LATE QUATERNARY FORAMINIFERA FROM VENDSYSSEL, DENMARK AND SANDNES, NORWAY

Systematic part

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The taxa presented are arranged in accordance with the classification used in Aarhus (Feyling-Hanssen, 1968 and 1969). By this classification, as distinct from Loeblich & Tappan's Treatise classification of 1964, the taxonomic use of wall structure is restricted to a lower, in most cases a generic level. Within each genus the lower categories are arranged alphabetically. Most of the species were photographed, some of them by scanning electron microscope. All the figured specimens, and some others, were measured, and the sample from which they have been taken is indicated. In connection with the measurements the following abbreviations are used: l = length, b = breadth, h = height, d = diameter, t = thickness. The figured specimens are registered in the Mineralogical Museum, Copenhagen.

Contents

Astrorhizidea Glaessner, 1945

Saccamminidae Brady, 1884

Psammosphaera Schulze, 1875

Psammosphaera fusca Schulze

Synonyms: 1875 *Psammosphaera fusca* Schultze: p. 113, pl. 2, figs. 8 a–f. – 1947 Höglund: p. 46, pl. 4, figs. 9–14. – 1960 Barker: pl. 18, figs. 1, 5–8. – 1964 a Feyling-Hanssen: p. 218.

Dimensions: A specimen from Postglacial deposits at Birkelse has max. d = 0.33 mm. Birkelse is the only locality where a few specimens of this species have been found.

Remarks: Höglund (1947) recorded *P. fusca* from the Gullmarfjord at depths between 57 and 118 m. It is very rare in the Postglacial deposits of

the Oslofjord area (Feyling-Hanssen, 1964 a). Some of the loosely cemented arenaceous tests of this species may have been destroyed during sedimentation or by washing of the sample in the laboratory. It may have been more common in the original assemblages and this also applies to other agglutinated forms.

Lituolidea Lamarck, 1809

Rzehakinidae Cushman, 1933

Silicosigmoilina Cushman & Church, 1929

Silicosigmoilina groenlandica (Cushman)
Pl. 1, figs. 1–6

Synonyms: 1933 *Quinqueloculina fusca* Brady, var. *groenlandica* Cushman: p. 2, pl. 1, fig. 4. – 1948 *Q. groenlandica* Cushman; Cushman: p. 34, pl. 3, fig. 18. – 1953 *Silicosigmoilina groenlandica* (Cushman); Loeblich & Tappan: p. 38, pl. 4, figs. 7–9. – 1964 a Feyling-Hanssen: p. 224, pl. 1, figs. 17–19. – 1965 Leslie: p. 171, pl. 2, fig. 8.

Dimensions: Two specimens from the Sandnes Clay were measured, one (pl. 1, figs. 1–3) has l = 0.48 mm, b = 0.25 mm, t = 0.17 mm, and the other (pl. 1, figs. 4–6) l = 0.55 mm, b = 0.30 mm, t = 0.21 mm.

Occurrence: This species accounts for 1–5 % of the fauna of zone 3 in Sandnes, in the middle part of the zone even up to 9 %. It is rare in zone 1. It occurs in zone C of the Older *Yoldia* Clay at Hirtshals, Vendsyssel, where it accounts for up to 2 % of the total fauna. A few specimens were found in the Older *Yoldia* Clay at Stortorn.

Remarks: *S. groenlandica* is recorded from late Quaternary deposits of the Oslofjord area (Feyling-Hanssen, 1964 a). The species lives today in arctic waters (Cushman, 1948; Leslie, 1965; Loeblich & Tappan, 1953; Wagner, 1968).

Miliammina Heron-Allen & Earland, 1930

Miliammina fusca (Brady)
Pl. 15, figs. 1–3

Synonyms: 1870 *Quinqueloculina fusca* Brady: p. 286, pl. 11, fig. 2. – 1938 Bartenstein: p. 391, text-fig. 11. – 1964 a *Miliammina fusca* (Brady); Feyling-Hanssen: p. 224, pl. 2, figs. 1, 2.

Dimensions: The hypotype (pl. 15, figs. 1–3) from Løkken has l = 0.26 mm, max. b = 0.16 mm.

Occurrence: A few specimens of *M. fusca* are found in the Postglacial deposits of Vendsyssel.

Remarks: *M. fusca* is a typical marsh form, which tolerates great variation in temperature and salinity (Lankford, 1959). It is widely distributed in temperate waters. In the Mississippi delta this species is common at a water depth of less than 2 m (Lankford, 1959). In Jade Bay (Bartenstein, 1938) it is common i the brackish-water faunas together with *Trochammina inflata* and *Jadammina polystoma.* Risdal (1964) recorded *M. fusca* from the Oslofjord down to a depth of 30 m. In the Postglacial deposits of the Oslofjord region (Feyling-Hanssen, 1964 a) this species occurs mainly in shallow-water facies.

Lituolidae Lamarck, 1809

Haplophragmoides Cushman, 1910

Haplophragmoides canariensis (d'Orbigny)

Synonyms: 1839 c *Nonionina canariensis* d'Orbigny: p. 128, pl. 2, figs. 33, 34. – 1938 *Haplophragmoides canariensis* (d'Orbigny); Bartenstein & Brand: p. 391, fig. 9. – 1939 Bartenstein: p. 375, fig. 1. – 1960 Barker: p. 72, pl. 35, figs. 1–3, 5.

Dimensions: A specimen from Postglacial deposits at Kodals Rende was measured: max. d = 0.40 mm, t = 0.20 mm. The species has not been found at other localities.

Remarks: *H. canariensis* was originally described and figured with a basal aperture by d'Orbigny and the available specimens are comparable with this description. However, Bartenstein (1938 and 1939) illustrated specimens with an areal aperture, but nevertheless described them as having a basal aperture (Bartenstein, 1939, p. 375).

Ammoscalaria Höglund, 1947

Ammoscalaria runiana (Heron-Allen & Earland)
Pl. 1. figs. 7, 8; pl. 15, fig. 4

Synonyms: 1916 *Haplophragmium runianum* Heron-Allen & Earland: p. 224, pl. 40, figs. 15–18. – 1947 *Ammoscalaria runiana* (Heron-Allen & Earland); Höglund: p. 162, pl. 9, figs. 23, 24. – 1964 a Feyling-Hanssen: p. 232, pl. 3, fig. 1.

Dimensions: The figured specimen from Løkken has d = 0.26 mm, t = 0.13 mm.

Occurrence: *A. runiana* was found in a few samples from Postglacial deposits at Løkken in Vendsyssel, but it is not common.

Remarks: *A. runiana* is a shallow-water species. It occurs in the Gullmarfjord at depths between 7 and 23 m (Höglund, 1947). In the Oslofjord (Risdal, 1964) this species is one of the dominant ones at depths from 4 to 6 m, and it is common at depths from 3 to 30 m. *A. runiana* is found in the Postglacial zone G and in the upper part of zone F in the late Quaternary deposits of the Oslofjord area (Feyling-Hanssen, 1964 a).

Textulariidae Ehrenberg, 1839

Textularia Defrance, 1824

Textularia bocki Höglund

Synonyms: 1947 *Textularia bocki* Höglund: p. 171, pl. 12, figs. 5–7; text-figs. 152, 153.

Dimensions: Specimen from Sandnes has l = 0.33 mm, b = 0.31 mm, t = 0.21 mm (last chamber broken off).

Occurrence: Two specimens of this species were found in zone 1 of the Sandnes Clay, viz. the measured specimen from boring no. I and another one from boring no. II (depth 6.80 m).

Remarks: The present specimens have a planispiral initial part. Loeblich & Tappan (1964, p. C 253) excluded such forms from *Textularia,* stating that specimens from the Pliocene of Siena, which they considered to be the type locality, were truly biserial. Nørvang (1966 b), on the other hand, considered *Textularia* to posses an initial planispire and erected the new genus *Textilina* for truly biserial forms.

Trochamminidae Schwager, 1877

Trochammina Parker & Jones, 1959

Trochammina inflata (Montagu)

Pl. 1, figs. 9–12

Synonyms: 1808 *Nautilus inflatus* Montagu: p. 81, pl. 18, fig. 3. – 1938 *Trochammina inflata* (Montagu); Bartenstein: p. 391, text-fig. 8. – 1952 a Parker: p. 459, pl. 3, figs. 1 a, b. – 1960 Barker: pl. 41, figs. 4 a–c. – 1961 Todd & Low: p. 15, pl. 1, figs. 22, 23. – 1962 Haake: p. 30, pl. 1, figs. 5, 6.

Dimensions: Specimen from Løkken (pl. 1, figs. 9, 10) has max. d = 0.38 mm, h = 0.20 mm, and one from Birkelse (pl. 1, figs. 11, 12) max. d = 0.38 mm, h = 0.15 mm.

Occurrence: A few specimens of this species occur in the Postglacial deposits in Vendsyssel. It is one of the dominant species in a few of the samples from Løkkens Blånæse and Kodals Rende north of Løkken.

Remarks: *T. inflata* appears to be a characteristic species in brackish water as well as in marshes with a high salinity (Phleger, Parker & Peirson, 1953). In the Mississippi delta (Lankford, 1959) it occurs only in the marsh fauna at depths of less than 0.3 m. The salinity there is usually below 2 ‰, but

occasionally becomes much higher because of evaporation. *T. inflata* occurs frequently in the brackish-water fauna of Jade Bay (Bartenstein, 1938) together with *Miliammina fusca* and *Jadammina polystoma.* Haake (1962) recorded a few specimens from the tidal flats at Langeoog. Todd & Low (1961) found it in great abundance in the water over a submerged bog at Martha's Vineyard Island. They suggested that "factors, such as pH and the nutrient elements available on the disintegrating bog, might be the determining influences favouring the existence of *Trochammina,* almost to the exclusion of all other Foraminifera".

Jadammina Bartenstein & Brand, 1938

Jadammina polystoma Bartenstein & Brand

Synonyms: 1938 *Jadammina polystoma* Bartenstein & Brand: p. 381, text-figs. 1–3. – 1964 a Feyling-Hanssen: p. 241, pl. 3, figs. 13–15.

Dimensions: An unfigured specimen from Birkelse has max. d = 0.33 mm, h = 0.10 mm.

Occurrence: A few specimens of *J. polystoma* were found in the Postglacial deposits in Vendsyssel. It is one of the most frequent species in a few of the samples from Løkkens Blånæse and Kodals Rende north of Løkken.

Remarks: *J. polystoma* was described from Jade Bay in Germany (Bartenstein & Brand, 1938), where it was one of the dominant species of the brackish-water fauna together with *Trochammina inflata* and *Miliammina fusca.* In the late Quaternary deposits of the Oslofjord area (Feyling-Hanssen, 1964 a) this species is found in the Postglacial zone G together with *M. fusca.*

Ataxophragmiidae Schwager, 1877

Eggerella Cushman, 1933

Eggerella scabra (Williamson)
Pl. 1, fig. 13; pl. 15, figs. 5–7

Synonyms: 1858 *Bulimina scabra* Williamson: p. 65, pl. 5, figs. 136, 137. – 1895 *Verneuilina polystropha* Reuss; Madsen: p. 183. – 1947 *Eggerella scabra* (Williamson); Höglund: p. 191, pl. 13, figs. 12–14, text-figs. 162–165. – 1960 Barker: pl. 47, figs. 15–17. – 1964 a Feyling-Hanssen: p. 243, pl. 4, figs. 4–6.

Dimensions: Specimen (pl. 1, fig. 13) from Birkelse has l = 0.50 mm, b = 0.23 mm. Recent specimen from Limfjorden, northern Jutland (pl. 15, figs. 5–7: l = 0.64 mm, b = 0.30 mm. As a fossil this species was only found at Birkelse, Vendsyssel.

Remarks: *E. scabra* is one of the most abundant species in the Gullmarfjord on the Swedish west coast (Höglund, 1947) where it is common at depths down to 60 m, but most frequent between 15 and 20 m. It is found down to 204 m. *E. scabra* is dominant at depths of 10–30 m in the Oslofjord (Risdal, 1964), but occurs down to 100 m. Feyling-Hanssen (1964 a) recorded *E. scabra* from Postglacial deposits in the Oslofjord area.

Miliolidea Ehrenberg, 1839

Fischerinidae Millett, 1898

Cyclogyra Wood, 1842

Cyclogyra involvens (Reuss)
Pl. 1, fig. 14

Synonyms: 1850 *Operculina involvens* Reuss: p. 370, pl. 46, fig. 30. – 1953 *Cornuspira involvens* (Reuss); Loeblich & Tappan: p. 49, pl. 7, figs. 4, 5. – 1964 a *Cyclogyra involvens* (Reuss); Feyling-Hanssen: p. 246, pl. 4, fig. 9.

Dimensions: Only two specimens were found in zone 3 of the Sandnes Clay. An incomplete specimen (pl. 1, fig. 14) has d = 0.43 mm, t = 0.08 mm, the other (not figured) d = 0.40 mm, t = 0.05 mm.

Miliolidae Ehrenberg, 1839

Quinqueloculina d'Orbigny, 1826

Quinqueloculina agglutinata Cushman
Pl. 1, fig. 15

Synonyms: 1917 *Quinqueloculina agglutinata* Cushman: p. 43, pl. 9, fig. 2. – 1948 Cushman: p. 33, pl. 3, fig. 13. – 1953 Loeblich & Tappan: p. 39, pl. 5, figs. 1–4. – 1964 a Feyling-Hanssen: p. 247, pl. 4, fig. 11. – 1965 Leslie: p. 168, pl. 3, fig. 1.

Dimensions: Specimen (pl. 1, fig. 15) from Hirtshals has l = 1.22 mm, b = 0.80 mm, t = 0.62 mm.

Occurrence: A few specimens are found in the Older *Yoldia* Clay of Vendsyssel.

Remarks: This species is recorded from Eemian deposits of the Netherlands (van Voorthuysen, 1957) and from late Quaternary deposits of the Oslofjord area (Feyling-Hanssen, 1964 a). It is known from Recent arctic faunas (Cushman, 1948; Loeblich & Tappan, 1953; Leslie, 1965).

Quinqueloculina lata Terquem
Pl. 1, figs. 16, 17

Synonyms: 1876 *Quinqueloculina lata* Terquem: p. 82, pl. 11, fig. 8. – 1961 Todd & Low: p. 15, pl. 1, figs. 10–13, 15. – 1964 a Feyling-Hanssen: p. 250, pl. 4, fig. 12.

Dimensions: The figured specimen from Løkken has l = 0.26 mm, b = 0.13 mm, t = 0.10 mm.

Occurrence: A few specimens of this species are found in Postglacial deposits of the Løkken area in Vendsyssel.

Remarks: *Q. lata* is a shallow-water species. In the late Quaternary deposits of the Oslofjord area Feyling-Hanssen (1964 a) found a few specimens in the Postglacial zone G.

Quinqueloculina seminulum (Linné)
Pl. 1, figs. 18–20

Synonyms: 1758 *Serpula seminulum* Linné: p. 786, pl. 2, fig. 1. – 1884 *Miliolina seminulum* (Linné); Brady: p. 157, pl. 5, fig. 6. – 1895 Madsen: p. 178. – 1929 *Quinqueloculina seminulum* (Linné); Cushman: p. 24, pl. 2, figs. 1, 2. – 1961 Todd & Low: p. 15, pl. 1, fig. 14. – 1962 Haake: p. 31, pl. 1, figs. 13, 14. – 1964 a Feyling-Hanssen: p. 251, pl. 6, fig. 1. – 1965 Leslie: p. 168, pl. 3, fig. 2. – 1967 Michelsen: p. 216, pl. 1, fig. 2.

Dimensions: Specimen from Postglacial deposits at Løkken (pl. 1, figs. 18–20) has l = 0.70 mm, b = 0.40 mm, t = 0.24 mm.

Occurrence: *Q. seminulum* occurs in zone 1 and zone 3 of the borings in Sandnes; it is rare. A few specimens are found in the Older *Yoldia* Clay of Vendsyssel, but it was not found in the Lateglacial deposits there. It is, however, common in some of the samples from the Postglacial at Løkken, accounting for up to 22 % of the total fauna.

Remarks: *Q. seminulum* seems to be widely distributed in cold as well as in warm waters. Cushman (1929) suggested that this may be caused by too wide a concept of this species. Bartenstein & Brand (1938) found that *Q. seminulum* is common in the North Sea but rare in the brackish-water fauna of the Jade Bay. Also, van Voorthuysen (1951 and 1960) suggested that *Q. seminulum* belongs to the North Sea faunas and not to the brackish-water ones. On the tidal flats of NW Germany Haake (1962) recorded this species in water with a salinity of 3 ‰. In the Baltic Sea it is found (Lutze, 1965) at depths of more than 20 m in water with a salinity exceeding 2 ‰. F. L. Parker (1948) recorded *Q. seminulum* at depths between 12 and 52 m, and in the Oslofjord it occurs at depths from 10 to 330 m (Risdal, 1964). *Q. seminulum* seems to prefer water with a salinity of more than 2 ‰. The species is found in the Eemian *Cyprina* Clay of Stensigmose, SE Jutland (Konradi, in press), and is recorded from Lateglacial and Postglacial deposits of the Oslofjord area (Feyling-Hanssen, 1964 a) and of Læsø, Denmark (Michelsen, 1967).

Quinqueloculina stalkeri Loeblich & Tappan
Pl. 2, figs. 1–3

Synonyms: 1953 *Quinqueloculina stalkeri* Loeblich & Tappan: p. 40, pl. 5, figs. 5–9. – 1964 a: Feyling-Hanssen: p. 252, pl. 4, figs. 13–18. – 1965 Leslie: p. 169, pl. 3, fig. 3. – 1965 Nagy: p. 119, pl. 1, fig. 22. – 1967 Michelsen: p. 217, pl. 1, fig. 3. – 1967 Todd & Low: p. 19, pl. 2, fig. 17.

Dimensions: Specimen from Sandnes (pl. 2, figs. 1–3) has l = 0.41 mm, b = 0.19 mm, t = 0.14 mm.

Occurrence: Only two specimens of this species were observed in zone 1 of the sequence in Sandnes. Very few specimens occur in the Older *Yoldia* Clay and in the Lateglacial deposits of Vendsyssel.

Remarks: *Q. stalkeri* was originally recorded from the Arctic (Loeblich & Tappan, 1953), where it was found at depths less than 50 m. At Spitsbergen (Nagy, 1965) it is found at water depths between 9 and 37 m, whereas Todd & Low (1967) recorded the species from greater depths at Alaska. Leslie (1965) and Wagner (1968) found *Q. stalkeri* in Hudson Bay. In the Oslofjord it occurs at depths exceeding 25 m (Risdal, 1964).

Feyling-Hanssen (1964 a) found *Q. stalkeri* in Lateglacial (Younger *Dryas* and early Holocene) deposits of the Oslofjord area in Norway, and Michelsen (1967) recorded it from Lateglacial deposits (Oldest *Dryas*) of Læsø in Denmark. The species is common in Hoxnian deposits (Holsteinian or Mindel-Riss Interglacial) off the east coast of England (Fisher, Funnell & West, 1969). It is also frequent in a sample from Holsteinian deposits of Esbjerg brickworks, SW Jutland.

Woszidlo (1962, p. 69, pl. 1, fig. 3) recorded a few specimens of *Quinqueloculina* cf. *stalkeri* from Holsteinian deposits of Schleswig-Holstein in Germany. Woszidlo's fig. 3 illustrates a specimen with a tubular chamber wider than those of *Q. stalkeri*.

Spiroloculina d'Orbigny, 1826.

Spiroloculina rotunda d'Orbigny

Synonyms: 1960 *Spiroloculina rotunda* d'Orbigny; Barker: pl. 9, figs. 15, 16.

Dimensions: One specimen was found in zone A of the Older *Yoldia* Clay at Hirtshals, Vendsyssel: l = 0.53 mm, b = 0.44 mm, t = 0.14 mm.

Triloculina d'Orbigny, 1826

Triloculina trigonula (Lamarck)
Pl. 2, figs. 4–6

Synonyms: 1804 *Miliolites (trigonula)* Lamarck: p. 351, no. 3, pl. 17, fig. 4 (1807). – 1960 *Triloculina trigonula* (Lamarck); Barker: p. 6, pl. 3, figs. 15, 16. – 1964 a Feyling-Hanssen: p. 258, pl. 6, figs. 11–13.

Dimensions: Specimen from Løkken (pl. 2, figs. 4–6) has l = 0.87 mm, b = 0.76 mm, t = 0.58 mm.

Occurrence: Single specimens of this species are found in the Postglacial deposits at Løkken, Vendsyssel.

Triloculina trihedra Loeblich & Tappan
Pl. 2, fig. 7; pl. 15, fig. 8

Synonyms: 1953 *Triloculina trihedra* Loeblich & Tappan: p. 45, pl. 4, fig. 10. – 1964 a Feyling-Hanssen: p. 259, pl. 6, fig. 6. – 1965 Buzas: p. 16, pl. 1, fig. 4. – 1967 Michelsen: p. 217, pl. 1, fig. 5. – 1969 Gudina: p. 12, pl. 4, fig. 2.

Dimensions: The figured specimen from Sandnes has l = 0.33 mm, b = 0.23 mm, t = 0.20 mm.

Occurrence: This species occurs in zones 1 and 3 of the Sandnes Clay; it is rare. It is also found in zones C and D of the Older *Yoldia* Clay at Hirtshals, usually accounting for less than 1 % of the total fauna.

Remarks: Hessland (1943) recorded this species (as *Triloculina tricarinata*) from Lateglacial deposits of SW Sweden, Feyling-Hanssen (1964 a) from Late- and Postglacial deposits of the Oslofjord area, and Michelsen (1967) from the late Quaternary of Læsø, Denmark. It is also found in Lateglacial deposits in Maine (Buzas, 1965). Loeblich & Tappan (1953) recorded this species from Alaska and Greenland at water depths of 22–46 m.

Pyrgo Defrance, 1824

Pyrgo williamsoni (Silvestri)
Pl. 2, figs. 8, 9; pl. 15, fig. 9

Synonyms: 1858 *Biloculina ringens* (Lamarck) *typica* Williamson: p. 79, pl. 6, figs. 169, 170; pl. 7, fig. 171. – 1923 *B. williamsoni* Silvestri: p. 73. – 1953 *Pyrgo williamsoni* (Silvestri), Loeblich & Tappan: p. 48, pl. 6, figs. 1–4. 1964 a Feyling-Hanssen: p. 264, pl. 7, figs. 5, 6; pl. 8, figs. 3–5. – 1967 Michelsen: p. 216, pl. 1, fig. 1.

Dimensions: Specimen from Sandnes (pl. 2, fig. 8) has l = 0.43 mm, b = 0.27 mm, t = 0.25 mm, and one from Hirtshals (pl. 2, fig. 9; pl. 15, fig. 9) has l = 0.42 mm, b = 0.25 mm, t = 0.25 mm.

Occurrence: This species occurs in zones 1 and 3 of the Sandnes Clay, but it is never frequent; in the Older *Yoldia* Clay of Vendsyssel it never accounts for more than 1 % of the total fauna.

Remarks: *P. williamsoni* is recorded from late Quaternary deposits of the Oslofjord area (Feyling-Hanssen, 1964 a) and of Læsø, Denmark (Michelsen, 1967). In Recent faunas it is known from Greenland, Canada and Alaska at water depths exceeding 13 m (Loeblich & Tappan, 1953) and from Spitsbergen at a depth of 15 m (Nagy, 1965). Risdal (1964) recorded the species from the Oslofjord at depths between 30 and 200 m.

P. williamsoni is found in material from the Skærumhede boring in Vendsyssel. It is most common in the *Turritella terebra* Zone.

Miliolinella Wiesner, 1931

Miliolinella subrotunda (Montagu)

Pl. 2, figs. 10–12

Synonyms: 1784 *"Serpula subrotunda dorso elevato"* Walker & Boys: p. 2, pl. 1, fig. 4. – 1803 *Vermiculum subrotundum* Montagu: pt. 2, p. 521. – 1964 a *Miliolinella* cf. *subrotunda* (Montagu); Feyling-Hanssen: p. 261, pl. 7, fig. 1.

Dimensions: Specimen from the Postglacial deposits at Løkken (pl. 2, figs. 10–12) has l = 0.25 mm, b = 0.18 mm, t = 0.15 mm.

Occurrence: Some specimens occur in zones 1 and 3 of the Sandnes Clay. A few specimens were found in zones C and D of the Older *Yoldia* Clay at Hirtshals and in Postglacial deposits of the Løkken area in Vendsyssel.

Remarks: Feyling-Hanssen (1964 a) recorded this species from Lateglacial and Postglacial deposits of the Oslofjord area.

Biloculinella Wiesner, 1931

Biloculinella depressa (d'Orbigny)
Pl. 15, fig. 10

Synonyms: 1826 *Biloculina depressa* d'Orbigny: p. 298, no. 7, Modèles no. 91. – 1960 *Pyrgo depressa* (d'Orbigny); Barker: pl. 2, figs. 12, 16; pl. 3, figs. 1, 2. – 1964 a *Biloculinella depressa* (d'Orbigny); Feyling-Hanssen: p. 265, pl. 7, figs. 8–10.

Dimensions: One broken specimen (pl. 15, fig. 10) occurred in the Older *Yoldia* Clay at Løkkens Blånæse: l = 0.63 mm, b = 0.59 mm, t = 0.29 mm.

Pateoris Loeblich & Tappan, 1953

Pateoris hauerinoides (Rhumbler)
Pl. 2, figs. 13–16

Synonyms: 1936 *Quinqueloculina subrotunda* (Montagu), forma *hauerinoides* Rhumbler: p. 206, 217, 226, text-figs. 167, 208–212. – 1953 *Pateoris hauerinoides* (Rhumbler); Loeblich & Tappan: p. 42, pl. 6, figs. 8–12, text-figs. 1 A, B. – 1964 a Feyling-Hanssen: p. 256, pl. 6, fig. 5. – 1967 Michelsen: p. 216.

Dimensions: Specimen from the Postglacial at Løkken (pl. 2, figs. 13–15) has max. d = 0.83 mm, t = 0.45 mm, and one from Hirtshals (pl. 2, fig. 16) has l = 0.50 mm, b = 0.36 mm, t = 0.23 mm.

Occurrence: This species occurs, very rarely, in zone 1 of the Sandnes Clay. A few specimens were found in the Older *Yoldia* Clay and in the Postglacial of Vendsyssel.

Remarks: *P. hauerinoides* is recorded from late Quaternary deposits of the Oslofjörd area (Feyling-Hanssen, 1964 a) and from Læsø, Denmark (Michelsen, 1967). It was originally described from Recent deposits of Kiel Bay (Rhunbler, 1936). In Recent arctic faunas the species is known from Alaska, Canada and Greenland (Cushman, 1948; Loeblich & Tappan, 1953; Leslie, 1965) and from Spitsbergen (Nagy, 1965).

Sigmoilopsis Finlay, 1947

Sigmoilopsis schlumbergeri (Silvestri)
Pl. 2, figs. 17, 18

Synonyms: 1904 *Sigmoilina schlumbergeri* Silvestri: p. 267. – 1960 *Sigmoilopsis schlumbergeri* (Silvestri); Barker: p. 16, pl. 8, figs. 1–4.

Dimensions: Two specimens occurred in zone 1 of the Sandnes Clay. One of those (pl. 2, figs. 17, 18) has l = 0.53 mm, b = 0.30 mm, t = 0.21 mm.

Nodosariidea Ehrenberg, 1839

Nodosariidae Ehrenberg, 1839

Dentalina d'Orbigny, 1839

Dentalina baggi Galloway & Wissler
Pl. 3, fig. 1

Synonyms: 1927 *Dentalina baggi* Galloway & Wissler: p. 49, pl. 8, figs. 14, 15. – 1953 Loeblich & Tappan: p. 54, pl. 9, figs. 10–15. – 1965 Leslie: p. 158, pl. 5, fig. 2. – 1967 Todd & Low: p. 22, pl. 3, fig. 10 (not. fig. 11).

Dimensions: Specimen (pl. 3, fig. 1) from Hirtshals has l = 2.11 m, max. b = 0.63 mm.

Occurrence: One specimen of this species occurs in Sandnes Clay of zone 1 type in the gravel pit of Foss-Eigeland, 6 km south of Sandnes. It is present in the zones A, C, D, E and F of the Older *Yoldia* Clay at Hirtshals, but it never accounts for more than 1 % of the total fauna.

Remarks: One specimen of *D. baggi* was found in the *Portlandia arctica* Zone of the Skærumhede boring in Vendsyssel. Galloway & Wissler (1927) originally described this species from the Pleistocene of the Lomita Quarry in California. It is recorded from Recent Alaskan waters by Loeblich & Tappan (1953) and by Todd & Low (1967), and Leslie (1965) found it in Hudson Bay.

Dentalina frobisherensis Loeblich & Tappan
Pl. 3, fig. 2

Synonyms: 1923 *Nodosaria mucronata* (Neugeboren); Cushman (not *Dentalina mucronata* Neugeboren, 1856): p. 80, pl. 12, fig. 5–7; pl. 13, figs. 7–9. – 1948 *Dentalina* sp. Cushman: p. 45, pl. 5, fig. 6. – 1953 *Dentalina frobisherensis* Loeblich & Tappan: p. 55, pl. 10, figs. 1–9. – 1961 Saidova: p. 59, pl. 17, fig. 118. – 1964 b Feyling-Hanssen: p. 48, pl. 1, fig. 5. – 1965 Leslie: p. 139, pl. 4, fig. 4. – 1965 Nagy: p. 120, pl. 1, fig. 26. – 1969 Gudina: p. 16, pl. 6, fig. 5.

Dimensions: Specimen from Hirtshals (pl. 3, fig. 2) has l = 1.34 mm, max. b = 0.33 mm.

Occurrence: This species is rare in the present material. In Sandnes only one specimen occurred in the lower part of boring no. VI. In the Older *Yoldia* Clay of Hirtshals it is present in the zones A, C and D, but never accounts for more than 1 % of the fauna.

Remarks: Loeblich & Tappan (1953) recorded this species in Frobisher Bay, Baffin Island and from off Point Barrow, Alaska. Saidova (1961) found it in the Okhotsk Sea and at Kamtchatka, and Nagy (1965) found it off Spitsbergen. Leslie (1965) and Wagner (1968) also recorded this species from arctic waters. *D. frobisherensis* is found in Postglacial Warm Interval deposits in eastern Spitsbergen (Feyling-Hanssen, 1964 b), and Gudina (1969) recorded it from the Quaternary of Siberia. One specimen has been found in the *Portlandia arctica* Zone of the Skærumhede boring in Vendsyssel.

Dentalina ittai Loeblich & Tappan

Synonyms: 1953 *Dentalina ittai* Loeblich & Tappan: p. 56, pl. 10, figs. 10–12. – 1964 a Feyling-Hanssen: p. 273, pl. 9, figs. 1, 2. – 1965 Leslie: p. 159, pl. 5, fig. 5.

