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THE ZOOLOGY OF EAST GREENLAND

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MARINE LAMELLIBRANCHIATA

BY

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WITH 29 FIGURES IN THE TEXT AND 3 PLATES

KØBENHAVN
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I. INTRODUCTION

The present paper deals with the lamellibranch fauna of the investigated part of the East Greenland coast, i. e. from Jørgen Brønlund Fjord, Peary Land, in about 82°10′ N., to Qeqertatsiaq in about 60° N., thus covering a distance of about 2500 km. In addition, the lamellibranch fauna of Jan Mayen is treated, as this seems justifiable in view of the marine climate and the geographical position of this island (about 70° N. 9° W.), and the lack of a full account of the bivalves living around it.

While, according to J. MADSEN (1949), the first printed information on an identifiable marine lamellibranch species from Iceland seems to date back to 1726, the invertebrate fauna of East Greenland, owing to the inaccessibility of this region, remained completely unknown up to the second half of the 19th century. The first report on lamellibranchs from East Greenland was published as late as 1874 by MÖBIUS, who had worked up the collections of "Die zweite deutsche Nordpolarfahrt in den Jahren 1869 und 1870 unter KOLDEWEY". MÖBIUS mentions in all 9 species of marine lamellibranchs, 8 of which were correctly identified though some were given a name now abandoned. The next contribution was that by the Danish zoologist POSSELT (1895), who reports 23 species of lamellibranchs from East Greenland collected by "Dansk Østgrønlands Ekspedition 1891—92" (leader: RYDER), and by the Swedish "Sofia"-expedition 1883 (leader: NORDENSKJÖLD). Of these, 20 species were valid; 12 were recorded from East Greenland for the first time. A few years later, in "Conspectus Faunæ Groenlandicæ", POSSELT & JENSEN (1898) listed the same species without any additions as regards East Greenland. AD. JENSEN (1904), in a revision of some arctic *Macoma* species, further adds 3 species to the East Greenland fauna. HÄGG (1904, 1905), publishing the molluscs secured during the Swedish zoological expedition to Spitzbergen, N. E. Greenland, and Jan Mayen in the year 1900 (leader: KOLTHOFF), mentions 28 bivalve species from the shelf of East Greenland, 24 of which were—at least in part—correctly identified, 8 species representing additions to the fauna list. In an important paper AD. JENSEN (1905) reports some new collections

from East Greenland, viz. the large material collected by SØREN JENSEN a member of the "AMDRUP-HARTZ-expedition" 1900, the material secured by CHR. KRUUSE during his journey with AMDRUP's expedition 1898—99 and from his stay at Angmagssalik 1901—02, and further, part of the material of the Swedish NATHORST expedition 1899. Of altogether 41 species dealt with by JENSEN as belonging to the recent lamellibranch fauna of East Greenland, all were—at least in part—correctly identified; 10 species were recorded for the first time from that region and one species, viz. *Lima* (*Limatula*) *hyperborea*, was even new to science. In addition to the earlier records from East Greenland, AD. JENSEN's paper contains an interesting section on the fossil Quaternary molluscan fauna of Greenland, as well as a useful list of the positions of the East Greenland localities. A few years later fresh, rather large, collections of marine molluscs were made during the "Danmark" Expedition 1906—08 to the N. E. coast with Danmarks Havn as its base. The material of recent lamellibranchs, however, has not been worked up till now. In "Duc d'Orleans", GRIEG (1909) reports 5 bivalve species taken by the "Belgica" off the N. E. coast of Greenland, and in 1916, he lists 10 species including the 5 previously mentioned. Of these, 8 species were valid, and all of them were formerly known from East Greenland. AD. JENSEN (1912) published part of the lamellibranchs collected during the Danish "Ingolf"-expedition 1895—96, giving a detailed account of the distribution of the species dealt with, thus also their occurrence at East Greenland and Jan Mayen, as well as exact figures of several of the species. However, no additions to the shelf fauna of East Greenland were made. ODHNER (1915) in his study on the mollusc fauna of the Icefjord, Spitzbergen, states the distribution of the species found, thus also East Greenland, and adds one lamellibranch species to the East Greenland fauna. LAMY (1926) and REMY (1928) record 6 and 9 lamellibranch species, respectively, which were taken by the "Pourquoi-Pas?" in 1925 and 1926 off N. E. Greenland. Of these, altogether 9 valid species, none was new to the region.

In 1929 G. SEIDENFADEN and in 1930 B. LØPPENTHIN, both members of LAUGE KOCH's expeditions, collected a minor material in N. E. Greenland; the lamellibranchs, however, being not worked up till now. During the following years very large collections were made by members of the Danish "Three-Year-Expedition" 1931—34 (leader: L. KOCH). Thus, R. SPÄRCK and G. THORSON took about 230 bottom samples with the PETERSEN grab and 280 dredge hauls in the Kejser Franz Josephs Fjord area 1931—32, H. MADSEN collected a few samples at Eskimonæs 1932—33, and G. THORSON again about 270 bottom samples and 60 dredge hauls in the Scoresby Sund complex 1933. At the same time, M. DEGERBØL, participating in "The Scoresbysund Committee's Expe-

dition 1932" (leader: E. MIKKELSEN), secured a small collection from the Kangerdlugssuaq area. On this THORSON (1934 a) published a brief paper, mentioning 15 species of lamellibranchs, 14 of which were correctly identified and all of them previously known from East Greenland. E. BERTELSEN, as a member of "The 7th Thule Expedition 1933" (leader: KNUD RASMUSSEN), also collected a rather large material in that area and near Angmagssalik, and as a participant in the "M. S. Thor's Cruise 1935" he brought home a rich and valuable material from the south-eastern coast stretches, especially from Lindenows Fjord. Recently P. JOHNSON, on the "Dansk Peary Land Expedition 1947—50" (leader: E. KNUTH), collected a few samples containing lamellibranchs in the northernmost part of Greenland.

Actually, the latest full account of the whole lamellibranch fauna of East Greenland is that by AD. JENSEN (1905). Besides some earlier collections, especially the very large material of lamellibranchs brought home by Danish expeditions in the thirties, have not been systematically worked up until now, apart, as mentioned above, from that collected by M. DEGERBØL. But on the basis of these large collections the following studies, i. a. dealing with the ecology of the East Greenland lamellibranchs, were published: SPÄRCK (1933) and THORSON (1933) on the animal communities in the Kejser Franz Josephs Fjord area; the latter also records a lamellibranch species new to East Greenland. Further, THORSON (1934 b) describes the animal communities of the Scoresby Sund area, and adds another valid species to the fauna list. Beside these treatises, the papers of H. MADSEN (1936) on the shore fauna of East Greenland, and that of E. BERTELSEN (1937 a) on the ecology of the fjords of Angmagssalik and Kangerdlugssuaq deserve great interest. However, none of these papers are, as a rule, quoted among "East Greenland records" in the following synopsis of the species, even though it turned out that in some instances erroneous determinations had been made. But the latter do not seem to affect the main results arrived at in the ecological studies mentioned. For that matter, the "Animal communities" are discussed on pp. 225—232. Yet references are made to the information on reproduction and larval development found in the papers by THORSON (1935, 1936). Especially the latter study is important and contains also much information on the growth and metabolism of several East Greenland lamellibranch species.

Finally, SOOT-RYEN (1941) in a revision of northern species of the families *Pholadomyidae*, *Thraciidae*, and *Periplomatidae*, recognises one further lamellibranch species new to East Greenland.

In addition to a total of 45 lamellibranch species correctly recorded by previous authors, the present study records 10 species "new" to the East Greenland fauna. Thus, 55 lamellibranch species are now known

from the coastal region of East Greenland, all of them taken as living specimens.

Information on the lamellibranch fauna of Jan Mayen was first given in the report by FRIELE (1878), viz. on 19 species collected by "The Norwegian North Atlantic Expedition 1876—78". Of these, 14 species were correctly identified. BECHER (1886), working up the molluscs secured by "Die österreichische Polarstation Jan Mayen", mentions 18 lamellibranch species, and of the 11 valid species, 4 were new to the fauna of the island. POSSELT (1895) adds another valid species. FRIELE & GRIEG (1901) in their work on the entire material of molluscs collected during the aforementioned Norwegian expedition, list 18 lamellibranch species from the shelf round Jan Mayen, and of the 15 valid species, 1 was new to its fauna. FRIELE (1902) mentions 8 species from Jan Mayen taken by the "Michael Sars" Expedition 1900, and subsequently, HÄGG (1904), AD. JENSEN (1912), LAMY (1913 a, 1913 b, 1926), REMY (1928), and SOOT-RYEN (1941) deal with lamellibranchs from Jan Mayen. New records contained in these papers increased the number of valid lamellibranch species known from the shelf of Jan Mayen to 28. As the present study reports further 3 species, the lamellibranch fauna of the island is at present known to number 31 species. Of these, 27 species were taken as living specimens, while 4 species were found only as dead specimens or empty shells.

Thus, since 2 of the Jan Mayen species are not known from East Greenland proper, the recent bivalve fauna of East Greenland including that of Jan Mayen totals 57 species, 55 of which were found as living specimens.

Fig. 1, p. 9, shows that the East Greenland region has on the whole been rather thoroughly investigated. Especially the largest fjord complexes of the world, Kejser Franz Josephs Fjord and Scoresby Sund (cf. fig. 2, p. 11), are very intensively and equally covered, so that only very few additions to the lamellibranch fauna of these areas can be expected during future investigations, even though one or the other deepwater species known to occur off N. E. Greenland will reach depths of less than 400 metres (i. e. the lower limit along the outer shelf here adopted). On the other hand, future collectors along the coasts from Angmagssalik to the south, especially along the southernmost part of East Greenland, may be expected to secure some more species not observed so far in East Greenland. This applies e. g. to *Nucula delphinodonta*, *Turtonia minuta*, *Thyasira croulinensis*, and the *Montacuta* species known from West Greenland. Also, thorough investigations of the fauna at lower depths around Jan Mayen are likely to furnish some additions.

It is hardly exaggerated to say that the material of East Greenland lamellibranchs now at hand is one of the largest ever brought home to

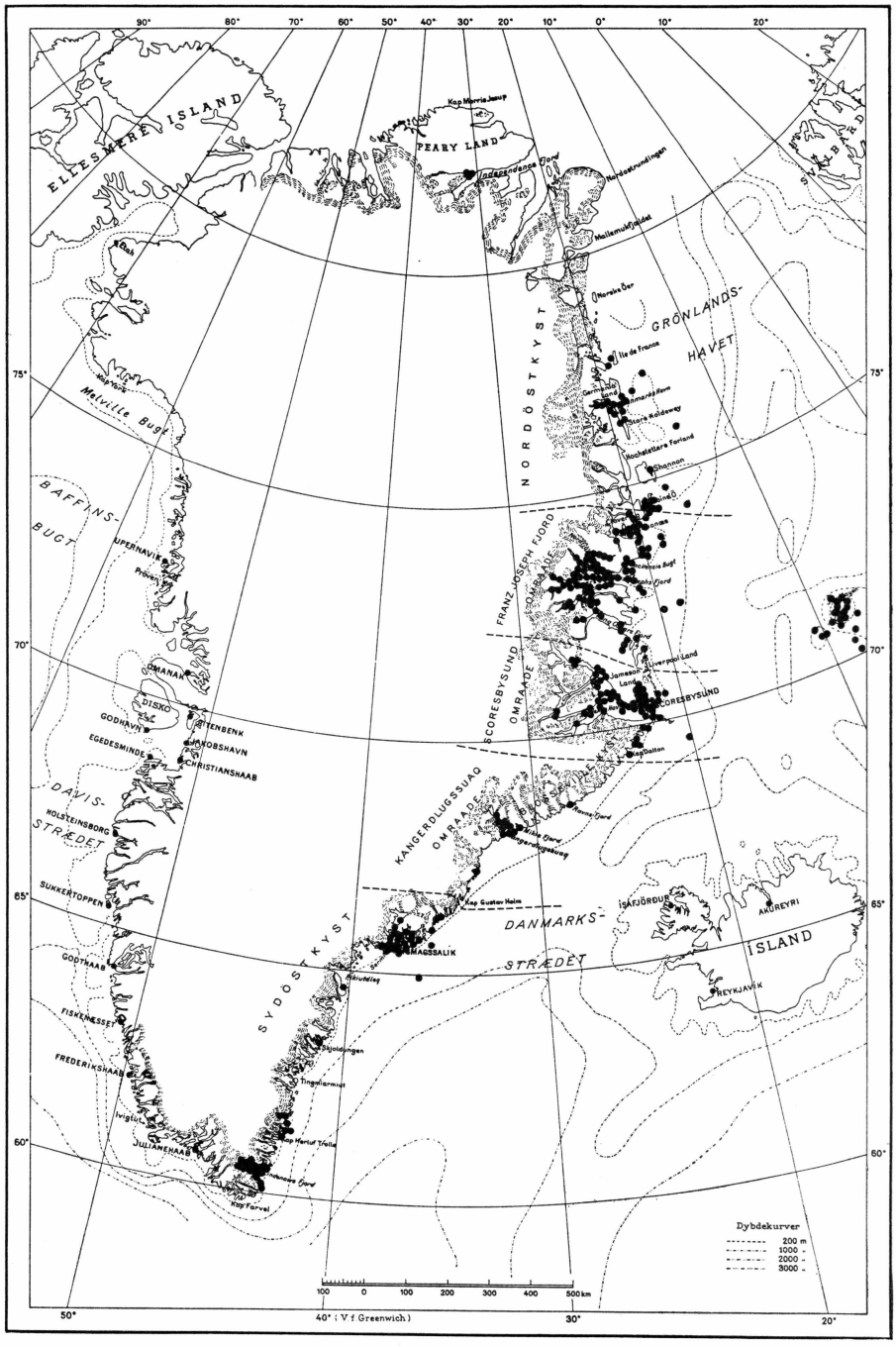

Fig. 1. Map showing all the localities along the East Greenland coast and round Jan Mayen where marine lamellibranchs have been collected.

a museum from arctic regions. Due, in particular, to the intensive collecting during the "Three-Year-Expedition", more than half the number of species dealt with are present from East Greenland in hundreds and several species even in thousands, of specimens. This large material is of considerable value, the more so because the bulk of the samples are preserved in 70 % alcohol and thus will be suitable for a study of the soft parts of the animals.

In the following "Synopsis" the data of the material of each species are given to their full extent. In accordance with the division of the East Greenland coast into five areas, viz. Nordøstkyst Area, Kejser Franz Josephs Fjord Area, Scoresby Sund Area, Kangerdlugssuaq Area, and Sydøstkyst Area (cf. the map, fig. 1), which has proved to be of value for a zoogeographical analysis, the material of each species is enumerated in the order from N. to S. The shelf around Jan Mayen, then, makes up the sixth area.

Generally, the systematic arrangement and almost all of the generic names employed in this paper are in agreement with THIELE (1935), and only in a few instances have synonyms been mentioned. Records quoted from the literature without revision are followed by the name of the particular author.

During the working up of the material it turned out that some of the species dealt with actually have a more limited distribution than hitherto believed. Especially, some of the northern species of the genera *Portlandia* [*Yoldiella*], *Dacrydium*, *Propeamussium*, *Thyasira*, and *Cuspidaria* have very often been misidentified. As to some of these it seemed justifiable already now to give some correcting notes, based upon studies of the whole material at hand. Further investigations into some of the genera mentioned are in progress. Information from other zoologists of possible errors or omissions in the fauna lists of the present paper will therefore be gratefully received.

As to the scientific terms used, a few explanations would seem necessary. Thus, the word "animal" indicates that soft parts are present, while "shell" and "valve" mean that no soft parts are preserved. The term "specimen" is used to cover both categories. Further, the word "adult" indicates a size of more than half the maximum size attained by the species in question, or, if known, the size of sexually mature animals; "half-grown" means a size below these limits, but larger than "young", which is used for the very small specimens whose life apparently lasted for less than 1-2 years.

The terms "prodissoconch I", and "prodissoconch II" agree with the definitions given by WERNER (1939). However, in some instances there remains some uncertainty as to the proper designation of the larval shell; then only "prodissoconch" is used.

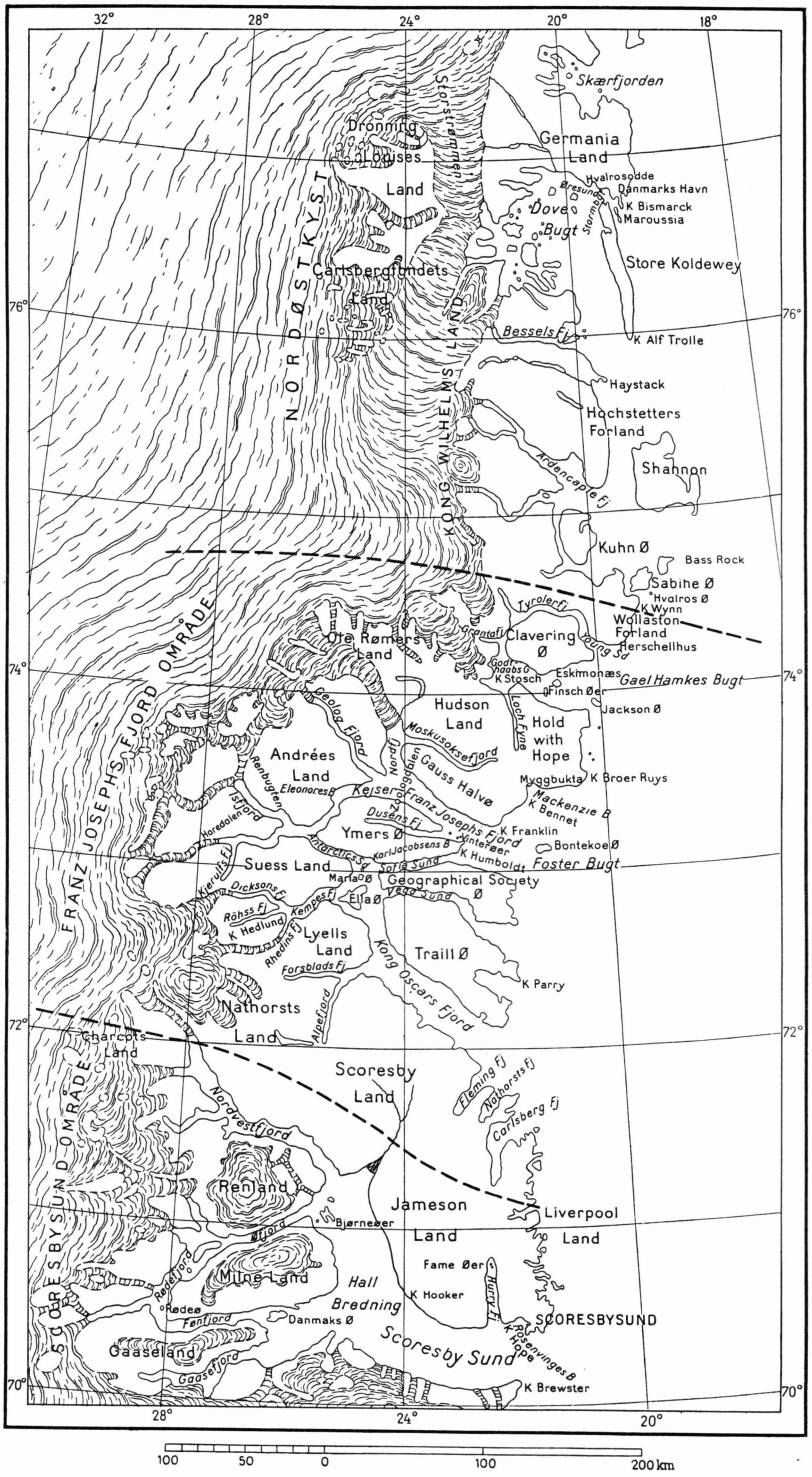

Fig. 2. Map of North-East Greenland, including the two large fjord complexes.

The terms "high-arctic", "panarctic", "boreal", etc., as used in this paper agree as far as possible with the definitions given by EKMAN (1953).

The spelling of the geographical names of Greenland is in accordance with the maps and the directions of the editorial committee; the Danish geographical terms translated into English mean: Bugt = bay; Dal = valley; Elv = river; Fjord = fjord; Havn = harbour; Kap = cape; Kyst = coast; Pynt = point; Sund = sound; Vig = creek; Ø = island.

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II. SYNOPSIS OF THE SPECIES

1. *Nucula tenuis expansa* Reeve.

Nucula expansa Reeve 1855, pl. 33, fig. 2.
Nucula tenuis G. O. Sars 1878, pl. 4, figs. 6a—c.

East Greenland records:

Nucula tenuis var. *expansa* Hägg 1904, p. 6.
Nucula tenuis Jensen 1905, pp. 315—316.
Nucula tenuis Odhner 1915, p. 72.
Nucula tenuis Thorson 1936, p. 52 et sequ.; on reproduction.

Occurrence at East Greenland (cf. the map fig. 12, p. 173):

Nordkyst Area: Jørgen Brønlund Fjord, ca. 11—13 m, clay, 8 adult, 30 half-grown and young animals, 4 adult and 1 half-grown valve (4 finds) — off the station, 11 m, greyish clay, 28 half-grown and young animals, 1 adult valve; Stormbugt, near Danmarks Havn, 19—38 m, hard bottom, *Delesseria*, 1 adult animal; S.E. of Shannon, 74°52′ N. 17°16′ W., 350 m, clay, mud, sand, 1 half-grown shell; S.E. of Sabine Ø, 207 m, fine clay with stones and gravel, "1 specimen" (Jensen).

Kejser Franz Josephs Fjord Area: Eskimonæs, Clavering Ø, 10—14 m, dark sandy clay, 1 adult animal — 50—55 m, clay, stones, gravel, 1 adult and 1 young animal (2 finds); Mackenzie Bugt, 12—35 m, mud, 12 animals (Hägg); Between Kap Weber and Ymers Ø, 400 m, clay with many stones, 1 half-grown animal; Kejser Franz Josephs Fjord, 73°16′ N. 23°15′ W., 28—36 m, clay, shells, stones, gravel, sand, 2 adult animals; Vinterøer off the mouth of Duséns Fjord, 15—30 m, stones and algae, 1 adult animal; Duséns Fjord opposite Kap Graah, 15—30 m, clay, *Desmarestia*, red algae, 12 adult animals, 2 valves (2 finds) — 26—40 m, clay, large stones, *Desmarestia*, 3 adult animals; Duséns Fjord, outer part, 370 m, tough, greyish-brown clay with much sand, 2 half-grown animals; Duséns Fjord, inner part, 4—10 m, clay, *Desmarestia*, 12 adult and 2 half-grown animals — 15—20 m, *Laminaria*, *Fucus*, 7 adult animals — 240 m, tough clay, 1 adult animal, 3 adult valves; Head of Duséns Fjord, 5—19 m, clay, *Desmarestia*, about 40 adult animals (3 finds); Inner part of Kejser Franz Josephs Fjord, 73°06′ N. 27°17′ W., ca. 40—70 m, mud, stones, 1 young animal; Solitærbugt, Ella Ø, 5—24 m, 1 half-grown animal — 20—25 m, 1 young animal; E.part of Vega Sund, 72°45′ N. 22°56′ W., 35—60 m, mud, 10 half-grown and young animals; Röhss Fjord, 72°43′ N. 26°38′ W., 35—60 m, mud, 2 adult animals; Kap Hedlund, 20—53 m, 1 adult animal.

Scoresby Sund Area: Off Kap Hope, 7 m, sand, 2 young animals; Off the mouth of Hurry Inlet, 55 m, sandy clay, 1 half-grown and 1 young animal;

The mouth of Hurry Inlet, 57 m, sandy clay, decaying algae, 1 young animal, 1 adult shell (drilled by *Natica*) (2 finds); Hurry Inlet, 0—13 m, sand and clay, "2 specimens" (JENSEN) — 94 m, sand and clay, "2 specimens" (JENSEN); Hurry Inlet, at Constable Pynt, 18—22 m, very soft clay, 12 animals; Hurry Fjord, off Constable Pynt, 21—31 m, clay, 64 adult, half-grown, and young animals (11 finds) — 44—46 m, tough clay, 28 half-grown and young animals (3 finds) — 91 m, clay, 1 half-grown and 1 young animal; E.side of Hurry Inlet, off Constable Pynt, 33—91 m, clay, 1 adult, 6 half-grown, and 9 young animals (5 finds); Hurry Inlet, off Fame Øer, 25—27 m, soft clay with gravel, 7 adult animals (2 finds); Hurry Inlet, at Fame Øer, 12—24 m, soft clay, *Laminaria*, red algae, 48 adult and half-grown animals (7 finds); Fame Øer, 70°50′ N. 22°33′ W., 5—8 m, mud, 1 adult animal — 23—25 m, clay, 10 adult and 1 young animals; Off Kap Hooker, 65 m, sand, 2 half-grown and 3 young animals — 57—72 m, sand mixed with clay, 7 adult, 4 half-grown, and 3 young animals (5 finds); N.E. of Danmarks Ø, 18—22 m, soft clay, *Desmarestia*, 14 adult and half-grown animals, 1 adult shell (drilled by *Natica*) (6 finds); S.E. of Danmarks Ø, 10—17 m, soft clay, gravel, 4 adult animals, 2 adult shells — 27—30 m, soft clay, gravel, 4 adult animals; Turner Sund, ca. 5.5 m, 16 adult animals; Kap Dalton, 17—21 m, fine clay with small stones, "7 specimens" (JENSEN).

Sydøstkyst Area: Fjord inside Kûngmiut, 10—15 m, 1 adult animal — 20 m, sandy clay, 1 adult and 1 young animal; Sermilik, 2nd E.fjord, 50 m, clay, 3 adult animals; Napassorssuaq N. of Kap Tordenskjold, 36 m, muddy sand, 1 young animal; Kap Tordenskjold, 90 m, clay, 1 young animal; Nanûseq N. of Lindenows Fjord, 46 m, algae, 1 adult animal — 58 m, gravel, clay, 1 young animal — 150—175 m, clay, 2 adult animals; Lindenows Fjord, outer part, 17 m, grey clay, 1 adult animal — 47—51 m, dark grey clay, 4 adult animals, 1 adult shell (5 finds) — 52—100 m, clay, sand, gravel, 16 adult and 2 young animals (4 finds); Lindenows Fjord, middle part, 40—80 m, clay, 10 adult and 1 young animal (3 finds) — 125—150 m, clay, 1 adult and 2 half-grown animals; Lindenows Fjord, inner part, 33 m, gravel, *Laminaria*, 1 half-grown and 1 young animal — 55—91 m, clay, 45 adult, half-grown, and young animals (7 finds) — 100—150 m, clay, 3 adult animals, 2 half-grown shells (2 finds); Lindenows Fjord, innermost part, 36 m, sand, *Laminaria*, 2 adult animals — 45—110 m, clay, 9 adult and 1 half-grown animals, 1 adult and 1 young shell (4 finds).

The species thus occurs along the East Greenland coast from Jørgen Brønlund Fjord in the N. to Lindenows Fjord in the S. with a vertical range from 0—13 m (Hurry Inlet) to 400 m (between Kap Weber and Ymers Ø). However, finds from depths exceeding 100 m are uncommon from E. Greenland. The bottom was clay, clay mixed with sand, mud, and gravel. On pure sandy bottom only a few animals have been taken. *Nucula tenuis* occurs within the Arctic *Macoma* community, but may also be met with in the upper region of the *Astarte crenata* community as well as in transitional zones. In Hurry Inlet, off Constable Pynt, more than 28 individuals per m^2 of a weight of 2.1 gr. were found (THORSON 1934 b).

Remarks: All of the East Greenland specimens are referable to *N. tenuis expansa* Reeve, even though there is some variation in the proportions of the shell. The ten largest specimens measure (length × height × breadth of shell): 17.4 × 14.1 × 9.5 — 17.3 × 13.6 × 9.2 — 17.2 × 13.5 × 9.2 — 16.4 × 13.3 × 7.9 — 16.3 × 14.0 × 8.8 — 16.3 × 12.7 × 8.4 — 16.3 × 12.6 × 8.1 — 16.2 × 12.9 × 8.7 — 16.0 × 13.1 × 8.6, and 16.0 × 12.9 × 8.7 mm, respectively. The species thus seems to reach its maximum size at E. Greenland. The colour of the periostracum of the specimens varies from a greenish-brown to a light brownish-yellow. In most specimens the surface is covered in some measure with brownish or greyish incrustations of bottom material.

Distribution: *Nucula tenuis* incl. of subspecies is known from nearly all Arctic seas hitherto examined, viz. West and East Greenland, Spitzbergen, Novaya Zemlya, the Barents Sea, the Murman Sea and the Murman Coast, the White Sea, the Kara Sea, the Siberian Ice Sea, Kamchatka, the Bering Sea and the Bering Strait, N. of America, Baffin Land, Grinnell Land, Labrador, Gulf of St. Lawrence, Nova Scotia; further, around Iceland, the Faroes, the Sound and the Belt Sea (Denmark), the British Isles, and along the European W. coast from the Arctic to Gibraltar (?), and in the Mediterranean (?); in the N. Pacific as far south as N. Japan and California, and along the E. coast of N. America southward to Cape Hatteras and the Florida Strait. Main distribution: Panarctic-boreal, circumpolar. Vertical range: From 2 m (Spitzbergen) to 2250 m (off Ireland, taken alive?).

Biology: Reproduction partly known from N. E. Greenland (Thorson 1936), where the species spawns at the end of July or the beginning of August. The eggs measure 130—140 μ in diameter. Accordingly, the larval development is lecithotrophic and the pelagic stage presumably very short or entirely lacking.

2. *Leda pernula costigera* Leche (cf. pl. 1, fig. 2).

Leda pernula G. O. Sars 1878, pl. 5, figs. 1a—d.
Leda pernula var. *costigera* Leche 1883, pl. 33, figs. 23—25.

East Greenland and Jan Mayen records:

Leda pernula Friele 1878, p. 222.
Leda pernula Posselt 1895, p. 69.
Leda pernula Posselt & Jensen 1898, p. 44.
Leda pernula Friele & Grieg 1901, p. 17.
Leda pernula Hägg 1904, p. 8.
Leda pernula Jensen 1905, p. 316.
Leda pernula Lamy 1913a, pp. 22—23.
Leda pernula Lamy 1913b, p. 601.
Leda pernula Odhner 1915, p. 57.

Leda [Nuculana] pernula REMY 1928, p. 220.
Leda pernula THORSON 1934a, p. 6.
Leda pernula THORSON 1936, pp. 55, 56; on reproduction.

Occurrence at East Greenland (cf. the map fig. 12, p. 173):

Nordøstkyst Area: Stormbugt at Danmarks Havn, 9.5—19 m, soft bottom, *Laminaria*, 1 adult valve — 19—38 m, hard bottom, *Delesseria*, 1 adult broken valve; S.E. of Sabine Ø, 207 m, fine clay, stones, gravel, 1 adult animal; S.E. of Lille Pendulum, 74°35′ N. 18°23′ W., 18—21 m, sandy mud, algae, 1 adult animal.

Kejser Franz Josephs Fjord Area: S.E. of Clavering Ø, 74°10′ N. 20°08′W., 25—40 m, mud, many shells and pebbles, 6 adult, 3 half-grown, and 1 young animals; Lerbugt at Clavering Ø, 2 half-grown animals from the stomach of *Phoca foetida*; Eskimonæs, Clavering Ø, 38—41 m, clay, gravel, brown algae, 1 young animal — 50—55 m, clay, gravel, stones, 11 adult, half-grown and young animals (2 finds); Loch Fyne, on the shore, 1 adult shell; 4 miles E. of Holland Ø, 130 m, clay, gravel, big stones, 1 half-grown animal; Off Mackenzie Bugt, 100 m, mud, 1 adult animal (HÄGG); Mackenzie Bugt, 12—35 m, mud, 14 animals (HÄGG); 73°20′ N. 21°20′ W., 70 m, mud, pebbles and shells, 1 adult animal; Kap Weber, 73°32′ N. 24°38′ W., 100—110 m, mud, gravel, and stones, 1 half-grown animal; Kejser Franz Josephs Fjord, 73°16′ N. 23°15′ W., 28—36 m, clay, shells, stones, gravel, and sand, 1 adult animal; Vinter Øer at the mouth of Duséns Fjord, 15—30 m, stones, algae, 5 adult animals; The mouth of Duséns Fjord off Kap Graah, 16—20 m, clay, *Desmarestia*, 1 adult animal — 26—40 m, clay, large stones, *Desmarestia*, 11 adult animals, 1 adult shell; Duséns Fjord, inner part, 20—25 m, clay, *Desmarestia*, 1 half-grown and 1 young animal; Inner part of Kejser Franz Josephs Fjord off Engdalen, 27—37 m, brown, soft clay, 6 adult animals (2 finds) — 36—55 m, brown, soft clay, *Laminaria*, 11 adult and 1 young animals (2 finds); Inner part of Kejser Franz Josephs Fjord, 73°06′ N. 27°17′ W., 3—9 m, mud, sand, algae, 2 adult animals — 40—70 m, mud, stones, 3 adult animals; Sophia Sund, E. of Botanikerbugt, 210 m, reddish clay, stones, gravel, 1 adult animal; Solitærbugt, Ella Ø, 2—24 m, 5 adults and 1 half-grown animals — 20—52 m, red algae, about 65 animals and some valves (several finds) — 50—95 m, clay, stones, 4 adult and 1 half-grown animals (2 finds); Solitærbugt off the Delta, 45 m, greyish-brown clay, 1 adult animal; E.part of Vega Sund, 72°45′ N. 22°56′ W., 35—60 m, mud, stones, 1 adult and 3 half-grown animals; Röhss Fjord, 72°43′ N. 26°38′ W., 35—60 m, mud, 1 half-grown animal; Kap Hedlund, Kempes Fjord, 4—27 m, clay, shells, 4 adult animals (2 finds) — 20—53 m, 8 adult animals (some finds); Forsblads Fjord, 5.5—26 m, 1 half-grown animal.

Scoresby Sund Area: Rosenvinges Bugt at the mouth of Scoresby Sund, 28—30 m, rocky bottom, 2 animals (REMY) — 70 m, tough, bluish mud on rocks, 2 animals (REMY); Off the mouth of Hurry Inlet, 20—28 m, stones, sand, algae, 1 half-grown animal — 55 m, clayey sand, 1 adult and 1 young animal — 140—153 m, brown clay with sand, 1 half-grown and 2 young animals; The mouth of Hurry Inlet, 28 m, sand, stones, algae, 1 adult animal — 140 m, brown clay, gravel, 1 young animal; Hurry Inlet, off Constable Pynt, 23—34 m, clay, 1 adult and 10 half-grown and young animals (8 finds) — 45 m, tough clay, 1 young animal; At Constable Pynt, 7—10 m, sand, 1 young animal — 18—22 m, very soft clay, 1 adult animal; Hurry Inlet,

off Fame Øer, 15—24 m, clay, red algae, 27 adult animals, 2 adult valves (4 finds); Fame Øer, 70°50′ N. 22°33′ W., 23—25 m, clay, 1 half-grown animal; Hurry Inlet, 70°43′ N. 22°29′ W., ca. 70 m, mud, 1 adult animal; Hurry Inlet, 94 m, clay with stones, 17 animals, 3 valves; Off Kap Hooker, 57—72 m, sand, or sand mixed with clay, 12 adult, 2 half-grown, and 6 young animals, 4 adult valves (9 finds); 8 miles W. of Kap Hooker, 13—14 m, sand mixed with clay, 1 adult, 2 half-grown and 1 young animals (3 finds); W.coast of Jameson Land opposite Kap Leslie, 22 m, sandy, micaceous clay, 3 adult and 1 young animals; Kap Leslie, 82 m, micaceous clay, 1 young animal; W.coast of Jameson Land opposite Bjørneøer, 30—51 m, clay, 1 adult, 1 half-grown, and 3 young animals (5 finds); Nordbugten, Nordvestfjord, 25—29 m, clay, 1 adult animal, 1 young shell, 1 adult valve (2 finds); N.E. of Danmarks Ø, 19—22 m, soft clay, 7 adult and half-grown animals (5 finds); S.E. of Danmarks Ø, 10—17 m, soft clay, gravel, 3 adult animals — 27—30 m, soft clay, gravel, 10 adult animals; Hekla Havn at Danmarks Ø, 5.5—11 m, 6 adult animals; The bay opposite Rødeø, Rødefjord, 13—18 m, soft clay with gravel, 17 adult animals — 37—39 m, sand, clay, stones, 4 adult animals (2 finds); Turner Sund, ca. 5.5 m, 6 adult animals; Kap Dalton, 17—21 m, clay with pebbles, 12 adult animals, 1 valve.

Kangerdlugssuaq Area: Uttentals Sund, 4—5 m, 1 adult animal — 10—14 m, 10 adult and half-grown animals — 20—ca. 50 m, clay, about 85 animals (9 finds) — 75—100 m, clay, 1 adult animal; Kangerdlugssuaq, 20—25 m, mud, clay, 1 adult animal — ca. 50 m, gravel, 3 adult animals — 80—100 m, stones, 4 adult animals.

Sydøstkyst Area: Off Angmagssalik, 47—75 m, clay with small stones and shells, 5 animals (Posselt, Posselt & Jensen); Ímíkêrteq, depth?, 1 valve; Tasîssaq near Angmagssalik, 25—30 m, 2 adult valves — 55—95 m, 3 adult animals; Sermilik, settlement Íkáteq, 200 m, 1 adult animal; Sermilik, 2nd E.fjord, 50 m, clay, 3 adult animals; Ikerasaussaq near Angmagssalik, 235 m, soft clay, 1 adult shell; Napassorssuaq N. of Kap Tordenskjold, 38 m, muddy sand, 17 adult, half-grown, and young animals; Qutdlît, 13 m, rocks, red algae, *Laminaria*, 1 adult animal; Nanûseq N. of Lindenows Fjord, 40—58 m, sand, clay, gravel, 2 adult animals (2 finds); Lindenows Fjord, outer part, 45—70 m, clay, sand, gravel, about 45 animals (3 finds) — 90—100 m, clay, 4 adult and 1 young animals (2 finds); Lindenows Fjord, middle part, 40—80 m, clay, 2 adult, 1 half-grown and 1 young animal (3 finds) — 125—150 m, clay, 4 adult and 4 half-grown animals — 150—175 m, clay, 1 adult shell; Lindenows Fjord, inner part, 15—30 m, clay, gravel, 1 adult animal — 45—78 m, clay, 3 adult and 1 young animals (3 finds) — 100—150 m, clay, 3 young animals, 1 adult shell (2 finds); Qeqertatsiaq, 60—70 m, sand, gravel, dead bryozoans, 1 adult and 1 half-grown animal, 1 half grown shell (drilled by *Natica*).

Jan Mayen Area: Jan Mayen, 95—113 m, mud with coarser material, about 25 adult, half-grown, and young animals, 1 young valve (2 finds); Jan Mayen, 132 m, "in large numbers" (Friele); Jan Mayen, 162 m, about 80 adult, half-grown, and young animals; 70°51′ N. 8°20′ W., 174 m, dark grey, sabulous clay (Friele & Grieg); Jan Mayen, 70°47′ N. 8°22′ W., 140 m, 130 animals (Lamy); S. of Jan Mayen, 70°52′ N. 10°33′ W., 180 m, grey, volcanic mud, 12 animals (Lamy). [71°12′ N. 8°38′ W., 1275 m!, grey clay, 1 adult animal].

Thus the species is of common occurrence both at E. Greenland and around Jan Mayen. Along E. Greenland live specimens have been found from S. E. of Lille Pendulum in the N. to Qeqertatsiaq in the S. with a vertical range from 3—9 m (inner part of Kejser Franz Josephs Fjord), or 2—24 m (Solitærbugt, Ella Ø) to 210 m (Sophia Sund). It seems to be equally common along the outer coast and in the inner fjords. It lives mainly on a clayey or muddy bottom, which may be mixed with sand or gravel, but it seems to avoid pure sand. Within the Arctic *Macoma* community it seems to attain its greatest abundance. Thus, at the W. coast of Jameson Land opposite Kap Leslie, 22 m, sandy clay, the species was represented in a number corresponding to 30 animals per m^2 with a live weight of 16 gr. (THORSON 1934 b).

Remarks: All of the specimens present from E. Greenland and Jan Mayen belong to var. *costigera* LECHE, which is remarkable for having the posterior end curved strongly upwards and for being provided with a well developed longitudinal rib on the interior of the shell. Some of the East Greenland specimens show a superficial resemblance to *Leda minuta* by having a rather distinct concentric striation on the surface. This applies e. g. to several specimens from Ella Ø.—The species may attain a considerable size at E. Greenland, the five largest specimens collected here measuring (length × height × breadth of shell): 32.0 × 14.8 × 8.0 — 31.5 × 14.6 × 8.0 — 31.3 × 14.8 × 7.8 — 31.1 × 13.5 × 8.1, and 29.7 × 14.1 × 8.6 mm, respectively. The largest valve measured about 34 mm in length.—Some animals had *Perigonimus* sp. attached to their shells.

Distribution (of *L. pernula* incl. of subspecies): West and East Greenland, Jan Mayen, Spitzbergen, Franz Josephs Land, Novaya Zemlya, the White Sea, the Kara Sea, the Murman Coast and the Murman Sea, the Finmark, the Siberian Ice Sea, the Bering Sea and Strait, Grinell Land, Baffinland, the Hudson Strait, Labrador to New England S. of Cape Cod, Iceland, the Faroes, the Shetlands, along the Norwegian coast southward to the Channel, the Sound and the Belt Sea (Denmark), W. coasts of Scotland and Ireland (shells only), the Bay of Biscay (shells only). Main distribution: Panarctic-boreal, circumpolar. Vertical range: From 3—9 m (E. Greenland), or 4 m (Spitzbergen) to 1275 m (near Jan Mayen).

Biology: Reproduction partly known from N. E. Greenland (THORSON 1936). On account of the egg-size, which is about 135 μ in diameter (calculated from fig. 9, p. 56, op. cit.), the larval development must be assumed to be lecithotrophic and non-pelagic or with a very short pelagic stage.

3. *Leda minuta* (O. F. Müller) (cf. pl. 1, fig. 10).

Leda minuta Jeffreys 1869 V, pl. 29, fig. 6.
Leda minuta G. O. Sars 1878, pl. 5, figs. 2a—b.

East Greenland and Jan Mayen records:

Leda minuta Friele & Grieg 1901, p. 17.
Leda minuta Jensen 1905, p. 317.

Occurrence at East Greenland (cf. the map fig. 3, p. 20):

Scoresby Sund Area: Kap Dalton, 17—21 m, clay, 1 adult shell.

Sydøstkyst Area: Ímíkêrteq, 65°45′ N. 36°58′ W., 19—56 m, 3 adult valves; Tasîssaq near Angmagssalik, 10—12 m, 2 adult animals — 25—50 m, 2 adult animals, 1 adult shell (2 finds); Angmagssalik, off the harbour, 45 m, 1 adult animal; Sermilik, settlement Íkáteq, 25 m, 1 adult animal; Napassorssuaq N. of Kap Tordenskjold, 36—38 m, muddy sand, 3 adult and 2 half-grown animals; Qutdlît, 30 m, sand and a little mud, 1 adult animal; Nanûseq N. of Lindenows Fjord, 40—60 m, sand, clay, and gravel, 1 adult animal, 1 adult shell (2 finds); Lindenows Fjord, 10—25 m, 1 adult animal; Lindenows Fjord, outer part, 4 m, gravel, *Laminaria*, 1 adult shell (drilled by *Natica*) — 25 m, clay, gravel, *Laminaria*, 1 adult animal — 48—100 m, clay, or clay with sand and gravel, 7 adult, 1 half-grown, and 2 young animals (3 finds) — 120 m, clay, 1 half-grown shell (drilled by *Natica*); Lindenows Fjord, middle part, 27 m, sand, *Laminaria*, remnants of algae, 1 adult shell (drilled by *Natica*) — 25—30 m, gravel, *Laminaria*, 1 adult animal — 30—120 m, clay, fine sand, dead bryozoans, *Laminaria*, 4 adult, 3 half-grown, and 7 young animals (8 finds) — 125—150 m, clay, 3 half-grown, and 1 young animals; Lindenows Fjord, inner part, 32 m, sand and clay, 1 adult animal — 25—77 m, clay, gravel, *Laminaria*, 3 adult, 7 half-grown, and 5 young animals (4 finds) — 100—150 m, clay, 2 half-grown and 5 young animals (2 finds); Lindenows Fjord, innermost part, 15—30 m, clay, gravel, 2 adult and 2 halfgrown animals (2 finds) — 35 m, gravel, *Laminaria*, 1 adult and 1 young animal — 90 m, clay, 1 young animal; Qeqertatsiaq, 60—120 m, sand, gravel, dead bryozoans, 1 adult, 3 half-grown, and 1 young animals, 2 half-grown valves (2 finds).

Jan Mayen Area: 70°54′ N. 8°24′ W., 128 m, dark-grey, sabulous clay (Friele & Grieg).

The single shell from Kap Dalton may be subfossil in spite of its rather fresh appearance. The species seems to be frequent only along the southernmost part of the E. Greenland coast, where its present northern limit may be fixed a little to the N. of Angmagssalik. The vertical range for living animals at E. Greenland is from 10—12 m (Tasîssaq) to 125—150 m (Lindenows Fjord), and the bottom from which they were taken, was primarily clay, mud, and sand, or gravel mixed with clay. However, adult animals, as well as younger ones, were occasionally found on rather purely sandy bottom.

Remarks: *Leda minuta* is known to be subject to a considerable variation and this also applies to the specimens from E. Greenland, especially as regards the proportions of their shells. The three largest

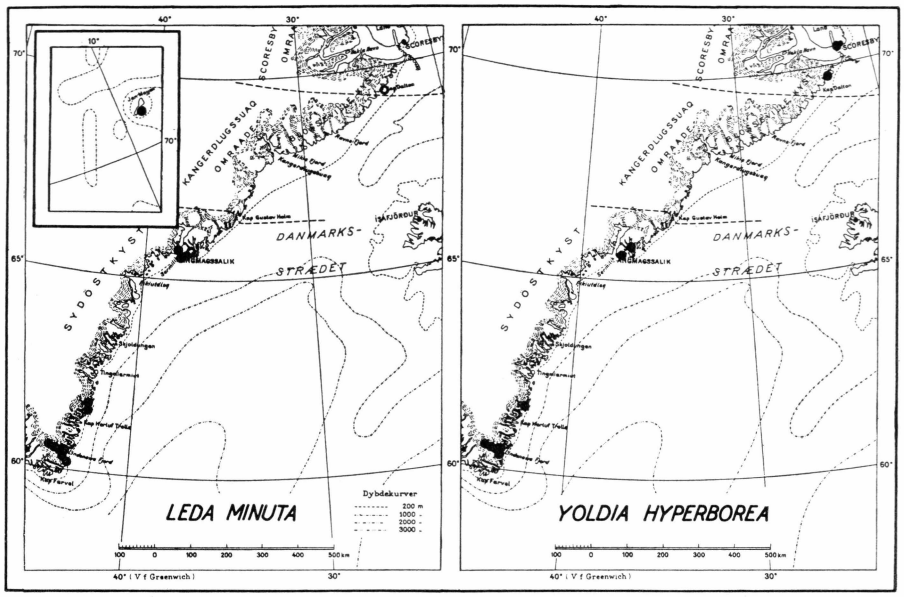

Fig. 3. Distribution of *Leda minuta* (O. F. MÜLLER) and *Yoldia hyperborea hyperborea* (LOVEN) TORELL along East Greenland and at Jan Mayen. — Full circles: Living animals. Open circles: Shells or valves only.

animals present measure (length × height × breadth of shell): 15.7 × 8.1 × 4.8 — 15.5 × 7.6 × 5.3, and 15.1 × 8.2 × 5.7 mm, respectively, while the largest, empty shell measures 15.5 × 8.2 × 5.4 mm.

Distribution: West Greenland, S. E. Greenland, Jan Mayen, Spitzbergen, the Finmark, the White Sea, the Bering Sea and the Bering Strait, the Chukotsk and the Beaufort Seas, Grinnell Land, Baffinland, Labrador, Nova Scotia, Iceland, the Faroes, and along the Norwegian coast. To the S. the species reaches N. Japan, San Diego (California), Fundy Bay, Maine, Ireland, Bretagne, and the Sound (Denmark). Main distribution: Lowarctic-boreal, discontinuously circumpolar, lacking in the most high-arctic seas. Vertical range: From 4 m to about 1900 m.

Biology: BARKER JØRGENSEN (in THORSON 1946, p. 281) assumes that the pelagic stage of the larva is probably very short, since pelagic larvae, which might be referred to *L. minuta*, have not been met with in the Sound (Denmark), in spite of adults being frequent.—The gonads of an animal from Tasiussaq Havn (W. Greenland, 8-8-31) contained rather large, but still immature and polygonal, eggs measuring about 150 × 110 μ. This egg-size indicates a lecithotrophic development of the larva.

4. *Yoldia hyperborea hyperborea* (Loven) Torell.

Yoldia hyperborea Torell 1859, pl. 2, figs. 6a—b.
Yoldia hyperborea hyperborea Ockelmann 1954, pl. 1, fig. 1, and pl. 2, fig. 3.

East Greenland records:

Yoldia hyperborea Thorson 1934b, p. 56.
Yoldia hyperborea Bertelsen 1937a, pp. 26, 28, 44, and 52—53.
Yoldia hyperborea hyperborea Ockelmann 1954, p. 9, et sequ.

