalves. This older and very rich fauna has only one certain species in common with the Paleocene of Copenhagen, namely *Corbula koeneni*.

The Thanetian of England and France

The fauna of the Thanet Formation of England, listed by Ward (1978), has no mutual species with the Selandian fauna of Copenhagen. However, a few related species are present. Cossmann & Pissarro (1904–1906, 1910–1913) illustrated the molluscs of the French Thanetian. This large fauna has no mutual species with the Selandian fauna of Copenhagen, but a few species seem to be related.

The Upper Paleocene of Ukraine and Poland

The Paleocene of Ukraine (Fig. 1) was first studied by Arkhanguelsky (1904), and later by, among others, Makarenko (1969, 1976) and Moroz (1972). Makarenko (1969) stated that 67 of the mollusc species were also found in the Danish Paleocene. Of these, 47 are found in the Selandian of Copenhagen. This high number of species seems to suggest a connection between the North Sea Basin and the Russian Basin in late Danian or early Selandian time. Arkhanguelsky (1904, p. 196) suggested such a connection. Grönwall & Harder (1907, p. 71) discussed the affinities of the Danish Paleocene mollusc fauna and concluded that the affinity with the Russian fauna was closer than with the Paleocene faunas from W. Europe (1907, p. 71).

Pozaryski & Pozaryska (1960) and Pozaryska (1967) found foraminiferal faunas of Danian and Selandian age in Poland and were thus also in favour of a connection. The molluscan fauna of the Babica Clay from central Poland was described by Krach (1963, 1969). According to Krach (1969, p. 17) this fauna shares only four species with the Danish Selandian fauna from Copenhagen, but shares 33 species with the Montian of Belgium. Krach (1981) studied a Paleocene fauna from the middle Vistula River, central Poland (Fig. 1). Here the Maastrichtian marls are overlain by glauconitic sandstone followed by marls, and both lithostratigraphic units are referred to the Montian by Krach and correlated with the Lellinge Greensand in Denmark and contemporary sediments in central Poland, Ukraine and the Crimea. The number of mollusc species shared with the Selandian of Copenhagen is 36 out of a total of 120 species (= 30%). However, the state of preservation of the Polish material is generally rather bad, as aragonitic shells have been dissolved, and thus in many cases the determination is based on moulds and impressions.

Additional studies of Ukrainian and Polish faunas are necessary before further palaeogeographic interpretations can be made. Judging from the plates in the papers mentioned above the material from Ukraine is also rather poorly preserved when compared to the Danish material, thus making a safe identification of Ukrainian species difficult.

The Paleocene of Austria

Traub (1938, 1979, 1980, 1981, 1984, 1989) described the Paleocene faunas from Haunsberg, north of Salzburg (Fig. 1, **38**) in Austria and concluded that they had minimal affinity with the Danish Paleocene of Copenhagen. The stratigraphic age of the Paleocene of Austria in fact ranges from late Danian to early Eocene (Ilerdian), according to Kuhn & Weidich (1987), Kuhn (1992) and Traub & Werner (1993). The connection between the North Sea Basin and Paratethys ended in the early Selandian (Heilmann-Clausen 1995, p. 70).

The Paleocene of West Greenland

Kollmann & Peel (1983) described and illustrated a gastropod fauna from the locality 'Sonja lens' in the Turritella Kløft on the Nugssuaq peninsula. This fauna has no species in common with the Selandian fauna from Copenhagen, but several species are related. According to Kollmann & Peel (1983) the 'Sonja lens' is a sandstone lens near the middle of the Sonja Member of the Agatdal Formation. Hansen (1980) considered this formation to be of middle Paleocene age which means a post-Danian, probably Selandian age, in accordance with Dam & Sønderholm's (1994) reference of the Agatdal Formation to the Selandian.

A study of the otoliths from the 'Sonja lens' is in progress. According to W. Schwarzhans (written communication 1998) this otolith fauna has ten species out of a total of 23 species shared with the otolith fauna from the Selandian of Copenhagen.

Conclusions

The Selandian molluscan fauna from the Lellinge Greensand of the Copenhagen area clearly differs from the older Danian molluscan fauna of Fakse. Although some of the differences may be due to variations in sedimentary facies there is clearly also a difference in age. The older Danian fauna indicates a warm sea whereas the younger Selandian fauna of Copenhagen points to a lower sea temperature. The connection between the North Sea Basin and Paratethys closed in the Early Selandian and this probably explains the dramatic change of the north European molluscan fauna from late Danian to Selandian. The Selandian fauna of Copenhagen also clearly differs from the older Montian fauna of Belgium.

The Selandian fauna from Copenhagen demonstrates affinities with the faunas from Selandian boulders from Denmark, Sweden and northern Germany, whereas the fauna from the Kerteminde Marl shows affinity to a lesser degree.

The affinities with the post-Danian faunas from Germany and Austria are very small, due primarily to different facies, but probably also to different ages and provincialism.

The fauna from the Paleocene of West Greenland demonstrates a number of related species, but this fauna shares no species with the Selandian of Copenhagen.

The high number of species in common with the Ukraine, central Poland and the Selandian fauna of Copenhagen indicates that a connection between the North Sea Basin and the Ukraine Basin existed in late Danian to early Selandian time.

Palaeoecological interpretation

The frequencies of the mollusc species from Sundkrogen are given in Table 4, pp. 31–33. In Tables 5–9 all mollusc species with a frequency higher than 1% are listed. The diversity of the molluscan fauna and the frequencies of common species from the different series are shown in Figs 6–10.

The glauconitic greensand (series 1 and 2)

In the lower part of the glauconitic greensand (series 1a, 1b) bivalves are dominant, and more than half of the bivalve species have their greatest frequency here, especially filtrating sessile genera belonging to the epifauna (*Cucullaea*, *Barbatia*, *Arcopsis*, *Lima*) and cementing genera like *Ostrea* and *Exogyra*. Representatives of the genera *Nucula*, *Glycymeris*, *Limopsis, Crassatella, Astarte, Venericardia, Lucina* and *Corbula* are burrowing and thus represent the infauna; of these, *Nucula* is a detritus predator and the other genera mentioned are filtrating. A very high number of the bivalve shells are crushed and/or green-coloured, especially the genera *Glycymeris* and *Astarte,* thus indicating a high energy situation which is also suggested by the common sessile bivalves. The bivalve specimens comprise 40.6% of all mollusc specimens in series 1a, 1b (Fig. 7; Table 5). In series 1c, the percentage of the bivalves decreases distinctly (Fig. 7; Table 6), but increases slightly in series 2 (Fig. 7; Table 7).

Table 4. Frequencies of mollusc species from Sundkrogen

	Species	Ravn	1a-b	1c	Series 2	3	4
**	*Leionucula* sp.		0.023	0.021			
	Nucula densistria von Koenen 1885	1	0.297	0.119	0.103	0.015	0.052
*	*Nucula? subaequilatera* von Koenen 1885	2	0.170	0.144	0.124	0.004	0.003
	Nuculana crassistria (von Koenen 1885)	4	2.549	2.156	1.034	0.345	3.365
	Nuculana symmetrica (von Koenen 1885)	5					0.005
	Nuculana ovoides (von Koenen 1885)	6	0.637	0.119	0.041	0.077	0.026
**	*Portlandia (Yoldiella) nielseni* n. sp.						0.106
*	*Cucullaea dewalquei* von Koenen 1885	7	0.425	0.192	0.207	0.027	0.003
	Barbatia praescabra (von Koenen 1885)	8	8.496	4.312	4.653	2.235	0.067
	Nuculina glabra Ravn 1939	14	0.042			0.008	
	Arcopsis limopsis (von Koenen 1885)	10	0.425	0.240	0.124	0.019	0.031
	Glycymeris corneti (von Koenen 1885)	12	6.372	1.437	2.068	0.182	0.003
	Limopsis monbergi Ravn 1939	13	0.680	0.311	0.289	0.062	0.005
	Modiolus sp.	46	1.487	0.168	0.124	0.019	0.005
	Crenella sphaericula von Koenen 1885	47	0.255	0.240	0.165	0.031	0.005
**	*Arcoperna?* sp.					0.004	
	Avicula sp.	38			0.041		
	Pinna sp.	39		0.119	0.021	0.004	0.003
	Propeamussium bisculptum (von Koenen 1885)	41	0.127	0.048	0.083	0.031	
	Propeamussium hauniense Ravn 1939	42	0.127	0.119	0.021	0.043	0.003
	Chlamys palaeocaenica (Staesche 1937)	43		0.023	0.021	0.004	0.003
**	*Plicatula selandica* n. sp.		0.042				
*	*Lima geinitzi* (von Hagenow 1842)	40	0.085	0.072	0.021	0.008	
*	*Ostrea* sp.	44	5.183	1.757	3.309	0.655	0.003
	Exogyra canaliculata (Sowerby 1813)	45	0.552	0.264	0.186	0.046	0.003
	Lucina lepis von Koenen 1885	20	0.340	0.359	0.248	0.008	
	Lucina planistria von Koenen 1885	21	0.297	0.048	0.041	0.023	0.003
*	*Lucina (Phacoides)* sp.	22	0.085		0.041	0.008	
	Astarte trigonula von Koenen 1885	16	7.859	2.875	3.577	0.124	0.003
	Crassatella hauniensis Ravn 1939	17		0.023	0.021	0.008	
	Crassatella groenwalli Roedel 1935	18	0.042	0.023		0.019	
	Crassatella subplana Ravn 1939	19	0.255	0.119	0.165	0.019	0.003
	Venericardia roedeli Ravn 1939	15	0.935	0.839	0.517	0.093	0.008
	Loxocardium cf. *tenuitesta* (Cossmann 1908)	23	0.042	0.023	0.021	0.008	
**	*Protocardia semidecussata* (von Koenen 1885)	24		0.048	0.062	0.004	
	Tellina sp.	28	0.042	0.072	0.083	0.008	0.010
*	*Tellina* n. sp. von Koenen 1885		0.042				
	Gari sp.	30		0.023		0.004	
	Cytherea sp.	25		0.719	0.352	0.066	0.005
	Circe angelini (von Koenen 1885)	27	0.042	0.264	0.041	0.013	0.003
**	*Veniella* cf. *ciplyensis* Vincent 1930		0.042		0.004	0.004	
	Corbula koeneni Cossmann 1908	34	1.487	0.599	0.931	0.136	0.005
	Teredinidae indet.	37	0.042	0.023	0.041	0.008	0.003
	Pholadomya margaritacea (Sowerby 1823)	31	0.340		0.083		
**	*Laternula (Laternulina) ravni* n. sp.	32	0.255	0.311		0.012	0.023
	Lyonsia sp.	35		0.072		0.004	0.005
**	*Lyonsia baltica* Roedel 1935		0.042			0.004	
**	*Thracia* sp.			0.023			0.003
**	*Cuspidaria* sp.		0.127	0.023	0.021	0.008	
	Verticordia granulosa Ravn 1939	33	0.127	0.048	0.103	0.019	0.013
	Bivalvia gen. et spec. indet.					0.004	
	Dentalium rugiferum von Koenen 1885	49	1.487	0.359	0.620	0.097	0.005
**	*Dentalium sundkrogensis* n. sp.	(49)	1.827	4.792	3.908	1.302	14.174
	Dentalium undiferum von Koenen 1885	50	3.398	1.797	1.241	1.162	0.647
**	*Dentalium* sp.				0.021	0.008	
	Siphonodentalium intumescens (von Koenen 1885)	51				0.008	0.388
	Emarginula sp.	53			0.021		
	Patella subglabra Ravn 1939	61					0.013
	Acmaea poulseni Ravn 1939	62				0.008	
*	*Solariella (Solariella) ravni* n. sp.	56			0.041	0.004	
**	*Solariella (Solariella) hauniensis* n. sp.						0.015
**	*Solariella?* sp.					0.004	

Table 4 (*continued*)

	Species	Ravn	1a-b	1c	Series 2	3	4
*	*Teinostoma ledoni* n. sp.	59	0.170			0.027	
*	*Lacuna (Pseudocirsope) ovalis* von Koenen 1885	64	0.012			0.004	
**	*Entomope kirstineae* n. sp.						0.023
	Alvania hauniensis Ravn 1939	70	0.127	0.287	0.476	0.105	1.069
*	*Cyclostrema denselineatum* Ravn 1939	60			0.021	0.012	
	Architectonica koeneni (Ravn 1939)	63	0.042	0.048	0.083	0.015	0.018
	Pseudomalaxis pingeli (Mørch 1874)	54			0.062	0.054	0.067
	Pseudomalaxis groenwalli (Ravn 1939)	55			0.021		
	Acrocoelum gracilis (von Koenen 1885)	88	2.549	3.642	5.170	1.647	0.634
	Acrocoelum obtusa (von Koenen 1885)	89	0.382	0.168	0.620	0.372	
	Mathilda (Fimbriatella) quadricincta Ravn 1939	90				0.004	0.003
	Mathilda (Fimbriatella) carinata Ravn 1939	91		0.023	0.021	0.046	0.021
	Mathilda lemchei Ravn 1939	92	0.340	0.192	0.331	0.070	0.016
	Bayania obtusata (von Koenen 1885)	82	0.425	0.048	0.393	0.031	0.078
	Haustator nana (von Koenen 1885)	80	15.208	43.603	36.187	63.149	52.035
	Haustator suessi (von Koenen 1885)	81	0.425	0.455	0.372	0.186	0.021
*	*Metacerithium hauniense* (von Koenen 1885)	93	0.127	0.048	0.062	0.004	
**	*Harrisianella subglabra* n. sp.				0.021	0.008	
**	*Bittium (Bittium) oedumi* n. sp.		0.085				
	Cerithiopsis hauniensis Ravn 1939	95	0.170		0.124	0.077	
	Cerithiopsis grewingki (von Koenen 1885)	94		0.024			0.003
	Cerithiopsis similis (Ravn 1939)	97	0.127	0.024	0.041	0.015	0.003
**	*Cerithiopsidella (Vatopsis) rasmusseni* n.sp.		0.085		0.004		
	Cerithiella (sensu lato) monbergi (Ravn 1939)	96	0.255	0.024	0.289	0.093	0.052
**	*Seila (Notoseila) heilmannclauseni* n. sp.		0.127		0.041	0.008	
**	*Seila (Notoseila) anderseni* n. sp.		0.170				
**	*Thereitis weinbrechti* n. sp.					0.027	0.039
**	*Biforina (Oriforina)* sp.				0.062	0.004	
	Eucycloscala crassilabris (von Koenen 1885)	72	0.850	0.958	1.592	0.775	1760
	Acirsa (Hemiacirsa) elatior (von Koenen 1885)	78	0.127	0.024	0.103	0.054	
	Acrilla gryi Ravn 1939	75	0.085		0.165	0.046	0.008
	Acrilla fenestrata Ravn 1939	76		0.216	0.124	0.019	
	Acrilla bruennichi Ravn 1939	77			0.103	0.015	0.013
	Coniscala johnstrupi (Mørch 1874)	71	0.127		0.103	0.039	0.039
	Cerithiscala poulseni (Ravn 1939)	73	0.212	0.192	0.476	0.856	
	Cerithiscala hauniensis (Ravn 1939)	74	1.062	0.958	1.365	0.446	
**	*Cirsotrema (Cirsotrema) hauniensis* n. sp.		0.042				
**	*Opalia (Pliciscala) thomseni* n. sp.						0.003
**	*Scaliidae* indet.		0.042		0.021		
	Aclis (Graphis) densestriatus Ravn 1939	79	0.042			0.058	0.018
	Polygyreulima solidula (von Koenen 1885)	87	0.042	0.024	0.083	0.015	0.031
	Aporrhais gracilis von Koenen 1885	98	0.127	0.096	0.062	0.031	5333
*	*Calyptraea* sp.	65	0.127	0.048		0.015	
	Xenophora sp.	58	0.255	0.120	0.103	0.023	0.005
	Lunatia detracta (von Koenen 1885)	66		0.024	0.124	0.015	0.526
	Lunatia detrita (von Koenen 1885)	67		0.192	0.165	0.004	0.114
	Tectonatica lindstroemi (von Koenen 1885)	68	1.784	0.935	3.040	0.920	0.515
	Naticidae indet.		3.186	2.450	1.551	1.666	1.797
*	*Amauropsella decussata* (von Koenen 1885)	69					0.005
*	*Sycostoma striata* (von Koenen 1885)				0.021		0.003
	Cassidaria elongata von Koenen 1885	101		0.144	0.103	0.039	0.003
	Charonia (Sassia) bjerringi (Ravn 1939)	102			0.021	0.004	0.008
**	*Charonia (Sassia) danica* n. sp.		0.042	0.024	0.021		0.010
	Murex (sensu lato) nanus Ravn 1939	109		0.024	0.041	0.008	0.010
	Urosalpinx pyruloides (von Koenen 1885)	110	0.042	0.048	0.021	0.058	0.008
*	*Tritonidea rosenkrantzi* Ravn 1939	106		0.024	0.021		
	Siphonalia hauniensis Ravn 1939	107	0.212		0.724	0.043	0.137
**	*Siphonalia ariejansseni* n. sp.		0.467	0.336	0.041	0.171	
	Astyris (Astyris) lappanni n. sp.	117		0.024	0.207	0.062	0.010
*	*Pseudoandonia crispata* (Ravn 1939)	114	0.042				
	Suessionia densestriata (von Koenen 1885)	103	0.382	0.240	0.765	0.511	0.161
	Suessionia canalifera Ravn 1939	104	5.905	4.959	7.031	3.553	2.149

Table 4 (*continued*)

	Species	Ravn	1a-b	1c	Series 2	3	4
	Pseudoliva koeneni Ravn 1939	105	0.042				0.004
	Fusus danicus von Koenen 1885	111	0.510	0.216	0.352	0.062	0.028
*	*Levifusus moerchi* (von Koenen 1885)	113			0.083	0.004	0.003
	Streptolathyrus? johnstrupi (von Koenen 1885)	112				0.004	
**	*Streptolathyrus danicus* n. sp.					0.058	0.487
**	*Streptolathyrus lemchei* n. sp.					0.004	
	Clavella hauniensis Ravn 1939	115					0.003
	Exilia crassistria (von Koenen 1885)	116	0.127	0.072	0.062	0.008	0.018
	Scaphella crenistria (von Koenen 1885)	122			0.021	0.008	
	Ancilla (Sparella) flexuosa (von Koenen 1885)	123	1.657	0.719	1.096	0.542	0.311
	Volutilithes nodifer (von Koenen 1885)	121	0.425	0.072	0.165	0.058	0.005
	Kroisbachia conoidea (von Koenen 1885)	124	0.042		0.083	0.015	0.091
	Admetula latesulcata (von Koenen 1885)	125	0.935	0.479	1.034	1.503	1.004
	Brocchinia tricincta (von Koenen 1885)	126	0.212	0.024	0.248	0.062	0.008
	Admete curta (von Koenen 1885)	127	0.042				
	Sveltella planistria (von Koenen 1885)	129			0.124	0.015	0.065
	Sveltella multistriata (Ravn 1939)	130	0.042	0.024	0.124	0.054	0.021
	Babylonella ravni (Glibert 1960)	128	3.101	2.156	3.805	1.244	1.833
**	*Cancellaria (sensu lato) jakobseni* n. sp.				0.062	0.004	
*	*Fusimitra densistria* (von Koenen 1885)	119	0.042				
*	*Fusimitra aequicostata* (von Koenen 1885)	120				0.004	
	Hemipleurotoma gryi (Ravn 1939)	131	0.765	0.431	0.765	0.186	0.329
	Hemipleurotoma danica (von Koenen 1885)	132	0.255	0.479	0.165	0.058	0.173
	Eopleurotoma selandica (von Koenen 1885)	133	0.255		0.041	0.012	0.124
	Pleurotomidae indet.		0.680		1.551	0.504	1.244
	Surcula hauniensis (von Koenen 1885)	134				0.015	0.021
	Surcula johnstrupi (von Koenen 1885)	135	0.212		0.207	0.004	0.021
	Surcula rosenkrantzi Ravn 1939	136	0.042	0.072	0.103	0.066	0.093
	Surcula torelli (von Koenen 1885)	137	0.467	0.264	0.806	0.124	0.300
	Surcula fissicosta (von Koenen 1885)	138				0.008	0.104
	Surcula sp. indet.				0.035	0.104	
	Pseudocochlespira koeneni (Arkhanguelsky 1904)	139	0.127	0.048	0.165	0.066	0.031
	Pseudocochlespira boeggildi (Ravn 1939)	140	0.127	0.096	0.083	0.209	0.044
**	*Pseudocochlespira rosenkrantzi* n. sp.	140				0.008	0.003
	Genotia brevior (von Koenen 1885)	141	0.042		0.186	0.004	0.003
	Pseudotoma steenstrupi (von Koenen 1885)	142			0.062		0.041
*	*Pseudotoma inconspicua* (von Koenen 1885)	143	0.042				
	Cordieria binodosa (von Koenen 1885)	144	0.850	0.359	1.075	0.155	0.124
**	*Actaeopyramis marcusseni* n. sp.					0.004	0.096
**	*Chrysallida (Parthenina) peterseni* n. sp.						0.010
**	*Cingulina harderi* n. sp.				0.008	0.013	
**	*Syrnola (Syrnola) granti* n. sp.		0.042			0.062	0.096
**	*Ebala* sp.				0.021		0.003
	Odostomia undifera (von Koenen 1885)	84	0.127	0.311	0.165	1.174	1.600
*	*Odostomia (Cyclodostomia) obtusa* (von Koenen 1885)	85			0.744		
	Odostomia (Cyclodostomia) pupaeformis (von Koenen 1885)	86					0.005
	Turbonilla beyrichi von Koenen 1885	83	0.807	1.797	1.386	0.817	1.266
	Actaeon pusillus Ravn 1939	145	0.085	0.359	0.393	0.170	0.378
	Ravniella regularis (von Koenen 1885)	146	0.722	0.479	1.241	1.162	0.104
	Retusa plicatella (von Koenen 1885)	147	2.549	3.594	0.579	1.274	1.463
	Crenilabium elatum (von Koenen 1885)	148	0.637	3.115	0.827	0.353	1.281
	Gilbertina ultima (von Koenen 1885)	149	1.274	0.838	1.241	0.504	0.155
*	*Ringicula (Ringiculina) erratica* Roedel 1937	150	0.042	0.040	0.062	0.012	
	Roxania clausa (von Koenen 1885)	151		0.048	1.654	0.008	0.393
*	*Bulla (Haminea?)* sp.	152		0.021		0.005	
**	*Acteocina?* sp.					0.008	
	Cylichna discifera von Koenen 1885	153	1.274	1.917	2.859	0.619	0.393
	Nautilus sp.	154	0.382	0.024	0.021	0.004	

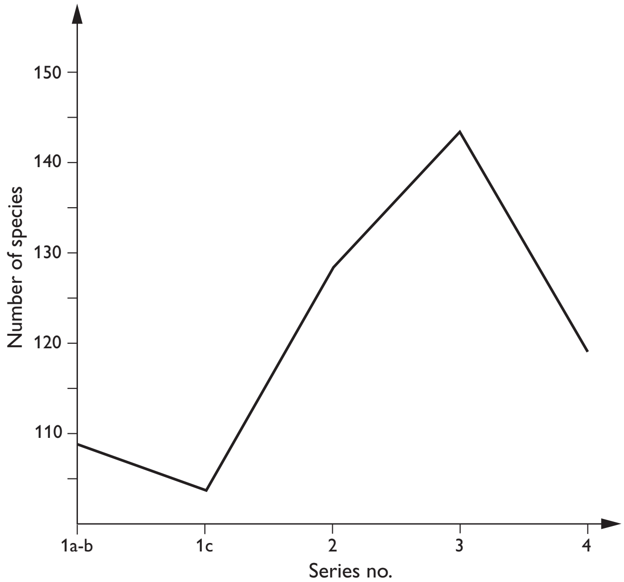

Fig. 6. Diversity of molluscan assemblages.