Dimensions: Specimen from Hirtshals has l = 0.38 mm, max. b = 0.10 mm.

Occurrence: This species is found in zones C, D, and F at Hirtshals and accounts for less than 1 % of the total fauna.

Remarks: *D. ittai* is known from the Recent faunas off Alaska, Canada and Greenland (Loeblich & Tappan, 1953; Leslie, 1965) and from Spitsbergen

(Nagy, 1965). Feyling-Hanssen (1964 a) recorded it from late Quaternary deposits of the Oslofjord area in Norway.

Dentalina pauperata d'Orbigny
Pl. 3, figs. 3, 4

Synonyms: 1846 *Dentalina pauperata* d'Orbigny: p. 46, pl. 1, figs. 57, 58. – 1884 *Nodosaria (D.) pauperata* (d'Orbigny); Brady: p. 500, fig. 14. – 1923 *N. pauperata* (d'Orbigny); Cushman: p. 72, pl. 14, fig. 13. – 1948 *Dentalina* sp. Cushman: p. 45, pl. 5, fig. 7. – 1953 *Dentalina pauperata d'Orbigny;* Loeblich & Tappan: p. 57, pl. 9, figs. 7–9. – 1961 *Dentalina* ex. gr. *pauperata* d'Orbigny; Saidova: p. 58, pl. 17, fig. 117. – 1965 *D. pauperata* d'Orbigny; Leslie: p. 159, pl. 5, fig. 3.

Dimensions: Specimen from Sandnes (pl. 3, fig. 4) has l = 1.80 mm, max. b = 0.45 mm. Specimen from Hirtshals (pl. 3, fig. 3) has l = 1.94 mm, max. b = 0.52 mm.

Occurrence: One specimen occurred at 19.40 m depth in boring no. VI in Sandnes, and some specimens are found in the Older *Yoldia* Clay of Vendsyssel.

Remarks: The specimen from Sandnes is more strongly tapering than usual for the species. It has, however, nearly horizontal sutures, an apiculate base, and its final chamber is somewhat produced towards the eccentric, radiate aperture.

The type originates from the Miocene of the Vienna basin. Nørvang (1945) suggested that *D. pauperata* is a boreo-arctic species. Loeblich & Tappan (1953) and Leslie (1965) recorded it in Recent samples from the North American Arctic, and Saidova (1961, p. 58) found a species, which she called *Dentalina* ex. gr. *pauperata* in the north-western Pacific and in the Okhotsk Sea. Gudina (1966, p. 21, 27, pl. 2, fig. 3) found 2 specimens in the Penultimate Interglacial of Siberia.

D. pauperata occurs in the lower cold zone and in the *Portlandia arctica* Zone of the Skærumhede boring in Vendsyssel.

Dentalina subsoluta (Cushman)
Pl. 3, fig. 5

Synonyms: 1923 *Nodosaria subsoluta* Cushman: p. 74, pl. 13, fig. 1. – 1967 *Dentalina* aff. *D. subsoluta* (Cushman); Todd & Low: p. 23, pl. 3, fig. 7.

Dimensions: The figured specimen from Hirtshals has l = 1.75 mm, max. b = 0.40 mm (initial chambers broken).

Occurrence: Three specimens were found in zone D of the Older *Yoldia* Clay at Hirtshals in Vendsyssel.

Remarks: Cushman (1923) described *D. subsoluta* from off the coast of Brazil. Todd & Low (1967) recorded the species from Alaskan waters, and Nørvang (1945) found it at Iceland.

Lenticulina Lamarck, 1804

Lenticulina gibba (d'Orbigny)

Synonyms: 1839 a *Cristellaria gibba* d'Orbigny: p. 63, pl. 7, figs. 20, 21. – 1899 Flint: p. 317, pl. 64, fig. 1. – 1923 Cushman: p. 105, pl. 25, fig. 4. – 1960 *Lenticulina gibba* (d'Orbigny); Barker: p. 144, pl. 69, figs. 8, 9. – 1964 a *Lenticulina (Robulus)* cf. *gibba* (d'Orbigny); Feyling-Hanssen: p. 278, pl. 9, fig. 11.

Dimensions: Specimen from Lateglacial deposits at Nr. Lyngby has max. d = 0.20 mm, t = 0.13 mm.

Occurrence: A single specimen was found in the Lateglacial deposits at Nr. Lyngby in Vendsyssel. One specimen was found in the Older *Yoldia* Clay at Løkken and a few occurred in zone D of the Older *Yoldia* Clay at Hirtshals.

Remarks: Feyling-Hanssen (1964 a) recorded rare specimens of *Lenticulina (Robulus)* cf. *gibba* in late Quaternary deposits of the Oslofjord area.

Lenticulina rotulata (Lamarck), forma *cultrata* Montfort

Synonyms: 1808 *Robulus cultratus* Montfort: p. 214, 54e genre. – 1923 *Cristellaria rotulata* (Lamarck)?; Cushman: p. 108, pl. 28, figs. 1, 2 (not pl. 22, fig. 2). – 1964 a *Lenticulina (Robulus) rotulatus* (Lamarck), forma *cultrata* Montfort; Feyling-Hanssen: p. 280, pl. 10, figs. 1, 2.

Dimensions: Specimen from Hirtshals has max. d = 0.19 mm, t = 0.10 mm.

Occurrence: A few specimens are found in zones D and F of the Older *Yoldia* Clay at Hirtshals, Vendsyssel.

Lenticulina thalmanni (Hessland)
Pl. 3, fig. 6.

Synonyms: 1943 *Robulus thalmanni* Hessland: p. 265. – 1960 Barker: p. 144, pl. 69, fig. 13.

Dimensions: Specimen from Sandnes (pl. 3, fig. 6) has max. d = 1.19 mm, t = 0.53 mm. Specimen from Løkken has max. d = 1.40 mm, t = 0.63 mm.

Occurrence: This species occurs, very rarely, in zone 1 of the Sandnes Clay. Single specimens are found in the Older *Yoldia* Clay from the Løkken area in Vendsyssel.

Astacolus de Montfort, 1808

Astacolus crepidulus (Fichtel & Moll)

Synonyms: 1798 *Nautilus crepidula* Fichtel & Moll: p. 107, pl. 19, figs. g–i. – 1960 *Astacolus crepidulus* (Fichtel & Moll); Barker: p. 142, pl. 67, fig. 20; pl. 68, figs. 1, 2. – 1964 b *Lenticulina (Astacolus) crepidula* (Fichtel & Moll); Feyling-Hanssen: p. 49, pl. 1, fig. 6.

Dimensions: A single broken specimen was found in the Older *Yoldia* Clay at Løkken: l = 0.31 mm, b = 0.18 mm, t = 0.08 mm. Another specimen was found in zone 1 of boring no. I in Sandnes.

Astacolus hyalacrulus Loeblich & Tappan

Synonyms: 1953 *Astacolus hyalacrulus* Loeblich & Tappan: p. 52, pl. 9, figs. 1–4. – 1965 Leslie: p. 156, pl. 5, fig. 1.

Dimensions: One specimen occurred in zone C of the Older *Yoldia* Clay at Hirtshals: l = 0.58 mm, max. b = 0.33 mm, t = 0.22 mm.

Remarks: Loeblich & Tappan (1953) recorded *A. hyalacrulus* from Recent faunas off Alaska, Canada, and Greenland at depths between 24 and 223 m. Leslie (1965) and Wagner (1968) recorded it from Hudson Bay.

Marginulina d'Orbigny, 1826

Marginulina glabra d'Orbigny
Pl. 3, fig. 7

Synonyms: 1826 *Marginulina glabra* d'Orbigny: p. 259, Modèles, no. 55. – 1964 a Feyling-Hanssen: p. 283, pl. 10, fig. 3. – 1967 Todd & Low: p. 22, pl. 3, figs. 8, 9.

Dimensions: Specimen from Lateglacial deposits at Løkken (pl. 3, fig. 7) has l = 0.27 mm, max. b = 0.14 mm.

Occurrence: A few specimens of this species occur in the Older *Yoldia* Clay, in the Lateglacial *Yoldia* Clay and in the Postglacial deposits of Vendsyssel.

Amphicoryna Schlumberger, 1881

Amphicoryna scalaris (Batsch)
Pl. 3, fig. 8; pl. 16, fig. 1

Synonyms: 1791 *Nautilus (Orthoceras) scalaris* Batsch: pl. 2, fig. 4. – 1923 *Nodosaria scalaris* (Batsch); Cushman: p. 81. – 1940 Buchner: p. 404, pl. 1, figs. 1–19. – 1958 *Lagenonodosaria scalaris* (Batsch); Parker: p. 258, pl. 1, figs. 32, 33. – 1960 *Amphicoryna scalaris* (Batsch); Barker: pl. 63, figs. 28–31; pl. 65, figs. 7–9. – 1967 *Lagenonodosaria scalaris* (Batsch); Todd & Low: p. 23, pl. 3, fig. 39.

Dimensions: Specimen from the *Zirfaea* layers at Blødegrøft (pl. 16, fig. 1) has l = 0.28 mm, b = 0.18 mm, and one from the Older *Yoldia* Clay at Hirtshals (pl. 3, fig. 8) has l = 0.33 mm, max. b = 0.19 mm.

Occurrence: A few specimens of *A. scalaris* are found in the Lateglacial *Zirfaea* layers and in the Older *Yoldia* Clay of Vendsyssel.

Remarks: Parker (1958) and Todd & Low (1967) referred this species to the genus *Lagenonodosaria*. Hofker (1932) and Buchner (1940) suggested that it must be regarded as the megalospheric form of the species *Amphicoryna scalaris*. This species is recorded from the Mediterranian (Buchner, 1940; Parker, 1958) and from the eastern part of the Atlantic (Cushman, 1923). In the Oslofjord (Risdal, 1964) it is found at a water depth of 100 m. Nørvang (1941 and 1945) found the species off Bergen in Norway and off Iceland, and suggested, that it is a boreo-lusitanian species. Todd & Low (1967) recorded *A. scalaris* from Alaskan waters.

Lagena Walker & Boys, 1784

Lagena aspera Reuss

Synonyms: 1862 *Lagena aspera* Reuss: p. 305, pl. 1, fig. 5. – 1933 Cushman: p. 8, pl. 1, figs. 6–8. – 1960 Barker: pl. 57, figs. 6?, 7, 10–12.

Dimensions: Two specimens were found in the Lateglacial *Zirfaea* layers at Skeen Møllebæk, Vendsyssel. One of those has l = 0.13 mm, t = 0.13 mm.

Lagena elongata (Ehrenberg)

Synonyms: 1844 *Miliola elongata* Ehrenberg: p. 274. – 1940 *Lagena elongata* (Ehrenberg); Buchner: p. 413, pl. 2, figs. 23, 24. – 1964 a Feyling-Hanssen: p. 287, pl. 11, fig. 9. – 1967 Todd & Low: p. 24, pl. 3, fig. 22.

Dimensions: One broken specimen was found in the Older *Yoldia* Clay at Hirtshals: l = 0.65 mm, t = 0.08 mm.

Remarks: *L. elongata* is recorded from late Quaternary deposits of the Oslofjord area (Feyling-Hanssen, 1964 a).

Lagena exculpta Brady

Synonyms: 1881 *Lagena exculpta* Brady: p. 61. – 1884 Brady: pl. 58, fig. 1; pl. 61, fig. 5. – 1913 Cushman: p. 28, pl. 13, fig. 5.

Dimensions: Specimen from Løkken has l = 0.25 mm, t = 0.20 mm.

Occurrence: Single specimens are found in the Postglacial of the Løkken area in Vendsyssel.

Lagena gracillima (Seguenza)
Pl. 4, fig. 1

Synonyms: 1862 *Amphorina gracillima* Seguenza: p. 51, pl. 1, fig. 37. – 1923 *Lagena gracillima* (Seguenza); Cushman: p. 23, pl. 4, fig. 5. – 1940 Buchner: p. 415, pl. 2, figs. 25–27. – 1964 a Feyling-Hanssen: p. 288, pl. 11, fig. 11. – 1965 Nagy: p. 120, pl. 1, fig. 28. – 1969 Gudina: p. 17, pl. 6, figs. 7, 8.

Dimensions: Specimen from Stortorn (pl. 4, fig. 1) has l = 0.85 mm, t = 0.18 mm.

Occurrence: One specimen occurred in zone 3 of boring no. V in Sandnes, and a few specimens were found in the Older *Yoldia* Clay of Vendsyssel.

Remarks: The figured specimen from Stortorn in Vendsyssel is curved, otherwise they are straight. Madsen (1895) recorded *L. gracillima* from the Quaternary of Denmark. It is found in Lateglacial and Postglacial deposits of the Oslofjord area (Feyling-Hanssen, 1964 a) and in the Quaternary of Siberia (Gudina, 1969). In Recent waters this species is known from off the coasts of Alaska, Canada and Greenland at depths between 21 and 146 m (Loeblich & Tappan, 1953). Nagy (1965) recorded it from Spitsbergen, and Risdal (1964) from the Oslofjord at depths of 100–330 m.

Lagena hirtshalsensis A.-L. Andersen, n. sp.
Pl. 4, fig. 2; pl. 16, figs. 10, 11; text-fig. 42.

Derivation of name:
From the town of Hirtshals, Denmark.

Type data: Holotype (MMH no. 11982) from zone C of the Older *Yoldia* Clay (sample no. 54 A) in the coast cliff at Hirtshals, Denmark.

Diagnosis: A rounded *Lagena* with irregular longitudinal ribs possessing a large number of spines.

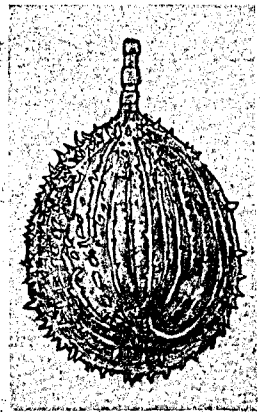

Fig. 42. *Lagena hirtshalsensis*, A. L. Andersen n. sp. Holotype from Older *Yoldia* Clay (spl. no. 54 A) at Hirtshals; × 130.

Description: Test free, unilocular, oval in longitudinal section, widest below the central part of the test, base rounded, circular in cross section; wall calcareous, hyaline, finely perforate, ornamented with 20–30 irregular longitudinal ribs with a large number of a spines, a few spines occurs between the ribs as well; aperture at the end of a narrow neck with annular thickenings, the neck is about $^1/_5$ of the total length.

Holotype (fig. 42): l = 0.34 mm, t = 0.22 mm. Paratype (pl. 4, fig. 2; pl. 16, figs. 10, 11) from sample no. 40 A has l = 0.38 mm, t = 0.22 mm.

Occurrence: Zone C of the Older *Yoldia* Clay at Hirtshals.

Remarks: *L. hirtshalsensis* n. sp. is close to *Lagena vikensis* (Hessland, 1943), but the latter is larger (Holotype: l = 0.65 mm, b = 0.43 mm), the number of ribs is smaller (10–15) and the apertural neck is shorter and smooth. *L. hirtshalsensis* n. sp. differs from *Lagena aspera* Reuss, 1862, *L. hispida* Reuss, 1863, *L. hispidula* Cushman, 1913, and *L. gibba* Buchner, 1940 by the presence of longitudinal ribs, on which most of the spines are placed.

Lagena hispida Reuss

Synonyms: 1863 *Lagena hispida* Reuss: p. 335, pl. 6, figs. 77–79. – 1895 Madsen: p. 191. – 1923 Cushman: p. 26, pl. 4, figs. 7, 8. – 1960 Barker: pl. 57, figs. 1–4.

Dimensions: Specimen from the Postglacial at Birkelse has l = 0.33 mm, t = 0.23 mm.

Occurrence: One specimen occurred in zone 3 of boring no. V, Sandnes, one specimen was found in the Lateglacial *Zirfaea* layers at Blødegrøft and one in Postglacial deposits from Birkelse in Vendsyssel.

Remarks: Risdal (1964) recorded *L. hispida* at depths between 100 and 330 m in the Oslofjord.

Lagena laevis (Montagu)

Synonyms: 1803 *Vermiculum laevae* Montagu: p. 524. – 1895 *Lagena laevis* Montagu; Madsen: p. 190. – 1953 *L. laevis* (Montagu); Loeblich & Tappan: p. 61, pl. 11, figs. 5–8. – 1964 a Feyling-Hanssen: p. 289, pl. 11, figs. 13–15. – 1965 Leslie: p. 163, pl. 5, fig. 8. – 1967 Michelsen: p. 218, pl. 1, fig. 7. – 1967 Todd & Low: p. 24, pl. 3, fig. 17.

Dimensions: Specimen from the Postglacial at Birkelse has l = 0.53 mm, t = 0.13 mm.

Occurrence: A few specimens are found in all the late Quaternary layers of Vendsyssel.

Remarks: *L. laevis* is recorded from the Holsteinian (Mindel-Riss Interglacial) deposits at Inder Bjergum in SW Denmark (Buch, 1955), and Madsen (1895) found it in the Lateglacial *Yoldia* Clay of Vendsyssel. It is recorded from the late Quaternary of SW Sweden (Hessland, 1943), the Oslofjord area in Norway (Feyling-Hanssen, 1964 a) and Læsø in Denmark (Michelsen, 1967). Loeblich & Tappan (1953) and Leslie (1965) found *L. laevis* off the coast of Alaska and Canada.

Lagena mollis Cushman

Synonyms: 1944 *Lagena gracillima* (Seguenza), var. *mollis* Cushman: p. 21, pl. 3, fig. 3. – 1953 *L. mollis* (Cushman); Loeblich & Tappan: p. 63, pl. 11, figs. 25–27. – 1964 a Feyling-Hanssen: p 290, pl. 11, figs. 16–19.

Dimensions: A broken specimen from Hirtshals has l = 0.53 mm, t = 0.16 mm.

Occurrence: Rare specimens of *L. mollis* occur in the Older *Yoldia* Clay at Hirtshals in Vendsyssel.

Lagena nebulosa Cushman

Synonyms: 1884 *Lagena laevis* (Montagu); Brady (not *Vermiculum laevis* Montagu, 1803): pl. 56, fig. 12. – 1923 *L. laevis* (Montagu), var. *nebulosa* Cushman: p. 29, pl. 5, figs. 4, 5. – 1940 *L. nebulosa* (Cushman); Buchner: p. 421, pl. 2, figs. 31, 32. – 1964 a Feyling-Hanssen: p. 291, pl. 12, fig. 1. – 1965 Leslie: p. 164, pl. 5, fig. 14.

Dimensions: One specimen was found in zone A of the Older *Yoldia* Clay at Hirtshals, Vendsyssel: l = 0.30 mm, t = 0.22 mm.

Lagena semilineata Wright
Pl. 4, fig. 3; pl. 16, fig. 2

Synonyms: 1886 *Lagena semilineata* Wright: p. 320, pl. 26, fig. 7. – 1953 Loeblich & Tappan: p. 65, pl. 11, figs. 14–22. – 1964 a Feyling-Hanssen: p. 291, pl. 12, fig. 2. – 1965 Leslie: p. 164, pl. 5, fig. 12. – 1967 Michelsen: p. 218, pl. 1, fig. 8.

Dimensions: Figured specimen from Hirtshals has l = 0.69 mm, t = 0.23 mm.

Occurrence: A few specimens of *L. semilineata* occur in the late Quaternary deposits of Vendsyssel.

Lagena setigera Millett

Synonyms: 1901 *Lagena clavata* d'Orbigny, var. *setigera* Millett: p. 491, pl. 8, fig. 9. – 1953 *L. setigera* Millett?; Loeblich & Tappan: p. 66, pl. 11, figs. 23, 24. – 1953 *L. gracillima* (Seguenza); Loeblich & Tappan (not *Amphorina gracillima* Seguenza, 1862): pl. 11, fig. 3. – 1964 a *L. setigera* Millett; Feyling-Hanssen: p. 289, pl. 12, fig. 3.

Dimensions: Specimen from Hirtshals has l = 0.44 mm, t = 0.19 mm.

Occurrence: *L. setigera* is found in zones E and F of the Older *Yoldia* Clay at Hirtshals. It is rare.

Lagena striata (d'Orbigny), forma *substriata* Williamson
Pl. 16, figs. 3, 4

Synonyms: 1848 *Lagena substriata* Williamson: p. 15, pl. 2, fig. 12. – 1940 *L. striata* (d'Orbigny); Buchner: p. 424, pl. 4, figs. 54–57 (not figs. 58–61). – 1964 a *L. striata* (d'Orbigny), forma *substriata* Williamson; Feyling-Hanssen: p. 294, pl. 12, fig. 6.

Dimensions: Specimen from Hirtshals (pl. 16, figs. 3, 4) has l = 0.25 mm, t = 0.09 mm.

Occurrence: A few specimens were found in the Older *Yoldia* Clay of Vendsyssel.

Lagena striata (d'Orbigny), forma *typica*
Pl. 16, fig. 5

Synonyms: 1839 b *Oolina striata* d'Orbigny: p. 21, pl. 5, fig. 12. – 1940 *Lagena striata* (d'Orbigny); Buchner: p. 424, pl. 4, figs. 58–61 (not figs. 54–57). – 1964 a *L. striata* (d'Orbigny), forma *typica;* Feyling-Hanssen: p. 293, pl. 12, figs. 4, 5. – 1967 *L. striata* (d'Orbigny); Michelsen: p. 219, pl. 1, fig. 9.

Dimensions: Specimen from Hirtshals (pl. 16, fig. 5) has l = 0.30 mm, t = 0.21 mm.

Occurrence: A few specimens were present in all the late Quaternary deposits of Vendsyssel.

Lagena sulcata laevicostata Cushman & Gray
Pl. 4, figs. 4, 5; pl. 16, figs. 7–9

Synonyms: 1946 a *Lagena sulcata* (Walker & Jacob), var. *laevicostata* Cushman & Gray: p. 68, pl. 12, figs. 13, 14. – 1964 a *L. sulcata* Cushman & Gray; Feyling-Hanssen: p. 295, pl. 12, fig. 7.

Dimensions: Specimen from Lateglacial deposits at Løkken (pl. 4, fig. 4) has l = 0.36 mm, t = 0.20 mm, and one from Hirtshals (pl. 4, fig. 5; pl. 16, figs. 7–9) has l = 0.43 mm, t = 0.21 mm.

Occurrence: This subspecies is found in all the late Quaternary layers of Vendsyssel, but it is rare.

Remarks: *L. sulcata laevicostata* is known from tropical and temperate seas (Cushman & McCullock, 1950). Lafrenz (1963) recorded it from the Eemian deposits of Schleswig-Holstein, and Feyling-Hanssen (1964 a) found it in the Postglacial of the Oslofjord area in Norway.

Lagena trigono-elliptica Balkwill & Millett

Synonyms: 1884 *Lagena trigono-elliptica* Balkwill & Millett: pp. 81, 87, pl. 3, fig. 8.

Dimensions: One specimen was found in Older *Yoldia* Clay at Hirtshals: l = 0.18 mm, t = 0.12 mm.

Lagena trigono-laevigata Balkwill & Millett
Pl. 4, figs. 6, 7; pl. 16, fig. 6

Synonyms: 1884 *Lagena trigono-laevigata* Balkwill & Millett: pp. 81, 86, pl. 3, fig. 6.

Dimensions: Figured specimen from Postglacial deposits at Løkken has l = 0.20 mm, t = 0.12 mm.

Occurrence: This species was rare in Postglacial deposits of the Løkken area; a few specimens occur in zone F of the Older *Yoldia* Clay at Hirtshals.

Remarks: The species seems to have little in common with ordinary *Lagena* forms. It should certainly be transferred to another genus, but as only few specimens are contained in the present material a revision has not been attempted.

Polymorphinidae d'Orbigny, 1839

Guttulina d'Orbigny, 1826

Guttulina austriaca d'Orbigny
Pl. 4, figs. 8, 9

Synonyms: 1846 *Guttulina austriaca* d'Orbigny: p. 223, pl. 12, figs. 23–25. – 1884 *Polymorphina oblonga;* Brady: p. 569, pl. 73, fig. 4. – 1927 *P. (Guttulina) austriaca* d'Orbigny; Galloway & Wissler: p. 57, pl. 9, fig. 9. – 1930 *Guttulina austriaca* d'Orbigny; Cushman & Ozawa: p. 29, pl. 4, figs. 3–5. – 1963 Lafrenz: p. 18, pl. 1, figs. 7, 8.

Dimensions: Specimen from Reve, Jæren (pl. 4, figs. 8, 9) has l = 0.73 mm, b = 0.31 mm, t = 0.28 mm.

Occurrence: The figured specimen is from a surface sample from Reve, southwest of Sandnes. The sample is most probably referable to zone 1 of Sandnes. Som specimens of *G. austriaca* were found in samples from zone 3 in the Sandnes borings, and in a sample from Nygaard brickworks, Karmøy. Some specimens were found in the Older *Yoldia* Clay at Frederikshavn, Stortorn, the Løkken area and in zones A, C, D, E, and F at Hirtshals, it is most common in zones C and F. It is rare in the Lateglacial *Zirfaea* layers at Blødegrøft and Skeen Møllebæk.

Remarks: Cushman & Ozawa (1930) recorded *G. austriaca* from deposits ranging from Eocene to Recent, i.a. it occurs in Pleistocene glacial clays in Montreal, Canada. Galloway & Wissler (1927) described it from the Pleistocene of the Lomita Quarry in California. Lafrenz (1963) found it quite commonly in *Cyprina* Clay (Eem Interglacial) especially on the Baltic side of Schleswig-Holstein. Konradi (in press) found it in the Eemian of Stensigmose, southern Jutland. Madsen (1865, pp. 205–206) recorded *Polymorphina oblonga* d'Orbigny from the Danish Quaternary and by this he referred to Brady's (1884) plate 73, figs. 2–4. According to Cushman & Ozawa (1930) and Barker (1960, p. 152) figs. 2 and 3 are of *Guttulina yabei,* whereas fig. 4 is of *G. austriaca.* Madsen may thus have had this latter species in his material of *P. oblonga.* He found the group in the Eemian deposits, in Older *Yoldia* Clay at Hirtshals, in *Zirfaea* layers, at Skeen Møllebæk and in Younger *Yoldia* Clay at Stensbæk. He also recorded some specimens from Røgle Klint; these may be of Holstein Interglacial age. *G. austriaca* has not been observed in Recent Arctic and Antarctic waters.

Guttulina dawsoni Cushman & Ozawa
Pl. 4, fig. 10

Synonyms: 1930 *Guttulina dawsoni* Cushman & Ozawa: p. 47, pl. 12, figs. 1, 2. – 1964 a Feyling-Hanssen: p. 297, pl. 12, figs. 10, 11. – 1964 b Feyling-Hanssen: p. 49, pl. 1, fig. 7. – 1965 Leslie: p. 161, pl. 6, fig.5.

Dimensions: Specimen from Hirtshals (pl. 4, fig. 10) has l = 0.95 mm, b = 0.32 mm, t = 0.26 mm.

Occurrence: This species is found in zone 3 of the Sandnes Clay with scattered specimens in zone 1. It occurs in zones C, E and F of the Older *Yoldia* Clay at Hirtshals, Vendsyssel, but is rare.

Remarks: Feyling-Hanssen (1964 a) recorded this species from late Quaternary deposits of the Oslofjord area, from Holocene deposits in Spitsbergen (1964 b), and from Recent faunas off East Greenland and Spitsbergen at depths of 8–28 m (1964 a). *G. dawsoni* seems to be a cold-water species (Cushman & Ozawa, 1930). It is recorded from Recent faunas off Canada (Cushman & Ozawa, 1930; Leslie 1965; Wagner, 1968).

Guttulina glacialis (Cushman & Ozawa)
Pl. 4, figs. 11–13

Synonyms: 1930 *Globulina glacialis* Cushman & Ozawa: p. 71, pl. 15, figs. 6, 7. – 1944 Cushman: p. 22, pl. 3, fig. 15. – 1948 Cushman: p. 50, pl. 5, figs. 15, 16. – 1962 *G.* cf. *glacialis* Cushman & Ozawa; Woszidlo: p. 69, pl. 1, fig. 12. – 1964 b *G. glacialis* Cushman & Ozawa; Feyling-Hanssen: p. 16, 25, pl. 1, figs. 11, 12. – 1965 *Guttulina glacialis* (Cushman & Ozawa); Leslie: p. 162, pl. 7, fig. 4. – 1969 *Globulina glacialis* Cushman & Ozawa; Gudina: p. 19: pl. 17, figs. 2–4.

Dimensions: Specimen from Lateglacial deposits at Løkken (pl. 4, figs. 11–13) has l = 0.44 mm, b = 0.23 mm.

Occurrence: Some specimens of *G. glacialis* are usually present in samples from zone 3 in the borings at Sandnes, whereas only one was observed in zone 1 of boring no. II. One specimen occurred in a surface sample from Elgane, Jæren. A few specimens were found in the Older *Yoldia* Clay of Vendsyssel and single specimens occur in the Lateglacial *Yoldia* Clay of the Løkken area.

Remarks: Cushman & Ozawa (1930) described this species from Pleistocene clays in Montreal, Canada. Woszidlo (1962) recorded scattered specimens of *Globulina* cf. *glacialis* from the Holsteinian of Schleswig-Holstein. Buzas (1965) found *G. glacialis* in late Pleistocene clay near Waterville in Maine, U.S.A., Feyling-Hanssen (1964 b) recorded it from Postglacial Warm Interval deposits of Barents Island, Spitsbergen, and Gudina (1969) found it

in Quaternary deposits of Siberia. Leslie (1965) recorded *G. glacialis* from Hudson Bay at depths from 32 to 212 m and in core samples of Holocene age there.

Guttulina irregularis d'Orbigny, forma *nipponensis* Cushman & Ozawa.

Synonyms: 1930 *Guttulina irregularis* d'Orbigny, forma *nipponensis* Cushman & Ozawa: p. 27, pl. 7, fig. 3.

Dimensions: One Specimen was found in Older *Yoldia* Clay at Hirtshals: l = 0.84 mm, b = 0.48 mm, t = 0.40 mm.

Remarks: Cushman & Ozawa (1930) described this species from the Pleistocene of Japan, and they also found it in Recent faunas.

Guttulina lactea (Walker & Jacob)
Pl. 4, figs. 14–18

Synonyms: 1798 *Serpula lactea* Walker & Jacob: p. 634, pl. 14, fig. 4. – 1930 *Guttulina lactea* (Walker & Jacob); Cushman & Ozawa: p. 43, pl. 10, figs. 1–4. – 1941 Ten Dam & Reinhold: p. 49, pl. 3, fig. 1. – 1945: Nørvang: p. 26. – 1949 a van Voorthuysen: p. 66, pl. 1, fig. 6. – 1955 Buch: p. 611. – 1962 Woszidlo: p. 69, pl. 1, fig. 9. – 1964 a Feyling-Hanssen: p. 297, pl. 12, figs. 12–14. – 1967 Michelsen: p. 219, pl. 1, fig. 10.