Occurrence at East Greenland (cf. the map fig. 3, p. 20):

Scoresby Sund Area: Amdrups Havn at the mouth of Scoresby Sund, 33 m, *Laminaria*, red algae, 3 adult animals; Turner Sund, ca. 5.5 m, 1 young animal.

Sydøstkyst Area: Fjord inside Kûngmiut, 20 m, sandy clay, a little *Desmarestia*, 1 adult animal; Tasîssaq near Angmagssalik, 25—30 m, 1 adult animal; Napassorssuaq N. of Kap Tordenskjold, 38 m, muddy sand, 1 adult animal; Nanûseq N. of Lindenows Fjord, 150—175 m, clay, 3 adult and 1 half-grown animals; Lindenows Fjord, the mouth, 125—150 m, gravel, clay, 1 adult animal; Lindenows Fjord, outer part, 10—20 m, grey clay, 3 adult, 5 half-grown, and 1 young animals (6 finds) — 45—50 m, dark, greyish clay, 6 adult and 3 young animals (5 finds) — 54—58 m, dark, greyish clay, 1 adult and 1 young animal (2 finds) — 60—70 m, clay, gravel, and sand, 28 adult and half-grown animals — 90 m, clay, 1 adult animal; Lindenows Fjord, middle part, 25—30 m, gravel, *Laminaria*, 2 adult valves — 40—50 m, clay, 1 half-grown animal — 60—80 m, clay, 2 adult and 1 half-grown animals; Lindenows Fjord, inner part, 77 m, clay, 1 half-grown animal — 100 m, clay, 1 adult animal — 150 m, clay, 1 young animal; Lindenows Fjord, innermost part, 15—30 m, clay, gravel, 1 adult animal, 1 half-grown shell.

The remarkable occurrence of this species together with many specimens of the brittle-star *Ophiacantha bidentata* (Bruz.) at Amdrups Havn, the mouth of Scoresby Sund, led Thorson (1934 b, p. 56) to the suggestion that in that area these two forms are especially associated with calm, sheltered places along the outer coast or near the open sea, where the ecological conditions are of a less severe character. Therefore, it seems noteworthy that the species has now been found in some other East Greenland localities where similar conditions must be assumed to prevail, viz. Turner Sund, Tasissaq near Angmagssalik, and Kûngmiut, and, further, that the species seems to be most frequent in the outer part of Lindenows Fjord. As to the causes of this type of distribution it seems probable that the supply of depositing organic matter is much larger in the localities mentioned (cf. p. 221) than in the more distant ones from the open sea, and that *Y. hyperborea* has a fairly high metabolism. The latter assumption is supported by the habits of the closely related and very active *Y. limatula* (cf. Drew 1899).—At E. Greenland the species thus occurs at places near the open sea from Amdrups Havn in the N. to Lindenows Fjord in the S., being by far commonest in the

latter district, with a vertical range for living specimens from 5.5 m (Turner Sund) to 150—175 m (Nanûseq N. of Lindenows Fjord). Most of the specimens were taken from a bottom consisting of clay, or clay mixed with gravel and sand.

Remarks: The systematics and the distribution of the species together with those of some other northern species of *Yoldia s. s.* have recently been revised (OCKELMANN 1954). All the specimens from E. Greenland may be referred to *Yoldia h. hyperborea*, though the animals present from Nanûseq differ slightly, showing a ratio of shell length to depth of pallial sinus as in *Y. hyperborea limatuloides*.—The five largest specimens from E. Greenland measure (length × height × breadth of shell): 44.7 × 22.9 × 12.5 — 36.5 × 18.2 × ca. 9.5 — 35.8 × 17.8 × 9.4 — 33.5 × 17.2 × 8.2, and 33.4 × 16.5 × 8.3 mm, respectively.

Distribution: (incl. of *Y. hyperborea limatuloides*): West Greenland S. of about 73° N., S. E. Greenland and at the mouth of Scoresby Sund, Spitzbergen, the Murman Coast, the Finmark, the Barents Sea, Waigatsch, Novaya Zemlya, the White Sea, the Kara Sea, the eastern part of the Siberian Ice Sea, the Bering Strait, the N. coast of Alaska, Wellington Channel, Jones Sound, Smith Sund, the mouth of Hudson Strait; to the South the species reaches W. Iceland, the southern islands of Lofoten, and ?Nova Scotia. Main distribution: Low-arctic, apparently discontinuously circumpolar and avoiding the most high-arctic seas. Vertical range: From 4 m (W. Greenland) to 677 m (W. Greenland).

Biology: A considerable part of the adult animals present from East Greenland are females with fairly large eggs in their gonads (material preserved in alcohol). In three females (Lindenows Fjord, 27-7-35) spawning had apparantly begun, and the condition of the other animals examined seems to indicate that the species spawns at S. E. Greenland at the end of July and later. Apparently mature eggs measure about 150 × 140 μ, are rich in yolk, and surrounded by a rather thin membrane. Even on fairly small specimens the prodissoconch was found to be indistinctly delimited and was not measured. On account of the egg-size, however, the larval development must be assumed to be lecithotrophic with the pelagic stage entirely lacking or of a very short duration.

5. *Yoldia* (*Megayoldia*) *thraciaeformis* (STORER) (cf. pl. 1, fig. 11).

Yoldia thraciaeformis GOULD & BINNEY 1870, p. 157, fig. 465.
Yoldia thraciaeformis OLDROYD 1924, pl. 1, fig. 1.

Occurrence at East Greenland (cf. the map fig. 22, p. 183):

Sydøstkyst Area: Lindenows Fjord, outer part, 100—150 m, clay with gravel, 1 adult animal; Lindenows Fjord, middle part, 125—150 m, clay,

1 adult and 1 young animal — 275 m, clay, 1 young animal; Lindenows Fjord, innermost part, 200—250 m, clay, 1 adult shell.

The species here recorded from East Greenland for the first time certainly inhabits only the deeper parts of the southernmost fjords of the whole East Greenland coast. Yet these finds are not surprising, as the species is rather common in the adjacent regions of S. W. Greenland.

Remarks: All the specimens from E. Greenland are of an appearance typical of the species. The two largest animals measure (length × height × breadth of shell): 35.5 × 22.0 × 13.0, and 26.8 × 15.5 × 9.5 mm, respectively. The empty shell measures 43 mm in length.

Distribution: West Greenland northwards to about 73° N., S. E. Greenland, the Gulf of St. Lawrence, off Newfoundland, Maine, and Massachusetts; along the N. American west coast from the Bering Strait southward to Oregon and Puget Sound. Main distribution: Subarctic, discontinuously circumpolar. Vertical range: From about 19 m (New England) to 790 m (Davis Strait).

Biology: One adult animal from Lindenows Fjord contained ripe sperm in its gonads (24-7-35). The egg-size is about 150 μ in diameter (specimens from Disko, W. Greenland, 7-9-28). The eggs are surrounded by a rather thin membrane. On account of the egg-size the larval development of this species must be assumed to be lecithotrophic with the pelagic stage very short or quite suppressed.

6. *Portlandia arctica* (Gray).

Portlandia arctica G. O. Sars 1878, pl. 4, figs. 7a—b.
Portlandia arctica var. nux, Brögger 1900—1901, figs. 3a—c.

East Greenland records:

Portlandia arctica Posselt 1895, p. 68.
Portlandia arctica Posselt & Jensen 1898, p. 40.
Portlandia arctica Hägg 1904, p. 14—15.
Yoldia [*Portlandia*] *arctica* Jensen 1905, pp. 317—319.
Portlandia arctica Odhner 1915, p. 60.
Portlandia arctica Thorson 1936, p. 55; p. 56, fig. 9, egg-size.
Portlandia arctica Jensen 1942, pp. 10—14, and p. 22.

Occurrence at East Greenland (cf. the map fig. 24, p. 184):

Nordøstkyst Area: Jørgen Brønlund Fjord, Peary Land, about 10 m, 2 young animals — about 13 m, clay, 2 adult, 6 half-grown and young animals, 1 adult and 3 young shells (2 finds) — 6 adult, 4 half-grown, and 3 young animals from *Somateria spectabilis* juv.

Kejser Franz Josephs Fjord Area: Kap Stosch, Gael Hamkes Bugt, about 15 m, 27 animals; Knudshoved (Karlshavn), 8—10 m, muddy bottom, 1 young animal, 1 adult and 1 half-grown shell; Kap Bennet, 73°26′ N. 21°13′ W., 9—11 m, sandy mud, algae, 1 adult animal; Mackenzie Bugt, 12—18 m, mud,

2 animals and 1 shell (HÄGG) — 12—35 m, mud, a large number of animals and some shells (HÄGG); Moskusoksefjord, outer part, 220 m, clay, a large number of animals (HÄGG); Moskusoksefjord, 15 m, 1 adult animal and 1 valve; Moskusoksefjord, off Ankerbjerg valley, 17—23 m, clay, big stones, 3 adult animals and 1 adult shell (2 finds) — 35—45 m, red clay, sand and gravel, 2 adult, 14 half-grown and young animals, 1 shell (2 finds); Off Strindbergs Halvø, Nordfjord, 19 m, clay, about 80 adult animals; Off the river, Nordfjord, 10—25 m, soft clay, 20 adult animals; Off the Danish House, Nordfjord, 8 m, fine grey clay, about 20 animals; Nordfjord, 3 miles S.E. of the Danish House, 205 m, fine grey clay, 1 adult and 1 half-grown animal; Off Waltershausen Gl., Nordfjord, 120 m, very fine and soft clay, 15 animals; Geologfjord, $^1/_2$ mile from the Nunatakgletscher, 410 m, fine greyish clay with fine gravel, 1 halve-grown valve; Eleonore Bugt, 15—27 m, clay, some stones, *Laminaria*, *Desmarestia*, 29 adult animals (2 finds); Duséns Fjord, at the anchoring place, 20—25 m, clay, *Desmarestia*, 4 adult animals; Inner part of Kejser Franz Josephs Fjord, 73°6′ N. 27°17′ W., 3—9 m, mud, sand, and algae, 10 adult and 1 young animals; Isfjord off Haredalen, 9—15 m, clay, about 20 adult animals — 27—35 m clay, 78 animals (some approaching *var. siliqua*) (2 finds) — 55—59 m, brown clay, 2 adult animals; Off Engdalen, inner part of Kejser Franz Josephs Fjord, 13—18 m, fine greyish clay, 1 adult animal — 27—37 m, brown clay, about 110 animals (3 finds) — 50—55 m, brown clay, about 50 animals (some approaching *var. siliqua*); Carl Jacobsens Bugt, Ymers Ø, 20 m, 1 adult shell; Solitærbugt, Ella Ø, 2—24 m, 3 adult animals (2 finds) — 20—52 m, 2 adult animals, 2 adult and 1 young shells (2 finds); Forsblads Fjord, 6—26 m, 1 young shell; The mouth of Kong Oscars Fjord, 72°1′ N. 23°3′ W., 32—40 m, mud, 2 adult and 1 half-grown animals; Fleming Fjord, 224 m, red clay, 13 adult and half-grown animals, 2 adult valves.

Scoresby Sund Area: Amdrups Havn, 6—10 m, *Laminaria*, brown algae, 1 adult animal; Hurry Inlet, 0—13 m, clay and sand, 18 adult and half-grown animals; Hurry Inlet at Constable Pynt, 7—10 m, sand, more than 100 animals, many half-grown; Hurry Inlet off Constable Pynt, 18—22 m, soft clay, 6 half-grown and young animals — 21—24 m, clay, 3 adult, 3 half-grown, and 13 young animals (8 finds) — 44—46 m, tough clay, 2 adult and 2 young animals (3 finds); In the middle of the fjord, off Constable Pynt, 92 m, clay, 2 half-grown animals; E.side of Hurry Inlet, opposite Constable Pynt, 45—46 m, clay, 2 young animals, 1 adult shell (drilled by *Natica*) (2 finds); Off Fame Øer, Hurry Inlet, 25 m, soft clay with pebbles, 4 adult animals, 1 adult shell (drilled by *Natica*); At Fame Øer, 70°50′ N. 22°33′ W., about 5—9 m, mud and clay, 15 adult, 4 half-grown and 6 young animals (2 finds) — 23—27 m, clay, 19 adult and 1 half-grown animals (3 finds); At Fame Øer, 15—18, soft clay, red algae, *Laminaria*, 11 animals — 20 m, tough clay, 1 adult animal — 22—24 m, soft clay, red algae, *Laminaria*, 18 animals, 4 valves (a few approaching var. *nux*); Off Kap Hooker, 57—60 m, sand mixed with clay, 2 adult and 1 half-grown animals (2 finds) — 67—72 m, sand mixed with clay, 3 adult, 3 half-grown, and 2 young animals, 2 adult shells (5 finds); 8 miles W. of Kap Hooker, 13 m, clayey sand, 1 half-grown shell (drilled by *Natica*); Kap Leslie, 58—82 m, glittering clay, 4 half-grown and 2 young animals, 1 adult valve (4 finds); Noa Vig, Milne Land, 10—15 m, soft clay, 14 adult and half-grown animals; W.coast of Jameson Land opposite Bjørneøer, 29—31 m, tough clay, 7 adult animals, 3 adult valves (7 finds); Off Bjørneøer, 20—30 m, clay, sand, 1 adult animal, 1 adult valve (drilled by *Natica*)

(2 finds); Nordostbugt, 4 miles from the mouth of Schucherts Flod, 29—33 m, light grey mud, about 75 animals, 17 valves (10 finds) — 46 m, light grey mud, 14 animals; Nordbugten, Nordvestfjord, 2—3 m, clay, *Fucus*, 1 young animal — 10—18 m, soft, light grey clay, about 100 adult, half-grown, and young animals — 25—30 m, soft clay, 30 adult, half-grown, and young animals, 6 valves (10 finds) — 30—37 m, soft, grey clay, about 120 adult, half-grown, and young animals — 325—339 m, soft clay, 3 adult and 2 young animals (2 finds); The bay opposite Rødeø in Rødefjord, 18—26 m, clay, *Laminaria*, 2 adult animals; S.E. of Danmarks Ø, 27—30 m, soft clay with gravel, 1 adult animal; Hekla Havn at Danmarks Ø, ca. 23 m, 1 adult animal, 1 adult shell (var. *nux*), 1 half-grown valve; Turner Sund, ca. 5.5 m, 25 adult and half-grown animals, 8 shells (a few approach var. *siliqua*); Kap Dalton, 17—19 m, fine clay with pebbles, 1 adult and 2 young shells.

Kangerdlugssuaq Area: Mikis Fjord, 3.5—4 m, sandy clay, 2 adult animals, 1 adult shell — 7—8 m, clay, 18 adult and half-grown animals — about 55 animals, from *Somateria mollissima* (L.).

Sydøstkyst Area: Sermilik, 2nd E.fjord, 25 m, 1 adult shell (probably subfossil, in spite of a rather fresh appearance).

Living *Portlandia arctica* have thus been found from Jørgen Brønlund Fjord (82°10′ N.) in the N. to Mikis Fjord (68°10′ N.) in the S., with a vertical range from 2—3 m (Nordvestfjord) to 339 m (Nordvestfjord). Generally, however, the species is commonest at depths between 10 and 50 m. It lives almost always in a muddy or clayey bottom, only rarely has it been taken from sandy bottoms. The optimal habitat of it seems to be localities situated off the mouth of rivers with melt water and off glacier fronts, where large quantities of mud and clay are deposited. In such places the *Portlandia arctica* community is formed with the present species as an absolute dominant. For instance, 4 miles outside the mouth of Schucherts Flod, 29—46 m, light grey mud, the species was found to occur with 90 animals per m^2, with a live weight of 21.4 gr., on an average, whereas all the other animals of the bottom fauna together weighed only 18.4 gr. per m^2 (Thorson 1934 b).

Remarks: The species varies greatly in the proportions of its shell, and several varieties of it have been described. However, almost all of the specimens from E. Greenland are referable to var. *portlandica* Reeve, only some specimens from Isfjord, from the inner part of Kejser Franz Josephs Fjord, and from Turner Sund approach var. *siliqua* Reeve. Further, from Hekla Havn at Danmarks Ø, an adult shell of var. *nux* Brögger is at hand, and a few specimens from Hurry Inlet, at Fame Øer, are intermediate between var. *nux* and var. *portlandica*. The largest animals (all of var. *portlandia*) measured (length × height × breadth of shell): 28.5 × 15.3 × 10.2 — 27.6 × 15.5 × 10.4 — 27.5 × 15.0 × 10.5 — 26.0 × 14.2 × 9.4 — 25.0 × 13.5 × 9.5 — 24.4 × 13.7 × 8.7 and 23.5 × 13.3 × 8.7 mm, respectively. The species thus seems to attain its maximum

size at East Greenland. JENSEN (1905) gives the measures of three specimens (from Turner Sund) approaching var. *siliqua* as 22.5 × 13.5 × 9.5 — 18.2 × 11.5 × 8.0 and 18.0 × 10.75 × 7.75 mm, respectively, and those of the adult shell of var. *nux.* (from Hekla Havn) as 16.0 × 10.5 × 8.75 mm. —Besides the frequent, black incrustations consisting of hardened bottom material, the posterior part of the shells of larger naimals is commonly overgrown with the hydroid *Perigonimus yoldiae-arcticae* BIRULA, sometimes to such a degree as to give the surface a bristle-like appearance.

Of some interest is the large size of the labial palps in *P. arctica* as compared with those of the closely related *P. intermedia.* For instance, in an animal of the former, 10.3 mm in length, the labial palps without proboscides were about 4.4 mm long and 2.1 mm broad, while in an animal of *P. intermedia*, 10.4 mm in length, they measured only about 2.8 × 1.2 mm. Both these animals were of course contracted by the preservation in alcohol, but this difference between the two species occurred in all animals examined. A very efficient sorting action is thus indicated by the size of the labial palps of *P. arctica*, and this may be regarded as an adaptation to the typical environment of the species where large amounts of bottom material with but a very small content of organic matter are deposited.

Distribution: Widely distributed in high-arctic seas, viz. West Greenland (along the northernmost coast only), East Greenland, Spitzbergen, the White Sea (as a relict in deeper water), the Barents Sea, Novaya Zemlya, the Kara Sea, the Siberian Ice Sea, Norton Sound, the seas N. of America, Grinnell Land, Baffinland, Jones Sound, Hudson Strait, and Hudson Bay. Main distribution: High-arctic and circumpolar. Vertical range: From 2—3 m (E. Greenland) to 339 m (E. Greenland).—Dead shells have been found at several places in the Northern Atlantic at great depths down to 2465 m.

Biology: Reproduction partly known from N. E. Greenland (THORSON 1936), where the species spawns from the end of July to the beginning of August. The nutritive matter of the egg measures about 140 μ in diameter. Further, in August 1932, THORSON (cf. JENSEN 1942, p. 22) observed barrel-shaped larvae ("test-larvae"), taken by plankton hauls in Nordfjord. These larvae probably belonged to *Portlandia arctica.* Thus, it seems certain that in this species the larval development is lecithotrophic and the pelagic larval life only of short duration.

7. *Portlandia intermedia* (M. Sars) (cf. pl. 1, fig. 12).

Yoldia intermedia M. Sars 1865, p. 38, figs. 92—96.
Portlandia intermedia G. O. Sars 1878, pl. 4, figs. 9a—b.

East Greenland and Jan Mayen records:

Yoldia intermedia Friele 1878, p. 222.
Portlandia intermedia Friele & Grieg 1901, p. 16.
Portlandia intermedia Hägg 1904, p. 11.
Portlandia intermedia Jensen 1905, p. 319.
Portlandia intermedia Odhner 1915, p. 62.
Portlandia intermedia Grieg 1916, p. 8.

Occurrence at East Greenland (cf. the map fig. 13, p. 174):

Nordøstkyst Area: Off the coast of N.E. Greenland, 75°58½′ N. 14°08′W., 300 m, brown and grey clay, "several specimens" (Grieg); Off Sabine Ø, 74°17′ N. 15°20′ W., 240 m, 1 young valve; S.E. of Sabine Ø, 207 m, fine clay, stones, gravel, 1 adult and 2 half-grown animals, 7 adult and half-grown valves.

Kejser Franz Josephs Fjord Area: Eskimonæs, Clavering Ø, 38—41 m, clay, gravel, brown algae, 1 young animal; Moskusoksefjord, outer part, 220 m, clay, 1 adult animal (Hägg); Kejser Franz Josephs Fjord, E. of Zoologdalen, 180 m, tough clay with stones, 1 adult animal; Eleonore Bugt, 130 m, tough clay with pebbles, 1 half-grown animal; Isfjord, innermost part, 350 m, fine, grey clay, 2 adult animals; The mouth of Duséns Fjord, 150 m, tough, brown clay, 1 half-grown animal; Duséns Fjord, middle part, 240 m, tough clay, 1 adult animal; Sophia Sund E. of Botanikerbugt, 210 m, clay, stones, 1 half-grown animal; Sophia Sund 1 mile E. of Robertson Ø, 310 m, reddish clay, 1 adult shell; Off Kap Elisabeth, Ella Ø, 310 m, brown clay, stones, 1 adult animal; Solitærbugt, Ella Ø, 5—24 m, 4 adult animals, 1 young shell (drilled by *Natica*) — 20—52 m, clay, 9 adult and 1 half-grown animals, 1 half-grown shell, 2 adult valves (drilled by *Natica*) (some finds) — 50—95 m, clay, stones, 10 adult and 1 half-grown animals (several finds); Kong Oscars Fjord, 73°02′ N. 24°30′ W., 180—215 m, mud, gravel and stones, 1 young shell; Kong Oscars Fjord, 72°56′ N. 24°33′ W. ca. 125 m, mud, some pebbles, sand, 1 adult animal; E. af Trail Ø, 72°28′ N. 21°48′ W., 180 m, mud, stones, 3 adult and 2 half-grown animals; Forsblads Fjord, 5.5—26 m, 5 half-grown and young animals, 7 half-grown and young shell — 95—170 m, clay, stones, gravel, about 40 animals; The mouth of Fleming Fjord, 215 m, tough clay, 1 adult and 3 young animals; Fleming Fjord, 220 m, red clay, 7 half-grown and young animals, 1 adult shell; Fleming Fjord off Vimmelskaftet, 27 m, clay, a few stones, 1 adult animal; N. of Kap Biot, 115 m, tough clay, a little gravel, some stones, 1 half-grown animal.

Scoresby Sund Area: Section between Kap Tobin and Kap Brewster, 340 m, fine, soft clay, 2 adult animals (2 finds); The mouth of Hurry Inlet, 95 m, clay, stones, 4 adult, 1 half-grown, and 3 young animals, 1 half-grown shell — 140 m, brown clay, gravel, 1 young animal; Hurry Inlet, 70°43′ N. 22°29′ W., ca. 80 m, mud, 3 half-grown animals; Off Kap Hooker, 60—72 m, sand mixed with clay, 2 young animals (2 finds) — 140 m, clay, gravel and sand, 1 adult and 2 young animals (2 finds); Section between Kap Stevenson and Kap Leslie, 120 m, soft clay, 1 half-grown animal, 1 young shell; W.coast of Jameson Land opposite Kap Leslie, 22 m, sandy, glittering clay, 1 young

animal; Kap Leslie, 82—92 m, glittering clay, 3 half-grown and 1 young animals (2 finds); W. coast of Jameson Land opposite Bjørneøer, 31 m, tough clay, 1 young animal — 78 m, clay, 1 half-grown animal; Nordostbugt, off the mouth of Schucherts Flod, 97 m, tough clay, 1 adult and 1 young valve — 123—160 m, soft clay, 1 half-grown and 1 young animal, 10 adult and half-grown valves (2 finds); Nordbugten, Nordvestfjord, 25—56 m, soft clay, 1 adult, 4 half-grown and 2 young valves (3 finds) — 157 m, soft clay, 1 adult animal; N. of Stewart Ø, 298 m, clay with stones, 2 young animals.

Kangerdlugssuaq Area: Uttentals Sund, 30—40 m, 1 half-grown animal.

Sydøstkyst Area: Lindenows Fjord, outer part, 400—600 m, clay, 2 half-grown animals; Lindenows Fjord, inner part, 200—350 m, clay, 4 adult animals.

Jan Mayen Area: Jan Mayen, 70°58′ N. 8°04′ W., 357 m, dark-grey, sabulous clay, and 70°51′ N. 8°20′ W., 174 m, dark-grey, sabulous clay, "a few specimens" (FRIELE, FRIELE & GRIEG).

Along East Greenland living animals of the species have thus been found from about 76° N. southward to Lindenows Fjord with a vertical range from 11—17 m (Solitærbugt) to 400—600 m (Lindenows Fjord). However, most of the finds are derived from depths exceeding 50 m and it was almost always found to live on a bottom of clay or mud, here and there mixed with sand and gravel. On the same type of bottom the species often seems to replace *Portlandia arctica* at greater depths.

Remarks: Unlike the preceding species, *Portlandia intermedia* varies only slightly. In arctic seas, however, it grows to a larger size than near the southern limit of its area of distribution. This larger form was called var. *major* by LECHE (1878, p. 24), and all the specimens from E. Greenland may be referred to it. But a separation into subspecies is hardly justifiable at present. The species probably attains its maximum size at E. Greenland, as the following measures of the six largest animals will show (length × height × breadth of shell): 16.1 × 9.2 × 7.2 — 16.1 × 9.2 × 6.6 — 14.7 × 8.6 × 6.7 — 14.6 × 8.3 × 5.8 — 14.1 × 8.5 × 6.3 and 13.3 × 7.6 × 5.7 mm. The largest shell at hand measures 14.0 × 8.6 × 7.0 mm.

Distribution: West Greenland, East Greenland, Jan Mayen, Spitzbergen, Novaya Zemlya, the Murman Coast, the Barents Sea, the Kara Sea, the Siberian Ice Sea, the Bering Strait, Wellington Channel, and N. Iceland. To the south the species reaches Norton Sound (Alaska), the Shetlands, Varanger Fjord (Norway), and Bohuslän (Sweden). Main distribution: Panarctic and circumpolar. Vertical range: From 7—9 m (Siberian Ice Sea) to about 1150 m (the Shetlands).—Dead shells have been found in the North Atlantic at depths down to 2330 m.

Biology: Reproduction unknown. Apparently the species does not spawn at N. E. Greenland in the summer, for none of the adult animals

(all of which were collected within the interval from the end of June to the end of September) were found with mature or nearly mature eggs.

[*Portlandia kolthoffi* HÄGG.

Portlandia kolthoffi HÄGG 1904, p. 12, figs. 1—3.

One animal and 6 valves of this species have been found N. of Jan Mayen, 72° 01′ N. 8°33′ W., 2400 m, ooze (HÄGG, l. c.). The species resembles *P. intermedia* in some degree, as stated by HÄGG. In the collections of the Copenhagen Museum no bivalve seems to be present which might belong to it, and so far as is known, it has not been found in any other locality than that mentioned].

8. *Portlandia lucida* (LOVÉN).

Portlandia lucida G. O. SARS 1878, pl. 4, figs. 8a—b.
Yoldiella lucida VERRILL & BUSH 1898, pl. 77, fig. 2; pl. 80, fig. 3.

Occurrence at East Greenland (cf. the map fig. 22, p. 183):

Sydøstkyst Area: Lindenows Fjord, outer part, 400—600 m, clay, Foraminifera, 6 adult animals.

The species, recorded here from E. Greenland for the first time, seems to occur only along the southernmost part of the East Greenland coast. Since, however, it is widely distributed in the N. Atlantic and is found e. g. in West Greenland and around Iceland, the find is not surprising.

Remarks: All the specimens from E. Greenland are of an appearance typical of the species. The three largest of them measure (length × height × breadth of shell): 6.9 × 4.5 × 2.9 — 6.4 × 4.3 × 2.7 and 6.2 × 4.1 × 2.4 mm, respectively.

Distribution: West Greenland, S. E. Greenland, W. and N. Spitzbergen, the Murman Coast, Novaya Zemlya, along the Norwegian coast from the Finmark to Drøbak, Bohuslän (Sweden), Iceland, the Shetlands, the Hebrides, Great Britain, W. of Ireland, France, the Mediterranean, and off N. America from the Gulf of St. Lawrence to North Carolina.—The occurrence of the species at S. E. Greenland in water of positive temperatures as well as its mode of occurrence in Icefjord, Spitzbergen (cf. ODHNER 1915, p. 62), indicate that the species avoids typically high-arctic waters.—Main distribution: Low-arctic-boreal, Mediterranean-Atlantic, and abyssal (in the N. Atlantic only). Vertical range: From 28—47 m (E. Iceland) to about 1900 m (W. of Iceland, Ingolf Exp. unpubl.), and 2740 m (Western Mediterranean).

Biology: Reproduction unknown.

9. *Portlandia lenticula* (MØLLER) (cf. pl. 1, fig. 13).

Portlandia lenticula G. O. SARS 1878, pl. 4, figs. 10a—b.
Yolfirlls lenticula var. *amblia* VERRILL & BUSH 1898, pl. 80, fig. 9; pl. 81, fig. 4.

East Greenland and Jan Mayen records:

Portlandia lenticula HÄGG 1904, p. 13.
Portlandia lenticula JENSEN 1905, p. 320.
Portlandia lenticula GRIEG 1909a, p. 534.
Yoldiella lenticula LAMY 1913a, p. 22.
Portlandia lenticula ODHNER 1915, p. 64.
Portlandia lenticula GRIEG 1916, p. 8.
Portlandia lenticula THORSON 1936, pp. 54—56; on reproduction.

Occurrence at East Greenland (cf. the map fig. 13, p. 174):

Nordøstkyst Area: Off the coast of N.E. Greenland, 75°58½′ N. 14°08′W., 300 m, brown and grey clay, "some specimens" (GRIEG).

Kejser Franz Josephs Fjord Area: Eskimonæs, Clavering Ø, 50—55 m, clayey gravel, 1 adult animal; E. of Store Finsch, 160 m, tough clay, 1 adult and 1 half-grown shell; Off Mackenzie Bugt, 100 m, mud, 1 adult animal (HÄGG); Between Mackenzie Bugt and Bontekoe Ø, 73°20′ N. 21°20′ W., 70 m, mud, some pebbles and shells, 1 adult animal; 1 mile E. of Kap Graah, 28—36 m, clay, shells, stones, gravel, sand, 1 adult shell; The mouth of Duséns Fjord, off Kap Graah, 100 m, tough, brown clay, 1 adult animal; Duséns Fjord, outer part, 370 m, tough clay with sand, 1 adult and 1 half-grown shell; Duséns Fjord, inner part, 130 m, tough, reddish-brown clay, 1 adult animal — 240 m, tough clay, 2 adult animals; Duséns Fjord, innermost part, 20—57 m, clay, 3 adult and 2 half-grown animals (3 finds); Kap Weber, 73°32′ N. 24°38′ W., 100—110 m, mud, gravel, stones, 2 adult shells; Nordfjord, off Waltershausen Gletscher, 120 m, fine, soft, grey clay, 3 adult animals; Moskusoksefjord, outer part, 220 m, clay, 1 adult and 2 young animals (HÄGG); Moskusoksefjord off Ankerbjerg valley, 35—45 m, red clay with sand, 4 adult animals (2 finds); Inner part of Kejser Franz Josephs Fjord, 73°06′ N. 27°17′ W., 40—70 m, mud, stones, 3 adult and 1 half-grown animals, 1 adult shell; E.part of Vega Sund, 72°45′ N. 22°56′ W., 35—60 m, mud, some stones, 3 adult and 1 half-grown animals, 1 half-grown shell; Solitærbugt, Ella Ø, 5—24 m, tough clay, 13 adult animals (several finds) — 20—52 m, tough clay, 18 adult and 1 half-grown animals, 9 adult valves (1 drilled by *Natica*) (several finds) — 50—95 m, tough clay, 3 adult animals (2 finds); Kap Hedlund, 20—53 m, 1 adult animal; Off Rhedin Fjord, 26—31 m, clay, *Fucus*, 1 adult valve; Röhss Fjord, 72°43′ N. 26°38′ W., 35—60, mud, 3 adult animals, 1 adult shell; Forsblads Fjord, 5.5—26 m, 1 adult shell — 94—170 m, clay with stones, 7 animals, 10 shells (JENSEN); Antarctics Havn, 72°01′ N. 23°03′ W., 32—40 m, mud, 1 adult animal; Fleming Fjord, off Vimmelskaftet, 27 m, clay, some stones, 1 adult animal, 1 adult and 1 half-grown shell; Fleming Fjord, 224 m, red clay, 1 adult animal.

Scoresby Sund Area: The mouth of Hurry Inlet, 94 m, clay with stones, "30 specimens" (JENSEN); Hurry Inlet, 0—13 m, clay and sand, "10 specimens" (JENSEN); Hurry Inlet, 70°43′ N. 22°29′ W., ca. 70 m, mud, 6 adult animals, 2 valves; Hurry Inlet, off Constable Pynt, 22—24 m, clay, 3 adult animals (3 finds) — 44—46 m, tough clay, 11 adult and 5 half-grown animals (5 finds) — 91 m, clay, 1 adult animal, 2 adult valves; Off Kap Hooker, 65 m,

sand, 4 adult animals — 57—69 m, sand mixed with clay, 10 adult and 3 half-grown animals, 4 adult shells (6 finds) — 140 m, clay, a few stones, and clay mixed with sand, 3 adult and 1 half-grown shells (3 finds); W. coast of Jameson Land opposite Kap Leslie, 22 m, sandy, glittering clay, 1 adult animal; Kap Leslie, 82—92 m, glittering clay, 11 adult animals (2 finds); W.coast of Jameson Land opposite Bjørneøer, 29—31 m, tough clay, 1 adult animal, 1 adult shell, 3 adult valves (3 finds) — 51—78 m, clay, 3 adult animals, 1 adult shell (drilled by *Natica*) (3 finds) — 103 m, tough clay, 2 adult shells (both drilled by *Natica*); Nordostbugt, $3^1/_2$ miles from the southernmost island, 123 m, soft clay, 2 adult shells, 3 adult valves; Nordostbugt, between the mouth of Schucherts Flod and the southernmost island, 80—97 m, tough, brown and bluish-grey clay, 3 adult animals (2 finds); Nordbugten, Nordvestfjord, 2—3 m, soft clay, *Fucus* and other algae, 1 adult shell — 25—30 m, soft clay, 39 adult and 1 half-grown animals, 4 shells (9 finds) — 56—67 m, soft clay, 11 adult and 2 half-grown animals (6 finds) — 160 m, soft clay, 1 adult shell — 332 m, soft clay, 1 half-grown shell; N.E. of Danmarks Ø, 19 m, soft clay, 1 adult animal; S.E. of Danmarks Ø, 11—17 m, soft clay, gravel, 1 adult animal — 27—30 m, soft clay, gravel, 1 adult animal; Kap Dalton, 13—21 m, fine clay, a few stones, 1 adult valve.

Kangerdlugssuaq Area: Uttentals Sund, 30—40 m, clay, 2 adult animals.

Sydøstkyst Area: Ikerasaussaq near Angmagssalik, 235 m, soft clay, 1 adult animal; Sermilik, 100 m, 1 adult shell (drilled by *Natica*).

Jan Mayen Area: S.W. of Jan Mayen, 70°52′ N. 10°33′ W., 180 m, gray, volcanic mud, 1 animal (LAMY).

Thus, living specimens of the species have been found from off the coast of N. E. Greenland (in about 76° N.) southward to Ikerasaussaq near Angmagssalik, with a vertical range from 0—13 m (Hurry Inlet) to 300 m (off N. E. Greenland) being commonest at depths between 20 and 200 m. The species seems to prefer a bottom of rather pure clay or mud which, however, may occasionally be mixed with sand and gravel. In the large fjord complexes it appears to be evenly distributed in the inner ramifications as well as in places near the open sea.

Remarks: The East Greenland specimens show some variation in the proportions of their shells, these being generally more inflated in the larger individuals. Some of the specimens from Ella Ø resemble *P. lenticula* var. *amblia* VERRILL & BUSH in having the posterior part of the shell more broadly rounded. The species probably attains its maximum size at E. Greenland, as the measures of the ten largest animals will show (length × height × breadth of shell): $8.3 \times 5.4 \times 5.0$ — $8.1 \times 5.3 \times 5.0$ — $7.9 \times 5.2 \times 4.4$ — $7.6 \times 4.8 \times 4.6$ — $7.0 \times 4.8 \times 4.1$ — $6.7 \times 4.2 \times 3.5$ — $6.7 \times 4.2 \times 3.4$ — $6.6 \times 4.2 \times 3.5$ — $6.5 \times 4.0 \times 3.1$ and $6.2 \times 4.0 \times 3.3$ mm, respectively.

Distribution: West Greenland, East Greenland, Jan Mayen, Spitzbergen, the Murman Coast, the Barents Sea, Novaya Zemlya, the

Kara Sea, the Siberian Ice Sea, Parry Islands, the Faroes, the Shetlands, and along the Norwegian coast from the Eastern Finmark southward to Bodø. Dead shells have been recorded from deeper water from N. of Cape Cod (var. *amblia*), Scotland, W. of Ireland, the Bay of Biscay (?), and W. of Morocco (?). Main distribution: Panarctic (circumpolar?). Vertical range: From 0—13 m (E. Greenland) to about 1400 m (N. of the Shetlands).

Biology: Reproduction partly known from N. E. Greenland (THORSON 1936). The nutritive matter of the egg measures about 120 μ in diameter. The development of the larva must be assumed to be lecithotrophic and non-pelagic or with a very short pelagic stage.

10. *Portlandia subaequilatera* (JEFFREYS) (cf. fig. 4, p. 33).

Yoldia forma propinqua LECHE 1878, pl. 1, figs. 7a—b.
Leda subaequilatera JEFFREYS 1879, pl. 46, fig. 3.

Jan Mayen records:

Yoldia pygmæa var. *symmetrica* FRIELE 1878, p. 222.
Portlandia tenuis FRIELE & GRIEG 1901, p. 15 (from stat. 225).
Portlandia subaequilatera FRIELE & GRIEG 1901, p. 16.

Occurrence at East Greenland:

Kejser Franz Josephs Fjord Area: Kong Oscars Fjord, 73°02′ N. 24°30′ W., ca. 180—215 m, mud, many stones, and gravel, 1 adult animal, 1 adult, worn shell.

Scoresby Sund Area: Nordbugten, Nordvestfjord, 163 m, soft clay, 1 adult animal.

Jan Mayen Area: Jan Mayen, 70°58′ N. 8°04′ W., 357 m, dark-grey, sabulous clay, 1 adult animal, 1 adult valve (FRIELE & GRIEG as *P. tenuis*) — 357 m, dark-grey, sabulous clay (FRIELE as *Yoldia pygmæa* var. *symmetrica*; FRIELE & GRIEG). [S. of Jan Mayen, 70°05′ N. 8°26′ W., 698 m, about 60 adult, half-grown, and young animals, about 60 adult, half-grown, and young shells; N. of Jan Mayen, 71°12′ N. 8°38′ W., 1275 m, grey clay, 5 adult animals, 7 adult shells (2 drilled by *Natica*).]

The species here recorded from Greenland for the first time seems to be only an occasional member of the shelf fauna.

Remarks: The identification has been confirmed by Dr. H. REHDER, who kindly compared specimens from Jan Mayen with some of those of JEFFREYS's collections at Washington. However, there remains some doubt as to the homogeneity of JEFFREYS's material. JEFFREYS (1879, p. 579) mentions the species taken between Scotland and the Faroes and N. of the Shetlands, the bottom temperatures being +0.67° and —1.1° C., respectively (cf. JEFFREYS 1878, p. 393 et sequ.). On the other hand, all

the other five finds mentioned by JEFFREYS are from much more southerly positions with bottom temperatures of about +6° to +9° C. Later on, the same author (1883, p. 391) recorded it again from the Faroe Channel, taken at a temperature of about —1.1° C.—A study was made of the unpublished material from the Ingolf Exp. as well as of the material taken by the Norwegian North Atlantic Exp. (see also the following species), besides a few other finds. These finds, 25 altogether, strongly indicate that the species, an extremely cold-stenothermal form, inhabits the Norwegian Sea and the bordering regions, living animals having been

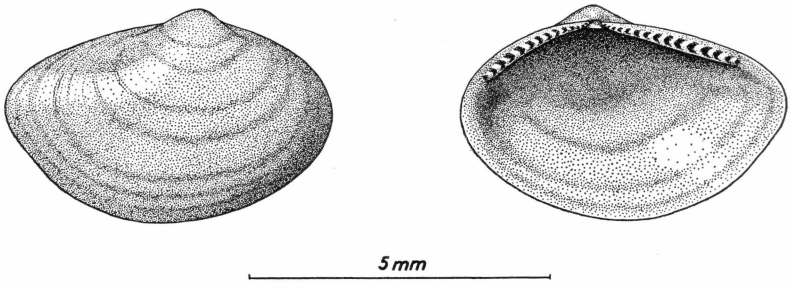

Fig. 4. *Portlandia subaequilatera* (JEFFREYS). Drawn from a specimen taken S. of Jan Mayen, 70°05′N.8°26′W., 698 m.

taken exclusively at temperatures between —1.4° and about +0.5° C. Only a single sample was taken at +3.0° C., but from this only 1 empty shell and 4 single valves were obtained (FRIELE & GRIEG, stat. 175). Thus it is possible that JEFFREYS' material of *P. subaequilatera* comprises two different forms which, in accordance with the different temperature conditions, occur in different parts of the whole area of distribution.

The specimens from Jan Mayen show a rather considerable variation as regards the ratio of height/length, and all the specimens from E. Greenland and Jan Mayen have comparatively more solid shells than those taken e. g. N. of the Faroes. The five largest specimens from Jan Mayen measure (length × height × breadth of shell): 6.9 × 4.7 × 3.3 — 6.4 × 4.4 × 3.2 — 5.9 × 4.2 × 2.9 — 5.7 × 3.8 × 2.7 and 5.0 × 3.4 × 2.4 mm, respectively, while the two animals from E. Greenland measure only 4.5 and 3.9 mm in length.

Distribution (which possibly has to be revised, see Remarks): West Greenland (66°22′ N. 57°16′ W., 686 m, bottom temp. about +0.5° C., 1 adult animal, 6 adult valves), East Greenland, Jan Mayen, S. of Spitzbergen, N. of Hope Island (77°25′ N. 27°30′ E., 160 m, 2 adult animals), the Kara Sea (LECHE 1878, as *Yoldia forma propinqua*), E. of Iceland (Ingolf Exp., unpublished), off N. and W. Norway, N. of the

Faroes (Ingolf Exp., unpublished), between the Faroes and Scotland, N. of the Shetlands, W. and S. of Ireland, southwards to the Azores, and N. America from off Massachusetts southward to Grenada (DALL 1889). Main distribution: Panarctic-boreal and abyssal (in the N. Atlantic only). Vertical range: From 113 m (the Kara Sea) to 3165 m (off N. America).

Biology: Reproduction unknown.

[*Portlandia tenuis* (PHILIPPI).

Leda pygmæa JEFFREYS 1869 V, pl. 29, fig. 5.
Portlandia tenuis BRØGGER 1900—01, pl. 14, figs. 16a—c.

This species was recorded from Jan Mayen, 70°58′ N. 8°04′ W., 357 m, stat. 225, by FRIELE & GRIEG (1901, p. 15). However, a re-examination proved that the specimens in question should actually be referred to *P. subaequilatera* (see this). Hence *P. tenuis* does not belong to the fauna of the area dealt with here.

Furthermore, as a study of the greater part of the specimens referred to *P. tenuis* (PHILIPPI) and to *P. subaequilatera* (JEFFREYS) by FRIELE & GRIEG revealed a number of erroneous identifications, the following corrections and confirmations may be given. The station numbers are those of the Norwegian North-Atlantic Expedition 1876—78, and, if not otherwise stated, at least one specimen from the particular locality was taken with the animal inside.

Referred to *Portlandia tenuis* by FRIELE & GRIEG: St. 1, *P. inconspicua* (VERRILL & BUSH)?, valves only; Balestrand, 200 m, *P. tenuis*; St. 124, *P. subaequilatera*, shells and valves only; St. 137, *P. subaequilatera*; St. 164, *P. subaequilatera*; St. 175, *P. subaequilatera*, shell and valves only; St. 192, *P. subaequilatera*, *P. fraterna*; St. 195, *P. inconspicua*?; St. 225, *P. subaequilatera*; St. 251, *P. subaequilatera*; St. 312, *P. subaequilatera*, *P. arctica*, valve only; St. 326, *P. lucida*, valves only; St. 338, *P. lucida*.

Referred to *Portlandia subaequilatera* by FRIELE & GRIEG: St. 18, *P. subaequilatera*; St. 48, *P. fraterna*; St. 124, *P. subaequilatera*, *P. fraterna*, valves only; St. 200, *P. subaequilatera*; St. 248, *P. subaequilatera*; St. 362, *P. intermedia*, valve only].

11. *Portlandia frigida* (TORELL) (cf. pl. 1, fig. 14).

Yoldia frigida TORELL 1859, pl. 1, fig. 3.
Portlandia frigida ODHNER 1915, pl. 1, figs. 30—32.

East Greenland and Jan Mayen records:

Yoldia frigida FRIELE 1878, p. 222.
Portlandia frigida FRIELE & GRIEG 1901, p. 15.
Portlandia frigida HÄGG 1905, p. 112.
Portlandia frigida JENSEN 1905, p. 320 (excl. of var. *nana*).

Portlandia frigida Grieg 1909a, p. 534.
Portlandia frigida Odhner 1915, p. 66.
Portlandia frigida Grieg 1916, p. 8.

Occurrence at East Greenland (cf. the map fig. 25, p. 185):

Nordøstkyst Area: Off the coast of N.E. Greenland, 75°58½′ N. 14°08′W., 300 m, brown and grey clay, "1 specimen" (Grieg).

Kejser Franz Josephs Fjord Area: S.E. of Clavering Ø, 74°10′ N. 20°08′W., 25—40 m, mud, shells, and pebbles, 1 adult animal; Eskimonæs, Clavering Ø, 50—55 m, clayey gravel, 1 adult animal; Between Mackenzie Bugt and Bontekoe Ø, 73°24′ N. 21°25′ W., 70 m, mud, shells, "10 specimens' (Odhner); E. af Kap Weber, 73°32′ N. 24°35′ W., 100—110 m, mud, gravel, stones, "many specimens" (Odhner); Moskusoksefjord, inner part, 100 m, clay, 3 small animals, 2 valves (Hägg); Inner part of Kejser Franz Josephs Fjord, 73°06′ N. 27°17′ W., 40—70 m, mud, stones, "4 specimens" (Odhner); Solitærbugt, Ella Ø, 5—24 m, 4 adult animals — 20—52 m, 6 adult animals, 8 adult valves (2 drilled by *Natica*) (some finds); Solitærbugt, off the Delta, 45 m, greyish-brown clay, 1 adult animal; Kong Oscars Fjord, S. of Ruths Ø, 72°56′ N. 24°49′ W., 125 m, mud, stones, sand, "3 specimens" (Odhner); Forsblads Fjord, 5.5—26 m, 1 adult shell — 95—170 m, clay with stones, 4 adult, 9 half-grown and young animals, 2 adult shells, 7 adult valves.

Scoresby Sund Area: The mouth of Hurry Inlet, 140 m, clay, brown clay with gravel, 2 adult shells (2 finds); Hurry Inlet, 94 m, clay with stones, 4 adult and 5 young animals, 4 adult valves; Hurry Inlet, 70°43′ N. 22°29′W., 70 m, mud, 3 adult animals, 1 adult shell; Hurry Inlet, off Constable Pynt, 44 m, tough clay, 1 adult animal; Off Kap Hooker, 57—72 m, clay mixed with sand, 11 adult and 3 half-grown animals (7 finds) — 65 m, sand, 1 adult and 1 half-grown animal — 140 m, clay, sand, gravel, 2 adult and 1 half-grown animals, 1 adult shell (3 finds); W.coast of Jameson Land opposite Kap Leslie, 23 m, sandy, glittering clay, 1 adult animal; Kap Leslie, 82 m, glittering clay, 1 adult animal; W.coast of Jameson Land opposite Bjørneøer, 51 m, clay, 1 adult animal; Nordbugten, Nordvestfjord, 59 m, soft clay, 1 adult animal — 107 m, soft clay, 1 adult animal; Kap Dalton, 13—21 m, fine clay with pebbles, 4 adult animals, 1 adult shell.

Kangerdlugssuaq Area: Uttentals Sund, 30—40 m, clay, 3 adult animals.

Jan Mayen Area: Jan Mayen, 95—113 m, 13 adult, 3 half-grown, and 4 young animals, 1 adult shell, 3 valves (at least 2 finds) — 104 m, ooze with coarser material, 9 half-grown and young animals; 70°50′ N. 8°29′ W., 162 m, 15 adult, half-grown, and young animals, 25 valves; 70°58′ N. 8°04′ W., 357 m, dark-grey, sabulous clay (Friele & Grieg); 70°54′ N. 8°24′ W., 128 m, dark-grey, sabulous clay (Friele, Friele & Grieg). [S. of Jan Mayen, 70°05′ N. °26′ W., 698 m, 1 adult valve].