Table 5. Frequency of mollusc species, series 1a and 1b

No.	Species	%
1	*Haustator nana*	15.21
2	*Barbatia praescabra*	8.50
3	*Astarte trigonula*	7.86
4	*Glycymeris corneti*	6.37
5	*Pseudoliva koeneni*	5.91
6	*Ostrea* sp.	5.18
7	*Dentalium undiferum*	3.40
8	*Naticidae* indet.	3.19
9	*Babylonella ravni*	3.10
10	*Acrocoelum gracilis*	2.55
11	*Retusa plicatella*	2.55
12	*Nuculana crassistria*	2.55
13	*Dentalium sundkrogensis*	1.83
14	*Tectonatica lindstroemi*	1.78
15	*Dentalium rugiferum*	1.49
16	*Corbula koeneni*	1.49
17	*Modiolus* sp.	1.49
18	*Ancilla flexuosa*	1.66
19	*Gilbertina ultima*	1.27
20	*Cylichna discifera*	1.27
21	*Cerithiscala hauniense*	1.06
Total		79.69

The scaphopods *Detalium rugiferum* and *D. undiferum* have their highest frequencies in series 1a, 1b, but almost all specimens are crushed and/or worn. *D. sundkrogensis* n. sp. is less frequent.

In series 1a, 1b, no less than 28 gastropod species have their highest frequency, and altogether the gastropod specimens comprise 52.7% of all mollusc specimens (Fig. 7). However, the gastropods are not very conspicuous because they are small. In series 1c the percentage of the gastropods increases to 75.4, and this percentage is almost unchanged in series 2 (75.2) (Fig. 7). However, 31 gastropod species have their greatest frequency in series 2, although the most common species *Haustator nana* has a distinct decrease in frequency (Fig. 10).

In series 1a, 1b, 21 species represent 79.7% of all molluscs (Table 5), in series 1c 12 species represent 80.7% (Table 6) and in series 2 14 species represent 80.5% (Table 7).

The glauconitic greensand has a very high content of reworked Danian fossils and thus indicates a high-energy situation with erosion of the underlying København Limestone (Danian). The abundance of corals indicates excellent conditions, i.e. oxygen-rich water and nutrient-rich sea currents.

The fine-grained greensand (series 3)

The bivalves have decreased in frequency in the fine-grained greensand (series 3) relative to the underlying glauconitic greensand, and only *Barbatia praescabra* has a frequency higher than 1% (Table 8). This fauna is dominated by many gastropod species, which comprise no less than 93% of all mollusc specimens (Fig. 7). Only a few gastropods have their highest frequency

Table 6. Frequencies of mollusc species, series 1c

No.	Species	%
1	*Haustator nana*	43.60
2	*Pseudoliva koeneni*	4.96
3	*Dentalium sundkrogensis*	4.79
4	*Barbatia praescabra*	4.31
5	*Acrocoelum gracilis*	3.64
6	*Naticidae* indet.	3.60
7	*Retusa plicatella*	3.59
8	*Crenilabium elatum*	3.12
9	*Astarte trigonula*	2.88
10	*Nuculana crassistria*	2.16
11	*Babylonella ravni*	2.16
12	*Cylichna discifera*	1.92
13	*Turbonilla beyrichi*	1.80
14	*Dentalium undiferum*	1.80
15	*Ostrea* sp.	1.76
16	*Glycymeris corneti*	1.43
Total		87.63

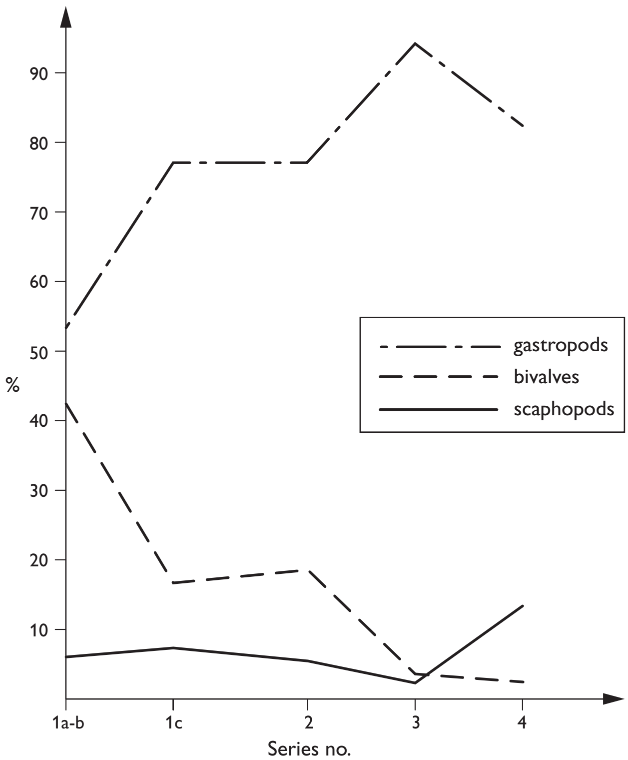

Fig. 7. Distribution of molluscan classes.

Table 7. Frequencies of mollusc species, series 2

No.	Species	%
1	*Haustator nana*	36.19
2	*Pseudoliva koeneni*	7.03
3	*Acrocoelum gracilis*	5.17
4	*Barbatia praescabra*	4.65
5	*Dentalium sundkrogensis*	3.91
6	*Babylonella ravni*	3.81
7	*Astarte trigonula*	3.58
8	*Ostrea* sp.	3.31
9	*Tectonatica lindstroemi*	3.04
10	*Cylichna discifera*	2.90
11	*Glycymeris corneti*	2.07
12	*Roxania clausa*	1.65
13	*Eucycloscala crassilabris*	1.59
14	*Naticidae* indet.	1.55
15	*Pleurotomidae* indet.	1.55
16	*Turbonilla beyrichi*	1.39
17	*Cerithiscala hauniensis*	1.37
18	*Ravniella regularis*	1.24
19	*Gilbertina ultima*	1.24
20	*Dentalium undiferum*	1.24
21	*Ancilla flexuosa*	1.10
22	*Cordieria binodosa*	1.08
23	*Nuculana crassistria*	1.03
Total		91.67

Table 8. Frequencies of mollusc species, series 3

No.	Species	%
1	*Haustator nana*	63.15
2	*Pseudoliva koeneni*	3.55
3	*Eucycloscala crassilabris*	2.24
4	*Naticidae* indet.	1.67
5	*Acrocoelum gracilis*	1.65
6	*Admetula latesulcata*	1.50
7	*Dentalium sundkrogensis*	1.30
8	*Retusa plicatella*	1.27
9	*Babylonella ravni*	1.24
10	*Odostomia undifera*	1.17
11	*Dentalium undiferum*	1.16
12	*Ravniella regularis*	1.16
Total		81.07

Table 9. Frequencies of mollusc species, series 4

No.	Species	%
1	*Haustator nana*	52.04
2	*Dentalium sundkrogensis*	14.17
3	*Aporrhais gracilis*	5.33
4	*Nuculana crassistria*	3.37
5	*Pseudoliva koeneni*	2.15
6	*Babylonella ravni*	1.83
7	*Naticidae* indet.	1.80
8	*Eucycloscala crassilabris*	1.76
9	*Pleurotomidae* indet.	1.64
10	*Odostomia undifera*	1.60
11	*Retusa plicatella*	1.46
12	*Crenilabium elatum*	1.28
13	*Turbonilla beyrichi*	1.27
14	*Alvania hauniensis*	1.07
15	*Admetula latesulcata*	1.00
Total		91.77

here but *Haustator nana* has a frequency of 63.1%. The gastropods are characterised by herbivores from the epifauna, such as species of Mathildidae and Cerithiopsidae. Representatives of the burrowing carnivores are also rather common (Naticidae and *Suessionia*). The opisthobranchiate species *Ravniella regularis* is also very common. Table 6 shows that ten species represent 80% of all molluscs. The molluscan fauna of the fine-grained greensand has the highest diversity of all series.

The amount of reworked material from the Danian is considerably lower when compared to the glauconitic greensand (series 1, 2). Spines of the echinoid *Palaeodiadema* are rather frequent, as is the coral *Trochocyatus calcitrapa*. The fine-grained greensand

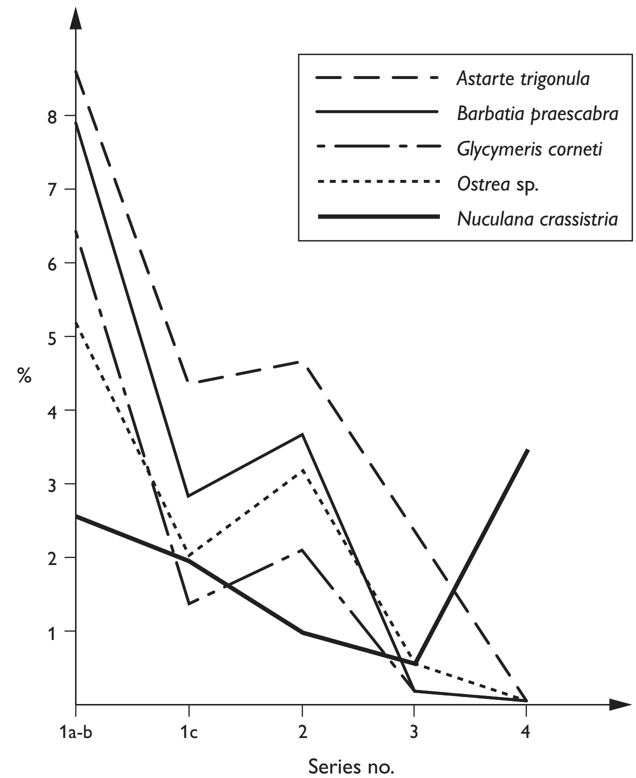

Fig. 8. Frequencies of common bivalve species.

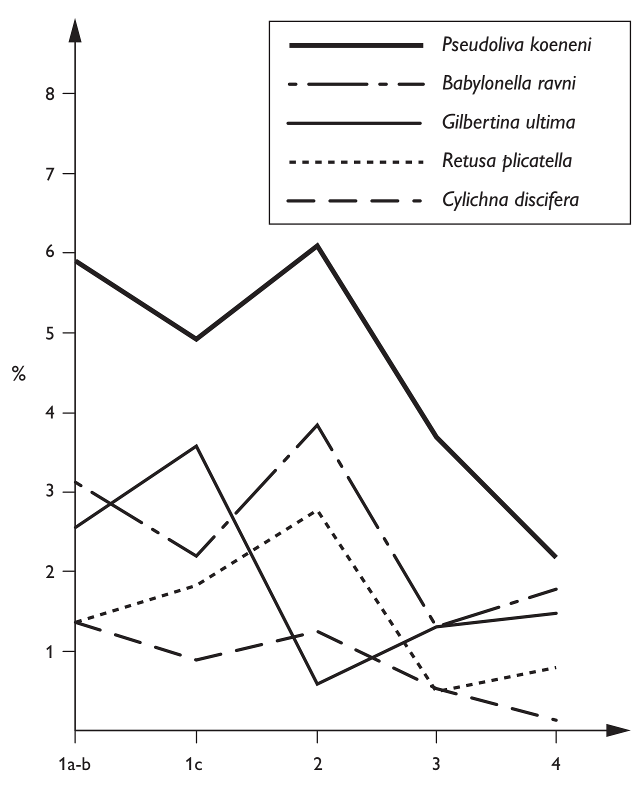

Fig. 9. Frequencies of some gastropod species.

thus indicates excellent conditions for almost all mollusc species, relatively better conditions than in the glauconitic greensand for burrowing echinoids, and good conditions for the corals.

The dark clay/marl (series 4)

The molluscan fauna of the dark clay and marl (series 4) is dominated by the gastropods, while their frequency has decreased to 81.4%, due to the high frequency of *Dentalium sundkrogensis* (14.2%) (Fig. 7; Table 9). *Gadila intumescens* is also common while other scaphopods are sparse. The bivalves generally have low frequencies, except for the small burrowing species *Nuculana crassistria*, which is very common (Fig. 8), often occurring with both valves united. The bivalve *Portlandia (Yoldiella) nielseni* n. sp. has been only found in the clay. According to Moore (1969, p. N239) the subgenus *Yoldiella* is mostly found in deep water.

Only a few gastropods have their highest frequency in the dark clay (Fig. 9). Harder (1922) considered the three gastropod species *Haustator (=Turritella) nana*, *Aporrhais gracilis* and *Eucycloscala crassilabris* to be characteristic of this series. The present study only partly confirms this (Fig. 10). The first species is the most common species in all sediment types and reaches its highest frequency in the fine-grained greensand. The frequency is distinctly lower in the dark marl, but the species is still extremely common, also as adult specimens, while adult specimens are almost absent in the glauconitic greensand and in the fine-grained greensand. *Aporrhais gracilis* is common and present almost only as adult specimens, but scarce in other sediments. *Eucycloscala crassilabris* has a frequency of 1.8% and is thus not as common as stated by Harder (1922). The species is represented by both juvenile and adult specimens.

Harder's conclusion is most likely drawn from the fact that these three species are very conspicuous because of their size. *Haustator* and *Eucycloscala* are members of the semi-infauna and filtrators while *Aporrhais* is epifaunic and both a detritus predator and filtrator. The rissoid species *Alvania hauniensis* is rather common, indicating the presence of algae and littoral conditions (Wenz 1939, p. 606), while the high number of the ectoparasitic *Odostomia* spp. indicates a rich fauna (Müller & Strauch 1991, p. 91). The number of burrowing carnivores is high, belonging to the Naticidae, the Cancellariidae, the Fasciolariidae, the

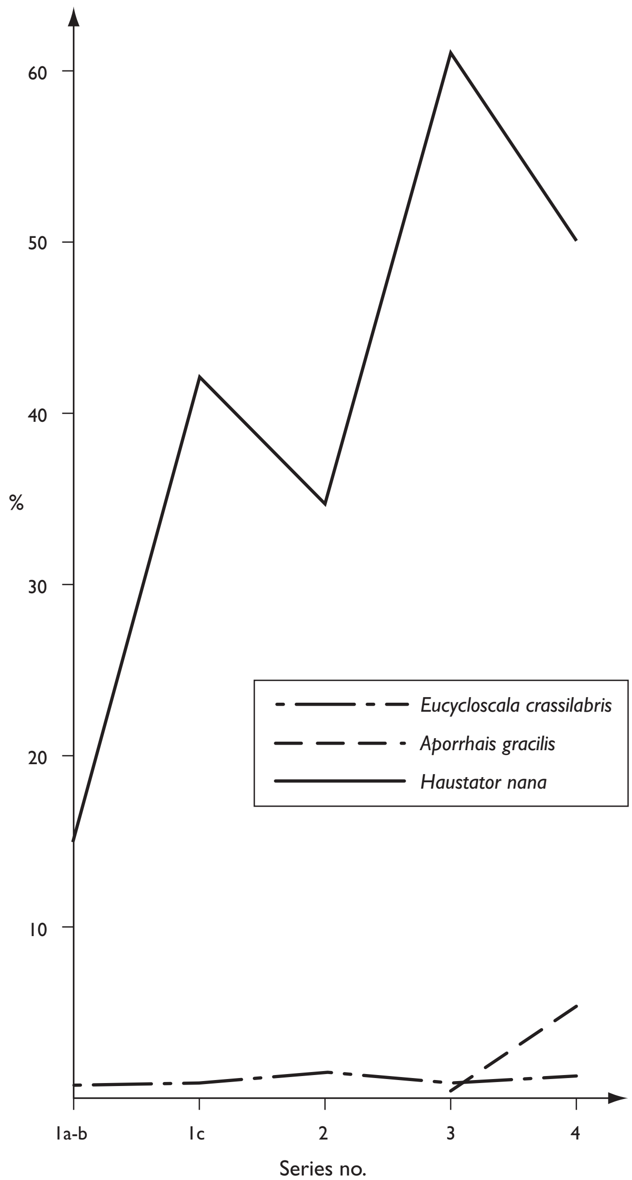

Fig. 10. Frequencies of *Haustator nana*, *Aporrhais gracilis* and *Eucycloscala crassilabris*.

Turridae and representatives of the opisthobranchiates. As adult specimens from these groups are common, they indicate nutrient-rich conditions and a soft bottom in quiet water. Harder (1922) assumed that the gastropod fauna was dominated by juvenile specimens, but many adult species are in fact small. Table 7 shows that only seven species represent 80.7% of all mollusc species.

The reworked Danian material is almost completely absent, whereas spines of echinoids, e.g. *Palaeodiadema* and spoon-shaped spines of a spatangoid are common, thus indicating a soft bottom with oxygen, sufficient for burrowing animals, and quiet water conditions. There are no indications of extreme anoxic conditions, as was assumed by Harder. The fauna is considered to be autochthonous by the present author.

The frequencies of *Dentalium sundkrogensis* (juvenile specimens only), *Nuculana crassistria*, *Aporrhais gracilis* and the common adult specimens of *Eucycloscala crassilabris* suggest that these species were favoured by the conditions. Furthermore, the decrease in diversity of the molluscan fauna (Fig. 6) indicates less favourable conditions for several species.

The very low number of anthozoans indicates quiet water conditions, without sea currents and a soft bottom, not suitable for this sessile animal group. The otolith fauna found in the dark clay is similar to the fauna found in the fine-grained greensand and the glauconitic greensand (W. Schwarzhans, personal communication 1996). The dark colour of the clay is due to a high content of organic material, consistent with the high pyrite content.

Discussion

Harder (1922) compared the succession at Sundkrogen with a similar sequence in several boreholes on Sjælland. The succession is characterised by sandy, glauconitic clay, overlain by a fining-upward sequence followed by a more or less dark, pyritic clay in the Copenhagen area, or by the Kerteminde Marl on Sjælland and Fyn, and in Jylland. Such a succession is generally interpreted as a transgression, though Harder assumed other sedimentary conditions. In the upper part of the dark clay he found thin sand horizons, which he considered to be littoral, and he furthermore considered the dark colour of the clay and the high pyrite content to reflect deposition in shallow, anoxic water with a high content of organic matter. He concluded that the sediments at Sundkrogen were initially deposited in a high-energy environment, rich in oxygen, in an area that gradually became isolated from the open sea by sand or by uplift.

Harder also pointed to evidence in the molluscan assemblage from the dark clay, which he considered to be dominated by three species of gastropods. Furthermore, he stated that a high number of juvenile specimens of several species are present, assuming that the dominant species had excellent conditions, while the juvenile specimens preferred more oxygen-rich conditions. He concluded that the molluscan fauna had been transported into the lagoon by the tide or by sea currents.

Rosenkrantz (1924) stated that a fauna dominated by small mollusc species was, except for the basal layers, characteristic of the deposits from the Selandian; he thus found no evidence for the lagoonal conditions assumed by Harder. Later, Rosenkrantz suggested that the different development of the Paleocene in the Copenhagen area compared to central Sjælland might be due to an uplift of the area south-west of Copenhagen (Rosenkrantz 1924). He proposed an inlet from the Selandian sea from north Sjælland and the Copenhagen area to Klagshamn in Sweden (Fig. 1) and that open sea conditions prevailed in central and western Sjælland.

The palaeoecology was also discussed by Ravn (1939). He found that many specimens of *Haustator nana* from the dark clay had been prey for naticid gastropods, whereas such borings in the shells from the fine-grained greensand were very rare. Ravn assumed that the fauna was autochthonous and that the well-preserved shells were not indicative of long distance transport. He concluded that the conditions for the molluscan assemblage were excellent, at least for reproduction.

Sorgenfrei (1965), on the basis of Ravn (1939), stated that the molluscan assemblage from the glauconitic greensand and from the marl (= the dark clay) had a higher number of species and specimens than the assemblage from the fine-grained greensand, and he characterised the molluscan assemblage from the Selandian of Copenhagen as a *Turritella–Aporrhais–Eucycloscala* community with *Natica* and *Dentalium*. He considered this community typical for a relatively shallow, more or less silty and sandy bottom of the transgressing Selandian sea.

Larsen & Jørgensen (1977) studied the palaeobathymetry of the lower Selandian on the basis of foraminifera and suggested that the coastline was possibly located in the Ystad area in Sweden (Fig. 1) during the early Selandian.

Andersen & Heilmann-Clausen (1984) discussed the 'reddish brown *Turritella* sandstone', which they interpreted as being deposited in shallow water, possibly near Bornholm.

Liboriussen *et al.* (1987) suggested an island or a row of islands along the Fennoscandian Border Zone consistent with the assumed lagoonal environment of Harder (1922).

Müller & Strauch (1991) in a discussion on the palaeoecology in Paleocene sediments from the Lower Rhine area (Hückelhofener Schichten), state that a typical *Turritella* coenosis might indicate anoxic conditions and that *Turritella* and *Aporrhais* were suited to live under extreme conditions. They concluded, however, that the diverse nature of the mollusc species precluded such extreme conditions.

On the basis of his coccolith studies from Sundkrogen, E. Thomsen (personal communication 1997) concluded that the coccolith flora and the considerable sedimentological difference between the Havdrup borehole and the Sundkrogen section indicate that the two areas were probably partly separated by some lagoonal barrier.

Table 10. Mollusc biofacies

	Brown *Turritella*-boulders	Glauconitic greensand (series 1, 2)	Fine-grained greensand (series 3)	Dark clay/marl (series 4)
Depth	Above wavebase, shallow water, tidal to subtidal	Below wavebase subtidal	Below wavebase subtidal deeper water	Deep water
Environment	Littoral zone, free oxygen, high energy	Marine, free oxygen, high to moderate energy	Moderate oxygen, moderate energy	Relatively low oxygen, low energy to no current
Molluscan fauna	Large specimens of *Turritella*, rather poor fauna	*Haustator* *Barbatia* *Astarte* *Glycymeris* community	*Haustator* *Pseudoliva* *Eucycloscala* community with *Natica*	*Haustator* *Dentalium* *Aporrhais* *Nuculana* community

Conclusion and palaeoecological interpretations

The Sundkrogen sequence is interpreted as being deposited during the Selandian transgression, resulting in erosion of the underlying Danian deposits (Gry 1935). The sea was initially shallow but water depth gradually increased resulting in deposition of fine-grained greensand and then the dark clay. This clay represents depositional conditions with lowest energy and relatively low oxygen content. The palaeoenvironment may have been a deeper shelf or an inlet with rather deep and quiet water. The lateral equivalent and contemporaneous or younger sediments of the Kerteminde Marl in central and west Sjælland are considerably thicker and show a different development, reflecting deeper water and open sea conditions.