Dimensions: Specimen from Reve, Jæren (pl. 4, figs. 14, 15) has l = 0.51 mm, b = 0.25 mm, t = 0.20 mm. Specimen from the Lateglacial at Løkken (pl. 4, figs. 16–18) has l = 0.36 mm, b = 0.18 mm, t = 0.15 mm.

Occurrence: A few specimens of *G. lactea* usually occur in samples from zone 3 of the Sandnes Clay, it is most common in the upper part of the zone and very few specimens are found in zone 1. It occurs in all late Quaternary deposits of Vendsyssel, but is not frequent.

Remarks: This species was originally described from the sea-shore near Sandwich in England. According to Cushman & Ozawa (1930) fossil specimens are recorded from Eocene through Pliocene. Ten Dam & Reinhold (1941) found it in Scaldisian deposits of the Netherlands and van

Voorthuysen (1949 a) recorded it from the Icenian (early Pleistocene) there. In Denmark, Buch (1955) found *G. lactea* in the so-called Esbjerg *Yoldia* Clay (Holstein Interglacial) near Ribe, and Woszidlo (1962) observed it in similar deposits in Schleswig-Holstein, northern Germany. Madsen (1895, p. 201) recorded *Polymorphina lactea* from the Danish Quaternary as well. However, he referred to Brady's (1884) figs. 11 and 14 on plate 71, which Barker (1960) considered to represent other species. Taking into consideration Madsen's comparatively broad concept of *Polymorphina lactea,* he may, however, well have observed the present species in some of his samples. Michelsen (1967) found *G. lactea* in Lateglacial (Oldest *Dryas*) deposits at Læsø in Denmark, and Feyling-Hanssen (1964 a) recorded it in early Holocene clays of the Oslofjord area. Nørvang (1945, p. 26) considered its Recent distribution to be cosmopolitan.

Guttulina problema (d'Orbigny)
Pl. 5, figs. 1, 2

Synonyms: 1826 *Polymorphina problema* d'Orbigny: p. 266, no. 61. – 1826 *P. communis* d'Orbigny: p. 266, pl. 12, figs. 1–4. – 1884 *P. problema* (d'Orbigny); Brady: p. 568, pl. 72, figs. 19, 20; pl. 73, fig. 1. – 1930 *Guttulina problema* (d'Orbigny); Cushman & Ozawa: p. 19, pl. 2, figs. 1–6; pl. 3, fig. 1.

Dimensions: Specimen from Karmøy, Jæren (pl. 5, figs. 1, 2) has l = 0.67 mm, b = 0.51 mm, t = 0.43 mm.

Occurrence: A single specimen was found in the deeper part of boring no. VI, Gann, Sandnes, and two others in a sample from the clay pit of Nygaard brickworks, Karmøy.

Remarks: This species has a long stratigraphical range, from Upper Cretaceous to Recent. Cushman & Ozawa (1930) recorded it from the Pleistocene Lomita Quarry in California. Madsen (1895, p. 205) recorded 2 specimens of this species in the Eemian *Cyprina* Clay of Ærø in Denmark and Lafrenz (1963, p. 18, pl. 1, fig. 9) recorded *Guttulina* sp. aff. *problema* (d'Orbigny) from Eemian deposits in Schleswig-Holstein in Germany. He figured a specimen which seems to have much in common with *G. problema.* Van Voorthuysen (1958, p. 11, pl. 3, fig. 31) found *G. problema* in the Poederlian (lowest Pleistocene) of Kruisschans in Belgium, and Hessland (1943, p. 264) recorded it from Holocene deposits in SW Sweden.

Globulina d'Orbigny, 1826

Globulina gibba d'Orbigny

Synonyms: 1826 *Globulina gibba* d'Orbigny: p. 266, no. 10, Modèle no. 63. – 1930 Cushman & Ozawa: p. 60, pl. 16, figs. 1–4. – 1946 b Cushman & Gray: p. 23, pl. 4, fig. 22. – 1962 Woszidlo: p. 69, pl. 1, fig. 11.

Dimensions: Specimen from Older *Yoldia* Clay at Hirtshals has l = 0.40 mm, b = 0.30 mm.

Occurrence: One specimen occurred in a zone 1 sample from Graveren clay pit in Sandnes, and another one in zone D of the Older *Yoldia* Clay at Hirtshals.

Remarks: According to Cushman & Ozawa (1930) the stratigraphical range of *G. gibba* is Eocene to Recent. Dinesen (1959, p. 71) found it in Oligocene deposits at Brejning in Denmark, and van Voorthuysen (1950 b, p. 59) recorded it from the oldest Pleistocene of the Netherlands. It is fairly common in the Pliocene of Timms Point (Cushman & Gray, 1946 b). Lafrenz (1963) recorded it from the Holsteinian of Schleswig-Holstein.

Globulina inaequalis Reuss
Pl. 5, fig. 3

Synonyms: 1850 *Globulina inaequalis* Reuss: p. 377, pl. 48, fig. 9. – 1930 Cushman & Ozawa: p. 73, pl. 18, figs. 2–4. – 1960 Barker: p. 148, pl. 71, fig. 13. – 1964 a Feyling-Hanssen: p. 298, pl. 12, fig. 17; pl. 13, figs. 1, 2; text-figs. 42–44.

Dimensions: Specimen from Hirtshals (pl. 5, fig. 3) has l = 0.46 mm, b = 0.33 mm, t = 0.27 mm.

Occurrence: One specimen of this species was found in the sample from Elgane, Jæren. It is slightly more common in Vendsyssel, where a few specimens occur in all the late Quaternary deposits.

Remarks: *G. inaequalis* is recorded from Postglacial deposits of the Oslofjord area (Feyling-Hanssen, 1964 a). According to Cushman & Ozawa (1930) it seems to be limited to temperate waters.

Globulina landesi (Hanna & Hanna)
Pl. 5, fig. 4

Synonyms: 1924 *Polymorphina landesi* Hanna & Hanna: p. 60, pl. 13, figs. 16, 17. – 1930 *Globulina landesi* (Hanna & Hanna); Cushman & Ozawa: p. 71, pl. 15, fig. 9. – 1964 a Feyling-Hanssen: p. 299, pl. 12, figs. 15, 16.

Dimensions: Specimen from Karmøy (pl. 5, fig. 4) has l = 0.46 mm, b = 0.35 mm, t = 0.28 mm.

Occurrence: Single specimens occur in a sample from Karmøy and in zones 1 and 3 of the Sandnes borings.

Remarks: *G. landesi* was described from the Eocene of Lewis County, Washington (Cushman & Ozawa, 1930). Feyling-Hanssen (1964 a) found it in Postglacial warm interval deposits (Holocene) of the Oslofjord area, and Cushman & Ozawa recorded it from Recent shore sand of the Sea of Japan.

Pseudopolymorphina Cushman & Ozawa, 1928

Pseudopolymorphina novangliae (Cushman)
Pl. 5, figs. 5, 6

Synonyms: 1923 *Polymorphina lactea* (Walker & Jacob), var. *novangliae* Cushman: p. 146, pl. 39, figs. 6–8. – 1930 *Pseudopolymorphina novangliae* (Cushman); Cushman & Ozawa: p. 90, pl. 23, figs. 1, 2. – 1952 a Parker: p. 410, pl. 5, fig. 1. – 1961 Saidova: p. 59, pl. 17, fig. 120. – 1964 a Feyling-Hanssen: p. 300, pl. 13, fig. 3. – 1964 b Feyling-Hanssen: p. 50. – 1967 Michelsen: p. 219, pl. 1, fig. 11. – 1969 Gudina: p. 20, pl. 7, figs. 5, 6.

Dimensions: Hypotype from Sandnes (pl. 5, fig. 5) has l = 0.78 mm, b = 0.30 mm, t = 0.28 mm. Specimen from Hirtshals (pl. 5, fig. 6) has l = 0.82 mm, b = 0.30 mm, t = 0.25 mm.

Occurrence: One specimen of *P. novangliae* was found in a sample from Reve, Jæren. Some specimens occurred in zone 3 of the borings in Sandnes and single specimens were also found in the zones 1 and 2. Some specimens occur in the Older *Yoldia* Clay and a few in the Lateglacial *Yoldia* Clay of Vendsyssel.

Remarks: Cushman & Ozawa (1930) found *P. novangliae* to be abundant in the cold water off the coast of New England. Saidova (1961) records it from 70 m depth in the northwestern Pacific. Feyling-Hanssen (1964 a, b) found the species in Lateglacial, zone A_u, layers of the Oslofjord area, and in Postglacial deposits in eastern Spitsbergen. Michelsen (1967) records *P. novangliae* from Lateglacial (Oldest *Dryas*) deposits of Læsø in Denmark, and Gudina (1969) records it from the Quaternary of Siberia.

Pseudopolymorphina soldanii (d'Orbigny)
Pl. 5, fig. 7

Synonyms: 1826 *Polymorphina soldanii* d'Orbigny: p. 265, no. 12. – 1930 *Pseudopolymorphina soldanii* (d'Orbigny); Cushman & Ozawa: p. 92, pl. 23, figs. 6–8.

Dimensions: Specimen from Sandnes (pl. 5, fig. 7) has l = 0.65 mm, b = 0.30 mm, t = 0.27 mm.

Occurrence: A single specimen occurred in zone 3 of the Sandnes Clay and a few specimens were found in zones C, E and F of the Older *Yoldia* Clay at Hirtshals, Vendsyssel.

Remarks: Cushman & Ozawa (1930) recorded this species from the Sutton Crag in England.

Pseudopolymorphina suboblonga Cushman & Ozawa
Pl. 5, figs. 8, 9

Synonyms: 1930 *Pseudopolymorphina suboblonga* Cushman & Ozawa: p. 91, pl. 23, fig. 3. – 1964 a Feyling-Hanssen: p. 300, pl. 13, fig. 4.

Dimensions: Hypotype from Reve, Jæren (pl. 5, figs. 8, 9) has l = 1.11 mm, b = 0.28 mm, t = 0.23 mm.

Occurrence: This species was found in a surface sample from Reve, Jæren, and also in a sample from the old brickworks of Sandnes. Two specimens of *P. suboblonga* were found in Lateglacial *Yoldia* Clay at Bindslev, Vendsyssel, and a few specimens occur in zone C of the Older *Yoldia* Clay at Hirtshals.

Remarks: *P. suboblonga* was originally recorded from the Pliocene of Okuwa, Japan, and it is found living off the coasts of Japan (Cushman & Ozawa, 1930). Feyling-Hanssen (1964 a) found it in Postglacial warm interval shore deposits at Brevik, SE Norway.

Pyrulina d'Orbigny, 1839

Pyrulina cylindroides (Roemer)
Pl. 5, figs. 10, 11

Synonyms: 1838 *Polymorphina cylindroides* Roemer: p. 385, pl. 3, fig. 26. – 1930 *Pyrulina cylindroides* (Roemer); Cushman & Ozawa: p. 56, pl. 14, figs. 1–5. – 1948 Cushman: p. 50, pl. 5, fig. 14. – 1960 Barker: p. 150, pl. 72, figs. 5, 6. – 1961 *Polymorphina cylindroides* Cushman; Saidova: p. 60, pl. 18, fig. 124.

Dimensions: Specimens from Sandnes (pl. 5, figs. 10, 11) has l = 0.59 mm, b = 0.25 mm, t = 0.22 mm.

Occurrence: A few specimens occur in zone 3 of the Sandnes Clay, and in zones A, B, C and F of the Older *Yoldia* Clay at Hirtshals in Vendsyssel.

Remarks: This species was originally described from Oligocene deposits in Germany. Cushman (1948) recorded it in Recent samples from NE Greenland, and Saidova (1961) found many specimens in the northwesternmost Pacific at depths from 100 to 300 m.

Sigmomorphina Cushman & Ozawa, 1928

Sigmomorphina undulosa (Terquem)

Synonyms: 1878 *Polymorphia undulosa* Terquem: p. 41, pl. 3, fig. 35. – 1930 *Sigmomorphina undulosa* (Terquem); Cushman & Ozawa: p. 131, pl. 34, figs. 4, 5. – 1964 a Feyling-Hanssen: p. 301, pl. 13, figs. 5–8.

Dimensions: Specimen from Løkken has l = 0.52 mm, b = 0.26 mm, t = 0.20 mm.

Occurrence: A few specimens of *S. undulosa* are found in Postglacial deposits of the Løkken area in Vendsyssel.

Glandulinidae Reuss, 1850

Glandulina d'Orbigny, 1826

Glandulina laevigata d'Orbigny
Pl. 5, fig. 12

Synonyms: 1826 *Nodosaria (Glandulina) laevigata* d'Orbigny: p. 252, pl. 10, figs. 1–3. – 1930 *Glandulina laevigata* d'Orbigny; Cushman & Ozawa: p. 143, pl. 40, fig. 1. – 1953 Loeblich & Tappan: p. 81, pl. 16, figs. 2–5. – 1965 Leslie: p. 161, pl. 7, fig. 1. – 1966 Gudina: p. 29, pl. 2, figs. 7, 8.

Dimensions: Specimen from Hirtshals (pl. 5, fig. 12) has l = 1.20 mm, max. b = 0.55 mm.

Occurrence: One specimen was found in a sample from the old brickworks of Sandnes, and a few specimens occur in the Older *Yoldia* Clay and in the Lateglacial *Yoldia* Clay of Vendsyssel.

Remarks: *G. laevigata* has been recorded from the oldest Quaternary of the Netherlands (van Voorthuysen, 1950 a) and Gudina (1966) found it in the Quaternary of Siberia. Nørvang (1945) suggested that the Recent distribution is cosmopolitan, at water depths of 30 to 3,260 m. Loeblich & Tappan (1953) found this species at depths exceeding 24 m off Alaska, Greenland and Canada, and Leslie (1965) found it in Hudson Bay at depths between 26 and 130 m.

Glandulina rotundata (Reuss)

Synonyms: 1923 *Nodosaria rotundata* (Reuss); Cushman: p. 63. – 1960 *Rectoglandulina rotundata* (Reuss); Barker: p. 128, pl. 61, figs. 17–19.

Dimensions: Specimen from Hirtshals has l = 0.35 mm, max. b = 0.25 mm.

Occurrence: A few specimens are found in zones A, C, D and F of the Older *Yoldia* Clay at Hirtshals.

Remarks: *G. rotundata* is found in the Oslofjord at depths of 100 and 200 m (Risdal, 1964).

Esosyrinx Loeblich & Tappan, 1953

Esosyrinx curta (Cushman & Ozawa)
Pl. 5, figs. 13–15

Synonyms: 1930 *Pseudopolymorphina curta* Cushman & Ozawa: p. 105, pl. 27, fig. 3. – 1953 *Esosyrinx curta* (Cushman & Ozawa); Loeblich & Tappan: p. 85, pl. 15, figs. 1–5. – 1964 a Feyling-Hanssen: p. 302. – 1964 b Feyling-Hanssen: p. 49, pl. 1, figs. 15, 16.

Dimensions: Specimen from Hirtshals (pl. 5, fig. 13) has l = 0.56 mm, b = 0.35 mm, t = 0.15 mm. Specimen from the Postglacial at Løkken (pl. 5, figs. 14, 15) has l = 0.30 mm, b = 0.16 mm, t = 0.11 mm.

Occurrence: This species was found, very rarely, in zone 3 of the Sandnes Clay, and a few specimens occur in the Older *Yoldia* Clay and in the Postglacial deposits of Vendsyssel.

Remarks: Feyling-Hanssen (1964 a and b) recorded this species from late Quaternary deposits of the Oslofjord area and from Postglacial deposits of Spitsbergen. In Recent arctic faunas it is found at depths exceeding 24 m (Loeblich & Tappan, 1953).

Laryngosigma Loeblich & Tappan, 1953

Laryngosigma hyalascidia Loeblich & Tappan
Pl. 5, fig. 16

Synonyms: 1953 *Laryngosigma hyalascidia* Loeblich & Tappan: p. 83, pl. 15, figs. 6–8. – 1964 a Feyling-Hanssen: p. 302. – 1964 b Feyling-Hanssen: p. 49, pl. 1, fig. 13.

Dimensions: Specimen from the Lateglacial at Løkken (pl. 5, fig. 16) has l = 0.33 mm, b = 0.16 mm, t = 0.15 mm.

Occurrence: A few specimens of this species were found in zone 3 of the Sandnes Clay, one at Reve, Jæren and a few in the Older *Yoldia* Clay, the Lateglacial *Yoldia* Clay and the Postglacial deposits of Vendsyssel.

Remarks: *L. hyalascidia* has been recorded from late Quaternary deposits of the Oslofjord area and from Postglacial deposits of Spitsbergen (Feyling-Hanssen, 1964 a and b). It is found in Recent arctic faunas at depths exceeding 31 m (Loeblich & Tappan, 1953). Lutze (1965) recorded the species from the Baltic at depths exceeding 14 m.

Laryngosigma williamsoni (Terquem)

Synonyms: 1878 *Polymorphina williamsoni* Terquem: p. 37. – 1930 *Sigmomorphina williamsoni* (Terquem); Cushman & Ozawa: p. 138, pl. 38, figs. 3, 4. – 1953 *Laryngosigma williamsoni* (Terquem); Loeblich & Tappan: p. 84, pl. 16, fig. 1. – 1964 b Feyling-Hanssen: p. 49, pl. 1, fig. 14.

Dimensions: Specimen from Hirtshals has l = 0.32 mm, b = 0.14 mm, t = 0.08 mm.

Occurrence: A few specimens were found in zone C of the Older *Yoldia* Clay at Hirtshals, Vendsyssel.

Remarks: Woszidlo (1962) recorded *L. williamsoni* from the Holsteinian deposits of Schleswig-Holstein, and Feyling-Hanssen (1964 b) found it in the Postglacial of Spitsbergen. It is recorded from depths exceeding 37 m off Greenland, Canada and Alaska (Loeblich & Tappan, 1953).

Oolina d'Orbigny, 1839

Oolina acuticosta (Reuss)
Pl. 6, fig. 1; pl. 17, fig. 1

Synonyms: 1862 *Lagena acuticosta* Reuss: p. 305, pl. 1, fig. 4. – 1923 Cushman: p. 5, pl. 1, figs. 1–3. – 1940 Buchner: p. 429, pl. 4, figs. 68, 69. – 1953 *L. apiopleura*

Loeblich & Tappan: p. 59, pl. 10, figs. 10, 15. – 1964 a Feyling-Hanssen: p. 284, pl. 11, fig. 3. – 1965 Leslie: p. 162, pl. 5, fig. 6. – 1967 Michelsen: p. 218, pl. 1, fig. 6. – 1967 *Oolina apiopleura* (Loeblich & Tappan); Todd & Low: p. 28, pl. 3, fig. 24.

Dimensions: Specimen from the Lateglacial *Yoldia* Clay at Løkken (pl. 6, fig. 1) has l = 0.28 mm, t = 0.20 mm, and one from Hirtshals (pl. 17, fig. 1) has l = 0.26 mm, t = 0.20 mm.

Occurrence: A few specimens of this species occur in the borings in Sandnes and in the district of Jæren. It was also found in a sample from Nygaard brickworks, Karmøy. *O. acuticosta* occurs in the Older *Yoldia* Clay, the Lateglacial *Yoldia* Clay and the Postglacial deposits of the Løkken area and in the Older *Yoldia* Clay at Hirtshals.

Remarks: *Lagena acuticosta* was originally described from Maastrichtian deposits in the Netherlands (Reuss, 1862). Loeblich & Tappan (1953) described *Lagena apiopleura* from off Alaska, and pointed out that *L. acuticosta* has a flattened base and subglobular form, whereas *L. apiopleura* has a pyriform appearance. However, the original descriptions and figures show that both species are more or less pyriform in outline. The surface of both species are ornamented with a few (8–12) longitudinal ribs, and they both have a short apertural neck. Because of these similarities all these forms are referred to *L. acuticosta* by the present authors. The presence of a short internal tube shows that the species must be classed as *Oolina*, which was also pointed out by Todd & Low (1967).

Oolina borealis Loeblich & Tappan
Pl. 6, fig. 2; pl. 17, figs. 2–4

Synonyms: 1858 *Entosolenia costata* Williamson (not *Oolina costata* Egger, 1857): p. 9, pl. 1, fig. 18. – 1953 *Oolina costata* (Williamson); Loeblich & Tappan: p. 68, pl. 13, figs. 4–6. – 1954 *O. borealis* Loeblich & Tappan: no. 12. – 1964 b Feyling-Hanssen: p. 50, pl. 2, figs. 5, 6. – 1965 Leslie: p. 165, pl. 6, fig. 4. – 1967 Todd & Low: p. 28, pl. 3, fig. 34.

Dimensions: The figured specimen from Nygaard brickworks has l = 0.64 mm, t = 0.45 mm.

Occurrence: A few specimens of this species occur in the Sandnes Clay and in the submorainic clay of Nygaard brickworks, Karmøy. Two specimens were found in the Older *Yoldia* Clay at Hirtshals.

Oolina caudigera (Wiesner)
Pl. 6, fig. 3

Synonyms: 1931 *Lagena (Entosolenia) globosa* (Montagu), var. *caudigera* Wiesner: p. 119, pl. 18, fig. 214. – 1953 *Oolina caudigera* (Wiesner); Loeblich & Tappan: p. 67, pl. 13, figs. 1–3. – 1964 a Feyling-Hanssen: p. 310, pl. 15, fig. 3. – 1964 b Feyling-Hanssen: p. 50, pl. 2, figs. 8–10. – 1965 Leslie: p. 165, pl. 6, fig. 3.

Dimensions: Specimen from the Lateglacial at Løkken (pl. 6, fig. 3) has l = 0.45 mm, t = 0.36 mm.

Occurrence: *O. caudigera* is found in nearly all the late Quaternary deposits of Vendsyssel, but it is rare.

Oolina desmophora (Jones)
Pl. 6, fig. 4; pl. 17, fig. 5

Synonyms: 1872 *Lagena vulgaris* Williamson, var. *desmophora* Jones: p. 54, pl. 19, figs. 23, 24. – 1933 *L. desmophora* Jones; Cushman: p. 29, pl. 7, figs. 11–14. – 1940 Buchner: p. 444, pl. 7, figs 98, 99. – 1960 *Oolina desmophora* (Jones); Barker: pl. 58, figs. 42, 43.

Dimensions: One specimen was found in the Postglacial deposits at Løkken, Vendsyssel: l = 0.21 mm, t = 0.13 mm.

Oolina globosa (Montagu)

Synonyms: 1803 *Vermiculum globosum* Montagu: p. 523. – 1895 *Lagena globosa* Montagu; Madsen: p. 189. – 1923 *L. globosa* (Montagu); Cushman: p. 20, pl. 4, figs. 1, 2. – 1960 *Oolina globosa* (Montagu); Barker: pl. 56, figs. 1–3.

Dimensions: Specimen from Skeen Møllebæk has l = 0.18 mm, t = 0.13 mm.

Occurrence: A few specimens occurred in the Lateglacial *Zirfaea* layers at Skeen Møllebæk and Blødegrøft in Vendsyssel.

Oolina hexagona (Williamson)
Pl. 17, fig. 6

Synonyms: 1848 *Entosolenia squamosa* (Montagu), var. *hexagona* Williamson: p. 20, pl. 2, fig. 23. – 1943 *Lagena hexagona* (Williamson); Hessland: p. 262, pl. 3, fig. 34. – 1953 *Oolina hexagona* (Williamson); Loeblich & Tappan: p. 69, pl. 14, figs. 1, 2. – 1964 a Feyling-Hanssen: p. 311, pl. 15, fig. 4. – 1965 Leslie: p. 165, pl. 6, fig. 5.

Dimensions: Specimen from Lateglacial deposits at Løkken (pl. 17, fig. 6) has l = 0.20 mm, t = 0.19 mm.

Occurrence: This species is very rare in the Sandnes Clay and in clay from Nygaard brickworks, Karmøy. A few specimens occurred in late Quaternary deposits of Vendsyssel.

Oolina isabella d'Orbigny

Synonyms: 1839 b *Oolina isabella* d'Orbigny: p. 20, pl. 5, figs. 7, 8.

Dimensions: Two specimens of this species occurred in boring no. I (depth 3.3 m), Sandnes. One of them has l = 0.25 mm, b = 0.18 mm. It carries 9 well defined, rounded ribs, two of which do not extend to the full length of the test, the others start at the base and extend up to the aperture; the test tapers pronouncedly towards the aperture.

Remarks: d'Orbigny recorded this species from off the Falkland Island. It resembles *Oolina costata* Williamson and *O. borealis* Loeblich & Tappan, but is only about one-third the size. It also differs from them in shape and extension of ribs.

Oolina lineata (Williamson)
Pl. 17, figs. 7, 8

Synonyms: 1848 *Entosolenia lineata* Williamson: p. 18, pl. 2, fig. 18. – 1940 *Lagena lineata* (Williamson); Buchner: p. 442, pl. 6, figs. 92–94. – 1953 *Oolina lineata* (Williamson); Loeblich & Tappan: p. 70, pl. 13, figs. 11–13. – 1962 Haake: p. 36, pl. 2, fig. 6.

Dimensions: Specimen from Hirtshals (pl. 17, figs. 7, 8) has l = 0.30 mm, t = 0.25 mm.

Occurrence: This species occurs in clay from the old brickworks of Sandnes and in a sample from Nygaard brickworks, Karmøy. A few specimens are found in the Older *Yoldia* Clay of Vendsyssel.

Remarks: *O. lineata* was originally described from Recent faunas off the British Isles, but has since been recorded from Arctic America and Greenland (Loeblich & Tappan, 1953; Leslie, 1965).

Oolina melo d'Orbigny
Pl. 6, fig. 5; pl. 17, fig. 9

Synonyms: 1839 b *Oolina melo* d'Orbigny: p. 20, pl. 5, fig. 9. – 1858 *Entosolenia squamosa,* var. *catenulata* Williamson: p. 13, pl. 1, fig. 31. – 1895 *Lagena squamosa* Montagu; Madsen (not *Vermiculum squamosa* Montagu, 1803): p. 194. – 1940 *L. melo* (d'Orbigny); Buchner: p. 437, pl. 6, fig. 84. – 1941 *L. squamosa* (Montagu), var. *apiglabra* Ten Dam & Reinhold: p. 48, pl. 2, fig. 11; pl. 6, fig. 5. – 1953 *Oolina melo* d'Orbigny; Loeblich & Tappan: p. 71, pl. 12, figs. 8–15. – 1963 Lafrenz: p. 20. – 1964 a Feyling-Hanssen: p. 312, pl. 15, figs. 6, 7. – 1965 Leslie: p. 166, pl. 6, fig. 2. – 1965 Nagy: p. 121. – 1967 Michelsen: p. 221, pl. 1, fig. 4.

Dimensions: The figured specimen from the Lateglacial at Løkken: l = 0.28 mm, t = 0.20 mm.

Occurrence: One specimen of *O. melo* was found in a clay sample from Rise, Jæren. A few specimens are found in all the late Quaternary deposits of Vendsyssel.

Remarks: The specimen figured by d'Orbigny (1839 b) has about 20 longitudinal cancellations. In Loeblich & Tappan's arctic material there are specimens with a number of rows varying from 8 to 19. This gradation justifies the reference of the present specimens with 10–20 rows to *O. melo.*

O. melo is widely distributed today, from the Arctic to the Mediterranean. It has been recorded both from the Holocene and the Pleistocene. *Lagena squamosa* (Montagu), var. *apiglabra* Ten Dam & Reinhold (1941) from Poederlian, Scaldisian and Amstelian of the Netherlands should be referred to *O. melo.*

Oolina squamosa (Montagu)
Pl. 17, fig. 10

Synonyms: 1803 *Vermiculum squamosum* Montagu: p. 526, pl. 14, fig. 2. – 1960 *Oolina squamosa* (Montagu); van Voorthuysen: p. 247, pl. 10, fig. 17.

Dimensions: Specimen from the Lateglacial of Løkken (pl. 17, fig. 10) has l = 0.18 mm, t = 0.15 mm.

Occurrence: Two specimens of *O. squamosa* were found in the late Quaternary of the Løkken area in Vendsyssel, one in the Lateglacial *Yoldia* Clay and one in the Older *Yoldia* Clay.

Oolina striatopunctata (Parker & Jones)
Pl. 17, fig. 11

Synonyms: 1865 *Lagena sulcata* (Walker & Jacob), var. *striatopunctata* Parker & Jones: p. 350, pl. 13, figs. 25–27. – 1948 *L. striato-punctata* Parker & Jones; Cushman: p. 47, pl. 5, fig. 10. – 1953 *Oolina striatopunctata* Parker & Jones; Loeblich & Tappan: p. 74, pl. 12, figs. 2–5.

Dimensions: Specimen from Hirtshals (pl. 17, fig 11) has l = 0.20 mm, t = 0.15 mm.

Occurrence: A few specimens occur in the Older *Yoldia* Clay at Hirtshals, Vendsyssel.

Oolina williamsoni (Alcock)
Pl. 18, figs. 1, 2

Synonyms: 1865 *Entosolenia williamsoni* Alcock: p. 193. – 1923 *Lagena williamsoni* (Alcock); Cushman: p. 61, pl. 11, figs. 8, 9. – 1960 *Oolina williamsoni* (Alcock); van Voorthuysen: p. 247, pl. 10, fig. 18. – 1964 a Feyling-Hanssen: p. 312, pl. 15, fig. 8. – 1967 Todd & Low: p. 29, pl. 3, fig. 29.

Dimensions: Specimen from Karmøy (pl. 18, figs. 1, 2) has l = 0.50 mm, t = 0.36 mm.

Occurrence: One specimen of *O. williamsoni* was found in zone 1 of the borings in Sandnes, one in clay from Nygaard brickworks, and a few in the Older *Yoldia* Clay of Vendsyssel.

Remarks: This species has been recorded from Eemian deposits of the Netherlands (van Voorthuysen, 1957). Feyling-Hanssen found it in the

Lateglacial (Younger *Dryas*) and in the Postglacial warm interval deposits of the Oslofjord area. It was originally described from off Ireland (Alcock, 1865), and van Voorthuysen (1951 and 1960) and Haake (1962) recorded it from off the Netherlands and from the German North Sea coast. Todd & Low (1967) found *O. williamsoni* in the Gulf of Alaska.

Fissurina Reuss, 1850

Fissurina annectens (Buchner)

Synonyms: 1940 *Lagena annectens* Buchner: p. 482, pl. 15, figs. 279–293.

Dimensions: A single specimen occurred in the Older *Yoldia* Clay at Hirtshals: l = 0.23 mm, b = 0.18 mm, t = 0.11 mm.

Fissurina crustosa, forma *devia* (Buchner)

Synonyms: 1940 *Lagena crustosa,* var. *devia* Buchner: p. 518, pl. 22, figs. 469–472.

Dimensions: A single specimen was found in the Older *Yoldia* Clay at Hirtshals in Vendsyssel: l = 0.16 mm, b = 0.15 mm, t = 0.11 mm.