The species has thus been found in small numbers from off N. E. Greenland, about 76° N. lat., southward to Uttentals Sund and, further, at Jan Mayen. It seems to be equally frequent along the outer coast and in the inner parts of the large fjords; hitherto, however, it has not been met with along the south-eastern coast stretch, but it may have been overlooked. The vertical range for living specimens is from 5—24 m

(Solitærbugt), or 13—21 m (Kap Dalton) to 300 m (off N. E. Greenland), and the species seems to be commonest at depths between 30 and 150 m, usually living on a bottom consisting of clay, mud, and clay mixed with sand and gravel.

Remarks: The species varies somewhat as regards the proportions of the shell, but is never as convex as *Portlandia fraterna*, with which it has previously been confused (cf. ODHNER 1915, p. 65). The ten largest animals present from E. Greenland measure (length × height × breadth of shell): 6.1 × 4.7 × 2.8 — 5.1 × 4.0 × 2.9 — 5.1 × 3.9 × 2.4 — 5.0 × 3.6 × 2.4 — 4.8 × 3.9 × 2.6 — 4.7 × 3.4 × 1.9 — 4.6 × 3.5 × 1.8 — 4.2 × 3.5 × 1.7 — 4.2 × 3.3 × 1.8 and 4.2 × 3.3 × 1.7 mm, respectively.

P. frigida is said to have a very wide distribution, being recorded, for instance, from as distant regions as the Mediterranean (JEFFREYS 1879, CARUS 1889) and Japan (JEFFREYS 1876 c). These records, however, are most probably incorrect, similarly as some smaller species of *Portlandia* seem to have been lumped together by several other writers. At any rate, JEFFREYS did not distinguish between *P. frigida* (TORELL) and *Yoldia nana* M. SARS (1865), the latter, at least in part, being referable to *P. fraterna* (VERRILL & BUSH); nor did any later author revise the records by JEFFREYS in the light of the studies by VERRILL & BUSH (1897, 1898).

In the fairly large collections of *Portlandia* from various parts of the N. Atlantic, kept in the Zool. Museum, Copenhagen, the true *P. frigida* is only present from regions with a typical high-arctic marine climate, indicating that it is of a much more limited distribution than hitherto assumed. Its high-arctic distribution also agrees very well with the observations from Icefjord, Spitzbergen, where, according to ODHNER (1915, p. 65), it has been found to live only at temperatures between —1.75 and +1.72° C.

It is even doubtful whether *P. frigida* occurs along the coast of New England, as recorded by e. g. VERRILL & BUSH, 1898, p. 872, for their fig. 4, pl. 79, as well as fig. 2, pl. 44, in VERRILL 1882, do not probably represent the true *P. frigida*.

Because of this apparent confusion in part of the literature, it seems advisable to include only those records of *P. frigida* which have been confirmed by ODHNER (1915) and the present study, awaiting a revision of those which are doubtful.

Distribution: N. W. Greenland (ODHNER; further, the records in THORSON 1951 are correct), E. Greenland, Jan Mayen, Spitzbergen (ODHNER), Novaya Zemlya (ODHNER), the Kara Sea (ODHNER), the W. part of the Siberian Ice Sea (ODHNER), and N. and E. of Iceland (67°19′ N. 15°52′ W., 552 m, 2 adult shells, 1 adult valve; 67°40′ N. 15°40′ W.,

932 m, 3 adult valves; 65°0′ N. 11°16′ W., 584 m, 1 adult valve. The other records from Iceland in J. MADSEN (1949) are erroneous, the specimens found being in the main referable to *P. fraterna*, which see). The following records may also prove to be correct: The Murman Coast (HERZENSTEIN 1885, KNIPOWITSCH 1900), the Barents Sea (FRIELE & GRIEG 1901, KNIPOWITSCH 1901 b, MELVILL & STANDEN 1900), the Finmark (G. O. SARS 1878, NORMAN 1902), and the Gulf of St. Lawrence (WHITEAVES 1872, 1901).—Main distribution: Probably high-arctic, in the N. Atlantic sector only. Vertical range: From 5—24 m (E. Greenland), or 8—9 m (E. Spitzbergen) to about 400 m (W. Greenland).

Biology: Reproduction unknown. For similar reasons to those stated for *P. intermedia* (p. 28), the species must be supposed to spawn at N. E. Greenland outside the summer season.

12. *Portlandia fraterna* (VERRILL & BUSH) (cf. pl. 1, fig. 15).

Yoldiella fraterna VERRILL & BUSH 1898, pl. 80, fig. 5; pl. 82, fig. 8.
Portlandia fraterna ODHNER 1915, pl. 1, figs. 26—29.

East Greenland records:

Portlandia frigida var. *nana* JENSEN 1905, pp. 320—321.
Portlandia fraterna ODHNER 1915, p. 68.

Occurrence at East Greenland:

Nordøstkyst Area: S.E. of Sabine Ø, 207 m, fine clay with stones and gravel, 1 adult shell.

Kejser Franz Josephs Fjord Area: Moskusoksefjord, off Høgboms Bjerg, 200 m, clay, 1 adult valve; Duséns Fjord, inner part, 20—25 m, soft clay, *Desmarestia*, 2 adult animals; Eleonore Bugt, 130 m, tough clay with pebbles, 16 adult animals, 1 adult shell; Between Eleonore Bugt and Ymers Ø, 460 m, tough, red and grey clay, 3 adult animals; Kejser Franz Josephs Fjord, 73°06′ N. 27°17′ W., 40—47 m, mud with stones "2 specimens" (ODHNER); Kong Oscars Fjord, 73°02′ N. 24°30′ W., 180—215 m, mud, many stones, gravel, 1 half-grown animal; E.part of Vega Sund, 72°45′ N. 22°58′ W., 35—60 m, soft mud, "many specimens" (ODHNER); Solitærbugt, Ella Ø, 20—52 m, 1 adult animal, 1 adult shell; E. of Traill Ø, 72°28′ N. 21°48′ W., 180 m, mud, some stones, 3 adult animals; Forsblads Fjord, 95—170 m, clay with stones, about 80 adult, half-grown animals and shells; The mouth of Fleming Fjord, 215 m, tough clay, 1 adult animal; Fleming Fjord, 222 m, red clay, 2 adult animals, 1 adult shell.

Scoresby Sund Area: The mouth of Hurry Inlet, 95 m, clay with stones, 4 adult and 2 half-grown animals, 3 adult shells; Hurry Inlet, 0—13 m, clay and sand, 5 adult animals; Hurry Inlet, 70°43′ N. 22°29′ W., 70 m, mud, "50 specimens" (ODHNER); Hurry Inlet, off Constable Pynt, 18—22 m, very soft clay, 1 adult animal — 21—23 m, clay, 2 adult and 1 half-grown animals (3 finds) — 44 m, tough clay, 1 adult animal — 91—92 m, clay, 1 adult and 1 half-grown animal, 1 adult shell (2 finds); Hurry Inlet, N. by N.W. of the Fame Øer, 23—25 m, solid mud, "10 specimens" (ODHNER);

Off Kap Hooker, 65 m, sand, 1 adult shell; Nordbugten, Nordvestfjord, 58—63 m, soft clay, 4 adult animals (2 finds) — 153 m, soft clay, 2 adult animals; Turner Sund, ca. 5.5 m, 1 adult animal; Kap Dalton, 13—21 m, fine clay with pebbles, 2 adult animals; "Øst-Grønland", depth?, 1 adult animal, 5 adult valves.

At N. E. Greenland the species is of widespread, though somewhat scattered, occurrence. It probably lives along the south-eastern coast stretch, too, where it has presumably been overlooked because of its tiny size. At any rate, it is now known to occur from Moskusoksefjord in the N. to Kap Dalton in the S. with a vertical range for live specimens from 5.5 m (Turner Sund) down to 460 m (between Eleonore Bugt and Ymers Ø), preferably living on a soft or tough clay bottom.

Remarks: The shape of the shell is rather characteristic, and in general the present species is easily distinguishable from *P. frigida* (cf. ODHNER 1915, p. 67). ODHNER (1915, p. 68) was also the first to point out that var. *nana* from E. Greenland is actually this species.

The position of *Yoldia nana* M. SARS (1865, p. 99, figs. 118—120) from Norway, however, is not quite clear, though both the original description and the figures agree very well with *P. fraterna*. But ODHNER (1915, p. 68) states that some specimens from Lofoten which he had examined, were not quite identical with either *P. frigida* or *P. fraterna*, but looked very much like *P. subangulata* (VERRILL & BUSH) (1898, p. 865, pl. 77, fig. 3, and pl. 79, fig. 6). However, the latter statement is probably not correct, for the type—apparently the only specimen of *P. subangulata* known so far—is considerably larger and has more numerous and crowded hinge-teeth.

In the Copenhagen Museum there are, however, some specimens from W. and S. Norway, as also from S. of Iceland, S. W. of Greenland, and S. W. of the Faroes which seem to belong to *P. inconspicua* (VERRILL & BUSH) (1898, p. 869, pl. 79, figs. 3,5). It is thus possible that ODHNER's remarks on *Y. nana* from Norway actually apply to this form, and that the original material of the latter is heterogeneous. At any rate it seems certain that *P. fraterna* occurs along the Norwegian coast.

The ten largest animals present from E. Greenland measure (length × height × breadth of shell): 3.7 × 2.4 × 1.9 — 3.7 × 2.4 × 1.8 — 3.5 × 2.3 × 1.8 — 3.4 × 2.3 × 1.8 — 3.3 × 2.3 × 1.7 — 3.2 × 2.1 × 1.6 — 3.2 × 2.1 × 1.5 — 3.1 × 2.1 × 1.5 — 3.0 × 2.2 × 1.6 and 3.0 × 2.2 × 1.5 mm, respectively. The largest empty shell measures 3.7 mm in length.

Distribution: West Greenland (ODHNER; further: 66°35′ N. 56°38′ V., 599 m, 20 adult and half-grown animals, 2 valves; 66°22′ N. 57°16′ W., 686 m, 1 adult valve; 65°16′ N. 55°05′ W., 682 m, 2 adult and 1 half-grown animal), East Greenland, Spitzbergen (ODHNER), the

Kara Sea (ODHNER), Matotschkin Schar (ODHNER), Norway (Ulfsfjord, and Østerfjord (ODHNER); Varanger Fjord (THIELE); further: 69°46′ N. 16°15′ E., 1187 m, 1 adult animal, 1 adult valve; 66°41′ N. 6°59′ E., 640 m, 2 adult shells, 9 adult valves; Bergen, depth?, 1 adult shell), N. and E. of Iceland (64°36′ N. 10°22′ W., 547 m, 2 adult animals; and the following erroneously referred to *P. frigida* in J. MADSEN (1949): 66°50′ N. 20°02′ W., 365 m, about 180 animals, about 60 valves; 8 miles S. E. of Snertastadir, 217 m, 2 adult shells; 67°19′ N. 15°52′ W., 552 m, more than 200 animals, numerous shells and valves; 67°40′ N. 15°40′ W., 932 m, 6 adult valves; 66°39.4′ N. 15°30.5′ W., 204 m, 19 animals, 10 valves; 66°32′ N. 15°15′ W., 141 m, 7 adult animals, 14 valves; 66°39′ N. 14°50′ W., 189 m, 1 adult shell; 66°23′ N. 12°05′ W., 1011 m, 3 adult animals, 3 valves; Off Borgarfjördur, 151 m, 2 adult valves; Nordfjördur, 75 m, 6 adult valves; 64°25′ N. 12°09′ W., 397 m, about 40 animals, 50 valves; 64°07′ N. 11°12′ W., 446 m, 4 adult animals. The following seem to be *P. inconspicua* (VERRILL & BUSH): 65°38′ N. 26°27′ W., 260 m, 3 adult valves; 65°03.6′ N. 23°47.6′ W., 143 m, 1 adult shell; 63°18′ N. 21°30′ W., 178 m, 1 adult valve; 63°05′ N. 20°07′ W., 557 m, 2 adult valves; 61°44′ N. 27°00′ W., 913 m, 5 adult valves; all taken W. and S. of Iceland), between Scotland and the Hebrides ("The Minch", according to ODHNER), and from the Gulf of St. Lawrence southward to off Georgia (JOHNSON 1934). Main distribution: Probably panarctic and abyssal (in the N. Atlantic only). Vertical range: From about 5.5 m (E. Greenland) down to about 2900 m (New England).

Biology: ODHNER (1915, p. 67) states that several animals from stat. 94 in Icefjord (ca. 145 m, 21-8-08) proved to contain mature sexual products. Dr. B. HUBENDICK, Stockholm, very kindly lent me this sample for examination. As a result of this it may be mentioned that almost mature eggs were found to measure about 115 × 95 μ, being rich in yolk and surrounded by a thin membrane. According to the rather considerable egg-size in this small species as well as to its great vertical range, a lecithotrophic larval development seems probable.

13. *Arca* (*Bathyarca*) *pectunculoides grandis* LECHE (with *Arca pectunculoides septentrionalis* G. O. SARS) (cf. pl. 1, fig. 16).

Arca pectunculoides var. *grandis* LECHE 1878, pl. 1, figs. 9 a—c.
Arca pectunculoides var. *septentrionalis* G. O. SARS 1878, pl. 4, figs. 2a—c.

East Greenland and Jan Mayen records:

Arca pectunculoides var. *major* FRIELE 1878, p. 222.
Arca pectunculoides POSSELT 1895, p. 69 (in part).
Arca pectunculoides POSSELT & JENSEN 1898, p. 52 (in part).
Arca pectunculoides var. *septentrionalis* FRIELE & GRIEG 1901, p. 21.

Arca pectunculoides var. *grandis* HÄGG 1904, p. 20.
Arca pectunculoides var. *septentrionalis* JENSEN 1905, p. 322 (in part).
Arca pectunculoides GRIEG 1916, p. 8.

Occurrence at East Greenland:

Nordøstkyst Area: Off the coast of N.E. Greenland, 75°58½′ N. 14°08′W., 300 m, brown and grey clay, "3 specimens and 2 empty shells" (GRIEG, who refers them to f. *typica*. However, the specimens probably belong to the present subspecies); S.E. of Shannon, 74°52′ N. 17°16′ W., 350 m, clay, sand, pebbles, 1 adult animal (with eggs, 4-7-99); S.E. of Sabine Ø, 207 m, fine clay, stones, gravel, 1 adult animal, 1 adult valve.

Kejser Franz Josephs Fjord Area: Duséns Fjord W. of Kap Graah, 150 m, brown clay, 2 adult animals (1 with ripe sperm, 12-8-32); Duséns Fjord, middle part, 240 m, tough clay, 1 adult animal; 5 miles S. of Bontekoe Ø, 245 m, very tough clay, a few stones, 1 adult animal (with immature eggs, 21-8-32); The middle part of Antarctics Sund, 540 m, tough, grey clay, big stones, 1 young animal; Solitærbugt, Ella Ø, 320 m, greyish-brown clay, 1 half-grown animal; E. of Traill Ø, 72°24′ N. 19°42′ W., ca. 260 m, 1 adult animal; E. of Greenland, 72°25′ N. 17°56′ W., 300 m, stones and sand, 1 adult animal (HÄGG); Kong Oscars Fjord, off Holms Vig, 225 m, tough, brown clay, 1 half-grown animal; 2 miles N. of Kap Wardlaw, 250 m, tough clay, big stones, 1 adult valve; 1 km from Murray Ø, 71°33′ N. 21°30′ W., 200 m, mud, a little sand, 1 adult animal.

Scoresbysund Area: Section between Kap Tobin and Kap Brewster, 340 m, fine, soft clay, 1 young animal — 530 m, clay, gravel, stones, 1 adult and 1 half-grown animal, 1 adult shell (2 finds); Section between Kap Leslie and Jameson Land, 289 m, soft clay, 4 adult valves (1 drilled by *Natica*) — 385—397 m, soft clay with gravel, 5 adult valves (3 finds); Section between Kap Stevenson and Kap Leslie, 421 m, tough clay, big stones, 2 adult valves — 550 m, soft clay, big stones, 1 adult valve.

Kangerdlugssuaq Area: Mikis Fjord, 175 m, muddy clay, 1 adult animal.

Sydøstkyst Area: Lindenows Fjord, the mouth, 400—600 m, clay, Foraminifera, 1 adult and 1 half-grown animal.

Jan Mayen Area: 70°58′ N. 8°04′ W., 357 m, dark-grey, sabulous clay, and 70°41′ N. 10°10′ W., 481 m, brown clay, stones (FRIELE, FRIELE & GRIEG). [S. of Jan Mayen, 70°05′ N. 8°26′ W., 698 m, about 80 adult, half-grown, and young animals, 1 adult shell, 26 valves (some animals with eggs or sperm, 23-7-96); 70°32′ N. 8°10′ W., 885 m, clay with stones, 1 half-grown and 1 young animal].

At E. Greenland *Arca pectunculoides grandis* (with *A. p. septentrionalis*) is thus known to occur from about 76° N. southward to Lindenows Fjord with a vertical range for live specimens from 150 m (Duséns Fjord) to 540 m (Antarctics Sund), and at Jan Mayen from 357 to 885 m. It seems to be a pronounced alittoral form, the typical habitat of which is a clayey bottom mixed with stones, pebbles, or gravel serving as a suitable support for the byssus of the animals.

Remarks: *Arca pectunculoides* s. l. is rather polymorphous and several varities have been described the systematic value of which,

however, needs further investigation. At present it may be stated that *A. p. pectunculoides* SCACCHI does not occur at E. Greenland and Jan Mayen, and seems to be absent from all typical arctic seas. In these it is replaced by *A. p. grandis* LECHE and *A. p. septentrionalis* G. O. SARS. It appears, however, that no essential differences exist between the latter two, and no separation of them is attempted. But, because of conspicuous differences from the main form, i. a. a greater size and a more strongly developed periostracum, and a fairly well delimited distribution, it seems justifiable to regard *Arca pectunculoides grandis* (with *septentrionalis*) as a geographical subspecies.

Within the material from E. Greenland and Jan Mayen there is some variation as regards outline and proportions of the shell, as in some specimens the ventral margin is fairly evenly rounded with only a slight byssal indentation, the shell being comparatively high, while others have a more oblong shell and a distinct byssal indentation. The five largest specimens from E. Greenland measure (length × height × breadth of shell): 14.3 × 10.3 × 8.8 — 12.2 × 9.2 × 7.1 — 10.5 × 7.7 × 5.8 — 9.2 × 6.2 × 4.5 and 7.9 × 5.6 × 4.2 mm, respectively, and the five largest ones from Jan Mayen: 16.8 × 12.5 × 10.3 — 16.6 × 12.4 × 9.3 — 16.3 × 11.6 × 8.8 — 15.9 × 12.0 × 9.2 and 15.5 × 11.3 × 8.5 mm, respectively. Further, HÄGG (1904, p. 20) states the size of one specimen from N. E. Greenland to be 8.0 × 6.9 × 5 mm.—It obviously offers a suitable substratum for various kinds of sedentary animals, as several of the specimens at hand had bryozoans, ascidians, actinians, Foraminifera, and *Spirorbis*-tubes attached to their shells.

Distribution: *Arca pectunculoides grandis* (with *A. p. septentrionalis*) is known from Baffinland, W. Greenland, E. Greenland, Jan Mayen, Spitzbergen, the Barents Sea, the Murman Coast and the Murman Sea, the Kara Sea, the Siberian Ice Sea to 166° E., the Finmark and Nordland, N. of Iceland, N. of the Shetlands, between the Faroes and the Hebrides, the Gulf of St. Lawrence, and Nova Scotia. The southern limit of distribution of the subspecies in American waters needs further investigation, just as the records from more southerly parts of the N. Atlantic (and the Mediterranean) are doubtful and require confirmation. Main distribution: Panarctic (in the N. Atlantic only). Vertical range: From 9—68 m (Siberian Ice Sea) to about 1400 m (S. W. of Bear Island).

The main form, *A. p. pectunculoides*, occurs mainly in deep water from S. W. Greenland, W. and S. of Iceland, S. W. of the Faroes, and N. Norway throughout the boreal regions, extending southward to the West Indies and Mexico, the Azores and Morocco, and the Mediterranean at depths down to about 3300 m (W. of Portugal).

Biology: Some of the animals present had eggs or sperm in their gonads. Mature eggs (from animals taken S. of Jan Mayen, 698 m, 23-7-96, preserved in alcohol) measured about 120 μ in diameter. There is a thin membrane and the yolk granules are rather conspicuous. The head of apparently ripe spermatozoans was found to be conical and 4.6—4.9 μ in length. The prodissoconch I of some young bottom stages was about 190 μ across. On account of the egg-size it seems probable that the larval development is lecithotrophic and the pelagic stage, if any, only short.

14. *Arca (Bathyarca) frielei* (JEFFREYS MS.) FRIELE (cf. pl. 1, fig. 17).

Arca frielei FRIELE 1879, pl. 4, fig. 9.
Arca frielei JEFFREYS 1879, pl. 45, fig. 4.

East Greenland and Jan Mayen records:

Arca pectunculoides POSSELT 1895, p. 69 (in part).
Arca pectunculoides POSSELT & JENSEN 1898, p. 52 (in part).
Arca pectunculoides var. *septentrionalis* HÄGG 1904, p. 20.
Arca pectunculoides var. *septentrionalis* JENSEN 1905, p. 322 (in part).

Occurrence at East Greenland:

Nordøstkyst Area: S.E. of Shannon, 74°52′ N. 17°16′ W., 350 m, clay, sand, pebbles, 2 half-grown animals; S. of Lille Pendulum Ø, 74°35′ N. 18°23′ W., 18—21 m, sandy mud, algae, 1 half-grown animal; Off Sabine Ø, 74°17′ N. 15°20′ W., 250 m, clay with stones, 1 half-grown valve ("1 specimen", JENSEN, as *A. pectunculoides*).

Kejser Franz Josephs Fjord Area: Duséns Fjord, middle part, 240 m, tough clay, 1 young animal; Off Isfjord, inner part of Kejser Franz Josephs Fjord, 760 m, tough clay, a few stones and pebbles, 3 adult animals (2 with ripe eggs, 1 with ripe sperm, 6-8-32), 3 adult valves (2 drilled by *Natica*); Off Ättestupan, inner part of Kejser Franz Josephs Fjord, 780 m, soft, grey, clay, 1 adult animal (with ripe sperm, 7-8-32). [Between Greenland and Jan Mayen, 72°42′ N. 14°49′ W., 2000 m, ooze with Foraminifera, 11 young animals (referred to *A. p. septentrionalis* by HÄGG; a re-examination showed, however, that these specimens probably belong to *A. frielei*)].

Scoresby Sund Area: Section between Kap Leslie and Jameson Land, 289 m, soft clay, 3 adult valves (1 drilled by *Natica*); Section between Kap Stevenson and Kap Leslie, 421 m, tough clay, big stones, 1 adult animal — 550 m, loose clay, big stones, 1 adult valve; At Bjørneøer, 306 m, tough clay, 1 adult valve; Nordostbugt, 4 miles off the mouth of Schucherts Flod, 30 m, light grey mud, 1 half-grown animal; Nordbugten, Nordvestfjord, 325 m, soft clay, 1 adult animal (with almost mature eggs, 24-7-33).

Jan Mayen Area: [S. of Jan Mayen, 70°05′ N. 8°26′ W., 698 m, 35 adult and 1 young animals, 1 adult shell, 1 half-grown and 3 young valves (some animals with ripe eggs or sperm, 23-7-96); 69°31′ N. 7°06′ W., 2455 m, 2 young animals, about 70 half-grown and young valves (about 20 drilled by *Natica*); 69°13′ N. 8°23′ W., 1889 m, 4 young valves; 68°27′ N. 8°20′ W., 1995 m, 7 young animals, 3 half-grown valves; 67°53′ N. 10°19′ W., 1890 m, 32 young

animals, 15 adult and half-grown valves (8 drilled by *Natica*); N. of Jan Mayen, 72°01′ N. 8°33′ W., 2400 m, ooze, 3 young animals (HÄGG, as *A. p. septentrionalis*, but probably *A. frielei*, as shown by a re-examination).]

The species here recorded from the Greenland shelf for the first time, seems to inhabit only the north-eastern coast stretches, where it is of a somewhat scattered and scarce occurrence. It lives predominantly in deep water, having been taken at E. Greenland from 18—21 m (S. of Lille Pendulum Ø) down to 780 m (inner part of Kejser Franz Josephs Fjord). However, only two finds derived from depths less than 240 m, and from the sea near Jan Mayen only finds from depths exceeding 600 m are known. All the finds of live animals seem to have been taken at bottom temperatures between about 0 and —1° C., indicating that the species is extremely cold-stenothermal. It occurs on essentially the same types of bottom as *A. p. grandis*, in company with which it is sometimes found.

Remarks: *Arca frielei* is not always easily distinguishable from *Arca pectunculoides grandis* (with *A. p. septentrionalis*) and further comparative studies of their morphology would be desirable. Generally, however, the specimens at hand agree with the original description in being oblique, rounded-triangular in outline, with a coarse and hairy periostracum, and with shorter series of hinge-teeth than specimens of *A. p. grandis* of equal size. Further, there seem to exist some other features which may turn out to be of distinctive value. Thus, in *A. frielei* the prodissoconch is somewhat larger, and the byssus is thinner and thread-like, whereas this latter is fairly strong and stem-like in *A. p. grandis* (with *A. p. septentrionalis*). Also, in the few animals of *A. frielei* with apparently ripe sperm, the head of the spermatozoan was found to be almost glubular, whereas it is conical in *A. p. grandis*.

The three largest animals present from E. Greenland measure (length × height × breadth of shell): 9.5 × 6.7 × 4.6 — 7.2 × 5.3 × 4.0 and 7.0 × 5.2 × 3.6 mm respectively, and the five largest from Jan Mayen: 16.9 × 13.1 × 10.2ff— 16.7 × 12.1 × 9.3 — 16.4 × 11.5 × 9.0 — 16.1 × 12.1 × 9.2 and 15.8 × 12.3 × 9.1 mm, respectively.

Figures 5 and 6, pl. 44, in VERRILL (1882) do not represent *A. frielei*, as already stated by FRIELE & GRIEG (1901, p. 20). Accordingly the records from the E. coast of N. America are doubtful, just as some records from more southerly places in the N. Atlantic which were included within the distribution of the species by FRIELE & GRIEG, who also regard *Arca imitata* SMITH (1885) from the N. Pacific as identical with it. Later on, however, FRIELE (1902, p. 16) doubted the correctness of this statement, supposing that *A. frielei* may turn out to be a species restricted to the depths of the Norwegian Sea. This supposition in fact

agrees with the material worked up by FRIELE & GRIEG as well as with the aformentioned finds extending the distribution to N. E. Greenland, and with the additional finds listed below.

Distribution: N. E. Greenland, Jan Mayen, W. and S. of Spitzbergen, N. and E. of Iceland (besides the record by FRIELE & GRIEG also: 68°08′ N. 16°02′ W., 1373 m, 7 valves; 67°40′ N. 15°40′ W., 932 m, 31 animals, 3 valves; 67°29′ N. 11°32′ W., 1666 m, 1 young animal; 66°23′ N. 10°26′ W., 1412 m, 21 animals, 12 valves; 66°23′ N. 8°52′ W., 1090 m, 1 shell, 2 valves), N. of the Faroes (besides the record by FRIELE & GRIEG also: 63°36′ N. 7°30′ W., 1322 m, 25 animals, 5 valves), off W. Norway (besides the records by FRIELE & GRIEG also: 62°58′ N. 1°56′ E., 1168 m, 1 animal, 1 shell, 2 valves), and the Faroe Channel (JEFFREYS 1879). Main distribution: Probably high-arctic and abyssal in the Norwegian Sea. Vertical range: From 18—21 m (N. E. Greenland) down to 2814 m (off W. Norway).

Biology: Apparently mature eggs (from animals preserved in alcohol taken S. of Jan Mayen, 698 m, 23-7-96, and off Isfjord, N. E. Greenland, 760 m, 6-8-32) measured about 120—130 μ in diameter, having a thin membrane and fairly conspicuous yolk granules. The prodissoconch I of some young bottom stages measured about 210 μ across. Probably, the larval development is lecithotrophic and the pelagic stage, if any, only short.

15. *Arca* (*Bathyarca*) *glacialis* GRAY (cf. pl. 1, fig. 18).

Arca glacialis G. O. SARS 1878, pl. 4, figs. 1a—c.
Arca glacialis LECHE 1878, pl. 1, fig. 8.

East Greenland and Jan Mayen records:

Arca glacialis FRIELE 1878, p. 222.
Arca glacialis BECHER 1886, p. 69.
Arca glacialis POSSELT 1895, pp. 69—70.
Arca glacialis POSSELT & JENSEN 1898, p. 53.
Arca glacialis FRIELE & GRIEG 1901, p. 19.
Arca glacialis FRIELE 1902, p. 4.
Arca glacialis HÄGG 1904, pp. 17—19.
Arca glacialis JENSEN 1905, pp. 321—322.
Arca glacialis GRIEG 1909a, p. 534.
Arca glacialis LAMY 1913a, p. 22.
Arca glacialis LAMY 1913b, pp. 600—601.
Arca glacialis ODHNER 1915, p. 73.
Arca glacialis GRIEG 1916, p. 8.
Arca glacialis LAMY 1926, p. 180.
Arca (Bathyarca) glacialis REMY 1928, p. 220.
Arca glacialis THORSON 1934a, p. 6.
Arca glacialis THORSON 1936, p. 51 et sequ; on reproduction.

Occurrence at East Greenland:

Nordøstkyst Area: Jørgen Brønlund Fjord, 28.5 m, clay, 5 adult, 1 half-grown animals (2 finds); Off Lille Koldewey, 76°35′ N. 18°26′ W., ca. 150 m, hard bottom, 1 half-grown shell; Off the coast of N.E. Greenland, 75°58½′ N. 14°08′ W., 300 m, brown and grey clay, "1 specimen" (GRIEG).

Kejser Franz Josephs Fjord Area: Eskimonæs, Clavering Ø, 50—55 m, clay, gravel, stones, 8 adult and 3 half-grown animals; Off Mackenzie Bugt, 100 m, mud, 25 animals, 1 valve (HÄGG); Mackenzie Bugt, 12—35 m, mud, 29 adult and 2 young animals (HÄGG); Between Mackenzie Bugt and Bontekoe Ø, 73°20′ N. 21°20′ W., 70 m, mud, pebbles, shells, 2 adult animals; 5 miles S. of Bontekoe Ø, 245 m, very tough clay, stones, gravel 1 half-grown animal; The mouth of Kejser Franz Josephs Fjord, 73°16′ N. 23°15′ W., 28—36 m, clay, shells, stones, gravel and sand, 2 adult animals; The mouth of Duséns Fjord, opposite Kap Graah, 26—40 m, clay, large stones, *Desmarestia*, 2 adult animals; Duséns Fjord, the mouth, 100 m, tough, brown clay, 1 adult animal; Duséns Fjord, outer part, 370 m, rather tough, greyish-brown clay, much sand, 1 adult animal; Duséns Fjord, middle part, 240 m, tough clay, 7 adult, 3 half-grown and 4 young animals; Ymers Ø, off Zoologdalen, 160 m, clay mixed with sand, 1 half-grown animal; Moskusoksefjord, outer part, 220 m, clay, 11 animals (HÄGG); Moskusoksefjord, off Ankerbjerg valley, 45 m, red clay, sand, a little gravel, 1 adult and 1 half-grown animal — 95 m, stiff clay, a few stones, 2 adult animals; Moskusoksefjord, inner part, 100 m, clay, 15 animals, 2 shells (HÄGG); Sofia Sund, E. of Botanikerbugt, 210 m, reddish clay, stones, gravel, 6 adult animals; Inner part of Kejser Franz Josephs Fjord, 73°06′ N. 27°17′ W., 40—70 m, mud, stones, 6 adult, 1 half-grown, and 2 young animals; 72°53′ N. 20°36′ W., 180 m, 3 adult animals; E.part of Vega Sund, 72°45′ N. 22°56′ W., 35—60 m, mud, stones, 2 adult, 7 half-grown and young animals; Kong Oscars Fjord, 72°56′ N. 24°33′ W., ca. 125 m, mud, some pebbles, a little sand, 2 adult animals; Solitærbugt, Ella Ø, 22—35 m, many red algae, 1 adult animal — 20—52 m, about 200 animals from 6.5 to 22 mm in length (several finds) — at all depths between 48 and 95 m, clay, stones, and sometimes shells, about 2460 animals of all sizes from 5 to about 21 mm in length (at least 14 finds); Solitærbugt, off the Delta, 45 m, greyish-brown clay, 2 adult animals; Kap Hedlund, 4—27 m, 4 adult animals — at all depths between 22 and 53 m, clay, stones, shells, sometimes *Fucus*, about 300, mostly adult or half-grown animals (at least 7 finds) — 67—95 m, about 350 animals (several finds); Röhss Fjord, 72°43′ N. 26°38′ W., 35—60 m, mud, 8 adult animals; Off the mouth of Rhedins Fjord, 25—30 m, clay, red algae, *Fucus*, 1 adult animal; E. of Traill Ø, 72°28′ N. 21°48′ W., 180 m, mud, some stones, 1 adult animal; Forsblads Fjord, ca. 95 m, clay with stones, 4 adult animals, 8 valves — 95—170 m, clay with stones, "2 specimens and 1 valve" (JENSEN); Antarctics Havn, 72°01′ N. 23°03′ W., 32—40 m, mud, 1 adult animal; Fleming Fjord, 222 m, clay, 2 adult and 1 young animal; Fleming Fjord, off Vimmelskaftet, 27 m, clay, some stones, 1 adult and 1 young animal; N. of Kap Biot, 115 m, tough clay, a little gravel, algae, 1 half-grown shell; 1 km from Murray Ø, 71°33′ N. 21°30′ W., 200 m, mud, a little sand, 2 adult animals.

Scoresby Sund Area: Rosenvinges Bugt, 28—30 m, rocks, 2 adult animals (REMY) — 70 m, tough, bluish clay on rocks, 6 adult animals (REMY); Amdrups Havn, 6—10 m, *Laminaria*, brown algae, 2 adult animals; Kap Hope, 238 m, clay with stones, 2 adult animals; The mouth of Hurry Inlet,

150 m, clay, 1 adult animal — depth?, 1 animal (LAMY); Hurry Inlet, outer part, 94 m, clay with stones, about 80 animals; Hurry Inlet, 19 m, clay, "11 specimens and 1 valve" (JENSEN); Hurry Inlet, off Constable Pynt, 23—46 m, clay, 9 adult and 1 half-grown animals (9 finds) — 89—91 m, clay, 1 adult and 1 half-grown animal (2 finds); At Fame Øer, 15—18 m, soft clay, red algae, *Laminaria*, 1 adult animal — 27 m, very tough clay, 2 adult animals; Off Fame Øer, 25 m, soft clay, gravel, 3 adult animals; Hurry Inlet, 70°43′ N. 22°29′ W., ca. 70 m, mud, 6 adult, 4 half-grown and 1 young animal; Off the southern end of Jameson Land, 19—113 m, 3 adult animals; Off Kap Hooker, 65—69 m, sand, and sand mixed with clay, 2 adult and 1 half-grown animals (3 finds) — 140 m, clay, sand, gravel, 4 adult animals (3 finds); W.coast of Jameson Land opposite Bjørneøer, 30—31 m, tough clay, 1 adult and 2 half-grown animals, 2 adult and 2 young valves (1 drilled by *Natica*) (4 finds) — 78 m, clay, 1 half-grown animal; Off Bjørneøer, 30—40 m, loose clay mixed with sand, 1 adult animal; Nordbugten, Nordvestfjord, 29—30 m, loose clay, 2 adult and 1 half-grown animals (2 finds) — 56—63 m, soft clay, 19 adult animals (5 finds) — 112—156 m, soft clay, 2 adult and 1 young animals, 1 adult valve (2 finds) — 325—339 m, soft clay, 3 half-grown and 5 young animals, 2 adult and 2 half-grown valves (3 finds); Kap Leslie, 82—88 m, glittering clay, 1 half-grown animal, 1 adult valve (2 finds); Between Kap Stevenson and Kap Leslie, 153 m, tough clay, stones, 1 half-grown valve (drilled by *Natica*); N.E. of Danmarks Ø, 20 m, soft clay, 1 adult animal; S.E. of Danmarks Ø, 27—30 m, soft clay, gravel, 28 adult and half-grown animals; The bay opposite to Rødeø, Rødefjord, 38 m, sand mixed with clay, 1 adult animal.

Kangerdlugssuaq Area: Mikis Fjord, 175 m, mud, clay, 3 adult and 1 half-grown animals (2 finds); Uttentals Sund, 10—14 m, 1 adult animal — 20—about 50 m, 26 adult and half-grown animals (6 finds); Kangerdlugssuaq, 40—50 m, 1 adult animal — 80—100 m, stones, 3 adult valves — 175 m, "1 specimen" (THORSON).

Sydøstkyst Area: Lindenows Fjord, the mouth, 125—150 m, gravel, clay, 17 adult and half-grown animals; Lindenows Fjord, outer part, 60—70 m, gravel, clay, sand, 3 adult animals — 100—150 m, clay, gravel, about 50 adult and half-grown animals (3 finds); Lindenows Fjord, middle part, 55 m, clay, 1 adult animal — 100—175 m, clay, about 55 adult and half-grown animals (3 finds); Lindenows Fjord, inner part, 75—150 m, clay, about 100 adult, half-grown, and young animals (3 finds) — 200—350 m, clay, 18 adult and half grown animals (2 finds) — 425 m, clay, 13 adult and half-grown animals; "Northern side of Lindenows Fjord", depth?, 1 adult and 1 half-grovn animal.

Jan Mayen Area: N. of Jan Mayen, 200—270 m, "16 specimens" (BECHER); Jan Mayen, 95—113 m, mud with coarser material, about 80 adult and half-grown animals, 1 adult shell, 3 valves (2 finds); Jan Mayen, 70°58′30″ N. 8°07′ W., 160 m, 19 animals (LAMY); 70°58′ N. 8°54′ W., 300 m, 1 valve (LAMY); 70°58′ N. 8°04′ W., 357 m, dark-grey, sabulous clay (FRIELE & GRIEG); 70°54′ N. 8°24′ W., 128 m, dark-grey, sabulous clay (FRIELE & GRIEG); 70°51′ N. 8°20′ W., 174 m, dark-grey, sabulous clay (FRIELE & GRIEG); 70°50′ N. 8°29′ W., 162 m, 1 adult animal, 5 adult, worn valves; 70°47′ N. 8°22′ W., 140 m, 6 animals (LAMY); 70°46′ N. 6°32′ W., 400 m, (FRIELE); S. of Jan Mayen, 70°52′ N. 10°33′ W., 180 m, grey, volcanic mud, 4 animals, 3 valves (LAMY).

The species is of common occurrence along the whole East Greenland coast from Jørgen Brønlund Fjord (about 82°10′ N.) southward to Lindenows Fjord with a vertical range of from 6—10 m (Amdrups Havn) down to 425 m (Lindenows Fjord), being generally found on clay bottom with stones and gravel. Although occasionally met with at smaller depths, this epifaunal species is most abundant below 40 m, where the *Astarte crenata* community occurs (cf. Spärck 1933; Thorson 1933, 1934 b). This community, being typical of arctic seas, has been found in several of the East Greenland fjords investigated. In general, it is rather poor as to the live weight of animals per sq. m. However, from Solitærbugt, Ella Ø, 45 m, clay, stones, Thorson (1933) reports the unusual total weight of slightly more than 300 gr. per sq. m., *Arca glacialis* occurring in a number of 30 animals per sq. m with a weight of 28.1 gr. Further, in Nordbugten, Nordvestfjord, 56—67 m, the species was found in a number of 27 animals per sq. m, weighing 38.4 gr, the total weight of the bottom fauna at that depth amounting to about 60 gr. per sq. m (Thorson 1934 b).

Remarks: The species shows a considerable variation in the proportions of the shell, especially as regards the ratio of breadth to length. This may be demonstrated by the following measures from 22 of the largest animals from Kap Hedlund (L = length, H = height, B = breadth of shell; measurements in millimetres):

L	H	B	H/L	B/L	L	H	B	H/L	L4
23.0	16.5	13.0	0,72	0.57	21.2	13.6	10.7	0.64	0.51
23.0	16.0	13.5	0.70	0.59	21.0	15.0	13.6	0.71	0.65
22.9	15.8	11.2	0.69	0.49	21.0	13.9	11.5	0.66	0.55
22.3	15.6	12.2	0.70	0.55	20.7	14.2	11.6	0.69	0.56
22.0	15.3	12.1	0.70	0.55	20.7	14.1	11.4	0.68	0.55
21.7	15.2	13.3	0.70	0.61	20.5	14.8	12.1	0.72	0.59
21.6	15.2	12.6	0.70	0.58	20.4	14.2	10.6	0.70	0.52
21.5	14.7	12.0	0.68	0.56	20.3	13.7	9.4	0.67	0.46
21.4	13.8	10.2	0.65	0.48	20.2	13.0	12.4	0.64	0.61
21.3	14.7	12.8	0.69	0.60	20.0	14.1	11.3	0.71	0.57
21.2	14.0	10.7	0.66	0.50	20.0	12.7	9.3	0.64	0.47

The three largest animals present from E. Greenland (from Kangerdlugssuak) measured 26.5 × 21.0 × 14.4 — 25.5 × 16.8 × 14.2 and 24.5 × 17.0 × 13.0 mm, respectively.—Many of the larger specimens had bryozoans (especially *Alcyonidium gelatinosum* (L.)), ascidians, and actinians attached to their shells.

Distribution: W. and E. Greenland, Jan Mayen, Spitzbergen, the Barents Sea, Novaya Zemlya, the Kara Sea, the Siberian Ice Sea

to 166° E., the Murman Coast, Eastern Finmark, Iceland, the Faroes, the Shetlands, and from the Union Strait to the Gulf of St. Lawrence. Dead shells are known from deep water from several places in the N. Atlantic, e. g. Western Finmark, the Bay of Biscay, and between the Hebrides and the Faroes. The species is also reported to occur in the Mediterranean from 55 to 2594 m (JEFFREYS). But, considering the main distribution of the species, this record seems to require further confirmation. Main distribution: Panarctic (in the Atlantic sector only). Vertical range: From 5 m (Spitzbergen) to 573 m (N. E. America), or about 4000 m? (E. Atlantic, living?).

Biology: Reproduction partly known from N. E. Greenland (THORSON 1936). There, the species seems to spawn at the end of July or the beginning of August. On account of the egg-size, which is 170 μ in diameter, a lecithotrophic and non-pelagic development of the larva is probable. Further, THORSON (1936, p. 63) found several hermaphroditic individuals and assumes that the species may be a normal hermaphrodite, with the sex-change at N. E. Greenland being completed in August.

16. *Dacrydium vitreum* (MØLLER) (cf. pl. 1, fig. 19).

Dacrydium vitreum TORELL 1859, pl. 1, fig. 2.
Dacrydium vitreum G. O. SARS 1878, pl. 3, figs. 2a—b.

East Greenland and Jan Mayen records:

Dacrydium vitreum FRIELE 1878, p. 222.
Dacrydium vitreum POSSELT 1895, p. 66 (in part).
Dacrydium vitreum POSSELT & JENSEN 1898, p. 21 (in part).
Dacrydium vitreum FRIELE & GRIEG 1901, p. 24.
Dacrydium vitreum JENSEN 1905, pp. 325—326.
Dacrydium vitreum JENSEN 1912, pp. 54—55 (in part).
Dacrydium vitreum ODHNER 1915, p. 82.
Dacrydium vitreum GRIEG 1916, p. 8.
Dacrydium vitreum THORSON 1934a, p. 6.

Occurrence at East Greenland (cf. the map fig. 14, p. 175):

Nordøstkyst Area: Off the coast of N.E. Greenland, 75°58½′ N. 14°08′W., 300 m, brown and grey clay, "3 specimens and some empty shells" (GRIEG); S.E. of Shannon, 74°52′ N. 17°16′ W., 350 m, clay, mud, a little sand, pebbles, 1 half-grown animal; Sabine Ø, 74°30′ N. 19°45′ W., 5.5—9.5 m, *Laminaria*, 1 very young animal; S.E. of Sabine Ø, 207 m, fine clay with stones and gravel, 1 adult animal; Off Sabine Ø, 74°14′ N. 15°20′ W., 239 m, clay with stones, 1 half-grown animal.

Kejser Franz Josephs Fjord Area: Eskimonæs, Clavering Ø, 50—55 m, clay, gravel, stones, a few red algae, 1 half-grown animal, 1 half-grown shell (2 finds); E. of Store Finsch, 160 m, tough clay, 1 adult animal; Between Kap Bennet and Bontekoe Ø, 73°20′ N. 21°20′ W., 70 m, mud, some pebbles and shells, 1 adult shell (drilled by *Natica*); Moskusoksefjord, off Ankerbjerg valley, 35—45 m, red clay, sand, gravel, 6 adult and 1 half-grown animals

(2 finds) — 95 m, tough clay, big stones, 1 adult animal; Moskusoksefjord, off Høgboms Bjerg, 200 m, tough clay, 1 adult animal; Duséns Fjord, inner part, 47 m, tough clay, 3 adult animals; Eleonore Bugt, 130 m, tough clay, small stones, 1 adult animal; W. of Ymers Ø, 73°15′ N. 25°42′ W., 760 m, mud, sand, stones, 2 half-grown valves; Inner part of Kejser Franz Josephs Fjord, 73°06′ N. 27°17′ W., 40—70 m, mud, stones, 10 adult and 1 half-grown animals, 1 adult shell (drilled by *Natica*); Kong Oscars Fjord, 73°02′ N. 24°30′ W., 180—215 m, mud, much gravel, stones, 1 adult animal; E.part of Vega Sund, 72°45′ N. 22°56′ W., 35—60 m, mud, some stones, 1 adult animal; Solitærbugt, Ella Ø, 5—24 m, 1 adult animal — 20—52 m, 14 adult animals (some with apparently mature eggs, 12-9—27-9-31.), 3 adult valves (several finds); Solitærbugt, off the Delta, 45 m, greyish-brown clay, 2 adult animals (1 with immature eggs, 24-8-32.); Röhss Fjord, 72°43′ N. 26°38′ W., 35—60 m, mud, 3 adult and 1 half-grown animals; Forsblads Fjord, 95 m, clay with stones, 1 adult animal — 95—170 m, clay with stones, 19 adult, half-grown, and young animals, 5 shells, 3 valves; Antarctics Havn, 72°01′ N. 23°03′ W., 32—40 m, mud, 2 adult animals; Fleming Fjord, 222 m, clay, 1 adult shell, 1 young valve.

Scoresby Sund Area: The mouth of Hurry Inlet, 140 m, clay, 1 adult shell; Hurry Inlet, 19 m, clay, 1 adult shell — 95 m, clay with stones, 20 adult, half-grown, and young animals, 3 shells; Hurry Inlet, at Constable Pynt, 18—22 m, very soft clay, 1 adult and 1 half-grown animal; Hurry Inlet, off Constable Pynt, 24 m, clay, 1 adult animal — 45 m, tough clay, 1 adult animal; — 92 m, clay, 1 adult animal; Off Kap Hooker, 65 m, sand, about 20 adult and half-grown animals (of 8 animals examined 2 had almost mature eggs, 3-7-33.) — 57—69 m, sand mixed with clay, about 45 adult and half-grown animals, 1 adult shell (6 finds); 8 miles W. of Kap Hooker, 14 m, sand with clay, 1 half-grown animal; Jameson Land, opposite Kap Leslie, 22 m, sandy, glittering clay, 1 adult animal; Section between Kap Leslie and Jameson Land, 284 m, soft clay, 1 adult animal; Off Kap Leslie, 240 m, loose clay, gravel, 1 adult animal; Kap Leslie, 62—82 m, glittering clay, 1 adult and 1 half-grown animal, 1 adult shell (2 finds); Section between Kap Stevenson and Kap Leslie, 106 m, soft clay, 1 adult animal, 1 adult valve; W.coast of Jameson Land, opposite Bjørneøer, 30 m, tough clay, 1 half-grown animal — 78 m, clay, 1 adult animal; Nordbugten, Nordvestfjord, 28 m, loose clay, 1 adult animal (with immature eggs, 24-7-33); N.E. of Danmarks Ø, 20 m, 2 adult animals; The bay opposite Rødeø in Rødefjord, 38 m, sand mixed with clay, 1 adult animal, 1 adult shell; Kap Dalton, 17—21 m, fine clay with pebbles, 2 adult and 1 half-grown animal, 3 adult valves.

Kangerdlugssuaq Area: Kangerdlugssuaq, depth?, 1 adult animal.

Sydøstkyst Area: Sermilik, off Íkáteq, 200 m, stones, clay, 1 adult animal; Lindenows Fjord, the mouth, 125—150 m, gravel, clay, 1 adult animal; Lindenows Fjord, outer part, 100 m, clay, 1 adult animal; Lindenows Fjord, middle part, 40—55 m, clay, 2 adult animals (1 with nearly mature eggs, 24-7-35) (2 finds) — 125—150 m, 1 adult animal; Lindenows Fjord, inner part, 42 m, clay, 1 adult animal — 100—150 m, clay, 3 adult animals, 1 adult shell (2 finds); Qeqertatsiaq, 60—70 m, sand, gravel, dead bryozoans, 1 adult animal.