The 'reddish brown *Turritella* sandstone' (Andersen & Heilmann-Clausen 1984), which the present author considers the equivalent of the Lellinge Greensand, accumulated in the littoral zone. The palaeoecological interpretations of this boulder type and the sequence at Sundkrogen are given in Table 10.

Systematic palaeontology

The taxonomy of the bivalves is mainly based on Moore (1969); the taxonomy of the scaphopods, archaeogastropods and opisthobranchia follows that given in *Treatise on invertebrate palaeontology* (Moore 1960). The taxonomy of the mesogastropods and neogastropods is based on Wenz (1938–1944) and Taylor & Sohl (1962).

Ravn (1939) gave the mollusc species serial numbers from 1 to 155 and the succession was most likely based on Thiele (1931) which was the standard taxonomic work on molluscs at that time. The succession in the present study differs from that in Ravn (1939) and for comparison the serial numbers in Ravn (1939) are given in column 'Ravn' (Table 4).

In description of the species size classification is based on Wenz (1938, p. vii) with the following meaning:

0–1	mm:	extremely small
1–5	mm:	very small
5–10	mm:	small
10–15	mm:	rather small
15–30	mm:	moderate large
30–50	mm:	medium large
50–70	mm:	rather large
70–100	mm:	large
100–200	mm:	very large
200–	mm:	unusually large

The Poul Harder 1920 collection is kept at the Geological Survey of Denmark and Greenland (GEUS). The type and figured specimens are stored at the Geological Museum of the University of Copenhagen and are indicated with the prefix MGUH.

Taxonomic descriptions

Class Bivalvia Linneaus 1758
Order Taxodonta Neumayr 1883
Family Nuculanidae H. & A. Adams 1858

Genus *Portlandia* Mörch 1857

Type species. *Nucula arctica* Gray 1824, *fide* Moore 1969, p. N239.

Subgenus *Yoldiella* Verrill & Bush 1897

Type species. *Yoldia lucida* Lovén 1846.

***Portlandia (Yoldiella) nielseni* n. sp.**
Plate 1, fig. 1A, B

?1935 *Leda* aff. *nana* von Koenen, 1893 - Roedel, p. 6, plate 1, fig. 1.

Type locality. Kokkestræde, southern coast of Langeland (Fig. 1, **15**).

Type stratum. Glacial boulder, presumably derived from the Lellinge Greensand, Selandian, Paleocene.

Derivation of name. This species is named after the Danish palaeontologist Mogens Stentoft Nielsen, Odense, Denmark.

Holotype. Plate 1, fig. 1, MGUH 24831 (leg. M.S. Nielsen).

Diagnosis. An inequilateral and subelliptical *Portlandia (Yoldiella)*. The anterior end is rounded; the posterior end is slightly acute. Exterior is smooth and glossy. There are two rows of hinge teeth with up to 12 teeth in each row.

Material. Sundkrogen (in the samples from the dark clay (series 4), labelled *'Leda* sp.' by Harder): 37 double and seven isolated valves were found. This material, however, is more or less defective.

Additional specimens are from glacial boulders at Kokkestræde with a molluscan fauna similar to that from the Selandian deposits of Copenhagen, and the best of these specimens is designated holotype.

Measurements. The length is up to 3.6 mm, height is up to 2.6 mm.

Description. The shell is very small, inequilateral and subelliptical. The anterior end is rounded and the posterior end is slightly acute. The shell is thin-walled and it has a smooth and glossy exterior. The slightly opisthogyrate umbo is situated anteriorly to the middle of the shell and only slightly projecting over the hinge margin. The convexity of the shell is strong, especially so on the anterior and middle parts, while the posterior end has a slight depression from the umbo to the upper posterior corner.

The anterior dorsal margin is convex and slopes somewhat obliquely downwards. The posterior dorsal margin is about 1½ times longer than the anterior dorsal margin and it is slightly concave on the first half of the length and slightly convex on the last half. The anterior margin is broadly convex and not distinctly separated from the anterior dorsal margin. It runs into the regularly convex ventral margin, which ascends regularly anteriorly and posteriorly. The short posterior margin meets the posterior dorsal margin at an angle of about 120°. The posterior margin is slightly convex and runs obliquely forward to the ventral margin without a distinct separation.

The exterior of the shell has fine growth lines, which are distinct and close-set near the umbo, but more spaced and weaker towards the margins. From the umbo a weak rounded edge runs towards the upper posterior corner. Lunula and area are absent.

The hinge has two rows of acute, slightly oblique teeth with a triangular transverse section. Both rows have up to 12 teeth. The anterior row is slightly convex, the posterior one is concave. The very small ligament pit is triangular and rather deep.

The interior of the shell is smooth and glossy, and the indistinct pallial line is situated far from the shell margin. The shallow pallial sinus is not very distinct, but seems to reach to about one third of the posterior dorsal margin. The anterior adducator scar is rather large and rounded triangular, while the smaller posterior one is rounded elliptical. The shell margin is sharp and smooth.

Length of the holotype is 3.5 mm, height 2.5 mm, thickness 1.2 mm.

Discussion. Roedel (1935) described and illustrated *Leda* aff. *L. nana* von Koenen 1893 from Paleocene boulders in northern Germany. Judging from the description the species seems to be conspecific with the specimens from Sundkrogen. The depository of Roedels' material is unknown.

Leda nana von Koenen 1893 (p. 1128, plate 75, figs 12–15) from the Latdorfian (Late Eocene) of Germany has an almost equilateral shell and only 9–10 teeth in each teeth row. Furthermore, the posterior margin shows gradual transition into the posterior dorsal margin.

Anderson (1973, p. 177, plate 1, figs 3, 4) described and illustrated *Nuculana (Jupiteria)* sp. from the Paleocene of Germany at Schacht Sophia Jacoba 6 (Lower Rhine area). This species has a rounded subelliptical outline and the valve is almost equilateral.

From the Paleocene of Spitzbergen (Svalbard) Anderson (1970, p. 89, plate 9, figs 1a–c, 2a–c) describes *Portlandia (Yoldiella) haeggi* Anderson 1970, which has a small rostrum and a more obtuse posterior end.

Nuculana (Jupiteria) rhamphidium (Cossmann 1908) from the Calcaire de Mons (Montian, equals Middle/Late Danian) of Belgium has a pointed posterior end and a sinus on the ventral margin. Furthermore, this species is larger (length up to 6.3 mm).

Nuculana (Jupiteria) prisca (Deshayes 1858) from the Thanetian of the Paris Basin is relatively higher and more convex. The posterior dorsal margin is slightly convex and the ligamental pit is considerably larger.

The well-known species *Portlandia (Yoldiella) pygmaea* (Münster 1837) from the Oligocene, Miocene and Pliocene of the North Sea Basin, has a more pointed posterior end and more teeth in the hinge.

Order Pterioidea Newell 1965
Family Plicatulidae Watson 1930

Genus *Plicatula* Lamarck 1801

Type species. *Spondylus plicatus* Linneaus 1758.

***Plicatula selandica* n. sp.**
Plate 1, fig. 2A, B

Type locality. Sundkrogen, excavation 1920.

Type stratum. Lellinge Greensand, Selandian, Paleocene.

Derivation of name. selandica (Lat.) = from Sealand (Sjælland), Denmark.

Holotype. Plate 1, fig. 2A, B, MGUH 24832.

Diagnosis. A *Plicatula* with an obliquely rounded outline and no radial sculpture.

Material. Sundkrogen (from the greensand; series 1b): one specimen with slightly defective left valve. Except for a small part of the anterior ventral part, the valve is well preserved.

Measurements. The only known specimen has a length of 4.0 mm and a height of 3.8 mm.

Description. The shell has an obliquely rounded outline, and a slightly opisthogyrate umbo which projects only slightly over the dorsal margin. The shell is inequilateral with the posterior part somewhat larger than the anterior. The shell is rather flat, having its greatest convexity in the middle and posterior parts.

The dorsal margin is relatively short and slightly convex. The anterior dorsal margin is short and regularly convex, with a gradual transition into the anterior margin which is also regularly convex. The anterior margin is gradually connected with the convex ventral margin. The posterior dorsal margin is about three times as long as the anterior dorsal margin and only slightly convex. It meets the posterior margin at an angle of 120°. The almost vertical posterior margin is slightly convex and meets the ventral margin at an angle of 120°. The outside of the shell shows the small prodissoconch which is distinctly separated from the rest of the shell. The shell is provided with irregularly placed concentric folds and has no radial sculpture. The interior of the shell shows the hinge very well. A narrow ligamental pit has the shape of a high, narrow triangle, situated behind the umbo. On both sides of the ligamental pit two triangular tooth grooves are present, of which the anterior one lies under the umbo. Close to the anterior tooth pit, a small, oblique tooth is seen; posteriorly a similar tooth is present. The interior of the shell is smooth, the pallial line is not visible. The adductor scar is ovate and placed slightly anterior of the vertical midline.

Discussion. This species seems to be characterised by its weak sculpture. *Plicatula ravni* Rosenkrantz 1920 (Rosenkrantz 1920a, p. 34, plate 2, figs 10–13) from the Danian lower Crania limestone has a strong radial sculpture. *Plicatula follis* Defrance 1826 *sensu* Cossmann & Pissarro (1904–1906, plate 41, fig. 133–2) from the Eocene of the Paris Basin has a similar outline but a more distinct concentric sculpture.

Order Pholadomyoidea Gray 1847
Family Laternulidae Hedley 1918

Genus *Laternula* Röding 1798

Type species. *Solen anatina* Linneaus 1758.

Subgenus *Laternulina* Habe 1952

Type species. *Anatina japonica* Lischke 1872, *fide* Moore 1969, p. N845.

***Laternula (Laternulina) ravni* n. sp.**
Plate 1, figs 4–6

1939 *Anatinidarum* sp. Ravn, p. 39.
1939 *Lyonsia* sp. Ravn, p. 40.

Type locality. Sundkrogen, excavation 1920.

Type stratum. Lellinge Greensand, Selandian, Paleocene.

Derivation of name. This species is named for the Danish palaeontologist Jesper Peter Johansen Ravn.

Holotype. Plate 1, fig. 5, MGUH 24517.

Paratypes. Plate 1, fig. 4, MGUH 24834; Plate 1, fig. 6, MGUH 24518.

Diagnosis. A *Laternula (Laternulina)* with a rounded subelliptical outline.

Material. Sundkrogen, glauconitic greensand (series 1, 2): 38/2 defective specimens; fine-grained greensand (series 3): 2/2 defective specimens and ten fragments; dark clay (series 4): 22/2 defective specimens and two fragments.

Other material: Sundkrogen (coll. Ravn): ten specimens.

Measurements. The length of the largest specimen is 16.1 mm, height is 12.5 mm.

Description. The shell is very thin-walled, subnacreous and rounded elliptical. The anterior end is higher than the posterior. The small opisthogyrate umbo is situated on the posterior part of the shell and only slightly projecting. The convexity of the shells cannot be estimated because of the state of preservation, but a fold from the umbo to the posterior corner indicates that the shells have been gaping posteriorly.

The posterior dorsal margin is slightly concave and meets the posterior margin at an angle of 120°. The posterior margin is only slightly convex, meeting the moderately convex ventral margin at an angle of 140°. The anterior dorsal margin is convex and longer than the posterior dorsal margin, with a gradual transition into the ventral margin.

The exterior of the shell has an ornament of more or less prominent concentric folds, which are strongest near the umbo and decrease in strength towards the margins. Concentric growth lines are visible.

The hinge is edentulous. Two spoon-shaped chondrophores are projecting into the shells, each supported by a buttress. The internal characters of the shell cannot be studied.

Discussion. The projecting chondrophores are characteristic for the family Laternulidae, and the ornamentation agrees with *Laternulina,* a subgenus of the genus *Laternula*, until now known from the Recent Western Pacific Ocean only (Moore 1969, p. N845).

Species of the Lyonsidae, to which Ravn referred the present material, differ by their radial sculpture, consisting of lirae or granules and their dorsal margin is straight. For comparison *Lyonsia baltica* Roedel 1935 is illustrated here (Plate 1, fig. 3).

Remarks. Ravn (1939, p. 40) described *Lyonsia* sp. on the basis of 14 specimens from the fine-grained greensand at Sundkrogen. In the collections of the Geological Museum, Copenhagen, only ten specimens were found, five of which are preserved with both valves united. All specimens are deformed because of the very thin shell wall, yielding no information of the convexity of the valves. The material shows differences in ornamentation and outline but all specimens are considered to be conspecific.

On three double-valved specimens the umbonal part is preserved, showing a projecting spoon-shaped chondrophore in each valve. Ravn (1939, p. 39) described such hinge fragments as *Anatinidarum* sp. and stated that both valves had such a chondrophore. In the material collected by Harder similar hinge fragments occur rather frequently.

Class Scaphopoda Bronn 1862
Family Dentaliidae Gray 1834, *fide* Moore 1960, p. I37

Genus *Dentalium* Linneaus 1758

Type species. *Dentalium elefantinum* Linneaus 1758, *fide* Moore 1960, p. I37.

Subgenus *Dentalium* Linneaus 1758

***Dentalium (Dentalium) rugiferum* von Koenen 1885**
Plate 1, figs 7, 8

1885 *Dentalium rugiferum* v. Koenen, von Koenen, pp. 71–72, plate 3, fig. 18.
1907 *Dentalium gracile* n. sp. – Grönwall & Harder, p. 36, plate 1, fig. 19.
non 1939 *Dentalium rugiferum* v. K. – Ravn, pp. 45–47 (*partim*), plate 1, fig. 16 (= *Dentalium sundkrogensis* n. sp.).

Remarks. The bulk of the material consists of variably worn fragments of larger specimens, although two juvenile specimens were recovered from the samples from Sundkrogen. They come from samples by Harder labelled *'Dentalium gracile'*. He referred all small specimens with ribs to this species, but the greater part differs in a number of features and this part is referred to the new species *Dentalium sundkrogensis* (see below). The genuine specimens of *D. rugiferum*, that occur in small numbers, are identical to the specimens in the author's collection of *Dentalium rugiferum* from Klintebjerg (Fig. 1), with the material described by von Koenen (1885) and also with the description of *D. gracile* from Rugård (Fig. 1) by Grönwall & Harder (1907). The number of longitudinal ribs and the shape of the obtuse growth lines are identical in the material studied by the author. The only specimen of *Dentalium gracile* found at Rugård consequently has to be referred to *D. rugiferum*. In his description of *D. rugiferum* von Koenen (1885) states that the smallest diameter of this species is 1 mm which indicates that no juvenile specimens were present in his material. Grönwall & Harder (1907) considered the posterior growth lines which appear before the primary longitudinal ribs to be diagnostic for their new species, but von Koenen obviously was not able to observe this feature. Juvenile specimens of *D. rugiferum* differ from *D. sundkrogensis* n. sp. in being less strongly curved, and by the presence of more primary ribs, a strong transverse ornament and growth lines on the posterior end. The longitudinal primary ribs appear at a diameter of about 1 mm. Finally, the delicate longitudinal striation on and between the ribs is absent in *D. rugiferum*.

***Dentalium (Dentalium) sundkrogensis* n. sp.**

Plate 1, figs 10, 11

1939 *Dentalium rugiferum* v. K. – Ravn, pp. 45–47 (*partim*), plate 1, fig. 16.

Type locality. Sundkrogen, excavation 1920.

Type stratum. Lellinge Greensand, Selandian, Paleocene.

Derivation of name. This species is named after the type locality.

Holotype. Plate 1, fig. 11, MGUH 24839.

Paratype. Plate 1, fig. 10, MGUH 24838.

Diagnosis. A rather small *Dentalium (Dentalium)* with an ornamentation of 10–12 sharp, almost equidistant primary ribs and a very fine secondary longitudinal striation on and between the ribs. The transverse sculpture is almost invisible. The initial shell part is strongly curved.

Material. Sundkrogen (coll. Harder 1920): dark clay (series 4): 5475 specimens; fine-grained greensand (series 3): 294 specimens; glauconitic greensand (series 1, 2): 436 specimens.

Other material: Sundkrogen (leg. Rosenkrantz 1920): 'le lambeau' (*sensu* Ravn 1939): 210 specimens; dark clay: 56 specimens; fine-grained greensand: 70 specimens; horizon unknown: 35 specimens.

Vestre Gasværk VI (leg. Rosenkrantz 1930): 5.29–5.47 m under level: one specimen; 5.95–6.17 m under level: 36 specimens; 6.17– 6.34 m under level: 18 specimens; 6.34–6.60 m under level: 126 specimens; 6.60–6.79 m under level: 13 specimens; 6.79–6.95 m under level: 21 specimens; 6.95–7.14 m under level: four specimens; 7.08–7.32 m under level: two specimens; 8.77–8.96 m under level: one specimen; 6.51–6.84 m under level: ten specimens.

Kongedyb II (leg. Rosenkrantz 1935): 24 specimens.

Measurements. The holotype has a posterior diameter of 0.2 mm, an anterior diameter of 0.4 mm and a length of 3.3 mm; fragments indicate a maximum length of 15 mm.

Description. The shell is rather small. Initially the curvature is strong and the shell rapidly increases in diameter. Later the shell is almost straight and only slowly increases in diameter.

The sculpture consists of 10–12 sharp, almost equidistant primary ribs, which are narrower than their interspaces but soon, weaker secondary ribs develop in the interspaces. A fine longitudinal striation is present on and between the ribs. The transverse sculpture is almost invisible. The shell has no posterior slit. The shell has a circular cross-section.

Discussion. Ravn (1939) stated the possibility of a new species in his description of small, strongly curved specimens of *Dentalium rugiferum*, but he also stated that transitional specimens seemed to be present in his material. In the collections of the Geological Museum he labelled such specimens as *Dentalium* cf. *rugiferum*. Yet he recognised the possibility of a new species, which was not conspecific with *D. gracile* Grönwall & Harder 1907. Ravn also described fragments of larger specimens which occurred together with typical specimens of *D. rugiferum* in the lower part of the section at Vestre Gasværk VI. In my opinion these specimens certainly belong to the new species. I have not found any transitional specimens between the new species and *D. rugiferum* in the large material of the new species from Sundkrogen (coll.

Harder and coll. MGUH) and Vestre Gasværk (coll. MGUH).

Harder referred all small striated specimens of *Dentalium* to *D. gracile*. In the large material in his collection the two specimens of *D. rugiferum* mentioned under *D. rugiferum* above were found. *D. sundkrogensis* is extremely common in the dark clay as stated by Harder (1922, p. 31) and Ravn (1939, p. 46).

Class Gastropoda Cuvier 1797
Order Archaeogastropoda Thiele 1925
Family Trochidae Rafinesque-Schmaltz 1815

Genus *Solariella* Wood 1842

Type species. *Solariella maculata* Wood 1842.

Subgenus *Solariella* Wood 1842

***Solariella (Solariella) ravni* n. sp.**
Plate 2, fig. 1A, B

1939 *Eumargarita (Solariella)* sp. Ravn, pp. 50–51, plate 1, fig. 22a, b.

Type locality. Sundkrogen, excavation 1920.

Type stratum. Lellinge Greensand, Selandian, Paleocene.

Derivation of name. The species is named after the Danish palaeontologist Jesper Peter Johansen Ravn.

Holotype. Plate 2, fig. 1A, B, MGUH 24841.

Diagnosis. A *Solariella (Solariella)* with two abapical strong spirals and 30 radial ribs. Umbilicus rather narrow.

Material. Sundkrogen, the glauconitic greensand (series 2): one juvenile and one fragment of a probable adult; the fine-grained greensand (series 3): one specimen.

Vestre Gasværk VI (Ravn 1939, pp. 50–51, plate 1, fig. 22a, b): one juvenile specimen.

Measurements. The height and width of the holotype is 1.2 mm. The fragment of an adult specimen indicates a maximum height of 5 mm.

Description. The shell is very small, trochiform and fragile. The aperture equals almost half the total shell height, the height/width ratio is 1. The fragment of an adult specimen indicates that the adult specimen has been relatively higher.

The shell has 2¾ whorls, of which slightly more than one whorl belongs to the paucispiral protoconch. The nucleus is depressed and not visible and the terminal part of the protoconch is smooth and glossy but a little worn. The boundary with the teleoconch is sharp.

The teleoconch consists of 1¾ convex and angular whorls that increase regularly in diameter and are separated by deep sutures.

The spiral ornament consists of four primary spirals, of which the adapical one is situated close to the upper suture. This spiral is considerably weaker than the two following spirals, of which the abapical situated at one third of the height of the whorl is the stronger. Another spiral is situated slightly below the middle of the whorl and a weak spiral is visible immediately above the abapical suture. On the flat base, four further spiral bands are present, decreasing in strength towards the umbilicus. The last spiral band demarcates the rather narrow umbilicus, in which a further weak spiral is visible. On the fragment of the probable adult specimen a secondary weak spiral develops in between the two upper primary ones.

The radial ornament initially has 15 close-set radial riblets on the first half whorl immediately before the boundary with the protoconch. On the other teleoconch whorls 30 almost orthocline radial ribs per whorl are present. They are considerably narrower than their interspaces causing rounded knobs on all four spiral bands, most prominently on the two strong spirals. On the fragmentary probable adult specimen the number of radial ribs is considerably higher and they are much weaker than their interspace. The radial ribs continue in the umbilicus. The aperture is oval.

Discussion. As the specimen from the greensand is larger and better preserved than the only specimen known by Ravn, (1939) and as further specimens can hardly be expected, it seems justified to introduce this new species.

Ravn (1939) mentioned a spiral riblet in between the strong spirals. This feature is not present in the juvenile holotype but the two other specimens show the feature. The holotype also differs by having equidistant spirals whereas in the other two specimens the two adapical spirals are more close-set. However, all specimens are believed to be conspecific. Ravn suggested an affinity with *'Trochus multilineatus'* Briart & Cornet, 1887 (p. 56, plate 23, figs 8a–c), but this species has only two primary spirals and the third spiral in between develops only on the body whorl. This spiral is situated close to the abapical spiral. The radial ornament is also distinctly weaker. No other related species are present in the Eocene of the Paris Basin (Cossmann & Pissarro 1910–13) or in the Montian of Belgium (Glibert 1973).

Solariella (Solariella) hauniensis **n. sp.**
Plate 2, fig. 2A, B

Type locality. Sundkrogen, excavation 1920.

Type stratum. Lellinge Greensand, Selandian, Paleocene.

Derivation of name. hauniensis (Latin) = from Copenhagen.

Holotype. Plate 2, fig. 2A, B, MGUH 24842.

Diagnosis. A very small *Solariella (Solariella)* with almost smooth whorls.

Material. Sundkrogen, the dark clay (series 4): two juvenile specimens.

Measurements. The height of the holotype is 0.9 mm, the width is 1.2 mm.

Description. The shell is very small, relatively thick-walled and 1.3 times wider than high. The protoconch is paucispiral, comprising three quarters of a whorl, separated by a distinct suture. The nucleus is relatively large and slightly depressed. The boundary with the teleoconch seems to be sharp but is worn on both specimens.

The holotype has only one convex teleoconch whorl, rapidly increasing in diameter. The suture is deep. A spiral carina is present on the middle of the whorl immediately beyond the boundary with the protoconch but it soon decreases in strength and remains visible as a weak angulation on the apical part of the whorl. As no radial sculpture is present and the growth lines are almost invisible, the shell has a smooth and glossy appearance.