Fissurina danica (Madsen)
Pl. 6, figs. 6, 7; pl. 18, fig. 3

Synonyms: 1895 *Lagena danica* Madsen: p. 196, pl. 1, fig. 4. – 1899 *L. castanea* Flint: p. 307, pl. 54, fig. 3. – 1923 Cushman: p. 9, pl. 1, figs. 12, 13. – 1940 Buchner: p. 496, pl. 18, figs. 369–373. – 1950 a *Fissurina castanea* (Flint); van Voorthuysen: p. 36, pl. 1, fig. 7, text-fig. 2. – 1964 a Feyling-Hanssen: p. 313, pl. 15, figs. 9–14.

Dimensions: Specimen from the Older *Yoldia* Clay at Frederikshavn (pl. 6, fig. 6) has l = 0.23 mm, b = 0.18 mm, t = 0.15 mm. Specimen from the Lateglacial at Løkken (pl. 6, fig. 7) has l = 0.20 mm, b = 0.18 mm, t = 0.14 mm, and one from Sandnes (pl. 18, fig. 3) has l = 0.23 mm, b = 0.18 mm, t = 0.14 mm.

Occurrence: A few specimens occur in zone 1 of the Sandnes Clay, and it is found in all the late Quaternary deposits of Vendsyssel, but never accounting for more than 1 % of the total fauna.

Remarks: Madsen (1895) described this species from the Quaternary of Denmark. He recorded it from Older *Yoldia* Clay, Lateglacial *Yoldia* Clay and *Zirfaea* layers. It is known from the Postglacial of the Oslofjord area (Feyling-Hanssen, 1964 a).

Fissurina fasciata (Egger)

Synonyms: 1857 *Oolina fasciata* Egger: p. 270, pl. 5, figs. 12–15. – 1940 *Lagena fasciata* (Egger); Buchner: p. 479, pl. 14, figs. 262–265. – 1964 a *Fissurina* cf. *fasciata* (Egger); Feyling-Hanssen: p. 313, pl. 15, figs. 15, 16.

Dimensions: Specimen from Rise, Jæren has l = 0.20 mm, b = 0.15 mm, t = 0.10 mm, and one from Hirtshals has l = 0.22 mm, b = 0.19 mm, t = 0.14 mm.

Occurrence: One specimen of *F. fasciata* was found in a sample from Rise, Jæren, and a few specimens were found in the Older *Yoldia* Clay of Vendsyssel.

Fissurina laevigata Reuss

Synonyms: 1850 *Fissurina laevigata* Reuss: p. 366, pl. 46, fig. 1. – 1895 *Lagena laevigata* Reuss; Madsen: p. 195, fig. 3. – 1964 a *Fissurina laevigata* Reuss; Feyling-Hanssen: p. 314, pl. 15, figs. 17, 18. – 1967 Michelsen: p. 220, pl. 1, fig. 13.

Dimensions: Specimen from the Older *Yoldia* Clay at Frederikshavn has l = 0.23 mm, b = 0.18 mm, t = 0.15 mm.

Occurrence: Two specimens of *F. laevigata* were found in a sample from Elgane, Jæren. This species was found in all the late Quaternary deposits of Vendsyssel, but it is never frequent.

Remarks: *F. laevigata* was originally described from the Tertiary of the Vienna basin. It occurs in Holocene deposits of the Oslofjord area (Feyling-Hanssen, 1964 a) and in Postglacial as well as Lateglacial deposits of Læsø in Denmark (Michelsen, 1967).

Fissurina lucida (Williamson)

Synonyms: 1848 *Entosolenia marginata* (Montagu), var. *lucida* Williamson: p. 17, pl. 2, fig. 17. – 1953 *Fissurina lucida* (Williamson); Loeblich & Tappan: p. 76, pl. 14, fig. 4. – 1964 a: Feyling-Hanssen: p. 315, pl. 15, fig. 21.

Dimensions: Specimen from the Older *Yoldia* Clay at Hirtshals has l = 0.25 mm, b = 0.16 mm, t = 0.14 mm.

Occurrence: A few specimens of *F. lucida* occur in the Older *Yoldia* Clay and in the Lateglacial *Yoldia* Clay of Vendsyssel.

Fissurina marginata (Montagu)

Synonyms: 1803 *Vermiculum marginatum* Montagu: p. 524. – 1895 *Lagena marginata* Walker & Boys; Madsen: p. 195. – 1948 *Entosolenia marginata* (Montagu)?; Cushman: p. 65, pl. 7, fig. 7. – 1953 *Fissurina marginata* (Montagu); Loeblich & Tappan: p. 77, pl. 14, figs. 6–9. – 1964 a *F. marginata* (Walker & Boys); Feyling-Hanssen: p. 315, pl. 15, fig. 22. – 1964 b Feyling-Hanssen: p. 49, pl. 2, fig. 11. – 1965 *F. marginata* (Montagu); Leslie: p. 161, pl. 6, fig. 10. – 1965 Nagy: p. 121, pl. 1, fig. 33.

Dimensions: Specimen from Hirtshals has l = 0.35 mm, b = 0.30 mm, t = 0.20 mm.

Occurrence: A few specimens of this species occurred in the Sandnes Clay. In Vendsyssel rare specimens were found both in the Older *Yoldia* Clay and in the Lateglacial *Yoldia* Clay.

Remarks: *F. marginata* is recorded from Arctic waters, and as a fossil from the late Quaternary of the Oslofjord area.

Fissurina orbignyana Seguenza
Pl. 6, fig. 8

Synonyms: 1862 *Fissurina orbignyana* Seguenza: p. 66, pl. 2, figs. 25, 26. – 1950 a van Voorthuysen: p. 36, pl. 1, fig. 4. – 1966 Gudina: p. 28, pl. 2, fig. 9. – 1969 Gudina: p. 21, pl. 7, fig. 9.

Dimensions: Specimen from Hirtshals (pl. 6, fig. 8) has l = 0.25 mm, b = 0.20 mm, t = 0.17 mm.

Occurrence: One specimen was found in a sample from Rise, Jæren, and two specimens occurred in the Older *Yoldia* Clay from Hirtshals.

Fissurina serrata (Schlumberger)
Pl. 6, fig. 9; pl. 18, figs. 4, 5

Synonyms: 1894 *Lagena serrata* Schlumberger: p. 258, pl. 3, fig. 7 – 1948 *Entosolenia serrata* (Schlumberger); Cushman: p. 63, pl. 7, fig. 3. – 1953 *Fissurina serrata* (Schlumberger); Loeblich & Tappan: p. 78, pl. 14, fig. 5. – 1965 Leslie: p. 161, pl. 6, fig. 11.

Dimensions: Specimen from the Older *Yoldia* Clay at Frederikshavn (pl. 6, fig. 9) has l = 0.33 mm, b = 0.18 mm, t = 0.10 mm, and one from zone D of the Older *Yoldia* Clay at Hirtshals (pl. 18, figs. 4, 5) has l = 0.31 mm, b = 0.16 mm, t = 0.09 mm. These are the only specimens found in the present material.

Fissurina sidebottomii (Buchner)

Synonyms: 1906 *Lagena fasciata* Egger, var. *carinata* Sidebottom: p. 7, pl. 1, fig. 17. – 1913 Sidebottom: p. 184, pl. 16, figs. 14–16. – 1940 *L. sidebottomii* Buchner: p. 484, pl. 16, figs. 297–299.

Dimensions: Specimen from Sandnes has l = 0.19 mm, b = 0.16 mm, t = 0.11 mm.

Occurrence: A few specimens of this species occasionally occurred in zone 1 of the Sandnes Clay.

Remarks: *F. sidebottomii* resembles *Fissurina annectens* (Burrows & Holland, 1895, p. 203, pl. 7, fig. 11) from the Coralline Crag near Ipswich; it differs, however, from that species, i.a. by its prominent marginal keel. The smaller forms of *F. sidebottomii* are relatively narrower than the larger ones, but the marginal keel is always distinct and the opaque bands parallel to the margin on both sides are narrow. *F. sidebottomii* was originally described from the Mediterranean.

Fissurina ventricosa (Wiesner)

Synonyms: 1931 *Lagena (Entosolenia) marginata*, var. *ventricosa* Wiesner: p. 120, pl. 19, fig. 222. – 1953 *Fissurina ventricosa* (Wiesner); Loeblich & Tappan: p. 79, pl. 14, fig. 15.

Dimensions: Specimen from the Older *Yoldia* Clay at Løkken has l = 0.25 mm, b = 0.19 mm, t = 0.16 mm.

Occurrence: A few specimens were found in the Older *Yoldia* Clay of Vendsyssel.

Parafissurina Parr, 1947

Parafissurina fusuliformis Loeblich & Tappan
Pl. 18, fig. 6

Synonyms: 1953 *Parafissurina fusuliformis* Loeblich & Tappan: p. 79, pl. 14, figs. 18, 19. – 1965 Leslie: p. 166, pl. 6, fig. 14. – 1967 Michelsen: p. 221, pl. 1, fig. 15.

Dimensions: Specimen from Hirtshals (pl. 18, fig. 6) has l = 0.26 mm, b = 0.11 mm, t = 0.11 mm.

Occurrence: A few specimens occur in zones C, D and F of the Older *Yoldia* Clay at Hirtshals.

Remarks: This species is recorded from the late Quaternary of Læsø in Denmark (Michelsen, 1967). It was described (Loeblich & Tappan, 1953) from off Canada at water depths of 24 m, 100 m and 146 m.

Parafissurina himatiostoma Loeblich & Tappan
Pl. 6, figs. 10, 11

Synonyms: 1953 *Parafissurina himatiostoma* Loeblich & Tappan: p. 80, pl. 14, figs. 12–14. – 1965 Leslie: p. 167, pl. 6, fig. 13.

Dimensions: Specimen from *Zirfaea* layers at Skeen Møllebæk (pl. 6, figs. 10, 11) has l = 0.28 mm, b = 0.18 mm, t = 0.15 mm.

Occurrence: A few specimens of this species are found in the Lateglacial *Zirfaea* layers and in the Older *Yoldia* Clay of Vendsyssel.

Remarks: Loeblich & Tappan (1953) described *P. himatiostoma* from off Alaska and Canada at depths exceeding 24 m. Leslie (1965) recorded it from depths between 26 and 130 m in Hudson Bay.

Parafissurina lateralis (Cushman), forma *carinata* (Buchner)
Pl. 6, figs. 12, 13

Synonyms: 1940 *Lagena lateralis* Cushman, forma *carinata* Buchner: p. 521, pl. 23, figs. 497–500. – 1964 a *Parafissurina lateralis* (Cushman), forma *carinata* (Buchner); Feyling-Hanssen: p. 316, pl. 15, figs. 25, 26.

Dimensions: Specimen from the Lateglacial at Løkken (pl. 6, figs. 12, 13) has l = 0.26 mm, b = 0.24 mm, t = 0.14 mm.

Occurrence: A few specimens of this species occur in the Lateglacial *Yoldia* Clay and in the Older *Yoldia* Clay of Vendsyssel.

Parafissurina lateralis (Cushman), forma *simplex* (Buchner)

Synonyms: 1940 *Lagena lateralis* Cushman, forma *simplex* Buchner: p. 520, pl. 23, figs. 487–492. – 1964 a *Parafissurina lateralis* (Cushman), forma *simplex* (Buchner); Feyling-Hanssen: p. 316, pl. 15, figs. 23, 24.

Dimensions: Specimen from the Postglacial deposits at Løkken has l = 0.27 mm, b = 0.14 mm, t = 0.11 m.

Occurrence: A few specimens of this species were found in zone 1 of the Sandnes Clay and in the Postglacial deposits of the Løkken area.

Parafissurina tectulostoma Loeblich & Tappan
Pl. 6, fig. 14

Synonyms: 1953 *Parafissurina tectulostoma* Loeblich & Tappan: p. 81, pl. 14, fig. 17. – 1965 Leslie: p. 167, pl. 6, fig. 12. – 1969 Gudina: p. 22, pl. 7, fig. 10.

Dimensions: Specimen from Lateglacial deposits at Løkken (pl. 6, fig. 14) has l = 0.28 mm, b = 0.16 mm, t = 0.15 mm.

Occurrence: This species occurred in zone 1 of boring no. I at Sandnes, and one specimen was also found in a sample of corresponding strata in Graveren clay pit. One specimen was found in the Lateglacial *Yoldia* Clay and a few occur in the Older *Yoldia* Clay of Vendsyssel.

Remarks: Loeblich & Tappan (1953) found this species in Frobisher Bay, Baffin Island, at a depth of 100.5 m. Gudina (1969) recorded it from the Quaternary of Siberia.

Buliminidea Jones, 1875

Buliminidae Jones, 1875

Buliminella Cushman, 1911

Buliminella elegantissima (d'Orbigny)
Pl. 6, fig. 15

Synonyms: 1839 b *Bulimina elegantissima* d'Orbigny: p. 51, pl. 7, figs. 13, 14. – 1947 *Buliminella elegantissima* (d'Orbigny); Höglund: p. 215, pl. 18, fig. 1; text-figs. 196, 197. – 1962 Haake: p. 34, pl. 2, figs. 1, 2. – 1964 a Feyling-Hanssen: p. 302, pl. 14, fig. 1. – 1967 Michelsen: p. 221, pl. 1, fig. 16.

Dimensions: Specimen from the Postglacial at Løkken (pl. 6, fig. 15) has l = 0.30 mm, b = 0.15 mm.

Occurrence. This species occurs in most of the late Quaternary deposits of Vendsyssel, but always accounts for less than 1 % of the total fauna.

Remarks: *B. elegantissima* has been recorded from Holsteinian deposits (Buch, 1955; Woszidlo, 1962). Lafrenz (1963) found it in Eemian deposits of Schleswig-Holstein, and it was also recorded from the Postglacial of the Oslofjord area (Feyling-Hanssen, 1964 a) and from late Quaternary deposits of Læsø (Michelsen, 1967). In the Gullmarfjord on the Swedish west coast the species is recorded at depths between 8 and 80 m (Höglund, 1947). In the Skagerrak, however, it also inhabits greater depths. Haake (1962) recorded *B. elegantissima* from off NW Germany and Risdal (1964) found it in the Oslofjord at depths between 10 and 100 m. It is also recorded from the Arctic (Leslie, 1965; Todd & Low, 1967).

Bulimina d'Orbigny, 1826

Bulimina fossa Cushman & Parker
Pl. 6, fig. 16; pl. 18, fig. 7

Synonyms: 1938 *Bulimina fossa* Cushman & Parker: p. 56, pl. 9, fig. 10. – 1960 *Bulimina* sp. nov. Barker: p. 104, pl. 51, figs. 18, 19. – 1963 *Bulimina* sp. 1 Lafrenz: p. 19, pl. 1, figs. 11, 12.

Dimensions: The figured specimen from the Lateglacial at Løkken has l = 0.20 mm, b = 0.12 mm.

Occurrence: One specimen of this species occurred in zone 4 of boring no. IV in Sandnes, and it was also observed in the clay pit of Kvellur south of Sandnes. *B. fossa* has been found in all the late Quaternary deposits of Vendsyssel, but it is never frequent.

Bulimina marginata d'Orbigny
Pl. 6, figs. 17–20

Synonyms: 1826 *Bulimina marginata* d'Orbigny: p. 269, pl. 12, figs. 10–12. – 1826 *B. aculeata* d'Orbigny: p. 269. – 1902 *B. gibba* Fornasini: p. 378, pl. 0, figs. 32, 34. – 1947 *B. marginata* d'Orbigny; Höglund: p. 227, pl. 20, figs. 1, 2; pl. 22, fig. 1; text-figs. 205–218. – 1960 *B. gibba* Fornasini; Barker: p. 102, pl. 50, figs. 1–4. – 1960 *B. marginata* d'Orbigny; Barker: p. 104, pl. 51, figs. 3–5. – 1960 *B. aculeata* d'Orbigny; Barker: p. 104, pl. 51, figs. 7–9. – 1964 a *B. marginata* d'Orbigny; Feyling-Hanssen: p. 303, pl. 14, figs. 2–5. – 1967 Michelsen: p. 225, pl. 2, figs. 7, 8.

Dimensions: Specimen from Sandnes (pl. 6, fig. 17) has l = 0.38 mm, b = 0.27 mm, and one from the Older *Yoldia* Clay at Frederikshavn (pl. 6, fig. 18) has l = 0.45 mm, b = 0.25 mm. Specimen from the Lateglacial at Løkken (pl. 6, fig. 19) has l = 0.38 mm, b = 0.21 mm, and one from Sandnes (pl. 6, fig. 20) has l = 0.60 mm, b = 0.28 mm.

Occurrence: Some specimens of this species occur in zone 1 of the Sandnes Clay and in the submorainic clay of Jæren. A single specimen occurred in zone 4 of boring no. I. This species has been found in the Older *Yoldia* Clay and the Lateglacial deposits of Vendsyssel, where it is most frequent in zone F of he Older *Yoldia* Clay at Hirtshals, with a percentage of up to 10 of the total fauna. The species is quite common in zones D and E, whereas it usually accounts for less than 1 % in zones A, B and C. It is rare in the Postglacial of Vendsyssel.

Remarks: This species shows great variation from small, very spiny specimens to large and subangular forms without spines (*B. gibba* Fornasini). They are all referred to the species *B. marginata.*

B. marginata has been recorded from the Holsteinian (Buch, 1955; Woszidlo, 1962) and from the Eemian (Lafrenz, 1963). Madsen (1895) found the species in Older *Yoldia* Clay and Lateglacial *Zirfaea* layers in Vendsyssel, and it was recorded from the late Quaternary deposits of Læsø, Denmark (Michelsen, 1967), SW Sweden (Brotzen, 1951) and the Oslofjord area (Feyling-Hanssen, 1964 a).

According to Nørvang (1945) this species prefers temperate waters. It is frequent in the Gullmarfjord at depths exceeding 20 m, most numerous at 40–50 m. In the Skagerrak it occurs at greater depths. *B. marginata* is found in the Oslofjord at depths between 15 and 310 m (Risdal, 1964). It is not present in the Baltic, probably because of the low salinity there (Lutze, 1965). *B. marginata* is frequent in the *Turritella terebra* Zone of the Skærumhede boring in Vendsyssel, and also occurs in the lower part of the *Portlandia arctica* Zone.

Bulimina striata d'Orbigny
Pl. 6, fig. 21

Synonyms: 1826 *Bulimina striata* d'Orbigny: p. 269. – 1843 Guérin-Méneville: p. 9, pl. 2, figs. 16, 16 a. – 1966 a Nørvang: p. 285, 286, pl. 24.

Dimensions: Specimen from the Lateglacial at Løkken (pl. 6, fig. 21) has l = 0.26 mm, b = 0.19 mm. This is the only specimen present in the material.

Globobulimina Cushman, 1927

Globobulimina auriculata arctica Höglund
Pl. 6, fig. 22

Synonyms: 1947 *Globobulimina auriculata* (Bailey), forma *arctica* Höglund: p. 254, text-figs. 266, 267, 270, 271. – 1953 Loeblich & Tappan: p. 110, pl. 20, figs. 8, 9. – 1964 a *G. auriculata arctica* Höglund; Feyling-Hanssen: p. 305, pl. 14, fig. 6. – 1965 Leslie: p. 161, pl. 9, fig. 6.

Dimensions: Specimen from Hirtshals (pl. 6, fig. 22) has l = 0.75 mm, max. b = 0.62 mm.

Occurrence: A few specimens occur in the Older *Yoldia* Clay and in the Lateglacial *Yoldia* Clay of the Løkken area, Vendsyssel. In the Older *Yoldia* Clay at Hirtshals it is most common in zones A, C and D, but always accounts for less than 1 % of the total fauna.

Remarks: Feyling-Hanssen (1964 a) recorded a few specimens of *G. auriculata arctica* in the late Quaternary of the Oslofjord area. It occurs in Recent faunas from off Spitsbergen, Greenland, Arctic Canada and Alaska. Loeblich & Tappan (1953) found it at water depths of 37 m, 48 m, 148 m and 223 m off Alaska, and Leslie (1965) found it in Hudson Bay at depths between 100 and 230 m. It was recorded from a depths of 37 m at Spitsbergen (Nagy, 1965).

Globobulimina turgida (Bailey)
Pl. 6, fig. 23

Synonyms: 1851 *Bulimina turgida* Bailey: p. 12, figs. 28–31. – 1947 *Globobulimina turgida* (Bailey); Höglund: p. 248, pl. 20, fig. 5; pl. 21, figs. 4, 8; pl. 22, fig. 5; text-figs. 247–257, 271. – 1964 a Feyling-Hanssen: p. 306.

Dimensions: Specimen from Hirtshals (pl. 6, fig. 23) has l = 0.66 mm, max. b = 0.56 mm (last chamber broken).

Occurrence: Two specimens were found, one in zone A and one in zone D of the Older *Yoldia* Clay at Hirtshals.

Remarks: Except for a single specimen in Lateglacial sediments, this species only occurs in the Postglacial deposits in the Oslofjord area (Feyling-Hanssen, 1964 a). It has not been found in Recent arctic faunas. *G. turgida* is very common in the *Turritella terebra* Zone of the Skærumhede boring in Vendsyssel.

Virgulina d'Orbigny, 1826

Virgulina fusiformis (Williamson)

Synonyms: 1858 *Bulimina pupoides,* var. *fusiformis* Williamson: p. 63, pl. 5, figs. 129, 130. – 1947 *"Bulimina" fusiformis* Williamson; Höglund: p. 232, pl. 20, fig. 3; text-figs. 219–233. – 1964 a *Virgulina fusiformis* (Williamson); Feyling-Hanssen: p. 307, pl. 14, figs. 15–18. – 1967 *Stainforthia fusiformis* (Williamson); Michelsen: p. 226, pl. 2, fig. 11.

Dimensions: Specimen from the Lateglacial at Løkken has l = 0.34 mm, max. b = 0.18 mm.

Occurrence: This species was found in a sample from Lerbrekk, Jæren. It occurs sparsely in the Older *Yoldia* Clay, the Lateglacial *Yoldia* Clay and the Postglacial deposits of Vendsyssel.

Remarks: *V. fusiformis* is found in late Quaternary deposits of the Oslofjord area, where it is particularly frequent in the Postglacial (Feyling-Hanssen, 1964 a). Michelsen (1967) recorded the species from the late Quaternary of Læsø in Denmark. Höglund (1947) found that *V. fusiformis* is common at depths exceeding 20 m in the Gullmarfjord. In the Oslofjord it occurs at depths exceeding 15 m (Risdal, 1964).

Virgulina loeblichi Feyling-Hanssen
Pl. 7, figs. 1–5

Synonyms: 1952 a *Virgulina complanata* Egger; Parker (not *V. schreibersiana,* var. *complanata* Egger, 1893): p. 417, pl. 6, fig. 2 (not fig. 1). – 1953 *Bulimina exilis* Brady; Loeblich & Tappan (not *B. elegans,* var. *exilis* Brady, 1884): p. 110, pl. 20, figs. 4, 5. – 1954 b *Virgulina loeblichi* Feyling-Hanssen: p. 191, pl. 1, figs. 14–18; text-fig. 3. – 1961 *V. concava* Höglund; Saidova (not *V. concava* Höglund, 1947): p. 82, pl. 24, fig. 171. – 1964 a *V. loeblichi* Feyling-Hanssen; Feyling-Hanssen: p. 308, pl. 14, figs. 12–14. – 1965 Basov & Slobodin: p. 197, 204, 206. – 1965 *Cassidella complanata* (Egger); Leslie (not *Virgulina schreibersiana,* var. *complanata* Egger, 1893): p. 79–86, 157; text-fig. 25; pl. 8, fig. 11. – 1966 *Stainforthia concava* (Höglund); Gudina (not *Virgulina concava* Höglund, 1947): p. 60, pl. 5, figs. 1, 2; pl. 12, fig. 1. – 1966 *Virgulina concava* Höglund; Choreva (not *V. concava* Höglund, 1947): p. 113, pl. 1, fig. 2. – 1967 *Stainforthia concava* (Höglund); Michelsen (part., not *V. concava* Höglund, 1947): p. 225, pl. 2, fig. 9 (not fig. 10). – 1969 *Stainforthia loeblichi* (Feyling-Hanssen); Gudina: p. 42, pl. 14, figs. 5, 6; pl. 16, fig. 5.

Dimensions: Specimen from the Older *Yoldia* Clay at Frederikshavn (pl. 7, fig. 1) has l = 0.33 mm, t = 0.13 mm, and one from the Lateglacial at Løkken (pl. 7, fig. 2) has l = 0.38 mm, t = 0.17 mm. Specimen from Sandnes (pl. 7, fig. 3) has l = 0.52 mm, t = 0.16 mm, one from Karmøy (pl. 7, fig. 4) l = 0.48 mm, t = 0.21 mm and one from Elgane, Jæren (pl. 7, fig. 5) l = 0.45 mm, t = 0.24 mm.

Occurrence: *V. loeblichi* occurs throughout zone 1 of the Sandnes Clay; it is not frequent but is one of the characteristic species of the zone. Two specimens were found in zone 4 of boring no. II, Sandnes and a few specimens at Elgane and Foss-Eigeland in Jæren. A single specimen was found in a sample from Nygaard brickworks, Karmøy. *V. loeblichi* occurs in the Older *Yoldia* Clay of Vendsyssel. It may amount to 5 % of the total fauna in samples from zones A and D at Hirtshals, but usually it accounts for less than 1 %. A few specimens occurred in the Lateglacial and Postglacial deposits of Vendsyssel.

Remarks: This species differs from *Virgulina concava* Höglund (1947, p. 257, pl. 23, figs. 3, 4; pl. 32, figs. 4–7; text-figs. 273–275) in being larger, more robust and in lacking a well-developed apical spine. It differs from *V. schreibersiana,* var. *complanata* Egger (1893, p. 292, pl. 8, figs. 91, 92) in being distinctly twisted and having inflated chambers, whereas *V. complanata* is strongly laterally compressed and almost flat. The wall structure of *V. complanata* is not known to us, but the shape of that species recalls Hofker's granular genus *Cassidella* (Loeblich & Tappan, 1964, pp. C 732, C 733).

V. loeblichi, having a radiate wall structure, should belong to Hofker's genus *Stainforthia* (Hofker, 1956, p. 908) which he erected for *Virgulina* forms with a radiate wall. However, Towe & Cifelli (1967, p. 755) found no support for "a major dichotomy in classification based on radial versus granular". They concluded that the mode of calcification of the granular wall was "basically similar to that of the radial wall, despite the dramatic difference seen in polarized light", and that "It would be relatively easy to derive one from the other and there is no reason to believe that such transformations could not occur among different lineages at different times". A particularly unsafe separation would appear if a difference in preferred orientation of optical c-axes is not accompanied by a difference in some morphological character.

V. loeblichi is an arctic species. Loeblich & Tappan (1953) recorded it from off Point Barrow, Baffin Island and Greenland at depths from 13 to 143 m. Saidova (1961) obtained it in the Okhotsk Sea and near the Aleutians, at depths from 84 to 2920 m, and Leslie (1965) found it in Hudson Bay from 106 to 230 m. Choreva (1966) recorded *V. loeblichi* from Quaternary deposits at Tchoukotsk, Gudina (1966) found it in the Quaternary of NW Siberia, in Q_{1-2} and Q_2 deposits, and Basov & Slobodin (1965) in Recent faunas of the Kara Sea and in early Pleistocene deposits around that sea. Michelsen (1967) found a few specimens in Oldest *Dryas* deposits at Læsø in Denmark, and Feyling-Hanssen (1964 a) recorded it in Lateglacial deposits of the Oslofjord area.

Uchio (1960, p. 63) regards *V. loeblichi* as well as *V. concava* as synonyms of *Vergulina complanata* Egger, thus making *V. loeblichi* a member of the living benthonic fauna off San Diego, California, at depths between 350 and 650 fathoms. This made Leslie, 1965, use the name *Cassidella complanata* for his true *V. lobelichi* in Hudson Bay. Uchio, however, (pl. 6, fig. 13) figures a slender, somewhat flattened specimen with high and only slightly inflated chambers which has little in common with the robust *V. loeblichi.*

Virgulina schreibersiana Czjzek
Pl. 7, figs. 6–8

Synonyms: 1848 *Virgulina schreibersiana* Czjzek: p. 147, pl. 13, figs. 18–21. – 1895 Madsen: p. 186. – 1964 a Feyling-Hanssen: p. 309, pl. 14, figs. 19–21. – 1967 *Stainforthia schreibersiana* (Czjzek); Michelsen: p. 226, pl. 2, fig. 12.

Dimensions: Specimens from Older *Yoldia* Clay at Stortorn (pl. 7, figs. 7, 8) has l = 0.40 mm, max. b = 0.13 mm, and one from the Lateglacial at Løkken (pl. 7, fig. 6) l = 0.38 mm, max. b = 0.14 mm.

Occurrence: *V. schreibersiana* occurs in the Older *Yoldia* Clay and in the Lateglacial deposits of Vendsyssel, usually accounting for less than 1 % of the total fauna. In a single sample from the Lateglacial at Dybvad brickworks it accounts for 5 %.

Remarks: Feyling-Hanssen (1964 a) found this species in the late Quaternary of the Oslofjord area. It is never frequent, but less rare in the Lateglacial than in the Postglacial zones. Michelsen (1967) found it in the late Quaternary of Læsø. A few specimens are found in the Oslofjord at depths between 30 and 100 m (Risdal, 1964), and it is found at Spitsbergen at depths of 5 m, 11 m and 37 m (Nagy, 1965).

Uvigerinidae Cushman, 1913

Uvigerina d'Orbigny, 1826

Uvigerina peregrina Cushman
Pl. 7, figs. 9–11

Synonyms: 1923 *Uvigerina peregrina* Cushman: p. 166, pl. 42, figs. 7–10. – 1947 Höglund: p. 279, pl. 23, fig. 9; text-figs. 291–304. – 1964 a Feyling-Hanssen: p. 316, pl. 15, figs. 27–29. – 1967 Michelsen: p. 228, pl. 2, fig. 15.

Dimensions: Small specimen (pl. 7, fig. 11) from the Postglacial at Løkken has l = 0.19 mm, b = 0.13 mm. Specimen from Hirtshals (pl. 7 fig. 10) has l = 0.88 mm, b = 0.38 mm.

Occurrence: This species occurs in zone 1 of the Sandnes Clay and in samples from Elgane and Reve, Jæren. It is found in the Older *Yoldia* Clay at Frederikshavn, Løkken and Hirtshals, but usually accounts for less than 1 % of the total fauna. At Hirtshals it is most common in zones A, D and F. A few specimens were found in the Lateglacial and in the Postglacial deposits of Vendsyssel.

Remarks: Some of the small specimens of *U. peregrina* from the late Quaternary of the Løkken area possess spinose projections at the lower margin of each chamber. These specimens have much in common with the subspecies *Uvigerina peregrina shiwoensis* Asano, 1958 (p. 35, pl. 6, figs. 5–8).