Jan Mayen Area: Jan Mayen, 94—113 m, mud with coarser material, 1 adult and 3 young animals, 2 adult valves (2 finds); 70°54′ N. 8°24′ W.,

128 m, dark-grey, sabulous clay, and 70°51′ N. 8°20′ W., 174 m, dark-grey, sabulous clay, "common" (FRIELE, FRIELE & GRIEG); S. of Jan Mayen, 70°50′ N. 8°29′ W., 162 m, 18 adult, half-grown, and young animals, 25 valves. [70°05′ N. 8°26′ W., 698 m, 1 adult shell].

The species is thus known to occur from off N. E. Greenland, about 76° N., southward to Qeqertatsiaq, being of widespread occurrence. At E. Greenland it ranges vertically from 5.5—9.5 m (Sabine Ø) to 350 m (S. E. of Shannon) and seems to be commonest at depths exceeding 30—40 m. Although it has been found alive on various types of bottom, it seems to prefer clay or mud which contains stones, gravel, and sand.

Remarks: The specimens from E. Greenland and Jan Mayen show some variation as regards the proportions of their shells. The ten largest animals from E. Greenland measure (length × height × breadth of shell): $6.2 \times 4.2 \times 3.5$ — $6.0 \times 4.7 \times 3.4$ — $5.8 \times 4.1 \times 3.1$ — $5.7 \times 4.2 \times 3.1$ — $5.6 \times 4.0 \times 3.1$ — $5.5 \times 4.1 \times 3.2$ — $5.4 \times 4.1 \times 3.2$ — $5.4 \times 4.0 \times 3.2$ — $5.4 \times 4.0 \times 3.1$ and $5.4 \times 3.8 \times 3.1$ mm, respectively. The two largest shells measure $6.0 \times 4.1 \times 3.4$ and $5.8 \times 4.5 \times 3.1$ mm.

In the literature *Dacrydium vitreum* is stated to be of a very wide distribution, occurring southward to Florida, the Azores, France, and the Mediterranean. This, however, is not correct, as an examination of the collections of *Dacrydium* in the Copenhagen Museum showed that they comprise 4 different forms from the N. Atlantic, most probably distinct species. Besides *D. vitreum*, these are provisionally listed as *Dacrydium* sp. a, b, and c, respectively, on p. 195, table II. Of these, species a is presumably restricted to the depths of the Norwegian Sea, while species b is present from great depths W. and S. W. of Iceland, and, finally, species c from intermediate depths from W., S. W., and S. E. of Iceland, S. W. of the Faroes, and W. Norway. Further studies on these species are in progress for later publication. But already now, it seems safe to state that *Dacrydium vitreum*, according to the whole material at hand, has a panarctic distribution, but is absent from truly boreal regions.

Distribution: Baffinland, W. and E. Greenland, Jan Mayen, Spitzbergen, the Barents Sea, the White Sea, Novaya Zemlya, the Kara Sea, the Murman Coast, the Finmark (southern limit of distribution in Norwegian waters not precisely known), N. and E. Iceland, N. of the Faroes, probably also the Gulf of St. Lawrence, and Nova Scotia. Main distribution: Panarctic (in the N. Atlantic only). Vertical range: From 5.5—9.5 m (E. Greenland) down to 2258 m (Davis Strait).

Biology: Forty animals from E. Greenland were examined as to the state of their gonads (material preserved in alcohol). Some of those

from Solitærbugt contained apparently mature eggs. These measured about 100 μ in diameter and were light yellow, rather yolky, and surrounded by a thin membrane. The size of the prodissoconch of 7 specimens from E. Greenland and 5 from Jan Mayen was found to vary from 120 to 132 μ across, with a mean of 126 μ. According to the egg-size and to the great vertical range of this tiny species, a lecithotrophic larval development with a very short or quite suppressed pelagic stage would seem probable.

17. *Crenella decussata* (Montagu).

Crenella decussata Jeffreys 1869 V, pl. 28, fig. 6.
Crenella decussata G. O. Sars 1878, pl. 3, figs. 4a—b.

East Greenland records:

Crenella decussata Jensen 1905, p. 329.
Crenella decussata Jensen 1912, p. 68.
Crenella decussata Odhner 1915, p. 80.

Occurrence at East Greenland (cf. the map fig. 23, p. 183):

[*Kejser Franz Josephs Fjord Area:* The record from Moskusoksefjord by Hägg (1905, p. 113) is due to misidentification. An examination showed that the specimen in question is actually a very young animal of *Modiolaria discors laevigata*].

Sydøstkyst Area: Tiniteqilâq near Angmagssalik, 65°56′ N. 37°40′ W., depth?, 1 adult animal; Kap Tordenskjold, 4 m, mud, decaying algae, *Laminaria*, 1 adult animal (with sperm, 1-7-35) — depth?, 1 adult animal; Napassorssuaq N. of Kap Tordenskjold, 38 m, muddy sand, 2 adult animals; Nanûseq N. of Lindenows Fjord, 30 m, gravel, clay, 1 adult animal — 40 m, sand, clay, 3 adult animals (1 with large, but not quite mature eggs, 19-7-35); Lindenows Fjord, outer part, 5 m, gravel, *Laminaria*, 3 half-grown animals — 12 m, sand, 1 adult animal (with sperm, 16-7-35) — 52 m, sand, 10 adult animals (1 with sperm, 1 with large, but not quite mature eggs, 16-7-35); Qeqertatsiaq, 60—70 m, sand, gravel, dead bryozoans, 2 adult and 3 half-grown animals.

At E. Greenland the species is thus known only from the south-eastern coast stretch from near Angmagssalik southward. It occurred on both sandy and clayey bottom, mixed with sand or gravel, at depths between 4 and 60—70 m.

Remarks: All the specimens at hand are of a typical appearance, though their shells are slightly heavier than those of specimens from more southerly regions. The five largest animals from E. Greenland measure (length × height × breadth of shell): $4.6 \times 5.6 \times 3.4$ — $3.9 \times 4.7 \times 2.7$ — $3.8 \times 4.6 \times 2.7$ — $3.8 \times 4.6 \times 2.4$ and $3.6 \times 4.7 \times 2.5$ mm, respectively.

Distribution: W. Greenland (northward to at least Upernivik, and in Melville Bay), S. E. Greenland, W. Spitzbergen, E. Spitzbergen

(empty shell only), Franz Joseph Land, Novaya Zemlya, the Kara Sea, the White Sea, the Barents Sea, the Murman Coast, the Finmark, all around Iceland, the Faroes, the Shetlands, W. Norway, the Kattegat (Denmark), the British Isles and Ireland, eastern N. America from Labrador to Cape Hatteras, the Pacific from the Bering Sea to San Pedro (California), and Korea. In the N. Atlantic it is reported to extend southward to Barbados (DALL 1886) and to occur also in the Mediterranean (Adventure Bank, JEFFREYS 1879). JENSEN (1912, p. 71) does not mention the record from the West Indies and says that the species is not recorded from the Mediterranean by French and Italian authors. Therefore, a confirmation of the latter records seems necessary. Main distribution: Probably low-arctic-boreal (continuously circumpolar?), in both hemispheres, avoiding the most high-arctic seas. Vertical range: From 2 m (W. Spitzbergen) to about 1100 m (S. of Iceland, and S. of the Faroes). In northern seas, however, it is mainly littoral, and the record by JEFFREYS from 3000 m is probably due to a mistake (cf. JENSEN 1912, p. 71).

Biology: None of the animals from E. Greenland were found to contain fully mature eggs. The egg-size is considerable, however, two animals had large, yolky, yet apparently premature eggs measuring about $170 \times 140\ \mu$. Accordingly, a lecithotrophic larval development seems probable, with the pelagic stage rather short or entirely lacking.

In ten specimens from E. Greenland the non-decussated area of the shell varied from 745 to 770 μ across, with a mean of 750 μ. This agrees with the statement by JØRGENSEN (1946). However, according to REES (1950), this measurement possibly represents the size of an interdissoconch, as REES found a delimited area of 290 μ across in two North Sea specimens and supposes this to be the prodissoconch.

18. *Modiolaria discors laevigata* (GRAY).

Modiolaria laevigata G. O. SARS 1878, pl. 3, figs. 3a—b.
Modiolaria discors var. *laevigata* JENSEN 1912, pl. 3, figs. 4a—b; var. *substriata*, ibid., pl. 3, figs. 5a—c.

East Greenland and Jan Mayen records:

Modiolaria discors MÖBIUS 1874, p. 251.
Modiolaria laevigata, and *Modiolaria corrugata* BECHER 1886, p. 69.
Modiolaria laevigata, and var. *substriata* POSSELT 1895, pp. 67—68.
Modiolaria laevigata, and var. *substriata* POSSELT & JENSEN 1898, p. 26 and p. 27.
Modiolaria laevigata FRIELE 1902, p. 4.
Modiolaria laevigata HÄGG 1904, pp. 23—24; *Modiolaria substriata*, ibid., p. 25; *Modiolaria corrugata*, ibid., p. 22.
Modiolaria laevigata et var. *substriata* JENSEN 1905, pp. 326—328.
Crenella decussata HÄGG 1905, p. 113.

Modiolaria laevigata LAMY 1913a, p. 22.
Modiolaria discors var. *laevigata* and var. *substriata* ODHNER 1915, p. 78.
Modiolaria laevigata LAMY 1926, p. 180.
Modiolaria laevigata REMY 1928, p. 222.
Modiolaria laevigata THORSON 1934a, p. 6.
Modiolaria discors THORSON 1935, pp. 297—304; on reproduction.
Modiolaria laevigata THORSON 1936, p. 51 et sequ.; on reproduction.

Occurrence at East Greenland (cf. the map fig. 14, p. 175):

Nordøstkyst Area: Danmarks Havn, 0—9 m, sandy mud, algae, 16 adult, half-grown, and young animals — 5.5—38 m, soft bottom, *Laminaria*, *Delesseria*, red algae, 33 adult, half-grown, and young animals, 2 shells, 2 valves (13 finds); Stormbugt at Danmarks Havn, 9.5—19 m, soft bottom, *Laminaria*, 3 adult, 1 half-grown and 1 young animal, 1 half-grown shell — 19—38 m, *Delesseria*, about 60 adult, half-grown, and young animals (3 finds) — 19—38 m, stones, shells, red algae, *Delesseria*, 1 adult and 1 half-grown animal (2 finds); Hvalrosodden at Danmarks Havn, on the shore, 1 adult shell — 0—4 m, soft bottom, *Laminaria*, 1 adult animal; Near Kap Bismarck, about 47 m, hydroids, 1 half-grown and 4 young animals; Kap Bismarck, on the shore, 1 half-grown shell, 6 adult valves; Øresund at Danmarks Havn, 28—56 m, hard bottom, *Delesseria*, hydroids, 2 adult and 1 young animals (2 finds); N.E. coast of Lille Koldewey, 28—38 m, stones, shells, hydroids, red algae, 2 adult and 1 young animals; Off the mouth of Mørkefjord, 2 m, sand, clay, stones, *Laminaria*, about 65 adult, half-grown, and young animals; S. of Lille Pendulum, 74°35′ N. 18°23′W., 18—21 m, sandy mud, algae, about 35 adult, half-grown, and young animals; Sabine Ø, depth?, *Laminaria*, "9 specimens" (JENSEN); Shannon, and Sabine Ø, 7.5—56 m (MÖBIUS).

Kejser Franz Josephs Fjord Area: Kap Borlase Warren, 19 m, *Laminaria*, 17 adult, half-grown, and young animals, 3 adult valves; Sandøen in Tyrolerfjord, 8 m, about 25 half-grown and young animals; West of Kap Mary, Clavering Ø, 21 m, stones, algae, 5 adult and 4 half-grown animals; S.E. of Clavering Ø, 74°10′ N. 20°8′W., 25—40 m, mud, shells, and pebbles, 6 adult and half-grown animals; Eskimonæs, Clavering Ø, 3.5—6 m, coarse sand, algae, 2 young animals — 6—14 m, sandy clay, algae, 19 adult, half-grown, and young animals (2 finds) — about 55 m, clayey gravel, *Laminaria*, 1 young animal; Jackson Ø, and Clavering Ø, 7.5—56 m (MÖBIUS); Loch Fyne, on the shore, 1 adult shell, 9 adult valves; Knudshoved (Karlshavn), 8—10 m, muddy bottom, 4 adult and 4 half-grown animals; Kap Broer Ruys, 73°30′ N. 20°18′W., 25—27 m, pure gravel, red algae, 1 adult animal; Mackenzie Bugt, 3—10 m, mud and sand, *Laminaria*, 1 animal (HÄGG) — 12—18 m, mud, 14 animals (HÄGG, as *M. laevigata* and *M. corrugata*) — 12—35 m, mud, numerous animals (HÄGG, as *M. laevigata*, *M. substriata*, and *M. corrugata*); Kap Bennet, 73°26′ N. 21°13′W., 9—11 m, sandy mud, algae, 1 adult animal; Nordfjord, depth?, 2 adult and 1 half-grown animals; Moskusoksefjord, 15 m, about 50 adult, half-grown, and young animals; Moskusoksefjord, off Ankerbjerg valley, 17—21 m, red clay, big stones, about 100 adult, half-grown, and young animals; Outer part of Moskusoksefjord, 220 m, clay, 1 very young animal (erroneously referred to *Crenella decussata* by HÄGG); Duséns Fjord, the mouth, off Kap Graah, 16—20 m, clay, *Desmarestia*, 2 half-grown animals; Duséns Fjord, inner part, 4—10 m, soft clay, *Desmarestia*, about 100 adult, half-grown, and young animals; Duséns Fjord, innermost part, 5—19 m, clay,

Desmarestia, 6 adult, 18 half-grown and young animals (3 finds); Eleonore Bugt, 3.5—12 m, clay, *Fucus*, *Laminaria*, *Desmarestia*, about 40 adult, half-grown, and young animals — 15—27 m, clay, *Laminaria*, *Desmarestia*, about 90 adult, half-grown, and young animals; Off Engdalen, inner part of Kejser Franz Josephs Fjord, 13—18 m, fine, grey, loose clay, 1 adult animal — 27—37 m, loose, brown clay, 1 half-grown and 3 young animals — 50—55 m, loose, brown clay, 2 young animals; Isfjord, off Haredalen, 9—15 m, loose, greyish-brown clay, 20 adult, half-grown, and young animals — 27—35 m, loose, brown clay, 16 half-grown and young animals (2 finds); Inner part of Kejser Franz Josephs Fjord, 73°06′ N. 27°17′W., 3—9 m, mud, sand, algae, 1 adult and 1 young animal; Karl Jakobsens Bugt, Ymers Ø, 5 m, clay with algae, 1 young animal — 13—14 m, clay, 1 half-grown and 1 young animal; Eastern part of Vega Sund, 72°45′ N. 22°56′W., 1—3 m, sand, brown algae, 3 young animals — 35—60 m, mud, some stones, 1 half-grown animal; Solitærbugt, Ella Ø, at all depths from 2 to 24 m, clay, *Fucus*, *Desmarestia*, about 400 adult, half-grown, and young animals (many finds); Solitærbugt, off Kap Oswald, 3—10 m, stones, *Fucus*, *Desmarestia*, about 180 adult, half-grown, and young animals (2 finds); Kap Hedlund, 4—27 m, about 100 animals, mainly young and half-grown ones (several finds) — 20—53 m, 1 adult and 6 half-grown animals; Off the mouth of Rhedins Fjord, 25—30 m, clay, *Fucus*, red algae, about 50 adult, half-grown, and young animals; Åkerbloms Ø, Kong Oscars Fjord, 20 m, stony bottom, 3 young animals.

Scoresby Sund Area: Kap Tobin, 17—31 m, *Laminaria*, *Desmarestia*, 1 half-grown and 3 young animals; Scoresbysund, 19—30 m, 6 half-grown and young animals — 19—113 m, 1 half-grown animal; Scoresbysund, off the station, 7—11 m, *Fucus*, *Laminaria*, 8 half-grown and young animals — 7—11 m, mixed bottom, 1 young animal, about 4 mm long, in stomach of *Ophiacantha bidentata* (personal information from Prof. THORSON); Amdrups Havn, Scoresby Sund, 3—4 m, *Fucus* and other algae, about 40 adult, half-grown, and young animals — 6—26 m, *Fucus*, *Laminaria*, red algae, 165 adult, half-grown, and young animals (3 finds); Rosenvinges Bugt, Scoresby Sund, depth?, "1 dead specimen, and 1 valve" (LAMY) — at the shore, 1 adult and 2 half-grown animals — 3—12 m, stones, algae, 29 adult, half-grown, and young animals (3 finds) — 70 m, bluish, tough clay on rocks, 1 adult animal (REMY); Off Kap Hope, 70°10′ N. 22°20′W., 25 m, 1 adult and 6 half-grown animals; Off Kap Hope, 4.5—13 m, sand, stones, *Laminaria*, 45 adult, half-grown, and young animals (7 finds); Off the mouth of Hurry Inlet, 20—28 m, stones, sand, algae, 1 adult and 1 young animal; Hurry Inlet, the mouth, 14—16 m, sand, algae, 3 adult, 7 half-grown and young animals (2 finds) — 57 m, sandy clay, decaying algae, 1 half-grown animal; Eastern side of Hurry Inlet, near the mouth, 25—40 m, sand, algae, about 25 adult, half-grown, and young animals (3 finds); Hurry Inlet, about 1 mile inside the mouth, 3.5—9 m, sand, stones, 25 adult, half-grown, and young animals (2 finds) — 12—38 m, sand, stones, algae, 35 adult, half-grown, and young animals (3 finds); Hurry Inlet, 2 miles inside the mouth, 7—15 m, stones, *Laminaria*, about 85 adult, half-grown, and young animals (2 finds); "Hurry Fjord", 19 m, clay, 15 adult, half-grown, and young animals; Hurry Inlet, off Constable Pynt, 23 m, clay, 1 adult animal — 31 m, clay, 2 adult animals; Fame Øer, 70°50′ N. 22°23′W., 5—ca. 9 m, mud, algae, 1 adult, 8 half-grown and young animals (2 finds); At Fame Øer, 4—6 m, gravel, algae, about 400 animals, almost altogether young ones — at all depths from 6 to 29 m, soft clay, gravel, stones, algae,

about 210 adult, half-grown, and young animals (10 finds); Off Kap Stewart, 70°27′ N. 22°35′ W., 13—18 m, mud, stones, algae, 1 adult and 2 young animals; 8 miles W. of Kap Hooker, 12—14 m, clayey sand, algae, 1 adult and 2 half-grown animals (3 finds); W. coast of Jameson Land opposite Bjørneøer, 10—31 m, clay, and loose sandy clay, 2 adult, 6 half-grown and young animals (3 finds); At Bjørneøer, 6—18 m, 1 adult, 10 half-grown and young animals (2 finds); Section from Kap Stevenson to Kap Leslie, 106 m, soft clay, 1 young animal; Danmarks Ø, 11—13 m, 1 adult animal; N.E. of Danmarks Ø, 19—22 m, soft clay, 3 adult, 1 half-grown, and 1 young animal (2 finds); S.E. of Danmarks Ø, 10—17 m, soft clay, gravel, 11 adult and 5 half-grown animals — 27—30 m, soft clay, gravel, 4 adult animals; Hekla Havn at Danmarks Ø, 5.5—11 m, about 50 adult, half-grown, and young animals; Rødefjord, the bay opposite Rødeø, 4—10 m, clay, *Fucus*, about 40 adult, half-grown, and young animals (2 finds); Turner Sund, about 6 m, about 70 adult, half-grown, and young animals; Henry Land, 38 m, stones, about 50 adult, half-grown, and young animals; Kap Dalton, 17—21 m, fine clay with pebbles, 18 adult, half-grown, and young animals, 2 valves.

Kangerdlugssuaq Area: Mikis Fjord, 3.5—4 m, 1 young animal; Uttentals Sund, at all depths from 3 to 25 m, about 575 adult, half-grown, and young animals (28 finds) — 30—60 m, 16 adult, half-grown, and young animals (4 finds); Kangerdlugssuaq, 5—25 m, muddy clay, stones, sand, 1 adult and 1 half-grown animal, 5 adult shells, 1 adult valve (8 finds) — 40—70 m, 3 adult shells — 100 m, 1 half-grown animal, 10 valves; Sôlos Sund, 67°17′ N. 33°52′W., rocky bottom, a few algae, 3 young animals — 19—30 m, rocky bottom, algae, 2 adult, and 10 young animals.

Sydøstkyst Area: Ingolf Fjord, about 66°15′ N., rocky bottom, algae, about 45 half-grown and young animals; Ödesund, 66°15′ N. 35°25′W., 10—29 m, rocky bottom, algae, 1 adult and 1 half-grown animal; Smalsund, 65°59′ N. 35°52′W., depth?, rocks, 3 young animals — 5.5—11 m, rocky bottom, algae, 2 adult and 1 young animals; Ikerasaussaq, 2—10 m, 2 adult animals; The fjord inside Kûngmiut, 5—20 m, 31 adult, half-grown, and young animals (4 finds); Angmagsivik, about 1—9 m, 1 half-grown animal; Tunoq near Angmagssalik, between tide-marks, 1 adult shell; Tasîssârssik near Angmagssalik, 3—30 m, about 110 adult, half-grown, and young animals (3 finds); Tasîssaq near Angmagssalik, 1—9 m, 4 half-grown and 1 young animals — at all depths from 5 to 40 m, about 175 adult, half-grown, and young animals (9 finds) — 38—80 m, 2 adult, and 3 half-grown animals (3 finds) — 100 m, 1 adult, and 2 half-grown animals; Angmagssalik Fjord, 20—45 m, 2 adult and 1 young animals (2 finds) — depth?, 10 adult and half-grown animals, 15 adult valves (2 finds) — 20—25 m, sand, 1 adult and 1 half-grown animal, 1 adult and 1 half-grown shell (2 finds); Angmagssalik, off the station, 60 m, 1 adult animal; Tiniteqilâq near Angmagssalik, 2 m, about 45 young animals — 9.5—19 m, 10 adult and half-grown animals — depth?, 9.5—19 m, 10 adult and half-grown animals — depth?, Fucaceae, sand, 5 adult and half-grown shells; Ímíkêrteq, 19—ca. 55 m, 1 adult and 10 young animals, 2 adult valves; Sermilik off Íkáteq, 25—125 m, 2 adult, 1 half-grown, and 2 young animals (3 finds); Sermilik off Ipîtâlaq, 5—7 m, about 20 adult and half-grown animals; 2nd E. fjord, Sermilik, 25—50 m, clay, 4 young animals (2 finds); Kap Dan, 65°32′ N. 37° W., 19—28 m, rocky bottom, *Laminaria*, 1 young animal; Sujunikajik, ca. 65°30′ N. 38°50′W., on the anchor, 1 adult and 1 half-grown animal; Øksefjord, ca. 10 m, *Laminaria*,

1 adult animal, 1 adult valve; Qutdlît, 13 m, rocks, *Laminaria*, red algae, 1 adult, 1 half-grown, and 1 young animal; Napassorssuaq, N. of Kap Tordenskjold, 5—8 m, rocks, *Laminaria*, 1 adult animal; Kap Tordenskjold, 4 m, ooze with decaying algae, *Laminaria*, 1 adult and 3 half-grown animals — 8 m, clay, decaying algae, 1 half-grown animal — 11 m, *Laminaria*, rocks, 28 adult, half-grown, and young animals; Kangerdluluk, about 61°05′ N., depth?, 1 adult shell; Lindenows Fjord, the mouth, 11 m, gravel, *Laminaria*, 1 adult animal — 100—150 m, bryozoans, sand, 1 half-grown and 2 young animals; Lindenows Fjord, outer part, 60—70 m, clay, gravel, sand, 1 half-grown animal, 1 half-grown shell (2 finds); Lindenows Fjord, middle part, 6 m, *Laminaria*, 1 adult animal — 60—80 m, clay, fine sand, 1 half-grown animal, 1 adult shell (2 finds); Lindenows Fjord, innermost part, 15—30 m, clay, gravel, sand, a few algae, 1 adult and 1 half-grown animal (2 finds).

Jan Mayen Area: Jan Mayen, 71°0′ N. 8°52′ W., 2.7—3.5 m, *Laminaria*, about 20 adult, half-grown, and young animals; N. of Jan Mayen, 15—25 m, stones, algae, 2 and 13 "specimens" (BECHER, as *Modiolaria corrugata* and *M. laevigata* respectively); Hvalros Bugt, 16—18 m, dark sand, 1 young animal; E. coast of Jan Mayen near Friele Glacier, 25—30 m, volcanic gravel, 1 adult and 2 young animals (REMY); Jan Mayen, 30 m, 2 adult valves; S. coast of Jan Mayen, 70°57′ N. 10°39′ W., 37 m, volcanic gravel, 1 dead specimen (LAMY); 70°48′ N. 7°30′ W., 100 m, (FRIELE); Jan Mayen, 28 m, and 95—113 m, "some smaller specimens" (JENSEN).

The species is by far the commonest Mytilid in the area and has been found at all suitable places along the East Greenland coast from Danmarks Havn (76°47′ N.) to the southernmost localities investigated, ranging vertically from just below the shore line (at the smallest depths often only young animals are met with) down to 220 m (Moskusoksefjord). It is, however, most abundant at depths less than 30—40 m and belongs to the epifauna of the vegetation, being especially associated with the zones with *Desmarestia*, *Laminaria*, and *Fucus*, where it may occur in large numbers. Thus, in Solitærbugt, Ella Ø, in one dredge-haul at 4—8 m, with large masses of *Desmarestia*, the species was taken in a number of 166 individuals (THORSON 1933, p. 53). Further, it occurred in a number of 225 individuals in one dredge-haul at 6—10 m, *Fucus*, *Laminaria*, in Amdrups Havn, Scoresby Sund (THORSON 1934 b, p. 56).

Remarks: All the specimens from E. Greenland and Jan Mayen are here recorded under the name of *Modiolaria discors laevigata* GRAY, a larger and somewhat elongated form being regarded as a subspecies of the typical *M. discors* (L.), with a more northerly distribution than the main form (cf. the discussion on the forms of *M. discors* in JENSEN 1912, pp. 60—61). In spite of about one-tenth of the specimens from E. Greenland exhibiting the features of var. *substriata* GRAY, these have been included under *M. discors laevigata* as well, because it is often very difficult, if not impossible, to decide to which form a young specimen

should be referred, and further, because several of the adults are intermediates. Apart from the inconstant differences as regards the shape and the surface of the shell—the typical *laevigata* with the margin behind the umbo less sloping and the posterior part almost smooth, the typical *substriata* distinctly striated on the posterior part and often more ventricose—no other distinctive feature has been detected. This seems to apply to the distribution and the vertical range of the two forms as well (cf. the distribution of the forms in question as specified in HÄGG 1904, p. 24 and pp. 25—26). Thus, in all the samples from E. Greenland with fairly large numbers of *M. discors laevigata*, the forma *substriata* is also present, it being only less abundant generally. Therefore, it seemed most convenient to include the latter in the records of the former, the real meaning of this dimorphism, however, being as yet unknown.

The specimens from E. Greenland vary considerably in the proportions of the shell, as may be illustrated by the subjoined table of the measurements of the largest specimens present (L = length, H = height, B = breadth of shell, measurements in millimetres):

Typical *M. discors laevigata*:						f. *substriata*:		
L	H	B	L	H	B	L	H	B
39.5	26.0	17.6	30.0	19.5	12.5	38.2	23.2	—
37.2	23.2	17.2	28.6	18.7	13.2	35.5	21.2	—
35.3	22.4	14.6	28.1	18.8	12.2	29.5	19.3	13.4
34.5	22.5	11.3	27.6	18.7	11.3	28.5	18.1	14.6
32.5	20.7	13.3	26.7	18.2	13.0	28.0	18.2	12.0
32.3	20.7	14.2	25.5	15.6	11.0	26.6	16.6	12.7
31.4	20.2	14.5	24.0	15.4	9.8	26.6	16.5	12.4
31.3	20.2	13.5	intermediate:			26.4	16.4	11.6
31.0	19.8	13.0	31.5	20.5	14.0	26.0	16.1	12.1
30.7	19.8	14.0	25.2	16.7	—	25.0	15.9	10.5

The largest specimens hitherto known are derived from Iceland, where the form *substriata* may attain a length of up to 52 mm. Thus, the species does not reach its maximum size at E. Greenland.

Distribution: *M. discors laevigata* (incl. of f. *substriata*) is known from almost all arctic coasts hitherto investigated, viz. Grinnell Land, Baffinland, West and East Greenland, Jan Mayen, Spitzbergen, Franz Joseph Land, Novaya Zemlya, the Kara Sea, the Barents Sea, the White Sea, the Siberian Ice Sea, the Bering Strait and the Bering Sea, the Aleutians, Kamchatka, and occurs further near Japan, the W. coast of N. America southward to Puget Sound; Labrador, New England southward to New York, Iceland, the Finmark, and Lofoten. Main

distribution: Panarctic, circumpolar, with boreal outposts. Vertical range: From 0 m to 374 m (the Barents Sea). (1800 m, Norwegian Sea, empty shell only).—*M. discors discors* has a more southerly distribution, reaching the Western Baltic, S. W. Europe, Madeira, and the ?Mediterranean.

Biology: Reproduction known from N. E. Greenland and (of *M. discors discors*), partly, from Denmark and the Western Baltic (THORSON 1935, 1936; MEYER & MÖBIUS 1872).—The large eggs, measuring about 300×220 μ, are laid in egg-strings in the nest of the parent, and the embryos develop without any pelagic larval stage at all. The embryonic shell was found to be about 400 μ in length in embryos still enclosed in the gelatinous mass of the string. In N. E. Greenland spawning takes place in the summer with the greatest intensity in August. The species is protandric. The one-year old animals are all in a functional ♂-phase. In the following year, the eggs begin to develop, the animals passing through a hermaphroditic stage, and, finally, they become functional females at the end of their third year of life.

[*Modiolaria corrugata* (STIMPSON).

Modiolaria corrugata JENSEN 1912, pl. 3, figs. 7a—d.

This species was recorded from Mackenzie Bugt N. of Kejser Franz Josephs Fjord by HÄGG (1904, p. 22). The specimens in question, however, belong to *Modiolaria discors laevigata* as stated by JENSEN (1905, p. 327). Further, BECHER (1886, p. 69) reported it from N. of Jan Mayen. JENSEN (1912, p. 62), however, expresses some doubt as to the correctness of the determination. Since *Modiolaria corrugata* has not been recorded by any later expedition to Jan Mayen, and, since *M. discors laevigata* is the only species of the genus known with certainty from that area, it seems justifiable to exclude *M. corrugata* from the faunalist of Jan Mayen as well].

19. *Modiolaria nigra* (GRAY).

Modiolaria nigra JEFFREYS 1869 V, pl. 28, fig. 4.
Modiolaria nigra MEYER & MÖBIUS 1872, p. 81, figs. 1—3.

East Greenland records:

Modiolaria nigra HÄGG 1904, p. 26.
Modiolaria nigra JENSEN 1905, p. 328.
Modiolaria nigra JENSEN 1912, p. 64.
Modiolaria nigra ODHNER 1915, p. 75.
Modiolaria nigra THORSON 1934a, p. 6.
Modiolaria nigra THORSON 1935, pp. 297—304; on reproduction.
Modiolaria nigra THORSON 1936, pp. 53—57, and 62; on reproduction.

Occurrence at East Greenland (cf. the map fig. 20, p. 181):

Nordøstkyst Area: Stormbugt at Danmarks Havn, 9.5—19 m, soft bottom, *Laminaria*, 3 adult animals; Hvalrosodden at Danmarks Havn, on the shore, 1 fragment of an adult valve — 0—6 m, sand, stones, *Laminaria*, 1 adult shell.

Kejser Franz Josephs Fjord Area: Kap Borlase Warren, 74°20′ N. 19° W., 19 m, *Laminaria*, 1 adult shell; S.E. of Clavering Ø, 74°10′ N. 20°08′ W., 25—40 m, mud, many shells, pebbles, 1 adult and 1 young animal; Kap Stosch, Gael Hamkes Bugt, ca. 15 m, 2 adult and 2 half-grown animals; Knudshoved (Karlshavn), 8—10 m, muddy bottom, 1 half-grown animal; Mackenzie Bugt, 12—35 m, mud, 15 animals (HÄGG); Moskusoksefjord, 15 m, 4 adult and 6 half-grown animals; Vinterøer, the mouth of Duséns Fjord, 15—30 m, stones, algae, 2 adult and 7 half-grown animals; The mouth of Duséns Fjord, off Kap Graah, 16—20 m, clay, *Desmarestia*, 4 adult animals — 26—40 m, clay, large stones, *Desmarestia*, 1 adult valve; Duséns Fjord, inner part, 20—25 m, loose clay, *Desmarestia*, 7 adult, 1 half-grown, and 3 young animals; Karl Jakobsens Bugt, Ymers Ø, 13 m, clay, 1 adult and 1 half-grown animal (2 finds) — 14—27 m, clay, 6 adult, 6 half-grown, and 12 young animals, fragments of 3 valves (8 finds) — 30 m, clay, 1 half-grown animal; Antarctics Havn, 72°01′ N. 23°03′ W., 32—40 m, mud, 1 young animal.

Scoresby Sund Area: Off Raffles Ø off Liverpool Land, 255 m, sand, gravel, stones, 1 adult animal; Off the mouth of Hurry Inlet, 20—28 m, sand, stones with algae, 3 young animals; Hurry Inlet, the mouth, 28 m, sand, stones, algae, 1 adult animal — 57 m, sandy clay, 1 young animal; 1 mile inside the mouth of Hurry Inlet, 15 m, sand, 4 young animals (2 finds); Hurry Inlet, 0—13 m, clay and sand, 2 adult animals, 3 adult shells — 19 m, clay, 4 young animals; Hurry Inlet, off Constable Pynt, 21—24 m, clay, 5 adult, 10 half-grown and young animals (7 finds); E. side of Hurry Inlet, off Constable Pynt, 33 m, clay, 1 half-grown animal; Hurry Inlet, at Constable Pynt, 7—10 m, sand, 2 adult, 2 half-grown, and 16 young animals — 18—22 m, rather soft clay, 1 adult and 1 young animal; Hurry Inlet, off Fame Øer, 25 m, soft clay, gravel, 10 adult and 2 half-grown animals; Near Fame Øer, 4—6 m, gravel, algae, 2 young animals — 6—12 m, rather soft clay, 1 adult, 3 half-grown, and 1 young animals (2 finds) — 15—18 m, soft clay, *Laminaria*, red algae, 20 adult, 2 half-grown, and 6 young animals (3 finds) — 18—22 m, tough clay, and soft, muddy clay, 11 adult, 15 half-grown, and 2 young animals, 1 adult valve (5 finds); Fame Øer, 70°50′ N. 22°33′ W., 5—8 m, mud, 3 adult and 1 young animals — 23—25 m, clay, 2 half-grown animals; Off Kap Hooker, 57 m, sand mixed with clay, 1 adult animal; 2 miles W. of Kap Hooker, 13 m, sand mixed with clay, 2 adult animals; 8 miles W. of Kap Hooker, 12—14 m, sand mixed with clay, 24 adult, 51 half-grown and young animals, 1 half-grown shell (drilled by *Natica*) (10 finds); W. coast of Jameson Land, opposite Kap Leslie, 21 m, sandy, glittering clay, 1 adult animal; W. coast of Jameson Land, opposite Bjørneøer, 10 m, loose, sandy clay, 1 adult animal; Turner Sund, about 5.5 m, about 50 adult, half-grown, and young animals, 3 adult valves; Kap Dalton, depth?, 1 adult valve — 17—21 m, clay, 24 adult, half-grown, and young animals, 1 adult shell — 30 m, clay with stones, 1 adult animal.

Sydøstkyst Area: Tasîssaq near Angmagssalik, 10—19 m, 1 adult animal; Nanûseq N. of Lindenows Fjord, 58 m, gravel and clay, 1 adult animal;

Lindenows Fjord, the mouth, 125—150 m, gravel, clay, 1 half-grown animal; Lindenows Fjord, outer part, 65 m, clayey sand, 1 young animal; Lindenows Fjord, middle part, 20—37 m, sand, gravel, rocks, *Laminaria*, 2 adult and 2 young animals, 1 young shell (5 finds) — 40—50 m, clay, 5 young animals; Lindenows Fjord, inner part, 25—50 m, clay, gravel, sand, 2 half-grown and 2 young animals (3 finds).

In East Greenland the species has thus been found from Danmarks Havn in the N. to Lindenows Fjord in the S. with a vertical range from 4—6 m or 5.5 m (Fame Øer and Turner Sund, respectively) to 255 m (off Raffles Ø). The latter depth, however, is exceptional, since the species has only rarely been met with at depths exceeding 40 m. Further, it is far less abundant than *Modiolaria discors laevigata*, and apparently does not penetrate as far into the ramifications of Kejser Franz Josephs Fjord and Scoresby Sund as is evidenced by comparison of the maps figs. 14 and 20. The species belongs to the epifauna, generally occurring at depths where the vegetation is scarce. It has been found to occur in a number of 32 adults and 54 juveniles, weighing together 115.8 gr., on an average per m^2, off Kap Hooker, 12 to 14 m, sand with clay (THORSON 1934 b, pp. 30—31).

Remarks: Apart from a remarkable variation in the proportions of the shell all the specimens from E. Greenland look rather uniform, The ten largest animals at hand measure (length × height × breadth of shell): $47.5 \times 22.5 \times 17.8$ — $44.6 \times 22.3 \times 15.0$ — $44.4 \times 21.5 \times 16.2$ — $44.3 \times 22.3 \times 14.2$ — $44.2 \times 23.3 \times 14.6$ — $43.0 \times 23.1 \times 13.7$ — $42.5 \times 23.2 \times 15.5$ — $40.6 \times 21.2 \times 13.6$ — $40.5 \times 20.5 \times 10.6$ and $40.3 \times 21.0 \times 10.3$ mm, respectively; thus they do not reach the maximum size of the species (up to 75 mm in length, E. Iceland). The shells of larger animals were very often covered with a brownish layer of precipitated material.

Distribution: West Greenland, East Greenland, Spitzbergen, Franz Joseph Land, Novaya Zemlya, the Kara Sea, the Siberian Ice Sea, the Bering Strait and the Bering Sea, the Sea of Okhotsk, the W. coast of N. America southward to Oregon, the seas N. of America, Parry Islands, Baffinland, Labrador, and from New England southward to Cape Hatteras, Iceland, the Faroes, the Shetlands, the Finmark, the West and South coasts of Scandinavia, reaching the Western Baltic, and in the North Sea reaching Holland. Main distribution: Pan-arctic-boreal and circumpolar. Vertical range: From 3 m (Novaya Zemlya) to 376 m (W. Greenland).

Biology: Reproduction known from N. E. Greenland (THORSON 1935, 1936). Spawning takes place during the whole summer with a maximum in August. Egg-strings, containing very large eggs, are at-

tached to the byssus of the parent. The eggs measure about 520 × 360 μ and are surrounded by a thin gelatinous envelope. The larval development is direct without any pelagic stage. Further, the species is distinctly protandric. According to THORSON (1935, p. 300), the shell of advanced embryos still inside the egg-string measured about 510 μ.

In ten young bottom-stages at hand a very distinct line, probably the outline of the embryonic shell, was found to vary from 450 to 540 μ in the longer axis, with a mean of 494 μ. This presumably corresponds with the prodissoconch I in other bivalve species.

20. *Mytilus edulis* LINNÉ (cf. pl. 3, fig. 11).

Mytilus edulis JEFFREYS 1869 V, pl. 27, fig. 1.

East Greenland and Jan Mayen records:

Mytilus edulis POSSELT 1895, p. 66.
Mytilus edulis POSSELT & JENSEN 1898, p. 19.
Mytilus edulis JENSEN 1905, pp. 322—325.
Mytilus edulis JENSEN 1912, p. 47.
Mytilus edulis LAMY 1913a, p. 23.

Occurrence at East Greenland[1]) (cf. the map fig. 23, p. 183):

Sydøstkyst Area: Fjord inside Kûngmiut, 5 m, 1 adult animal; Ikerasaussaq near Angmagssalik, 2—10 m, 1 adult animal; Angmagsivik near Angmagssalik 1—ca. 9.5 m, 1 adult animal, 1 young shell, 2 adult valves; Tasîussaq near Angmagssalik, between tide-marks, 1 adult animal, 1 young valve — depth?, 1 adult animal, 8 adult valves — depth?, "numerous specimens" (JENSEN) — 1—9.5 m, 6 adult, 40 half-grown and young animals — 9.5—19 m, 1 adult animal; Tasîssaq, "Strømstedet", 65°35′ N., 0—9.5 m, 30 adult, half-grown, and young animals and shells; Ikersârssik, Sermilik, between tide-marks, 1 adult animal, 1 adult shell; Kangerdluluk, about 61°05′ N., depth?, 1 half-grown animal, 1 half-grown shell.

Jan Mayen Area: S. of Jan Mayen, 70°52′ N. 10°33′ W., 180 m, grey, volcanic mud, 1 live animal (LAMY).

Living specimens of the mussel have thus been found at E. Greenland only at the south-eastern coast. At present the northern limit of distribution may be fixed at about 66°30′ N., where a few and small specimens have once been observed (JENSEN 1905, p. 325). In postglacial times, however, it must have ranged far more to the North, as is evidenced by the abundance of *Mytilus* shells on raised beaches both at N. E. Greenland and several other arctic localities, where the species is now extinct (cf. NATHORST 1901, JENSEN 1905, and NOE-NYGAARD 1932).

From the samples at hand and from the literature it appears that

[1]) As to the find of a half-grown animal taken by means of a pelagic net in 75°37′N.6°40′W., see JENSEN 1912, p. 47.

the species is of common occurrence in the vicinity of Angmagssalik, where it lives mainly in shallow water from the tidal zone to a few metres below, preferably in localities where the currents are strong. It has only occasionally been met with at depths of about 10 metres or more, and the adults belong to the epifauna on rocks, stones, and gravel, the young animals to the epifauna of the vegetation.—A detailed discussion of its ecology and occurrence at S. E. Greenland is found in the papers by JENSEN (1905, 1912), H. MADSEN (1936), and BERTELSEN (1937 a).

The single record from S. of Jan Mayen from a comparatively great depth, quite unusual to the species, is rather surprising. It may have been a young or half-grown animal, accidentally carried out from the littoral zone with seaweeds. It seems quite probable, however, that the species occurs at Jan Mayen, the marine fauna of which otherwise comprises subarctic elements.

Remarks: Two of the animals at hand are highly deformed, the posterior ends of their shells being split into two portions; these shells are otherwise extremely convex. This deformation is possibly due to injury by ice-pressure. In general, all of the larger specimens from S. E. Greenland are remarkable by having more or less distinct, concentric furrows parallel to the lines of growth (cf. pl. 3, fig. 11). Since the species lives in shallow water and, thus, at S. E. Greenland is subject to an extreme and regular variation of the ecological conditions in the course of the year, these concentric furrows may be regarded as "year-rings". If so, the mussel shows a very retarded growth at S. E. Greenland. Thus, a specimen 83.7 mm long appeared to be 18 years old, a second 52.5 mm long, 11 years, and a third only 35 mm long, 4 years, when they died. Similar observations were made by VIBE (1950) and H. MADSEN (1940) on *M. edulis* from N. W. Greenland. This prolonged lifetime of the mussel probably has a stabilising effect on its populations in these regions.

The shells of some of the specimens are rather solid compared with specimens from the boreal regions, on the other hand thin-shelled ones are also present. Five of the largest specimens measure (length × height × breadth of shell): 83.7 × 40.0 × 36.3 — 60.8 × 27.2 × 22.2 — 59.2 × 26.2 × 27.0 — 52.5 × 25.3 × 21.5 and 47.8 × 22.5 × 17.5 mm, respectively.—A few specimens had bryozoans and *Spirorbis*-tubes attached to their shells.

Distribution: In areas adjacent to E. Greenland and Jan Mayen, the species is known to live at West Greenland northward to the Thule district (VIBE 1950), Baffinland (Ponds Inlet, dead specimens (H. MADSEN 1936), Padloping Island, about 67° N., living (ELLIS 1955)), and around Iceland. At present, however, it is absent from Spitzbergen, but lives sublittorally at Novaya Zemlya. Further, it is widely distributed,

occurring in the Chukotsk and Beaufort Seas, in the N. Pacific from the Bering Strait southward to Japan and Lower California, in the N. Atlantic from Labrador to N. Carolina, and along the coasts of Europe into the Mediterranean and far into the Baltic. It has also been recorded from several other, distant places, but these records may be due to confusion with nearly related species. Main distribution: Low-arctic-boreal (discontinuously circumpolar), Mediterranean-Atlantic. Vertical range: From the tidal zone to 180 m (Jan Mayen); only occasionally, however, at depths below 50 m.

Biology: The reproduction of the species has not been studied at S.E. Greenland. As is well known, however, its propagation has been investigated by many authors in various other places. At S.E. Greenland the species, no doubt, reproduces essentially in the same way as is known from other areas, i. e. it is unisexual and spawns small eggs which develop into planktotrophic larvae with a prolonged pelagic stage.

[*Pinna pectinata* Linné [*P. rudis* Poli, non Linné].

Pinna pectinata Locard 1898, pl. 15, fig. 27.

To this species Lamy (1913 a, p. 23) refers a single fragment taken S. of Jan Mayen, 70°52′ N. 10°33′ W., 180 m, grey, volcanic mud. However, provided the determination is correct, this fragment must be fossil, for no species of *Pinna* is known to live in the arctic and the truly boreal regions of the N. Atlantic. The species extending farthest northward is *P. fragilis* Pennant, which at present has its northern limit of distribution in the English Channel].

21. *Pecten* (*Chlamys*) *islandicus* O. F. Müller.

Pecten islandicus G. O. Sars 1878, pl. 2, fig. 2.
Pecten islandicus Jensen 1912, pl. 1, figs. 4a—d.

East Greenland and Jan Mayen records:

Pecten islandicus, and *Pecten striatus* Becher 1886, p. 68.
Pecten islandicus Friele 1902, p. 4.
Pecten islandicus Jensen 1905, p. 333.
Pecten islandicus Jensen 1912, p. 16.
Chlamys islandica Lamy 1913a, p. 22.
Chlamys islandica Lamy 1913b, pp. 599—601.
Pecten (*Chlamys*) *islandicus* Odhner 1915, p. 84.
Chlamys islandica Lamy 1926, p. 180.
Pecten islandicus Thorson 1933, pp. 12—14, 19, 22, 32, 38, 39, 57—59, and 68.

Occurrence at East Greenland (cf. the map fig. 26, p. 186):

Kejser Franz Josephs Fjord Area: Solitærbugt, Ella Ø, 4—24 m, 1 adult and 1 half-grown animal (2 finds) — 11—12 m, *Fucus*, *Desmarestia*, 1 half-grown animal — 13—19 m, *Desmarestia* in quantity, 3 adult animals (2 with

large oocytes and immature eggs, 18-9-32) — 20—21 m, *Desmarestia*, shells, 1 adult animal (THORSON) — 20—52 m, stones, large quantities of red algae, 2 adult (one with the gonad in recuperation, the other with very little sperm, and small and middle-sized oocytes, 12-9—27-9-31), and 2 half-grown animals (3 finds) — 62—64 m, shells, gravel, 1 adult animal (gonad lank, few spermatozoa, small oocytes, 8-7-32) — 19—40 m, clay, red algae, 3 adult shells; Kap Hedlund, off the mouth of Rhedins Fjord, 7—10 m, *Fucus*, about 125 young animals (5—7 mm, 18-7-32) (THORSON) — 12—20 m, *Fucus*, *Desmarestia*, red algae, rocks, 1 half-grown and about 60 young animals (at least 3 finds) — 26—31 m, rocky reef, clay, *Fucus*, 1 young animal, 6 adult shells (2 finds); Kap Hedlund, 4—27 m, 12 young animals, 1 half-grown valve — 8—14 m, clay, *Desmarestia*, *Fucus*, red algae, 1 adult animal (with ripe sperm and large oocytes, 17-7-32) — 21—22 m, shells, clay, 1 adult animal (gonads somewhat lank, a little sperm, oocytes, 14-7-32) — 20—53 m, 2 half-grown and 30 young animals, some valves (at least 2 finds); Forsblads Fjord, 95—170 m, clay with stones, fragments of 2 valves (probably subfossil).

Sydøstkyst Area: Off Angmagssalik, 264 m, "1 fragment" (probably subfossil) (JENSEN); Lindenows Fjord, northern side, 10—75 m, mud, 1 half-grown animal; Lindenows Fjord, middle part, 40 m, hard bottom, 1 adult animal (with unripe eggs, 26-7-35) — 40—50 m, clay, 2 adult animals (1 with spermatocytes and a few spermatozoons, 1 with oocytes, 25-7-35); Lindenows Fjord, inner part, 30—50 m, gravel, 1 adult animal (with spermatocytes and spermatozoa, 22-7-35).

Jan Mayen Area: N. of Jan Mayen, 140—180 m, "numerous specimens with bryozoans on their shells", and "1 specimen" (the latter as *Pecten striatus*, BECHER); 71°04′ N. 7°56′ W., 70 m, 5 animals (LAMY); 70°59′ N. 8°40′ W., depth?, 3 valves, fragments (LAMY); 70°40′ N. 8°40′ W., 40 m, 4 animals, 3 fragments (LAMY); 70°40′30″ N. 8°36′ W., 75 m, 15 animals (LAMY); S. of Jan Mayen, 70°52′ N. 10°33′ W., 180 m, grey, volcanic mud, 1 animal, 3 fragments (LAMY); Jan Mayen, 104 m, mud bottom, 9 adult animals (3 with ripe sperm, 3 with both spermatozoa and spermatocytes, 1 with oocytes and unripe eggs, 2 with ripe eggs, 28-6-00); Jan Mayen, depth? (FRIELE).