The periphery is rounded, the base is convex with a narrow umbilicus, demarcated by a distinct smooth spiral rib. In the umbilicus, a further smooth and weaker spiral rib is visible. The aperture is elliptical, the labrum is broken. The columella is smooth and provided with a thin callus which partly covers the umbilicus.

Discussion. One shell is well preserved while the other is a little worn. The establishment of a new taxon in spite of the limited material seems justified because the well-preserved juvenile shell shows the protoconch and the final sculpture of the teleoconch.

The new species is characterised by the almost complete absence of ornamentation. No related species is known to the author. From the Danish Late Oligocene, *Solariella (Solariella) ronaldjansseni* Schnetler 1987 (in: Schnetler & Beyer 1987, p. 210, plate 1, figs 9–11) has a similar ornament, but this species has a subsutural ramp and a larger protoconch.

Solariella? **sp.**
Plate 1, fig. 12A, B

Description. A single juvenile specimen was recovered in a sample of unsorted material from the fine-grained greensand (series 3). The shell is very thin-walled and fragile. The protoconch consists of 1½ convex whorls which are separated by deep sutures. The nucleus is of medium size. The teleoconch has a radial sculpture of fine opisthocyrt riblets, 25 of which are present on the first teleoconch whorl. The riblets are considerably narrower than their interspace. On the last whorl the riblets become opisthocline.

The shell is almost as high as wide. The flat base is demarcated by a spiral riblet and on the base there are three further weak riblets. The umbilicus is narrow. The aperture is rounded ovate with a widened labrum and inner lip. The callus on the inner lip partly covers the umbilicus.

The juvenile state of the specimen prevents a specific identification.

Family Cyclostrematidae Fischer 1885

Genus *Teinostoma* H. & A. Adams 1853

Type species. *Teinostoma politum* A. Adams 1853.

Subgenus *Teinostoma* H. & A. Adams 1853

***Teinostoma (Teinostoma) ledoni* n. sp.**
Plate 2, figs 3A–C, 4A–C

1939 *Tinostoma trigonostoma* Desh.? – Ravn, pp. 51–52, plate 1, fig. 23A–C.

Type locality. Sundkrogen, excavation 1920.

Type stratum. Lellinge Greensand, Selandian, Paleocene.

Derivation of name. This species is named after the French palaeontologist Daniel Ledon, Versailles, France.

Holotype. Plate 2, fig. 3A–C, MGUH 24843.

Paratype. Plate 2, fig. 4A–C, MGUH 24844.

Diagnosis. A lenticular *Teinostoma (Teinostoma)* with weak radial and spiral ornament. On the base the demarcation of the callus is semicircular.

Material. Sundkrogen (coll. Harder 1920), glauconitic greensand (series 1, 2): six specimens; fine-grained greensand (series 3): six specimens.

Vestre Gasværk VII (Ravn 1939), marl: two specimens.

Vestre Gasværk VI (Ravn 1939), greensand: one specimen.

Measurements. The height is up to 0.9 mm, width is up to 1.4 mm.

Description. The shell is very small and lenticular, 1.6 times as wide as high. The protoconch has two smooth whorls. The nucleus is small and does not reach above the upper side of the shell. The transition into the teleoconch is not well defined.

The teleoconch consists of 1½ whorls that increase very rapidly in diameter. The last whorl equals the total shell height. The periphery is angular on the middle of the whorl and the whorls are separated by rather indistinct sutures. The base is almost flat. The callus completely covers the umbilicus and the inner lip. The demarcation of the callus is semicircular on the base.

The aperture is oval and placed obliquely to the shell axis. The columellar side of the aperture is thickened and provided with a rather thick callus. The labrum is prosocline and sharp. On the first teleoconch whorl, 15 spiral bands are separated by spiral furrows. They are strongest and most widely spaced on the adapically side of the whorl. Numerous radial riblets run prosocyrt across the upper side of the shell, resulting in a pattern of delicate rectangular pits. On the base there are 20 weak spiral bands, separated by spiral furrows being most prominent near the callus. The radial riblets on the base are stronger than the spiral ribs, thus resulting in a rather prominent pattern of rectangular pits on the base. This delicate sculpture can be observed only on two rather well-preserved specimens. On the last half teleoconch whorl the shell is smooth and glossy, except for eight spiral bands near the periphery.

Discussion. Ravn (1939) tentatively referred the new species to *Teinostoma trigonostoma* Deshayes 1864, which is from the Eocene of the Paris Basin. The two species are similar in general outline but the new species differs by its labrum being connected to the base at a more acute angle. Also the shape of the callus on the inner lip is sinuous whereas the callus on *T. trigonostoma* is virtually rectilinear. Furthermore, the new species has a more prominent spiral ornamentation. The two species are closely related.

Glibert (1973) recorded three species of *Teinostoma* from the Montian of Belgium. Of these, only *Teinostoma bilabratum* Briart & Cornet 1887 was referred to *Teinostoma sensu stricto*. This species has a higher apex and a narrower umbilicus.

From the Eocene of the Paris Basin Gougerot (1967) described and illustrated the species *Teinostoma priscum* Deshayes 1863 and *T. complanatum* Deshayes 1864. These species have a strong spiral ornamentation, but their whorls increase more slowly in diameter.

Order Mesogastropoda Thiele 1929
Family Lacunidae Gray 1857

Genus *Entomope* Cossmann 1888

Type species. *Litiopa klipsteini* Cossmann 1882.

***Entomope kirstineae* n. sp.**
Plate 2, figs 7, 8; Plate 5, fig. 1

Type locality. Kongedyb II (Fig. 1, **30**).

Type stratum. Lellinge Greensand, Selandian, Paleocene.

Derivation of name. This species is named after Kirstine Nielsen, Birkerød, Denmark.

Holotype. Plate 2, fig. 8, MGUH 24520.

Paratypes. Plate 2, fig. 7, MGUH 24519; Plate 5, fig. 1, MGUH 24868.

Diagnosis. An *Entomope* with a spiral sculpture of five, fine widely spaced furrows.

Material. Sundkrogen, (coll. Harder), dark clay (series 4): seven defective shells and three fragments.

Kongedyb II (leg. Rosenkrantz 1935): three juvenile shells and the last whorl of one adult specimen.

Vestre Gasværk (leg. Rosenkrantz 1931): one specimen.

Measurements. The height of the holotype is 2.1 mm, width is 1.1 mm. The fragmentary paratype suggests a maximum height of 5 mm.

Description. The shell is very small, ovately-conical and relatively thick-walled. The last whorl equals ¾ of the total shell height and the height of the aperture is almost half that of the total shell height.

The protoconch consists of 2¾ convex, smooth and glossy whorls, which are separated by distinct sutures. The nucleus is small and the first protoconch whorl is planispiral which gives the apex an obtuse shape. The whorls increase rather rapidly in diameter. The boundary with the teleoconch is sharp and indicated by a prosocline thread-like riblet.

The teleoconch whorls are slightly convex and separated by distinct, linear sutures. On the holotype, 1½ teleoconch whorls are present; the fragmentary adult specimen suggests that the adult shell had at least 1½ further whorls. The aperture is ovate. The parietal lip and the labrum meet at an acute angle; the labrum is not thickened. The columella is only slightly concave and partly covers the umbilicus. At the end of the columella a distinct siphonal notch is slightly turned to the left. The umbilicus is a narrow furrow, separated from the convex base by a rather distinct ridge.

The spiral sculpture consists of five, fine spiral furrows, which are present from the first teleoconch whorl onwards. The furrows are widely spaced and continue on all teleoconch whorls rather unchanged. On the base ten further spiral furrows, adaxially in decreasing distance, are visible. A radial sculpture is absent, only prosocline growth lines are present.

Discussion. The best preserved of the three juvenile specimens from Kongedyb II is designated the holotype.

From the Paleocene of West Greenland Kollmann & Peel (1983, pp. 34–35, figs 43, 44) record two species, of which *Entomope* sp. 1 seems to be related to the present species. It differs however, in having a considerably higher number of spirals.

From the Eocene of the Paris Basin and from the Calcaire de Mons, Kollmann & Peel mention three species, of which *Bithyniella*(?) *montensis* Glibert 1973 and *Bithyniella*(?) *nana* Briart & Cornet 1887, both illustrated in Glibert (1973, plate 2, figs 17, 16, respectively), have no spiral ornamentation, while *Dissochilus lineata* Briart & Cornet 1887 (Glibert 1973, plate 2, fig. 12) has an ornament of numerous spirals.

Genus *Harrisianella* Olsson 1929

Type species. *Harrisianella peruviana* Olsson 1929.

***Harrisianella subglabra* n. sp.**
Plate 3, fig. 2; Plate 5, fig. 4

Type locality. Sundkrogen, excavation 1920.

Type stratum. Lellinge Greensand, Selandian, Paleocene.

Derivation of name. subglabra (Latin) = almost smooth.

Holotype. Plate 3, fig. 2, MGUH 24851.

Paratype. Plate 5, fig. 4, MGUH 24871.

Diagnosis. A *Harrisianella* with 14 opisthocline, sharp radial ribs and a weak spiral sculpture.

Material. Sundkrogen, fine-grained greensand (series 3): three defective juvenile specimens; dark clay sample (series 4): one defective specimen.

Measurements. The height of the holotype is 1.5 mm, width is 0.5 mm.

Description. The shell is very small and slender turriculate and three times as high as wide. The last whorl is less than half the total shell height with the height of the aperture one quarter of the total shell height. The protoconch consists of five smooth and convex whorls separated by deep sutures. On the terminal protoconch whorl opisthocline, slightly flexuous radial riblets quickly increase in strength. The transition into the teleoconch is gradual.

The teleoconch whorls are convex and separated by deep sutures. The aperture is ovate and the labrum is partly broken. The columella is slightly s-shaped and has a thin callus. The short canal is slightly turned to the left. The spiral ornament is weak and most prominent between the radial ribs. Adapically a very weak spiral rib is situated close to the suture; abapically two spiral ribs are present, of which the abapical one is the stronger, demarcating the slightly convex base. On the base, two weak spiral riblets are visible. The radial sculpture consists of 14 rather sharp, opisthocline and flexuous radial ribs which are most prominent abapically.

Discussion. The introduction of a new taxon is possible in spite of the restricted material because the protoconch and the teleoconch sculpture are rather characteristic.

In general outline and sculpture the new species rather well resembles *Harrisianella (Teliostomopsis) regularicostata* (Briart & Cornet 1873) which is illustrated by Glibert (1973, plate 5, fig. 15). This species, however, has a more prominent spiral ornamentation and prominent spirals on the base. The protoconch was described neither by Briart & Cornet nor by Glibert.

Family Cerithiidae Férussac 1821

Genus *Bittium* Leach (*in* Gray 1847)

Type species. *Strombiformis reticulatum* da Costa 1778.

Subgenus *Bittium* Leach (*in* Gray 1847)

Bittium (Bittium) oedumi n. sp.

Plate 2, fig. 6; Plate 5, fig. 2

Type locality. Sundkrogen, excavation 1920.

Type stratum. Lellinge Greensand, Selandian, Paleocene.

Derivation of name. This species is named after the Danish geologist Hilmar Ødum.

Holotype. Plate 2, fig. 6, MGUH 24846.

Paratype. Plate 5, fig. 2, MGUH 24869.

Diagnosis. A *Bittium (Bittium)* with a highly turriculate protoconch of five whorls. Teleoconch whorls with four spiral ribs and 14 orthocline radial ribs. Aperture is small.

Material. Sundkrogen (coll. Harder), glauconitic greensand (series 2): two juvenile specimens were isolated from an unsorted sample.

Measurements. The height of the holotype is 1.1 mm, width is 0.4 mm.

Description. The shell is very small, slender and turriculate, and the height equals almost three times the width. The last whorl equals almost half the total shell height and the aperture is less than one fifth of the total shell height.

The multispiral protoconch is highly turriculate, consisting of five convex whorls separated by distinct sutures. The nucleus is relatively large and smooth, while the subsequent protoconch whorls are provided with two distinct, smooth spiral ribs. Two very weak spiral riblets are present immediately under the adapical, and over, the abapical suture. The adapical spiral rib is slightly above the middle of the whorl, the stronger abapical one is at one third of the height. The adapical part of the whorl is distinctly concave, the interspace between the distinct spiral ribs is slightly concave.

A radial ornamentation is present from the second protoconch whorl; it consists of very delicate riblets which initially are almost orthocline but they gradually become sinuous with their sinus on the concave adapical part of the whorl. On the two weak spiral riblets at the sutures, the radial riblets cause very small knobs. Across the two distinct spiral ribs they run almost orthocline and below the abapical one they change course to slightly prosocline. Twenty-five radial riblets occur on the last protoconch whorl. The boundary with the teleoconch is visible as a prominent opisthocline rib.

The largest specimen has only 1½ teleoconch whorls. They are convex and separated by deep sutures. The aperture is rounded, subcircular and a very short siphonal canal is turned slightly to the left.

On the teleoconch whorls, the four spirals of the protoconch continue and a fifth spiral rib appears immediately after the boundary to the protoconch. This spiral rib is situated between the adapical weak riblet and the adapical distinct spiral rib and it is weaker than the two distinct spiral ribs, but increases in strength. The adapical weak riblet forms a smooth sutural band. The two distinct spiral ribs continue and are the strongest on the teleoconch. Adapically the weak spiral rib demarcates the flat base where another weak spiral riblet is present. The spirals are a little stronger than their interspace. The radial sculpture consists of 14, almost orthocline radial ribs, only a little weaker than the spiral ribs. At the intersection between the distinct spiral ribs and the radial ornamentation small knobs occur. The spiral ribs are distinct in between these knobs, resulting in a pattern of rectangular pits.

Discussion. A number of species of the genus *Bittium* have been recorded from the Paris Basin; these have been revised by Gougerot & Le Renard (1985). *Bittium oedumi* n. sp. differs from the Paris species by its protoconch and slender shape.

Family Cerithiopsidae H. & A. Adams 1854

Genus *Cerithiopsidella* Bartsch 1911

Type species. *Cerithiopsis cosmia* Bartsch 1907.

Subgenus *Vatopsis* Gründel 1980

Type species. *Cerithium bimonilifera* Sandberger 1858.

Cerithiopsidella (Vatopsis) rasmusseni n. sp.

Plate 2, fig. 5; Plate 5, fig. 6

Type locality. Sundkrogen, excavation 1920.

Type stratum. Lellinge Greensand, Selandian, Paleocene.

Derivation of name. This species is named after the Danish geologist Leif Banke Rasmussen.

Holotype. Plate 2, fig. 5, MGUH 24845.

Paratype. Plate 5, fig. 6, MGUH 24873.

Diagnosis. A *Cerithiopsidella (Vatopsis)* with a rather thick-set outline. Spiral ornamentation consists of four spirals, of which two strong knob-bearing spirals are situated abapically on the whorls.

Material. Sundkrogen, greensand (series 1c): one well-preserved protoconch, one defective juvenile and one defective specimen with three teleoconch whorls; fine-grained greensand (series 3): one shell; it consists of the protoconch and 1½ teleoconch whorls. Except of the lack of the nucleus, the specimen is well preserved.

Measurements. The height of the holotype is 1.5 mm, width is 0.6 mm.

Description. The shell is very small and turriculate, 2.5 times as high as wide. The last whorl equals 0.4 of the total shell height while the aperture is 0.25 of the total shell height. The protoconch consists of four slightly convex whorls separated by deep sutures. The nucleus is of medium size. The last three protoconch whorls have a radial sculpture of fine hair-like riblets which run almost orthocline across the whorls. Their number is above 20 on each whorl. From the second sculptured protoconch whorl, a spiral riblet occurs immediately above the abapical suture; it increases in strength and lies higher on the whorl in the apertural direction. On the terminal ¼ protoconch whorl, the riblet forms a carina situated at one third of the height of the whorl. A much weaker spiral riblet is situated immediately below the adapical suture. On the terminal whorl the radial riblets become orthocline and more close-set. The boundary with the teleoconch is distinct marked by the sudden appearance of the teleoconch sculpture.

The teleoconch whorls are slightly convex and separated by deep sutures. The ornament comprises two, strong knob-bearing spiral ribs, regularly distributed on the whorls. The aperture is subcircular; the labrum and most of the canal are broken.

The spiral ornamentation of the teleoconch starts with four spirals, of which the adapical one is very weak and situated close to the suture. The following two spiral ribs are stronger, especially spiral number three, which is the continuation of the carina on the terminal protoconch whorl. A fourth weak spiral is situated immediately above the abapical suture, and on the flat base, two weaker spiral ribs are present. The radial sculpture consists of radial ribs, 16 of which are present on the last teleoconch whorl. These ribs are opisthocline on the first teleoconch whorl but they soon become almost orthocline. The radial ribs are of the same width as their interspaces. At the points of intersection with the spiral ornament rounded knobs occur, most prominently on the two strong spiral ribs. The orthocline growth lines are almost invisible.

Discussion. The protoconch of the new species resembles fairly well *Cerithiopsidella (Vatopsis)* illustrated by Gründel (1980, p. 220, figs 4, 5); for this reason the new species is referred to this subgenus. I know of no related species.

Genus *Seila* A. Adams 1861

Type species. *Triphoris dextroversa* A. Adams & Reeve 1850.

Subgenus *Notoseila* Finlay 1927

Type species. *Cerithium terebelloides* Hutton 1873.

Seila (Notoseila) heilmannclauseni n. sp.

Plate 2, figs 9, 10

Type locality. Sundkrogen, excavation 1920.

Type stratum. Lellinge Greensand, Selandian, Paleocene.

Derivation of name. This species is named after the Danish palaeontologist Claus Heilmann-Clausen, University of Aarhus, Denmark.

Holotype. Plate 2, fig. 10, MGUH 24848.

Paratype. Plate 2, fig. 9, MGUH 24847.

Diagnosis. A *Seila (Notoseila)* with a spiral sculpture consisting of three narrowly spaced spiral ribs of the same strength. The protoconch is multispiral and smooth; the terminal protoconch whorl is carinated.

Material. Sundkrogen, fine-grained greensand (series 3): four defective juvenile specimens; the best specimen has four teleoconch whorls.

Measurements. Height is 2.0 mm, width is 0.6 mm.

Description. The shell is very small and highly turriculate, almost 3.5 times higher than wide. The last whorl equals a quarter of the total shell height and the aperture one sixth of the total shell height. The protoconch is multispiral and highly conical, consisting of five convex whorls, separated by deep sutures. The nucleus and a part of the first protoconch whorl are broken in the holotype. The whorls are smooth and glossy, except for very fine opisthocline growth lines. The relatively small and glossy nucleus could be studied on the paratype. On the last protoconch whorl a carina is situated on the middle of the whorl and below, there is a spiral band. A spiral band appears on the carina and these spiral bands are of equal strength on the last quarter of the terminal protoconch whorl. The transition into the teleoconch is gradual being suggested by more prominent growth lines.

The largest specimen has four teleoconch whorls which are flat with three spiral ribs of similar strength separated by rather indistinct sutures. The aperture is small and rounded rectangular, the columella is smooth and straight, and the short canal is turned to the left. The base is flat and it is demarcated by a fourth spiral rib.

The spiral sculpture starts with three spiral ribs, two of which are the continuations of the spirals on the protoconch, a third weaker spiral is situated below the adapical suture. This latter spiral rib rapidly increases in strength, reaching the strength of the two other spiral bands after one whorl. The spirals are rather sharp and slightly narrower than their interspaces. A weaker fourth spiral rib is visible in the abapical suture, partly covered by the subsequent whorl. This spiral rib demarcates the base on the last whorl and is accompanied by a spiral furrow on the base. There is no radial sculpture but numerous growth lines run opisthocyrt across the whorls. They are visible only between the spirals and they are regularly thickened. On the base, the growth lines are prosocyrt.

Discussion. Marshall (1978) revised the family Cerithiopsidae. According to this revision the new species has to be referred to *Seila (Notoseila)* because of the lecithotropic protoconch and the flat teleoconch whorls with spirals of equal strength.

From the Paleocene of West Greenland Kollmann & Peel (1983, p. 51, fig. 95) illustrate a *Seila* species, with a paucispiral protoconch and three spiral ribs, of which the abapical one is considerably stronger. This species is obviously not closely related to the new species.

From the Montian of Belgium, Glibert (1973, p. 54, plate 7, fig. 3) described and illustrated *Seila tenuifila* (Briart & Cornet 1877). This species, however, has four strong spiral bands. Glibert also described *Seila ravni* (p. 55, fig. 26; plate 78, fig. 4), which has angular whorls and three unequal, widely spaced, spiral ribs; the protoconch is unknown. This species thus cannot be referred to the subgenus *Notoseila*. Neither of these species is related to the new species.

Glibert (1973, p. 56) also noted the presence of *Seila* spp. from the Danian of Fakse, Denmark. Ravn (1933) recorded three species from Fakse, referred by him to the genus *Newtoniella* (now considered to be a synonym of *Cerithiella*): *N. subglabra*, *N. faxensis* and *N. fissicosta*. None of these species has a columellar fold, and a revision might thus refer some or all of them to the genus *Seila*. They all differ from the new species particularly by their teleoconch sculpture.

Gougerot & Le Renard (1981) revised the species of the genus *Seila* from the Eocene of the Paris Basin. The new species seems to be most closely related to *Seila mundula* (Deshayes 1864), but this species is less slender and its spiral ribs are more widely spaced. *S. trilirata* (Deshayes 1864) has a very different protoconch (Gougerot & Le Renard 1981, fig. 13).

***Seila (Notoseila) anderseni* n. sp.**
Plate 2, fig. 11

Type locality. Sundkrogen, excavation 1920.

Type stratum. Lellinge Greensand, Selandian, Paleocene.

Derivation of name. This species is named after the Danish conservator Søren Bo Andersen, University of Aarhus, Denmark.

Holotype. Plate 2, fig. 11, MGUH 24849.

Diagnosis. A *Seila (Notoseila)* with a spiral ornamentation of four spiral ribs, of which the two upper ones are separated by an interspace of same width as the spirals, whereas the two abapical spiral ribs are more close-set.

Material. Sundkrogen, greensand (series 1c): two specimens.

Measurements. The height of the holotype is 2.3 mm, width is 0.7 mm.

Description. The shell is very small, highly turriculate and slender with a height more than three times the width. The height of the last whorl is 2/5 of the shell height, and that of the aperture ¼ of the shell height. The protoconch consists of five convex whorls separated by deep sutures. The slightly defective nucleus is rather small and the whorls are smooth and glossy, except for very delicate opisthocline growth lines. On the terminal part of the protoconch these growth lines become more prominent. The boundary with the teleoconch is sharp and indicated by an opisthocline riblet and the sudden start of the teleoconch ornamentation. The teleoconch whorls are almost flat and dominated by four smooth spiral ribs, of which the two abapical ones are the more close-set. The upper two spirals are separated by an interspace of almost the same width as the spirals themselves, whereas the two lower spirals are separated by a narrower interspace. The suture is not very distinct, but the two abapical spirals are wider than the upper part of the subsequent whorl. A fifth smooth spiral rib is covered by the subsequent whorl but it is visible on the base as the demarcating spiral. This spiral rib is accompanied on the base by a weaker spiral.

There is no radial sculpture; opisthocline growth lines are only visible in the interspaces between the smooth spiral bands.