Madsen (1895) recorded *Uvigerina pygmaea* from the Lateglacial *Yoldia* Clay in Vendsyssel. Those specimens are probably referable to *U. peregrina.* Feyling-Hanssen (1964 a) recorded the species from Postglacial deposits of the Oslofjord area, and Michelsen (1967) found it in the late Quaternary of Læsø in Denmark. The main Recent distribution of *U. peregrina* is the lusitanian and boreal parts of the Atlantic and the Pacific at depths between 30 and 4,350 m (Nørvang, 1945). Höglund (1947) recorded it in the Gullmarfjord at depths from 28 to 72 m and in the Skagerrak down to water depths of 700 m. In the Oslofjord (Risdal, 1964) it is found at depths between 40 and 200 m.

U. peregrina is quite common in the *Turritella terebra* Zone of the Skærumhede boring in Vendsyssel. It occurs also in the lower part of the *Portlandia arctica* Zone and the upper part of the *Abra nitida* Zone.

Trifarina Cushman, 1923

Trifarina angulosa (Williamson)
Pl. 18, figs. 8, 9

Synonyms: 1858 *Uvigerina angulosa* Williamson: p. 67, pl. 5, fig. 140. – 1947 *Angulogerina angulosa* (Williamson); Höglund: p. 283, pl. 23, fig. 8; text-figs. 305–308. –

1964 a Feyling-Hanssen: p. 317, pl. 16, figs. 1–3. – 1967 *Trifarina angulosa* (Williamson); Michelsen: p. 227, pl. 2, fig. 13.

Dimensions: Specimens from Hirtshals (pl. 18, figs. 8, 9) has l = 0.44 mm, b = 0.24 mm.

Occurrence: A few specimens of this species were found in zone 1 of the Sandnes Clay. It occurs in the Older *Yoldia* Clay of Vendsyssel, but never accounts for more than 1 % of the total fauna. A few specimens were found in the Lateglacial *Zirfaea* layers and in the Postglacial deposits of Vendsyssel.

Remarks: This species was recorded from the Icenian (early Pleistocene) of the Netherlands (van Voorthuysen, 1950 a). Buch (1955) found it in Holsteinian deposits in Denmark, Lafrenz (1963) in Eemian deposits of Schleswig-Holstein, and Madsen (1895) in the Older *Yoldia* Clay of Vendsyssel. *T. angulosa* has been recorded from the late Quaternary of Læsø, Denmark (Michelsen, 1967) and from Postglacial deposits of the Oslofjord (Feyling-Hanssen, 1964 a). The Recent distribution of this species seems to be in boreal and lusitanian parts of the Atlantic and the Pacific at water depths down to 3,300 m (Nørvang, 1945). Höglund (1947) found it in the Skagerrak at depths between 83 and 700 m, and Risdal (1964) in the Oslofjord at depths from 40 to 200 m.

A few specimens of *T. angulosa* occur in the lower part of the *Portlandia arctica* Zone, and a broken specimen was found in the *Turritella terebra* Zone of the Skærumhede boring in Vendsyssel.

Trifarina fluens (Todd)
Pl. 7, figs. 12–15; pl. 18, fig. 10

Synonyms: 1947 *Angulogerina fluens* Todd, in Cushman & Todd: p. 67, pl. 16, figs. 6, 7. – 1953 Loeblich & Tappan: p. 112, pl. 20, figs. 10–12. – 1964 a Feyling-Hanssen: p. 318, pl. 16, figs. 4, 5. – 1967 *Trifarina fluens* (Todd); Michelsen: p. 227, pl. 2, fig. 14.

Dimensions: Specimen from Sandnes (pl. 7, figs. 13, 14) has l = 0.54 mm, b = 0.27 mm, and another one from Sandnes (pl. 7, fig. 12; pl. 18, fig. 10) l = 0.37 mm, b = 0.20 mm. Specimen from Older *Yoldia* Clay at Frederikshavn (pl. 7, fig. 15) l = 0.40 mm, b = 0.18 mm.

Occurrence: This species is found in zones 1 and 3 of the Sandnes Clay, and also in the samples from Jæren. It is not frequent. One specimen was found in a sample from Nygaard brickworks, Karmøy. The species occurs in many samples from the Lateglacial *Yoldia* Clay and the *Zirfaea* layers of Vendsyssel. It is a characteristic species of the Older *Yoldia* Clay, but usually accounts for less than 1 % of the total fauna. Only a few specimens were found in the Postglacial deposits.

Remarks: Todd (1957) recorded this species from Cainozoic deposits at Carter Creek in Alaska. It is found in the late Quaternary deposits of the Oslofjord area (Feyling-Hanssen, 1964 a) and of Læsø, Denmark (Michelsen, 1967). The species is found in Recent faunas off Alaska, Canada and Greenland (Cushman & Todd, 1947; Loeblich & Tappan, 1953; Leslie, 1965), and off Spitsbergen (Nagy, 1965) at a depth of 1.5–37 m.

Bolivinitidae Cushman, 1927

Bolivina d'Orbigny, 1829

Bolivina pseudoplicata Heron-Allen & Earland

Pl. 7, fig. 16; pl. 18, fig. 11

Synonyms: 1930 *Bolivina pseudoplicata* Heron-Allen & Earland: p. 81, pl. 3, figs. 36–40. – 1947 Höglund: p. 263, pl. 24, fig. 2; pl. 32, figs. 8–11; text-fig. 287. – 1964 a Feyling-Hanssen: p. 319. – 1967 Michelsen: p. 222, pl. 2, figs. 1, 2.

Dimensions: The figured specimen from Postglacial deposits at Løkken has l = 0.33 mm, b = 0.16 mm, t = 0.10 mm.

Occurrence: One specimen was found at Elgane, Jæren, and a few in zone 1 of the Sandnes Clay. A few specimens occur in the *Yoldia* Clay and in the Postglacial deposits of Vendsyssel.

Remarks: The main Recent distribution of this species is Atlantic-Mediterranean. It also occurs off the Swedish west coast up to Hardangerfjord on the Norwegian west coast (Höglund, 1947; Lange, 1956; Risdal, 1963, 1964; Riise, 1964). Feyling-Hanssen, (1964 a) found it in Holocene deposits of the Oslofjord area, and Michelsen (1967) recorded it from Postglacial

and Lateglacial deposits of Læsø, Denmark. Van Voorthuysen (1957) recorded it from the Eemian at Amersfoort in the Netherlands and (1958, p. 17, pl. 4, fig. 58) from the Pliocene of Kruisschans, Belgium. Cushman & Gray (1946 b, p. 34, pl. 5, figs. 48–50) figured specimens very similar to *Bolivina pseudoplicata* from the Pliocene of Timms Point, California.

Bolivina pseudopunctata Höglund

Synonyms: 1947 *Bolivina pseudopunctata* Höglund: p. 273, pl. 24, fig. 5; pl. 32, figs. 23, 24; text-figs. 280, 281, 287. – 1953 Loeblich & Tappan: p. 111, pl. 20, figs. 13, 14. – 1964 a Feyling-Hanssen: p. 319, pl. 16, fig. 7. – 1967 Michelsen: p. 223, pl. 2, fig. 3.

Dimensions: Specimen from Hirtshals has l = 0.24 mm, max. b = 0.12 mm, t = 0.08 mm.

Occurrence: Two specimens were found in the Older *Yoldia* Clay at Hirtshals in Vendsyssel. They occurred in zones D and F.

Bolivina cf. *robusta* Brady
Pl. 7, fig. 17

Synonyms: 1947 *Bolivina* cf. *robusta* Brady; Höglund: p. 270, pl. 24, figs. 8, 9; pl. 32, figs. 16–18; text-fig. 287. – 1956 Lange: p. 65, 70, 78, pl. 10, fig. 6. – 1964 a Feyling-Hanssen: p. 321, pl. 16, fig. 9. – 1964 Riise: p. 47, 100, pl. 13 A, fig. 2; pl. 15, fig. 6. – 1967 Michelsen: p. 223, pl. 2, fig. 4.

Dimensions: Specimen from Older *Yoldia* Clay at Stortorn (pl. 7, fig. 17) has l = 0.38 mm, b = 0.23 mm, t = 0.10 mm.

Occurrence: One specimen was found in zone 4 of boring no. I in Sandnes. A few specimens occurred in the *Yoldia* clays and in the Postglacial deposits of Vendsyssel.

Remarks: Brady (1884, p. 421, pl. 53, figs. 7–9) described *B. robusta* from the Pacific (Ki Islands and Fiji Islands). Höglund (1947) described, from the Gullmarfjord and from the Skagerrak, a *B.* cf. *robusta* which differs from Brady's species in lacking an apical spine and in being furnished with only one indentation of the basal margin of each chamber, i.e. one on each side, and close to the median line, whereas Brady described series of indentations.

This *B.* cf. *robusta* is frequent in the Skagerrak at depths from 300 to 500 m. In the Oslofjord it is dominant (Risdal, 1964) at depths exceeding 100 m. Lange considered *B.* cf. *robusta* to be a late immigrant into the Skagerrak. Only scattered occurrences of this species are known from older deposits: Feyling-Hanssen (1964 a) found one specimen in Lower Holocene at Oslo, Michelsen (1967) found 3 specimens in Postglacial deposits at Læsø, and Buch (1955, p. 612) found a fragment, of a more slender form than Höglund's, in Mindel-Riss Interglacial deposits near Ribe, SW Jutland. Matoba (1967, p. 251, pl. 25, figs. 14–16) recorded typical *Bolivina robusta* Brady from Upper Miocene to Lower Pleistocene in the Choshi district, east of Tokyo.

Bolivina spathulata (Williamson)

Synonyms: 1858 *Textularia variabilis* Williamson, var. *spathulata* Williamson: p. 76, pl. 6, figs. 164, 165. – 1937 *Bolivina spathulata* (Williamson); Cushman: p. 162, pl. 15, figs. 20–24. – 1947 Höglund: p. 271, pl. 24, fig. 7; pl. 32, figs. 21, 22; text-figs. 286, 287. – 1964 a Feyling-Hanssen: p. 321, pl. 16, fig. 10.

Dimensions: A twisted specimen with distinctly limbate sutures and slightly flared keel occurred in boring no. I in Sandnes (depth 6.40 m): l = 0.33 mm, b = 0.18 mm, t = 0.08 mm (initial chambers broken off). Another specimen of the same length occurred in the same sample.

Cassidulinidae d'Orbigny, 1839

Cassidulina d'Orbigny, 1826

Cassidulina crassa d'Orbigny
Pl. 7, figs. 18, 19

Synonyms: 1839 b *Cassidulina crassa* d'Orbigny: p. 56, pl. 7, figs. 18–20. – 1953 *C. islandica* Nørvang; Loeblich & Tappan: p. 118, pl. 24, fig. 1. – 1958 *C. crassa* d'Orbigny; Nørvang: p. 36, pl. 8, figs. 20–23; pl. 9, figs. 24, 25. – 1964 a Feyling-Hanssen: p. 322, pl. 16, figs 11–13. – 1965 *C. barbara* Buzas: p. 25, pl. 5, figs. 2, 3. – 1965 *C. islandica* Nørvang; Leslie: p. 157, pl. 10, fig. 4. – 1967 *C. crassa* d'Orbigny; Michelsen: p. 245, pl. 7, fig. 3.

Dimensions: Specimen from Older *Yoldia* Clay at Løkken (pl. 7, figs. 18, 19) has max. d = 0.28 mm, min. d = 0.22 mm, t = 0.16 mm.

Occurrence: This species occurs in all Pleistocene fossiliferous samples from Sandnes, Jæren and Karmøy, generally accounting for 10–40 % of the fauna. It is usually less frequent in zone 3 than in the other deposits. It is one of the most abundant species in the Older *Yoldia* Clay and the Lateglacial deposits of Vendsyssel. In the Older *Yoldia* Clay at Hirtshals the species is most frequent in zones A and D, accounting for up to 60 %. It is rare in the Postglacial deposits of Vendsyssel.

Remarks: *C. crassa* is rarely found in Miocene deposits in the Netherlands (van Voorthuysen, 1950 b). It was recorded from the Holsteinian in SW Jutland (Buch, 1955), Schleswig-Holstein (Woszidlo, 1962) and off England (Fisher, Funnell & West, 1969). Madsen (1895) found the species in Holsteinian deposits, in Older *Yoldia* Clay and in Lateglacial deposits. Brotzen (1961) found that *C. crassa* is the dominant species in arctic faunas from deposits at Gothenburg, which were radiologically dated at 24,000–30,000 years B.P. It has been recorded from late Quaternary deposits in SW Sweden (Hessland, 1943; Brotzen, 1951), in the Oslofjord area (Feyling-Hanssen, 1964 a), on Læsø, Denmark (Michelsen, 1967) and in Maine (Buzas, 1965). *C. crassa* is an arctic species (Loeblich & Tappan, 1953; Nagy, 1965; Leslie, 1965). A few specimens occur in Kattegat (Lange, 1956) and in the Oslofjord (Risdal, 1964).

C. crassa occurs in the *Portlandia arctica* Zone of the Skærumhede boring, but it is not frequent. This is probably due to the preparation methods; small specimens seem to be under-represented in the material.

Cassidulina laevigata d'Orbigny
Pl. 7, figs. 20, 21; pl. 18, fig. 12.

Synonyms: 1826 *Cassidulina laevigata* d'Orbigny: p. 282, pl. 15, figs. 4, 5. – 1958 Nørvang: p. 38, pl. 9, figs. 27–31. – 1967 Michelsen: p. 246, pl. 7, fig. 4.

Dimensions: The figured specimen from the Lateglacial at Løkken has max. d = 0.24 mm, min. d = 0.21 mm, t = 0.13 mm.

Occurrence: One badly preserved specimen was found in zone 1 of boring no. II, Sandnes. A few specimens were found in the Older *Yoldia* Clay and in the Lateglacial and Postglacial deposits of Vendsyssel.

Remarks: It has not been possible to distinguish between the subspecies *C. laevigata carinata* Silvestri and *C. laevigata laevigata* d'Orbigny in the present material. *C. laevigata carinata* is considered a guide fossil of the marine Quaternary of the Mediterranean. *C. laevigata* is frequent in the lowest Pleistocene of the Netherlands (van Voorthuysen 1950 a, b), and Woszidlo (1962) recorded the species from Holsteinian deposits of Schleswig-Holstein. It was recorded from the late Quaternary of the Oslofjord area (Feyling-Hanssen, 1964 a) and from Læsø, Denmark (Michelsen, 1967).

In Recent faunas the species is found in the Skagerrak and the Kattegat (Lange, 1956), and in the Oslofjord, where it occurs at depths between 10 and 330 m (Risdal, 1964). Ishiwada (1964) recorded *C. laevigata carinata* from the Tosa Bay, Japan.

Islandiella Nørvang, 1958

Islandiella islandica (Nørvang)
Pl. 7, figs. 22–25

Synonyms: 1945 *Cassidulina islandica* Nørvang: p. 42, fig. 7. – 1958 *Islandiella islandica* (Nørvang); Nørvang: p. 27, pl. 6, figs. 1–5; pl. 7, figs. 6, 7. – 1966 *Cassilamellina islandica* (Nørvang); Gudina: p. 66, pl. 7, figs. 2, 3; pl. 13, fig. 2.

Dimensions: Specimen from Sandnes (pl. 7, figs. 22, 23) has max. d = 0.42 mm, min. d = 0.35 mm, t = 0.28 mm, and one from the Older *Yoldia* Clay at Løkken (pl. 7, figs. 24, 25) has max. d = 0.58 mm, min. d = 0.50 mm, t = 0.35 mm.

Occurrence: This species is rare in zone 1 of the Sandnes Clay. It occurs at Bø brickworks, Karmøy, and some specimens were found in the Older *Yoldia* Clay of Vendsyssel.

Remarks: As discussed by Nørvang (1958) this species is very close to *Islandiella californica* (Cushman & Hughes). The sutures in *I. californica* are usually flush with the surface and show a tendency to become limbate. *I. islandica* also seems closely related to *I. japonica* (Asano & Nakamura, 1937) from the Sea of Japan, as recorded by Troitskaja (1969, p. 150).

I. islandica is described from Recent faunas northeast of Iceland, at water depths of 38–220 m (Nørvang, 1945). It is rare at depths exceeding 100 m.

The species is found in the lower part of the *Portlandia arctica* Zone, in the *Abra nitida* Zone and in the lower glacigenic deposits of the Skærumhede boring in Vendsyssel.

Islandiella norcrossi (Cushman)
Pl. 8, figs. 1, 2

Synonyms: 1933 *Cassidulina norcrossi* Cushman: p. 7, pl. 2, fig. 7. – 1953 Loeblich & Tappan: p. 120, pl. 24, fig. 12. – 1958 *Islandiella norcrossi* (Cushman); Nørvang: p. 32, pl. 7, figs. 8–11 (not figs. 12, 13); pl. 8, fig. 14. – 1964 a Feyling-Hanssen: p. 325, pl. 16, fig. 20; pl. 17, fig. 1. – 1966 *Planocassidulina norcrossi* (Cushman); Gudina: p. 69, pl. 6, figs. 2, 3; pl. 12, fig. 6. – 1968 *Cassidulita norcrossi* (Cushman); de Civrieux: p. 157, pl. 5, fig. 5. – 1969 *Planocassidulina norcrossi* (Cushman); Gudina: p. 48, pl. 15, figs. 10, 11.

Dimensions: Specimen from Sandnes (pl. 8, fig. 1) has max. d = 0.38 mm, min. d = 0.33 mm, t = 0.18 mm, another specimen from the same locality (pl. 8, fig. 2) has max. d = 0.38 mm, min. d = 0.32 mm, t = 0.17 mm. Fifty randomly chosen specimens from zone D of the Older *Yoldia* Clay at Hirtshals were measured: the average diameter is 0.29 mm, with a standard deviation of 0.04 mm. The number of chambers in the last whorl varies from 6 to 10, most specimens have 9.

Occurrence: This species is common in and characteristic of zone 1 in Sandnes. It does not occur in the other zones at Sandnes, but is present in samples from Jæren and Karmøy. *I. norcrossi* occurs in many samples from the Older *Yoldia* Clay in Vendsyssel. In the Older *Yoldia* Clay at Hirtshals it is most frequent in zone D, where it usually accounts for 5–10 % of the total fauna, maximum 20 %. It is also quite frequent in zone A. Only a few specimens were found in the Lateglacial and Postglacial deposits of Vendsyssel.

Remarks: de Civrieux (1968) separated *Cassidulita* from *Cassidulina* and *Islandiella,* with *Cassidulina norcrossi,* subsp. *australis* Phleger & Parker, 1951, as type species. In *Cassidulita* the chambers are said to be uniserially coiled, whereas in *Cassidulina* and *Islandiella* they are biserially alternating on both sides of the test. In the present material of *Islandiella norcrossi* there is a tendency towards alternating chambers in the later part of the test. We suspect that *I. norcrossi* and *I. teretis* are conspecific, and, therefore, we cannot support the segregation of a genus *Cassidulita* on the criterion mentioned above.

I. norcrossi was recorded from the late Quaternary of Læsø, Denmark (Michelsen, 1967), and it is quite common in Lateglacial deposits of the Oslofjord area. Gudina (1966 and 1969) found this species in the Quaternary of Siberia. Nørvang (1945) found *I. norcrossi* in Recent faunas north and east of Iceland, and suggested that its Recent distribution is arctic. The species is found in Recent faunas off Alaska, Canada and Greenland at depths exceeding 13 m (Loeblich & Tappan, 1953), and off Spitsbergen at depths 0–50 m (Nagy, 1965). Cushman (1933), Leslie (1965), Todd & Low (1967) and Wagner (1968) also recorded this species in arctic faunas.

I. norcrossi is found in the lower part of the *Portlandia arctica* Zone and in the *Turritella terebra* Zone of the Skærumhede boring. In the latter zone it is most common in the upper and the lowermost parts. It occurs also in the lower glacigenic deposits of the boring.

Islandiella teretis (Tappan)
Pl. 8, figs. 3–6; pl. 18, fig. 13

Synonyms: 1951 *Cassidulina teretis* Tappan: p. 7, pl. 1, fig. 30. – 1953 Loeblich & Tappan: p. 121, pl. 24, figs. 3, 4. – 1964 a *Islandiella teretis* (Tappan); Feyling-Hanssen: p. 326, pl. 16, fig. 17. – 1965 *Cassidulina teretis* Tappan; Buzas: p. 24, pl. 5, fig. 1. – 1966 Gudina: p. 62, pl. 5, fig. 9; pl. 6, fig. 1; pl. 12, fig. 5. – 1969 Gudina: p. 47, pl. 15, fig. 9.

Dimensions: Specimen from Sandnes (pl. 8, figs. 3, 4; pl. 18, fig. 13) has max. d = 0.60 mm, min. d = 0.53 mm, t = 0.30 mm, and one from the Older *Yoldia* Clay at Løkken (pl. 8, figs. 5, 6) has max. d = 0.66 mm, min. d = 0.58 mm, t = 0.33 mm.

Occurrence: *I. teretis* occurs in zone 1 of the borings in Sandnes. It is not frequent, but, together with *I. norcrossi,* characteristic of the zone. A single specimen of this species was found in zone 3 of boring no. I in Sandnes. It occurred also in the samples from Jæren and Karmøy. *I. teretis* occurs in many samples from the Older *Yoldia* Clay in Vendsyssel. At Hirtshals it is most common in zones A, C and D. A few specimens were found in the Lateglacial deposits of Vendsyssel.

Remarks: Gudina (1966) referred Nørvang's (1958) figs. 8, 12 and 13 of *I. norcrossi* to *I. teretis.* We agree upon this as to figs. 12 and 13, but consider fig. 8 a good representation of *I. norcrossi.*

I. teretis was recorded from the oldest Quaternary of the Netherlands (van Voorthuysen, 1950 a); it was referred to as *Cassidulina laevigata* d'Orbigny,

var. *carinata* Cushman. *I. teretis* is described from the Pleistocene of Alaska (Tappan, 1951). Gudina (1966 and 1969) found it in the Quaternary of Siberia, and it is recorded from late Quaternary deposits of the Oslofjord area (Feyling-Hanssen, 1964 a) and of Maine (Buzas, 1965). In Recent faunas this species is known from off Alaska, Canada and Greenland at depths exceeding 13 m (Loeblich & Tappan, 1953). In Hudson Bay it occurs at depths between 50 and 230 m (Leslie, 1965; Wagner, 1968). Nagy (1965) found a few specimens off Spitsbergen at 9 m and 37 m depth.

In the Skærumhede boring in Vendsyssel *I. teretis* occurs in the lower part of the *Portlandia arctica* Zone; it is frequent in the *Abra nitida* Zone and in the upper and lower part at the *Turritella terebra* Zone. It occurs also in the lowermost glacigenic deposits of the Skærumhede boring.

Chilostomellidae Brady, 1881

Allomorphina Reuss, 1850

Allomorphina fragilis Hofker
Pl. 8, figs. 7–9

Synonyms: 1951 *Allomorphina pacifica* Hofker (not *Allomorphina pacifica* Cushman & Todd, 1949): p. 139, pl. 86. – 1952 *A. fragilis* Hofker, new name; Thalman: p. 14. – 1960 *A. pacifica* Hofker; Barker (not *Allomorphina pacifica* Cushman & Todd, 1949): p. 112, pl. 55, figs. 24–26.

Dimensions: Specimen from Løkken (pl. 8, figs. 7–9) has max. d = 0.25 mm, h = 0.18 mm.

Occurrence: Two specimens were found in the Lateglacial *Yoldia* Clay of the Løkken area in Vendsyssel.

Robertinidea Reuss, 1850

Epistominidae Wedekind, 1937

Hoeglundina Brotzen, 1948

Hoeglundina elegans (d'Orbigny)

Synonyms: 1826 *Rotalia (Turbinulina) elegans* d'Orbigny: p. 276, no. 54. – 1884 *Pulvinulina elegans* (d'Orbigny); Brady: p. 699, pl. 105, figs. 3–6. – 1953 *Höglundina elegans* (d'Orbigny); Phleger, Parker & Peirson: p. 43, pl. 9, figs. 24, 25.

Dimensions: One broken specimen was found in zone 1 of boring no. II, Sandnes: max. d = 0.46 mm, t = 0.28 mm.

Robertinidae Reuss, 1850

Robertina d'Orbigny, 1846

Robertina arctica d'Orbigny

Synonyms: 1846 *Robertina arctica* d'Orbigny: p. 203, pl. 21, figs. 37, 38. – 1947 Höglund: p. 219, pl. 18, fig. 2; pl. 19, fig. 1; text-figs. 198, 203. – 1948 Cushman: p. 61, pl. 6, figs. 16–18. – 1965 Leslie: p. 170, pl. 8, fig. 14.

Dimensions: Specimen from Hirtshals has l = 0.30 mm, b = 0.20 mm (last chamber broken).

Occurrence: A few specimens were found in zones A and D of the Older *Yoldia* Clay at Hirtshals.

Remarks: *R. arctica* is known from Recent faunas off Spitsbergen (Höglund, 1947; Nagy, 1965), Canada and Greenland (Cushman, 1948; Leslie, 1965) and Alaska (Todd & Low, 1967).

Robertinoides Höglund, 1947

Robertinoides pumilum Höglund
Pl. 8, figs. 10, 11

Synonyms: 1947 *Robertinoides pumilum* Höglund: p. 227, pl. 18, fig. 5. – 1964 a Feyling-Hanssen: p. 343, pl. 19, fig. 15.

Dimensions: Specimen from Hirtshals (pl. 8 figs. 10, 11) has l = 0.29 mm, t = 0.15 mm.

Occurrence: Two specimens were found in zone D of the Older *Yoldia* Clay at Hirtshals.

Remarks: This species was recorded from Holocene deposits of the Oslofjord area (Feyling-Hanssen, 1964 a). In the Gullmarfjord it occurs at depths of 20–22 m and in the Skagerrak at 249–700 m (Höglund, 1947).

Spirillinidea Reuss, 1862

Spirillinidae Reuss, 1862

Spirillina Ehrenberg, 1843

Spirillina vivipara Ehrenberg

Synonyms: 1843 *Spirillina vivipara* Ehrenberg: p. 323, pl. 3, fig. 41. – 1953 Loeblich & Tappan: p. 112, pl. 21, figs. 2, 3. – 1962 Haake: p. 42, pl. 3, fig. 8.

Dimensions: One specimen was found in zone F of the Older *Yoldia* Clay at Hirtshals, Vendsyssel: d = 0.16 mm, h = 0.03 mm.

Patellina Williamson, 1858

Patellina corrugata Williamson

Synonyms: 1858 *Patellina corrugata* Williamson: p. 46, pl. 3, figs. 86–89. – 1953 Loeblich & Tappan: p. 114, pl. 21, figs. 4, 5. – 1964 a Feyling-Hanssen: p. 335, pl. 18, fig. 9. – 1965 Leslie: p. 167, pl. 9, fig. 8.

Dimensions: Specimen from the Postglacial at Løkken had d = 0.25 mm, h = 0.10 mm.

Occurrence: Scattered specimens occur in zone 1 of the Sandnes Clay. Single specimens were found in the Older *Yoldia* Clay, in the Lateglacial *Yoldia* Clay and in the Postglacial deposits of Vendsyssel.

Remarks: Madsen (1895) recorded *P. corrugata* from Lateglacial *Yoldia* Clay in Vendsyssel.

Discorbidea Ehrenberg, 1838

Discorbidae Cushman, 1927

Buccella Andersen, 1952

Buccella frigida (Cushman)
Pl. 8, figs. 12–14; pl. 19, fig. 1

Synonyms: ? 1895 *Rotalia beccarii*, var. *lucida* Madsen: p. 214, pl. 1, fig. 6. – 1922 a *Pulvinulina frigida* Cushman: p. 12 (144). – 1930 *Eponides frigida* (Cushman), var. *calida* Cushman & Cole: p. 98, pl. 13, fig. 13. – 1949 a *E. frigidus* (Cushman); van Voorthuysen: p. 66, pl. 1, fig. 3. – 1952 *Buccella frigida* (Cushman); Andersen: p. 144, figs. 4–6. – 1953 Loeblich & Tappan: p. 115, pl. 22, figs. 2, 3. – 1957 van Voorthuysen: p. 33, pl. 24, fig. 15. – 1961 *Eponides frigidus* (Cushman); Saidova: p. 64, pl. 19, fig. 131. – 1962 *Buccella frigida* (Cushman); Woszidlo: p. 73, pl. 2, figs. 25, 26. – 1963 Lafrenz: p. 25, pl. 2, figs. 10–14. – 1964 a Feyling-Hanssen: p. 337, pl. 18, figs. 15–18. – 1965 Leslie: pp. 72–75, 156, pl. 10, fig. 2; text-fig. 23. – 1966 Gudina: p. 31, pl. 5, fig. 7; pl. 12, fig. 4. – 1967 Matoba: p. 252, pl. 26, fig. 9. – 1969 Gudina: p. 24, pl. 8, fig. 4.

Dimensions: The figured specimen from Sandnes has max. d = 0.33 mm, min. d = 0.27 mm, t = 0.19 mm.

Occurrence: This species occurs throughout the Sandnes Clay but is particularly frequent in the lower part of zone 3. It occurs also in samples from Jæren and Karmøy. In Vendsyssel it is more common in the *Yoldia* Clays than in the Postglacial deposits. The species is most frequent in zones C, E

and F of the Older *Yoldia* Clay at Hirtshals and is also found in the *Zirfaea* layers.

Remarks: *B. frigida* is rare in the Lateglacial and Postglacial deposits of the Oslofjord area. Brotzen (1951) recorded it from similar deposits at Surte, SW Sweden, and Michelsen (1967) described *Buccella* cf. *frigida* from Lateglacial and Postglacial deposits of Læsø in Denmark. Madsen (1895) recorded *Rotalia beccarii,* var. *lucida* from the late Quaternary of Vendsyssel and from Holsteinian and Eemian deposits of southern Denmark; it is described as having a smooth umbilical side and should probably be referred to *Buccella frigida.* Konradi (in press) recorded *B. frigida* as common in the Eemian of Stensigmose, southern Denmark. It occurs both i the *Cyprina* Clay and in the *Tapes* Sand there, reaching a maximum of 36 % in the uppermost part of the *Tapes* Sand. It occurs also in Eemian and Holsteinian deposits in Schleswig-Holstein (Lafrenz, 1963; Woszidlo, 1962). Van Voorthuysen considered it a characteristic element of Eemian faunas in the Netherlands. It is less common in the oldest Quaternary there, and it is also rare in the Pleistocene Crag Series of East Anglia (van Voorthuysen, 1957; Funnell, 1961). Matoba (1967) recorded this species from Pliocene and Lower Pleistocene deposits of the Choshi district east of Tokyo.