As mentioned above, the fragments derived from Forsblads Fjord and from the sea off Angmagssalik are probably Quaternary fossils, just as the species has been found in raised layers in other East Greenland localities (cf. JENSEN 1905) even as far north as N. of Kap Bismarck (JENSEN 1917). Thus, the species has hitherto been met with alive in E. Greenland only in the inner parts of Kejser Franz Josephs Fjord and further, in the southernmost part of the Sydøstkyst Area. The isolated occurrence in the inner parts of Kejser Franz Josephs Fjord may reasonably be regarded as a relict from postglacial times when milder conditions prevailed at N.E. Greenland.—In Solitærbugt, Ella Ø, and at Kap Hedlund the species seems to belong to the epifauna of the vegetation (THORSON 1933). Here the young animals are especially associated with the *Fucus* zone at smaller depths, where they may occur in large numbers attached to algae. The adults seem to migrate out to somewhat greater depths, being characteristic of the zone with red algae.

Remarks: In the larger specimens at hand the outline of the shell varies from nearly symmetrical to markedly oblique. Further, the majority of the adult and half-grown individuals from E. Greenland have valves which are provided with radiating undulations resembling those found in *Pecten aratus*. The shells are mainly of a beautiful red colour, but a few specimens from Lindenows Fjord and from Jan Mayen have almost white shells. The seven largest specimens from E. Greenland measure (length × height × breadth of shell): About 88.0 × 91.5 × 26.5 — 80.5 × 88.0 × 23.5 — 83.5 × 79.5 × 22.5 — 80.5 × 85.5 × 28.0 — 72.5 × 76.5 × 22.5 — 71.5 × 76.0 × 27.0 and 71.5 × 75.0 × 22.3 mm, respectively, while the five largest specimens from Jan Mayen measure: 78.0 × 84.0 × 25.0 — 77.5 × 81.0 × 23.5 — 76.8 × 81.0 × ? — 74.5 × 82.5 × 25.0 and 74.5 × 81.8 × 20.3 mm, respectively. Almost all of the larger specimens had crusts of bryozoans, sponges, hydroids, ascidians, cirripeds, and polychaete-tubes (*Spirorbis* spec., *Miroserpula inflata*), and also a few Rhodophyceae, attached to their shells.

Distribution: Baffinland, West and East Greenland, Jan Mayen, Spitzbergen, W. of Novaya Zemlya, the Barents Sea, the Kara Sea, the White Sea, the Finmark, the W. coast of Norway southward to Stavanger, Iceland, the Faroes, from Labrador southward to Cape Cod, the Bering Strait and the Bering Sea, Kamchatka, Korea, N. Japan, and N.W. America southward to Puget Sound. Dead shells are known from Bohuslän (Sweden), the North Sea, W. of Scotland, Ireland, France, the Azores, and the Mediterranean. Main distribution: Subarctic in both the N. Atlantic and the N. Pacific, discontinuously circumpolar, lacking in typical high-arctic seas. Vertical range: From a few metres to 356 m (W. Greenland).

Biology: Pelseneer (1935) states that the species is a hermaphrodite. Twelve differently sized adults from E. Greenland and 9 adults of about the same order of magnitude from Jan Mayen were examined as to the state of their gonads, and of those from E. Greenland 4 were found to be in a hermaphroditic stage. These four specimens were full-grown, measuring about 88, 76.5, 66, and 62 mm in shell height, respectively, and the appearance of their gonads seems to indicate that spawning occurs in the summer and that in each season a functional male phase precedes a functional female phase. Apparently mature eggs measure 100 × 80 μ and are surrounded by a thin membrane (material preserved in alcohol). Ten measurements of the largest diameter of the prodissoconch II of young bottom stages varied from about 220 to 280 μ, with a mean of 251 μ. Both as to egg-size and the size of the prodissoconch II, as well as to the size of the adults, the species is very much like *Pecten opercularis*, whose larvae are known to have a pelagic and plankto-

trophic development (cf. FULLARTON 1890, AMIRTHALINGHAM 1928, JØRGENSEN 1946, REES 1950, 1954). Therefore, it seems justifiable to assume a similar mode of larval development for the present species.

[*Pecten* (*Chlamys*) *striatus* O. F. MÜLLER.

Pecten striatus JEFFREYS 1869 V, pl. 23, fig. 4.

According to BECHER (1886, p. 68) one specimen of this species is said to have been taken N. of Jan Mayen at 140—180 m depth. This record, however, is undoubtedly due to a misidentification (cf. JENSEN 1912, p. 24). The specimen in question must have been *Pecten islandicus*, to which it has been referred here (cf. p. 64). *Pecten striatus* has its northern limit of distribution S.E. and S.W. of Iceland; hence, it does not belong to the fauna of the area dealt with here].

[*Propeamussium* (*Hyalopecten*) *frigidum* (JENSEN).

Pecten frigidus JENSEN 1912, pl. 1, figs. 7a—f.

HÄGG (1904, p. 30, as *Pecten fragilis*) records 19 animals of this species from the sea between Greenland and Jan Mayen, 72°42′ N. 14°49′ W., 2000 m, ooze with Foraminifera. Further, the Danish Ingolf Expedition took it alive at several stations S. of Jan Mayen (JENSEN 1912, p. 34). Although the smallest depth at which the species has hitherto been found alive, is 1090 m, it seems not entirely out of the question that it may occur on the shelves of E. Greenland and Jan Mayen as well].

22. *Propeamussium* (*Cyclopecten*) *imbriferum* (LOVÉN) (cf. pl. 2, fig. 1).

Pecten Hoskynsi G. O. SARS 1878, pl. 2, figs. 1a—c.
Pecten imbrifer var. *major* JENSEN 1912, pl. 2, figs. 1a—i.

East Greenland and Jan Mayen records:

Pecten Hoskynsi FRIELE 1878, p. 222.
Pecten Hoskynsi BECHER 1886, pp. 68—69.
Pecten imbrifer POSSELT 1895, p. 66.
Pecten imbrifer POSSELT & JENSEN 1898, p. 12.
Pecten imbrifer FRIELE & GRIEG 1901, p. 8.
Pecten imbrifer FRIELE 1902, p. 4.
Pecten imbrifer HÄGG 1904, p. 31.
Pecten imbrifer JENSEN 1905, p. 332.
Pecten imbrifer JENSEN 1912, pp. 25—26.
Pecten imbrifer THORSON 1934a, p. 6.

Occurrence at East Greenland (cf. the map fig. 25, p. 185):

Nordøstkyst Area: S.E. of Pendulum Øer, 74°35′ N. 18°15′ W., 150 m, mud, stones, 1 adult animal (HÄGG).

Kejser Franz Josephs Fjord Area: Kong Oscars Fjord, 72°56′ N. 24°33′ W., about 125 m, mud, pebbles, sand, 1 adult animal; Between Maria Ø and Ella Ø, 250 m, clay, gravel, big stones, 1 adult valve; The western mouth of Ant-

artics Sund, 230 m, big stones, clay, 1 adult animal; Kap Hedlund, 71—80 m, ascidian epifauna, 1 adult valve; Forsblads Fjord, 95 m, clay with stones, 1 adult valve — 95—170 m, clay with stones, about 125 mainly adult animals, some shells.

Scoresby Sund Area: Off the mouth of Scoresby Sund, 69°25′ N. 20°1′W., 315 m, clay with big stones, 1 adult valve; The mouth of Hurry Inlet, 143 m, clay with stones, 1 half-grown animal; Off Kap Hooker, ca. 150 m, soft clay, stones, 1 adult animal; Section between Kap Leslie and Jameson Land, 385 m, soft clay, 1 fragment of an adult valve; Section between Kap Leslie and Kap Stevenson, 106—120 m, soft clay, 2 adult valves (2 finds); Hall Fjord, between Milne Land and Bjørneøer, 550 m, tough clay, 1 half-grown valve.

Kangerdlugssuaq Area: Mikis Fjord, 175 m, 1 adult and 1 half-grown animal, 1 half-grown valve.

Jan Mayen Area: N. of Jan Mayen, 140—180 m, "2 specimens" (Becher); 70°50′ N. 8°29′W., 162 m, 1 adult animal; 70°46′ N. 6°32′W., 400 m (Friele). [70°41′ N. 10°10′W., 481 m, brown clay, stones, 18 adult animals; 70°05′ N. 8°26′W., 699 m, "3 specimens and a number of valves" (Jensen)].

Thus, the species is apparently of rare and scattered occurrence at E. Greenland, where it is hitherto known to occur from S. E. of Pendulum Øer southward to Mikis Fjord and only at depths exceeding 100 m. Its typical habitat seems to be clayey bottom with stones. It is capable of spinning a bundle of long and very thin byssus threads, and when undisturbed, byssal attachment is likely to be a normal habit of it.

Remarks: *Propeamussium imbriferum* varies considerably as regards the sculpture of its shell, and a form with the vesicles fused together into concentric, projecting, down-turned lamellae was described as var. *lamellosa* by Posselt (1895). But, after an examination of a fairly large material, I feel convinced that neither this nor var. *major* Leche (1878) should be regarded as subspecies.

Things are different, however, as to var. *minor* of Jensen (1912, p. 26, pl. 2, figs. 2a—b), who considers this a geographical subspecies. However, although resembling *P. imbriferum* very much in the appearance of its shell, var. *minor* differs sufficiently in its anatomy, ecology, and distribution to be regarded as a species distinct from *P. imbriferum*. Perhaps "var. *minor*" will turn out to be identical with one of the related forms described from north-eastern America, such as *Cyclopecten pustulosus* Verrill, or *C. subimbrifer* Verill & Bush. But this has not yet been decided, and further studies are in progress on this subject for later publication. In order to make the zoogeographical discussion as complete as possible, "var. *minor*" will be listed as *Propeamussium* sp. a in the present paper, and some corrections of earlier records of *P. imbriferum* will be given below.

The ten largest specimens present from E. Greenland measure (length × height of shell): 20.8 × 21.2—20.7 × 21.4—20.5 × 20.9—20.0 ×

20.3—19.1 × 19.6—18.5 × 19.0—18.2 × 18.7—17.5 × 17.2—17.3 × 17.1 and 16.8 × 17.5 mm, respectively. As in dead specimens the right valve is bent inwards concentrically with the margin—a phenomenon which is due to the violent shutting of the shell in the agonies of death—the breadth of the shell was not determined.—Several specimens had crusts of bryozoans, *Spirorbis*-tubes, and Foraminifera attached to their shells.

Distribution: Davisstrædet and N.W. Greenland, E. Greenland, Jan Mayen, W. Spitzbergen (229 m, 1 adult shell, FRIELE & GRIEG 1901, st. 357), E. Spitzbergen, Bear Island, the Barents Sea, Novaya Zemlya, the Kara Sea, the Finmark, and off N. and W. Norway (all the finds in FRIELE & GRIEG 1901, p. 9, are correctly referred to *P. imbriferum*, but from stations 48, 192, and 357, only shells and valves are present), E. of Iceland and off N.W. Iceland (FRIELE & GRIEG 1901, st. 48; FRIELE 1902, st. 10, and st. 13; JENSEN 1912, st. 59; the other records from Iceland in the latter paper and also in J. MADSEN 1949 must be referred to *Propeamussium* sp. a), and N. of the Faroes (only st. 143 in JENSEN 1912, the remaining ones are *Propeamussium* sp. a). Main distribution: Probably high-arctic (in the N. Atlantic sector only). Vertical range: From 66 m (the Kare Sea) down to 836 m (W. of Lofoten). A single valve is present from W. of Tromsø, about 1200 m depth.

Biology: A sample of 40 animals from Forsblads Fjord (30-8-1900) was examined as to the state of the gonads with the following result: 21 animals of all sizes from 14.4 to 20.7 mm in length had both spermatocytes and spermatozoa, while 19 animals of all sizes from 14.5 to 20.8 mm in length had oocytes and smaller or larger immature eggs in their gonads. No trace of hermaphroditism was detected, and within each of the two groups the gonads were of a rather uniform appearance and at nearly the same stage of development. Taking this into account, spawning may be assumed to occur at N.E. Greenland rather late in the autumn. The largest, still unripe, eggs found in animals from N.E. Greenland measured about 115 × 95 μ. Further, an individual from N.W. Greenland (490 m, 1-8-28) contained apparently mature eggs measuring about 130 μ in diameter and with a thin membrane. In 13 young animals from E. Greenland and Jan Mayen the prodissoconch was found to vary from 164 to 175 μ across, with a mean of 170 μ. Thus, it seems justifiable to assume a lecithotrophic larval development with a short or almost lacking pelagic stage.

23. *Propeamussium* (*Arctinula*) *groenlandicum* (SOWERBY) (cf. pl. 2, fig. 2).

Pecten grønlandicus G. O. SARS 1878, pl. 2, figs. 4 a—c.
Camptonectes groenlandica VERRILL & BUSH 1898, pl. 85, fig. 7.

East Greenland and Jan Mayen records:

Pecten groenlandicus Friele 1878, p. 222.
Pecten groenlandicus Becher 1886, p. 69.
Pecten groenlandicus Posselt 1895, p. 65.
Pecten groenlandicus Posselt & Jensen 1898, p. 9.
Pecten groenlandicus Friele & Grieg 1901, p. 9.
Pecten groenlandicus Friele 1902, p. 4.
Pecten groenlandicus Hägg 1904, pp. 28—30.
Pecten groenlandicus Jensen 1905, pp. 331—332.
Pecten groenlandicus Jensen 1912, pp. 30—31.
Chlamys (Palliolum) groenlandica Lamy 1913a, p. 23; 1913b, pp. 600—602.
Pecten (Palliolum) groenlandicus Odhner 1915, p. 87.
Chlamys (Palliolum) groenlandica Lamy 1926, p. 180.
Chlamys (Palliolum) groenlandica Remy 1928, p. 222.
Pecten groenlandicus Thorson 1934a, p. 6.
Pecten groenlandicus Thorson 1936, p. 50 et sequ.; on reproduction.

Occurrence at East Greenland (cf. the map fig. 15, p. 176):

Nordøstkyst Area: Danmarks Havn, 9.5—19 m, *Delesseria*, hard bottom, 1 half-grown animal — 19—28 m, red algae, hard bottom, 1 half-grown animal; Stormbugt at Danmarks Havn, 9.5—19 m, *Laminaria*, soft bottom, 17 adult, half-grown, and young animals, 3 adult valves; S.E. of Shannon, 74°52′ N. 17°16′W., 350 m, mud, sand, pebbles, 2 half-grown animals; S.E. of Pendulum Øer, 74°35′ N. 18°15′W., 150 m, mud and stones, 2 animals (Hägg); S.E. of Hvalrosø, 74°30′ N. 18°40′W., 80—100 m, mud and stones, "a large number of animals" (Hägg); Sabine Ø, depth?, *Laminaria*, 4 adult animals.

Kejser Franz Josephs Fjord Area: Kap Borlase Warren, 19 m, *Laminaria*, 1 adult animal; S.E. of Clavering Ø, 74°10′ N. 20°8′W., 25—40 m, mud, shells, pebbles, 1 adult animal; Eskimonæs, Clavering Ø, eastern harbor, 45—55 m, clay, gravel, stones, red algae, about 40 adult, half-grown, and young animals (3 finds); Eskimonæs, off "Knolden", 38—41 m, gravel, clay, brown algae, 3 adult animals; Kap Stosch, Gael Hamkes Bugt, about 15 m, 1 adult animal; Between Kap Weber and Ymers Ø, 400 m, clay, big stones, 1 adult animal; Moskusoksefjord, 15 m, 18 adult, half-grown, and young animals; Eleonore Bugt, 15—27 m, clay, *Laminaria*, *Desmarestia*, a few red algae, about 100 adult, half-grown, and young animals (2 finds); Vinterøer at the mouth of Duséns Fjord, 15—30 m, stones, algae, about 50 adult, half-grown, and young animals; E. of Kap Graah, 73°16′ N. 23°15′W., 28—36 m, clay, shells, stones, gravel, and sand, 1 adult animal; The mouth of Duséns Fjord, opposite Kap Graah, 15—40 m, clay, stones, *Desmarestia*, 48 adult and half-grown animals (3 finds); Dusén Fjord, at the anchoring place, 20—25 m, loose clay, *Desmarestia*, 1 half-grown animal — 56 m, tough clay, 1 adult animal; Karl Jakobsens Bugt, Ymers Ø, 18 m, clay, 1 adult animal; Isfjord, off Haredalen, 30—35 m, loose brown clay, 2 adult animals; Inner part of Kejser Franz Josephs Fjord, 73°6′ N. 27°17′ W., 3—9 m, mud with sand and algae, 10 adult and half-grown, and 2 young animals — about 40—70 m, mud, stones, 2 young animals; Eastern part of Vega Sund, 72°45′N. 22°56′W., 35—60 m, mud, some stones, 8 adult and half-grown animals; Solitærbugt, Ella Ø, 2—24 m, 24 adult and half-grown animals (several finds) — at all depths from 20 to about 95 m, mainly clay with stones, shells, gravel, and algae, at least 1500 animals measuring from 7 to about 32 mm in length

(at least 20 finds); Solitærbugt, off the Delta, 45 m, greyish-brown clay, 1 young animal; Kap Hedlund, 4—27 m, 3 adult animals — 20—53 m, 15 adult and half-grown animals (at least 2 finds) — 67—90 m, 3 half-grown animals; Röhss Fjord, 72°43′ N. 26°38′W., 35—60 m, mud, 6 half-grown and young animals; The mouth of Forsblads Fjord, 5.5—26 m, about 70 animals, mostly adults; Forsblads Fjord, 95—170 m, clay with stones, 2 adult and 1 half-grown animals, 9 valves; Fleming Fjord, 222 m, red clay, 1 young valve; [(Between Greenland and Jan Mayen, 72°42′ N. 14°49′W., 2000 m, mud with Foraminifera, 1 very young animal, 1 damaged shell (HÄGG)].

Scoresby Sund Area: Rosenvinges Bugt, 28—30 m, rocks, and 70 m, tough bluish clay on rocks, "numerous" (REMY); Off Kap Hope, 9—12 m, sand, algae, 1 young animal; Off the mouth of Hurry Inlet, 55 m, clayey sand, 1 half-grown and 3 young animals, 2 adult valves (3 finds); The mouth of Hurry Inlet, 20—28 m, stones with algae, sand, 1 young animal — 55—57 m, sandy clay, 2 adult, 1 half-grown, and 3 young animals (3 finds) — 95 , clay with stones, 1 adult animal, 1 young valve; Hurry Inlet, about 1 mile inside the mouth, 12—13 m, sand, many stones, 2 half-grown animals — 35—38 m, sand, stones, *Laminaria*, *Fucus*, red algae, 11 adult and half-grown animals; Hurry Inlet, 1 mile inside the mouth, 14—16 m, sand, 1 half-grown and 3 young animals (4 finds); E. coast of Hurry Inlet, near the mouth, 14—15 m, *Laminaria*, 2 half-grown animals — 25—40 m, sand, stones, many algae, about 55 adult, half-grown, and young animals (3 finds) — 60—75 m, loose clay, stones with algae, 14 adult and 1 young animals; "Hurry Fjord", 19 m, clay, about 50 animals, mainly adults; Hurry Inlet, off Constable Pynt, 33 m, clay, 1 half-grown animal — 46 m, tough clay, 1 young animal — 91 m, clay, 1 young animal; Hurry Inlet, at Fame Øer, 22—24 m, soft clay, *Laminaria*, red algae, 1 half-grown and 1 young animal; Hurry Inlet, 70°43′ N. 22°29′W., about 70 m, mud, 3 half-grown animals; Off Kap Stewart, 70°27′ N. 22°35′W., 13—18 m, mud, stones, algae, 1 half-grown animal; Off Kap Hooker, 65 m, sand, 5 young animals — 57—69 m, clayey sand, 19 half-grown and young animals (7 finds); 8 miles W. of Kap Hooker, 13 m, clayey sand, algae, 1 half-grown animal; W. coast of Jameson Land opposite Kap Leslie, 22 m, sandy glittering clay, 1 adult, 1 half-grown, and 2 young animals (4 finds); W. coast of Jameson Land opposite Bjørneøer, 10 m, loose sandy clay, 10 adult and half-grown animals — 20—40 m, loose sandy clay, 22 adult, half-grown, and young animals; Nordbugten, Nordvestfjord, 10—18 m, loose light-grey clay, about 20 adult and half-grown animals — 28—37 m, loose light-grey clay, about 50 adult, half-grown, and young animals (2 finds); Hekla Havn at Danmarks Ø, 5.5—21 m, *Fucus*, 20 adult and half-grown animals; S.E. of Danmarks Ø, 10—17 m, soft clay with gravel, 2 adult animals; The bay opposite Rødeø, Rødefjord, 13—18 m, soft clay with gravel, about 50 adult, half-grown, and young animals — 30—35 m, soft clay, large stones, about 100 adult and half-grown animals; Turner Sund, about 5.5 m, 1 adult animal, 1 young valve; Off Henry Land, about 38 m, stones, 1 adult valve; Kap Dalton, 17—21 m, fine clay with pebbles, 1 fragment of a young valve.

Kangerdlugssuaq Area: Ravns Fjord, about 50 m, mud, 1 half-grown animal; Mikis Fjord, 7—8 m, sandy clay, 1 adult animal — 17—20 m, sandy clay, 1 adult animal; Uttentals Sund, 4—5 m, 1 young animal — 9—41 m, about 50 adult, half-grown, and young animals (7 finds); Kangerdlugssuaq, 10 m, sandy ooze, 1 adult animal — 10—20 m, 3 adult animals — 50—100 m, stones, 22 adult and half-grown animals (2 finds).

Sydøstkyst Area: Ødesund, 66°15′ N. 35°25′ W., 9.5—28 m, stony bottom with algae, 2 adult animals; Off Angmagssalik, 65°40′ N. 35°32′W., 47—75 m, clay, "15 specimens" (Posselt); Angmagssalik, off the harbour, 45 m, 2 adult animals; Tasîssaq near Angmagssalik, 50—94 m, 10 adult and 1 young animals (2 finds); Sermilik, 2nd eastern fjord, 50 m, 1 adult animal; Nanûseq N. of Lindenows Fjord, 50—60 m, gravel, clay, 4 adult animals; Lindenows Fjord, inner part, 25—30 m, gravel, clay, 7 adult and 1 half-grown animals — 40—50 m, clay, 1 half-grown animal; Lindenows Fjord, innermost part, 15—30 m, clay, gravel, 2 adult animals.

Jan Mayen Area: Jan Mayen, depth?, and Jan Mayen, 100 m (Friele); N. of Jan Mayen, 15—25 m, and 130—180 m, stones and pebbles with algae, "numerous specimens" (Becher); Jan Mayen, 20—60 m, 1 adult and 2 half-grown animals; Jan Mayen, 140 m, 20 adult and half-grown animals; Jan Mayen, 95—113 m, mud, about 180 adult, half-grown, and young animals; 70°54′ N. 8°24′ W., 128 m, dark-grey, sabulous clay, 1 half-grown animal, 10 adult valves; 70°51′ N. 8°20′ W., 174 m, dark-grey, sabulous clay, about 40 adult and half-grown animals, 5 adult valves; N.W. coast of Jan Mayen, 1 mile N. of Tour de Briele, 150 m, stones, volcanic gravel, mud, 100 specimens, mostly alive (Remy); 71°04′ N. 7°56′ W., 70 m, 1 animal (Lamy); 70°59′ N. 8°40′ W., depth?, 2 animals (Lamy); 70°58′30″ N. 8°42′ W., 40 m, 5 animals (Lamy); 70°58′30″ N. 8°07′ W., 160 m, 55 animals (Lamy); 70°52′N. 10°33′ W., 180 m, grey volcanic mud, 55 animals (Lamy); 70°50′ N. 8°35′ W., 120 m, 3 animals (Lamy); 70°50′ N. 8°29′ W., 162 m, more than 50 adult, half-grown, and young animals; 70°47′ N. 8°22′ W., 140 m, 130 animals (Lamy); 70°39′30″ N. 8°37′ W., 140 m, 75 animals (Lamy). [70°05′ N. 8°26′W., 698 m, 1 valve (Jensen).]

The species is thus very common both at E. Greenland and around Jan Mayen. Although it has not hitherto been recorded from N. of Danmarks Havn, it most probably occurs as far north as the northernmost coasts of Greenland. The vertical range for live animals is, at E. Greenland, from 4—5 m (Uttentals Sund) to 400 m (between Kap Weber and Ymers Ø). Generally, however, it was met with in the largest numbers at depths between 20 and 60—70 metres on clay bottom containing stones, gravel, or shells, while on sandy bottom usually only young or half-grown animals were found. The species is especially abundant at the depths of the deeper *Ophiocten* zone of the Arctic *Macoma* community (Thorson 1933). Thus, 310 individuals were taken in a single dredge-haul at Ella Ø at depths of 34—38 m, and at 33 m, in the same place a maximum weight af 20.8 gr. per m^2 was found.

Remarks: The species probably reaches its maximum size at E. Greenland. However, as almost all of the larger specimens at hand had damaged shell margins, only a few of them could be measured exactly. Thus, the largest specimen present was at least 32.5 mm in length. The measurements of some others are (length × height of shell): 29.5 × 27.5 — 29.0 × 28.5 — 29.0 × 26.5 — 28.7 × 27.8 — 28.6 × 26.2, and 28.5 × 27.3 mm, respectively. Several adult animals were found with a bundle of a few

exceedingly fine byssus threads, and possibly the species, when undisturbed, normally lives attached to objects on the sea bottom. — Some of the specimens had *Spirorbis*-tubes, crusts of bryozoans, and Foraminifera attached to their shells.

Apart from its distribution in arctic seas, the present species is reported to occur in a smaller form in the N. Atlantic, as far south as N.W. Africa, and LOCARD (1898) and JENSEN (1912) named this var. *minor*. An examination of the material collected by the Danish "Ingolf" and "Thor" expeditions showed, however, that this Atlantic form must be regarded as a distinct species which, though very closely resembling *P. groenlandicum* in the appearance of its shell, differs in its anatomy. Consequently the distribution of *P. groenlandicum* must be revised, and some corrections of earlier records of the latter are given below.—The Atlantic form ("var. *minor*" of LOCARD, and JENSEN) is provisionally listed as *Propeamussium* sp.b in the present paper; however, a detailed treatise on this subject is in progress.

Distribution: Jones Sound, Grinnell Land, Baffinland, N.W. Greenland, E. Greenland, Jan Mayen, Spitzbergen, Franz Joseph Land, Novaya Zemlya, the Kara Sea, the Siberian Ice Sea to 167°30′ E. (SOOT-RYEN), the Barents Sea, the Murman Coast, the Finmark, N. and E. Iceland (the records from S. Iceland in J. MADSEN (1949) should be referred to *Propeamussium* sp.b, to which also the following records in JENSEN (1912) belong: Stations 18, 40, 69, 81, and 85, and from 63°05′ N. 20°07′ W., and 62°57′ N. 19°58′ W.), N.W. of the Faroes (only the record from 63°15′ N. 9°35′ W., in JENSEN (1912) is correct, the remaining ones are *Propeamussium* sp.b.), and probably also the Gulf of St. Lawrence, and off Newfoundland. Main distribution: Panarctic (circumpolar?). Vertical range: From 4—5 m (E. Greenland) to 850 m (N.W. Greenland), or 2000 m (between E. Greenland and Jan Mayen, according to HÄGG).

Biology: Reproduction partly known from N.E. Greenland (THORSON 1936). There the species does not spawn till late in the autumn. The egg-size (yolk mass only) is about 140 μ in diameter, and accordingly the pelagic stage of the larva must be assumed to be very short or almost absent. Further, there is evidence of the species being a hermaphrodite, as "a small number of hermaphrodites were regularly found in each series of *Pecten groenlandicus* examined" (THORSON, l. c. p. 63).

24. *Lima* (*Limatula*) *hyperborea* (JENSEN) (cf. pl. 2, fig. 3).

Limatula hyperborea JENSEN 1905, p. 329, figs. 1a—d.
Lima hyperborea JENSEN 1912, pl. 2, figs. 5a—e.

East Greenland and Jan Mayen records:
Limatula hyperborea JENSEN 1905, pp. 329—330.
Lima hyperborea JENSEN 1912, p. 41.

Occurrence at East Greenland (cf. the map fig. 26, p. 186):

Kejser Franz Josephs Fjord Area: Forsblads Fjord, about 95 m, clay with stones, 1 adult animal — 95—170 m, clay with stones, 12 adult animals (including the type specimen), 14 adult and half-grown valves; Fleming Fjord, 222 m, clay, 2 adult animals; 1 km. from Murray Ø, 71°33′ N. 21°30′ W., 200 m, mud, a little sand, 1 adult animal.

Scoresby Sund Area: Nordbugten, Nordvestfjord, 111 m, soft clay, 1 adult valve, broken.

Jan Mayen Area: S. of Jan Mayen, 70°05′ N. 8°26′ W., 698 m, 1 adult animal, fragments of 2 adult valves.

Thus, the species seems to be rare at East Greenland, occurring there in fairly deep water, only.

Remarks: All of the specimens from E. Greenland and Jan Mayen agree with the description of the species. The largest animals at hand measure (length × height × breadth of shell): 9.5 × 15.0 × 9.0 (type specimen) — 9.2 × 15.3 × 8.9 — 8.9 × 15.5 × 9.3 — 9.1 × 14.6 × 8.3 — 8.7 × 14.5 × 8.7 and 6.1 × 10.0 × 5.5 mm, respectively. Foraminifera and *Spirorbis*-tubes were attached to some of the valves.

Distribution: N.W. Greenland, N.E. Greenland, Jan Mayen, Spitzbergen, the Kara Sea, the Barents Sea, and N. of the Faroes. Since *L. hyperborea* was described as late as 1912, possibly some other records from arctic seas have reference to it (cf. JENSEN 1912, p. 41). Main distribution: High-arctic, and in the depths of the Norwegian Sea. Vertical range: From 75—95 m (the Kara Sea) to 1320 m (N. of the Faroes).

Biology: Reproduction unknown.

25. *Lima* (*Limatula*) *subauriculata* (MONTAGU).

Lima subauriculata JEFFREYS 1869 V, pl. 25, fig. 3.
Lima subauriculata JENSEN 1912, pl. 2, figs. 6a—c.

Occurrence at East Greenland (cf. the map fig. 22, p. 183):

Sydøstkyst Area: Qeqertatsiaq, 60—70 m, sand, gravel, dead bryozoans, 1 adult animal — 75—90 m, gravel, stones, 1 adult animal.

The species here recorded from E. Greenland for the first time seems to be restricted to the southernmost coast of E. Greenland, where it is in connection with its area of distribution at S.W. Greenland. In former times, however, the species must have lived along more northerly coasts of E. Greenland as well; this is evidenced by the finding of a shell in Pleistocene deposits as far north as Peary Land (DAN LAURSEN 1954).

Remarks: In appearance the specimens at hand are typical of the species. Their measurements are (length × height × breadth of shell): 3.7 × 6.3 × 3.3 and 3.0 × 4.7 × 2.4 mm, respectively. Thus, they are below the maximum size of the species, which is about 11 mm in height (specimens from W. Greenland).

Distribution: W. Greenland northward to 72°47′ N. lat., S.E. Greenland, Iceland, the Murman Coast, the Faroes, along the European coasts from W. Finmark to the Canary Islands, the Mediterranean, along the American east coast from Labrador to the Strait of Florida, and along the American west coast from the Bering Sea to Lower California. Main distribution: Wide, i. e. subarctic-boreal, Mediterranean-Atlantic. Vertical range: From about 7 m (the Faroes) to ?3300 m (according to JEFFREYS 1879). However, JENSEN (1912, pp. 43—44) states the greatest depth at Norway, the Faroes, Iceland, and Greenland at which the species has been found to live, to be about 300 m. He suggests, therefore, that the records of the species from great depths should in reality be referred to *Lima similis* JENSEN, which resembles *L. subauriculata* very much.

Biology: Reproduction unknown.

The genus *Astarte* SOWERBY.

It is well known that the northern species of *Astarte* are often very puzzling, and certainly several species have been described the validity of which is doubtful. During my study of the Greenland specimens, I observed that the finer structure of the periostracum was very characteristic in some species (cf. pl. 1, figs. 1—8); and these differences were also useful for an identification of the small specimens. It therefore appears that a general study of the periostracum of the northern forms of *Astarte* would be a valuable contribution to a systematic clarification of this difficult genus.

26. *Astarte borealis* (CHEMNITZ).

Tridonta borealis G. O. SARS 1878, pl. 5, figs. 8a—b.
Astarte semisulcata var. *placenta* LECHE 1878, pl. 1, figs. 4a—c.
Astarte borealis JENSEN 1912, pl. 4, figs. 1a—f.

East Greenland and Jan Mayen records:

Astarte borealis MÖBIUS 1874, p. 251.
Astarte borealis FRIELE 1878, p. 223.
Astarte (*Tridonta*) *borealis* and *Astarte producta* BECHER 1886, p. 69 and 70.
Astarte borealis POSSELT 1895, p. 71.
Astarte borealis POSSELT & JENSEN 1898, pp. 62—63.
Astarte borealis FRIELE & GRIEG 1901, p. 24.

Astarte borealis HÄGG 1904, pp. 33—34.
Astarte borealis JENSEN 1905, pp. 335—336.
Astarte borealis JENSEN 1912, pp. 92—93.
Astarte (*Tridonta*) *semisulcata* LAMY 1913b, p. 599.
Astarte borealis ODHNER 1915, p. 91.
Astarte (*Tridonta*) *borealis* LAMY 1926, pp. 179—180.
Astarte borealis THORSON 1934a, p. 6.
Astarte borealis THORSON 1936, pp. 51—53; on reproduction.

Occurrence at East Greenland (cf. the map fig. 15, p. 176):

Nordøstkyst Area: Jørgen Brønlund Fjord, ca. 10—13 m, 4 adult, 5 half-grown, and 1 young animals, 1 adult shell (2 finds) — 21—46 m, clay, 6 adult and 1 half-grown animals, 1 adult shell (3 finds); Danmarks Havn, 76°47′ N. 18°45′ W., on the shore, about 30 shells (probably subfossil) — 0—9.5 m, soft bottom, *Laminaria*, 2 adult animals, 1 adult shell (2 finds) — 6—15 m, soft bottom, stones, *Laminaria*, 2 adult animals, 1 adult shell (2 finds); "Skibshavnen" at Danmarks Havn, 0—19 m, mud mixed with sand, algae, 3 adult shells; Stormbugt at Danmarks Havn, 19—38 m, stones, shells, *Delesseria*, 1 adult valve, broken; Hvalrodsodden at Danmarks Havn, 0—4 m, soft bottom, 1 adult animal; Off the Eskimo house ruin, Danmarks Havn, 0—ca. 4 m, mud, sand, dead shells, algae, 3 adult and 1 half-grown animals, about 20 adult shells; S. of Lille Pendulum, 74°35′ N. 18°35′ W., 18—21 m, sandy mud, algae, 19 adult and half-grown animals; Shannon, and Sabine Ø, 7.5—19 m (MÖBIUS); Sabine Ø, 74°30′ N. 19°45′ W., 5.5—9.5 m, 2 young animals, 1 half-grown shell (drilled by *Natica*).

Kejser Franz Josephs Fjord Area: Kap Borlase Warren, 19 m, *Laminaria*, 3 adult animals, 1 half-grown shell (drilled by *Natica*); Sandø in Tyrolerfjord, depth?, 27 adult valves; S.E. of Clavering Ø, 74°10′ N. 20°08′ W., 25—40 m, mud, many shells, gravel, 3 adult animals; Clavering Ø, and Jackson Ø, 7.5—19 m, (MÖBIUS); Zackenberg Bugt, Wollaston Forland, on the shore, 1 adult shell (subfossil?); Eskimonæs, Clavering Ø, 4—6 m, coarse gravel, brown and green algae, 18 adult, half-grown, and young animals — 10—14 m, dark, sandy clay, 3 half-grown animals; Kap Stosch, on the shore, 1 adult shell; Loch Fyne, on the shore, 2 adult valves; Knudshoved (Karlshavn), 8—10 m, muddy bottom, 2 adult animals; Mackenzie Bugt, 12—18 m, mud, 2 adult and 9 young animals (var. *sericea*, HÄGG); Kap Bennet, 73°26′ N. 21°13′ W., 9—11 m, sandy mud, algae, 1 adult animal; Moskusoksefjord, 15 m, 1 adult animal; Mouth of Duséns Fjord, off Kap Graah, 15—40 m, clay, stones, *Desmarestia*, 32 adult animals (3 finds); Duséns Fjord, at the anchoring place, 10 m, loose clay, *Desmarestia*, 5 adult and 4 half-grown animals — 20—26 m, clay, 18 adult animals (2 finds); Duséns Fjord, inner part, 4—10 m, soft clay, *Desmarestia*, about 500 adult, half-grown, and young animals — 15—20 m, *Laminaria*, *Fucus*, 1 half-grown animal; Head of Duséns Fjord, 5—19 m, clay, *Desmarestia*, *Laminaria*, about 30 adult and half-grown animals (4 finds); Inner part of Kejser Franz Josephs Fjord, off Ättestupan, 73°06′ N. 27°17′ W., 3—9 m, mud, sand, algae, 5 adult, 1 half-grown, and 1 young animals; Karl Jakobsens Bugt, Ymers Ø, at all depths from 2 to 16 m, clay, 9 adult, 11 half-grown, and 11 young animals (10 finds); Eastern mouth of Vega Sund, 72°45′ N. 22°56′ W., 1—3 m, sand, brown algae, 1 half-grown animal; Solitærbugt, Ella Ø, at all depths from 2 to 24 m, clay, brown algae, *Desmarestia*, about 700 adult, half-grown, and young animals (at least 11

finds) — 20—52 m, 21 adult and half-grown animals (at least 3 finds); Solitærbugt, off Kap Oswald, 3—15 m, *Fucus*, *Desmarestia*, 6 adult, 6 half-grown, and 1 young animals (2 finds); Kap Hedlund, 7—10 m, 7 adult animals — 4—27 m, about 100 adult and half-grown animals (at least 2 finds) — 20—53 m, 2 adult and 1 half-grown animals: Åkerbloms Ø, Kong Oscars Fjord, 20 m, stony bottom, about 30 adult, half-grown, and young animals, 1 adult shell (drilled by *Natica*); Mouth of Forsblads Fjord, 5.5—26 m, 2 adult animals.

Scoresby Sund Area: Amdrups Havn, Scoresby Sund, 6—10 m, *Laminaria*, about 50 adult, half-grown, and young animals — 22—33 m, *Laminaria*, red algae, 2 half-grown animals (2 finds); Rosenvinges Bugt, Scoresby Sund, 8—12 m, stony bottom, algae, 13 adult and 1 half-grown animals (2 finds); Off Kap Hope, 7—20 m, sand, stones, *Laminaria* and other algae, about 800 animals of all sizes from 2 to 44.5 mm in length (17 finds); Off the mouth of Hurry Inlet, 20—30 m, sand, stones, *Laminaria*, red algae, about 50 adult, half-grown, and young animals (2 finds) — 57 m, sandy clay, 1 young animal; Mouth of Hurry Inlet, 19 m, clay, 2 adult animals, 2 adult shells — 28—38 m, sand, stones, algae, 1 adult, 1 half-grown, and 5 young animals (2 finds); 1—2 miles inside the mouth of Hurry Inlet, 6—16 m, sand, stones, algae, 15 adult animals, 3 adult shells (7 finds); E. side of Hurry Inlet, near the mouth, 25 m, sand, algae, 3 adult animals (2 finds); Hurry Inlet, at Constable Pynt, 7—10 m, sand, about 50 adult, half-grown, and young animals; Fame Øer, 70°50′ N. 22°33′ W., 5—9 m, mud, algae, 6 adult and 1 half-grown animals (2 finds); At Fame Øer, 4—12 m, very soft clay, about 30 adult and half-grown animals (2 finds) — 15—27 m, soft or tough clay, algae, 52 adult and half-grown animals (8 finds); Off Kap Stewart, 70°27′ N. 22°35′ W., 13—18 m, mud, stones, algae, 1 half-grown animal; Off Kap Hooker, 62 m, 1 young animal; 8 miles W. of Kap Hooker, 13—14 m, clayey sand, 1 half-grown and 3 young animals (3 finds); W. coast of Jameson Land opposite Kap Leslie, 21—23 m, sandy, glittering clay, 11 adult animals (5 finds); Jameson Land, at the shore, 1 adult shell; Off Bjørneøer, 6—13 m, 4 adult and 6 half-grown animals — 18—28 m, 5 adult and 3 half-grown animals; Hekla Havn at Danmarks Ø, depth?, mud, 8 adult and 1 half-grown animals, 3 adult shells, 1 adult valve; S.E. of Danmarks Ø, 27—30 m, soft clay, gravel, 12 adult and half-grown animals; The bay opposite Rødeø, Rødefjord, 4—10 m, clay, *Fucus*, about 40 adult, half-grown, and young animals (2 finds); N. of Stewart Ø, 69°55′ N. 22°45′ W., 290 m, clay with stones, 1 adult valve; Turner Sund, ca. 5 m, 7 adult animals; Kap Dalton, 17—21 m, clay, 3 young animals.

Kangerdlugssuaq Area: Kangerdlugssuaq, 17—20 m, 1 adult animal; — ca. 50 m, gravel, 1 adult valve (THORSON).

Sydøstkyst Area: Kûngmiut, depth?, 1 adult animal; The fjord inside Kûngmiut, 5 m, 1 adult animal — 20 m, 2 adult animals; Tasîssârssik near Angmagssalik, 20—30 m, 1 adult shell; Tasîssaq near Angmagssalik, 1—9.5 m, stony bottom, some algae, 8 adult and 7 half-grown animals, 1 adult and 1 half-grown shell (3 finds) — 10—19 m, muddy bottom, 2 adult animals (2 finds) — 38—56 m, stony bottom, few algae, 4 adult valves; Tiniteqilâq, 65°56′ N. 37°40′ W., 9.5—19 m, 1 adult shell; Off Angmagssalik, 47—75 m, clay, small stones, 9 specimens (JENSEN); Angmagssalik, depth?, 1 adult animal — ca. 25 m, 2 adult animals; Angmagssalik, off the harbour, 45 m, 1 adult animal; Sujunikajik, about 65°30′ N. 38°50′ W., on the anchor, 1 half-grown animal; Nanûseq N. of Lindenows Fjord, 22 m, mud, decaying

algae, 1 half-grown animal — 30—40 m, clay, sand, gravel, 3 adult, 1 half-grown, and 3 young animals (2 finds); Lindenows Fjord, outer part, 7—20 m, greyish clay, about 65 animals, mostly adults (10 finds) — 25—84 m, clay, gravel, sand, 17 adult, 12 half-grown, and 4 young animals (7 finds) — 90—100 m, clay, 10 adult and half-grown animals, 1 half-grown shell (2 finds); Lindenows Fjord, middle part, 25—55 m, clay, sand, gravel, *Laminaria*, 27 adult, half-grown, and young animals, 4 adult valves (6 finds) — 45—65 m, sand, 2 adult and 1 half-grown animals (2 finds); Lindenows Fjord, inner part, 25—50 m, sand, clay, gravel, 5 adult and 1 young animals (3 finds) — 55—91 m, clay, 6 adult, 2 half-grown and 1 young animals (3 finds); Qeqertatsiaq, 50—70 m, sand, dead bryozoans, 2 adult, 1 half-grown, and 3 young animals (3 finds).

Jan Mayen Area: N. of Jan Mayen, 140—180 m, 4 specimens (Becher); 70°59′ N. 8°40′ W., depth?, 2 animals, "var. *semisulcata* Leach" (Lamy); "Drifvedsbugten", 70°55′ N. 8°30′ W., 14—21 m, dark sand, 30 adult, 6 half-grown, and 4 young animals; "Mary-Muss-bugten", 23 m, dark sand, 3 adult and 1 half-grown animals; "Hvalross-bugten", 16—ca. 36 m, dark sand, 2 adult, 2 half-grown, and 1 young animals (2 finds); Jan Mayen, 19—28 m, (Friele, Friele & Grieg); Jan Mayen, at 28 and 95 m, (Jensen); 2 miles S.E. of Jameson Bay, depth?, 3 animals (Lamy); S. of Jan Mayen, 200 m, 1 specimen (as *A. producta* Sowerby, Becher); 70°40′30″ N. 8°36′ W., 75 m, 4 animals, 1 valve (as *A.* (*Tridonta*) *semisulcata* Leach, Lamy); 70°40′ N. 8°40′ W., 40 m, 40 animals, 60 valves (as *A.* (*Tridonta*) *semisulcata*, Lamy). [Between Greenland and Jan Mayen, 72°42′ N. 14°49′ W., 2000 m, ooze with Foraminifera, 1 shell (Hägg); further, the Ingolf Expedition found valves at depths of about 700, 1890, and 2090 m, respectively, S. of Jan Mayen (Jensen). These valves, however, are hardly recent and provide absolutely no proof that the species is able to persist at such great depths].

Thus, the species is very common both at E. Greenland, where it occurs in suitable places along the whole stretch from Jørgen Brønlund Fjord in the North to Qeqertatsiaq in the South, and at Jan Mayen. However, it seems to be almost absent from the innermost parts of the Kejser Franz Josephs Fjord and Scoresby Sund complexes. The minimum depth from which living specimens are known from E. Greenland is a few metres below the shore line (Danmarks Havn, Karl Jakobsens Bugt, E. mouth of Vega Sund, Solitærbugt) and the maximum depth for living specimens is 100 m (Lindenows Fjord). At Jan Mayen the species has been found to live from 16—18 m down to 200 m. However, the species is a typical coastal form, which at E. Greenland appears to be most abundant at depths of less than 30 m. Both the upper limit of the vertical range of the species and the scarcity or absence from the innermost fjords are presumably due to the action of the ice-foot and of an upper layer of almost entirely fresh water during the spring. This layer generally reaches its greatest thickness in the innermost fjords and, though only persisting for a short period, will be fatal to most of the animals which come into touch with it (Thorson 1933). — The sub-

stratum where the species has been found to live varies greatly, viz. from stony bottom or gravel to tough clay and mud. Yet the species has most often been taken from a bottom consisting of soft clay, sandy clay, or sand. The species may constitute a considerable part of the infauna, especially within the *Gomphina fluctuosa* and the Arctic *Macoma* communities. Thus, the species has been found to occur in the *Astarte borealis-Pectinaria* zone of the latter in an average number of 90 individuals per m^2 with a weight of 35—40 gr. (Solitærbugt, Ella Ø, clay bottom, from 2 to about 12—14 m) (Thorson 1933). Further, at Jameson Land opposite Kap Leslie (21—23 m, sandy clay) where the Arctic *Macoma* community has been met with, *Astarte borealis* was represented in an average number of 11 specimens per m^2, weighing 71.4 gr., whereas the total weight of the bottom fauna averaged 150.3 gr. per m^2. The largest numbers, however, of the species were found within the *Gomphina fluctuosa* community (off Kap Hope, 9—20 m, sand), namely in average numbers of 49.5 adults and 397 juveniles per m^2 with a weight of 165 and 110 gr., respectively. The corresponding figure for the total fauna in that place was 372.64 gr. per m^2 (Thorson 1934b).

Remarks: *Astarte borealis* is a highly variable species as regards the proportions and sculpture of the shell and the appearance of the periostracum. This variation has resulted in the description of some varieties as e. g. var. *placenta* Mørch, var. *withami* (Wood) Leche, and var. *sericea* Posselt. Although the greater number of the specimens from E. Greenland and Jan Mayen may probably be referred to forma *placenta*, which is comparatively compressed and elongated, other specimens resembling forma *sericea* or forma *withami* are at hand in addition to a number of intermediates. In all these forms the structure of the periostracum is essentially the same, being fibrous and more or less frayed (cf. pl. 1, fig. 1), though macroscopically it may look rather different, with or without a silky lustre and of different thickness, while the colour may vary from a light brownish-yellow in juveniles to a dark brown or almost black in larger adults. Independently of this variation, the concentric folds on the dorsal part of the shell are more or less distinct, and the proportions of the shell vary from one individual to the other. On the whole, considering the intraspecific variation within the large material at hand, there seems to be no regular tendency. Therefore, until more is known about this, it seems most convenient not to ascribe subspecific rank to any of the forms mentioned above.

The variation in shape is demonstrated by the following measures (in mm) and ratios of some of the largest specimens from East Greenland:

L	H	B	H/L	B/L	L	H	B	H/L	B/L
47.6	37.4	18.0	0.79	0.38	41.1	33.1	13.6	0.81	0.33
45.7	37.2	17.8	0.81	0.39	41.0	33.3	13.8	0.81	0.34
44.8	34.0	16.2	0.76	0.36	40.9	29.3	14.2	0.72	0.35
44.7	34.1	14.5	0.76	0.32	40.8	32.3	16.2	0.79	0.40
44.6	34.6	15.4	0.78	0.35	40.7	34.4	17.4	0.85	0.43
44.5	36.4	16.5	0.82	0.37	40.4	30.6	13.9	0.76	0.34
44.2	34.6	17.4	0.76	0.39	40.3	30.3	14.2	0.75	0.35
43.7	33.8	15.5	0.77	0.35	38.6	30.4	13.9	0.79	0.36
43.5	33.6	17.1	0.77	0.39	38.0	31.5	16.2	0.83	0.43
42.4	31.8	15.0	0.75	0.35	34.5	27.5	11.2	0.80	0.32
41.5	31.6	15.5	0.76	0.37	32.5	26.9	12.7	0.83	0.39

In some of the larger specimens the umbonal region of the shell was rather eroded, and a few had hapteres of algae or polychaete-tubes attached to their shells.