The aperture is rounded rectangular, the labrum is broken. The columella is slightly concave and smooth. A short siphonal canal is turned to the left.

Discussion. From the Eocene of the Paris Basin, Gougerot & Le Renard (1981) described and illustrated three species of *Seila (Notoseila)* with four spiral ribs. Of these, *Seila quadrisulcata* (Lamarck 1804) has four equally strong spirals, separated by interspaces of the same width as the spirals themselves. *Seila variata* (Deshayes 1864) has flat whorls and very indistinct sutures and *Seila quadricingulata* (Deshayes 1864) has convex whorls.

Seila tenuifila from the Montian of Belgium has four spiral ribs, but this species is more slender, has a smaller aperture and a shorter canal.

Genus *Thereitis* Le Renard 1997

1980 *Tembrockia* Gründel, p. 234.

Type species. Seila (Notoseila?) angusta Tembrock 1964.

***Thereitis weinbrechti* n. sp.**
Plate 3, fig. 1; Plate 5, fig. 5

Type locality. Sundkrogen, excavation 1920.

Type stratum. Lellinge Greensand, Selandian, Paleocene.

Derivation of name. This species is named after the German palaeontologist Friedrich Weinbrecht, Glücksburg, Germany.

Holotype. Plate 3, fig. 1, MGUH 24850 (leg. H. Ødum).

Paratype. Plate 5, fig. 5, MGUH 24872.

Diagnosis. A *Thereitis* with a protoconch of six whorls. The terminal protoconch whorls have 25 radial riblets; teleoconch whorls are relatively low.

Material. Sundkrogen (coll. Harder 1920), fine-grained greensand (series 3): five specimens; dark clay (series 4): 14 specimens (defective, partly damaged by pyrite oxidation). Sundkrogen (leg. H. Ødum 1920), fine-grained greensand (series 3): two specimens.

Kongedyb II (leg. Rosenkrantz 1935): 11 specimens (coll. MGUH).

Kongedyb I (leg. Rosenkrantz 1935): one specimen (coll. MGUH).

Measurements. The height of the holotype is 1.5 mm, width is 0.6 mm.

Description. The shell is very small and highly turriculate, 2½ times as high as wide. The protoconch is multispiral, consisting of five to six moderately convex whorls separated by distinct sutures. The nucleus is small. From the second protoconch whorl onwards a spiral ornamentation of two spiral ribs is present. The adapical spiral band is situated on the middle of the whorl while the abapical is situated midway between the upper one and the lower suture. Immediately above the abapical suture a weaker spiral rib is present, starting from the second protoconch whorl. On the last half whorl of the protoconch immediately below the adapical suture, a fourth weak spiral rib appears. A radial sculpture of fine riblets is present on the protoconch from the second protoconch whorl onward. These riblets are almost orthocline below the adapical suture and strongly opisthocline between the two spiral ribs on the middle of the whorl. Initially, they cut the second spiral rib at an angle of 25°; this angle increases to 45° on the terminal protoconch whorl. The number of radial riblets is 25 on the last protoconch whorl. The boundary with the teleoconch is marked by the sudden disappearance of the radial riblets.

On the largest specimen, only one, almost flat teleoconch whorl is present. It is provided with three spiral ribs of which the adapical one is the weakest. This rib is the continuation of the spiral rib situated below the adapical suture on the protoconch; the two stronger spiral ribs are continuations of the two strong spiral ribs on the protoconch. The lowermost spiral gradually weakens and demarcates the flat base of the shell. Very fine growth lines are visible between the spiral ribs with their sinus on the middle of the whorl.

The aperture comprises one fifth of the total shell height and is rounded ovate, the inner lip is smooth and the labrum is broken. The canal is short and rather wide.

Discussion. The genus *Tembrockia* was established by Gründel (1980, p. 234, figs 19, 20), with *Seila (Notoseila ?) angusta* Tembrock 1964, from the Oligocene and Early Miocene of the North Sea Basin as holotype. Janssen (1984, p. 158, plate 49, fig. 11) described and illustrated a representative of the genus from the Middle Miocene (Hemmoorian) of Winterswijk-Miste, The Netherlands. Le Renard (1997, p. 45) stated that the genus name *Tembrockia* is occupied by a bivalve genus introduced by Glibert & van der Poel (1967, p. 138) and introduced *Thereitis* nom. nov. for the gastropod genus. The new species from the Paleocene of Copenhagen is the oldest known representative of the genus. I have compared the Paleocene material with specimens in my collection of *T. angusta* from the Late Oligocene at Nr. Vissing, Denmark and Glimmerode, Germany. The Paleocene species differs from the type species of the genus by having a more thick-set protoconch, consisting of five to six whorls instead of seven, and 25 radial riblets instead of 30. Furthermore, the teleoconch whorl is relatively lower on the new species.

Family Triphoridae Gray 1847

Genus *Biforina* Bucquoy, Dautzenberg & Dollfus 1884

Type species. *Trochus perversus* Linneaus 1758.

Subgenus *Oriforina* Gründel 1975

Type species. *Biforina (Oriforina) praeversa* Gründel 1975.

***Biforina (Oriforina)* sp.**
Plate 3, fig. 3; Plate 5, fig. 3

Material. Sundkrogen (coll. Harder), greensand sample (series 1b): four specimens. One is a juvenile and two are fragments; fine-grained greensand (series 3): one specimen (juvenile).

Measurements. The pictured specimen has a height of 1.4 mm with a width of 0.5 mm.

Description. The shell is very small, sinistral and turriculate. The height is 2.8 times larger than the width. The aperture comprises ¼ of the total shell height. The largest available specimen consists of the protoconch and ½ teleoconch whorl. The protoconch has 4½ whorls, which are slightly angular abapically and separated by deep sutures. The nucleus is relatively large. The protoconch has a spiral ornamentation of two hair-like lirae. The adapical one of these is situated a little below mid-height, the abapical one lies close to the abapical suture. The upper spiral rib increases in strength and continues on the teleoconch whorl as a prominent spiral rib. The last three protoconch whorls have very fine, slightly opisthocline radial riblets, which are merely suggested at the adapical suture and invisible abapically. There are 20 of them on the terminal protoconch whorl. The riblets are slightly opisthocline. The transition into the teleoconch is gradual.

Teleoconch has half a whorl and its ornament is very vague. Apparently, two rows of rounded knobs are situated on the adapical part of the whorl. Just below the abapical suture a weak spiral riblet is present and abapically, two spiral ribs occur, of which the adapical one is the stronger. This spiral rib is the continuation of the angulation on the protoconch. The abapical spiral is weaker and demarcates the flat base which has a weak spiral. Radial sculpture is visible as weak opisthocline riblets which are almost orthocline on the adapical part of the whorl; on the abapical part they become opisthocline and run into the strong spiral at an angle of 45°. The number of radial ribs seems to be 16 (estimated) on the teleoconch whorls. The aperture is rounded rectangular and the canal is very short and slightly turned to the right. The columella is smooth.

Discussion. The sculpture of the protoconch is characteristic for the subgenus *Oriforina*, established by Gründel (1975). The investigated specimens are juveniles and cannot be compared with the related taxa from the Eocene of the Paris Basin. From the Paleocene of West Greenland, Kollmann & Peel (1983, p. 52, fig. 96) recorded *Ogivia* sp. 1, which has a sculpture consisting of two rows of knobs but a different aperture and canal. The genus *Biforina* and the subgenus *Oriforina* are, according to Gründel (1975, p. 152) recorded from the Eocene onwards; therefore the material from the Selandian of Sundkrogen represents the oldest known record of *Biforina*.

Remarks. The specimens recorded from Sundkrogen are the sole representatives of the family Triphoridae known from the Selandian of Copenhagen. The family is well represented in the Danian of Fakse (five species, of which one is very common).

Family Epitoniidae Berry 1910

Genus *Cirsotrema* Mörch 1852

Type species. *Scalaria varicosa* Lamarck 1822.

Subgenus *Cirsotrema* Mörch 1852

***Cirsotrema (Cirsotrema) hauniensis* n. sp.**
Plate 3, figs 4, 5

Type locality. Sundkrogen, excavation 1920.

Type stratum. Lellinge Greensand, Selandian, Paleocene.

Derivation of name. hauniensis (Latin) = from Copenhagen.

Holotype. Plate 3, fig. 4, MGUH 24853.

Paratype. Plate 3, fig. 5, MGUH 24854.

Diagnosis. A *Cirsotrema (Cirsotrema)* with a spiral ornamentation of nine, rather weak spirals and 18 narrow radial, widely spaced ribs. On the adapical part of the whorl, rather weak spines are present.

Material. Sundkrogen (coll. Harder), greensand sample (series 1b): two specimens (fragments), apparently belonging to one specimen.

Measurements. The holotype (fragment with three intermediate whorls) has a height of 1.3 mm and a width of 0.8 mm. The fragmentary paratype indicates a maximum height of 5 mm.

Description. The shell is very small, fragile and highly turriculate estimated almost twice as high as wide. The protoconch is not preserved. The convex whorls increase slowly and regularly in diameter and are separated by deep sutures. The last whorl equals about one third and the aperture about one fourth, of the total shell height. The basal disc is rather narrow and demarcated by a distinct spiral rib.

The spiral ornament consists of nine rather weak flat spiral ribs which are separated by narrower interspaces; they are most prominent on the abapical part of the whorl. The spirals are spread over 18 more or less opisthocyrt radial ribs and they are distinct on the back side of the ribs. The ribs, placed perpendicular to the shell surface, are considerably narrower than their interspaces. The number of radial ribs increases abapically. On the body whorl they become more lamellaceous with rather weak spines at the intersections with the adapical spiral ribs. On the demarcating spiral, the radial ribs are formed as small lamellae in the direction of the aperture. The radial ribs continue on the basal disc towards the columella. The aperture is subcircular and the thickened labrum is connected with the callus on the concave columella.

Discussion. The most complete fragment has three intermediate whorls, the other one consists of the last whorl with the complete aperture. As the two fragmentary specimens exhibit the characters of the teleoconch and the aperture, the introduction of a new species is possible.

The species *Cirsotrema (C.) morleti* (de Boury 1883) and *C. ?bourdoti* (de Boury 1883) *sensu* Le Renard & Pacaud (1995, p. 93) from the Eocene of the Paris Basin seem to be related, but they differ from the new species in having more angular whorls and a lower number of radial ribs.

The genus *Cirsotrema* is known from the Eocene onwards (Wenz 1940, p. 795) and the species from the Selandian of Denmark is therefore the oldest representative of the genus.

Genus *Opalia* H. & A. Adams 1853

Type species. *Scalaria australis* Lamarck 1822.

Subgenus *Pliciscala* de Boury 1887

Type species. *Scalaria gouldi* Deshayes 1861.

Opalia (Pliciscala) thomseni n. sp.

Plate 3, fig. 7

Type locality. Sundkrogen, excavation 1920.

Type stratum. Lellinge Greensand, Selandian, Paleocene.

Derivation of name. This species is named after the Danish geologist Erik Thomsen, University of Aarhus, Denmark.

Holotype. Plate 3, fig. 7, MGUH 24856.

Diagnosis. An *Opalia (Pliciscala)* with medium convex whorls and a spiral ornamentation of ten fine riblets. Radial sculpture consists of 25 weak, flexuous ribs. The aperture is ovate.

Material. Sundkrogen (coll. Harder), a sample from the dark clay with several hundreds of specimens of *Haustator nana*: one defective specimen. The specimen has a well-preserved protoconch and the first 1½ teleoconch whorls.

Measurements. The height of the holotype is 2.5 mm, width is 1.4 mm.

Description. The shell is very small and turriculate, almost twice as high as wide. The whorls are convex and separated by deep sutures. The multispiral protoconch consists of 4½ moderately convex whorls, which are separated by deep sutures. The nucleus is relatively large. The protoconch whorls are smooth and glossy, except for the terminal whorl which is provided with very fine slightly prosocline radial riblets. Immediately before the transition into the teleoconch these riblets become more prominent and close-set. The boundary with the teleoconch is sharp and indicated by an almost orthocline rib, at which position the spiral ornamentation of the teleoconch appears.

The teleoconch whorls are moderately convex and separated by deep sutures. The spiral ornamentation consists of ten very fine, hair-like lirae, much weaker than their interspaces. The spirals are most prominent and close-set on the abapical part of the whorls. They run across about 25 weak and flexuous radial ribs being most prominent between the ribs and almost invisible on them; the radial ribs have approximately the same width as their interspaces. On the first quarter of the first teleoconch whorl, the ribs are almost orthocline, later becoming flexuous. On the adapical part of the whorl they run prosocline, having their most backward point on the second spiral riblet. From this point they run opisthocline and straight towards the abapical suture, cutting it at an angle of 75°. Between the radial ribs, fine growth lines are visible running parallel to the radial ornament.

The aperture is broken on the only known specimen but it must have been ovate. The smooth columella is concave. The demarcating spiral on the base is accompanied by two spiral lirae. On the base, the growth lines reach the columella with a backward curve.

Discussion. Five *Opalia (Pliciscala)* species are recorded from the Eocene of the Paris Basin: *Opalia (P.) gouldi* Deshayes 1861, *O. (P). sellei* De Raincourt 1876, *O. (P.) propinqua* Deshayes 1861, *O. (P.) lamarckii* Deshayes 1861 and *O. (P.) marginalis* Deshayes 1861. They all have less flexuous radial riblets. The subgenus *Pliciscala* is known from the Eocene of Europe and North America (Wenz 1940, p. 791) and onwards; the Danish species is the oldest known representative of the subgenus.

Scalidae indet.
Plate 3, fig. 6

Material. Sundkrogen (coll. Harder): one specimen, labelled '*Scalaria* sp.' by Harder.

Description. The slender shell has 3½ very convex teleoconch whorls preserved, separated by deep sutures. The last whorl equals one third, and the aperture one sixth, of the total estimated shell-height. The aperture is almost circular.

The spiral sculpture consists of nine spiral bands, separated by narrower furrows. Adapically a rather weak spiral is situated close to the suture. The two following spiral bands are very weak, while the remaining six spiral furrows increase in strength abapically. Ornamentation of the flat base is not preserved.

The radial sculpture consists of 12 prosocline ribs which are slightly narrower than their interspaces. These ribs are not visible on the adapical spiral band but they are strong on the middle of the whorl. Abapically they become weaker again. Growth lines, having the same direction as the radial ribs, are visible between the ribs.

The specimen cannot be referred to any known representatives of Scalidae from the Paleocene of Copenhagen.

Family Ranellidae Gray 1834

Genus *Charonia* Gistel 1848

Type species. *Murex tritonis* Linneaus 1758.

Subgenus *Sassia* Bellardi 1872

Type species. *Triton appenninica* Sassi 1827.

***Charonia (Sassia) danica* n. sp.**
Plate 3, figs 8, 10

Type locality. Beach at Longelse Sønderskov, Langeland, Denmark (glacial boulder; Fig. 1, **16**).

Type stratum. Most probably Lellinge Greensand, Selandian, Paleocene.

Derivation of name. danicus (Lat.) = Danish.

Holotype. Plate 3, fig. 8, MGUH 24857.

Paratype. Plate 3, fig. 10, MGUH 24859.

Diagnosis. A *Charonia (Sassia)* with regularly convex whorls and a weak radial sculpture. The canal is turned to the left.

Material. Sundkrogen (coll. Harder), the fine-grained greensand (series 3): one protoconch and one fragment; dark clay (series 4): one complete and one defective protoconch and two fragments. Other material: Sundkrogen (leg. Ødum 1920): one fragment.

Longelse Sønderskov, Langeland, glacial boulder from the beach (leg. M.S. Nielsen, Odense): two slightly defective juvenile specimens.

Measurements. The height of the holotype is 5.3 mm, width is 3.3 mm.

Description. The shell is small and subfusiform, with convex whorls separated by deep sutures. The shell is relatively thin-walled and fragile, an explanation why only fragmentary specimens occur in the material from Sundkrogen. The relatively large protoconch has a naticoid shape and consists of 4½ convex whorls separated by distinct sutures. The nucleus is small, and the protoconch whorls quickly increase in diameter. The first two are smooth, followed by three thread-like spirals. They are regularly spaced and much narrower than their interspaces. On the last protoconch whorl, the number of spiral riblets is five to six, and on the base of the protoconch another ten spirals are present. On the terminal ¼ whorl of the protoconch, ten slightly prosocline radial riblets appear. They are of almost the same strength as the spirals, and the two sculptural elements thus result in a reticulate pattern of parallellograms. These riblets indicate the transition into the teleoconch.

The holotype shows only one half teleoconch whorl. This whorl is regularly convex and has a spiral ornamentation which is the continuation of the spiral riblets on the protoconch. The spiral ribs are much narrower than their interspaces, but soon weaker secondary spirals are inserted, resulting in alternating stronger and weaker spirals. The base and the neck of the canal are covered with a similar spiral sculpture. Six rather weak radial ribs are visible on the half teleoconch whorl present; they are weaker toward the base.

The convex base is abruptly constricted into the siphonal canal, which is rather short and narrow distinctly turned to the left. The labrum is thickened and presumably provided with knobs. The columella is concave and has three weak denticles, of which the two abapical ones are more close-set. The callus is thin and the aperture is rather wide.

Discussion. The new species differs convincingly from *Charonia (Sassia) bjerringi* (Ravn 1939). A protoconch of this species is illustrated here (Plate 3, fig. 9). The new species has a considerably larger and less pointed protoconch, with five to six spiral riblets instead of three. The new species has regularly convex whorls; *C. (S.) bjerringi* has angular whorls caused by three prominent spiral ribs. Finally, the aperture of the new species is more ovate and the canal is distinctly turned to the left, whereas the canal in *C. (S.) bjerringi* is almost straight.

Sassia formosa (Deshayes 1865) from the Eocene of the Paris Basin has a similar sculpture but a straight canal.

Order Neogastropoda Wenz 1938
Family Buccinidae Latreille 1825

Genus *Siphonalia* A. Adams 1863

Type species. Buccinum cassidariaeformis Reeve 1846.

***Siphonalia ariejansseni* n. sp.**
Plate 5, figs 7–10

Type locality. Beach at Longelse Sønderskov, Langeland, Denmark (glacial boulder; Fig. 1, **16**).

Type stratum. Most probably Lellinge Greensand, Selandian, Paleocene.

Derivation of name. This species is named after the Dutch palaeontologist Arie W. Janssen, Xevkija, Malta.

Holotype. Plate 5, fig. 10, MGUH 24877.

Paratypes. Plate 5, fig. 7, MGUH 24874; Plate 5, fig. 8, MGUH 24875; Plate 5, fig. 9, MGUH 24876.

Diagnosis. A small *Siphonalia* with a spiral sculpture consisting of eight to ten close-set spiral ribs of which the adapical one forms a sutural band. Radial sculpture consists of ten to eleven opisthocline, sharp ribs which are weaker than their interspace. On the last whorl, the radial ribs gradually decrease in strength towards the canal.

Material. Sundkrogen (coll. Harder), glauconitic greensand (series 1, 2): 27 specimens; fine-grained greensand (series 3): 44 specimens; dark clay (series 4): one specimen. All specimens are juvenile.

Glacial boulder from Longelse Sønderskov, Langeland (Fig. 1): 67 specimens (coll. M.S. Nielsen) and three specimens (coll. K.I. Schnetler).

Glacial boulder from Dimes Odde by Bagenkop, Langeland (Fig. 1): one specimen (coll. M.S. Nielsen).

Measurements. The holotype has a height of 6.6 mm and a width of 2.9 mm.

Description. As the entire material from Sundkrogen consists of juvenile specimens the description is also based on the material from Langeland (Fig. 1).

The shell is small and fusiform. The height equals

2.3 times the width, the aperture and canal half of the total shell height and the last whorl $^{2}/_{3}$ of the total shell height.

The protoconch is multispiral and consists of 3½ medium convex whorls, which are separated by distinct sutures. The nucleus is small and the whorls increase slowly and regularly in diameter. The protoconch whorls are smooth and glossy, except for the terminal ¼ whorl, which has five opisthocline radial riblets. On very juvenile specimens these riblets continue on the base with an opisthocyrt sinus. The transition into the teleoconch is gradual, being sometimes suggested by a change from a dark to lighter colour.

The teleoconch whorls are medium to highly convex and separated by deep somewhat undulating sutures. The last whorl is large and the convex base is suddenly constricted into the siphonal canal, which has almost the same length as the aperture and is slightly turned to the left. The aperture is ovate and relatively small, the labrum is sharp and the inner lip and the columella are smooth and s-shaped.

The spiral sculpture consists of eight to ten spiral ribs of which the adapical one is separated from the next by a wider space. The adapical spiral is divided into two from the second teleoconch whorl and forms a sutural band. The base of the last whorl and the neck of the canal are provided with a similar sculpture.

The radial sculpture consists of ten to eleven opisthocline radial ribs which are weaker than the spaces between them. The ribs are prominent and sharp especially in the direction of the aperture. On the last whorl they get gradually weaker. Opisthocline growth lines are visible between the radial ribs; they have a sinus on the adapical third of the whorl (Plate 5, fig. 9).

Remarks. As the new species has a similar sculpture to *Suessionia canalifera* (Ravn 1939) and the material from Sundkrogen consists of juvenile specimens only, I had initially included the material into this species. However, new material from glacial boulders from Longelse Sønderskov, Langeland (Fig. 1) that includes several presumed adult specimens, have convinced me that the Sundkrogen specimens are not conspecific with *Suessionia canalifera*. The new species differs from *S. canalifera* by having a smaller, not cupuliforme protoconch, considerably more convex whorls and a less slender outline. On the teleoconch whorls, the radial ribs become wider spaced and the radial ribs are opisthocline, while they are orthocline on *S. canalifera*.

Siphonalia hauniensis Ravn 1939 has more angular whorls with only six spiral ribs and 15–17 almost orthocline radial ribs. Furthermore, this species has a longer canal than the new species.

Family Columbellidae Swainson 1840

Genus *Astyris* H. & A. Adams 1853

Type species. *Columbella rosacea* Gould 1851, *fide* Wenz 1938–1944, p. 1148.

Subgenus *Astyris* H. & A. Adams 1853

Astyris (Astyris) lappanni n. sp.
Plate 4, figs 1, 2; Plate 6, fig. 1

1939 *Buccinofusus* sp.? – Ravn, p. 82, plate 3, fig. 14.

Type locality. Sundkrogen, excavation 1920.

Type stratum. Lellinge Greensand, Selandian, Paleocene.

Derivation of name. This species is named after the German palaeontologist Werner Lappann, Heiligenhaus-Isenbügel, Germany.

Holotype. Plate 4, fig 1, MGUH 3795 (= Ravn 1939, plate 3, fig 14).

Paratypes. Plate 4, fig. 2, MGUH 24523; Plate 6, fig. 1, MGUH 24878.

Diagnosis. An *Astyris (Astyris)* with a conical protoconch consisting of 4¾ whorls. The spiral sculpture consists of ten to eleven spiral bands of which the two adapical ones are strongest separated by a wider spiral furrow. Radial sculpture is weak.

Material. Sundkrogen (Ravn 1939): one specimen (leg. Rosenkrantz 1920). Sundkrogen (coll. Harder 1920): glauconitic greensand (series 1, 2): 11 specimens; fine-grained greensand (series 3): 15 specimens and one fragment; dark clay (series 4): four specimens.