B. frigida is widespread in arctic waters. Leslie (1965) found live populations in Hudson Bay at 37 to 212 m depth. The bottom temperature varied from 2.98°C to – 1.78°C and the salinity was 3.3 ‰. Loeblich & Tappan (1953) found this species from Point Barrow to Greenland at depths from 18 to 136 m. Saidova (1961) recorded it from the eastern seas of the USSR and in the northwestern Pacific at 36 to 140 m depth, and Ishiwada (1964) found it off Kushiro (northern Japan) from 28 to 228 m. Scattered occurrences have been recorded from subarctic and boreal waters (Haake, 1962; Boltovskoy, 1954; Murray, 1965 a).

Buccella tenerrima (Bandy)
Pl. 8, figs. 15–17

Synonyms: 1950 *Rotalia tenerrima* Bandy: p. 278, pl. 42, fig. 3. – 1952 *Buccella inusitata* Andersen: p. 148, figs. 10, 11. – 1953 Loeblich & Tappan: p. 116, pl. 22, fig. 1. – 1964 b *B. tenerrima* (Bandy); Feyling-Hanssen: p. 47, pl. 3, figs. 3–5. – 1965 Leslie: p. 157, pl. 10, fig. 1. – 1967 *B. inusitata* Andersen; Michelsen: p. 229, pl. 3, fig. 3. – 1969 Gudina: p. 25, pl. 8, fig. 7.

Dimensions: Specimen from Elgane, Jæren (pl. 8, figs. 15–17) has max. d = 0.56 mm, min. d = 0.49 mm, h = 0.28 mm.

Occurrence: A few specimens of this species were found in zone 1 of the Sandnes Clay and in samples from Jæren and Karmøy. Some specimens were found in the Older *Yoldia* Clay at Hirtshals, Vendsyssel.

Remarks: Gudina (1969) recorded this species from the Quaternary of Siberia. It is found in late Quaternary deposits of Læsø, Denmark (Michelsen, 1967) and in Postglacial deposits of Spitsbergen (Feyling-Hanssen, 1964 b). The species is known today from arctic waters (Loeblich & Tappan, 1953; Leslie, 1965; Wagner, 1968). Off Spitsbergen it is found at depths between 4 and 50 m (Nagy, 1965).

B. tenerrima occurs in the lower part of the *Portlandia arctica* Zone of the Skærumhede boring in Vendsyssel.

Rosalina d'Orbigny, 1826

Rosalina globularis d'Orbigny

Synonyms: 1826 *Rosalina globularis* d'Orbigny: p. 271, pl. 13, figs. 1, 2. – 1931 *Discorbis globularis* (d'Orbigny); Cushman: p. 22, pl. 4, fig. 9. – 1964 a *Rosalina globularis* d'Orbigny; Feyling-Hanssen: p. 335. – 1967 Michelsen: p. 235.

Dimensions: Specimen from Older *Yoldia* Clay at Løkken has max. d = 0.31 mm, min. d = 0.28 mm, h = 0.18 mm.

Occurrence: A few specimens were found in the Older *Yoldia* Clay of the Løkken area in Vendsyssel.

Rosalina milletti (Wright)

Synonyms: 1911 *Discorbina milletti* Wright: p. 13, pl. 2, figs. 14–17. – 1957 *Rosalina milletti* (Wright); van Voorthuysen: p. 33, pl. 24, fig. 17. – 1962 Haake: p. 43, pl. 3, figs. 12, 13.

Dimensions: One specimen was found in zone A of the Older *Yoldia* Clay at Hirtshals: max. d = 0.25 mm, min. d = 0.18 mm, h = 0.08 mm.

Remarks: *R. milletti* was originally described from Recent faunas off Iceland (Wright, 1911). It also occurs along the coasts of the Netherlands (van

Voorthuysen, 1960) and NW Germany (Haake, 1962). Van Voorthuysen (1957) recorded it from Eemian deposits of the Netherlands.

Rosalina vilardeboana d'Orbigny
Pl. 8, figs. 18–20

Synonyms: 1839 b *Rosalina vilardeboana* d'Orbigny: p. 44, pl. 6, figs. 13–15. – 1960 Barker: p. 178, pl. 86, fig. 9. – 1964 a Feyling-Hanssen: p. 336, pl. 18, figs. 10, 11.

Dimensions: Specimen from the Sandnes Clay (pl. 8, figs. 18–20) has max. d = 0.30 mm, min. d = 0.26 mm, h = 0.11 mm.

Occurrence: This species is rare in zones 1 and 3 of the Sandnes Clay, two specimens were found in a sample from Opstad, Jæren. A single specimen was found in the Older *Yoldia* Clay of the Løkken area, Vendsyssel.

Glabratella Dorreen, 1948

Glabratella wrightii (Brady)

Synonyms: 1881 *Discorbina wrightii* Brady: p. 413, pl. 21, fig. 6. – 1948 *Eponides wrightii* (Brady); Cushman: p. 72, pl. 8, fig. 4. – 1965 *Glabratella wrightii* (Brady); Leslie: p. 161, pl. 10, fig. 7.

Dimensions: Specimen from Hirtshals has max. d = 0.15 mm, h = 0.09 mm.

Occurrence: One specimen occurred in zone 1 and one in zone 3 of boring no. I, Sandnes. A few specimens were found in zones A, D and F of the Older *Yoldia* Clay at Hirtshals.

Epistominella Husezima & Maruhasi, 1944

Epistominella exigua (Brady)

Synonyms: 1884 *Pulvinulina exigua* Brady: p. 696, pl. 103, figs. 13, 14. – 1964 a *Epistominella exigua* (Brady); Feyling-Hanssen: p. 338, pl. 18, figs. 19, 20.

Dimensions: One specimen occurred in boring no. I, Sandnes: max. d = 0.20 mm, min. d = 0.18 mm, h = 0.11 mm.

Occurrence: This species is very rare in the present material; in addition to the measured specimen, one was found at Opstad and one at Reve, Jæren.

Epistominella takayanagii Iwasa

Synonyms: 1955 *Epistominella takayanagii* Iwasa: pp. 16, 17, text-fig. 4. – 1964 b *Eponides patagonica* (d'Orbigny); Feyling-Hanssen (not *Rotalina patagonica* d'Orbigny, 1839 b): p. 48, pl. 3, figs. 1, 2. – 1965 *Epistominella takayanagii* Iwasa; Leslie: p. 160, pl. 9, fig. 10. – 1965 *E. exigua* (Brady); Nagy (not *Pulvinulina exigua* Brady, 1884): p. 123, pl. 2, fig. 9.

Dimensions: Specimen from Older *Yoldia* Clay at Hirtshals has max. d = 0.20 mm, h = 0.09 mm.

Occurrence: A few specimens occur in the Sandnes Clay, and some in samples from Foss-Eigeland and Opstad, Jæren. A few specimens were found in the late Quaternary deposits at Løkken and Hirtshals.

Asterigerinidae d'Orbigny, 1839

Eoeponidella Wickenden, 1949

Eoeponidella laesoeensis Michelsen

Synonyms: 1962 *Asterigerina* sp. Haake: p. 46, pl. 5, figs. 1, 2. – 1963 *Asterellina pulchella* (Parker); Anderson (not *Pninaella? pulchella* Parker, 1952): p. 314, pl. 1, figs. 5–7. – 1965 Leslie: p. 156, pl. 9, fig. 9. – 1965 Lutze: p. 95, pl. 13, figs. 5–9. – 1967 *Eoeponidella laesoeensis* Michelsen: p. 230, pl. 3, figs. 5–8; text-figs. 3–7.

Dimensions: Specimen from the Lateglacial at Løkken has max. d = 0.18 mm, h = 0.11 mm, and one from Hirtshals has max. d = 0.16 mm, h = 0.06 mm.

Occurrence: A few specimens were found in the Older *Yoldia* Clay and in the Lateglacial *Yoldia* Clay. One specimen was found in the Postglacial deposits of Vendsyssel.

Remarks: *E. laesoeensis* was described from Late- and Postglacial deposits of Læsø, Denmark (Michelsen, 1967). It is known from the Bering Sea (Anderson, 1963), Hudson Bay (Leslie, 1965) and the Baltic (Lutze, 1965). Haake (1962) found the species in Recent faunas off NW Germany.

Anomalinidae Cushman, 1927

Anomalina d'Orbigny, 1826

Anomalina globulosa Chapman & Parr
Pl. 9, figs. 1–3

Synonyms: 1937 *Anomalina globulosa* Chapman & Parr: p. 117, pl. 9, fig. 27. – 1960 Barker: p. 194, pl. 94, figs. 4, 5.

Dimensions: Specimen from the Postglacial at Løkken (pl. 9, figs. 1–3) has max. d = 0.40 mm, h = 0.23 mm.

Occurrence: *A. globulosa* occurs in the Postglacial deposits in Vendsyssel, and a few specimens were also found in the Older *Yoldia* Clay.

Planulina d'Orbigny, 1826

Planulina ariminensis d'Orbigny
Pl. 9, figs. 4–6

Synonyms: 1826 *Planulina ariminensis* d'Orbigny: p. 280, pl. 14, figs. 1–3. – 1950 b van Voorthuysen: p. 66, pl. 4, fig. 1. – 1960 Barker: pl. 93, figs. 10, 11.

Dimensions: Specimen from Sandnes (pl. 9, figs. 4–6) has max. d = 0.65 mm, min. d = 0.49 mm, t = 0.16 mm.

Occurrence: Two specimens were found in zone 1 of the Sandnes Clay, and some specimens were observed in Older *Yoldia* Clay at Hirtshals.

Remarks: Van Voorthuysen (1950 b) recorded this species from older Pleistocene deposits of the Netherlands. It occurs in the *Turritella terebra* Zone and in the lower part of the *Portlandia arctica* Zone of the Skærumhede boring in Vendsyssel.

Hyalinea Hofker, 1951

Hyalinea baltica (Schroeter)
Pl. 9, figs. 7, 8

Synonyms: 1783 *Nautilus balthicus* Schroeter: p. 20, pl. 1, fig. 2. – 1931 *Anomalina balthica* (Schroeter); Cushman: p. 108, pl. 19, fig. 3. – 1964 a *Hyalinea balthica* (Schroeter); Feyling-Hanssen: p. 351, pl. 21, figs. 14–16. – 1967 Michelsen: p. 245.

Dimensions: Specimen from Sandnes (pl. 9, figs. 7,8) has max. d = 0.49 mm, t = 0.10 mm, and one from Hirtshals has max. d = 0.62 mm, t = 0.15 mm.

Occurrence: Some specimens occur in zone 1 of the Sandnes Clay. One specimen, probably reworked, was found in zone 3 of boring no. I. The species was found in many samples from the Older *Yoldia* Clay of Vendsyssel, being most common in zones A and D at Hirtshals. A few specimens were found in Lateglacial *Yoldia* Clay of the Løkken area.

Remarks: Together with *Cassidulina laevigata carinata* this species is an index fossil in the oldest Quaternary deposits of the Mediterranean (Selli, 1967). It is known from late Quaternary deposits of the Oslofjord area (Feyling-Hanssen, 1964 a) and from Læsø, Denmark (Michelsen, 1967). Nørvang (1945) states that its Recent distribution is boreal and lusitanian at depths between 40 and 4500 m. It is common in the Oslofjord at depths of 11–330 m. (Risdal, 1964).

H. baltica is found in the *Turritella terebra* Zone, the lower part of the *Portlandia arctica* Zone, and the upper part of the *Abra nitida* Zone of the Skærumhede boring in Vendsyssel.

Orbitoididea Schwager, 1876

Planorbulinidae Schwager, 1877

Cibicides Montfort, 1808

Cibicides lobatulus (Walker & Jacob)
Pl. 9, figs. 9–14

Synonyms: 1798 *Nautilus lobatulus* Walker & Jacob: p. 642, pl. 14, fig. 36. – 1895 *Truncatulina lobatula* Walker & Jacob; Madsen: p. 212. – 1948 *Cibicides lobatulus* (Walker & Jacob); Cushman: p. 78, pl. 8, fig. 14. – 1961 Nyholm: p. 157–196, pl. 1–5; text-figs. 1–21. – 1964 a Feyling-Hanssen: p. 339, pl. 19, figs. 1–3. – 1965 Leslie: p. 158, pl. 10, fig. 6. – 1967 Michelsen: p. 244, pl. 6, fig. 8; pl. 7, figs. 1, 2.

Dimensions: Specimen from the Older *Yoldia* Clay at Løkken (pl. 9, figs. 9–11) has max. d = 0.56 mm, t = 0.24 mm, and one from Reve, Jæren (pl. 9, figs. 12–14) has max. d = 0.63 mm, t = 0.25 mm.

Occurrence: This species occurs sparsely in all zones of the Sandnes Clay, except zone 2, and also in samples from Jæren and Karmøy. It was found in many of the samples from Older *Yoldia* Clay and Lateglacial deposits in Vendsyssel. In the Older *Yoldia* Clay at Hirtshals it is most common in zones A, D and F. A few specimens were found in Postglacial deposits of the Løkken area.

Remarks: Woszidlo (1962) found a few specimens of *C. lobatulus* in Holsteinian deposits of Schleswig-Holstein. It was recorded from late Quaternary deposits of the Oslofjord area (Feyling-Hanssen, 1964 a) and of Læsø, Denmark (Michelsen, 1967). Its Recent distribution seems to be cosmopolitan, but it is most common in boreal waters of moderate depth (Feyling-Hanssen, 1964 a). *C. lobatulus* is found in Hudson Bay (Leslie, 1965; Wagner, 1968) and off Spitsbergen, where it occurs at depths down to 50 m (Nagy, 1965). Risdal (1964) recorded it from the Oslofjord at 30–330 m, and Lutze (1965) found a few specimens in the Femernbelt at depths of about 20 m.

Cibicides pseudoungerianus (Cushman)

Synonyms: 1922 b *Truncatulina pseudoungerianus* Cushman: p. 97, pl. 20, fig. 9. – 1931 *Cibicides pseudoungerianus* (Cushman); Cushman: p. 123, pl. 22, figs. 3–7. – 1960 Barker: p. 194, pl. 94, fig. 9. – 1964 a Feyling-Hanssen: p. 340, pl. 19, figs. 4–6.

Dimensions: One specimen was found in the Older *Yoldia* Clay at Løkken: max. d = 0.53 mm, min. d = 0.40 mm, t = 0.20 mm.

Cibicides refulgens Montfort

Synonyms: 1808 *Cibicides refulgens* Montfort: p. 122, 31re genre. – 1884 *Truncatulina refulgens* (Montfort); Brady: p. 659, pl. 92, figs. 7–9.

Dimensions: Two broken specimens were found in zone 1 of boring no. I, Sandnes. The largest one has max. d = 0.47 mm, h = 0.27 mm. The species occurs also at Lerbrekk, Jæren.

Nonionidea Subbotina, 1959

Nonionidae Schultze, 1854

Nonion Montfort, 1808

Nonion barleeanum (Williamson)
Pl. 9, figs. 15–18

Synonyms: 1858 *Nonionina barleeanum* Williamson: p. 32, pl. 3, figs. 68, 69. – 1953 *Nonion zaandamae* (van Voorthuysen); Loeblich & Tappan: p. 87, pl. 16, figs. 11, 12. – 1964 a *N. barleeanum* (Williamson); Feyling-Hanssen: p. 329, pl. 17, figs. 7–12. – 1965 *Melonis zaandamae* (van Voorthuysen); Leslie: p. 164, pl. 7, fig. 10.

Dimensions: Specimen from the Older *Yoldia* Clay at Løkken (pl. 9, figs. 15, 16) has d = 0.50 mm, t = 0.25 mm, and one from Sandnes (pl. 9, figs. 17, 18) has d = 0.47 mm, t = 0.22 mm.

Occurrence: This species is rare in zone 1 of the Sandnes Clay and in samples from Jæren. It occurs in many samples from the Older *Yoldia* Clay in Vendsyssel, usually accounting for less than 1 % of the total fauna, with a maximum of 3 % in some samples from the Older *Yoldia* Clay at Løkken and from zone D of the Older *Yoldia* Clay at Hirtshals. A few specimens were found in the Lateglacial and Postglacial deposits in Vendsyssel.

Remarks: In the material from Løkken there are some thick forms among the specimens of *N. barleeanum;* one of those has d = 0.55 mm, t = 0.39 mm. They show affinity to *N. pompilioides* (Fichtel & Moll). Most of the present specimens are close to *N. affine* (Reuss) (cf. Boltovskoy, 1958; Nørvang, 1959), but usually have more chambers in the last-formed whorl.

Van Voorthuysen (1950 a) recorded this species in the oldest Quaternary deposits of the Netherlands, and it is found in Holsteinian deposits of SW Jutland (Buch, 1955). Feyling-Hanssen (1964 a) found the species in the late Quaternary of the Oslofjord area, where it is most common in the Holocene. *N. barleeanum* is also recorded from Postglacial deposits of SW Sweden (Hessland, 1943; Brotzen, 1951). *N. barleeanum* is found in Recent faunas of the Arctic at depths of more than 31 m (Loeblich & Tappan, 1953). Leslie (1965) found it in Hudson Bay at depths between 109 and 212 m. In the Oslofjord it occurs at depths of 30–330 m (Risdal, 1964).

N. barleeanum is found in the *Turritella terebra* Zone and in the lower part of the *Portlandia arctica* Zone of the Skærumhede boring in Vendsyssel.

Nonion labradoricum (Dawson)
Pl. 10, figs. 1, 2

Synonyms: 1860 *Nonionina labradorica* Dawson: p. 191, fig. 4. – 1939 *Nonion labradoricum* (Dawson); Cushman: p. 23, pl. 6, figs. 13–16. – 1953 Loeblich & Tappan: p. 86, pl. 17, figs. 1, 2. – 1964 a Feyling-Hanssen: p. 331, pl. 17, figs. 15–18. – 1965 *Nonionella labradorica* (Dawson); Leslie: p. 165, pl. 7, fig. 8. – 1967 *Nonionella labradoricum* (Dawson); Michelsen: p. 248, pl. 7, fig. 8. – 1967 *Florilus labradoricus* (Dawson); Todd & Low: p. 35, pl. 5, fig. 9.

Dimensions: Specimen from Sandnes (pl. 10, figs. 1, 2) has max. d = 0.73 mm, min. d = 0.53 mm, t = 0.42 mm. Specimen from Older *Yoldia* Clay at Løkken has max. d = 0.69 mm, and one from Hirtshals has max. d = 0.62 mm.

Occurrence: This species is characteristic of zone 1 of the Sandnes Clay, but occurs sparsely in other zones there. It was common in samples from Jæren. *N. labradoricum* was found in most of the samples from Older *Yoldia* Clay in Vendsyssel. It is most common in zones A, C and D of the Older *Yoldia* Clay at Hirtshals, with a frequency of 1–2 % of the total fauna. The species occurs also in the Lateglacial deposits of Vendsyssel, and a few specimens were found in the Postglacial deposits of the Løkken area.

Remarks: Most specimens of *N. labradoricum* from the Older *Yoldia* Clay at Løkken and zones A, C and D of the Older *Yoldia* Clay at Hirtshals are large, with diameters between 0.55 mm and 0.75 mm. In zones E and F at Hirtshals and in the Lateglacial deposits at Løkken they are usually smaller, with diameters ranging from 0.25 to 0.40 mm.

Madsen (1895) recorded *Nonionina scapha,* var. *labradorica* from Older *Yoldia* Clay and Lateglacial deposits of Vendsyssel and from Holsteinian deposits of SW Jutland. Buch (1955) found one specimen, recorded as *N.* cf. *labradoricum,* in the Holsteinian at Inder Bjergum, SW Jutland. This differs from *N. labradoricum* by the presence of eight pores at base of the apertural face, and by having a sharp margin.

N. labradoricum was recorded from the late Quaternary of SW Sweden (Hessland, 1943; Brotzen, 1951), of Læsø, Denmark (Michelsen, 1967) and of the Oslofjord area (Feyling-Hanssen, 1964 a). Feyling-Hanssen (1964 b) found it in Postglacial deposits of Spitsbergen. *N. labradoricum* is not known from the oldest Quaternary, and it is not known from the Holsteinian, except for a few specimens recorded by Madsen (1895) from Esbjerg brickworks, SW Jutland. The species is not known from the Eemian, except for at few specimens in the *Turritella terebra* Zone of the Skærumhede Series. It occurs also in the lower part of the *Portlandia arctica* Zone, in the upper part of the *Abra nitida* Zone, and in the lowermost glacigenic deposits of the Skærumhede boring. In Recent faunas this species is found in arctic and boreal areas, but it is most frequent in the Arctic (Nørvang, 1945). It is known from off Alaska, Canada, Greenland and Spitsbergen (Loeblich & Tappan, 1953; Leslie, 1965; Nagy, 1965). Risdal (1964) found the species in the Oslofjord at depths of 20–330 m.

Nonion umbilicatulum (Walker & Jacob)
Pl. 10, figs. 3, 4; pl. 19, figs. 2, 3

Synonyms: ? 1798 *Nautilus umbilicatulus* Walker & Jacob: p. 641, pl. 14, fig. 34. – 1803 Montagu: p. 191. – 1957 *Nonion umbilicatulus* (Walker & Jacob); van Voorthuysen: p. 29, pl. 23, fig. 4. – 1962 *N. umbilicatulum* (Walker & Jacob); Haake: p. 41, pl. 3, figs. 3, 4. – 1963 Lafrenz: p. 23, pl. 1, figs. 23–25. – 1967 Michelsen: p. 247, pl. 7, fig. 6.

Dimensions: The figured specimen from Hirtshals has max. d. = 0.25 mm, t = 0.10 mm.

Occurrence: A few specimens occurred in the Older *Yoldia* Clay and in Postglacial deposits of Vendsyssel.

Remarks: This species is known from Hoxnian (Holsteinian) deposits of the western North Sea (Fisher, Funnell & West, 1969). It is recorded from Eemian deposits of the Netherlands (van Voorthuysen, 1957) and Schleswig-Holstein (Lafrenz, 1963), and Konradi (in press) found it in the Eemian of Stensigmose, SE Jutland. Michelsen (1967) recorded this species from the late Quaternary of Læsø, Denmark. *N. umbilicatulum* occurs in Recent faunas from the coasts of the Netherlands (van Voorthuysen, 1960) and NW Germany (Haake, 1962).

Nonionella Cushman, 1926

Nonionella aff. *auricula* Heron-Allen and Earland
Pl. 10, figs. 5, 6

Dimensions: Specimen from Sandnes (pl. 10, figs. 5, 6) has max. d = 0.36 mm, min. d = 0.30 mm, t = 0.19 mm.

Description: Test ovate to subcircular in outline, slightly trochoid and moderately compressed, with rounded periphery; 9 chambers in the last-formed whorl, not inflated, slowly increasing in size as added, in addition 6 chambers of the previous whorl are visible on the spiral side; sutures distinct, curved backwards, the latest one slightly depressed, the others flush with the surface and limbate; wall calcareous, densely perforate, except for a low area above the aperture, granulate in optical respect; aperture an interiomarginal slit extending towards the umbilicus.

The present specimens differ from *N. auricula* in being thicker and having limbate sutures flush with the surface and in having less rapidly increasing chambers. They resemble *Pulvinulina lobsannensis* Andreae, 1884 (= *Nonionella lobsannensis* (Andreae)) from the Middle Oligocene of Elsass, but differ in their more broadly rounded periferal margin, broader sutures, and greater diameter.

Occurence: This species has a scattered occurrence in zone 1 of the Sandnes Clay. It also occurs in samples from Opstad and Rise, Jæren, and is present in a sample from Nygaard brickworks, Karmøy.

Nonionella auricula Heron-Allen & Earland
Pl. 10, figs. 7–9

Synonyms: 1930 *Nonionella auricula* Heron-Allen & Earland: p. 192, pl. 5, figs. 68–70. – 1953 Loeblich & Tappan: p. 92, pl. 16, figs. 6–10. – 1964 a Feyling-Hanssen: p. 327, pl. 16, figs. 21–23. – 1965 Leslie: p. 164, pl. 7, fig. 7.

Dimensions: Specimen from Sandnes (pl. 10, figs. 7–9) has max. d = 0.40 mm, min. d = 0.27 mm, t = 0.17 mm.

Occurrence: A few specimens occur in zone 1 of the Sandnes Clay, and the species is also present in the samples from Karmøy. It is found in the Older *Yoldia* Clay and in the Lateglacial *Yoldia* Clay of Vendsyssel, usually accounting for less than 1 % of the total fauna.

Remarks: Feyling-Hanssen (1964 a and b) found this species in late Quaternary deposits of the Oslofjord area and from Postglacial deposits of Spitsbergen. Loeblich & Tappan (1953) found it in Recent arctic areas at water depths of more than 21 m, and in Hudson Bay it occurs at depths between 26 and 130 m (Leslie, 1965). The species is known from the coasts of New England (Cushman, 1944) and from off the British Isles (Heron-Allen & Earland, 1930).

Nonionella iridea Heron-Allen & Earland

Synonyms: 1932 *Nonionella iridea* Heron-Allen & Earland: p. 438, pl. 16, figs. 14–16. – 1964 a Feyling-Hanssen: p. 327, pl. 16, figs. 24–26.

Dimensions: One specimen was found in Older *Yoldia* Clay at Frederikshavn: max. d = 0.20 mm, min. d = 0.18 mm, t = 0.13 mm.

Nonionella turgida (Williamson)

Synonyms: 1858 *Rotalina turgida* Williamson: p. 50, pl. 4, figs. 95–97. – 1939 *Nonionella turgida* (Williamson); Cushman: p. 32, pl. 9, figs. 2, 3. – 1964 a Feyling-Hanssen: p. 328, pl. 17, figs. 2–6. – 1967 Michelsen: p. 247, pl. 7, figs. 7 a, b.

Dimensions: One specimen occurred in Older *Yoldia* Clay at Løkken: max. d = 0.28 mm, min. d = 0.16 mm, t = 0.13 mm.

Astrononion Cushman & Edwards, 1937

Astrononion gallowayi Loeblich & Tappan
Pl. 10, figs. 10–12

Synonyms: 1953 *Astrononion gallowayi* Loeblich & Tappan: p. 90, pl. 17, figs. 4–7. – 1964 a Feyling-Hanssen: p. 332, pl. 18, fig. 4. – 1967 Michelsen: p. 246, pl. 7, fig. 5.

Dimensions: Specimen from Lateglacial *Yoldia* Clay at Bindslev (pl. 10, fig. 10) has max. d = 0.38 mm, t = 0.15 mm, and one from Nygaard brickworks, Karmøy (pl. 10, figs. 11, 12) has max. d = 0.46 mm, t = 0.21 mm.

Occurrence: Some specimens of *A. gallowayi* occur in zone 1 of the Sandnes Clay and in surface samples from Jæren and Karmøy. It is very rare in zone 3. It is found in the Older *Yoldia* Clay and the Lateglacial deposits of Vendsyssel, usually accounting for less than 1 % of the total fauna. A few specimens were found in the Postglacial deposits.

Remarks: *A. gallowayi* is very close to *A. hamadense* Asano, 1950, which is widely distributed in cold waters off Japan and which also occurs in the Pliocene of Japan (Ishiwada, 1964). *A. gallowayi* is known from Holsteinian deposits of Schleswig-Holstein (Woszidlo, 1962). It is found in the late Quaternary of the Oslofjord area (Feyling-Hanssen, 1964 a), of Spitsbergen (Feyling-Hanssen, 1964 b) and of Læsø, Denmark (Michelsen, 1967). Loeblich & Tappan (1953) and Leslie (1965) recorded the species from Recent arctic faunas, and Risdal (1964) found it at depths between 25 and 330 m in the Oslofjord.

Pullenia Parker & Jones, 1862

Pullenia bulloides (d'Orbigny)
Pl. 10, figs. 13, 14

Synonyms: 1826 *Nonionina bulloides* d'Orbigny: p. 293, no. 2. – 1943 *Pullenia bulloides* (d'Orbigny); Cushman & Todd: p. 13, pl. 2, figs. 15–18. – 1964 a Feyling-Hanssen: p. 333, pl. 13, figs. 1, 2.

Dimensions: Specimen from Sandnes (pl. 10, figs. 13, 14) has d = 0.31 mm, t = 0.28 mm.

Occurrence: One specimen was found in zone 1 of boring no. II in Sandnes, and it was also found in a sample from Kvellur, Ganddal. *P. bulloides* occurs in all the late Quaternary deposits of Vendsyssel, but it is rare.

Remarks: *P. bulloides* is found in the oldest Quaternary deposits of the Netherlands (van Voorthuysen, 1950 b). Feyling-Hanssen (1964 a) recorded it from Postglacial deposits of the Oslofjord area. In the Oslofjord this species is found at depths between 30 and 330 m (Risdal, 1964).

Pullenia osloensis Feyling-Hanssen

Synonyms: 1954 a *Pullenia quinqueloba minuta* Feyling-Hanssen: p. 133, pl. 2, fig. 3. – 1954 b *P. osloensis,* new name, Feyling-Hanssen: p. 194, pl. 1, figs. 33–35. – 1964 a Feyling-Hanssen: p. 334, pl. 18, figs. 5, 6.

Dimensions: Specimen from Hirtshals has max. d = 0.17 mm, t = 0.10 mm.

Occurrence: One specimen was found in the clay layer of the gravel pit at Foss-Eigeland, Jæren, one at Kvellur, and a few in the Older *Yoldia* Clay at Hirtshals.

Remarks: *P. osloensis* was described from late Quaternary deposits of the Oslofjord area. In the Oslofjord it has been recorded from depths between 30 and 330 m (Risdal, 1964).

Pullenia subcarinata (d'Orbigny)

Synonyms: 1939 b *Nonionina subcarinata* d'Orbigny: p. 28, pl. 5, figs. 23, 24. – 1958 *Pullenia quinqueloba* (Reuss); Batjes: p. 139, pl. 6, fig. 8. – 1960 *P. subcarinata* (d'Orbigny); Barker: p. 174, pl. 84, figs. 14, 15. – 1964 a Feyling-Hanssen: p. 334, pl. 18, figs. 7, 8.

Dimensions: Specimen from Sandnes has max. d = 0.28 mm, min. d = 0.23 mm, t = 0.17 mm (last chamber broken). Specimen from Hirtshals has max. d = 0.30 mm, t = 0.18 mm.

Occurrence: This species occurs in zone 1 of the Sandnes Clay and in a sample from Lerbrekk, Jæren. A few specimens were found in the Older *Yoldia* Clay and in the Lateglacial *Yoldia* Clay of Vendsyssel.

Remarks: Feyling-Hanssen (1964 a) recorded *P. subcarinata* from the Postglacial of the Oslofjord area. It is found in the Oslofjord at depths between 30 and 330 m (Risdal, 1964).