Distribution: W. Greenland, E. Greenland, Jan Mayen, Spitzbergen, Franz Joseph Land, Novaya Zemlya, the White Sea, the Murman Coast, the Finmark, the Barents Sea, the Kara Sea, the Siberian Ice Sea, the Bering Sea and the Bering Strait, Alaska, the sea N. of America, Grinnell Land, Baffinland, Parry Islands, the Hudson Strait, Labrador, Newfoundland, and Nova Scotia. In the Pacific the species extends southward to the Sea of Okhotsk, Japan, the Aleutians, and Forrester Island, and in the Atlantic, Massachusetts Bay, Iceland, and off Norway southward to Bergen and in the northern part of the North Sea. Further, it lives in the Kattegat, the Danish Belts, the Sound, and the Baltic to E. of Bornholm. Main distribution: Panarctic and circumpolar, with boreal outposts. Vertical range: From about 0 m (E. Finmark) or 1 m (Iceland) to 463 m (N. of Spitzbergen). Dead shells have been found in the northern Atlantic down to 2710 m.

Biology: Reproduction partly known from N.E. Greenland (Thorson 1936). There the species does not spawn till very late in the autumn at a time when no larvae were observed in the plankton. The eggs are adhesive by means of a mucous membrane and measure 150—200 μ in diameter. On account of the egg-size the larval development must be assumed to be lecithotrophic with a very short or entirely lacking pelagic stage. There is some indication of the species being a hermaphrodite.

27. *Astarte montagui* (DILLWYN).

Astarte compressa JEFFREYS 1869 V, pl. 37, fig. 3.
Astarte Montagui JENSEN 1912, pl. 4, figs. 2a—c.

East Greenland and Jan Mayen records:

Astarte compressa MÖBIUS 1874, p. 251.
Astarte striata var. *globosa* FRIELE 1878, p. 222.
Astarte (*Nicania*) *Banksii* BECHER 1886, p. 70.
Astarte Banksii POSSELT 1895, p. 73.
Astarte Banksii POSSELT & JENSEN 1898, forma *typica*, *Nicania Banksii* p. 69, var. *Warhami* p. 71.
Astarte banksii forma globosa FRIELE & GRIEG 1901, p. 26.
Astarte banksii HÄGG 1904, p. 39.
Astarte Banksii JENSEN 1905, pp. 333—335.
Astarte Montagui JENSEN 1912, pp. 99—100.
Astarte montagui ODHNER 1915, p. 100.
Astarte Banksi var. *Warhami* LAMY 1926, p. 180.
Astarte Warhami REMY 1928, p. 223.
Astarte banksi THORSON 1934a, p. 6.
Astarte banksi THORSON 1936, pp. 50—53, 55—57, and 63; on reproduction.

Occurrence at East Greenland (cf. the map fig. 16, p. 177:

(If nothing else is stated, the specimens are referable to forma *warhami*).

Nordøstkyst Area: Jørgen Brønlund Fjord, ca. 10—13 m, clay, 2 adult and 2 young animals (2 finds) — 21—46 m, 5 adult animals; Jørgen Brønlund Fjord, off the station, 11 m, greyish clay, 2 adult animals; Tenting place at Kap Bismårck, 1 adult valve (subfossil?); Danmarks Havn, on the shore, 3 adult valves — 0—11 m, soft bottom, *Laminaria*, about 70 adult, half-grown, and young animals, 4 adult shells, 1 adult valve (5 finds) — 9.5—28 m, hard or soft bottom, *Delesseria*, *Laminaria*, 14 adult and half-grown animals, 1 adult valve (4 finds); The sound between Kap Bismarck and "Maatten", 19—38 m, hard bottom, *Delesseria*, *Laminaria*, 1 half-grown animals; Øresund at Danmarks Havn, 28—38 m, 1 fragment; Off the eskimo house ruins, Danmarks Havn, 0—7.5 m, sandy mud, shells, algae, 2 half-grown animals, 25 adult shells; Hvalrosodden at Danmarks Havn, on the shore, 1 adult valve — 0—4 m, soft bottom, *Laminaria*, 4 adult animals, 1 adult shell; S. of Lille Pendulum, 74°35′ N. 18°23′W., 18—21 m, sandy mud, algae, about 40 adult and half-grown animals; Sabine Ø, 74°30′ N. 19°45′ W., 5.5—9.5 m, 1 adult animal, 4 adult shells.

Kejser Franz Josephs Fjord Area: Kap Borlase Warren, 74°20′ N. 19° W., 19 m, *Laminaria*, 5 adult and 1 half-grown animals, 2 adult shells (drilled by *Natica*); Zackenberg Bugt, Wollaston Forland, on the shore, 9 adult shells; S.E. of Clavering Ø, 74°10′ N. 20°08′W., 25—40 m, mud, shells, pebbles, 7 adult and 3 young animals; Eskimonæs, Clavering Ø, 4—6 m, coarse gravel, brown and green algae, 20 adult and half-grown animals — 10—22 m, clay, gravel, sand, algae, 4 adult animals (2 finds) — 28—55 m, gravel, sand, a few algae, 20 adult, half-grown, and young animals (5 finds); Jackson Ø, depth?, (as *Astarte compressa* MONTAGU, MÖBIUS); Knudshoved (Karlshavn), 8—10 m, muddy bottom, 3 adult animals, 3 adult shells; Moskusoksefjord, 15 m, 4 adult and 2 young animals, 2 adult valves; Vinterøer at the mouth of Duséns Fjord, 15—30 m, stones, algae, 4 adult and 1 half-grown animals; The mouth

of Duséns Fjord off Kap Graah, 16—20 m, clay, *Desmarestia*, 1 adult animal; Duséns Fjord at the anchoring place, 10—25 m, loose clay, *Desmarestia*, 47 adult, half-grown, and young animals (2 finds; a few specimens approach f. *striata*) — 27—51 m, tough clay, 3 half-grown animals (2 finds); Duséns Fjord, inner part, 4—10 m, soft clay, 9 adult and half-grown animals; Head of Duséns Fjord, 5—19 m, clay, *Desmarestia*, 13 adult and half-grown animals (4 finds); Eleonore Bugt, 3.5—12 m, clay, *Fucus*, *Laminaria*, *Desmarestia*, 2 adult and 2 half-grown animals — 15—27 m, clay, *Laminaria*, *Desmarestia*, 17 adult animals; Isfjord, off Haredalen, 2.5—5 m, *Fucus*, *Laminaria*, green algae, 4 adult and 2 half-grown animals — 9—15 m, loose, greyish-brown clay, 14 adult and half-grown animals; Off Engdalen, inner part of Kejser Franz Josephs Fjord, 27—45 m, loose, brown clay, *Laminaria*, 16 adult and half-grown animals (3 finds); Inner part of Kejser Franz Josephs Fjord, 73°06′ N. 27°17′ W., 3—9 m, mud, sand, algae, 2 adult, 2 half-grown, and 3 young animals; Karl Jakobsens Bugt, Ymers Ø, 3—8 m, clay, 2 half-grown and 4 young animals (4 finds) — 16—25 m, clay, 3 adult animals (3 finds); E. mouth of Vega Sund, 72°45′ N. 22°56′ W., 1—3 m, sand, brown algae, 1 young animal; Solitærbugt, Ella Ø, at all depths from 2 to 25 m, *Desmarestia*, brown algae, about 300 adult, half-grown, and young animals (at least 7 finds) — 20—74 m, clay, shells, stones, algae, about 150 animals, mainly adult or half-grown (9 finds); 55—95 m, 1 adult animal — 20—52 m, 4 adult animals (f. *striata*); Kap Hedlund, 4—27 m, clay, stones, shells, about 165 adult and half-grown animals (at least 5 finds) — 20—53 m, 27 adult animals (at least 2 finds); Åkerbloms Ø in Kong Oscars Fjord, 20 m, stony bottom, 13 adult, half-grown, and young animals.

Scoresby Sund Area: Amdrups Havn, Scoresby Sund, 6—10 m, *Laminaria* and other brown algae, 14 adult and 2 half-grown animals (a few approaching f. *striata*) — 22—33 m, *Laminaria*, red algae, 36 adult, half-grown, and young animals (2 finds; a few approaching f. *striata*); Rosenvinges Bugt, 8—12 m, stones, algae, 4 adult animals (2 finds) — depth?, 1 valve (Lamy) — 28—30 m, rocks, 5 adult animals (Remy) — 70 m, tough, bluish clay on rocks, 6 adult animals (Remy); Scoresbysund, at the station, 7—11 m, *Laminaria*, *Fucus*, 4 adult, 1 half-grown, and 1 young animal; Off Kap Hope, 9—20 m, sand, *Laminaria*, about 500 adult, half-grown, and young animals (13 finds; most of the specimens belong to f. *warhami*. A few, however, are referable to f. *striata*, and some are intermediate); Off the mouth of Hurry Inlet, 20—30 m, stones, *Laminaria*, red algae, about 140 adult, half-grown, and young animals (2 finds; f. *striata*, f. *warhami*, and intermediates) — 38—55 m, clayey sand, stones, 20 adult, half-grown, and young animals (3 finds; f. *warhami*, f. *striata*, and intermediates); In the mouth of Hurry Inlet, 14—21 m, sand, clay, detritus, 8 adult and 8 young animals (4 finds) — 28—57 m, sand, stones, clay, algae, 26 adult, half-grown, and young animals, 1 adult shell (4 finds; mainly f. *warhami*, a few f. *striata*, and intermediates) — 140 m, clay, 1 young animal; "Hurry Fjord", 0—13 m, clay and sand, 1 adult animal; E. side of Hurry Inlet near the mouth, 25 m, sand, algae, 1 adult animal; Hurry Inlet, at Constable Pynt, 7—10 m, sand, about 100 adult, half-grown, and young animals — 18—22 m, very soft clay, 1 adult animal; Off Constable Pynt, 21—33 m, clay, 19 adult and 2 half-grown animals (7 finds) — 44—46 m, tough clay, 15 adult animals (5 finds); Hurry Inlet, near Fame Øer, 6—7 m, clay, 11 adult and half-grown animals — 4—12 m, gravel, stones, *Laminaria*, 16 adult, half-grown, and young animals (2 finds) — 12—25 m, soft or tough

clay, algae, about 270 adult, half-grown, and young animals (15 finds); Off Fame Øer, 25 m, soft clay, gravel, 60 animals, mainly adults; Fame Øer, 70°50′ N. 22°33′ W., 5—ca. 9 m, mud, algae, 2 adult and 2 half-grown animals (2 finds) — 23—25 m, clay, 3 adult animals; Kap Stewart, 70°27′ N. 22°35′W., 13—18 m, mud, stones, algae, 1 adult animal; Off Kap Hooker, 20 m, sand, about 50 adult, half-grown, and young animals (f. *warhami*, f. *striata*, and intermediates); 8 miles W. of Kap Hooker, 12—14 m, sand mixed with clay, algae, 4 adult, 6 half-grown, and 1 young animals (8 finds); W. coast of Jameson Land opposite Kap Leslie, 21—22 m, sandy, glittering clay, 6 adult and 1 half-grown animals (5 finds; 2 animals approach f. *striata*); Section between Kap Leslie and Jameson Land, 385 m, soft clay, 1 young animal; At Bjørneøer, 6—13 m, 18 adult and half-grown animals — 18—28 m, about 40 adult, half-grown, and young animals; N.E. of Danmarks Ø, 18—20 m, soft clay, 3 adult and 3 young animals (3 finds); S.E. of Danmarks Ø, 10—30 m, soft clay with gravel, 9 adult and 3 half-grown animals (2 finds); Hekla Havn at Danmarks Ø, depth?, 8 adult and 1 half-grown animals (4 of f. *warhami*, 5 of f. *striata*), 3 adult shells (2 of f. *warhami*, 1 approaching the typical form); The bay opposite Rødeø in Rødefjord, 4—10 m, clay, *Fucus*, about 30 adult, half-grown, and young animals (2 finds) — 13—18 m, soft clay with gravel, about 50 adult and half-grown animals — 30—39 m, sand, clay, stones, 5 adult and 2 young animals (4 finds); Turner Sund, ca. 6 m, 9 adult and 1 half-grown animals; Kap Dalton, 17—21 m, clay, 12 adult animals, 6 adult shells — 30 m, clay with stones, 1 adult animal, 2 adult valves; "East Greenland", depth?, 7 adult and 1 young animals, 3 adult shells (drilled by *Natica*).

Kangerdlugssuaq Area: Mikis Fjord, 3.5—8 m, 5 adult, 5 half-grown, and 1 young animals (2 finds); Kangerdlugssuaq, 5 m, 1 adult animal (dead) — 11—15 m, 1 adult animal (dead) — 25 m, 1 adult animal (ovaries filled with large eggs, 18-8-32); Uttentals Sund, 4—8 m, 13 adult and half-grown animals (4 finds) — 9—15 m, about 70 adult and half-grown animals, 3 adult shells (7 finds).

Sydøstkyst Area: Fjord inside Kûngmiut, 10—15 m, 4 adult and 2 half-grown animals — 20 m, 4 adult, 1 half-grown, and 2 young animals; Tiniteqilâq, 9—19 m, 2 adult shells; Sermilik, 2nd E. fjord, 5 m, sandy clay, stones, 2 adult and 2 young animals, 1 adult shell — 25 m, clay, 2 adult animals; Sermilik, settlement Ipîtâlaq, 5—7 m, about 25 adult and half-grown animals; Tasîssârssik near Angmagssalik, 20—30 m, 1 half-grown animal; Tasîssaq near Angmagssalik, 1—9 m, about 35 adult, half-grown, and young animals (3 finds) — 10—19 m, muddy bottom, about 50 adult, half-grown, and young animals (2 finds; a few animals are f. *striata*) — 25—38 m, rocky bottom, some few algae, 21 adult and half-grown animals (2 finds) — 38—56 m, stony bottom, some few algae, 3 adult and 3 half-grown animals, 1 adult shell, 20 adult valves (2 finds) — 56—94 m, 3 adult animals; Angmagssalik, 0—17 m, 3 adult animals — 20 m, sand, 1 adult animal (approaching f. *striata*); Angmagssalik, off the harbour, 45 m, 3 adult and 1 half-grown animal; Napassorssuaq, N. of Kap Tordenskjold, 38 m, muddy sand, 2 young animals (f. *striata*); Kap Tordenskjold, depth?, 2 adult animals — 4 m, unsavoury mud, *Laminaria*, 3 adult and 1 half-grown animals — 12 m, dark clay, remnants of algae, 2 adult animals; Nanûseq N. of Lindenows Fjord, 22 m, mud, decaying algae, 2 adult animals — 40—60 m, clay, gravel, sand, 13 adult and 3 half-grown animals (3 finds; some specimens approach f. *striata*); The

mouth of Lindenows Fjord, 11 m, clay, gravel, 1 adult and 3 young animals (f. *striata*) — 125—150 m, gravel, clay, 17 adult and half-grown animals (f. *striata*); Lindenows Fjord, outer part, 4—7 m, gravel, mud, clay, *Laminaria*, 7 adult, 2 half-grown, and 4 young animals, 10 adult shells (4 finds) — 10—25 m, clay, sand, gravel, *Laminaria*, 38 adult, half-grown, and young animals (4 finds; f. *warhami*, f. *striata*, and intermediates) — 30—58 m, gravel, clay, mud, sand, *Laminaria*, 30 adult, half-grown, and young animals, 1 adult shell (4 finds; f. *striata*, f. *warhami*, and intermediates) — 60—84 m, gravel, clay, sand, about 85 adult, half-grown, and young animals (2 finds; mainly f. *striata*) — 90—100 m, clay, 12 adult, half-grown, and young animals, 1 adult shell (2 finds; f. *striata*); Lindenows Fjord, middle part, 25—32 m, sand, gravel, clay, *Laminaria*, 3 adult, 1 half-grown, and 5 young animals, 2 adult valves (3 finds; f. *striata*, and f. *warhami*) — 50—80 m, fine sand, clay, 5 adult and 2 young animals (4 finds; f. *warhami*, f. *striata*, and intermediates) — 120 m, clayey sand, 2 young animals; Lindenows Fjord, inner part, 32—55 m, clay, 4 adult, 2 half-grown, and 2 young animals, 2 adult valves (3 finds; f. *warhami*, and f. *striata*); Qeqertatsiaq, 50—70 m, sand, gravel, dead bryozoans, about 1000 animals from 2 to 17.2 mm in length (7 finds; almost all of the specimens are of f. *striata*) — 75—90 m, sand, dead bryozoans, gravel, stones, 1 half-grown and 2 young animals (2 finds; f. *striata*) — 120 m, sand, dead bryozoans, 1 young animal (f. *striata*).

Jan Mayen Area: N.W. of Jan Mayen, 1 mile N. of Tourde Brielle, 150 m, stones, volcanic gravel, mud, 2 valves (Remy, as *A. Warhami*); Jan Mayen, 70°58′ N. 8°04′ W., 357 m, dark, sabulous clay, "1 specimen" (f. *globosa*) (Friele, Friele & Grieg); S. of Jan Mayen, 200 m, "1 specimen" (Becher). [S.E. of Jan Mayen, 69°31′ N. 7°06′ W., 2465 m, 5 valves (probably subfossil); Between Greenland and Jan Mayen, 72°42′ N. 14°49′ W., 2000 m, ooze with Foraminifera, 1 shell of subfossil appearance (f. *typica*) (Hägg)].

The species is thus very common along the E. Greenland coast from Jørgen Brønlund Fjord in the N. to Qeqertatsiaq in the S., with a vertical range for living specimens from a few metres below the shore (1—3 m, E. mouth of Vega Sund; 2 m, Solitærbugt, Ella Ø; 0—4 m, Hvalrosodden near Danmarks Havn) down to 385 m (Section between Kap Leslie and Jameson Land). However, only occasionally has it been met with at depths exceeding 100 m. Even though it has been found alive on various types of bottom, varying from rocks to mud, the species generally lives on sand, sandy clay, or clay, being a common member of all of the zones of the Arctic *Macoma* community, and the *Gomphina fluctuosa* community (Thorson 1933, 1934b). It may also occur in the upper region of the *Astarte crenata* community. The following examples may demonstrate the frequency of the species in some places of East Greenland (from Thorson 1934b). In Hurry Inlet, at Fame Øer (15—27 m, hard clay) the species was represented in an average number of 32 individuals per m^2 with a weight of 47.15 gr. The total weight of the bottom fauna at that place amounted to 202.6 gr. per m^2 on an average. Further, off Kap Hope (9—20 m, sand) it was found to occur in an

average number of 109 individuals per m^2, weighing 33.5 gr., whereas the total weight of the bottom fauna was 372.64 gr. per m^2. The great abundance of the species at Qeqertatsiaq is also remarkable. From here about 1000 individuals originating from 7 finds (50—70 m, sand, gravel, dead bryozoans) are present. — The species appears to be of rather scarce occurrence at Jan Mayen, since only a few animals and only from deeper water have been taken there.

Remarks: The species is exceedingly variable, especially as regards the proportions of the shell. However, almost all of the specimens from the area in question may be referred to two forms, viz. f. *warhami* Hancock, which is elongated, elliptical, rounded at both ends, and almost equilateral, and f. *striata* (Leach) Sars, which is less elongated and usually more tumid. These two forms, however, are gradually connected by intermediates. Further, between f. *striata* and the even more tumid and shorter typical *A. montagui* there is no distinct limit. Ad. Jensen (1912, p. 104) points out that the variation within the whole species follows a certain rule, the shape of the shell becoming more elongated and generally less tumid gradually as the marine climate grows more severe. This also holds good of the conditions at E. Greenland. Thus, f. *striata* is entirely lacking in the Nordøstkyst Area and almost entirely absent from the Kejser Franz Josephs Fjord Area. In the Scoresby Sund Area f. *warhami* is still by far the commonest form, whereas f. *striata* is dominant along the southernmost coast of E. Greenland. This variation in shape may probably be regarded as a cline, the extremes of which are the typical *A. montagui* or the even more tumid f. *globosa* Møller, and the f. *warhami*.

The largest specimen of f. *warhami* from E. Greenland measures $27.8 \times 20.6 \times 12.2$ mm, while the largest specimen referable to f. *striata* attains $24.0 \times 19.5 \times 10.1$ mm. The following table may elucidate the remarkable variation in shape found in E. Greenland specimens.

From Hekla Havn one specimen, measuring $14.0 \times 12.8 \times 7.8$ mm, is at hand which very much resembles the typical *A. montagui*. However, this specimen is an empty shell and may perhaps be fossil.—The concentric ribs on the shell of the specimens from E. Greenland are more or less pronounced; often these ribs are lacking on the ventral part, which is then provided with fine growth lines only (*A. fabula* Reeve). The colour of the periostracum is most often chestnut or reddish-brown, but it may also be straw-yellow or orange, a colour usually, but not always, found in juveniles, or dark brown in larger specimens. Macroscopically, the periostracum is almost smooth with some minor, irregular, concentric folds, and as a rule with a rather faint lustre. Under the microscope the periostracum shows irregular, radiating rows

f. *warhami*					f. *striata*				
L	H	B	H/L	B/L	L	H	B	H/L	B/L
25.1	16.7	10.5	0.67	0.42	21.5	17.6	9.8	0.82	0.46
24.4	17.8	11.5	0.73	0.47	20.3	16.4	8.6	0.81	0.42
24.1	17.8	9.4	0.74	0.39	18.5	15.8	10.2	0.85	0.55
23.8	17.8	8.3	0.75	0.35	17.8	14.7	8.3	0.83	0.47
23.6	18.2	9.7	0.77	0.41	17.2	15.0	8.2	0.87	0.48
23.3	18.5	9.3	0.79	0.40	17.0	14.8	8.5	0.87	0.50
23.3	17.5	10.3	0.75	0.44	16.6	13.7	7.8	0.83	0.47
22.9	18.2	8.6	0.79	0.38	16.4	14.0	7.7	0.85	0.47
22.5	17.8	9.7	0.79	0.43	16.3	14.2	7.6	0.87	0.47
22.5	17.0	11.5	0.76	0.51	16.0	13.2	6.7	0.83	0.42
22.5	17.8	10.3	0.79	0.46	16.0	13.1	8.2	0.82	0.51
22.0	16.6	9.3	0.75	0.42	15.6	14.2	8.2	0.91	0.53
21.8	16.5	9.4	0.76	0.43	15.4	13.4	7.4	0.87	0.48
21.6	16.8	9.6	0.78	0.44	15.4	13.0	7.6	0.84	0.49
20.6	16.3	8.2	0.79	0.40	15.3	12.8	7.7	0.84	0.50
19.0	14.5	7.0	0.76	0.37	15.2	13.1	7.7	0.86	0.51

of faint, dot-like depressions (cf. pl. 1, fig. 2). Dark to almost black incrustations of bottom material were found on the shell of several specimens and a few had polychaete tubes and crusts of bryozoans attached to their shells.

Distribution: W. Greenland, E. Greenland, Jan Mayen, Spitzbergen, Franz Josephs Land, the Barents Sea, the Murman Sea and the Murman Coast, the White Sea, Novaya Zemlya, the Kara Sea, the Siberian Ice Sea, the Bering Sea and the Bering Strait, Arctic N. America, Parry Islands, Grinnell Land, Baffinland, Labrador, Newfoundland, Gulf of St. Lawrence, Nova Scotia, Iceland, the Finmark, the Norwegian W. and S. coasts, the Swedish W. coast, the Faroes, the Shetlands, Scotland, and England. To the S., the species reaches the Aleutians, Queen Charlotte Islands, Massachusetts Bay, the Belts and the Sound (Denmark), the Western Baltic, and the Bay of Biscay. Main distribution: Panarctic-boreal, circumpolar. Vertical range: From O m (W. Baltic), or about 2 m (Spitzbergen, E. Greenland) to 445 m (W. Greenland).

Biology: Reproduction partly known from N.E.Greenland (Thorson 1936). There the species spawns very late in the autumn. The larvae, however, were not observed. The egg-size is 150—200 μ, and the eggs are surrounded by a mucous membrane which is adhesive. Judging by the large eggs, the larval development is lecithotrophic and presumably with a very short or entirely lacking pelagic stage. The species may turn out to be hermaphroditic (Thorson l. c., p. 63).

28. *Astarte elliptica* (BROWN).

Crassina elliptica BROWN 1827, pl. 18, fig. 3.
Astarte elliptica JENSEN 1912, pl. 4, figs. 4a—g.

East Greenland records:

Astarte sulcata MÖBIUS 1874, p. 251.
Astarte compressa with var. *depressa* POSSELT 1895, pp. 72—73.
Astarte compressa with var. *depressa* POSSELT & JENSEN 1898, pp. 67—68.
Astarte elliptica JENSEN 1905, pp. 339—341.
Astarte elliptica JENSEN 1912, p. 108.
Astarte elliptica ODHNER 1915, p. 93.
Astarte elliptica REMY 1928, p. 223.
Astarte elliptica THORSON 1934a, p. 7.
Astarte elliptica THORSON 1936, p. 50 et sequ.; on reproduction.

Occurrence at East Greenland (cf. the map fig. 16, p. 177):

Nordøstkyst Area: Île de France, 77°35′5″ N. 18°12′ W., 53 m, 1 adult animal; Danmarks Havn, 5.5—11 m, soft bottom, *Laminaria*, 1 adult and 1 young animal; Hvalrosodden at Danmarks Havn, on the shore, 5 adult valves (recent?); North-East Greenland (without precisely stated locality) (MÖBIUS, as *Astarte sulcata*).

Kejser Franz Josephs Fjord Area: S.E. of Clavering Ø, 74°10′ N. 20°08′ W., 25—40 m, mud, shells, pebbles, 4 adult and 1 half-grown animals; Eskimonæs, Clavering Ø, 10—14 m, sandy, dark clay, 3 adult animals — 28—29 m, sand, pebbles, fragments of brown algae, 1 adult animal — 45—55 m, clayey gravel, algae, 16 adult, half-grown, and young animals (3 finds); E. of Jackson Ø, 73°50′ N. 18°35′ W., 170 m, stiff clay, gravel, stones, 1 adult animal; Kejser Franz Josephs Fjord, 73°16′ N. 23°15′ W., 28—36 m, clay, shells, stones, gravel, and sand, 1 adult animal; Vinterøer off the mouth of Duséns Fjord, 15—30 m, stones, algae, 2 adult animals; The mouth of Duséns Fjord, off Kap Graah, 15—30 m, clay, *Desmarestia*, 8 adult animals (2 finds) — 26—40 m, clay, stones, *Desmarestia*, about 25 adult animals; Duséns Fjord, at the anchoring place, 10 m, loose clay, *Desmarestia*, 4 half-grown animals — 20—26 m, clay, *Desmarestia*, 1 adult and 1 half-grown animal (2 finds) — 56—57 m, tough clay, 1 adult and 1 young animal (2 finds); Duséns Fjord, inner part, 4—10 m, soft clay, about 30 adult, half-grown, and young animals — 10—20 m, clay, *Fucus*, *Laminaria*, 4 adult and 1 young animals (2 finds); Head of Duséns Fjord, 5—19 m, clay, stones, about 25 adult and half-grown animals (3 finds) — 30 m, clay with much sand, 1 adult animal; Moskusoksefjord, 15 m, 1 adult animal; Eleonore Bugt, 15—27 m, clay, *Laminaria*, *Desmarestia*, 3 adult animals; Karl Jakobsens Bugt, Ymers Ø, 8 m, clay, 2 half-grown animals; E. part of Vega Sund, 72°45′ N. 22°56′ W., 35—60 m, mud, some stones, 1 adult and 1 young animal; Solitærbugt, Ella Ø, 3 m, clay, brown algae, 2 young animals — at all depths from 2 to 24 m, clay, stones, *Desmarestia*, about 370 adult, half-grown, and young animals (10 finds) — 22—35 m, clay, shells, stones, *Fucus*, *Laminaria*, *Desmarestia*, red algae, about 70 animals, mainly adult and half-grown ones (6 finds) — at all depths from 20—95 m, clay, stones, gravel, about 650 adult, half-grown, and young animals (29 finds); Solitærbugt, off Kap Oswald, 3—10 m, *Fucus*, *Desmarestia*, 1 adult animal; Kap Hedlund, 4—27 m, clay, about 150 adult, half-grown, and young animals (at least 6 finds) — 20—53 m, clay, about 100 adult and

half-grown animals (4 finds) — 67—90 m, 5 adult animals; Åkerbloms Ø, Kong Oscars Fjord, 20 m, stony bottom, 1 adult animal, 1 adult shell; The mouth of Forsblads Fjord, 5.5—26 m, 2 adult animals, 1 adult shell.

Scoresby Sund Area: Rathbone Ø, depth?, 1 adult valve (highly deformed); Off Kap Hope, 7.5—10 m, sand, *Laminaria*, 1 adult animal — 15 m, sand, 1 adult animal; Rosenvinges Bugt, Scoresby Sund, 8—10 m, stones, algae, 6 adult and 1 half-grown animals, 2 adult shells (2 finds) — 28—30 m, rocky bottom, 1 adult animal (Remy) — 70 m, tough, bluish mud on rocks, 2 adult animals (Remy); Amdrups Havn, Scoresby Sund, 22—33 m, *Laminaria*, red algae, 14 adult, half-grown, and young animals (2 finds); Scoresbysund, off the station, 7—11 m, *Fucus*, *Laminaria*, 2 adult animals; Off the mouth of Hurry Inlet, 30—38 m, stones, sand, *Laminaria*, red algae, 2 adult and 6 half-grown animals (2 finds); The mouth of Hurry Inlet, 19 m, clay, 1 adult and 1 half-grown animal — 28 m, sand, stones, algae, 1 half-grown and 2 young animals; 1 mile inside the mouth of Hurry Inlet, 35—38 m, sand, stones, *Laminaria*, *Fucus*, red algae, 2 adult animals; Hurry Inlet, 20—28 m, stones, sand, algae, 14 adult and half-grown animals; Hurry Inlet, off Fame Øer, 25 m, 5 adult animals; At Fame Øer, 8—12 m, gravel, stones, *Laminaria*, 1 adult animal — 12—18 m, soft clay, 8 adult animals (2 finds) — 20—25 m, very tough clay, 2 adult animals (2 finds); Kap Stewart, 70°27′ N. 22°35′ W., 13—18 m, mud, stones, algae, 1 adult animal; W. coast of Jameson Land, opposite Kap Leslie, 22 m, sandy, glittering clay, 3 adult and 1 young animals (3 finds); N.E. of Danmarks Ø, 18—20 m, soft clay, *Desmarestia*, 13 adult and 3 young animals (8 finds); S.E. of Danmarks Ø, 10—17 m, soft clay, gravel, about 50 adult, half-grown, and young animals (2 finds) — 27—30 m, soft clay, gravel, 17 adult animals; Hekla Havn at Danmarks Ø, 5.5—11 m, mud, 17 adult, half-grown, and young animals (2 adult animals of var. *depressa*); The bay opposite Rødeø in Rødefjord, 7—10 m, clay, *Fucus*, about 45 adult, half-grown, and young animals — 30—39 m, sand, clay, stones, 7 adult, 2 half-grown, and 1 young animals (4 finds); At Bjørneøer, 6—13 m, 21 adult and half-grown animals — 18—28 m, stones, gravel, red algae, about 60 adult, half-grown, and young animals; Nordbugten in Nordvestfjord, 2—3 m, loose clay, *Fucus* and other algae, 2 young animals; Kap Dalton, 17—21 m, clay, 28 adult and 1 young animals, 1 adult shell.

Kangerdlugssuaq Area: Kangerdlugssuaq, 8 m, stones, 1 adult animal — 10—25 m, stones, 3 adult animals (2 finds) — 20—25 m, muddy clay, 3 adult animals (1 with large, mature eggs, 12-8-32), 1 adult shell (2 finds); Uttentals Sund, 10—15 m, about 25 adult and half-grown animals (2 finds).

Sydøstkyst Area: Off the coast of S.E. Greenland, 65°40′ N. 35°32′ W., 47—75 m, clay with small stones, "several specimens" (Posselt); Ikerasaussaq near Angmagssalik, 0—10 m, 1 adult animal; Tiniteqilâq near Angmagssalik, 9—19 m, 2 adult and 1 half-grown animal; Sermilik, settlement Ipîtâlaq, 5—7 m, about 300 adult and half-grown animals; Tasîssaq near Angmagssalik, 6—8 m, 1 young animal — 10—12 m, about 20 adult and half-grown animals — 25—30 m, 27 adult and half-grown animals — 38—56 m, stones, algae, 6 adult animals, 2 adult shells (2 finds) — 56—94 m, 5 adult animals; Angmagssalik, depth?, 9 adult animals, 2 adult shells (1 drilled by *Natica*), 10 valves — ca. 25 m, 2 adult animals; Angmagssalik, off the harbour 45 m, 3 adult animals; Angmagssalik, opposite the station, 60 m, 1 adult animal; Lindenows Fjord, the mouth, 125—150 m, gravel, clay, about 35

adult and half-grown animals; Lindenows Fjord, outer part, 30—36 m, mud, sand, *Laminaria*, 3 half-grown animals — 90 m, 1 adult and 1 half-grown animal; Qeqertatsiaq, 50—60 m, sand, dead bryozoans, 4 adult, 2 half-grown, and 3 young animals (2 finds) — 60—70 m, sand, gravel, dead bryozoans, about 70 adult, half-grown, and young animals (3 finds).

Jan Mayen Area: Not found alive. [The Ingolf Expedition took 2 adult valves S. of Jan Mayen, 69°31′ N. 7°06′ W., at a depth of 2465 m. However, these valves are either subfossil or have been transported out from the shelf].

Thus, the species is of common occurrence at East Greenland, where it has hitherto been found from Île de France in the N. to Qeqertatsiaq in the S., with a vertical range for living specimens from about 2 m (Solitærbugt, Ella Ø, and Nordbugten in Nordvestfjord) to 170 m (E. of Jackson Ø), and 125—150 m (Lindenows Fjord). For the most part, however, it has been met with at depths between about 5 and 50 m, though it seems to be most abundant at depths below 50 m along the southernmost coast. The type of bottom was commonly clay, or clay mixed with sand, stones, and gravel. But it may also occur on sand or mud. The species may be exceedingly abundant locally, especially within the Arctic *Macoma* community. Thus, in Solitærbugt, Ella Ø, 21 m, clay, it was present in a number corresponding to 120 individuals per m^2 with a weight of about 307 gr. Further, at a different depth (30 m, clay, stones) in the same place it was found in a number corresponding to 250 individuals per m^2, weighing 266.3 gr. (THORSON 1933). In general, however, the species appears not to be quite as frequent at E. Greenland as *A. borealis* and *A. montagui*.—The apparent absence of the species from the area of Jan Mayen is difficult to explain, as it is so commonly found in the adjacent areas.

Remarks: The species is subject to considerable variation as regards the proportions and the appearance of the surface of the shell. In general, the specimens from E. Greenland are more elongated than those from other areas. The highly elongated specimens which were found at Hekla Havn, Danmarks Ø, were named var. *depressa* by POSSELT (1895, p. 72, pl. 1, figs. 5—7). However, there seems to be no reason to distinguish between these and the other specimens from E. Greenland. As it is the rule in this species, the East Greenland specimens are usually provided with concentric folds on the whole shell, not rarely, however, these folds disappear on the ventral part, and in some specimens the surface is even almost smooth. The periostracum is of a reddish-brown colour, growing darker in the larger adults, and is characteristic by its fine, mesh-like structure easily seen under the microscope (cf. p. 1, fig. 3).—The subjoined table shows the variation in shape in the largest and some of the larger specimens from E. Greenland.

L	H	B	H/L	B/L	L	H	B	H/L	B/L
34.2	23.5	13.0	0.69	0.38	30.3	21.6	12.1	0.71	0.40
32.6	22.5	11.7	0.69	0.36	30.1	20.8	12.0	0.69	0.40
32.4	22.7	11.8	0.70	0.36	29.7	21.2	12.0	0.71	0.40
32.3	22.3	13.1	0.69	0.41	29.5	21.5	12.5	0.73	0.42
31.7	23.2	10.7	0.73	0.34	29.5	21.3	11.3	0.72	0.38
31.7	21.9	11.2	0.69	0.35	28.4	19.5	9.5	0.69	0.33
30.7	22.2	10.7	0.72	0.35	28.2	21.1	11.8	0.75	0.42
30.4	21.6	11.2	0.71	0.37	28.0	19.5	10.8	0.70	0.39

Some of the specimens had crusts of bryozoans, polychaete tubes, hydroids, balanids, or hapteres of algae attached to their shells.

Distribution: W. and E. Greenland, Spitzbergen, Franz Joseph Land, Novaya Zemlya, the Kara Sea, the White Sea, the Murman Coast, the N. and W. coasts of Norway, Iceland, the Faroes, Baffinland, Hudson Bay, Labrador, Denmark, and Great Britain. To the south the species reaches Massachusetts Bay, the W. Baltic to Bornholm, and France. Main distribution: Panarctic-boreal (in the N. Atlantic only). Vertical range: From about 2 m (E. Greenland) to 442 m (W. Greenland). Dead shells have been found in the N. Atlantic down to 2465 m.

Biology: Reproduction partly known from N.E. Greenland (Thorson 1936), where the species spawns very late in the autumn. The eggs are 150—200 μ in diameter and surrounded by a mucous membrane. On account of the egg-size the larval development must be assumed to be lecithotrophic, with the pelagic stage of very short duration or entirely lacking. The species may be a hermaphrodite.

29. *Astarte crenata* (Gray).

Nicania crenata Gray 1824, p. 242.

East Greenland and Jan Mayen records:

Astarte crebricostata Möbius 1874, p. 252.
Astarte sulcata var. *crenata* Friele 1878, p. 222.
Astarte subaequilatera and *A. crenata* Becher 1886, pp. 70—71.
Astarte acuticostata and *A. crenata* Posselt 1895, pp. 70—72.
Astarte crenata Posselt & Jensen 1898, p. 64.
Astarte crenata and *A. acuticostata* Friele & Grieg 1901, p. 25.
Astarte crenata and *A. acuticostata* Friele 1902, p. 4.
Astarte crenata Hägg 1904, pp. 36—38.
Astarte crenata Jensen 1905, pp. 337—339.
Astarte crenata Grieg 1909a, p. 534.
Astarte crenata Jensen 1912, pp. 113—119.
Astarte crebricostata Lamy 1913a, p. 23.
Astarte crebricostata Lamy 1913b, pp. 600—602.

Astarte crenata ODHNER 1915, p. 95.
Astarte crenata GRIEG 1916, p. 8.
Astarte crebricostata LAMY 1926, pp. 179—180.
Astarte crenata THORSON 1934a, p. 6.
Astarte crenata THORSON 1936, pp. 50—51, 55—57, and 63; on reproduction.

Occurrence at East Greenland (cf. the map fig. 5, p. 95):

Astarte crenata crenata (GRAY) (cf. pl. 1, fig. 20).

Astarte crenata forma *typica* JENSEN 1912, pl. 4, figs. 5 a—c.

Nordøstkyst Area: Île de France, 77°35.5′ N. 18°12′ W., 53 m, stones, 16 "specimens" (GRIEG) (4 adult and 1 half-grown animals are found in the collection of the Copenhagen Museum); The Greenland Sea, about 77° N. 17½° W., 280 m, mud, a little gravel, 3 adult animals, 1 adult shell; The Greenland Sea, 75°58.5′ N. 14°08′ W., 300 m, brown and grey clay, 4 "specimens" (GRIEG); Shannon, 57 m, (MÖBIUS, as *A. crebricostata*, but probably this form); S.E. of Lille Pendulum, 74°35′ N. 18°15′ W., 150 m, mud and stones, 2 animals (HÄGG, as var. *incostata*); S.E. of Sabine Ø, 207 m, fine clay, stones, gravel, 2 adult and 2 young animals, 10 adult and 1 half-grown valves.

Kejser Franz Josephs Fjord Area: N.E. of Jackson Ø, 74°05′ N. 17°47′W., 205 m, stiff clay, gravel, stones, 1 adult and 5 half-grown animals; Off Kap Broer Ruys, 73°24′ N. 20°0′ W., 200 m, 2 adult animals, 2 adult, worn valves; N. of Bontekoe Ø, 73°20′ N. 21°20′ W., 70 m, mud, some pebbles and shells, 2 adult animals; Off Mackenzie Bugt, 100 m, mud, 10 animals (HÄGG); E. of Geographical Society Ø, 72°53′ N. 20°36′ W., 180 m, 6 adult animals, 1 adult valve; E. of Geographical Society Ø, 72°51′ N. 20°32.5′ W., 234 m, clay, 1 adult shell; Duséns Fjord W. of Kap Graah, 150 m, brown clay, 3 adult animals; Duséns Fjord, middle part, 240 m, tough clay, 1 adult animal; Kejser Franz Josephs Fjord E. of Zoologdalen, 180 m, tough clay with stones, 3 adult animals; Geologfjord, off Bjørneø, 70 m, stiff clay, gravel, stones, 2 adult animals; Between Kap Weber and Ymers Ø, 400 m, clay, big stones, 1 adult shell; E. of Kap Weber, 73°32′ N. 24°35′ W., 100—110 m, mud, gravel, stones, 2 adult animals; Sofia Sund, E. of Botanikerbugt, 210 m, reddish clay, stones, gravel, 9 adult and 1 half-grown animals; Kong Oscars Fjord, 72°56′ N. 24°33′ W., ca. 125 m, mud, some pebbles, sand, 2 adult and 1 young animals; Between Maria Ø and Ella Ø, 250 m, clay with gravel and big stones, 1 adult animal; Off Solitærbugt, Ella Ø, 200 m, greyish-brown clay, 1 half-grown animal; Solitærbugt, Ella Ø, depth?, clay, stones, 7 adult and 1 half-grown animals, 1 adult shell; more than 20 m, 2 adult and 1 half-grown animal — 48—95 m, clay, stones, gravel, about 150 animals, mainly adult and half-grown ones (at least 8 finds) — 62—80 m, clay, pebbles, shells, about 40 adult and half-grown animals (3 finds; some animals with mature eggs, 1-7—8-7-32); The Greenland Sea, 72°25′ N. 17°56′ W., 300 m, stones and sand, 5 animals (HÄGG, as var. *incostata*); Kap Parry, 72°28′ N. 21°48′W., 180 m, mud, some stones, 2 adult animals; E. of Traill Ø, 72°24′ N. 19°42′W., 245 m, 1 adult animal, 1 adult and 1 young shell; E. part of Vega Sund, 72°45′ N. 22°56′ W., 38—60 m, mud, stones, 5 adult, 1 half-grown, and 1 young animals; Off Vimmelskaftet, Fleming Fjord, 27 m, clay, few stones, 2 adult and 1 young animals.

Scoresby Sund Area: Kap Tobin, 226 m, 1 adult animal; Section between Kap Tobin and Kap Brewster, 340 m, fine, soft clay, 1 adult shell; Scoresby

Sund, off the mouth of Rosenvinges Bugt, 300 m, stones, 1 adult animal; Kap Hope, 228 m, clay with stones, 3 adult animals; The mouth of Hurry Inlet, 150 m, clay, 5 adult and 1 young animals; Hurry Inlet, 70°36′ N. 22°31′ W., 95 m, clay with stones, about 85 adult, half-grown, and young animals, 15 adult valves; Off Kap Hooker, 142 m, sandy clay, 1 adult animal — ca. 150 m, soft clay, stones, 1 adult shell.

Astarte c. crenata has thus been found at E. Greenland from Île de France in the N. to Scoresby Sund in the S. with a vertical range for living specimens from 27 m (Fleming Fjord) to 300 m (Greenland Sea, and Scoresby Sund). It appears to be most abundant near the outer coast and has not been taken in the innermost ramifications of Kejser Franz Josephs Fjord and Scoresby Sund.

Astarte crenata acuticostata Jeffreys (cf. pl. 1, fig. 21).

Astarte acuticostata Jeffreys 1881, pl. 61, fig. 9.
Astarte crenata var. *acuticostata* Jensen 1912, pl. 4, figs. 5k—m.

Nordøstkyst Area: The Greenland Sea, 75°58.5′ N. 14°08′ W., 300 m, brown and grey clay, 1 "specimen" (Grieg).

Kejser Franz Josephs Fjord Area: N.E. of Jackson Ø, 74°05′ N. 17°47′ W., 205 m, stiff clay, gravel, stones, 1 adult animal; E. of Jackson Ø, 73°58′ N. 18°23′ W., 400 m, stiff clay with few pebbles, 1 half-grown animal; 2 miles S.W. of Bontekoe Ø, 240 m, very tough clay, gravel, stones, 3 half-grown animals; 5 miles S. of Bontekoe Ø, 245 m, very tough clay, stones, gravel, 2 adult and 2 half-grown animals; Kejser Franz Josephs Fjord S.W. of Kap Franklin, 320 m, clay and stones, 1 adult animal; Between Kap Weber and Ymers Ø, 400 m, clay with big stones, 1 adult animal; Duséns Fjord W. of Kap Graah, 150 m, solid, brown clay, 1 adult animal; Duséns Fjord, 240 m, tough clay, 8 adult, 1 half-grown and 1 young animals, 1 half-grown shell, 1 adult valve; Antarctics Sund, 410 m, grey clay with some stones, 1 adult and 1 half-grown animal; Solitærbugt, Ella Ø, off the delta, 240 m, tough, greyish-brown clay, 2 adult and 1 young animals; Off Solitærbugt, Ella Ø, 200 m, tough, greyish-brown clay, 2 adult and 1 half-grown animals; Solitærbugt, Ella Ø, 55—95 m, 3 adult animals — 310 m, tough, greyish-brown clay, 1 adult animal; Kong Oscars Fjord, 73°02′ N. 24°30′ W., 180—215 m, mud, gravel, stones, 5 adult animals; Kempes Fjord, off Kap Oswald, 410 m, light grey clay, 1 adult animal; Kap Hedlund, 20—53 m, 3 adult animals — 67—90 m, 33 adult animals (several finds); Kap Parry, 72°28′ N. 21°48′ W., 180 m, mud, some stones, 2 adult animals; Davy Sund, off Drømmebugt, 225 m, clay, gravel, stones, 1 adult animal; Kong Oscars Fjord, off the great valley in Traill Ø, 225 m, tough, brown clay, 2 adult and 1 young animals; Forsblads Fjord, 95—170 m, clay with stones, about 90 adult, half-grown, and young animals (as var. *inflata* in Jensen 1905 b, 1912); N. of Kap Biot, 115 m, tough clay, some gravel and stones, 5 adult and 1 half-grown animals; Fleming Fjord, 220 m, clay, 1 adult animal; 1 km. from Murray Ø, 71°33′ N. 21°30′ W., 200 m, mud, a little sand, 3 adult animals.

Scoresby Sund Area: Section between Kap Tobin and Kap Brewster, 374—530 m, clay, gravel, stones, 3 adult and 1 half-grown animals (3 finds); Off Kap Hope, 260 m, fat clay, 1 adult and 1 half-grown valve; Between the mouth of Hurry Inlet and the S. coast of Scoresby Sund, 245 m, sandy clay,

3 half-grown animals; Off Kap Hooker, 140 m, clay, sand, gravel, 2 adult and 1 young animals; Section between Kap Stevenson and Kap Leslie, 106—120 m, soft clay, 2 adult animals, 1 half-grown valve (drilled by *Natica*) (2 finds) — 162 m, tough clay, stones, 1 adult animal; Section between Kap Leslie and Jameson Land, 180—233 m, tough clay, 1 adult animal, 16 adult valves (3 finds) — 284—397 m, soft clay, gravel, 1 adult and 1 young animal, 6 valves (2 drilled by *Natica*) (4 finds); Off Bjørneøer, 306—337 m, tough clay, 5 adult valves (2 finds); Nordostbugt, $3^1/_2$ km. from southernmost island, 123 m, rather soft clay, 1 adult shell; N. of Stewart Ø, 69°55′ N. 22°45′ W., 290 m, clay with stones, 1 adult and 1 young animal. [Between Iceland and Greenland, 66°42′ N. 26°40′ W., 550 m (FRIELE).]

Jan Mayen Area: W. of Jan Mayen, 200—270 m, 2 "specimens" (BECHER, as *A. crenata*; these specimens, however, belong perhaps to *Astarte c. acuticostata*). [70°41′ N. 10°10′ W., 481 m, brown clay, stones (FRIELE, FRLELE & GRIEG); S. of Jan Mayen, 70°05′ N. 8°26′ W., 698 m, about 70 adult, half-grown, and young animals, about 200 adult, half-grown, and young valves; S. of Jan Mayen, 70°32′ N. 8°10′ W., 890 m, 1 adult and 1 half-grown animal, 1 half-grown valve; Jan Mayen, 71°12′ N. 8°38′ W., 1275 m, grey clay, 20 adult and half-grown animals].