Vestre Gasværk VI (leg. Rosenkrantz 1930): one specimen.

Kongedyb II (leg. Rosenkrantz 1935): one specimen.

Measurements. The maximum height is 4.9 mm, maximum width is 2.5 mm.

Description. The shell is very small, fusiform and rather thick-walled. Its height is twice the width, the last whorl is ¾ of the total shell height and the aperture equals half the total shell height.

The multispiral conical protoconch comprises 4¾ medium convex whorls separated by distinct sutures. The nucleus is small and the first protoconch whorl is planispiral. The subsequent whorls quickly increase in height. The first two protoconch whorls are smooth and glossy while the following ones show very delicate, opisthocyrt growth lines. On the terminal protoconch whorl these growth lines are stronger. On the terminal ¼ protoconch whorl, two spiral ribs are present below the adapical suture while six spiral bands are visible on the abapical part of the whorl. The transition into the teleoconch is gradual, and visible as a prominent growth line running opisthocyrt across the whorl; on the base it runs in a distinct opisthocyrt sinus. In addition, the shell surface becomes less smooth and glossy.

In the largest specimen 2½ teleoconch whorls are present. The height of the ovate aperture with the canal is half the total shell height. The canal is short and rather wide and turned to the left. The inner lip and the left margin of the canal are s-shaped. The labrum is sharp with internally seven lirae. The callus is very thin. The spirals on the base are barely visible but continue on the inner lip. The adapical angle of the aperture has a narrow anal ridge.

Ornament consists of ten to eleven spiral bands separated by narrower furrows. The two adapical bands are the strongest being separated by a wider spiral furrow. On the middle part of the whorls the spirals are rather weak but they increase in strength abapically. The neck of the canal has a similar spiral sculpture.

Radial sculpture is extremely weak on most specimens. Only two specimens show 16 weak, opisthocyrt folds that are narrower than their interspaces. Opisthocyrt growth lines are visible on all specimens.

Discussion. Ravn (1939) tentatively referred the single specimen known by him to *Buccinofusus* Conrad 1868. He considered *Buccinofusus* (?) *subglaber* from Fakse to be a related species. However, that species differs from *Astyris lappanni* by having a higher number of spiral bands (14), numerous radial folds, a labrum without internal lirae and a depressed columellar margin. The whorls are also more convex.

Kollmann & Peel (1983, p. 70, fig. 145) referred a closely related form from the Paleocene of West Greenland to the genus *Parvisipho* Cossmann 1889. The type of Kollmann & Peel (MGUH 15759) and additional material (MGUH 1977.848, 1977.849) were studied. The Greenland species differs, however, from the new species by a number of features. The number of spirals is higher (15 on the first teleoconch whorl), the number of lirae on the inner side of the labrum is 18, the last protoconch whorl is less convex and finally the shell is larger (up to 10 mm). The Greenland species should also be referred to *Astyris sensu stricto*. Kollmann & Peel (1983) also considered *Buccinofusus*(?) *subglaber* Ravn 1933 from the Danian of Fakse, Denmark and *Parvisipho preyei* Traub 1980 (Traub 1980, p. 39, plate 5, fig. 6) from the Paleocene of Austria to be related to the Greenland species. Le Renard (1989) revised the small species from the Eocene of the Paris Basin, previously referred to the genera *Parvisipho* and *Siphonalia* and in detail described the protoconch features of these species. The multispiral, conical protoconch of the new species in my opinion does not agree with that of *Parvisipho*. Representatives of the genus *Buccinofusus* are generally rather large.

I assign the new species to the genus *Astyris sensu stricto*, which in all features agrees very well with my material. This genus is represented in the Paleocene of Austria by *A. balzari* Traub 1981 (Traub 1981, p. 50, plate 10, fig. 12). In general outline, size and ornamentation this species agrees well with the Danish species and seems closely related; however, the protoconch has only two whorls in the Austrian species.

Parvisipho preyei, mentioned above, is larger than *Astyris sensu stricto* and has a spiral ornamentation of almost the same strength all over the whorl, whereas *Astyris sensu stricto* has a very characteristic spiral ornamentation: very weak or absent on the adapical half of the whorl and more prominent on the abapical part of the whorl. Thus, *Parvisipho preyei* is most probably not an *Astyris*.

Family Fasciolariidae Lamarck 1799

Genus *Streptolathyrus* Cossmann 1901

Type species. *Streptochetus mellevillei* Cossmann 1889.

***Streptolathyrus danicus* n. sp.**
Plate 3, figs 11, 13; Plate 6, fig. 2

Type locality. Vestre Gasværk, excavation 1930 (Fig. 1, **26**).

Type stratum. Lellinge Greensand, Selandian, Paleocene.

Derivation of name. danicus (Latin) = Danish.

Holotype. Plate 3, fig. 13, MGUH 24522.

Paratypes. Plate 3, fig. 11, MGUH 24860; Plate 6, fig. 2, MGUH 24879.

Diagnosis. A small *Streptolathyrus* with four to six spiral ribs and 12 orthocline radial ribs. At the intersections small rounded knobs are present. The columella is smooth.

Material. Sundkrogen (coll. Harder 1920), glauconitic greensand (series 1): three specimens; fine-grained greensand (series 3): 16 juvenile specimens; dark clay (series 4): 27 presumably adult specimens, 157 juvenile specimens and four fragments.

Sundkrogen (leg. Rosenkrantz 1920), fine sand: one specimen.

Vestre Gasværk VI (leg. Rosenkrantz 1930), 6.51–6.84 m under level: one specimen; unknown depth: one specimen. Kongedyb I (leg. Rosenkrantz 1935): seven specimens.

Measurements. The height of the holotype is 4.5 mm, width is 2.4 mm.

Description. The shell is very small and subfusiform. The height is about twice the width. The last whorl equals 2/3 of the total shell height, the aperture and canal are about half as high. The protoconch is conical and consists of 2¾ convex whorls, separated by rather distinct sutures. The nucleus is small and depressed. The first protoconch whorl slowly increases in diameter while the terminal 1¾ protoconch whorls quickly increases in diameter. The last half protoconch whorl is provided with a radial sculpture of opisthocyrt riblets that increase in strength abapically. The transition into the teleoconch is gradual.

The largest specimen has about two highly convex teleoconch whorls separated by deep sutures. The whorls have a rather flat ramp adapically. The teleoconch whorls increase quickly in height and diameter; the last whorl is 2/3 of the total shell height, the aperture and canal half the shell height. The periphery is convex with a concave transition into the relatively long siphonal canal. The aperture is ovate and clearly constricted into the canal, which is rather narrow and slightly twisted. The labrum is broken on all specimens and the smooth inner lip shows traces of resorption of calcareous matter.

The spiral ornament consists of six primary spirals, which are already visible on the last ¼ whorl of the protoconch. The abapical one is the weakest; it soon disappears, hidden by the following whorls. Three spirals of almost the same strength are narrower than their interspaces. The spirals run undulating across the radial ribs. The base and the neck of the canal have a similar spiral sculpture. The number of spirals varies from four to six.

The radial sculpture consists of 12 almost orthocline ribs, nearly as wide as their interspaces. They disappear on the base. At the points of intersection of spiral and radial ribs small knobs occur, especially on the three middle spirals. Orthocline to slightly opisthocyrt growth lines are visible between the radial ribs.

Discussion. This rather common species was labelled '*Fusus* sp.' by Harder. Cadée & Janssen (1994) revised the NW European Oligocene and Miocene Fasciolariidae traditionally included in the genus *Streptochetus* Cossmann 1889. Among the genera accepted is *Streptolathyrus* Cossmann 1901, known from the Eocene of the Paris Basin and from the Oligocene and Miocene of NW Europe (Cadée & Janssen 1994, p. 80). The new species agrees well with the revised diagnosis of the genus. However, it has a smooth columella, while most species of the genus have one or two denticles on the columella. Mr Cadée and Mr Janssen kindly examined specimens of the new species and found no objections to referring the Danish material to the genus *Streptolathyrus*. Thus, *S. danicus* and the following one, are the oldest known representatives of the genus.

Streptolathyrus lemchei **n. sp.**
Plate 3, fig. 12; Plate 6, fig. 3

Type locality. Sundkrogen, excavation 1920.

Type stratum. Lellinge Greensand, Selandian, Paleocene.

Derivation of name. This species is named after the Danish zoologist Henning Lemche.

Holotype. Plate 3, fig. 12, MGUH 24521 (leg. H. Lemche).

Diagnosis. A slender *Streptolathyrus* with a broadly conical protoconch. Spiral ornamentation consists of seven primary spiral ribs with secondary ribs inserted on the following whorls. Radial sculpture consists of up to 16 opisthocline to opisthocyrt ribs. The columella has two distinct folds.

Material. Sundkrogen: one specimen. It was collected in 1920 by Lemche but not recorded by Ravn (1939). A drawing of the specimen is among the drawings of Paleocene molluscs in the Rosenkrantz files in the Geological Museum, Copenhagen.

Gundestrup on the island of Fyn (boulders of Kerteminde Marl from the gravel-pit at Gundestrup; Fig. 1): four specimens preserved as imprints (coll. M.S. Nielsen, Odense).

Measurements. The holotype has a height of 14.0 mm and a width of 4.8 mm. The material from the Kerteminde Marl boulders indicates a maximum height of up to 20 mm.

Description. The shell is rather small to medium-sized, slender and fusiform. The height is three times the width with the last whorl $^2/_3$ of the total shell height. The height of the aperture and canal is slightly less than half the shell height.

The multispiral protoconch is broadly conical and consists of 3¼ convex to very convex whorls separated by deep sutures. The nucleus is small, and the two first protoconch whorls increase only slowly in diameter, while the terminal protoconch whorl quickly increases. The protoconch whorls are smooth, except for 12 very fine opisthocline riblets on the last. On the terminal part of the last whorl, these riblets become sharp, less opisthocline and wider spaced. Also two weak spirals appear slightly below the middle of the whorl and these become situated lower and accompanied by two further spirals. The transition into the teleoconch is gradual.

The holotype has five convex teleoconch whorls separated by deep sutures. The body whorl is $^2/_3$ of the total shell height. The base is convex and gradually constricted into the rather short and narrow siphonal canal, that is slightly turned to the left. The aperture is ovate and the labrum is broken. The s-shaped columella bears two distinct folds, placed a little adapically from the constriction of the aperture into the canal. The callus is rather thin.

The ornamentation starts with seven spiral ribs, one of which is placed slightly below the adapical suture. The next two spirals are very weak and situated above the middle of the whorl. The abapical part of the whorl shows four strong spiral ribs that are equal in strength and regularly distributed. Secondary spirals soon are inserted and on the penultimate whorl, 16 spiral ribs are present. The base and the neck of the canal have a similar spiral sculpture.

There are ten opisthocline to opisthocyrt radial ribs, almost as wide as their interspaces and on the last whorl there are 16. The spirals run in an undulating shape over the radial elements. Growth lines are visible in between the radial ribs.

Discussion. The protoconch of the new species is more broadly conical than the protoconch of typical representatives of the genus *Streptolathyrus*. On the other hand the species agrees well with respect to general outline, sculpture and folds on the columella. *Streptolathyrus lemchei* differs clearly from *S. danicus*, described above by the presence of two distinct folds on the columella, the broad protoconch and the spiral sculpture.

Family Cancellariidae H. & A. Adams 1853

Genus *Cancellaria* Lamarck 1799

Type species. Voluta reticulata Linneaus 1767.

***Cancellaria (sensu lato) jakobseni* n. sp.**
Plate 4, fig. 3; Plate 6, fig. 4

Type locality. Sundkrogen, excavation 1920.

Type stratum. Lellinge Greensand, Selandian, Paleocene.

Derivation of name. This species is named after curator Sten Lennart Jakobsen, Geological Museum, University of Copenhagen.

Holotype. Plate 4, fig. 3, MGUH 24524 (leg. Rosenkrantz 1920).

Paratype. Plate 6, fig. 4, MGUH 24880.

Diagnosis. A *Cancellaria (sensu lato)* with two prominent, narrow spirals on the periphery and 12 narrow radial ribs. The shell has a glossy appearance due to the narrow spirals and radial ribs.

Material. Sundkrogen (coll. Harder): two defective specimens and one fragment of a larger individual come from a sample labelled '*Cancellaria* sp.' Harder, and one specimen from a sample of *Babylonella ravni*.

In the collections of the Geological Museum, Copenhagen: one specimen was found in a sample with *Babylonella ravni*, labelled by Rosenkrantz *Cancellaria angulifera*.

Measurements. The holotype has a height of 2.2 mm and a width of 1.3 mm.

Description. The shell is very small, subfusiform and rather thick-walled. The height is slightly more than 1.5 times the width. The last whorl equals ¾ of the total shell height. The mammilated protoconch is somewhat obliquely placed and consists of 2½ smooth and convex whorls. The nucleus is small and situated slightly below the first whorl of the protoconch. This increases rapidly in diameter whereas the last whorls increase only slowly, thus resulting in a subcylindrical shape. On the last ¼ protoconch whorl, opisthocyrt radial riblets are visible, and above the abapical suture there is a weak spiral band. Near the middle of the last ¼ protoconch whorl two very weak spirals appear. The transition into the teleoconch is gradual. The largest shell has 2¼ teleoconch whorls, which are angular and separated by deep sutures. The aperture and the canal equals almost half the total shell height. The siphonal canal is rather short and narrow and turned only slightly to the left. The inner lip and the left margin of the canal are s-shaped. On the columella two rather weak spiral folds are present. The labrum is broken in all specimens.

Ornament consists of four primary spirals, the adapical one of which is in between the upper suture and the next spiral rib. The following two spirals are the strongest ones, the fourth spiral rib is weak and situated immediately above the abapical suture. In one shell, a secondary spiral occurs between spirals three and four, thus resulting in five, almost equally strong spirals. In the other specimens, no secondary spirals are developed. On the base, two spirals are present. One specimen differs somewhat by having more angular whorls due to the fact that the two middle spirals are stronger developed and no secondary spirals occur.

There are 12, rather strong radial ribs narrower than their interspaces. These ribs are almost orthocline and disappear on the base. Very delicate growth lines can be observed between the radial ribs.

Discussion. Babylonella ravni has a larger protoconch and a different spiral ornamentation which, as pointed out by Ravn (1939) also demonstrates a wide range of variation. Many species of Cancellariidae show such variability (as for instance *Babylonella pusilla* Philippi 1843) from the Late Oligocene of the North Sea Basin).

A related form is *Cancelrana* sp. 1 (Kollmann & Peel 1983, p. 92, fig. 207), which is larger and has a considerably larger protoconch. I refer the new species to *Cancellaria* (*sensu lato*) because of the mammilated protoconch which is not typical of the family Cancellariidae.

Family Turridae Swainson 1840 emend. Powell 1966

Subfamily Turriculinae Powell 1942

Pseudocochlespira n. gen.

Diagnosis. Rather small to medium-sized Turriculinae of the cochlespirid group, more or less elongate-pagodiform in shape. The protoconch is conical and multispiral consisting of 3½ to 4¾ whorls; the terminal part has radial riblets and spiral ornamentation, or radial riblets only.

Discussion. Pseudocochlespira in general outline and size resembles species of the genus *Cochlespira* Conrad 1865 (Powell 1966, p. 42, plate 5, figs 3–6) (type species *Pleurotoma cristata* Conrad 1848), but the protoconch of species in that genus is subcylindrical consisting of two smooth whorls. In the North Sea Basin, the genus is represented by *Cochlespira volgeri* (Philippi 1847) (Oligocene) and *C. corneti* (von Koenen 1872) (Miocene). These species have previously been referred to the genera *Ancistrosyrinx* and *Tahusyrinx* as discussed below.

Within the cochlespirid group of the Turriculinae several genera resemble *Pseudocochlespira* superficially. Powell (1966) described and illustrated representatives of this group. *Ancistrosyrinx* Dall 1881 (Powell 1966, p. 41, plate 5, fig. 2) has a small paucispiral protoconch, consisting of 1½ whorls only and the peripheral carina furthermore is produced into numerous upcurving spines.

Cochlespiropsis Casey 1904 *sensu* Powell (1966, p. 42, plate 5, fig. 7) also has a paucispiral protoconch. The aperture is long and narrowly pyriform and the canal is twisted and weakly notched.

Tahusyrinx Powell 1942 (Powell 1966, p. 42, plate 5, fig. 8) has a multispiral protoconch consisting of four whorls of which the terminal two are carinated and radially ribbed. Also, the only species known is rather small, and found in the Eocene of New Zealand.

Parasyrinx Finlay 1924 *sensu stricto* (Powell 1966, p. 43, plate 5, fig. 10) has a protoconch of two rounded smooth whorls and is known from the Oligocene of New Zealand.

Parasyrinx (Lirasyrinx) Powell 1942 (Powell 1966, p. 43, plate 5, fig. 9) has a protoconch of 2½ whorls, of which the tip is planorbid and the following two have strong spiral lirae.

Cosmasyrinx Marwick 1931 (Powell 1966, p. 43, plate 5, fig. 11) has a paucispiral, smooth and erect protoconch with a bulbous nucleus. This genus is rather small and only known from the Miocene and Late Oligocene of New Zealand.

Within the Turridae, the new genus has a general similarity to *Clinura* Bellardi 1875, but species in this genus have a diagonally cancellated protoconch and consequently cannot be assigned to the Turriculinae. Powell (1966, p. 140) and Charig (1963, p. 278) assigned *Clinura* to the subfamily Thatcheriinae. From the Paleocene of West Greenland Kollmann & Peel (1983, p. 97–98, figs 220–221) referred two forms to *Clinura*, and they considered *Clinura* sp. 2 to be related to *Surcula (Cochlespira) bøggildi* Ravn 1939. The protoconch of the new genus, however, excludes an assignment to *Clinura*.

The new species *Pseudocochlespira rosenkrantzi*, described below, was considered to be closely related to *Surculites* sp. by Kollmann & Peel (1983, p. 98, fig. 222). The species from Greenland has a similar outline but differs in having a serrated carina, a more concave adapical part of the whorl and a protoconch consisting of three whorls, of which the last half whorl is carinated. The taxonomic position of *Surculites* Conrad 1865 was discussed by Powell (1966, p. 146) who concluded that this genus was not a Turrid. Wenz (1943, p. 1390, fig. 3928) considered *Clinura* to be a subgenus of *Surculites*. As the protoconch of the type species of *Surculites* is not known, this reference seems questionable. Traub (1980, p. 42) followed Wenz when establishing *Surculites (Clinura) lineatus* from the Paleocene of Austria. Pacaud & Le Renard (1995, p. 166) assigned *Surculites* to the subfamily Fasciolariinae.

Apparently, there is no suitable genus for the species from the Selandian of Copenhagen and hence the establishment of a new genus is justified.

Derivation of name. pseudo (Greek) = false.

Type species. *Surcula (Cochlespira) boeggildi* Ravn 1939.

Holotype. Ravn 1939, plate 4, fig. 9, MGUH 3816.

***Pseudocochlespira rosenkrantzi* n. sp.**
Plate 4, figs 4, 5; Plate 6, fig. 5

1939 *Surcula (Cochlespira) boeggildi* n. sp. – Ravn, p. 93 (*partim*), plate 4, fig. 14.

Type locality. Sundkrogen, excavation 1920.

Type stratum. Lellinge Greensand, Selandian, Paleocene.

Derivation of name. This species is named after the Danish geologist Alfred Rosenkrantz.

Holotype. Plate 4, fig. 4, MGUH 24525 (leg. Rosenkrantz 1920).

Paratype. Plate 4, fig. 5 and Plate 6, fig. 5, MGUH 3821 (= Ravn 1939, plate 4, fig. 14).

Diagnosis. A slender *Pseudocochlespira* with a weak spiral ornamentation, a relatively large protoconch and a carina without knobs.

Material. Three specimens are available. The two pictured specimens were collected by Rosenkrantz in 1920, and the incomplete specimen (MGUH 3821) was illustrated as *Surcula (Cochlespira) boeggildi* by Ravn (1939). The complete specimen (MGUH 24524) and a large fragment of MGUH 3821 were neither mentioned nor illustrated.

Sundkrogen (coll. Harder): one defective specimen.

Measurements. The holotype has a height of 34.2 mm and a width of 11.0 mm.

Description. The shell is medium sized and slender fusiform. The height is three times the width, the body whorl is 0.6 of the total shell height. The aperture equals half of the total shell height.

The protoconch consists of 3¾ convex whorls which are separated by deep sutures. The nucleus is small. The whorls are smooth, except for the last one, which has 15 radial riblets. Initially these riblets are only a little opisthocline; later, they become stronger opisthocline and more distinct and sharp. The riblets run across seven fine spirals on the beginning of the last whorl. On the terminal part of the protoconch the number of fine spirals increases to 12 and close-set sigmoidal radial ribs occur. The adapical spiral has weak knobs and is developed as a sutural band. The boundary with the teleoconch is sharp. On the adapical part of the whorl the spirals disappear giving the teleoconch whorl a more glossy appearance. The largest specimen has six teleoconch whorls which have a distinct carina slightly below mid-height. The carina divides the whorl into a concave adapical part and a flat to slightly convex abapical part. The whorls are separated by deep sutures. The aperture is ovate and the siphonal canal, rather long and narrow is slightly turned to the left. The labrum is broken and the columella is smooth.

Ornamentation begins on the first teleoconch whorl with a solitary sutural spiral, the only one on the adapical part of the whorl. On the carina, two spirals are present with three others below it. On the following whorl, the number of spirals has increased; the sutural band is divided into two and on the adapical part seven spirals appear. Of these, the upper two are rather weak and well-spaced, while the five abapical spirals are close-set and stronger. On the carina three spirals are present, and below the carina four spirals are seen. On the last whorl the number of adapical spirals is 12, with four spirals on the carina and six below.

The radial sculpture is weak. On the first ¼ teleoconch whorl four to five opisthocline riblets are seen, but they soon disappear; thus the carina on the rest of the teleoconch is without knobs. Growth lines are visible. Adapically they run prosocline and the deep sinus is placed in the middle of the adapical part of the whorl. Below the sinus the growth lines run strongly opisthocline and meet the abapical suture at an angle of 15°.

Discussion. The new species differs from *Pseudocochlespira boeggildi* (Ravn 1939) in a number of features. Firstly, it is a larger species, which has a more slender outline and a more glossy appearance because of the weaker developed spiral ornamentation. On *P. boeggildi,* the spirals on the adapical part of the whorl are almost of equal strength and regularly spaced. The carina on the new species is situated more adapically and has no knobs. Finally, the protoconch of the new species is larger (one additional whorl is present) and it has more convex whorls.

P. koeneni (Arkhanguelsky 1904) differs from the two other species of the new genus in having an almost invisible spiral ornamentation on the teleoconch, resulting in resemblance with *Cochlespira volgeri* (Philippi 1843) from the Oligocene. The protoconch of *P. koeneni* is less slender and has no terminal spiral ornamentation but the radial riblets are similar to the riblets of the two other representatives of this new genus.