Elphidiidae Galloway, 1933

Elphidium Montfort, 1808

Elphidium albiumbilicatum (Weiss)

Pl. 10, figs. 15–19; pl. 19, figs. 4–8

Synonyms: 1954 *Nonion pauciloculum* Cushman, subsp. *albiumbilicatum* Weiss: p. 157, pl. 32, figs. 1, 2. – 1957 *N. depressulus* (Walker & Jacob), forma *asterotuberculatus* van Voorthuysen: p. 28, pl. 23, fig. 3. – 1960 *N. depressulus* (Walker & Jacob), forma *asterotuberculata* van Voorthuysen: p. 254, pl. 11, fig. 21. – 1962 *N. depressulum* (Walker & Jacob), forma *asterotuberculatum* van Voorthuysen; Haake: p. 41, pl. 3, fig. 5. – 1963 *N. pauciloculum* Cubhman, subsp. *albiumbilicatum* Weiss; Lafrenz: p. 22, pl. 1, figs. 19–22. – 1965 *Cribrononion asklundi* (Brotzen); Lutze: p. 104, pl. 15, fig. 42. – 1969 *Protelphidium asterotuberculatus* (van Voorthuysen); Gudina: p. 35, pl. 12, fig. 6.

Dimensions: Specimen from Hirtshals (pl. 10, fig. 15) has max. d. = 0.39 mm, t = 0.15 mm. Specimen from the Postglacial at Løkken (pl. 10, figs. 16, 17) has max. d = 0.50 mm, t = 0.20 mm, and another one from the same deposit (pl. 19, figs. 4–8) has max. d = 0.46 mm. Specimen from Sandnes (pl. 10, figs. 18, 19) has max. d = 0.41 mm, min. d = 0.35 mm, t = 0.18 mm.

Ocurrence: *E. albiumbilicatum* was found in all the borings from Sandnes, it was rare but scattered through all zones. A few specimens occurred in some of the surface samples from Sandnes and Jæren. It is found in all the Quaternary deposits of Vendsyssel. In the Older *Yoldia* Clay at Hirtshals it is most frequent in zone E, accounting for 6–56 % of the total fauna, and in zone F in which it accounts for 3–16 %, and is also quite common in zone D. In the Postglacial deposits of the Løkken area the species usually accounts for less than 3 % of the total fauna, maximum 15 %.

Remarks: *E. albiumbilicatum* has a central area and sutures with opaque bands of papillate shell material (pl. 19, figs. 6–8) which taper towards the

periphery. The aperture is a basal slit. Sutural pores are observed in specimens from the Quaternary of Vendsyssel, but not in specimens from the Sandnes Clay. The wall structure of the present specimens is radiate, and the species is therefore transferred to the genus *Elphidium.* Some af the specimens of *E. subarcticum* Cushman, 1944, from the late Quaternary of the Oslofjord area (Feyling-Hanssen, 1964 a) and from the Recent faunas of the Oslofjord (Risdal, 1964) should be referred to *E. albiumbilicatum.*

Lutze (1965) recorded *Cribrononion asklundi* from Recent faunas of the Baltic; he considered *E. hallandense* Brotzen and *Nonion depressulus,* forma *asterotuberculatus* van Voorthuysen as being synonymous with *E. asklundi* Brotzen. Lutze's specimens are, however, small, less than 0.5 mm, whereas Brotzen's *E. asklundi* has max. d = 1.0 mm and *E. hallandense* (= *E. subarcticum*) 0.75 mm. For this reason Lutze suggested that the material from the Baltic consisted of juvenile specimens; however, the small size as well as the lack of double rows of pores in Lutze's specimens suggest that they do not belong to Brotzen's species.

For the purpose of comparison, the greatest diameter of 50 specimens of *E. albiumbilicatum,* 50 specimens of *E. asklundi* and 50 specimens of *E. subarcticum* from the coast cliff of Hirtshals, was measured. The mean greatest diameter of *E. albiumbilicatum* is 0.33 mm, standard deviation 0.06 mm, *E. asklundi* has mean greatest diameter 0.83 mm, standard deviation 0.09 mm, and the mean greatest diameter of *E. subarcticum* is 0.6 mm, standard deviation 0.1 mm. The means are compared by Student's t-test (Miller & Kahn, 1965); this shows that the means of the greatest diameters are different at a 0.05 level of signifiance. Due to this, and also to difference in other characters, the species are considered to be well-defined and easily distinguishable.

Weiss (1954) described this species from Gardiners Clay, New York, supposedly of Pleistocene interglacial age. Woszidlo (1962) recorded it from the Holsteinian of Schleswig-Holstein, and some of his specimens have elongate slits in some of the sutures and the number of chambers in the last-formed whorl is 6–8, whereas Weiss' specimens have 7–9. Woszidlo thus found great affinity to exist between this species and *N. depressulus,* forma *asterotuberculatus* van Voorthuysen, 1957 from Eemian deposits of Amersfoort in the Netherlands. Lafrenz (1963) found *E. albiumbilicatum* in Eemian deposits of Schleswig-Holstein, and he places van Voorthuysen's *N. d.* f. *asterotuberculatus* in the synonomy of *E. albiumbilicatum.* It is possible that *Protelphidium* sp. 3 of Michelsen (1967) from the Lateglacial of Læsø, Denmark also belongs here. Konradi (in press) found this species in Eemian deposits at Stensigmose, SW Jutland, and Gudina (1969) recorded it from the Quaternary of Siberia. Rottgardt (1952) found that *E. albiumbilicatum* (recorded as *E. asklundi*) is common in areas with a salinity down to

0.35 % along the coast of eastern Holstein. Only a few specimens occur in the open sea at greater depths. It is found in Recent faunas off NW Germany (Haake, 1962) and in shallow and brackish waters in the Baltic (Lutze, 1965). In the Oslofjord (Risdal, 1964) the species is found at depths down to 10 m, it is most frequent between 4 and 6 m.

Elphidium asklundi Brotzen
Pl. 10, figs. 20, 21; pl. 11, figs. 1–5

Synonyms: 1943 *Elphidium asklundi* Brotzen, in Hessland: p. 267, fig. 109-1. – 1966 Feyling-Hanssen: fig. 11.

Dimensions: Specimen from the Older *Yoldia* Clay at Løkken (pl. 10, figs. 20, 21) has max. d = 1.16 mm, t = 0.53 mm. Specimen from the Older *Yoldia* Clay at Stortorn (pl. 11, fig. 1) has max. d = 0.95 mm, t = 0.40 mm, one from Sandnes (pl. 11, figs. 2, 3) has max. d = 0.88 mm, min. d = 0.73 mm, t = 0.39 mm, and one from Hirtshals (pl. 11, fig. 4, 5) has max. d = 0.94 mm, t = 0.45 mm.

Occurrence: This species occurs in zones 1, 2 and 3 of the Sandnes Clay, being particularly characteristic of zone 3. It occurred also in samples from Jæren and Karmøy. *E. asklundi* is characteristic of the Older *Yoldia* Clay of Vendsyssel. It is found in all fossiliferous zones at Hirtshals except zone B. In zone C it accounts for up to 21 % of the total fauna. This species occurs also in the Lateglacial *Zirfaea* layers, and a single specimen was found in the Younger *Yoldia* Clay at Gølstrup.

Remarks: *E. asklundi* is usually milk-white in colour with 9–12 chambers in the last-formed coil. The sutures have irregular double rows of pores, the aperture consists of a row of pores at the base of the apertural face, and the wall structure is granulate. Some specimens from zones E, F and D at Hirtshals are more flattened than usual and have irregular double rows of elongate slits in the sutures. These forms seem related to *E. incertum* (Williamson), but, as it is extremely difficult to distinguish them from the thicker and more typical *asklundi* forms, they were all referred to *E. asklundi* in the Hirtshals material.

Brotzen (1943) described *E. asklundi* from Lateglacial deposits in Halland, Sweden, and later he found the species in Lateglacial and early Postglacial deposits at Surte, Sweden (1951). It was recorded from Icenian

deposits of the Netherlands (van Voorthuysen, 1949 a) and from the Holsteinian of SW Jutland (Buch, 1955). Madsen (1895) recorded *Polystomella arctica* Parker & Jones from Holsteinian deposits, Older *Yoldia* Clay and Lateglacial deposits. He pointed out that the specimens often have sutures with irregular double rows of pores and also that some of them are very close to *E. incertum* (recorded as *Polystomella striatopunctata,* var. *incerta* Williamson). Madsen's *P. arctica* should most probably be referred to *E. asklundi.*

E. asklundi occurs in material from the Skærumhede boring in Vendsyssel, and is most common in the *Abra nitida* Zone, in a part of the *Turritella terebra* Zone and in the lower glacigenic deposits of the boring.

Elphidium bartletti Cushman
Pl. 11, figs. 6–9; pl. 20, figs. 1–4

Synonyms: 1933 *Elphidium bartletti* Cushman: p. 4, pl. 1, fig. 9. – 1939 Cushman: p. 64, pl. 18, fig. 10. – 1948 Cushman: p. 59, pl. 6, fig. 13. – 1946 *E. goësi* Stschedrina: p. 144, pl. 4, fig. 20. – 1953 *E. bartletti* Cushman; Loeblich & Tappan: p. 96, pl. 18, figs. 10–14. – 1958 *Cribroelphidium vulgare* Voloshinova: p. 174, pl. 7, figs. 2–10. – 1961 *C. goësi* (Stschedrina); Saidova: p. 80, pl. 24, fig. 166. – 1963 *Elphidium bartletti* Cushman; Lafrenz: p. 27, pl. 2, figs. 21–23; pl. 3, figs. 1–4. 1964 b Feyling-Hanssen: p. 48, pl. 3, figs. 8, 9. – 1964 Ishiwada: p. 38, pl. 3, fig. 44. – 1965 Leslie: p. 160, pl. 8, fig. 10. – 1966 *Cribroelphidium goësi* (Stschedrina); Gudina: p. 58, pl. 3, figs. 1–6; pl. 10, fig. 4; pl. 11, fig. 5; text-fig. 8. – 1967 *Elphidium bartletti* Cushman; Todd & Low: p. A 33, pl. 4, fig. 19.

Dimensions: Specimen from Sandnes (pl. 11, figs. 6, 7) has max. d = 0.67 mm, min. d = 0.51 mm, t = 0.32 mm, and another one from Sandnes (pl. 11, figs. 8, 9) has max. d = 0.80 mm, min. d = 0.62 mm, t = 0.40 mm (both specimens have last chamber broken). Another specimen from the same locality (pl. 20, figs. 1–4) has max. d = 0.88 mm, min. d = 0.68 mm, t = 0.42 mm.

Occurrence: *E. bartletti* is common in the Sandnes Clay, usually accounting for 1–5 % of the fauna in samples from zone 1 and 1–20 % in samples from zone 3. It occurred in many of the surface samples from Sandnes, Ganddalen and Jæren, and was common in the samples from Karmøy. *E. bartletti* is rare in the late Quaternary of Vendsyssel, where it accounts for less than 1 % of the total fauna of the Older *Yoldia* Clay, and only a few specimens were found in the Lateglacial *Yoldia* Clay and in the Lateglacial *Zirfaea* layers.

Remarks: Cushman described *E. bartletti* from Labrador and other arctic waters as having 10–12, or more, chambers in the last-formed whorl, having a greatest diameter of 0.90 mm and being 0.35 mm thick. Loeblich & Tappan (1953) found specimens with 7 to 12 chambers in the last-formed whorl, most commonly 9 or 10, in their material from Greenland and the North American Arctic. They considered *Cribroelphidium arcticum* Tappan from the Alaskan Pleistocene to be identical with *E. bartletti.* Stschedrina (1946) described *Elphidium goësi* with 9–10 chambers, from arctic seas. The figured holotype is slightly thicker than Cushman's figure of *E. bartletti,* but, as Gudina (1966, pp. 59, 60) remarks it is hardly possible to separate it from *E. bartletti.* The present writers also consider the two conspecific. Gudina (1966, p. 58) enters *Cribroelphidium vulgare* Voloshinova in her synonymy of *C. goësi,* a concept which is followed by the present writers.

Most of the specimens of *E. bartletti* from Karmøy, Sandnes, Jæren and Vendsyssel agree with the general concept of the species, e.g. as figured by Loeblich & Tappan (1953, pl. 18, figs. 11–14). The periphery is broadly rounded, the peripheral margin moderately, if at all, lobate; sutures quite broad but narrowing towards the periphery; the umbilical area as well as the sutural depressions, most of the apertural face and the area below it have a densely papillate surface (pl. 20, figs. 3, 4), the so-called "granular or vesicular shell material". The sutural pores are of irregular form, often elongate and even slit-like, and scattered pores occur over the central area. A few specimens have a more restricted central area, forming almost a stellate depression, and narrower sutures. They resemble the specimen in Loeblich & Tappan's fig. 10.

E. bartletti has mainly been recorded from the Arctic, from shallow water down to a depth of 1,140 m (Stschedrina, 1958, *Cribroelphidium goësi,* 99–1,140 m in the Greenland Sea); usually, however, it occurs at depths less than 100 m. It is found as far south as off Kushiro, eastern Hokkaido, at 36–228 m (Ishiwada, 1964). It is rare in southern Alaskan fjord stations, at 20–50 m (Todd & Low, 1967), and F. L. Parker (1952 a, p. 411) recorded it, as *Elphidium articulatum* (d'Orbigny), from off New Hampshire on the North American east coast. Gudina (1966, p. 21) conidered *E. bartletti* a boreo-arctic species.

Feyling-Hanssen (1964 b) found this species in Holocene warm interval deposits in Spitsbergen; only 2 specimens have been found in deposits of Younger *Dryas* age in the Oslofjord area (Feyling-Hanssen, 1964 a). Konradi (in press) recorded it from the Eemian of Stensigmose, Jutland, and it is regarded as characteristic of the Eemian of Schleswig-Holstein (Lafrenz, 1963; Lafrenz & Woszidlo, 1963). It is not found in Holsteinian (Hoxnian) deposits there, but Catt & Penny (1966, p. 409) recorded it from the Bridlington Crag at Dimlington, Holderness, which they supposed to be of Hol-

steinian age. Three specimens occurred in Weybourne Crag (Funnell, 1961) and Gudina (1966) recorded it from the Siberian Quaternary. A few specimens occur in material from the Skærumhede boring in Vendsyssel.

Elphidium clavatum Cushman
Pl. 11, figs. 10–13; pl. 20, figs. 5–8

Synonyms: 1930 *Elphidium incertum* (Williamson); Cushman (not *Polystomella umbilicatula,* var. *incerta* Williamson, 1858): pp. 18, 19, pl. 7, figs. 8, 9. – 1930 *E. incertum,* var. *clavatum* Cushman: p. 20, pl. 7, fig. 10. – 1939 Cushman: p. 57, pl. 16, figs. 1, 2. – 1953 *E. clavatum* Cushman; Loeblich & Tappan: p. 98, pl. 19, figs. 8–10. – 1964 a *E. incertum incertum* (Williamson); Feyling-Hanssen (not *Polystomella umbilicatula,* var. *incerta* Williamson, 1858): p. 344, pl. 19, figs. 16, 17; pl. 20, figs. 9, 10. – 1964 a *E. incertum clavatum* Cushman; Feyling-Hanssen: p. 345, pl. 20, figs. 11–15. – 1965 *E. clavatum* Cushman; Buzas: p. 23, pl. 3, figs. 3, 4. – 1965 *E. incertum* (Williamson); Leslie: p. 160, pl. 8, figs. 1–8. – 1966 *E. clavatum* Cushman; Buzas: pp. 585–594, pl. 71, figs. 1–8. – 1966 *E. subclavatum* Gudina; Gudina: p. 45, pl. 4, figs. 4–10; pl. 9, fig. 3; pl. 10, fig. 3. – 1967 *E. clavatum* Cushman; Michelsen: p. 236, pl. 4, fig. 6.

Dimensions: Specimen from Sandnes (pl. 11, figs. 10, 11) has max. d = 0.36 mm, min. d = 0.29 mm, t = 0.18 mm, and another one from Sandnes (pl. 11, fig. 13) has max. d = 0.38 mm, min. d = 0.31 mm, t = 0.18 mm. Specimen from the Lateglacial at Løkken (pl. 11, fig. 12) has max. d = 0.29 mm, t = 0.16 mm, and another one from the same deposit (pl. 20, figs. 7, 8) has max. d = 0.28 mm. Specimen from the Postglacial at Løkken (pl. 20, figs. 5, 6) has max. d = 0.36 mm, and another one from these deposits max. d = 0.44 mm. Fifty randomly chosen specimens from the Older *Yoldia* Clay at Hirtshals were measured: Average diameter is 0.27 mm with a standard deviation of 0.04 mm. The number of chambers in the last formed coil is 8–11, mostly 9.

Occurrence: This species dominates the microfauna of almost all fossiliferous samples from the borings at Sandnes as well as those from the late Quaternary of Jæren, accounting for 40 to almost 100 % of the specimens. *E. clavatum* is a dominant species in the Older *Yoldia* Clay and in the Lateglacial deposits of Vendsyssel. Usually it accounts for 40–60 % of the total fauna, maximum 98 %. It occurs in most samples from the Postglacial, but usually with a percentage of less than 5 %. In a few samples it accounted for 30 %.

Remarks: Some specimens of *E. clavatum* from Postglacial deposits in Vendsyssel should most probably be referred to *E. selseyense* (Heron-Allen

& Earland, 1909). Transitional forms seem to occur, however, and at the present state of knowledge, they are all classed as *E. clavatum*.

E. clavatum is found in the oldest Quaternary of the Netherlands (van Voorthuysen, 1949 a, 1950 a and b). Buch (1955) and Woszidlo (1962) recorded the species from Holsteinian deposits of SW Jutland and Schleswig-Holstein, and Fisher, Funnel & West (1969) found it in the Holsteinian of the western North Sea. It is frequent in Eemian deposits at Stensigmose, SE Jutland (Konradi, in press). Madsen (1895) recorded this species from Quaternary deposits in Denmark and Schleswig-Holstein, and Gudina (1966, 1969) found it in the Quaternary of Siberia. *E. clavatum* is recorded from late Quaternary deposits of SW Sweden (Hessland, 1943; Brotzen, 1951), the Oslofjord area (Feyling-Hanssen, 1964 a), Spitsbergen (Feyling-Hanssen, 1964 b), Læsø, Denmark (Michelsen, 1967) and Maine, USA (Buzas, 1965). Its Recent distribution seems to be arctic-boreal (Cushman, 1939). It is one of the most frequent species in Recent arctic faunas in the Atlantic as well as in the Pacific (Cushman, 1948; Loeblich & Tappan, 1953; Saidova, 1961; Leslie, 1965; Nagy, 1965). Risdal (1964) found this species in the Oslofjord at all depths down to the deepest sample at 330 m; it is not frequent.

Only a few specimens occur in the material from the Skærumhede boring in Vendsyssel; this is probably due to the old preparation methods, which may have excluded small specimens.

Elphidium gerthi van Voorthuysen
Pl. 11, fig. 14

Synonyms: 1951 *Elphidium* sp. 1 van Voorthuysen: p. 25, pl. 2, fig. 19. – 1957 *Elphidium gerthi* van Voorthuysen: p. 32, pl. 23, fig. 12. – 1962 Haake: p. 48, pl. 5, fig. 10. – 1962 *Elphidium* sp. 1 Haake: p. 51, pl. 5, fig. 9. – 1963 *E. gerthi* van Voorthuysen; Lafrenz: p. 28, pl. 3, figs. 5, 6. – 1967 Michelsen: p. 238, pl. 5, fig. 3.

Dimensions: Specimen from the Postglacial at Løkken (pl. 11, fig. 14) has max. d = 0.31 mm, t = 0.14 mm.

Occurrence: Some specimens occur in zone 1 of the Sandnes Clay, but it is more common at Reve, Jæren; 3 specimens were observed in a sample from Karmøy. *E. gerthi* occurs in most of the fossiliferous samples from the Postglacial of Vendsyssel, usually accounting for 1–4 % of the total fauna. A few specimens were found in the Lateglacial *Yoldia* Clay and in the Older *Yoldia* Clay of Vendsyssel.

Remarks: Haake (1962) found transitional forms between the typical *E. gerthi* with a clear umbilical plug and forms without a plug (referred to as *Elphidium* sp. 1). Lafrenz (1963) referred all these different forms to *E. gerthi* in the Eemian of Schleswig-Holstein. In the material from the late Quaternary deposits of the Løkken area the same variations were observed and they are all classed as *E. gerthi.*

This species is found in Holsteinian deposits of Schleswig-Holstein (Woszidlo, 1962). It is recorded from the Eemian of the Netherlands (van Voorthuysen, 1957) and at Stensigmose, SE Jutland (Konradi, in press). Michelsen (1967) recorded it from late Quaternary deposits of Læsø, Denmark. This species is known from the tidal flats off the Netherlands (van Voorthuysen, 1951 and 1960) and off NW Germany (Haake, 1962). Lutze (1965) found *E.* cf. *gerthi* in the Baltic; this form should probably also be referred to *E. gerthi.* It is found at depths exceeding 15 m in areas with a salinity of more than 1 ‰. Van Voorthuysen (1957) considered *E. gerthi* to be a brackish-water species.

Elphidium groenlandicum Cushman
Pl. 12, figs. 1–8; pl. 21, figs. 1–3

Synonyms: 1933 *Elphidium groenlandicum* Cushman: p. 4, pl. 1, fig. 10. – 1939 *Elphidiella groenlandica* (Cushman); Cushman: p. 66, pl. 19, fig. 3. – 1953 Loeblich & Tappan: p. 106, pl. 19, figs. 13, 14. – 1957 *Elphidium discoidale* (d'Orbigny); Todd (not *Polystomella discoidalis* d'Orbigny 1839 b): p. 224, pl. 28, fig. 14. – 1961 *E. batialis* Saidova: p. 77, pl. 23, fig. 161. – 1964 *E. abyssicola* Ishiwadi: p. 38, pl. 3, figs. 48, 49. – 1967 *Elphidiella groenlandica* (Cushman); Todd & Low: p. 34, pl. 4, fig. 21. – 1969 *E. tumida* Gudina: p. 40, pl. 13, fig. 4; pl. 14, figs. 1, 2. – 1969 *E. groenlandica* (Cushman); Gudina: p. 40, pl. 13, fig. 3.

Dimensions: Specimen from Sandnes (pl. 12, figs. 1, 2) has max. d = 0.68 mm, min. d = 0.59 mm, t = 0.38 mm, and one from Elgane, Jæren, (pl. 12, fig. 3) has max. d = 0.63 mm, min. d = 0.57 mm, t = 0.38 mm. Specimen from the Older *Yoldia* Clay at Frederikshavn (pl. 12, fig. 8) has max. d = 1.50 mm, t = 0.75 mm and one from the Older *Yoldia* Clay at Løkken (pl. 12, figs. 4, 5) has max. d = 0.93 mm, t = 0.58 mm. Hypotype from Hirtshals (pl. 12, figs. 6, 7; pl. 21, figs. 1–3) has max. d = 0.80 mm, t = 0.40 mm. Fifty randomly chosen specimens from Hirtshals were measured; average of greatest diameter is 0.9 mm, standard deviation 0.3 mm, number of chambers in the last-formed whorl is 11–16, mostly 12. Average diameter of 100 specimens from the *Portlandia arctica* Zone (96.7–97.0 m below

the surface) of the Skærumhede boring is 1.0 mm, standard deviation 0.2 mm, number of chambers 11–17, mostly 14.

Occurrence: This species is rare in the Quaternary of Sandnes and Jæren, but it is a characteristic member of the assemblage. One or a few specimens were found in samples from Jæren and in many samples from zone 1 of the borings in Sandnes. One specimen occurred in zone 3 of boring no. II. *E. groenlandicum* is a characteristic species in the Older *Yoldia* Clay of Vendsyssel; it is rare, usually accounting for less than 1 % of the total fauna. The species is most common in zones A and D of the Older *Yoldia* Clay at Hirtshals. Single specimens of this species were found in Late- and Postglacial deposits of Vendsyssel.

Remarks: *Elphidium groenlandicum* was described by Cushman in 1933. In 1939 he transferred the species to *Elphidiella* observing that, like many arctic species, this one also has double rows of sutural pores. Gudina (1969) described a new species, *Elphidiella tumida,* characterised by irregular double rows of pores and distinguished from *E. groenlandica* by the absence of an acute periphery and the characteristic pinnate appearance of the sutures. It has 12–15 chambers in the last-formed whorl, whereas *E. groenlandica* has 14–17. In the present material some specimens have a single row of pores in all sutures, others have a single row in some sutures and double rows in other sutures, and some have double rows in all sutures. The rows may be irregular, so that they are double towards the central part of the test and single towards the periphery, but they may also be regularly double throughout the suture. There thus occurs in the present material transitional forms which make it impossible to keep to two species apart. *Elphidium groenlandicum* has priority and we have returned the species to the genus *Elphidium* because of its irregular or inconsistent double rows of sutural pores.

Todd (1957) recorded this species, as *Elphidium discoidale* (d'Orbigny), from Miocene or Pliocene deposits at Carter Creek, Alaska, and Gudina (1969), as *Elphidiella tumida,* from the Quaternary of Siberia. It has been recorded in arctic waters at depths exceeding 13 m (Cushman, 1933, 1939, 1948; Nørvang, 1945; Loeblich & Tappan, 1953; Todd & Low, 1967; Gudina, 1969). *Elphidium batialis* Saidova, 1961, and *E. abyssicola* Ishiwada, 1964, seem to resemble *E. groenlandicum,* but a closer comparison has not been undertaken.

E. groenlandicum is frequent in the *Portlandia arctica* Zone of the Skærumhede boring, and occurs also in the *Abra nitida* Zone, the *Turritella terebra* Zone and in the lowermost glacigenic deposits.

Elphidium gunteri Cole
Pl. 12, figs. 9, 10; pl. 21, figs. 4–7

Synonyms: 1931 *Elphidium gunteri* Cole: p. 34, pl. 4, figs. 9, 10. – 1939 Cushman: p. 49, pl. 13, fig. 10. – 1962 Haake: p. 48, pl. 5, figs. 3, 4. – 1963 Lafrenz: p. 29, pl. 3, figs. 7, 8.

Dimensions: Specimen from Hirtshals (pl. 12, figs. 9, 10) has d = 0.71 mm, t = 0.32 mm, and one from the Postglacial at Løkken (pl. 21 figs. 4–7) has d = 0.39 mm.

Occurrence: *E. gunteri* occurs in many samples from Postglacial deposits of the Løkken area. It usually accounts for less than 1 % of the total fauna, with a maximum of 10 %. A few specimens were found in the Lateglacial *Yoldia* Clay and in the Older *Yoldia* Clay of Vendsyssel.

Remarks: *E. gunteri* has a characteristic papillate surface in its central area, along the sutures and in the lower part of the apertural face (pl. 21, figs. 6, 7) even the prominent central knobs have a marginal ornament of low, conical papillae. There is a row of circular pores above and parallel to the basal aperture.

E. gunteri was described from Pliocene in Florida (Cole, 1931). It is recorded from the Eemian of the Netherlands (van Voorthuysen, 1957) and of Stensigmose, SE Jutland (Konradi, in press). Lankford (1959) suggested that *E. gunteri* may tolerate great ecological variations. He recorded it from the Mississippi delta at depths exceeding 0.3 m. It is most common towards the open shelf, and does not occur in the marsh fauna. Phleger (1956) recorded this species from the coasts of Texas at depths of less than 50 m. F. L. Parker (1954) found *E. gunteri* at depths down to 185 m in the Mexican Gulf, but it is most frequent at depths less than 50 m. Cushman (1944) recorded it from the coasts of North Carolina and New England. It is found in shallow-water areas with brackish water along the coasts of the Netherlands (van Voorthuysen, 1951 and 1960), Langeoog (Haake, 1962) and Jade Bay (Richter, 1964 a).

Elphidium incertum (Williamson)
Pl. 12, figs. 11, 12; pl. 21, figs. 8, 9

Synonyms: 1858 *Polystomella umbilicatula,* var. *incerta* Williamson: p. 44, pl. 3, fig. 82 a. – 1948 *Elphidium incertum* (Williamson); Cushman: pp. 56, 57, pl. 6, figs.

7 a, b. – 1953 Loeblich & Tappan: p. 100. – 1965 *E. varium* Buzas: pp. 21, 22, pl. 2, fig. 7; pl. 3, figs. 1, 2. – 1966 *E. incertum* (Williamson); Buzas: pp. 585–594, pl. 72, figs. 1–6.

Dimensions: Specimen from Postglacial deposits at Løkken (pl. 12, figs. 11, 12) has max. d = 0.59 mm, t = 0.25 mm, and another one from the same deposit (pl. 21, figs. 8, 9) has max. d = 0.61 mm, t = 0.25 mm.

Occurrence: *E. incertum* is very rare in zones 1 and 3 of the Sandnes Clay as well as in samples from Jæren. It is more common in the samples from Karmøy. *E. incertum* occurs in all the late Quaternary deposits of Vendsyssel, but it is never frequent.

Remarks: Some specimens of *E. incertum* in the present material show resemblance to *E. asklundi* Brotzen and it is sometimes difficult to separate the two species. The wall structure of *E. incertum* is granulate. It was recorded from Eemian deposits of Schleswig-Holstein (Lafrenz, 1963) and of Stensigmose, SE Jutland (Konradi, in press). Michelsen (1967) found it in Late- and Postglacial deposits on Læsø, Denmark. *E. incertum* is common in Hudson Bay (Leslie, 1965).

Elphidium macellum (Fichtel & Moll)
Pl. 12, figs. 13, 14; pl. 22, figs. 1–4

Synonyms: 1798 *Nautilus macellus* Fichtel & Moll: p. 66, var. B, pl. 10, figs. h–k. – 1939 *Elphidium macellum* (Fichtel & Moll); Cushman: p. 51, pl. 14, figs. 1–3; pl. 15, figs. 9, 10. – 1943 Hessland: pl. 3, fig. 40. – 1960 Barker: p. 226, pl. 110, figs. 8, 11. – 1964 a Feyling-Hanssen: p. 347, pl. 20, fig. 16. – 1967 Michelsen: p. 239, pl. 5, fig. 5.

Dimensions: Figured specimen from the Postglacial at Løkken has max. d = 0.61 mm, t = 0.20 mm.

Occurrence: *E. macellum* occurred in many samples from the Postglacial deposits of Vendsyssel, but it was never frequent. A few specimens were found in the Lateglacial deposits and in the Older *Yoldia* Clay of Vendsyssel.

Remarks: The wall surface of this species is strewn with short, blunt papillae (pl. 22, fig. 4) which in the ordinary stereomicroscope looks like a coarse perforation. A real perforation is not seen on the scanning electron micrographs. Papillae are also scattered over the apertural face and densely surround the apertural holes being inclined towards the center of the holes (pl. 22, fig. 3).

E. macellum is recorded from Postglacial deposits of the Oslofjord area (Feyling-Hanssen, 1964 a) and from the late Quaternary of Læsø, Denmark (Michelsen, 1967). Hessland (1943) found the species in young Postglacial deposits in SW Sweden. It was originally described from Recent Mediterranean faunas.