Astarte c. acusticostata has thus been taken at East Greenland from about 76° N. southward to Stewart Ø, and it is also common in deep water near Jan Mayen. As a rule it is a deep-water form. But in the inner parts of Kejser Franz Joseph Fjord and Scoresby Sund it often seems to replace *Astarte c. crenata* at smaller depths. The vertical range for living specimens at E. Greenland is from 20—53 m (Kap Hedlund) down to 530 m (Section between Kap Tobin and Kap Brewster).

Transitional forms between *Astarte c. crenata* and *Astarte c. acuticostata.*

Nordøstkyst Area: S.E. of Sabine Ø, 207 m, fine clay, stones, gravel, 1 adult animal.

Kejser Franz Josephs Fjord Area: Solitærbugt, Ella Ø, 52—54 m, much clay, some stones, 1 adult animal; Kong Oscars Fjord, 73°02′ N. 24°30′ W., 180—215 m, mud, much gravel, stones, 1 adult and 5 half-grown animals.

Scoresby Sund Area: Off Kap Hooker, 140 m, sandy clay, gravel, 1 half-grown animal, 1 adult shell (2 finds).

Astarte crenata subaequilatera SOWERBY.

Astarte subaequilatera SOWERBY 1855, pl. 167, fig. 13.
Astarte crenata var. *subæquilatera* JENSEN 1912, pl. 4, figs. 5d—e.

Scoresby Sund Area: 70°05′ N. 21°50′ W., depth?, 4 animals (LAMY, as *A. crebricostata.* These specimens are here, though with some hesitation, referred to the present form.).

Kangerdlugssuaq Area: Mikis Fjord, 175 m, mud, 1 adult animal; Uttentals Sund, 25—30 m, 2 adult and 1 half-grown animals — 30—40 m, 4 adult and 1 young animals, 1 young valve (2 finds) — ca. 50 m, 1 adult and 1 half-grown animal.

Sydøstkyst Area: Lindenows Fjord, the mouth, 125—150 m, gravel, clay, 6 adult and 1 young animals; Lindenows Fjord, outer part, 100—150 m, clay, gravel, 1 half-grown shell — 500—700 m, 1 adult and 3 young animals. [Danmarkstrædet, 64°42′ N. 27°40′ W., 800 m, 1 adult valve].

Jan Mayen Area: Jan Mayen, 104 m, ooze with coarser material, 2 adult animals, 1 adult shell; 70°50′ N. 8°35′ W., 120 m, 25 animals (2 finds) (LAMY, as *A. crebricostata*); 70°47′ N. 8°22′ W., 140 m, 35 animals (LAMY, as *A. crebricostata*); 70°39′30″ N. 8°37′ W., 140 m, 22 animals (LAMY, as *A. crebricostata*); 70°58′30″ N. 8°07′ W., 160 m, 1 animal (LAMY, as *A. crebricostata*); 70°50′ N. 8°29′ W., 162 m, 5 adult and 1 half-grown animals, 27 adult, half-grown, and young valves; N. of Jan Mayen, 140—180 m, 3 "specimens" (BECHER, as *A. subaequilatera*); S. of Jan Mayen, 180 m, grey, volcanic mud, 40 living and 10 dead specimens (LAMY, as *A. crebricostata*); 70°58′ N. 8°54′W., 300 m, 2 animals (LAMY, as *A. crebricostata*); 70°57′20″ N. 8°50′ W., depth?, 1 valve (LAMY, as *A. crebricostata*); 70°21′ N. 8°25′ W., 301 m, 2 adult shells (as var. *inflata* in JENSEN 1912); 70°46′ N. 6°32′ W., 400 m (FRIELE, as *A. crenata*). [70°41′ N. 10°10′ W., 481 m, brown clay, stones (FRIELE & GRIEG, as *A. crenata*)].

Astarte c. subaequilatera has thus been found at East Greenland from off Kap Brewster in the N. to Lindenows Fjord in the S. with a vertical range from 25—30 m (Uttentals Sund) to 500—700 m (Lindenows Fjord). Further, it is common around Jan Mayen, where living specimens have been taken at depths from 104 to 481 m.

Transitional forms between *Astarte c. crenata* and *Astarte c. subaequilatera.*

Scoresby Sund Area: Hurry Inlet, 95 m, clay with stones, 3 adult animals.

Astarte crenata inflata HÄGG.

Astarte crenata var. *inflata* HÄGG 1904, figs. 4—6.
Astarte crenata var. *inflata* JENSEN 1912, pl. 4, figs. 5h—i.

Nordøstkyst Area: Off Sabine Ø, 74°17′ N. 15°20′ W., 240 m, clay with stones, 1 adult and 1 half-grown animal, 3 adult valves (1 drilled by *Natica*); S.E. of Sabine Ø, 207 m, fine clay, stones, gravel, 2 adult and 1 half-grown animals, 5 adult shells, 5 valves (as forma *typica* in JENSEN 1905, 1912).

Kejser Franz Josephs Fjord Area: Mouth of Kejser Franz Josephs Fjord, 200—300 m, mud, 1 animal (HÄGG); Duséns Fjord, the mouth, 150 m, tough, brown clay, 1 adult animal; Duséns Fjord W. of Kap Graah, 150 m, solid, brown clay, 12 adult and 1 half-grown animals; The Greenland Sea, 72°25′ N. 17°56′ W., 300 m, stones and sand, 7 animals (HÄGG); Forsblads Fjord, ca. 95 m, clay with stones, 2 adult animals — 95—170 m, clay with stones, about 140 adult, half-grown, and young animals, 15 valves.

Scoresby Sund Area: Off the mouth of Hurry Inlet, 140—148 m, brown clay, gravel, stones, 4 adult animals (2 finds); The mouth of Hurry Inlet, 140 m, brown clay, gravel, 1 half-grown animal.

Astarte c. inflata is thus known to occur at East Greenland from off Sabine Ø in the N. to Scoresby Sund in the S. with a vertical range from about 95 m (Forsblads Fjord) to 300 m (72°25′ N. 17°56′ W.). This form appears to live exclusively in places near the outer coast.

Transitional forms between *Astarte c. crenata* and *Astarte c. inflata.*

Scoresby Sund Area: The mouth of Hurry Inlet, 143 m, clay with stones, 2 adult animals, 3 adult valves.

Transitional forms between *Astarte c. acusticostata* and *Astarte c. inflata.*

Kejser Franz Josephs Fjord Area: Forsblads Fjord, ca. 95 m, clay with stones, 3 adult animals — 95—170 m, clay with stones, about 45 adult, half-grown, and young animals, 10 adult valves.

Including all the subspecies, *Astarte crenata* has thus been found at E. Greenland from Île de France in the N. to Lindenows Fjord in the S. with a vertical range from 27 m (Fleming Fjord, *A. c. crenata*) or 25—30 m (Uttentals Sund, *A. c. subaequilatera*) down to 500—700 m (Lindenow's Fjord, *A. c. subaequilatera*). Around Jan Mayen it ranges from 104 m (*A. c. subaequilatera*) to 1275 m (*A. c. acuticosta*). However, as will be evident from the above, the subspecies are of different distribution within the area under consideration. The species including the subspecies almost always occurs on a bottom consisting of clay of varying consistency, which may be mixed with gravel, pebbles, or stones.

Astarte crenata is the characteristic species of a deep-water community which occurs from about 45 m to about 200 m in Kejser Franz Josephs Fjord (SPÄRCK 1933, THORSON 1933) and from 40—50 m down to at least 550 m in Scoresby Sund (THORSON 1934b). Further, the same community was met with in Mikis Fjord and at Kangerdlugssuaq (THORSON 1934a, BERTELSEN 1937a (in the latter paper *A. crenata* was erroneously referred to *A. sulcata*)). The species, however, was by no means always found in the bottom samples from this community. Thus it is an interesting fact that no living specimens of it have been taken in the fjords to the north and west of Kap Leslie, Scoresby Sund. As the *Astarte crenata* community in general is very poor as to number of species as well as to weight of animals per m^2, *Astarte crenata* was only seldom represented by more than 10 individuals per m^2.

Remarks: The species is on the whole subject to great variation, and the material at hand allows a distinction between four forms of it within the area dealt with here. Because of differences in the distribution—horizontally and in part also vertically—it seems justifiable to regard these forms as subspecies. However, it should be emphasised at once that intermediates are not rarely met with. It may even be impossible to decide to which subspecies a given specimen should be referred.

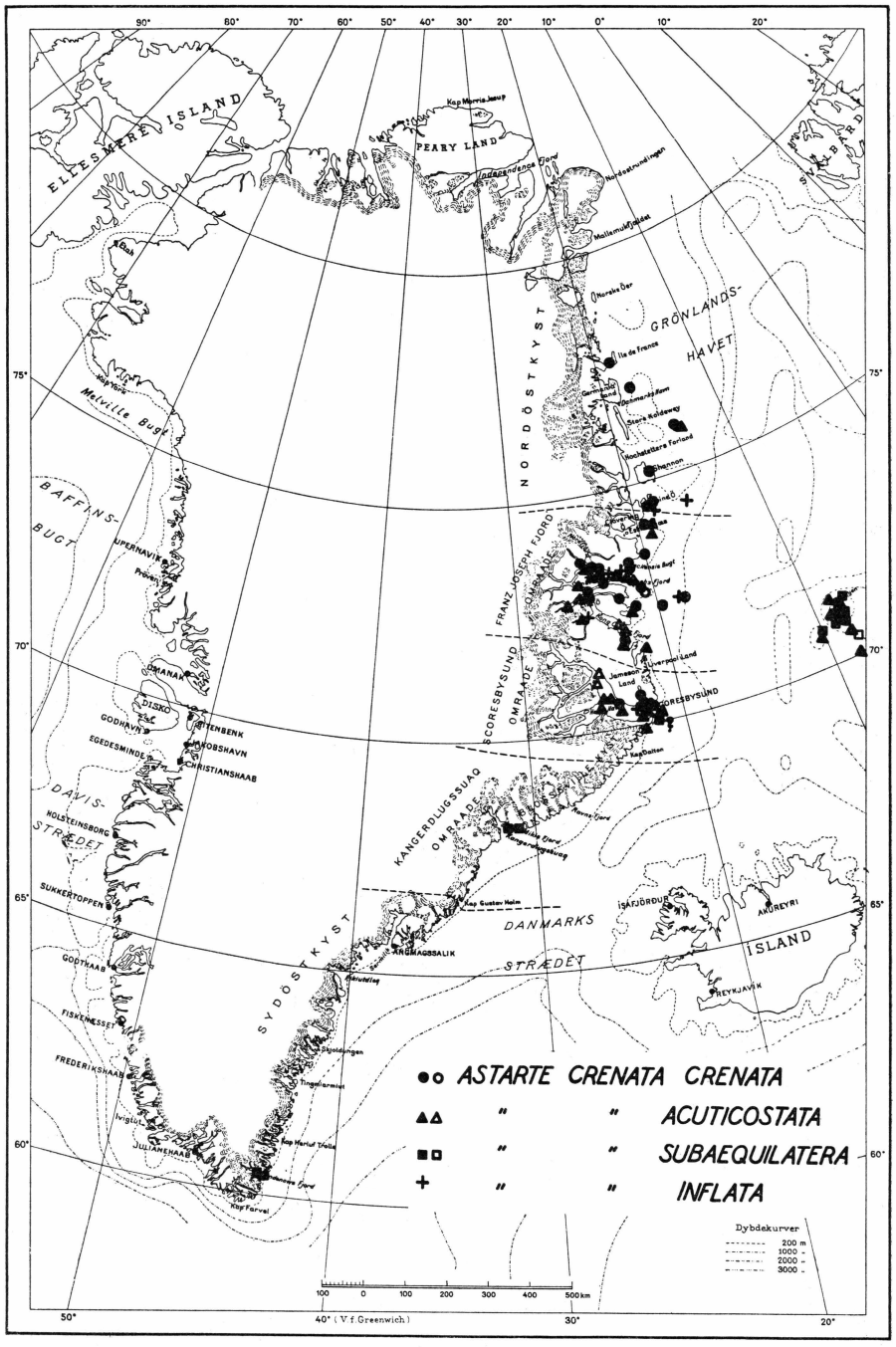

Fig. 5. Distribution of *Astarte crenata crenata* (GRAY), *A. c. acuticostata* JEFFREYS, *A. c. subaequilatera* SOWERBY, and *A. c. inflata* HÄGG along East Greenland and round Jan Mayen. — Full symbols: Living animals. Open symbols: Shells or valves only.

Such cases are recorded above under the heading "Transitional forms". Hence, in spite of this polymorphy, they must be regarded as one species. To the characteristics of the different forms of *A. crenata* as described by JENSEN (1912, pp. 114—119) some remarks on the structure of the periostracum may be added here. In *Astarte c. crenata* the periostracum is generally somewhat shining and rather smooth, though with some minor, and darker, concentric folds, which are often more numerous towards the ventral edge. A rather indistinct structure of very fine, dot-like depressions and irregular grooves may be observed under a microscope (cf. pl. 1, fig. 5). *Astarte c. acuticostata* differs in lacking the minor folds, the periostracum covering almost smoothly the concentric ribbing of the shell (cf. pl. 1, fig. 6). On the other hand, in *Astarte c. subequilatera* the periostracum is generally more wrinkled and the fine structure of dots is often more marked (cf. pl. 1, fig. 7). In *Astarte c. inflata*, minor folds of the periostracum are usually lacking. The latter is characteristic by the rather distinct dot-like depressions arranged in radial and irregular, concentric rows (cf. pl. 1, fig. 8). In this character as well as in the outline of the shell, *Astarte c. inflata* resembles *A. sulcata* to some degree. No intermediate specimens, however, between these two species were observed. As was pointed out by AD. JENSEN (1912, p. 116), f. *crebricostata* MC. ANDR. & FORBES comes very close to *Astarte c. subequilatera*. The periostracum of the former is of the same appearance as that of the latter, and perhaps it may be difficult to keep these two forms apart as separate subspecies.

The considerable variation of the proportions of the shell is demonstrated by the following tables with the measures (in mm) and ratios of the largest specimens of each of the subspecies.

It will appear from the tables that the maximum-sizes of the subspecies are different. Only *Astarte c. crenata* and *A. c. subaequilatera* may attain almost the same maximum-size.—In some of the specimens at hand the umbonal region is strongly eroded. Many specimens had crusts of bryozoans and living *Alcyonidium gelatinosum*, *Spirorbis*-tubes, Foraminifera, hydroids, and ascidians attached to their shells.

Distribution (incl. of the subspecies): W. and E. Greenland, Jan Mayen, Spitzbergen, Franz Joseph Land, the Finmark, the Barents Sea, the Murman Coast, Novaya Zemlya, the Kara Sea, the Siberian Ice Sea, N. of America, Baffinland, the Hudson Bay, Labrador, Newfoundland, the Gulf of St. Lawrence, Nova Scotia, and Iceland. In the Atlantic the species extends southward to Maine, the Hebrides, and Norway N. of Lofoten. Main distribution: Panarctic and circumpolar. Vertical range: From 4 m (Spitzbergen) down to 1275 m (near Jan Mayen).

Astarte crenata crenata from East Greenland:

L	H	B	H/L	B/L	L	H	B	H/L	B/L
32.0	22.5	14.5	0.70	0.45	25.2	19.6	11.9	0.78	0.47
27.8	21.8	13.0	0.75	0.47	24.5	19.3	10.8	0.79	0.44
27.5	21.5	13.5	0.78	0.49	23.9	18.5	12.4	0.77	0.52
27.1	20.2	11.8	0.75	0.44	23.6	17.8	11.3	0.75	0.48
27.0	20.6	13.0	0.76	0.48	23.0	18.4	10.4	0.80	0.45
26.8	20.7	12.4	0.77	0.46	22.9	17.5	11.0	0.76	0.48
26.1	19.7	12.3	0.75	0.47	20.8	16.7	10.7	0.80	0.51
25.6	20.5	12.2	0.80	0.48	20.2	15.7	9.7	0.78	0.48

Astarte crenata acuticostata

East Greenland:					Jan Mayen:				
L	H	B	H/L	B/L	L	H	B	H/L	B/L
13.3	10.6	7.3	0.80	0.55	12.7	10.7	7.2	0.84	0.57
12.9	10.6	6.8	0.82	0.53	12.4	10.0	6.9	0.81	0.56
12.2	10.0	7.1	0.82	0.58	12.2	10.0	6.8	0.82	0.56
11.5	9.3	5.7	0.81	0.50	11.6	9.7	6.7	0.84	0.58
11.4	9.5	6.7	0.83	0.59	11.5	9.9	6.5	0.86	0.57
11.3	9.0	5.7	0.80	0.50	10.8	9.1	5.5	0.84	0.51
11.2	9.5	6.0	0.85	0.54	10.7	8.8	6.1	0.72	0.57
10.6	8.5	6.0	0.80	0.57					
10.4	8.7	6.4	0.84	0.61					

Astarte crenata subaequilatera

East Greenland:					Jan Mayen:				
L	H	B	H/L	B/L	L	H	B	H/L	B/L
32.2	25.5	13.0	0.79	0.40	30.0	21.6	14.2	0.72	0.47
30.7	23.7	11.4	0.77	0.37	27.6	21.2	13.5	0.77	0.49
30.5	24.2	11.8	0.79	0.39	25.5	19.6	13.4	0.77	0.52
27.2	21.4	11.8	0.79	0.43	21.8	17.2	10.4	0.79	0.48
25.4	19.5	12.5	0.77	0.49	21.2	16.5	11.1	0.78	0.52
25.2	18.3	9.5	0.72	0.38					

Astarte crenata inflata from East Greenland:

L	H	B	H/L	B/L	L	H	B	H/L	B/L
21.3	16.1	10.9	0.76	0.51	17.2	13.1	7.9	0.76	0.46
21.0	16.4	10.8	0.78	0.51	17.1	13.0	8.9	0.76	0.52
19.2	14.6	9.8	0.76	0.51	16.8	12.5	8.6	0.74	0.51
18.2	14.0	10.3	0.77	0.57	16.4	11.6	8.9	0.71	0.54
18.0	13.8	9.3	0.77	0.52	15.8	12.1	9.4	0.77	0.59
17.7	13.0	8.3	0.73	0.47	14.6	11.0	7.3	0.75	0.50

Biology: Reproduction partly known from N.E. Greenland (THORSON 1936), where the species spawns very late in the autumn. The eggs are adhesive by means of a mucous membrane and measure 150—200 μ in diameter. Hence a lecithotrophic development of the larva with a very short or no pelagic stage must be assumed. Further, THORSON (l. c., p. 63) suspects the species to be a hermaphrodite.—According to my own investigations, the four subspecies occurring at E. Greenland do not apparently differ as to egg-size, the yolk mass of mature eggs in all of them being found to be about 170 μ in diameter (material preserved in alcohol). Yet the thickness of the surrounding adhesive membrane was found to vary somewhat from individual to individual. But this variation merely seems to be dependent on a varying content of liquid substances.

30. *Astarte sulcata* (DA COSTA).

Astarte sulcata Jensen 1912, pl. 4, figs. 3a—c.

East Greenland records:

Astarte sulcata POSSELT 1895, p. 72 (in part).
Astarte sulcata POSSELT & JENSEN 1898, p. 65 (in part).
Astarte sulcata JENSEN 1905, p. 339.
Astarte sulcata JENSEN 1912, p. 106.

Occurrence at East Greenland (cf. the map fig. 23, p. 183):

Sydøstkyst Area: Off the S.E. coast of Greenland, 65°40′ N. 35°32′ W., 47—75 m, clay with small stones, "4 specimens" (POSSELT; but not mentioned by JENSEN, 1912); Off the coast of S.E. Greenland, 245 m, clay with stones, "several specimens" (POSSELT; 4 adult animals are still in the collection of the Copenhagen Museum); Off Angmagssalik, 65°30′ N. 37°20′ W., 264 m, stony bottom, 1 half-grown valve; Off S.E. Greenland, 64°56′ N. 36°19′ W., 384 m, sandy bottom, 1 adult shell (drilled by *Natica*); Lindenows Fjord, outer part, 400—600 m, clay, Foraminifera, 1 adult animal. (Further, the species is recorded from N.E. Greenland by MÖBIUS (1874, p. 251), and from Jan Mayen by BECHER (1886, p. 71). But, as pointed out by AD. JENSEN (1912, p. 106), these records must be due to erroneous identifications).

Thus, the species is of sparse occurrence at S.E. Greenland, where it seems to be restricted to deeper water off the outer coast.

Remarks: In *Astarte sulcata* the periostracum is remarkable by its fine, distinct grooves, undulating concentrically (cf. pl. 1, fig. 4). All the specimens from S.E. Greenland are comparatively densely ribbed. The three largest at hand measure (length × height × breadth of shell): 22.9 × 18.2 × 11.2 — 20.3 × 15.8 × 9.5 and 20.1 × 15.7 × 9.4 mm, respectively.—Three specimens have crusts of bryozoans attached to their shells.

Distribution: S.W. Greenland, S.E. Greenland, N.W., W., and S. of Iceland, the Faroes, the western part of the Murman Coast, and Norway N. of Lofoten. Further, the species occurs along the European W. coast from N. Norway over the North Sea, the Kattegat, Great Britain and Ireland, France, into the Mediterranean, and off N.W. Africa. Main distribution: Wide, viz. subarctic-boreal, Mediterranean-Atlantic (unknown from N. America proper). Vertical range: From about 10 m (Norway) down to 830 m (the Faroes), or 2000 m? (N. Atlantic).

Biology: Mature eggs have been observed at Plymouth in July and October, and ripe sperm in January and July (LEBOUR 1938). A specimen taken S.W. of Iceland (320 m, June, 96., Ingolf Exp. st. 85), contained apparently mature eggs in its gonads. These eggs were about 220 μ in outer diameter, the yolk mass alone measuring 175 $\times$ 165 μ, and were adhesive. Accordingly, a lecithotrophic development of the larva and a very short or quite absent pelagic stage must be assumed for this species.

31. *Turtonia* [*Cyamium*] *minuta* (FABRICIUS).

Cyamium minutum JEFFREYS 1869 V, pl. 33, fig. 5.
Cyamium minutum G. O. SARS 1878, pl. 19, figs. 14a—c.

Occurrence at Jan Mayen:

Jan Mayen, 95—113 m, mud, 1 adult valve, taken by the AMDRUP-HARTZ Exped. 1900.

This valve is of rather fresh appearance, with parts of the ligament preserved. It measures (length $\times$ height) 1.75 $\times$ 1.3 mm. The species, here recorded from Jan Mayen for the first time, may probably also occur at S.E. Greenland, as it is known to live round Iceland and at W. Greenland. It often lives in crevices and between seaweeds and may therefore easily be overlooked.

Distribution: West Greenland, Jan Mayen (valve only), W. Spitzbergen, the Finmark, the Barents Sea, the White Sea, the Bering Sea, Alaska, Iceland, and the Faroes. Further, the species occurs at N. America southward to lower California and Massachusetts Bay, and along the European coasts from N. Norway over Britain, France, and into the Mediterranean. Main distribution: Wide, viz. low-arctic-boreal, Mediterranean-Atlantic; probably not continuously circumpolar. Vertical range: From 0 m (Iceland) to 440 m (acc. to DAUTZENBERG & FISCHER 1912).

Biology: Already JEFFREYS (1864, II) noted that the eggs of this species are adhesive. MORSE (1919) found 14 eggs in the gonads of one

individual and 7 in another. Further, according to MATVEEVA (1953), spawning occurs in the White Sea and the Barents Sea from June to August. Fertilisation is internal and the egg-masses, containing 2—6 eggs, are laid on stones and algae. Recently, OLDFIELD (1955) stated that the species is unisexual and spawns at England from March to July, the egg capsules being fastened to the byssus of the parent. It is thus certain that the species has a non-pelagic larval development.

[*Thyasira flexuosa* (MONTAGU).

Lucina flexuosa FORBES & HANLEY 1853, p. 54, pl. 35, fig. 4.
Axinus flexuosus JEFFREYS 1869 V, pl. 33, fig. 1.

On an examination of large numbers of *Thyasira* from Arctic and European waters it became evident that *Thyasira gouldi* (PHILIPPI), *T. sarsi* (PHILIPPI), and *T. equalis* (VERRILL & BUSH) are specifically distinct and should not be included within *T. flexuosa* (MONTAGU), as has unfortunately been done by many writers. In all probability, *T. flexuosa* has a boreal-lusitanian main distribution and is absent from arctic waters. Accordingly it must be excluded from the fauna lists of E. Geeenland and Jan Mayen; the records of *T. flexuosa* from these regions actually refer to *T. gouldi* and *T. equalis*, respectively (which see).

There are two further species of *Thyasira* which have been lumped together with *T. flexuosa* by some authors. One is *T. granulosa* MONTEROSATO, which is at hand from W. and S.W. Norway, while the other is a possibly undescribed species, provisionally listed as *Thyasira* spec. a in list II, p. 197. A fairly large material of it is at hand from S.W. Greenland, Norway, and Danish waters, and it seems to be an Atlantic species usually living in deeper water. Further studies on these *Thyasira* species are in progress].

32. *Thyasira gouldi* (PHILIPPI) cf. pl. 2, figs. 4—5).

Cryptodon gouldii GOULD & BINNEY 1870, p. 100, fig. 406.
Axinus Gouldii G. O. SARS 1878, pl. 19, figs. 6a—b.

East Greenland and Jan Mayen records:

Axinus flexuosus POSSELT 1895, pp. 73—74 (in part).
Axinus flexuosus POSSELT & JENSEN 1898, p. 80 (in part).
Axinus flexuosus JENSEN 1905, p. 341 (in part).
Thyasira flexuosa ODHNER 1915, p. 103 (in part).
Axinus flexuosus THORSON 1936, pp. 51 et sequ.; on reproduction.

Occurrence at East Greenland (cf. the map fig. 6, p. 105):

Nordøstkyst Area: Jørgen Brønlund Fjord, ca. 10 m, 1 adult animal; Danmarks Havn, 0—9.5 m, mud mixed with sand, algae, 4 adult and 1 half-grown animals, 1 adult shell (drilled by *Natica*), 3 adult valves (3 finds) —

5.5—11 m, soft bottom, *Laminaria*, 1 adult shell (drilled by *Natica*) — 19—38 m, soft bottom, *Delesseria*, 1 adult animal; Stormbugt, Danmarks Havn, 9—19 m, soft bottom, *Laminaria*, 2 adult valves; Off the Eskimo house ruins at Danmarks Havn, 0—7.5 m, mud mixed with sand, algae, 1 adult shell; Off Hvalrosodden, Danmarks Havn, 0—4 m, mud mixed with sand, stones, 2 adult animals.

Kejser Franz Josephs Fjord Area: Eskimonæs, Clavering Ø, 10—14 m, sandy, dark clay, 1 adult animal, 1 adult shell; Knudshoved (Karlshavn), 8—10 m, muddy bottom, 1 adult animal; The mouth of Duséns Fjord, opposite Kap Graah, 15—30 m, clay, *Desmarestia*, 1 adult shell (drilled by *Natica*); Duséns Fjord, at the anchoring place, 10 m, loose clay, *Desmarestia*, 1 adult animal; Duséns Fjord, inner part, 4—10 m, soft clay, *Desmarestia*, about 100 adult, half-grown, and young animals (several adults with ripe eggs or sperm, 11-8-33) — 15—20 m, *Laminaria*, *Fucus*, 1 adult animal; Eleonore Bugt, 3.5—12 m, clay, *Fucus*, *Laminaria*, *Desmarestia*, 1 adult animal — 23 m, fat clay with some stones, 1 adult and 1 half-grown animal; Karl Jakobsens Bugt, Ymers Ø, 3—8 m, clay, 6 adult and 2 half-grown animals (7 finds); Inner part of Kejser Franz Josephs Fjord, 73°06′ N. 27°17′ W., 3—9 m, mud with sand, algae, 1 adult and 1 half-grown animal; Solitærbugt, Ella Ø, 3—13 m, clay, *Fucus*, *Desmarestia*, 16 adult and half-grown animals, 1 adult shell (drilled by *Natica*) (5 finds) — 4—16 m, 12 adult animals — 2—24 m, 2 adult animals, 1 adult shell (drilled by *Natica*) — 5—24 m, about 75 adult, half-grown, and young animals (several adults with ripe eggs or sperm, 2 with eggs between their gills, 10-9—19-9-31) (several finds) — 20—52 m, 8 adult animals, 1 adult shell (drilled by *Natica*) (some finds); Kap Hedlund, 4—27 m, 1 adult animal — 26—31 m, clay, 1 adult animal; Forsblads Fjord, 6—26 m, 1 half-grown animal.

Scoresby Sund Area: Amdrups Havn, at the mouth of Scoresby Sund, 33 m, *Laminaria*, red algae, 6 adult animals; Off Kap Hope, 9 m, sand, 1 half-grown animal; Off the mouth of Hurry Inlet, 16 m, sand and algae, 1 adult animal — 55 m, clayey sand, 1 adult and 1 half-grown animal; The mouth of Hurry Inlet, 55—57 m, sandy clay, about 25 adult, half-grown, and young animals (6 finds); Hurry Inlet, 0—13 m, clay and sand, 6 adult animals; Hurry Inlet, at Constable Pynt, 7—10 m, sand, 6 adult and 2 half-grown animals — 18—22 m, very soft clay, 20 adult and half-grown animals; Off Constable Pynt, 21—24 m, clay, about 225 adult, half-grown, and young animals (10 finds) — 44 m, tough clay, 1 half-grown animal; E. side of Hurry Inlet, off Constable Pynt, 31—46 m, clay, 14 adult and 3 half-grown animals (6 finds); Hurry Inlet off Fame Øer, 16—20 m, very tough clay, 19 adult and half-grown animals (5 finds); Fame Øer, 70°50′ N. 22°33′ W., ca. 9 m, mud, algae, 1 adult animal — 23—25 m, clay, 2 adult and 4 half-grown animals; Fame Øer, 6—12 m, very soft clay, 7 adult animals (2 finds) — 15—22 m, soft and tough clay, *Laminaria*, red algae, about 130 adult, half-grown, and young animals (4 finds); Off Kap Hooker, 65 m, sand, about 25 adult, half-grown, and young animals (3 adults with mature eggs between their gills, 3-7-33) — 57—72 m, sand mixed with clay, about 135 adult, half-grown, and young animals (10 finds); 8 miles W. of Kap Hooker, 12—14 m, sand mixed with clay, a few algae, about 100 adult, half-grown, and young animals, 9 shells (all drilled by *Natica*) (10 finds); W. side of Jameson Land opposite Kap Leslie, 21—23 m, sandy, glittering clay, about 55 adult, half-grown, and young animals, 1 adult shell (drilled by *Natica*) (10 finds); Section between

Kap Leslie and Jameson Land, 385 m!, soft clay, 4 adult animals; Kap Leslie, 82 m, glittering clay, 1 half-grown animal; W. coast of Jameson Land opposite Bjørneøer, 30 m, tough clay, 2 half-grown animals; Off Bjørneøer, 18—28 m, stones, gravel, red algae, 1 adult animal; Nordbugten in Nordvestfjord, 2—3 m, loose clay, *Fucus* and other algae, 2 half-grown animals; N.E. of Danmarks Ø, 19—22 m, soft clay, *Desmarestia*, 8 adult (1 with eggs between its gills, 21-8-33), and 1 half-grown animals (3 finds); Hekla Havn at Danmarks Ø, depth?, mud, 5 adult animals; The bay opposite Rødeø in Rødefjord, 4—10 m, clay, *Fucus*, 11 adult animals (2 finds); Turner Sund, ca. 5.5 m, 1 adult animal; Kap Dalton, 17—21 m, fine clay with pebbles, 1 adult and 2 half-grown animals.

Kangerdlugssuaq Area: Uttentals Sund, 5—7 m, 1 adult shell.

Sydøstkyst Area: Fjord inside Kûngmiut, 20 m, sandy clay, *Desmarestia*, 2 adult animals; 1 adult shell; Sermilik, 2nd E. fjord, 25 m, clay, 1 adult animal; Sermilik, "Fuglefjæld", 100 m, stones, 1 adult valve; Napassorssuaq, N. of Kap Tordenskjold, 38 m, muddy sand, 25 adult, half-grown, and young animals (2 adults with eggs between their gills, 25-6-35); Qutdlît N. of Kap Tordenskjold, 30 m, sand, a little mud, 1 adult and 3 half-grown animals; Nanûseq N. of Lindenows Fjord, 40—58 m, clay, sand, gravel, 1 adult and 2 half-grown animals (2 finds); Lindenows Fjord, outer part, 7 m, greyish-brown clay, 1 adult animal — 12 m, grey clay, 2 adult animals — 30—36 m, ooze, sand, *Laminaria*, 1 adult animal — 45—46 m, dark grey clay, 1 adult and 1 half-grown animal (2 finds) — 65 m, clayey sand, 1 adult animal; Lindenows Fjord, middle part, 25—30 m, gravel, *Laminaria*, 1 adult animal; Lindenows Fjord, inner part, 25—50 m, clay, 1 adult animal; Lindenows Fjord, innermost part, 20 m, clay, gravel, 1 half-grown animal.

Jan Mayen Area: Jan Mayen, 104 m, mud, 2 adult valves (1 drilled by *Natica*).

Thyasira gouldi is thus a common species at East Greenland, where it has been taken alive from Jørgen Brønlund Fjord in the N. to Lindenows Fjord in the S. From the Kangerdlugssuaq area, however, hitherto only a single shell is present, where, nevertheless, it must be supposed to live. The vertical range for living specimens at E. Greenland is from a few metres below the shore line down to 385 m (section between Kap Leslie and Jameson Land). However, the latter find is exceptional and the only one from E. Greenland from depths exceeding 100 m, and by far the majority of the finds originate from depths less than 50 metres. The species occurred on various types of bottom. Most frequently, however, it has been taken from a bottom consisting entirely, or partly, of clay or mud. It appears to be associated in some degree with the Arctic *Macoma* community, here reaching its greatest abundance. Thus, off Constable Pynt, Hurry Inlet, 21—24 m, soft clay, it occurred in an average number of 186 individuals per m^2, with a weight of 5.6 gr. (THORSON 1934b, p. 28, as *Axinus flexuosus*).

Remarks: The specimens at hand were compared with a sample of *T. gouldi* from New England and no essential difference between

them was observed. *T. gouldi* varies somewhat, however, in the outline of its shell. This is generally rather evenly rounded, height and length being almost equal, but some of the specimens at hand are somewhat pyriform. Adult specimens always have two distinct postero-dorsal folds or undulations, and the hinge-margin is more thickened and stronger than in its relatives. Young specimens in which the undulations are less markedly developed, are easily identified by means of their fairly conspicuous prodissoconch, which was always found to measure more than 215 μ across, most often 240—260 μ, and which is thus considerably larger than in *T. equalis*, *T. sarsi*, and *T. flexuosa*.

The ten largest specimens present from E. Greenland measure (length × height × breadth of shell): 9.0 × 9.3 × 6.3 — 8.6 × 8.8 × 5.5 — 8.2 × 8.4 × 5.1 — 8.1 × 8.2 × 5.3 — 7.9 × 8.2 × 5.1 — 7.6 × 7.6 × 4.4 — 7.5 × 7.6 × 4.9 — 7.3 × 6.7 × 4.2 — 7.1 × 7.0 × 4.3 and 6.8 × 6.6 × 4.3 mm, respectively.—Some specimens had chestnut-coloured patches of precipitated material on their shells near the antero-dorsal and postero-dorsal margins.

Distribution: (On the basis of the collections in the Copenhagen Museum some brief notes on the occurrence of *T. gouldi* in certain places are given below): West Greenland (animals present from many localities along the whole coast as far northward as Thule, at depths from 10—15 to 75—94 m), East Greenland, Jan Mayen (only valves known so far), Spitzbergen (many of the records of *T. flexuosa* should undoubtedly be referred to *T. gouldi*, which is present from depths between 19—28 and 56—75 m), Novaya Zemlya, the Kara Sea, the Barents Sea, the White Sea, the Murman Coast, the Siberian Ice Sea in about 184° E. (Soot-Ryen), the Finmark, all round Iceland (most of the records of *T. flexuosa* from smaller depths in J. Madsen (1949) should be referred to *T. gouldi*, which is present from many localities and in large numbers from depths between 8 and 203 m, mainly, however, from depths less than 100 m), the Faroes (present from depths between about 10 and 90 m), and, further, Grinnell Land, Baffinland, Labrador, Newfoundland, the Gulf of St. Lawrence, and Nova Scotia. In the Pacific it reaches from the Bering Sea and Alaska to Korea and Queen Charlotte Islands, and in the Atlantic to Connecticut, the Faroes, and W. Norway (Hardanger?). Main distribution: Panarctic, probably continuously circumpolar. Vertical range: From 2—3 m (E. Greenland) to 385 m (E. Greenland), or ?"400 fathoms" (Johnson 1934).

Biology: Reproduction partly known from N.E. Greenland (Thorson 1936, as *Axinus flexuosus*). There the species spawns in August—September. The eggs are slightly oval, measuring about 170 × 190 μ, and the larval development is presumably lecithotrophic with a very

short or entirely lacking pelagic stage. According to THORSON (l. c., p. 64), hermaphroditic individuals were found.—To this may be added that in 7 young specimens from E. Greenland and Jan Mayen the longer axis of the prodissoconch varied from 235 to 269 μ, with a mean of 250 μ. Possibly the earliest stages develop inside the parent, as 8 of the animals from E. Greenland were found to contain ripe eggs between the filaments of the inner gills. These eggs were of the same size and appearance as mature eggs taken from the gonads.

33. *Thyasira equalis* (VERRILL & BUSH) (cf. fig. 7, p. 108).

Cryptodon equalis VERRILL & BUSH 1898, pl. 91, figs. 5, 6.

East Greenland and Jan Mayen records:

Axinus flexuosus var. *Gouldii* FRIELE 1878, p. 223.
Axinus flexuosus FRIELE & GRIEG 1901, p. 31.
Axinus flexuosus HÄGG 1904, p. 41.
Axinus flexuosus JENSEN 1905, p. 341 (in part).
Thyasira flexuosa ODHNER 1915, p. 103 (in part).
Cryptodon flexuosus GRIEG 1916, p. 8.

Occurrence at East Greenland (cf. the map fig. 6, p. 105):

Nordøstkyst Area: The Greenland Sea, 75°58½′ N. 14°08′ W., 300 m, brown and grey clay, some empty shells (GRIEG, who did not comment on the form of the specimens; probably, however, they belong to the present species); S.E. of Shannon, 74°52′ N. 17°16′ W., 350 m, clayey mud, sand, pebbles, 2 adult animals; S.E. of Sabine Ø, 207 m, fine clay, stones, gravel, 2 adult animals.

Kejser Franz Josephs Fjord Area: E. of Jackson Ø, 73°58′ N. 18°23′W., 400 m, stiff clay with a few pebbles, 2 adult and 3 half-grown animals; S.E. of Jackson Ø, 73°39′ N. 18°14′ W., 202 m, clay, big stones, 2 adult animals; E. of Store Finsch, 160 m, tough clay, 2 adult and 1 half-grown animals; Between Store Finsch and Clavering Ø, 310 m, tough clay, 1 adult animal; Between Kap Stosch and Eskimonæs, 405 m, tough clay, 1 young animal, 4 adult valves; 4 miles E. of Holland Ø, 130 m, clay, gravel, big stones, 2 adult animals; 5 miles S. of Bontekoe Ø, 245 m, very tough clay, stones, gravel, 3 adult and 1 half-grown animals; Between Kap Graah and Vinterøer, 56 m, tough, greyish-brown clay, gravel, 1 adult animal; The mouth of Duséns Fjord opposite Kap Graah, 100 m, tough, brown clay, 1 adult animal; The mouth of Duséns Fjord, 150 m, tough, brown clay, 2 half-grown animals; Duséns Fjord, middle part, 240 m, tough clay, 2 adult animals — 370 m, rather tough, yellowish-brown clay, much sand, 6 adult animals; Duséns Fjord, inner part, 51—57 m, tough clay, 3 adult animals, 3 adult shells (1 drilled by *Natica*) (4 finds) — 130 m, tough, reddish brown clay, 2 adult animals; A little E. of Zoologdalen in Ymers Ø, 180 m, very tough clay, stones, 1 adult animal; Off Zoologdalen, Ymers Ø, 160 m, clay mixed with sand, 9 adult animals; Nordfjord, between the Danish House and Kap Ovibos, 270 m, rather fat, grey clay, 1 adult and 1 half-grown animal; Nordfjord, 3 miles S.E. of the Danish House, 205 m, fine, grey clay, 5 adult animals; Nordfjord, off Waltershausen Gletscher, 120 m, very fine, loose, grey clay, 25 adult

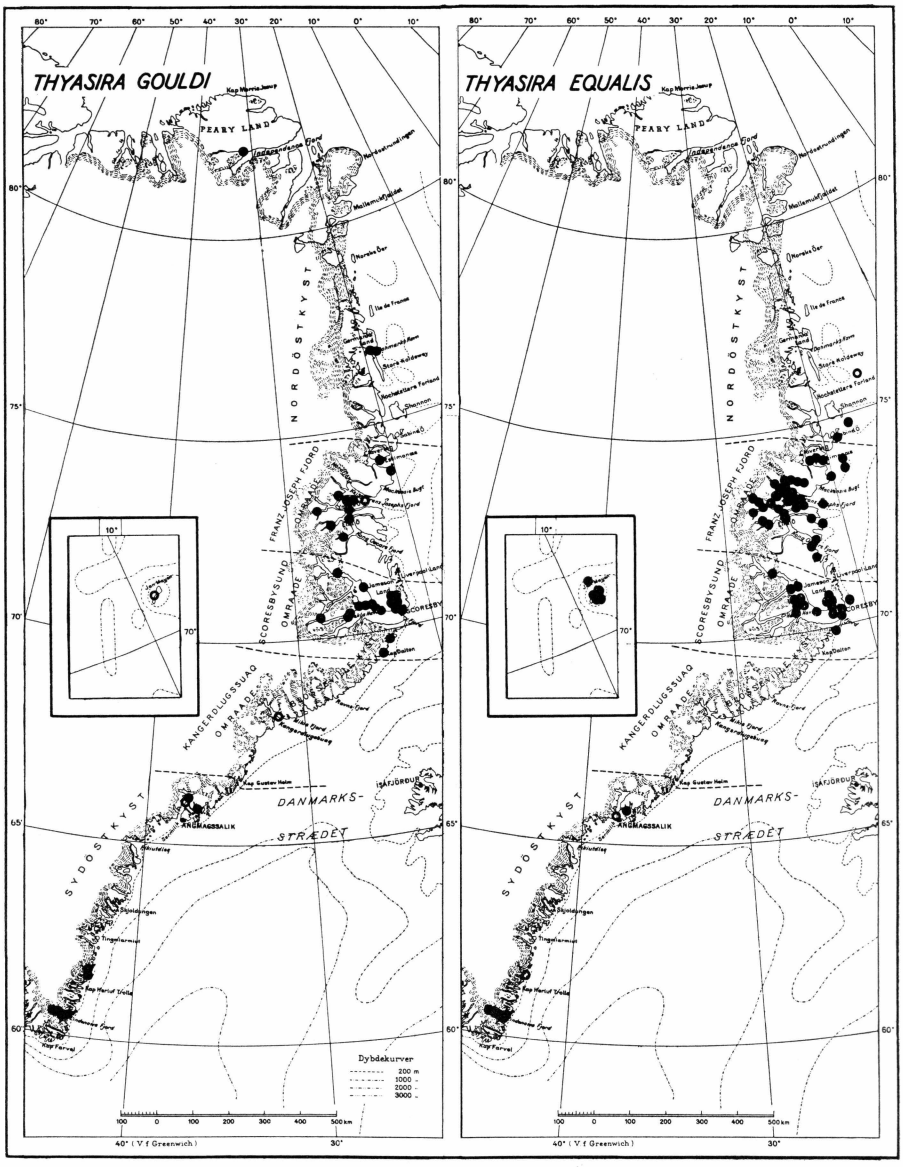

Fig. 6. Distribution of *Thyasira gouldi* (PHILIPPI) and *Thyasira equalis* (VERRILL & BUSH) along East Greenland and at Jan Mayen. — Full circles: Living animals. Open circles: Shells or valves only.

and half-grown animals; Outer part of Moskusoksefjord, 220 m, clay, 3 animals (HÄGG, as *Axinus flexuosus*); Moskusoksefjord, off Ankerbjerg valley, 35—45 m, red clay, sand, gravel, 23 adult and half-grown animals (2 finds) — Off Ankerbjerg, 95 m, fat clay, big stones, 2 adult and 2 half-grown animals — Off Høgboms Bjerg, 200 m, fat clay, 11 adult and half-grown animals; Inner part of Moskusoksefjord, 100 m, clay, 2 animals (HÄGG, as *Axinus flexuosus*);

Geologfjord, off Agardhs Bjerg, 375 m, fine, grey clay with fine gravel, 1 half-grown animal; Geologfjord, $^1/_2$ mile from Nunatakgletscher, 410 m, fine, grey clay with fine gravel, 6 adult animals; Eleonore Bugt, 23 m, fat clay, some stones, 1 adult animal — 130 m, tough clay, pebbles, 13 adult and half-grown animals; Between Eleonore Bugt and Ymers Ø, 460 m, tough, red and grey clay, 1 adult, 2 half-grown, and 1 young animals, 1 adult valve; 1 mile E. of Robertson Ø in Sofia Sund, 310 m, reddish clay, 2 adult and 3 half-grown animals; Sofia Sund, a little E. of Botanikerbugt, 210 m, clay, big stones, 1 adult animal; E. part of Antarctics Sund, 410 m, fat, grey clay, some larger stones, 2 half-grown animals; Inner part of Kejser Franz Josephs Fjord, 73°06′ N. 27°17′ W., ca. 40—70 m, mud, stones, 4 adult and 1 half-grown animals; Inner part of Kejser Franz Josephs Fjord, 73°15′ N. 25°42′ W., 760 m, ooze, sand, stones, 16 adult and half-grown animals; Off Blomsterbugten, inner part of Kejser Franz Josephs Fjord, 575 m, tough, fine, grey clay, a few stones, 1 adult shell; Off Ättestupan, inner part of Kejser Franz Josephs Fjord, 780 m, very loose, grey clay, 2 adult animals; Off Engdalen, inner part of Kejser Franz Josephs Fjord, 230 m, grey clay with stones, 10 adult and half-grown animals; Off Haredalen, in Isfjord, 240 m, tough clay, stones, 3 half-grown animals; 3 miles from the large glacier at the head of Isfjord, 430 m, fine, grey clay, sand, 1 adult and 1 half-grown animal; Off the mouth of Kjærulfs Fjord, 630 m, fine, loose, grey clay with gravel, 4 adult and 4 half-grown animals; 6 miles S.E. of Franklin Ø, 210 m, tough clay, gravel, 7 adult animals; E. parts of Vega Sund, 72°45′ N. 22°56′ W., 35—60 m, mud, some stones, 6 adult animals; Solitærbugt, Ella Ø, 5—24 m, 5 adult animals — 20—52 m, 11 adult animals, 1 adult shell (several finds); Solitærbugt, off Delta, 45 m, greyish-brown clay, 7 adult animals; Off the bend of Dickson Fjord, 640 m, fine, loose clay and sand, 1 adult and 3 half-grown animals; Kap Hedlund, 4—27 m, 1 adult animal; Off Drømmebugt in Davy Sund, 225 m, clay, gravel, stones, 3 adult animals; Antarctics Havn, 72°01′ N. 23°03′ W., 32—40 m, mud, 1 adult animal; Fleming Fjord, 222 m, red clay, 4 adult and 2 half-grown animals.

Scoresby Sund Area: Off Raffles Ø, 235—255 m, sand, gravel, stones, 2 adult animals (2 finds); Off Kap Tobin, 123 m, gravel and clay, 2 adult and 2 half-grown animals; Section between Kap Tobin and Kap Brewster, 340 m, fine, soft clay, about 25 adult and half-grown animals (2 finds) — 530 m, very soft clay, gravel, stones, 1 half-grown animal; Between the mouth of Hurry Inlet and the S. coast of Scoresby Sund, 245 m, sandy clay, 2 adult animals; Off the mouth of Hurry Inlet, 140—153 m, brown clay, gravel, sand, about 35 adult and half-grown animals (4 finds); The mouth of Hurry Inlet, 140—150 m, clay, gravel, stones, about 30 adult and half-grown animals (4 finds); Hurry Inlet, 70°43′ N. 22°29′ W., ca. 70 m, mud, 7 adult and 1 half-grown animals; Hurry Inlet, at Constable Pynt, 22—24 m, very soft clay, 2 adult animals, 1 adult valve (2 finds); Off Constable Pynt, 44—46 m, tough clay, 3 adult animals (1 with mature sperm, 7-7-33) (2 finds); In the middle of Hurry Inlet, off Constable Pynt, 89—92 m, clay, 19 adult and half-grown animals, 1 adult shell (4 finds); E. side of Hurry Inlet, off Constable Pynt, 31—45 m, clay, 11 adult and 1 half-grown animals (4 finds) — 91 m, clay, 7 adult and 2 half-grown animals; Hurry Inlet of Fame Øer, 19 m, very tough clay, 4 adult animals; Off Kap Hooker, 67 m, clay, sand, 17 adult and half-grown animals (4 finds) — 140—142 m, clay, sand, gravel, 14 adult, half-grown, and young animals (4 finds) — 220 m, clay, gravel, 5 adult and 1 half-

grown animals (2 finds); Section between Kap Leslie and Jameson Land, 180—182 m, tough clay, 8 adult animals (2 finds); Off Kap Leslie, 260 m, loose clay, gravel, 3 adult and 3 half-grown animals; Kap Leslie, 88—92 m, glittering clay, 16 adult and half-grown animals (2 finds); Section between Kap Stevenson and Kap Leslie, 106 m, soft clay, 1 adult animal; Noa Vig in Milne Land, 10—15 m, very soft clay, 5 adult animals (1 with sperm, 1 with large, immature eggs, 26-8-33); Hall Fjord, off Noa Vig, 500 m, clay and gravel, 2 adult animals; W. coast of Jameson Land opposite Bjørneøer, 29—31 m, tough clay, 3 adult animals (3 finds) — 51—78 m, clay, 9 adult and 2 half-grown animals (2 finds) — 91—123 m, clay, stones, 5 adult and 5 half-grown animals (3 finds); At Bjørneøer, 333—337 m, tough clay, 2 adult animals (2 finds); Nordbugten in Nordvestfjord, 28—30 m, loose clay, 10 adult animals (4 finds) — 56—63 m, soft clay, 34 adult and half-grown animals (6 finds) — 107—163 m, soft and loose clay, 39 adult and half-grown animals (7 finds) — 325—339 m, loose and soft clay, 22 adult and half-grown animals (4 finds); N. of Stewart Ø, 298 m, clay with stones, 4 adult and 1 young animals.