Kollmann & Peel (1983, p. 98) suggest that *P. boeggildi* and *P. koeneni* should be related to a species compared by them to the genus *Clinura* from the Paleocene of West Greenland. The genus *Clinura* however, has a daphnelloid protoconch. *Surcula perspirata* von Koenen 1890 (p. 323, plate 30, fig. 10) resembles the new species in general outline but it has a low conical protoconch with a smooth surface and a depressed nucleus. Furthermore, the ornament on the base and on the neck of the canal differs by having two rather strong spirals below the carina and 10 weaker spirals.

Order Entomotaeniata Cossmann 1896
Family Pyramidellidae d'Orbigny 1840

Genus *Actaeopyramis* Fischer 1885

Type species. *Monoptygma striata* Gray 1847.

Actaeopyramis marcusseni n. sp.

Plate 4, fig. 6; Plate 6, fig. 8

Type locality. Sundkrogen, excavation 1920.

Type stratum. Lellinge Greensand, Selandian, Paleocene.

Derivation of name. This species is named after the Danish geologist Ib Marcussen, Geological Survey of Denmark and Greenland, Copenhagen.

Holotype. Plate 4, fig. 6, MGUH 24861.

Paratype. Plate 6, fig. 8, MGUH 24883.

Diagnosis. A very small *Actaeopyramis* with a very weak radial sculpture and an angulated last whorl.

Material. Sundkrogen (coll. Harder), dark clay (series 4): 37 specimens; fine-grained greensand (series 3): one defective specimen. All specimens are juvenile, except for the defective specimen.

Measurements. The holotype has a height of 1.4 mm and a width of 0.9 mm.

Description. The shell is very small, ovoid and comparatively rather solid. The largest specimen has one protoconch and two teleoconch whorls. The shell height equals 1.6 times the width and the aperture height is half the total shell height. The protoconch is heterostrophic with only the terminal ¾ whorl visible slightly projecting above the teleoconch. The boundary with the teleoconch is sharp.

The teleoconch whorls are slightly to moderately convex and separated by deep sutures. The body whorl equals more than ⅔ of the total shell height. The base is convex and there is a weak angulation at the transition to the base. The aperture is oval and the labrum is sharp-edged with a gradual transition into the columellar part. The columella is concave and bears a fold. There is an edge near the columella. A narrow umbilicus is present.

The spiral sculpture starts at the boundary with the protoconch from where eight spiral bands are present separated by narrower furrows. The spiral bands increase in strength in abapical direction. The base has a similar spiral ornamentation.

Radial sculpture is absent; the growth lines are barely visible but prosocline. On a few specimens former apertures are visible; they run from the adapical suture at an angle of 60°.

Remarks. The genus *Actaeopyramis* was hitherto only recorded from the Eocene of Europe, North America, Japan and Australia and onwards to Recent (Wenz 1850, p. 850).

Genus *Chrysallida* Carpenter 1857

Type species. *Chemnitzia communis* C.B. Adams 1852.

Subgenus *Parthenina* Bucquoy, Dautzenberg & Dollfus 1883

Type species. *Turbo interstincta* Montagu 1815.

Chrysallida (Parthenina) peterseni n. sp.

Plate 4, figs 8, 9

Type locality. Sundkrogen, excavation 1920.

Type stratum. Lellinge Greensand, Selandian, Paleocene.

Derivation of name. This species is named after the Danish geologist Kaj Strand Petersen, Geological Survey of Denmark and Greenland, Copenhagen.

Holotype. Plate 4, fig. 8, MGUH 24863.

Paratype. Plate 4, fig. 9, MGUH 24864.

Diagnosis. A *Chrysallida (Parthenina)* with a subcylindrical outline and without radial sculpture and spiral ornamentation. Flexuous growth lines are present.

Material. Sundkrogen (coll. Harder 1920), dark clay (series 4): one well-preserved juvenile shell and three defective shells.

Measurements. The holotype has a height of 0.6 mm and a width of 0.3 mm.

Description. The shell is very small, subcylindrical and slender and is twice as high as wide. Only the last whorl of the heterostrophic protoconch is visible. The transition into the teleoconch is indicated by a change in colour and by the sudden appearance of the sculpture. In the available complete specimen, 2¼ teleoconch convex whorls are present separated by deep sutures. The whorls increase quickly in height but only slowly in diameter, resulting in an almost cylindrical outline and relatively high whorls. The last one equals ⅔ of the total shell height, and the aperture less than half the total shell height. The aperture is rounded ovate and has a weak siphonal notch abapically. The labrum is prosocline; the columella is thickened and has a very weak fold.

The teleoconch is smooth, except for very numerous flexuous growth lines which run prosocline across the whorls.

Remarks. Species of *Chrysallida (Parthenina)* generally have a more or less prominent spiral ornamentation consisting of fine spiral ribs between the radial ribs. The subgenus *Parthenina* was first recorded from the Eocene of Europe and North America (Wenz 1940, p. 846) and the new species is thus the oldest known representative of this subgenus.

Genus *Syrnola* A. Adams 1860

Type species. *Syrnola gracillima* A. Adams 1860.

Syrnola (Syrnola) granti **n. sp.**

Plate 4, fig. 7; Plate 6, fig. 9

Type locality. Sundkrogen, excavation 1920.

Type stratum. Lellinge Greensand, Selandian, Paleocene.

Derivation of name. This species is named after the German palaeontologist Andreas Grant, Schwerin-Lankow, Germany.

Holotype. Plate 4, fig. 7, MGUH 24861.

Paratype. Plate 6, fig. 9, MGUH 24884.

Diagnosis. A *Syrnola (Syrnola)* with flat to slightly convex whorls and a spiral ornamentation of very fine spiral furrows, situated in the adapical part of the whorl. The aperture is small and ovate.

Material. Sundkrogen (coll. Harder 1920), dark clay (series 4): 37 specimens labelled '*Melania* sp.'; fine-grained greensand (series 3): 16 specimens from a sample of unsorted material; glauconitic greensand (series 2): one specimen.

Measurements. The holotype has a height of 3.5 mm and a width of 1.1 mm.

Description. The shell is very small and very slender, rather thick-walled. The shell height is slightly more than three times the width. The last whorl has a height of one third and the aperture one fifth of the total shell height.

The sinistral protoconch has 1½–2 whorls, its axis making an angle of 85° with the shell axis. The small nucleus is visible above the first protoconch whorl. The transition into the teleoconch is gradual and not easy to detect.

The largest specimen available (the holotype) comprises five whorls which are low and flat to slightly convex and separated by rather deep sutures. The base is convex and the aperture ovate. The labrum is broken and on the columella a distinct fold is visible.

The shell has a smooth and glossy appearance and a spiral ornamentation is seen only as very delicate spiral furrows below the adapical suture. There is no radial sculpture. Slightly flexuous growth lines run across the whorls, having their shallow sinus at one third of the whorl below the adapical suture.

Discussion. *Syrnola rutoti* (Glibert 1973, plate 10, fig. 15) differs from the new species by having lower whorls, while *Syrnola conica* Briart & Cornet 1873, illustrated by Glibert (1973, plate 10, fig. 16) has a less slender outline and a higher last whorl.

Genus *Cingulina* A. Adams 1860

Type species. *Cingulina circinata* A. Adams 1860.

Cingulina harderi **n. sp.**

Plate 4, fig. 12; Plate 6, fig. 10

Type locality. Sundkrogen, excavation 1920.

Type stratum. Lellinge Greensand, Selandian, Paleocene.

Derivation of name. This species is named after the Danish geologist Poul Harder.

Holotype. Plate 4, fig. 10, MGUH 24865.

Paratype. Plate 6, fig. 10, MGUH 24885.

Diagnosis. A *Cingulina* with a spiral ornamentation of five flat spiral bands of which the adapical one forms a subsutural band. The spiral bands are separated by narrower spiral grooves. No fold is visible on the columella.

Material. Sundkrogen (coll. Harder 1920), dark clay (series 4): one specimen, four defective specimens and one fragment; fine-grained greensand (series 3): one specimen; glauconitic greensand (series 1c): one specimen.

Measurements. The holotype has a height of 3.8 mm and a width of 1.1 mm.

Description. The shell is very small and slender, slightly more than three times as high as wide. The shell is rather thick-walled. The protoconch is heterostrophic; only the terminal whorl is visible situated at an obtuse angle to the axis of the shell. The transition into the teleoconch is gradual.

The teleoconch of the holotype has 4¾ whorls which are slightly convex to almost flat and separated by rather shallow sutures. The whorls are relatively high and the last one equals half the total shell height. The aperture is rounded ovate, the labrum is broken and the columella is smooth and only slightly concave. A thin callus covers the inner lip.

The spiral ornament consists of five flat spiral bands of which the adapical one is stronger than the others and thus forms a subsutural band. The spirals are separated by much narrower intermediate grooves. On the base, a similar ornamentation is present. On the last two whorls a spiral groove is visible immediately above the abapical suture.

The radial sculpture is very weak and only visible as a punctuate pattern of the spiral grooves. On the last medium whorl the number of these depressions is 20. They are circular to elliptical, having their largest dimension in the direction of the spirals. Growth lines are invisible. The shell is glossy on the spiral bands.

Discussion. The material is derived from a sample labelled '*Mathildia* sp.' by Harder; this sample also contained specimens of *Mathilda lemchei* Ravn 1939, which indeed has a very similar outline and sculpture. The new species is in good agreement with the genus *Cingulina* A. Adams 1860 in most features. It differs in having narrower spiral grooves and no visible fold on the columella. The genus *Cingulina* is known from the Eocene of Europe, Japan and North America (Wenz 1940, p. 867), and consequently the new species is the oldest known representative of the genus.

Genus *Ebala* Leach 1847

Type species. Turbo nitidissima Montagu 1803.

Ebala sp.

Plate 4, fig. 11

Material. Sundkrogen (coll. Harder) greensand (series 1): one defective specimen; fine-grained greensand (series 3): one defective specimen; dark clay (series 4): one defective specimen.

Measurements. The height of the illustrated specimen is 2.4 mm and the width is 0.8 mm.

Description. The protoconch is broken on all specimens and the aperture is defective. However, the general outline is in good agreement with the genus *Ebala*.

The shell is very small and slender turriculate, with a height three times its width. The last whorl equals 0.4 times the total shell height. The whorls are highly convex and separated by deep sutures. The shell is smooth and glossy and only very delicate prosocline growth lines are visible. The aperture is defective but ovate.

Anisocycla rutoti Cossmann 1921 (Cossmann 1921, p. 309; Cossmann 1924, p. 2, plate 5, figs 1 and 64) from the Montian of Belgium has less convex whorls.

Genus *Acteocina* Gray 1847

Type species. Actaeon wetherelli Lea 1843.

Acteocina? sp.

Plate 4, fig. 13

Material. Sundkrogen (coll. Harder 1920) dark clay (series 4): one juvenile specimen.

Measurements. The specimen has a height of 1.8 mm and a width of 1.2 mm.

Description. The shell is very small, ovoid and relatively thick-walled. The height/width ratio is 1.5, the last whorl equals 0.9 and the aperture 0.6 of the total shell height.

Only the terminal part of the heterostrophic protoconch is visible, projecting dome-like above the whorls. The transition into the teleoconch is gradual. In the juvenile specimen available only two teleoconch whorls are present. The whorls are slightly convex and separated by canaliculate sutures. The first teleoconch whorl increases very slowly in diameter resulting in a horizontal suture, but the last teleoconch whorl abruptly increases in diameter which results in an oblique suture. The narrow aperture tapers and widens abapically. The labrum is gradually connected with the highly concave inner lip. No fold is visible on the columella but as the aperture is partly filled with sediment its true character may be hidden. The base is convex and there is a narrow umbilicus.

Ornament consists of fine spiral furrows which are almost invisible on the middle of the whorls. On the first teleoconch whorl, five spiral furrows are visible; the last whorl and the apex have a similar spiral sculpture. The furrows are rather distinct on the base. The shell has no radial sculpture but very delicate opisthocline growth lines are visible.

Remarks. The specimen differs from the genus *Acteocina* Gray 1847 by having an ovoid outline instead of a cylindric one and by the lack of a fold on the columella. Since the available specimen is juvenile these characteristics possibly have not developed.

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Plate 1

Fig. 1. *Portlandia (Yoldiella) nielseni* n. sp.
Holotype. Fig 1A: right valve, interior, × 10. Fig. 1B: right valve, exterior, × 10. MGUH 24831.
From glacial boulder at Kokkestræde, Langeland, leg. M.S. Nielsen.

Fig. 2. *Plicatula selandica* n. sp.
Holotype. Fig. 2A: left valve, interior; × 6. Fig. 2B: left valve, exterior, × 6. MGUH 24832.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 3. *Lyonsia baltica* Roedel 1935.
Hinge of right valve, × 10. MGUH 24833.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 4. *Laternula (Laternulina) ravni* n. sp.
Paratype. Hinge of right valve, × 7.5. MGUH 24834.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 5. *Laternula (Laternulina) ravni* n. sp.
Holotype. Right valve, exterior, × 4. MGUH 24517.
From Sundkrogen, excavation 1920, leg. A. Rosenkrantz.

Fig. 6. *Laternula (Laternulina) ravni* n. sp.
Paratype. Right valve, exterior, × 4. MGUH 24518.
From Sundkrogen, excavation 1920, leg. A. Rosenkrantz.

Fig. 7. *Dentalium rugiferum* von Koenen 1885.
Juvenile specimen, × 30. MGUH 24835.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 8. *Dentalium rugiferum* von Koenen 1885.
Juvenile specimen, × 30. MGUH 24836.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 9. *Veniella* cf. *ciplyensis* Vincent 1930.
Fig. 9A: left valve, interior, × 7.5. Fig. 9B: left valve, exterior, × 7.5. MGUH 24837.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 10. *Dentalium sundkrogensis* n. sp.
Paratype. Lateral view, × 30. MGUH 24838.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 11. *Dentalium sundkrogensis* n. sp.
Holotype. Lateral view, × 30. MGUH 24839.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 12. *Solariella*? sp.
Juvenile specimen. Fig. 12A: apertural view, × 30. Fig. 12B: rear view, × 30. MGUH 24840.
From Sundkrogen, excavation 1920, coll. Poul Harder.

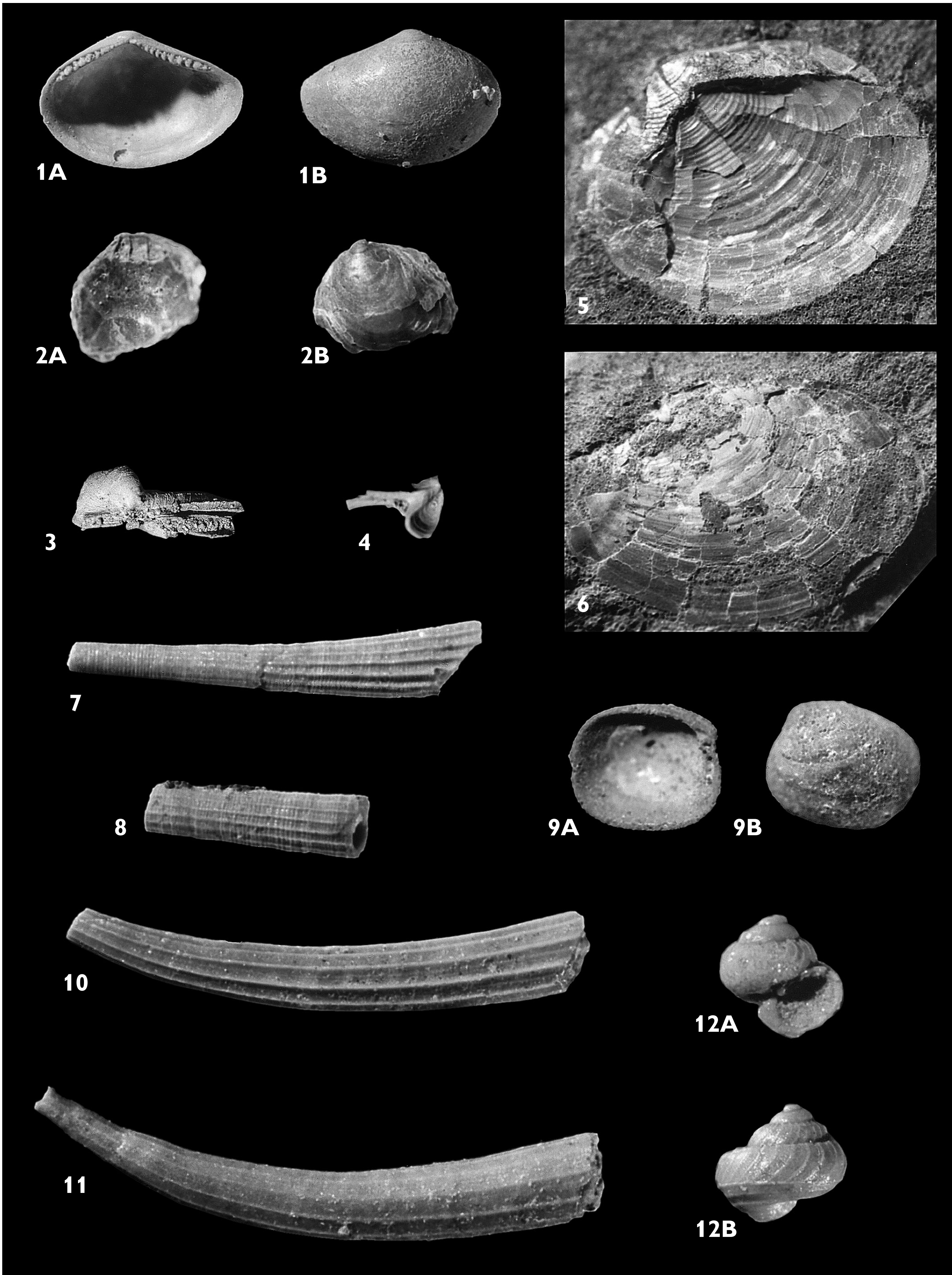
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Plate 2

Fig. 1. *Solariella (Solariella) ravni* n. sp.
Holotype. Fig. 1A: apertural view; × 30. Fig. 1B: rear view, × 30. MGUH 24841.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 2. *Solariella (Solariella) hauniensis* n. sp.
Holotype. Fig 2A: apical view, × 38. Fig 2B: umbilical view, × 38. MGUH 24842.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 3. *Teinostoma ledoni* n. sp.
Holotype. Fig. 3A: apertural view, × 30. Fig. 3B: apical view, × 30. Fig. 3C: umbilical view, × 30. MGUH 24843.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 4. *Teinostoma ledoni* n. sp.
Paratype. Fig. 3A: apertural view, × 30. Fig. 4B: apical view, × 30. Fig. 4B: umbilical view, × 30. MGUH 24844.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 5. *Cerithiopsidella (Vatopsis) rasmusseni* n. sp.
Holotype, × 30. MGUH 24845.
Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 6. *Bittium (Bittium) oedumi* n. sp.
Holotype. Fig. 6A: apertural view, × 30. Fig. 6B: rear view, × 30. MGUH 24846.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 7. *Entomope kirstineae* n. sp.
Paratype, × 20. MGUH 24519.
From Kongedyb II, leg. A. Rosenkrantz 1935.

Fig. 8. *Entomope kirstineae* n. sp.
Holotype, × 20. MGUH 24520.
From Kongedyb II, leg. A. Rosenkrantz 1935.

Fig. 9. *Seila (Notoseila) heilmannclauseni* n. sp.
Paratype. Apertural view, × 30. MGUH 24847.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 10. *Seila (Notoseila) heilmannclauseni* n. sp.
Holotype. Apertural view, × 30. MGUH 24848.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 11. *Seila (Notoseila) anderseni* n. sp.
Holotype. Apertural view, × 30. MGUH 24849.
From Sundkrogen, excavation 1920, coll. Poul Harder.

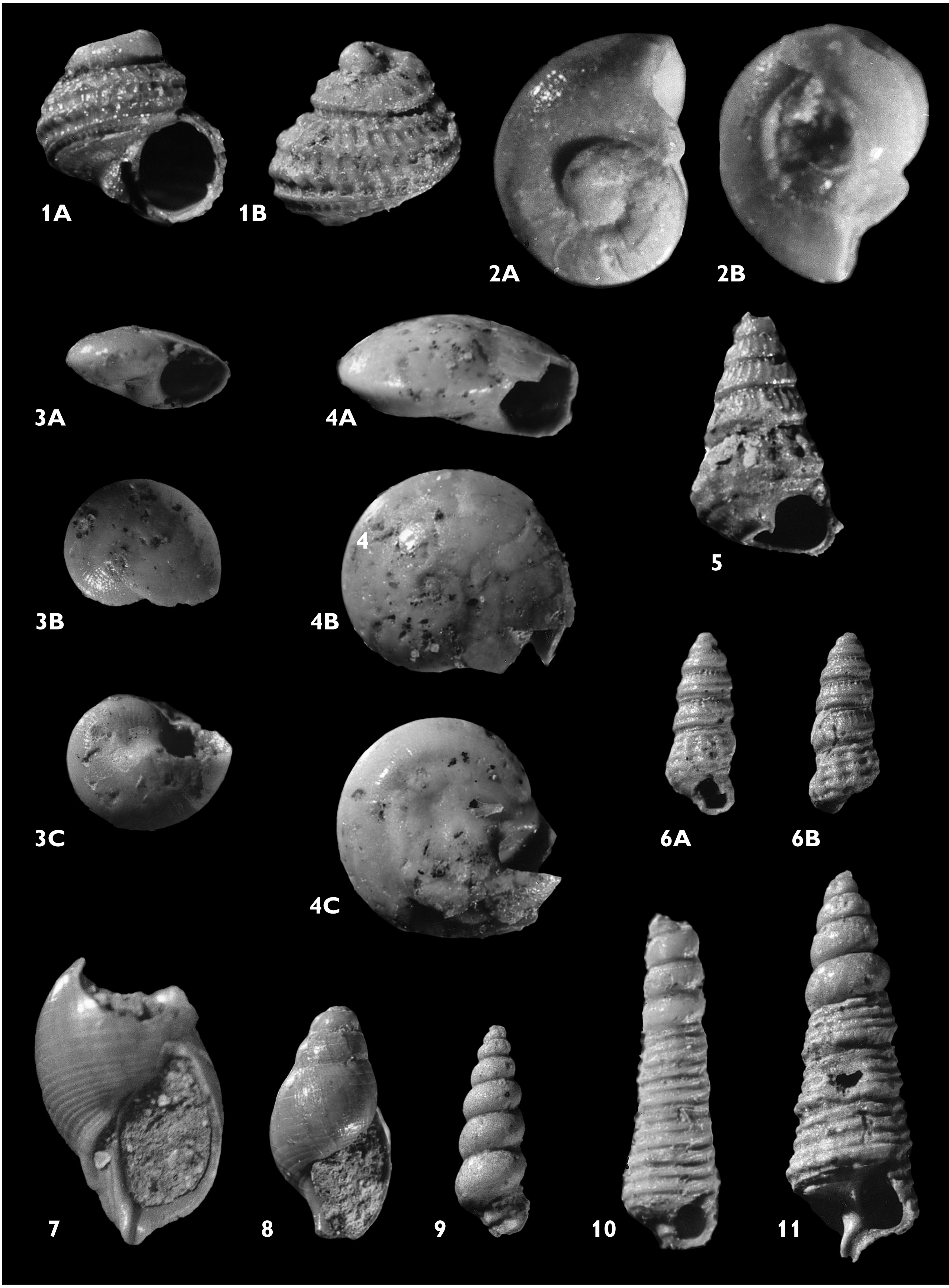
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Plate 3

Fig. 1. *Thereitis weinbrechti* n. sp.
Holotype, × 30. MGUH 24850.
From Sundkrogen, excavation 1920, leg. Hilmar Ødum.