Elphidium magellanicum Heron-Allen & Earland
Pl. 12, figs. 15, 16

Synonyms: 1932 *Elphidium magellanicum* Heron-Allen & Earland: p. 440, pl. 16, figs. 26–28. – 1939 Cushman: p. 62, pl. 17, figs. 11, 12. – 1963 Lafrenz: p. 30, pl. 3, figs. 14–16. – 1967 Michelsen: p. 240, pl. 5, fig. 6.

Dimensions: Specimen from the Postglacial at Løkken (pl. 12, figs. 15, 16) has max. d = 0.39 mm, t = 0.23 mm.

Occurence: Scattered specimens occurred in samples from boring no. VI, Sandnes, one from Lerbrekk, Jæren, and one from Nygaard, Karmøy. A few specimens were found in the Older *Yoldia* Clay and in the Postglacial deposits of Vendsyssel.

Remarks: This species is recorded from Eemian deposits of Schleswig-Holstein (Lafrenz, 1963) and at Stensigmose, SE Jutland (Konradi, in press). Michelsen (1967) found it in the late Quaternary of Læsø, Denmark.

Elphidium margaritaceum Cushman
Pl. 13, figs. 1, 2; pl. 22, figs. 5–8

Synonyms: 1930 *Elphidium advenum* (Cushman), var *margaritaceum* Cushman: p. 25, pl. 10, fig. 3. – 1939 Cushman: p. 61, pl. 17, fig. 2. – 1957 *E. margaritaceum* Cushman; van Voorthuysen: p. 32, pl. 23, fig. 13. – 1962 Haake: p. 49, pl. 5, fig. 11. – 1963 Lafrenz: p. 30, pl. 4, fig. 1. – 1967 Michelsen: p. 240, pl. 5, fig. 7. – 1969 *E. pulvereum* Todd; Lévy et al.: p. 96, pl. 1, fig. 8.

Dimensions: Figured specimen from the Postglacial at Løkken has max. d. = 0.33 mm, t = 0.13 mm.

Occurrence: *E. margaritaceum* occurred in many samples from Postglacial deposits of the Løkken area; it usually accounts for less than 1 % of the total fauna, with a maximum of 44 % in one sample from Løkkens Blå-

næse. It occurs also to the Lateglacial *Yoldia* Clay and in the Older *Yoldia* Clay of Vendsyssel, but it is never frequent in these deposits.

Remarks: This species has a densely and coarsely papillate surface; the papillae are characteristically low and rounded. It is recorded from the oldest Quaternary of the Netherlands (van Voorthuysen, 1950 a and b). Woszidlo (1962) recorded it from Holsteinian deposits of Schleswig-Holstein, and the species is found in Eemian deposits of the Netherlands (van Voorthuysen, 1957), Schleswig-Holstein (Lafrenz, 1963) and at Stensigmose, SE Jutland (Konradi, in press). Michelsen (1967) found it in late Quaternary deposits of Læsø, Denmark. Cushman (1930 and 1944) recorded *E. margaritaceum* in Recent faunas off Rhode Island and New England, and it is found on the tidal flats of the Netherlands (van Voorthuysen, 1951 and 1960) and NW Germany (Haake, 1962).

Elphidium owenianum (d'Orbigny)

Synonyms: 1839 b *Polystomella oweniana* d'Orbigny: p. 30, pl. 3, figs. 3, 4. – 1939 *Elphidium owenianum* (d'Orbigny); Cushman: p. 53, pl. 14, figs. 9–12.

Dimensions: One specimen was found in zone 1 of the Sandnes Clay: max. d = 0.55 mm, min. d = 0.50 mm, t = 0.30 mm (last chamber broken). Another specimen occurred in a sample from Bø brickworks, Karmøy.

Remarks: *E. owenianum* was originally recorded from the coast of Patagonia south of Rio Negro. According to Cushman (1939) it has been recorded from the Falkland Islands, off Argentina and off South Georgia.

Elphidium subarcticum Cushman
Pl. 13, figs. 3–7; pl. 22, fig. 9

Synonymes: 1944 *Elphidium subarcticum* Cushman: p. 27, pl. 3, figs. 34, 35. – 1953 Loeblich & Tappan: p. 105, pl. 19, figs. 5–7. – 1964 b Feyling-Hanssen, p. 48, pl. 3, figs. 11, 12. – 1966 Buzas: pp. 585–594, pl. 92, figs. 7–10. – 1967 Michelsen: p. 241, pl. 5, fig. 8. – 1969 *Cribroelphidium subarcticum* (Cushman); Gudina: p. 38, pl. 12, figs. 11, 12.

Dimensions: Specimen from Karmøy (pl. 13, figs. 3, 4) has max. d = 0.75 mm, min. d = 0.63 mm, t = 0.34 mm, and one from the Older *Yoldia* Clay at Stortorn (pl. 13, fig. 5) has max. d. = 0.58 mm, t = 0.23 mm, Specimen

from Hirtshals (pl. 13, figs 6, 7; pl. 22, fig. 9) has max. d = 0.88 mm, t = 0.32 mm.

Occurrence: This species occurs in samples from Sandnes, Jæren and Karmøy. It is rare, but less so in zone 3 of the Sandnes Clay. It occurs in many of the samples from the late Quaternary deposits of Vendsyssel. It is usually not frequent except in the *Zirfaea* layers and in samples from the Lateglacial *Yoldia* Clay at Dybvad, where it accounts for up to 28 % of the total fauna. In the Older *Yoldia* Clay at Hirtshals this species is found in zones A, C and D; it was most frequent in zone C, accounting for up to 3 % of the total fauna.

Remarks: *E. subarcticum* has broad opaque bands on each side of the sutures, The sutures are only slightly curved backwards, and the opaque bands continue across the periphery. Usually there is one row of sutural pores, but some specimens with an irregular double row of pores in the sutures were observed in the material from Vendsyssel. The number of chambers is 7–10, mostly 8. *E. hallandense* Brotzen, 1943 is most probably synonymous with *E. subarcticum*. Todd & Low (1967) suggested that *E. subarcticum* is synonymous with *E. frigidum* Cushman, 1933, and Buzas (1966) considered it to be synonymous with *E. pauciloculum* (Cushman, 1944). Some specimens of *E. subarcticum* from the late Quaternary of the Oslofjord area (Feyling-Hanssen, 1964 a) and from Recent faunas of the Oslofjord (Risdal, 1964) should most probably be referred to *E. albiumbilicatum* (Weiss).

Buch (1955) and Woszidlo (1962) recorded *E. subarcticum* from the Holsteinian of SW Jutland and Schleswig-Holstein. It is not found in Eemian deposits of Schleswig-Holstein (Lafrenz & Woszidlo, 1963). The species is recorded from late Quaternary deposits of SW Sweden (Brotzen, 1943 and 1951), from Spitsbergen (Feyling-Hanssen, 1964 b) and from Læsø, Denmark (Michelsen, 1967). Cushman (1944) described *E. subarcticum* from the coast of Maine. Loeblich & Tappan (1953) recorded it from off north Alaska, Canada and Greenland at depths exceeding 12 m, and Todd & Low (1967) found the species off SE Alaska. In the Oslofjord it is found at depths between 10 and 310 m, but it is not common (Risdal, 1964).

Elphidium umbilicatulum (Williamson)
Pl. 13, figs. 8–11; pl. 23, figs. 1–4

Synonyms: 1858 *Polystomella umbilicatula* (Walker); Williamson (not *Nautilus umbilicalutus* Walker & Jacob, 1798): p. 42, pl. 3, figs. 81, 82. – 1875 Terquem: p. 429,

pl. 2, fig. 3. – 1939 *Elphidium excavatum* (Terquem); Cushman: p. 58, pl. 16, figs. 10–12 (not figs. 7–9). – 1962 Haake: p. 47, pl. 5, fig. 5. – 1964 a Feyling-Hanssen: p. 344, pl. 20, figs. 7, 8. – 1965 *Cribrononion* cf. *alvareziana* (d'Orbigny); Lutze (not *Polystomella alvarezianum* d'Orbigny, 1939): p. 101, pl. 15, fig. 46. – 1967 *Elphidium excavatum* (Terquem); Michelsen: p. 238, pl. 5, fig. 2. – 1968 *Cribrononion articulatum* (d'Orbigny); Lutze: p. 27, pl. 1, figs. 1, 2. – 1968 *Elphidium excavatum boreale* Nutzdina: p. 47, pl. 1, figs. 1–3. – 1969 *E. boreale* Nutzdina; Gudina: p. 31, pl. 10, figs. 4, 5; pl. 11, figs. 1–4. – 1969 *E. umbilicatulum* (Williamson) (not Walker & Jacob); Lévy et al.: p. 96, pl. 1, fig. 6; pl. 2, figs. 1, 2.

Dimensions: Specimen from the Postglacial at Løkken (pl. 13, figs. 8, 9; pl. 23, figs. 1–4) has max. d = 0.51 mm, t = 0.21 mm. Hypotype from Reve, Jæren (pl. 13, figs. 10, 11) has max. d = 0.39 mm, min. d = 0.30 mm, t = 0.18 mm (last chamber broken).

Occurrence: A few specimens of this species were found in zone 4 of the Sandnes Clay, it was also present in a sample from boring no. VI in Sandnes, in a sample from Reve, from Foss-Eigeland and from Nygaard, Karmøy. It is common in the Postglacial deposits of Vendsyssel, with a maximum of 40 % of the total fauna in a sample from Løkken, whereas in most samples it accounts for less than 10 %. It occurred also in the Late-glacial deposits and in the Older *Yoldia* Clay of Vendsyssel. In the Older *Yoldia* Clay at Hirtshals it is most frequent in zone E with up to 6 % of the fauna; in zones F and D it accounts for up to 4 % of the total fauna, usually 1–2 %.

Remarks: *E. umbilicatulum* is characterised by the pronounced, broad and straight sutural bridges and by a smooth surface. The papillation is limited to the umbilicus, the sutural pores and to a narrow rim above and below the aperture (pl. 23, figs. 1–4).

The present species was described and figured by Williamson (1858) as *Polystomella umbilicatula* (Walker). He referred to *Nautilus umbilicatulus* Walker & Jacob, 1798, but according to the description and illustration this is not the same species, and does, in fact, not belong to *Elphidium*. This problem was discussed by Lévy et al. (1969). As mentioned by Lutze (1965) and Lévy et al. (1968), *Polystomella excavata* Terquem, 1875 is different from the present species. Lutze (1968) referred this species to *C. articulatum* (d'Orbigny).

E. umbilicatulum was recorded, as *Elphidium excavatum*, from the oldest Quaternary of the Netherlands (van Voorthuysen, 1950 a and b), Buch (1955) and Woszidlo (1962) found the species in the Holsteinian of SW Jutland and Schleswig-Holstein, and it occurs in the Eemian of the Netherlands (van Voorthuysen, 1957), Schleswig-Holstein (Lafrenz, 1963) and Stensigmose, SE Jutland (Konradi, in press). *E. umbilicatulum* has also been

recorded from late Quaternary deposits of SW Sweden (Hessland, 1943; Brotzen, 1951), of the Oslofjord area (Feyling-Hanssen, 1964 a) and of Læsø, Denmark (Michelsen, 1967). It is recorded from Recent faunas of the North Sea (Williamson, 1858; Terquem, 1875; van Voorthuysen, 1951, 1960; Haake, 1962), and is found in the Oslofjord at depths 3–6 m (Risdal, 1964) and in Kiel Bay in shallow water with salinity down to 0.2–0.8 ‰ (Lutze, 1965, 1968).

Elphidium ustulatum Todd
Pl. 13, figs. 12, 13; pl. 23, figs. 5–7

Synonyms: 1957 *Elphidium ustulatum* Todd: p. 230, pl. 28, fig. 16. – 1958 *Elphidium* sp. 2 van Voorthuysen: p. 25, pl. 9, fig. 98. – 1966 *Protelphidium lenticulare* Gudina: p. 55, pl. 3, figs. 7–9; pl. 9, fig. 1. – 1969 Gudina: p. 35, pl. 12, figs. 7, 8.

Dimensions: Specimen from Elgane, Jæren (pl. 13, figs. 12, 13) has max. d = 0.50 mm, min. d = 0.43 mm, t = 0.24 mm. Specimen from Lundergaard mose, Vendsyssel (pl. 23, figs. 5–7) has max. d = 0.42 mm.

Occurrence: Two specimens were found in a clay sample from Elgane, Jæren, and one specimen was found in zone 1 of the borings in Sandnes. A single specimen was found in zone F of the Older *Yoldia* Clay at Hirtshals, Vendsyssel.

Remarks: Todd (1957) described *E. ustulatum* from Carter Creek, northern Alaska. The microfauna in which it was found is supposed to be of Miocene or Pliocene age. One of the characteristic features is the angled but not carinate periphery; another one is the elongate sutural slits, one in each suture, which start about half-way between the umbilical region and the margin and extend almost to the periphery but are closed at both ends. In the present specimens the aperture is partly obliterated by papillate surface ornamentation. The later sutural pores are surrounded by papillae, whereas the earlier pores have wrinkled borders. The greatest diameter of the specimens from Carter Creek ranges from 0.45 to 0.57 mm.

Van Voorthuysen (1958) recorded *E. ustulatum,* as *Elphidium* sp. 2, from the Pliocene of Kruisschans in Belgium, and Gudina (1966, 1969) recorded it, as a new species *Protelphidium lenticulare,* from the Quaternary of Siberia. It occurs in Quaternary deposits, more than 50,000 years old, of Clyde Foreland, Northeast Baffin Island (Feyling-Hanssen, 1967), and also in a sample from Holderness Basement Till (Saale Interstadial).

Elphidiella Cushman, 1936

Elphidiella arctica (Parker & Jones)
Pl. 14, fig. 1

Synonyms: 1864 *Polystomella arctica* Parker & Jones, in Brady: p. 471, pl. 48, fig. 18. – 1930 *Elphidium arcticum* (Parker & Jones); Cushman: p. 27, pl. 11, figs. 1–6. – 1939 *Elphidiella arctica* (Parker & Jones); Cushman, p. 65, pl. 18, figs. 11–14. – 1964 b Feyling-Hanssen: p. 48, pl. 3, fig. 13. – 1967 Todd & Low: p. 34, pl. 4, fig. 15.

Dimensions: Specimen from Karmøy (pl. 14, fig. 1) has max. d = 0.92 mm, t = 0.47 mm.

Occurrence: One specimen was found in zone 1 of boring no. V, Sandnes, another one in zone 3 of boring no. II. It also occurred in a sample from Lerbrekk, Jæren, and in one from Nygaard, Karmøy. One specimen, probably reworked, was found in zone E of the Older *Yoldia* Clay at Hirtshals, Vendsyssel.

Remarks: Feyling-Hanssen found a few specimens in the late Quaternary of the Oslofjord area (1964 a) and of Spitsbergen (1964 b). This species is found in Recent faunas off Alaska, Canada and Greenland (Loeblich & Tappan, 1953; Leslie, 1965). It occurs at water depths exceeding 24 m at Spitsbergen (Nagy, 1965). *E. arctica* occurs in the sample from Holderness Basement Till, and one specimen is found in a sample from the lower part of the *Portlandia arctica* Zone in the Skærumhede boring, Vendsyssel.

Cryptoelphidiella Feyling-Hanssen, n. gen.

Derivation of name: The name *Cryptoelphidiella* alludes to the likeness to *Elphidiella* and to the fact that the sutural pores are covered. Type species: *Cryptoelphidiella itriaensis* n. sp.

Diagnosis: *Cryptoelphidiella* resembles *Elphidiella* but has its apparent double row of sutural pores covered by shell material. Wall structure radiate.

Remarks: The type species is the only known species assignable to *Cryptoelphidiella.*

Occurrence: Sandnes Clay, Norway.

Cryptoelphidiella itriaensis Feyling-Hanssen, n. sp.
Pl. 13, figs. 14–17; pl. 23, figs. 8–11; pl. 24, fig. 1

Derivation of name: From Itria which is an old name for Jæren.

Type data: The holotype is a complete specimen (MMH no. 12116) from the Pleistocene Weichselian zone 3 of boring no. II at Gann in the city of Sandnes, southwestern Norway. The boring was carried out by the Norwegian Geotechnical Institute, the specimen collected by Feyling-Hanssen, 1965.

Diagnosis: A yellowish-white to semi-translucent *Cryptoelphidiella* with 8 (or 7) broad chambers in the last-formed whorl and with papillate surface in the central area and over the whole of and below the apertural face.

Description: Test planispiral with peripheral margin broadly rounded; central part with papillate surface sculpture which extends along the latest, or the later, sutures and over the whole of the apertural face, being also distributed on the surface of the previous whorl below the apertural face (pl. 23, figs. 8–10). The papillae are short, blunt and have an irregular, often triangular base (pl. 24, fig. 1). Chambers 8 or 7 in the last-formed whorl, broad but only slightly inflated; sutures slightly depressed between the two or three latest chambers, otherwise almost flush with the surface, curved backwards. In the binocular microscope (magnification 50–200) 9 pairs of apparent pores occur in each suture, they seem to be covered by clear shell material through which they appear very distinctly as double rows of short, dark lines, in the electron scanning microscope the sutures appear with a single row of pores, or rather depressions, closed with granular material (pl. 23, figs. 10, 11). Wall calcareous, semi-translucent, densely and very finely perforate, glistening yellowish-white, in optical respect with radiate structure; aperture a row of pores at the base of the apertural face with some additional scattered pores in the apertural face.

Dimensions: The holotype from zone 3 of the Sandnes Clay (pl. 13, fig. 14) has max. d = 0.43 mm, min. d = 0.33 mm, t = 0.24 mm. Paratype from the same sample (pl. 13, fig. 15; pl. 23, figs. 8–11; pl. 24, fig. 1) has max. d = 0.30 mm, min. d = 0.25 mm, t = 0.18 mm. Another specimen from zone 3, Sandnes (pl. 13, figs. 16, 17) has max. d = 0.48 mm, min. d = 0.38 mm, t = 0.27 mm. Unfigured specimen from the same zone has max. d = 0.44 mm and only 7 chambers in the last-formed whorl.

Occurrence: 11 specimens of this species were found in the deeper part (zone 3) of boring no. V, Gann, Sandnes. Other specimens occur in zone 3 of the other borings from that locality. One specimen was found in zone 1 of boring no. I, and 11 in a sample from Nygaard brickworks, Karmøy.

Remarks: F. L. Parker (1958, p. 271, pl. 4, figs. 8, 9) described and figured an *Elphidium* cf. *E. minimum* (Seguenza) from borings in Quaternary deposits in the eastern Mediterranean. The figures show, though indistinctly, double rows of elongate pores along the sutures. It is otherwise a more compressed form with 10 chambers in the last-formed whorl.

Protelphidium Haynes, 1956

Protelphidium anglicum Murray
Pl. 14, figs. 2–5; pl. 24, figs 2–5

Synonyms: 1858 *Nonionina crassula* (Walker); Williamson (not *Nautilus crassulus* Walker & Jacob, 1798): pp. 33, 34, pl. 3, figs. 70, 71. – 1884 *N. depressula* (Walker & Jacob); Brady (part., not. *Nautilus depressulus* Walker & Jacob, 1798): pp. 725, 726, pl. 109, figs. 6 a, b. – 1962 *Nonion depressulum* (Walker & Jacob); Haake: p. 40, pl. 3, figs. 1, 2. – 1964 a *N. depressulus asterotuberculatus* van Voorthuysen; Feyling-Hanssen: p. 331, pl. 17, figs. 13, 14. – 1964 *N. depressulus* (Walker & Jacob), forma *asterotuberculatus* van Voorthuysen; Risdal: p. 88. – 1965 a *Protelphidium* sp. nov. Murray: p. 405, pl. 1, fig. 4. – 1965 b *P. anglicum* Murray: pp. 149, 150, pl. 25, figs. 1–5; pl. 26, figs. 1–6.

Dimensions. Hypotype from the Postglacial at Birkelse (pl. 14, figs. 4, 5) has max. d = 0.53 mm, t = 0.25 mm. Specimen from the Postglacial at Løkken (pl. 14 figs. 2, 3) has max. d = 0.51 mm, t = 0.23 mm, and another one from the same deposit (pl. 24, figs. 2–5) has max. d = 0.34 mm.

Occurrence: *P. anglicum* is one of the most frequent species in the Postglacial deposits of Vendsyssel; it usually accounts for 10–40 % of the total fauna, with a maximum of 85 % in a sample from Løkken. A few specimens were found in the Older *Yoldia* Clay and in the Lateglacial *Yoldia* Clay of Vendsyssel.

Remarks: *P. anglicum* possesses a very pronounced papillation along the aperture and along the partly open sutures. The papillae are cylindrical, long and bluntly pointed, the base is circular and the length approximately

3 times the basal diameter (pl. 24, figs. 4, 5). The test wall is very finely perforate.

Murray (1965 b) described the species *P. anglicum* from the Plymouth region, and discussed the differences between this species and topotypes of *Nonion depressulus* (Walker & Jacob, 1798). He found that the major point of difference between the two species is in the wall structure, *Nonion depressulus* has a granulate wall structure whereas *P. anglicum* has a radiate wall structure.

The wall structure was studied on 100 randomly selected specimens from the Postglacial at Løkken to see whether one or both of these species is present in the material. All specimens proved to have a radiate wall structure. To make a further comparison with Murray's results, the number of chambers in the last-formed whorl was counted for the same 100 specimens:

Number of chambers	Results from Murray (1965 b)				*Protelphidium anglicum* from Løkken	
	Nonion depressulus		*Protelphidium anglicum*			
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
6					1	1
7	1	3	4	8	12	12
8	6	16	19	38	47	47
9	17	46	19	38	26	26
10	12	32	7	14	12	12
11	1	3	1	2	1	1
12					1	1
Total	37	100	50	100	100	100
Mean	9.2 chambers		8.6 chambers		8.4 chambers	
Standard deviation	0.8 chambers		0.9 chambers		1.0 chambers	

There is no significant distinction between the number of chambers in the outer whorl (the differences between the means are less than twice the standard deviation). It seems that there are no significant differences between *N. depressulus* and *P. anglicum* except for the wall structure. Lévy et al. (1969) recorded *Nautilus depressulus* Walker & Jacob, 1798 from the Dunkerque area. They found that the specimens have a radiate wall structure and classed these as *Protelphidium depressulum* (Walker & Jacob). Murray (1965 a and b) recorded both a granulate species, which he considered to

be *Nonion depressulus* (Walker & Jacob) and a radiate one, for which he erected *P. anglicum.*

P. anglicum is very abundant round the British coasts, particularly in areas of lowered salinity (Murray, 1965 a and b). Many forms from boreal shallow-water areas, which are usually referred to as *Nonion depressulus,* should most probably be classed as *P. anglicum:* Brand (1941), van Voorthuysen (1951, 1960), Rottgardt (1952), Jarke (1961), and Richter (1964 a and b). Studies of the wall structure on some specimens from the German marsh areas provided by Dr. F.-W. Haake, show that the specimens which he in 1962 referred to *N. depressulus* are synonymous with *P. anglicum.* The forms which Lafrenz (1963) referred to *N. depressulus,* should probably also be transferred to *P. anglicum.* Madsen (1895) recorded *Nonionina depressula* Walker & Jacob from late Quaternary deposits of Vendsyssel. Undoubtedly some of these belong to *P. anglicum* as well.

Examination of some samples from Postglacial deposits of the Oslofjord area (Feyling-Hanssen, 1964 a) and some Recent samples collected by Risdal (1964) in the Oslofjord, shows that their *N. depressulus asterotuberculatus* van Voorthuysen is synonymous with *P. anglicum.* Risdal recorded this species at depths between 3 and 30 m in the Oslofjord. Konradi (in press) recorded *P. anglicum* from the Eemian at Stensigmose, SE Jutland.

Protelphidium niveum (Lafrenz)
Pl. 14, figs. 6, 7

Synonyms: 1963 *Nonion ? niveum* Lafrenz: p. 24, pl. 2, figs. 1–4.

Dimensions: Specimen from the Older *Yoldia* Clay at Stortorn (pl. 14, figs. 6, 7) has max. d = 0.24 mm, min. d = 0.19 mm, t = 0.12 mm.

Occurrence: A few specimens of this species were found in the Older *Yoldia* Clay of Vendsyssel.

Remarks: The present specimens have no sutural pores, the aperture consists of two pores at the base of the apertural face. The wall structure is radiate, and the species is therefore referred to the genus *Protelphidium.* Lafrenz (1963) described this species from Eemian deposits of Schleswig-Holstein, and Konradi (in press) recorded it from Eemian deposits at Stensigmose, SE Jutland.

Protelphidium orbiculare (Brady)
Pl. 14, figs. 8–11; pl. 24, figs. 6–8

Synonyms: 1881 *Nonionina orbicularis* Brady: p. 415, pl. 21, fig. 5. – 1939 *Nonion orbiculare* (Brady); Cushman: p. 23, pl. 6, figs. 17–19. – 1953 *Elphidium orbiculare* (Brady); Loeblich & Tappan: p. 102, pl. 19, figs. 1–4. – 1964 a *Protelphidium orbiculare* (Brady); Feyling-Hanssen: p. 349, pl. 21, fig. 3. – 1965 *Elphidium orbiculare* (Brady); Leslie: p. 168, pl. 7, fig. 11. – 1967 Michelsen: p. 242, pl. 6, fig. 3.

Dimensions: Specimen from the Older *Yoldia* Clay at Løkken (pl. 14, figs. 8, 9; pl. 24, figs. 6–8) has max. d = 0.56 mm, t = 0.35 m, and one from Karmøy (pl. 14, figs. 10, 11) has max. d = 0.75 mm, min. d = 0.64 mm, t = 0.45 mm. Fifty randomly chosen specimens from the Older *Yoldia* Clay at Hirtshals were measured: The average diameter is 0.47 mm, with a standard deviation of 0.06 mm. The number of chambers in the last-formed whorl is 7–9, mostly 8.

Occurrence: This species is most frequent in zone 3 of the Sandnes Clay. It occurs also in zone 1 from Sandnes and in samples from Tvihaugbekken, Elgane, Opstad and Reve, Jæren. It was the dominant species, accounting for 23 %, in a sample from Nygaard clay pit, Karmøy. *P. orbiculare* is found in most samples from the Older *Yoldia* Clay in Vendsyssel. It is most frequent in zone C at Hirtshals, accounting for up to 6 % of the total fauna. Usually it accounts for less than 1 %. A few specimens were found in the Lateglacial and Postglacial deposits of Vendsyssel.

Remarks: This species possesses a papillate sculpture above and below the aperture and along the sutures. The papillae are short, bluntly pointed and have a subcircular base. *P. orbiculare* is recorded from the oldest Quaternary of the Netherlands (van Voorthuysen, 1950 a and b). Buch (1955) and Woszidlo (1962) found that it is frequent in the lower, cold, part of the Holsteinian in SW Jutland and in Schleswig-Holstein. Lafrenz (1963) recorded the species from the Eemian in Schleswig-Holstein, and Konradi (in press) from the Eemian at Stensigmose, SE Jutland. It was recorded from late Quaternary deposits of SW Sweden (Hessland, 1943; Brotzen, 1951), in the Oslofjord area and of Spitsbergen (Feyling-Hanssen, 1964 a and b), of Læsø, Denmark (Michelsen, 1967) and in Maine (Buzas, 1965). *P. orbiculare* is known from Recent arctic waters (Cushman, 1948; Loeblich & Tappan, 1953; Leslie, 1965; Nagy, 1965; Wagner, 1968).

P. orbiculare occurs in the lower part of the *Portlandia arctica* Zone and the upper part of the *Abra nitida* Zone of the Skærumhede boring in Vendsyssel.

Rotaliidea Ehrenberg, 1839

Rotaliidae Ehrenberg, 1839

Ammonia Brünnich, 1772

Ammonia batavus (Hofker)
Pl. 14, figs. 12, 13

Synonyms: 1951 *Streblus batavus* Hofker: pp. 492, 501, fig. 340. – 1957 van Voorthuysen: p. 28, text-fig. 1 d. – 1962 Haake: p. 52, pl. 6, figs. 6–12. – 1964 a *Ammonia batavus* (Hofker); Feyling-Hanssen: p. 349, pl. 21, figs. 4–13. – 1965 *A. beccarii* (Linnaeus); Lutze: p. 95, pl. 15, fig. 33. – 1967 *A. batavus* (Hofker); Michelsen: p. 235, pl. 4, figs. 3–5.

Dimension: Specimen, from the Postglacial at Løkken (pl. 14, figs. 12, 13) has max. d = 0.69 mm, h = 0.33 mm.

Occurrence: This species has a scattered occurrence in zone 1 of the Sandnes Clay and in some samples from Jæren. It is one of the dominant species in the Postglacial deposits of Vendsyssel, where it usually accounts for 30–70 % of the total fauna, maximum 93 %. This species is also found in the Lateglacial deposits and in the Older *Yoldia* Clay of Vendsyssel, but it is never frequent.

Remarks: Hofker (1951) separated the North Sea species *A. batavus* from *A. beccarii* (Linnaeus). The species is recorded from Holsteinian deposits of SW Jutland (Buch, 1955) and Schleswig-Holstein (Woszidlo, 1962). Lafrenz (1963) found it in Eemian deposits of Schleswig-Holstein, van Voorthuysen (1957) from the Eemian of the Netherlands, and Konradi (in press) from the Eemian of Stensigmose, SE Jutland. *A. batavus* is frequent in the Postglacial of the Oslofjord area (Feyling-Hanssen, 1964 a) and in the late Quaternary of Læsø, Denmark (Michelsen, 1967). *A. batavus* was recorded from Recent faunas in the North Sea (Hofker, 1951; van Voorthuysen, 1960; Haake, 1962) and in the Plymouth ditrict (Murray, 1965 a). It occurs in the Oslofjord at depths less than 60 m, most frequently between 4 m and 6 m (Risdal, 1964), and in the Baltic in water with salinity exceeding 1.5 % (Lutze, 1965).

Some of the present specimens of *A. batavus* seem closely related to *A. corallinorum* (d'Orbigny).

Globigerinidea Carpenter, Parker & Jones, 1862

Globigerinidae Carpenter, Parker & Jones, 1862

Globigerina d'Orbigny, 1826

Globigerina bulloides d'Orbigny

Synonyms: 1826 *Globigerina bulloides* d'Orbigny: p. 277, no. 1; Modèles nos. 76, 17.

Dimensions: Specimen from zone 4 of the Sandnes Clay has max. d = 0.27 mm.

Occurrence: A few specimens were found in zone 4 of boring no. IV, Sandnes and in a sample from Kvellur clay pit, Ganddalen.

Globigerina pachyderma (Ehrenberg)

Synonyms: 1861 *Aristerospira pachyderma* Ehrenberg: p. 303.

Dimensions: Specimen from zone 4 of the Sandnes Clay has max. d = 0.21 mm.

Occurrence: A few specimens found in zones 1, 2 and 4 of boring no. V, and one specimen was found in zone 4 of boring no. IV, Sandnes.