Fig. 2. *Harrisianella subglabra* n. sp..
Holotype. Apertural view, × 30. MGUH 24851.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 3. *Biforina* sp.
Apertural view, × 30. MGUH 24852.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 4. *Cirsotrema (Cirsotrema) hauniensis* n. sp.
Holotype. Apertural view, × 15. MGUH 24853.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 5. *Cirsotrema (Cirsotrema) hauniensis* n. sp.
Paratype. Apertural view (fragmentary shell, probably from the same specimen as MGUH 248539), × 10. MGUH 24854.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 6. Scalidae indet.
Apertural view, × 10. MGUH 24855.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 7. *Opalia (Pliciscala) thomseni* n. sp.
Holotype. Apertural view, × 20. MGUH 24856.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 8. *Charonia (Sassia) danica* n. sp.
Holotype. Apertural view, × 10. MGUH 24857.
From glacial boulder from Longelse Sønderskov, Langeland, leg. M.S.Nielsen.

Fig. 9. *Charonia (Sassia) bjerringi* (Ravn 1939).
Apertural view of protoconch, × 10. MGUH 24858.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 10. *Charonia (Sassia) danica* n. sp.
Paratype. Protoconch, × 10. MGUH 24859.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 11. *Streptolathyrus danicus* n. sp.
Paratype. Fig. 11A: apertural view, × 10. Fig. 11B: rear view, × 10. MGUH 24860.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 12. *Streptolathyrus lemchei* n. sp.
Holotype. Fig. 12A: apertural view, × 5. Fig. 12B: rear view, × 5. MGUH 24521.
From Sundkrogen, excavation 1920, leg. H. Lemche.

Fig. 13. *Streptolathyrus danicus* n. sp.
Holotype. Fig. 13A: apertural view, × 10. Fig. 13B: rear view, × 10. MGUH 24522.
From Vestre Gasværk, coll. A. Rosenkrantz 1931.

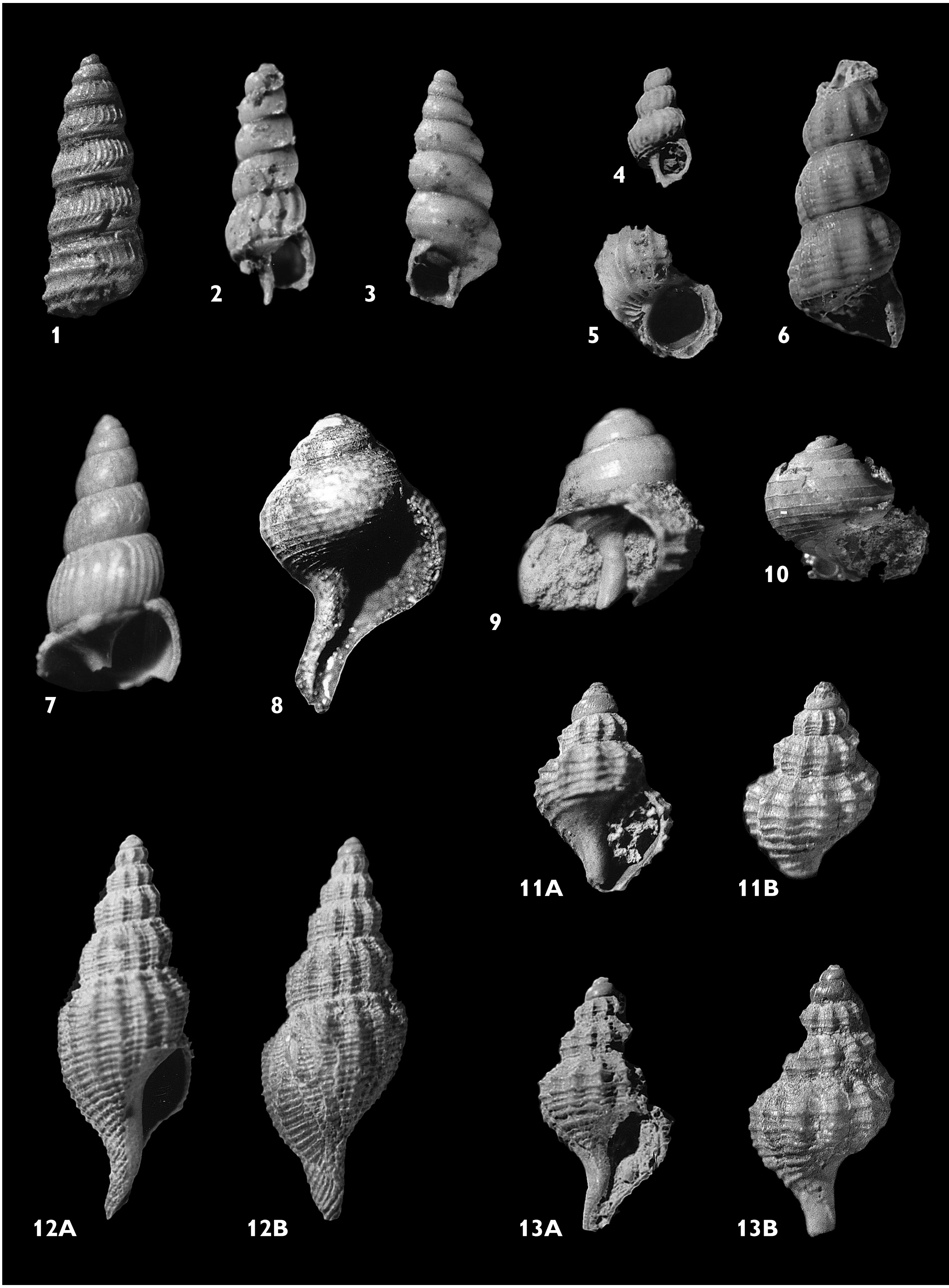
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Plate 4

Fig. 1. *Astyris (Astyris) lappanni* n. sp.
Holotype. Fig. 1A: apertural view, × 10. Fig. 1B: rear view, × 10. MGUH 3795.
From Sundkrogen, excavation 1920, leg. A. Rosenkrantz.

Fig. 2. *Astyris (Astyris) lappanni* n. sp.
Paratype. Apertural view, × 10. MGUH 24523.
From Vestre Gasværk, leg. A. Rosenkrantz 1931.

Fig. 3. *Cancellaria (sensu lato) jakobseni* n. sp.
Holotype. Fig 3A: apertural view, × 20. Fig. 3B: rear view, × 20. MGUH 24524.
From Sundkrogen, excavation 1920, leg. A. Rosenkrantz.

Fig. 4. *Pseudocochlespira rosenkrantzi* n. gen. et n. sp.
Holotype. Fig. 4A: apertural view, × 1.9. Fig. 4B: rear view, × 1.9. MGUH 24525.
From Sundkrogen, excavation 1920, leg. A. Rosenkrantz.

Fig. 5. *Pseudocochlespira rosenkrantzi* n. gen. et n. sp.
Paratype. Apertural view, × 3. MGUH 3821.
From Sundkrogen, excavation 1920, leg. A. Rosenkrantz.

Fig. 6. *Actaeopyramis marcusseni* n. sp.
Holotype. Fig. 6A: apertural view, × 30. Fig. 6B: rear view, × 30. MGUH 24861.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 7. *Syrnola (Syrnola) granti* n. sp.
Holotype. Apertural view, × 10. MGUH 24862.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 8. *Chrysallida (Parthenina) peterseni* n. sp.
Holotype. Apertural view, × 38. MGUH 24863.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 9. *Chrysallida (Parthenina) peterseni* n. sp.
Paratype. Apertural view, × 30. MGUH 24864.
Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 10. *Cingulina harderi* n. sp.
Holotype. Apertural view, × 10. MGUH 24865.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 11. *Ebala (sensu lato)* sp.
Apertural view, × 20. MGUH 24866.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 12. *Acteocina*? sp.
Fig. 12A: apertural view, × 30. Fig. 12B: rear view, × 30. MGUH 24867.
From Sundkrogen, excavation 1920, coll. Poul Harder.

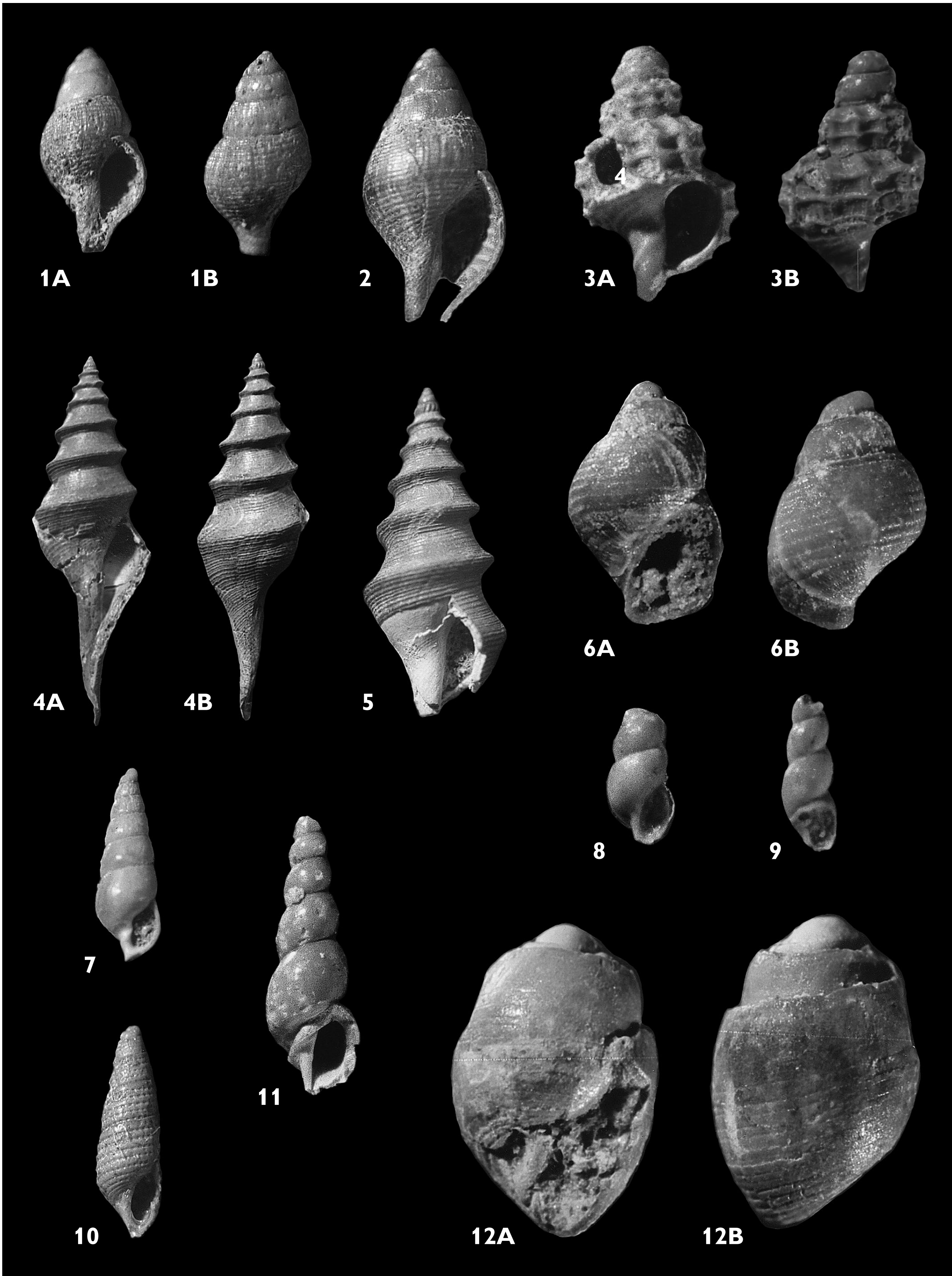
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Plate 5

Fig. 1. *Entomope kirstineae* n. sp.
Paratype. Apex, × 35. MGUH 24868.
From Sundkrogen, coll. Poul Harder 1920.

Fig. 2. *Bittium (Bittium) oedumi* n. sp.
Paratype. Protoconch × 60. MGUH 24869.
From Sundkrogen, coll. Poul Harder 1920.

Fig. 3. *Biforina (Oriforina)* sp.
Apertural view, × 55. MGUH 24870.
From Sundkrogen, coll. Poul Harder 1920.

Fig. 4. *Harrisianella subglabra* n. sp.
Paratype. Apertural view, × 60. MGUH 24871.
From Sundkrogen, coll. Poul Harder 1920.

Fig. 5. *Thereitis weinbrechti* n. sp.
Paratype. Rear view, × 35. MGUH 24872.
From Sundkrogen, coll. Poul Harder 1920.

Fig. 6. *Cerithiopsidella (Vatopsis) rasmusseni* n. sp.
Paratype. Apertural view of protoconch, × 60. MGUH 24873.
Sundkrogen, coll. Poul Harder 1920.

Fig. 7. *Siphonalia ariejansseni* n. sp.
Paratype. Rear view of juvenile specimen, × 35. MGUH 24874.
From Sundkrogen, coll. Poul Harder 1920.

Fig. 8. *Siphonalia ariejansseni* n. sp.
Paratype. Apertural view of juvenile specimen, × 35. MGUH 24875.
From Sundkrogen, coll. Poul Harder 1920.

Fig. 9. *Siphonalia ariejansseni* n. sp.
Paratype. Lateral view, × 20. MGUH 24876.
From glacial boulder at Longelse Sønderskov, Langeland, leg. M.S. Nielsen.

Fig. 10. *Siphonalia ariejansseni* n. sp.
Holotype. Fig. 10A: apertural view, × 15. Fig. 10B: rear view, × 15. MGUH 24877.
From glacial boulder at Longelse Sønderskov, Langeland, leg. M.S. Nielsen.

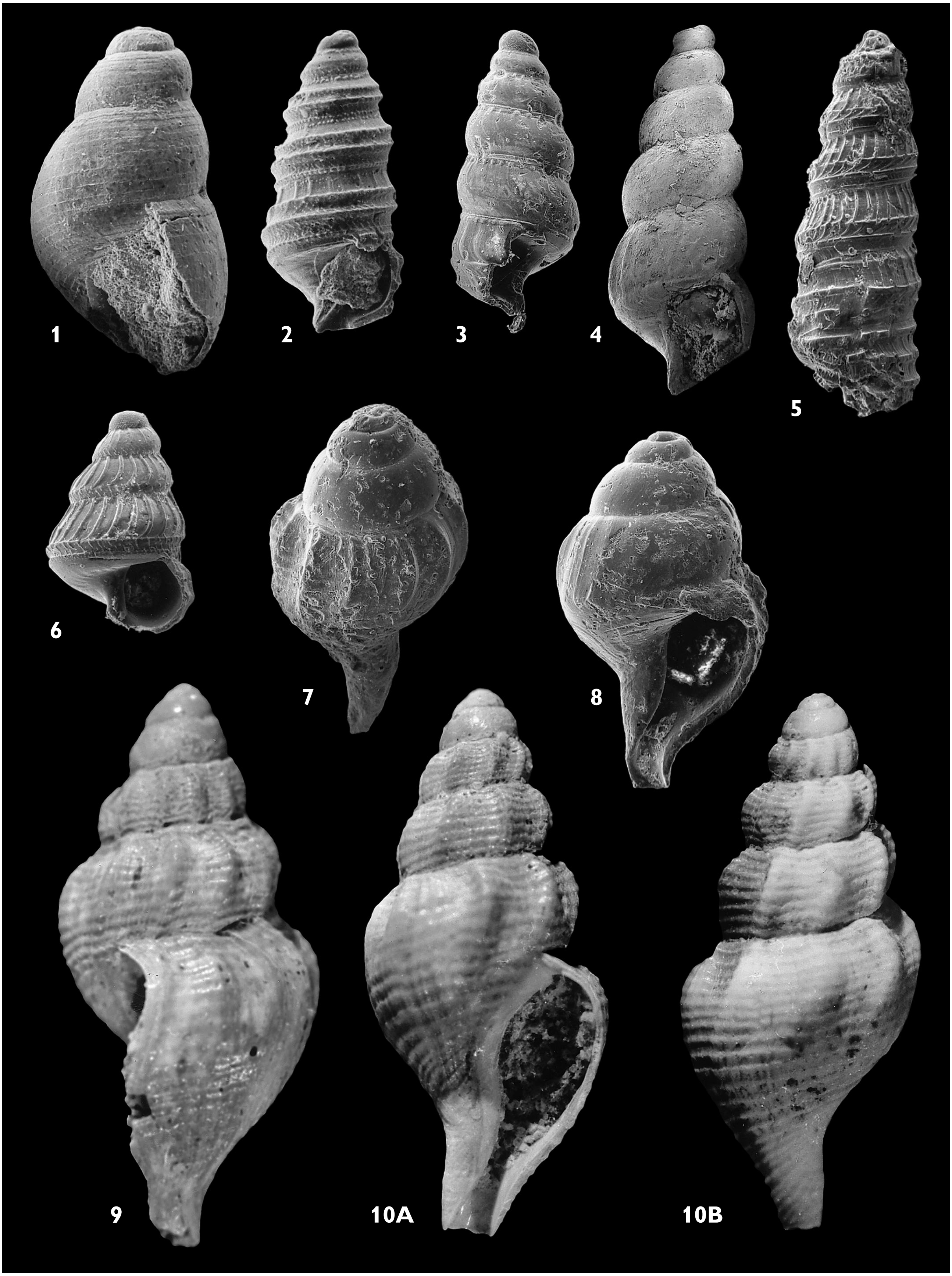
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Plate 6

Fig. 1. *Astyris (Astyris) lappanni* n. sp.
Paratype. Rear view of juvenile specimen, × 20. MGUH 24878.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 2. *Streptolathyrus danicus* n. sp.
Paratype. Rear view of juvenile specimen, × 25. MGUH 24879.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 3. *Streptolathyrus lemchei* n. sp.
Holotype. Apex, × 25. MGUH 24521.
From Sundkrogen, excavation 1920, leg. H. Lemche.

Fig. 4. *Cancellaria (sensu lato) jakobseni* n. sp.
Paratype. Apertural view, × 35. MGUH 24880.
From Sundkr ogen, excavation 1920, coll. Poul Harder.

Fig. 5. *Pseudocochlespira rosenkrantzi* n. gen. et n. sp.
Paratype. Apex, × 20. MGUH 3821.
From Sundkrogen, excavation 1920, leg. A. Rosenkrantz.

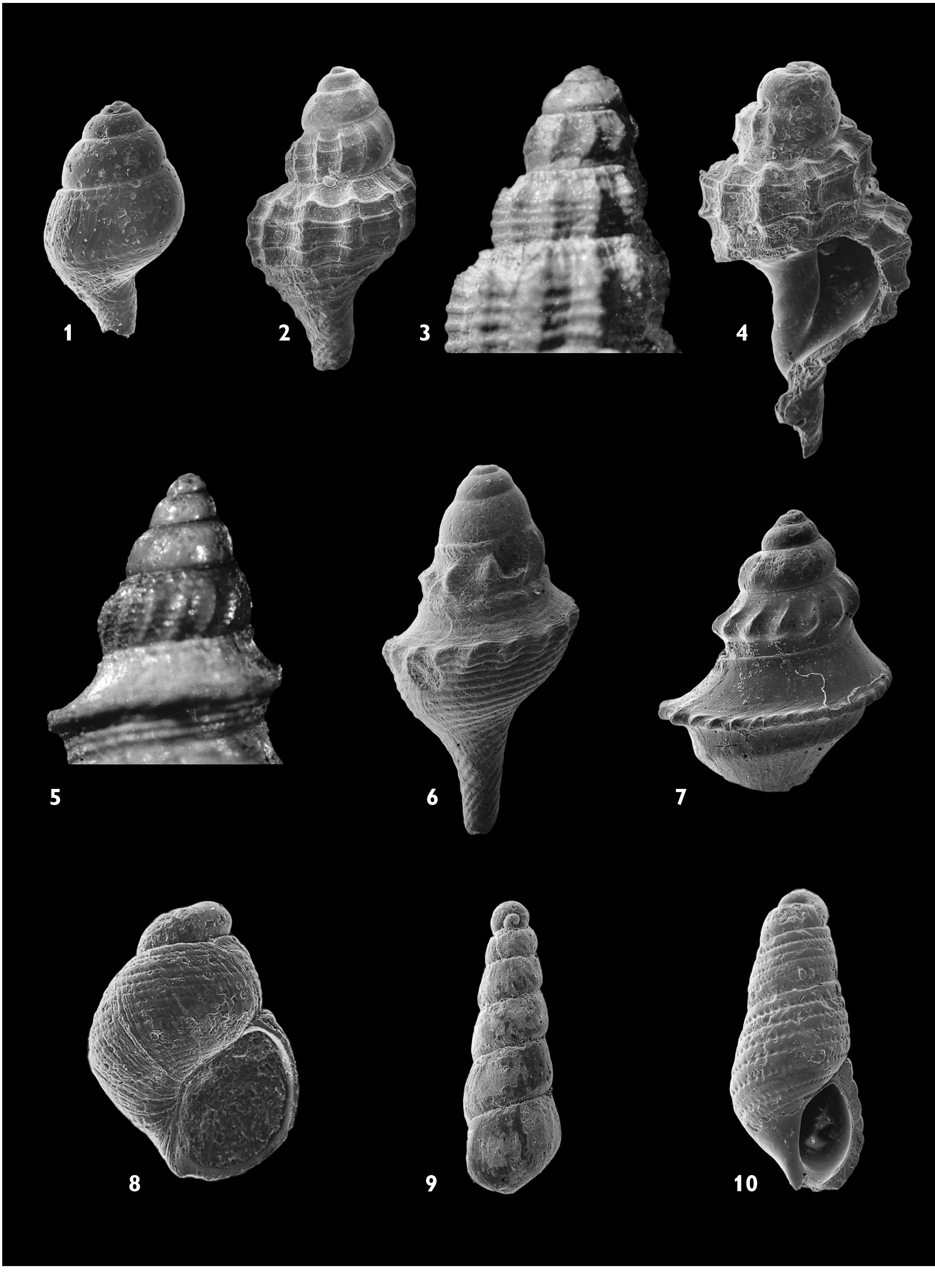
Fig. 6. *Pseudocochlespira boeggildi* (Ravn 1939).
Rear view of juvenile specimen, × 20. MGUH 24881.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 7. *Pseudocochlespira koeneni* (Arkhanguelsky 1904).
Juvenile specimen, × 20. MGUH 24882.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 8. *Actaeopyramis marcusseni* n. sp.
Paratype. Apertural view, × 50. MGUH 24883.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 9. *Syrnola (Syrnola) granti* n. sp.
Paratype. Rear view, × 35. MGUH 24884.
From Sundkrogen, excavation 1920, coll. Poul Harder.

Fig. 10. *Cingulina harderi* n. sp.
Paratype. Apertural view × 35. MGUH 24885.
From Sundkrogen, excavation 1920, coll. Poul Harder.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