Sydøstkyst Area: Ikerasagssuaq, 235 m, soft clay, 1 adult animal; Sermilik, settlement Íkáteq, 200 m, 1 adult valve (drilled by *Natica*); Qutdlît N. of Kap Tordenskjold, 30 m, sand, a little mud, 1 half-grown shell; Nanûseq N. of Lindenows Fjord, 150—175 m, clay, 1 adult animal; Lindenows Fjord, the mouth, 400—600 m, clay, Foraminifera, 6 adult animals; Lindenows Fjord, outer part, 65 m, clayey sand, 1 adult animal — 100 m, clay, 1 adult and 1 half-grown animal; Lindenows Fjord, middle part, 40—75 m, clay, rocks, 2 adult, 1 half-grown, and 1 young animals (4 finds) — 90—120 m, clayey sand, and fine sand, 2 adult and 1 half-grown animals (3 finds) — 125—150 m, clay, about 85 adult, half-grown and young animals, 1 adult shell (drilled by *Natica*); Lindenows Fjord, inner part, 40—50 m, clay, 1 adult animal — 64—91 m, clay, about 40 adult, half-grown, and young animals (5 finds) — 100—150 m, clay, about 150 adult, half-grown, and young animals (3 finds); Lindenows Fjord, inner most part, 45 m, clay, 6 adult animals — 90 m, 14 adult and half-grown animals (2 finds).

Jan Mayen Area: Jan Mayen, 94—113 m, mud, 5 adult valves (1 drilled by *Natica*) (2 finds); 70°54′ N. 8°24′ W., 128 m, dark-grey, sabulous clay, 11 adult animals, 4 adult shells (3 drilled by *Natica*), 1 adult valve (erroneously referred to *A. flexuosus* var. *gouldi* by Friele, Friele & Grieg); 70°50′ N. 8°29′ W., 162 m, about 100 adult, half-grown, and young animals, about 50 adult and half-grown valves (about 25 drilled by *Natica*); 70°51′ N. 8°20′ W., 174 m, dark-grey, sabulous clay, 11 adult animals, 3 adult shells (all drilled by *Natica*), 1 adult valve (erroneously referred to *A. flexuosus* var. *gouldi* by Friele, Friele & Grieg); 70°58′ N. 8°04′ W., 357 m, dark-grey, sabulous clay, 1 adult animal. [71°12′ N. 8°38′ W., 1275 m, grey clay, 12 adult and half-grown animals].

The species is thus known to live from S.E. of Shannon in the N. to Lindenows Fjord in the S. with a vertical range from 10—15 m (Milne Land) down to 780 m (inner part of Kejser Franz Josephs Fjord) being equally distributed in the inner parts of the large fjords and in places near the open sea. It is also common at Jan Mayen, where it has been taken, however, only from depths below 100 m. Although it has not hitherto been met with in the Kangerdlugssuaq Area, it must

be supposed to occur in deeper water along the whole East Greenland coast. The majority of the finds were obtained from depths exceeding 100 metres, and only comparatively few are derived from less than 50 m. In that respect there is thus a distinct difference between the ecology of the present species and that of *T. gouldi*.—The bottom from which it was obtained was generally loose or tough clay with or without a content of coarser components. It will appear from the above that the species is a common member of the *Astarte crenata* and the Foraminifera communities at E. Greenland. Actually most of the finds

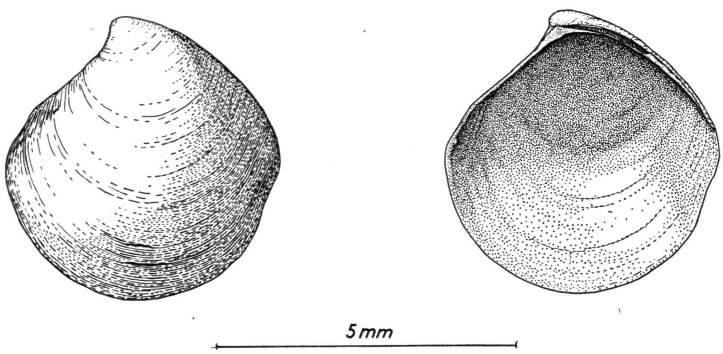

Fig. 7. *Thyasira equalis* (Verrill & Bush). Drawn from a specimen taken S. of Jan Mayen, 70°50′N.8°29′W., 162 m.

from these communities listed as *Axinus flexuosus* by Spärck (1933) and Thorson (1933, 1934b) should be referred to it. Locally the species was met with in large numbers. Thus, in Nordfjord off Waltershausen Gletscher, 120 m, very fine, loose, grey clay, it occurred in a number corresponding to about 250 individuals per m^2, and in Moskusoksefjord, 45 m, clay, sand, gravel, it was taken in a number corresponding to 200 individuals and a weight of 4.5 gr. per m^2 (Spärck 1933).

It seems also noteworthy that a single dredge-haul in the inner part of Lindenows Fjord, 100—150 m, clay, yielded about 120 individuals of the species, and another one, at Jan Mayen, 162 m, yielded about 100 animals besides many valves.

Remarks: Although there is some variation within the material from E. Greenland and Jan Mayen, the species is easily identified when once recognised. Along the postero-dorsal margin it has a slightly sunken, lanceolate portion clearly marked off by an incised line, and the radiating undulation on the posterior part is broad and shallow. Also, the hinge-margin is essentially the same in both valves, the vestige of a cardinal tooth noticeable in *T. gouldi* is lacking, and the hinge-margin is thinner than in specimens of *T. gouldi* of the same size. In

the larger specimens the height of the shell most often exceeds the length, the outline being somewhat pyriform. In some specimens, however, length and height are about equal and the outline more evenly rounded. The ten largest specimens at hand from E. Greenland measure (length × height × breadth of shell): 8.8 × 10.0 × 6.8 — 8.3 × 9.3 × 6.2 — 7.2 × 8.0 × 4.8 — 7.2 × 7.4 × 4.6 — 6.5 × 7.2 × 4.7 — 6.4 × 6.9 × 4.3 — 6.1 × 6.6 × 4.2 — 6.0 × 6.6 × 4.0 — 5.6 × 5.8 × 3.4 and 5.5 × 6.2 × 3.9 mm, respectively. At E. Greenland the species thus seems to grow to a larger size than that attained by specimens from N.E. America. In the majority of the specimens at hand, however, the length does not exceed about 5 mm.—Dark-brown or black incrustations at the margins in front of and behind the umbo are common.

Since it has not been recognised by previous European authors, it must be supposed that several of the records of *T. flexuosa* in the literature cover the present species. The fairly large collections at hand, however, seem to allow of a classification as to the main distribution of the species, and some brief notes on its occurrence in areas outside E. Greenland and Jan Mayen are given below.

Distribution: N.E. America between 47°40′ N. 47°35′ W., and 37°08′ N. 74°33′ W., at 170 to 2810 m (Verrill & Bush 1898; Dall (1901, p. 787) also lists *Cryptodon croulinensis* var. *altus* Verrill & Bush under this species and states that the distinguishing character of the latter is inconstant), West Greenland (animals present from Bredefjord northward to 69°17′ N. 52°50′ W., at 25 to 686 m; probably the species occurs along the whole coast of W. Greenland), East Greenland, Jan Mayen, Spitzbergen (1 adult shell from Kings Bay, 56—75 m; see also the revision of the determinations by Friele & Grieg below), the Kara Sea (without exact locality, 1 adult valve being present from 155 m), N. and E. Iceland (animals present from off Eyjarfjördur to Reydarfjördur at depths between 26—53 and 415 m; most of the records of *T. flexuosa* from deeper water along these coast stretches in J. Madsen (1949) should be referred to the present species), N.W. Iceland (Talknafjördur, 1 shell only), S.E. Iceland (Lonsvik, 75 m, 1 shell only), N.E. of the Faroes (62°35′ N. 4°04′ W., 620—640 m, 1 animal).

An examination of the collections of the Norwegian North Atlantic Expedition listed as *T. flexuosa* in Friele & Grieg (1901, p. 31) showed that this species was actually not taken. The specimens from stations 253, 261, Balestrand, and Husø, belong to *Thyasira* spec. a, whereas animals of *T. equalis* are present from stations 18, 31, 87, 137, 192, 223, 224, 225, 253, 261, 262, 267, 273, 323, 326, 337 (338), and 357, and, 1 shell only, from station 33. The specimens from Spitzbergen, Advent Bay, and Magdalena Bay, collected by the same expedition, are

T. gouldi. Besides, several other lamellibranch species, which have also been misidentified, are present in these samples.

Main distribution: Probably panarctic and abyssal (in the N. Atlantic only). Vertical range: From 10—15 m (N.E. Greenland) down to 2810 m (off N.E. America).

Biology: None of the animals from E. Greenland examined proved to contain quite mature eggs, and thus it would seem that spawning does not take place in the summer months. However, one animal (from Noa Vig, Milne Land, 28-8-33) had fairly large, yet apparently premature eggs measuring about 120 μ in diameter. So eggs ready to be spawned are probably slightly larger. This indicates that the larval developmet is lecithotrophic and the pelagic stage very short or quite suppressed. In 33 specimens derived from E. Greenland and Jan Mayen the size of the prodissoconch varied from 158 to 171 μ across with a mean of 165 μ.

34. *Thyasira croulinensis* (JEFFREYS).

Axinus Croulinensis JEFFREYS 1869 V, pl. 33, fig. 2.
Axinus croulinensis G. O. SARS 1878, pl. 19, figs. 8a—b.

Jan Mayen records:

Thyrasira croulinensis LAMY 1913b, p. 601.

Occurrence at Jan Mayen: 70°47′ N. 8°22′ W., 140 m, "1 dead specimen" (LAMY).

The species in question was not found in the Danish collections from E. Greenland and Jan Mayen and the find mentioned above is the only one from the region considered. However, as it is primarily a deep water species, future expeditions may secure it from the outer shelf of S.E. Greenland as well.

Distribution: W. Greenland, Jan Mayen (dead specimen only), S. and W. Spitzbergen, the Murman Coast, W. of Iceland, off N. Norway and along the Norwegian W. and S. coasts, the Skagerak, the British Isles, off S.W. Europe, the Canary Islands, the Azores, the Mediterranean, N. of Cape Cod (VERRILL & BUSH 1898, but not mentioned from that place by DALL 1901, and JOHNSON 1934), and off Bermuda. Main distribution: Low-arctic-boreal, Mediterranean-Atlantic, and abyssal. Vertical range: From about 25 m (New England) to about 2700 m (off S. and W. Ireland).

Biology: Reproduction unknown.

35 *Axinopsis orbiculata* G. O. Sars (cf. pl. 2, figs. 7—8).

Axinopsis orbiculata G. O. Sars 1878, pl. 19, figs. 11a—d.

East Greenland and Jan Mayen records:

Axinus orbicularis Friele 1878, p. 223.
Axinopsis orbiculata Friele & Grieg 1901, p. 30.
Axinopsis orbiculata Hägg 1904, pp. 44—45.
Axinopsis orbiculata Jensen 1905, p. 342.
Axinopsis orbiculata Odhner 1915, p. 105.
Axinopsis orbiculata Grieg 1916, p. 8.

Occurrence at East Greenland (cf. the map fig. 17, p. 178):

Nordøstkyst Area: Danmarks Havn, 0—9.5 m, mud mixed with sand, algae, 1 adult animal, 1 adult shell — 5.5—11 m, soft bottom, *Laminaria*, 4 adult animals, 4 adult shells, 7 adult valves (3 finds); Off Hvalrosodden, Danmarks Havn, 0—4 m, mud mixed with sand, stones, 5 adult animals, 3 adult valves; The Greenland Sea, 75°58½′ N. 14°08′ W., 300 m, brown and grey clay, "1 specimen" (Grieg); S. of Lille Pendulum, 74°35′ N. 18°23′ W., 18—21 m, sandy mud, algae, 2 adult animals; Sabine Ø, depth?, *Laminaria*, 2 adult animals — 5.5—9.5 m, 1 adult animal.

Kejser Franz Josephs Fjord Area: Mackenzie Bugt, 12—18 m, mud, 1 adult animal (Hägg); Duséns Fjord, inner part, 4—10 m, soft clay, 4 adult animals (resembling f. *inequalis*) — 15—20 m, *Laminaria*, *Fucus*, 1 adult animal; Eleonore Bugt, 23 m, fat clay with some stones, 8 adult and half-grown animals (6 resembling f. *inequalis*) — 130 m, tough clay with pebbles, 4 adult animals, 1 adult shell; Between Eleonore Bugt and Ymers Ø, 460 m, tough, grey and red clay, 1 adult animal; Karl Jakobsens Bugt, Ymers Ø, 4 m, clay, 3 adult animals, 1 adult valve — 14—16 m, clay, 3 adult animals; Solitærbugt, Ella Ø, 3 m, clay, brown algae, 1 adult animal (resembling f. *inequalis*) — 3—7 m, *Fucus*, *Desmarestia*, 1 adult animal — 5—24 m, 2 adult animals — 20—52 m, 2 adult animals; Inner part of Kejser Franz Josephs Fjord, 73°06′ N. 27°17′ W., 3—9 m, mud with sand, algae, 11 adult animals, 3 adult shells.

Scoresby Sund Area: Off Kap Hope, 3.25 m, sand, 1 adult animal — 7—12 m, sand, 30 adult and half-grown animals, 3 adult shells (2 drilled by *Natica*) (6 finds) — 10—13 m, sand, *Laminaria*, 3 adult animals — 20 m, sand, 9 adult animals; Off the mouth of Hurry Inlet, 15 m, sand, 1 adult animal — 20—28 m, sand, stones, algae, 2 adult animals; The mouth of Hurry Inlet, 14—21 m, sand, detritus of algae, 5 adult animals (2 finds) — 55—57 m, sandy clay, 12 adult animals (6 finds); 1 mile inside the mouth of Hurry Inlet, 14—16 m, sand, 5 adult animals (3 finds); Hurry Inlet, 0—13 m, clay and sand, 1 adult animal; Hurry Inlet, at Constable Pynt, 7—10 m, sand, 1 adult animal; Off Constable Pynt, 21—24 m, clay, 22 adult animals (6 finds); In the middle of Hurry Inlet, off Constable Pynt, 92 m, clay, 1 adult animal; Off Kap Hooker, 65 m, sand, 7 adult animals (1 with large, polygonal eggs, 3-7-33), 1 adult valve — 57—72 m, sand mixed with clay, 8 adult animals, 1 adult shell, 1 adult valve (6 finds); 8 miles W. of Kap Hooker, 12—13 m, clayey sand, 3 adult animals (2 finds); Kap Leslie, 54 m, glittering clay, 2 adult animals, 1 adult shell (2 finds); Hekla Havn at Danmarks Ø, depth?, mud, 2 adult animals; Nordostbugt, 4 miles from the mouth of Schucherts Flod, 30 m, light grey mud, 1 adult shell; Nordbugten in Nordvestfjord,

10—18 m, very loose, light grey clay, 9 adult animals — 28 m, loose clay, 1 adult animal — 157 m, soft clay, 1 adult animal; Turner Sund, 5.5 m, "18 specimens, 6 valves" (JENSEN).

Kangerdlugssuaq Area: Mikis Fjord, 3.5—4 m, sandy clay, 6 adult (5 with larger or smaller, immature eggs, 17-8-33), and 3 half-grown animals; Uttentals Sund, 6—8 m, 2 adult animals (one with mature, the other with large, but still immature eggs, 28-8-33).

Sydøstkyst Area: Ímíkêrteq, 65°45′ N. 36°58′ W., depth?, 1 adult shell; Tasîssaq near Angmagssalik, "Strømstedet", depth?, 2 half-grown animals; Tasîssaq, 10—12 m, 1 adult animal (with immature eggs, 8-8-33); Sermilik, 2nd E. fjord, 5 m, sandy clay, stones, 3 adult animals — 12—25 m, clay, 6 adult animals (with immature eggs, 24-7-33), 1 adult shell (2 finds); Sermilik, settlement Íkáteq, 25 m, 4 adult animals, 1 adult shell; Napassorssuaq N. of Kap Tordenskjold, 26 m, glittering sand, gravel, a little *Laminaria*, 1 adult (with nearly mature eggs, 25-6-35), 1 half-grown animal — 36—38 m, muddy sand, 12 adult animals (with mature or nearly mature eggs, 25-6-35) (2 finds); Qutdlît N. of Kap Tordenskjold, 13 m, rocks, *Laminaria*, red algae, 2 adult animals (with nearly mature eggs, 25-6-35) — 30 m, sand, a little mud, 15 adult animals; Kap Tordenskjold, depth?, 1 adult shell — 8 m, sandy clay, 7 adult animals — 11 m, *Laminaria*, 1 adult animal — 12 m, black clay, fragments of algae, 5 adult animals — 22 m, black clay, 1 adult animal (with immature eggs, 1-7-35) — 28—32 m, clay, 5 adult animals (2 finds) — 36 m, sandy clay, *Laminaria*, about 50 adult and half-grown animals (some with mature eggs, 30-6-35) — 55 m, clay, 3 adult and 1 half-grown animals, 1 adult shell; Nanûseq N. of Lindenows Fjord, 4 m, sand, 1 adult (with small, immature eggs, 19-7-35), and 2 half-grown animals; Lindenows Fjord, the mouth, 10—11 m, gravel, *Laminaria*, 2 adult animals, 2 adult shells (2 finds) — 25 m, sand, gravel, *Laminaria*, 1 adult animal; Lindenows Fjord, outer part, 10 m, sand and grey clay, 6 adult (1 with large, still immature eggs, 27-7-35) and 2 half-grown animals, 1 adult shell (drilled by *Natica*) (2 finds) — 47—58 m, dark grey clay, 3 adult animals (2 finds) — 100 m, clay, 1 adult valve; Lindenows Fjord, middle part, 11 m, sand, remnants of algae, 30 adult and half-grown animals (among 12 individuals examined, 6 contained smaller or larger, polygonal eggs, 26-7-35) — 16—27 m, sand, remnants of algae, *Laminaria*, 10 adult and half-grown animals (3 finds) — 40—50 m, clay, 2 adult animals (2 finds) — 125—150 m, clay, 1 adult animal; Lindenows Fjord, inner part, 40—64 m, clay, 1 adult animal, 1 adult shell (2 finds) — 150 m, clay, 1 adult animal; Lindenows Fjord, innermost part, 15—30 m, 6 adult animals — 36 m, sand, *Laminaria*, 3 adult and 2 half-grown animals — 100 m, clay, 1 adult valve; Qeqertatsiaq, 60—70 m, sand, gravel, dead bryozoans, 3 adult animals.

Jan Mayen Area: Jan Mayen, 19—28 m, "frequently occurring" (FRIELE, FRIELE & GRIEG); Jan Mayen, 104 m, fragments of 2 adult valves.

The species is thus known to occur at E. Greenland from Danmarks Havn in the N. to Qeqertatsiaq in the S. and, further, at Jan Mayen. At E. Greenland it ranges vertically from a few metres below the shore down to 460 m (between Eleonore Bugt and Ymers Ø). Most often, however, it was taken at depths not exceeding 50—70 m. The species

seems to prefer a bottom consisting of clay mixed with sand, but it was also found alive on almost pure sand and on soft or tough clay.

Remarks: The specimens from E. Greenland are subject to some variation. Generally the umbo is of an almost equilateral position, and the shell is evenly rounded. Some specimens, however, approach var. *inequalis* of VERRILL & BUSH (1898, p. 794, pl. 92, figs. 5—6) to a smaller or larger degree. The hinge-margin may also vary somewhat, as in some specimens present it is rather weakly developed, whereas in others it is clearly thickened. The dorsal edges just in front of and behind the umbo are very often provided with oblong, chestnut-coloured patches, and sometimes the latter are developed as crusts. The ten largest specimens at hand from E. Greenland measure (length × height × breadth of shell): 4.6 × 4.4 × 2.8 — 4.6 × 4.4 × 2.5 — 4.5 × 4.3 × 2.4 — 4.5 × 4.3 × 2.3 — 4.4 × 4.2 × 2.6 — 4.3 × 4.1 × 2.4 — 4.3 × 4.0 × 2.3 — 4.3 × 4.0 × 2.3 — 4.2 × 4.1 × 2.1 and 4.2 × 4.0 × 2.2 mm, respectively. The species thus reaches its maximum size at E. Greenland.

Distribution: West Greenland, East Greenland, Jan Mayen, Spitzbergen, Novaya Zemlya, the Kara Sea, the Siberian Ice Sea, the Murman Coast, E. and W. Finmark, Iceland, Labrador, Newfoundland, Nova Scotia, and the Bay of Fundy. The species extends southward to N. of Cape Cod, N. of the Hebrides, and Bodø (Norway). Main distribution: Panarctic, Atlanto-arctic. Vertical range: From 2—3 m (several places in the Arctic) down to 944 m (N. of the Hebrides).

Biology: The gonads of about 60 individuals from E. Greenland were examined. The eggs are almost spherical, measuring 160—175 μ in diameter (from material preserved in alcohol), and no gelatinous envelope was observed. According to the egg-size in this tiny species, a lecithotrophic development of the larva with a very short or entirely lacking pelagic stage must be assumed. Spawning at E. Greenland may probably take place rather late in the summer. Although more than half the number of animals examined contained larger or smaller, immature eggs, or quite mature eggs, no individuals with sperm were at all found. As the material includes no animals less than about 1.5 mm in length—the smaller ones were presumably lost when the samples were taken—it is impossible to decide whether the species is a protandric hermaphrodite.

36. *Serripes groenlandicus* (BRUGUIÈRE).

Aphrodite grönlandica G. O. SARS 1878. pl. 5, figs. 3 a—b.
Cardium (Serripes) groenlandicum, JENSEN 1912, pl. 3, figs. 12a—b (young).

East Greenland and Jan Mayen records:

Cardium groenlandicum MÖBIUS 1874, p. 251.
Cardium groenlandicum FRIELE 1878, p. 222.

Cardium (*Serripes*) *groenlandicum* BECHER 1886, p. 70.
Cardium groenlandicum POSSELT 1895, p. 70.
Cardium (*Serripes*) *groenlandicum* POSSELT & JENSEN 1898, p. 56.
Serripes groenlandicum FRIELE & GRIEG 1901, p. 34.
Cardium groenlandicum HÄGG 1904, p. 50.
Cardium (*Serripes*) *groenlandicum* JENSEN 1905, pp. 353—354.
Cardium (*Serripes*) *groenlandicum* JENSEN 1912, pp. 85—86.
Cardium groenlandicum ODHNER 1915, p. 117.
Cardium (*Serripes*) *groenlandicum* LAMY 1926, pp. 179—180.
Cardium groenlandicum THORSON 1936, p. 62; on reproduction.

Occurrence at East Greenland (cf. the map fig. 8, p. 115):

Nordøstkyst Area: Danmarks Havn, 0—11 m, muddy bottom, sand, *Laminaria*, 1 half-grown and 3 young animals, 1 adult, 1 half-grown and 4 young shells, 4 adult valves, some fragments (8 finds) — 9.5—15 m, soft bottom, *Laminaria*, *Delesseria*, 1 young animal, 1 adult shell, 2 adult valves (2 finds) — 19—28 m, *Delesseria*, red algae, 1 half-grown animal, 2 adult shells (2 finds); Stormbugt at Danmarks Havn, 9.5—19 m, soft bottom, *Laminaria*, 1 young animal, 10 adult valves — 19—28 m, *Delesseria*, 1 adult worn valve; Hvalrosodden at Danmarks Havn, on the shore, 1 adult, worn shell — 0—4 m, sand, 3 half-grown animals; Koldewey, 76°28′ N. 18°20′ W., on the shore, 1 adult shell, 1 adult valve, some fragments; S. of Lille Pendulum, 74°35′ N. 18°23′ W., 18—29 m, sandy mud, algae, 2 half-grown animals; Sabine Ø, depth?, *Laminaria*, 1 adult animal.

Kejser Franz Josephs Fjord Area: Zackenbergbugt, Wollaston Forland, on the shore, 1 adult valve; Sandø, Tyrolerfjord, on the shore, 1 adult shell, 4 fragments; S.E. of Clavering Ø, 74°10′ N. 20°08′ W., 25—40 m, mud, many shells and pebbles, 2 adult and 1 young animals; Kap Stosch, ca. 15 m, 1 adult animal; 10 km N. of Loch Fyne, on the shore, 1 adult shell, 1 adult valve; Mackenzie Bugt, 12—35 m, mud, 3 animals (HÄGG); Vinterøer at the mouth of Duséns Fjord, 15—30 m, stones and algae, 1 adult animal; Moskusoksefjord, 15 m, 1 adult animal, 1 adult valve; Moskusoksefjord, off Ankerbjerg valley, 17—21 m, red clay, rather big stones, 1 adult shell; Eleonore Bugt, 15—27 m, gravel, large stones, 2 adult animals; Off Haredalen, Isfjord, 30—35 m, loose, brown clay, 5 adult animals; Solitærbugt, Ella Ø, depth?, 1 adult animal — 4—40 m, 2 adult animals; Kap Hedlund, depth?, 1 adult animal — 14—17 m, clay, shells, stones, 2 adult and 2 half-grown animals (4 finds) — 4—27 m, 1 half-grown animal; "East Greenland" (MÖBIUS, who did not give any further information).

Scoresby Sund Area: The mouth of Hurry Inlet, 19 m, clay, 1 adult and 2 half-grown animals; Hurry Inlet, 1 mile inside the mouth, 14—16 m, sand, 3 adult animals (3 finds); Hurry Inlet, 0—13 m, clay and sand, 2 adult and 1 half-grown animals, 1 half-grown valve; Hurry Inlet, at Constable Pynt, 7—10 m, sand, 5 half-grown and young animals; Hurry Inlet, at Fame Øer, 8—12 m, gravel, stones, *Laminaria*, 1 young animal — 15—18 m, soft clay, *Laminaria*, red algae, 1 adult animal; Fame Øer, 70°50′ N. 22°33′ W., ca. 9 m, mud, algae, 4 half-grown and 1 young animals; Off Kap Hooker, 65 m, sand, 1 young animal; 8 miles W. of Kap Hooker, 12—14 m, sand mixed with clay, 6 adult, 24 half-grown and 4 young animals, 2 shells (1 drilled by *Natica*) (10 finds); Nordbugten in Nordvestfjord, 10—18 m, very loose, light-grey clay, 3 adult animals; Hekla Havn, Danmarks Ø, depth?, 4 adult animals;

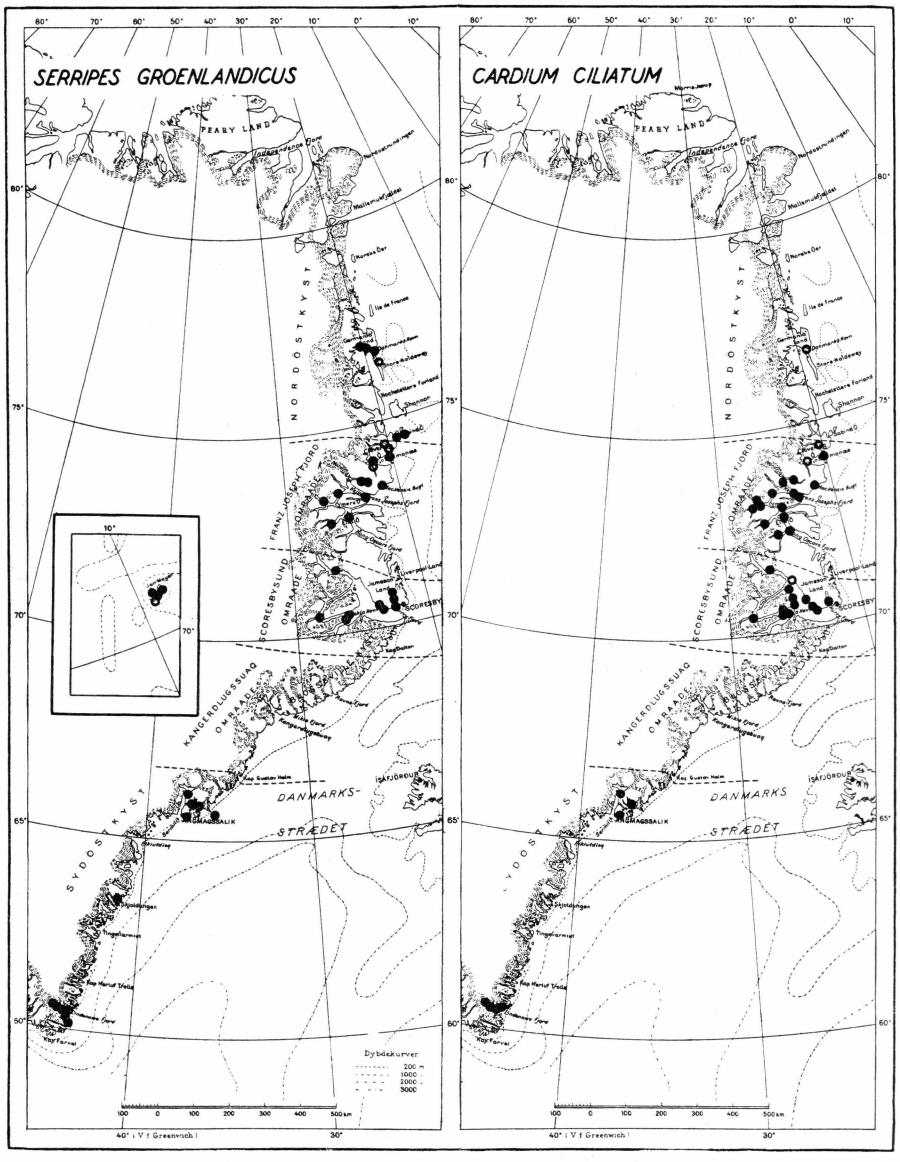

Fig. 8. Distribution of *Serripes groenlandicus* (BRUGUIÈRE) and of *Cardium ciliatum* FABRICIUS along East Greenland and at Jan Mayen. — Full circles: Living animals. Open circles: Shells or valves only.

S.E. of Danmarks Ø, 10—17 m, soft clay with gravel, 1 young animal; The bay opposite to Rødeø in Rødefjord, 7—10 m, clay, *Fucus*, 1 adult animal — 13—18 m, soft clay, with gravel, 5 half-grown animals.

Sydøstkyst Area: Off Angmagssalik, 65°40′ N. 35°32′ W., 47—75 m, clay with small stones (POSSELT & JENSEN, JENSEN); Angmagssalik, 0—17 m, 1 adult animal, 1 adult shell (2 finds) — ca. 25 m, 1 adult animal; Angmagssalik,

off the harbour, 45 m, 1 adult shell; Fjord inside Kûngmiut, 20 m, sandy clay, small quantities of *Desmarestia*, 1 adult animal; Ikerasaussaq, 0—10 m, *Fucus*, *Laminaria*, 1 adult animal; Sermilik, 2nd E. fjord, 5 m, sandy clay, 1 half-grown animal — 12 m, sandy clay, 1 young animal; Skjoldunge Fjord, 63°32′ N. 41°50′ W., $2^1/_2$—20 m, clay, 3 half-grown animals; Nanûseq N. of Lindenows Fjord, 40 m, sand, clay, 1 adult animal; Lindenows Fjord, the mouth, 8—12 m, gravel, *Laminaria*, 2 half-grown animals; Lindenowsfjord, outer part, 48—52 m, sand, and dark grey clay, 2 young animals (2 finds); Lindenows Fjord, middle part, 8 m, gravel, sand, 1 half-grown animal — 10—16 m, sand, *Laminaria*, remnants of algae, 3 half-grown and 2 young animals, 1 adult shell (3 finds) — 22—32 m, sand, *Laminaria*, remnants of algae, 2 half-grown and 4 young animals (3 finds) — 40—50 m, clay, 2 young animals (2 finds); Lindenows Fjord, inner part, 25—50 m, clay, gravel, sand, 2 adult, 8 half-grown and young animals (4 finds); Lindenows Fjord, innermost part, 15—30 m, clay, gravel, algae, 15 adult, half-grown, and young animals (3 finds); Qeqertatsiaq, 60—70 m, sand, gravel, dead bryozoans, 1 half-grown animal.

Jan Mayen Area: "Drivvedsbugten" 70°55′ N. 8°30′ W., 14—21 m, black sand, 3 adult and 1 half-grown animals; Mary-Muss-Bugten, 23 m, black sand, 7 adult animals; Jan Mayen, 20 m, stones, algae, sand, and 30 m, rocky bottom with sand, "17 specimens" (BECHER); Jan Mayen, 19—38 m, "numerous" (FRIELE, FRIELE & GRIEG); E. of Jan Mayen, 30 m, sand, 1 young animal (HÄGG); Jan Mayen, 104 m, muddy bottom, 3 adult shells (1 drilled by *Natica*), 9 adult valves — 94—113 m, shells only (JENSEN); 70°59′ N. 8° 40′ W., depth?, 2 valves (LAMY); Jan Mayen, 2 miles S.E. of Jameson Bay, depth?, 4 animals (LAMY). [N. of Jan Mayen, 72°01′ N. 8°33′ W., 2400 m, ooze, 1 shell (HÄGG); 67°63′ N. 10°19′ W., 1900 m, 1 fragment of a right valve (JENSEN)].

At E. Greenland the species is thus known to occur from Danmarks Havn in the N. to Qeqertatsiaq in the S., and it is also common at Jan Mayen. However, it has not yet been found in the Kangerdlugssuaq Area, where, according to its distribution in other parts of E. Greenland, it must be assumed to live. The vertical range for living specimens at E. Greenland is from 0—4 m (Hvalrosodden at Danmarks Havn) to 60—70 m (Qeqertatsiaq). The species has been taken from various kinds of bottom, viz. sand, gravel, clay, and mud. At least at E. Greenland, however, the preferred type of bottom seems to be sand, and sandy clay. This is illustrated by fig. 9, p. 117, which is based upon the number of animals and the number of finds obtained from different types of bottom at E. Greenland and expressed in percentages of the total. These frequency polygones also show a distinct difference between the present species and *Cardium ciliatum* as regards choise of substratum.

As to weight, the species may locally constitute a considerable part of the whole infauna of the *Gomphina fluctuosa* community and the transitional zone between this and the Arctic *Macoma* community. This is exemplified by the species having been found off Kap Hooker, 12—14 m, sand with clay, in an average number of 6 adults and 28

juveniles per m², weight 34.9 gr., while the total weight of the bottom fauna amounted to about 270 gr. per m². Further, in Hurry Inlet, 1 mile inside the mouth, 13—16 m, sand, it occurred in an average number

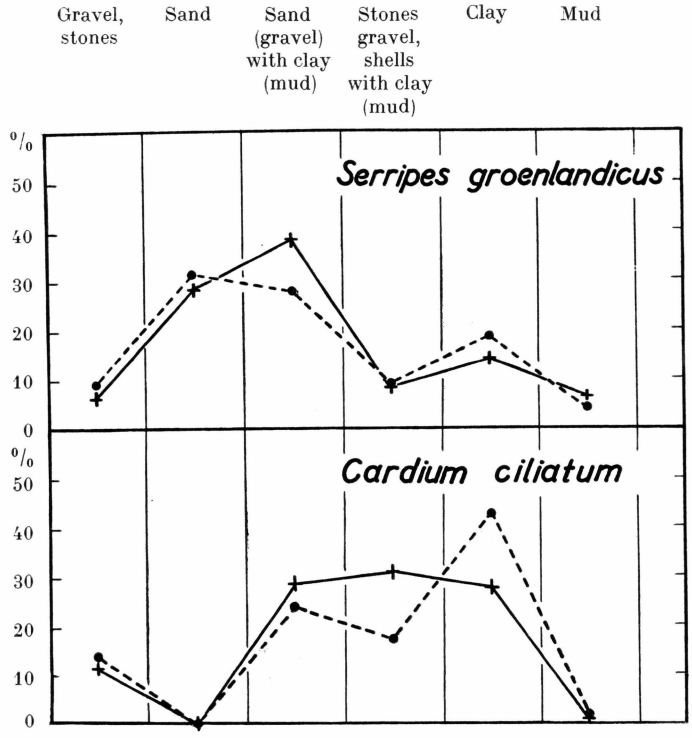

Fig. 9. Relative frequency of *Serripes groenlandicus* (BRUGUIÈRE) and of *Cardium ciliatum* FABRICIUS on different types of bottom expressed in percentages of the total number of animals found (full lines, crosses) and in percentages of the total number of samples (broken lines, dots). Based upon the material from East Greenland.

of 1.5 individuals per m², with a weight of 28.8 gr., while the total weight of the bottom fauna averaged only about 70 gr. per m² (THORSON 1934b).

Remarks: Although there is a remarkable variation within the material from E. Greenland, a distinction between different forms does not seem convenient (cf. also JENSEN 1912, pp. 88—89). Ten of the largest, intact specimens from E. Greenland measured (length × height × breadth of shell): 78.3 × 61.5 × 42.0 — 70.6 × 53.7 × 35.5 — 67.3 × 52.2 × 32.8 — 58.3 × 46.9 × 32.3 — 57.5 × 44.1 × 32.9 — 54.1 × 43.0 × 25.5 — 53.4 × 42.3 × 27.9 — 46.7 × 37.4 × 24.2 — 45.4 × 37.7 × 23.0 and 43.0 × 34.2 × 22.0 mm, respectively. The maximum size of the species

is about 110 mm (specimens from W. Greenland).—The shells of larger specimens are very often superficially eroded, and crusts of bryozoans and *Spirorbis*-tubes were attached to some of the empty shells and valves at hand.

The shells of East Greenland specimens often show very conspicuous, concentric marks, which may be "year-rings". If so, the species seems to attain a considerable age. Thus, three specimens, 58.3, 53.4, and 46.7 mm in length, appeared to be 14, 11, and 12 years old, respectively.

Distribution: W. and E. Greenland, Jan Mayen, Spitzbergen, Novaya Zemlya, Franz Joseph Land, the Barents Sea, the Murman Coast, the White Sea, the Kara Sea, the Siberian Ice Sea, Kamchatka, the Bering Strait and the Bering Sea, the Aleutians, Alaska, the Sea N. of America, Parry Islands, Baffinland, the Hudson Strait, Labrador, Newfoundland, the Gulf of St. Lawrence, Nova Scotia, and Iceland. The species extends southward to Hakodadi (Japan), Puget Sound, Cape Cod, S. Iceland, and Porsangerfjord (N. Norway). Main distribution: Panarctic and circumpolar. Vertical range: From 0—1 m (Iceland) to 303 m (W. Greenland). Empty shells are known from the N. Atlantic down to 2450 m.

Biology: According to Thorson (1936) the species is a distinctly protandric hermaphrodite. — None of the animals from E. Greenland examined were found to contain quite mature eggs. However, an animal from E. Iceland (Vopnafjördur, 11 m, 14-6-99) had apparently ripe eggs whose yolk mass measured about 95 μ in diameter and was not particularly rich in nutrient matter. Eleven measurements of prodissoconch I of young animals from Iceland varied from 156 to 169 μ across, with a mean of 162 μ, while 10 measurements of prodissoconch II varied from 342 to 355 μ, with a mean of 347 μ. On comparing the egg-size with the size of prodissoconch II the larval development must be supposed to be planktotrophic and with a pelagic stage.

37. *Cardium* (*Clinocardium*) *ciliatum* Fabricius.

Cardium ciliatum G. O. Sars 1878, pl. 5, figs. 4a—b.
Cardium ciliatum Jensen 1912, pl. 3, fig. 10 (young).

East Greenland records:

Cardium ciliatum Posselt 1895, p. 70.
Cardium ciliatum Posselt & Jensen 1898, p. 59.
Cardium ciliatum Hägg 1904, pp. 51—53.
Cardium ciliatum Jensen 1905, p. 352.
Cardium ciliatum Jensen 1912, p. 80.
Cardium ciliatum Odhner 1915, p. 120.
Cardium ciliatum Thorson 1936, p. 51, et sequ.; on reproduction.

Occurrence at East Greenland (cf. the map fig. 8, p. 115):

Nordøstkyst Area: Stormbugt, Danmarks Havn, 9.5—19 m, soft bottom, *Laminaria*, 1 adult shell.

Kejser Franz Josephs Fjord Area: S.E. of Clavering Ø, 74°10′ N. 20°08′ W., 25—40 m, mud, many shells and pebbles, 2 adult animals; Zackenberg Bugt, Wollaston Forland, on the shore, 2 adult shells; Kap Stosch, on the shore, 1 adult valve — ca. 15 m, 1 half-grown shell (drilled by *Natica*); Mackenzie Bugt, 12—35 m, mud, 2 animals (HÄGG); Kejser Franz Josephs Fjord, 73°16′ N. 23°15′ W., 28—36 m, clay, shells, stones, gravel, sand, 1 adult and 1 half-grown animal; Vinterøer at the mouth of Duséns Fjord, 15—30 m, stones, algae, 3 half-grown animals; Between Kap Graah and Vinterøer, 56 m, tough, greyish-brown clay, a little gravel, 1 adult animal; The mouth of Duséns Fjord opposite Kap Graah, 15—40 m, clay, stones, *Desmarestia* and red algae, 14 adult and 1 young animals (3 finds); Nordfjord, off the River, 10—25 m, loose clay, 1 half-grown animal; Moskusoksefjord, 15 m, 15 adult and half-grown animals; Eleonore Bugt, at the anchoring place, 23 m, fat clay with some stones, 3 adult and 2 half-grown animals; Eleonore Bugt, 3.5—12 m, clay, *Fucus*, *Laminaria*, *Desmarestia*, 4 adult animals — 15—27 m, clay, *Laminaria*, *Desmarestia*, 12 adult and half-grown animals, 1 adult shell — 130 m, tough clay with pebbles, 1 young shell; Off Engdalen, inner part of Kejser Franz Josephs Fjord, 27—37 m, loose, brown clay, 2 adult and 9 half-grown animals (2 finds) — 50—55 m, loose, brown clay, 1 adult animal; Off Haredalen, Isfjord, 27—35 m, loose, brown clay, 21 adult and half-grown animals (2 finds); Inner part of Kejser Franz Josephs Fjord, 73°06′ N. 27°27′ W. ca. 3—9 m, mud with sand and algae, 5 adult, 7 half-grown and young animals; Karl Jakobsens Bugt, Ymers Ø, 8 m, clay, 1 half-grown animal — 13—20 m, clay, 4 adult and 1 half-grown animals (4 finds) — 27 m, clay, 1 adult animal; Solitærbugt, Ella Ø, 11—14 m, shells, *Desmarestia*, *Laminaria*, 10 adult and half-grown animals (2 finds) — 17—25 m, stones, *Desmarestia*, 10 adult animals (3 finds) — at all depths from 2 to 52 m, clay, shells, stones, pebbles, algae, about 200 adult, half-grown, and young animals (about 25 finds); Kap Hedlund, 4—27 m, clay, shells, pebbles, stones, about 130 adult, half-grown, and young animals (at least 7 finds) — 20—53 m, clay, shells, pebbles, about 65 adult and half-grown animals (5 finds); Åkerblom's Ø, Kong Oscars Fjord, 20 m, stony bottom, 1 adult animal; Forsblads Fjord, the mouth, 5.5—26 m, 2 adult animals, 1 adult shell.

Scoresby Sund Area: Hurry Inlet, 19 m, clay, 1 adult and 2 half-grown animals, 2 adult shells; Off Kap Hooker, 62—67 m, sand mixed with clay, 2 half-grown animals (2 finds); 8 miles W. of Kap Hooker, 12—14 m, clay mixed with sand, algae, 3 adult, 2 half-grown and 2 young animals (6 finds); W. coast of Jameson Land opposite Kap Leslie, 22 m, sandy, glittering clay, 1 adult animal; Kap Leslie, 58 m, glittering clay, 1 young animal; Noa Vig in Milne Land, 10—15 m, very soft clay, 2 adult animals; At Bjørneøer, 6—13 m, stones, gravel, red algae, 2 adult animals — 18—28 m, stones, gravel, red algae, 1 adult animal; Nordostbugt, 4 miles from the mouth of Schucherts Flod, 29 m, light grey mud, 1 young shell; Nordbugten, Nordvestfjord, 10—18 m, very loose, light grey clay, 2 young animals — 28—37 m, loose clay, 3 adult and 1 young animals, 1 young shell (2 finds); Danmarks Ø, depth?, 1 half-grown shell; Hekla Havn, Danmarks Ø, depth?, 2 adult and 1 half-grown animals; N.E. of Danmarks Ø, 19—20 m, soft clay, 2 adult animals (2 finds); S.E. of Danmarks Ø, 10—19 m, soft clay, gravel, *Des-*

marestia, 2 adult animals (2 finds) — 27—30 m, soft clay, gravel, 9 adult and half-grown animals; The bay opposite Rødeø, Rødefjord, 13—18 m, soft clay with gravel, about 60 adult, half-grown, and young animals — 30—35 m, soft clay with many big stones, 1 adult animal.

Sydøstkyst Area: Fjord inside Kûngmiut, 20 m, sandy clay, small quantities of *Desmarestia*, 1 adult animal; Angmagssalik, off the harbour, 45 m, 1 adult and 1 half-grown animal; Angmagssalik, 56—94 m, 2 adult animals; Sermilik, 2nd E.fjord, 5 m, sandy clay, stones, 1 half-grown animal; Nanûseq N. of Lindenows Fjord, 40 m, sand, clay, 1 adult animal — 50—60 m, clay and gravel, 2 half-grown animals; Lindenows Fjord, outer part, 48 m, dark grey clay, 1 adult and 1 half-grown animal — 50—70 m, gravel, clay, sand, 1 adult and 2 half-grown animals, 2 adult shells (2 finds) — 90 m, clay, 1 half-grown animal; Lindenows Fjord, middle part, 40—50 m, clay, 1 young animal; Lindenows Fjord, inner part, 25—50 m, clay, sand, 2 young animals (2 finds); Lindenows Fjord, innermost part, 15—30 m, clay, gravel, 1 adult animal.

Thus living specimens have been taken at East Greenland from S.E. of Clavering Ø in the N. to Lindenows Fjord in the S. Although hitherto only one fresh-looking shell from the Nordøstkyst Area is at hand and no specimens at all from the Kangerdlugssuaq Area, the species must be supposed to occur along the whole East Greenland coast. At any rate, the species appears to be the most abundant Cardiid in Kejser Franz Josephs Fjord and Scoresby Sund. It lives generally on a bottom of clay or mud sometimes mixed with gravel, sand, shells, and stones. Compared with *Serripes groenlandicum*, the species seems to prefer a more clayey bottom (see fig. 9, p. 117). At E. Greenland the species was especially found within the Arctic *Macoma* community and the transitional zones between this and the adjoining communities and may there constitute a considerable part of the bottom-fauna. Thus, off Kap Hooker (12—14 m, sand mixed with clay), it was represented by an average number of 8 individuals per m^2, with a weight of 32.35 gr., whereas the total weight of the bottom-fauna amounted to 272.25 gr. per m^2 (THORSON 1934b). — The vertical range for living specimens at E. Greenland varies from 2—7 m (Ella Ø, and Sermilik) to 90 m (Lindenows Fjord), the main part of the finds originating from depths between 10 and 40 m.

Remarks: As regards the shape of the shell there is a rather considerable variation within the specimens from E. Greenland. Some specimens are rather oblong and oblique-triangular, while others are more rounded in outline, just as the ratio breadth to length may vary somewhat. The ten largest specimens from E. Greenland measure (length × height × breadth of shell): $57.8 \times 47.9 \times 33.7$ — $54.6 \times 43.6 \times 31.6$ — $54.4 \times 41.5 \times 35.4$ — $52.5 \times 45.1 \times 31.4$ — $52.2 \times 43.5 \times 28.7$ — $51.7 \times 42.5 \times 31.7$ — $51.6 \times 45.1 \times 31.7$ — $51.5 \times 42.0 \times 31.3$ — $50.5 \times 39.5 \times 28.8$ and $49.6 \times 39.2 \times 31.1$ mm, respectively. Further HÄGG (1904) records an animal measuring 62 mm in length and 58 mm in height.

The maximum length of the species seems to be about 81 mm (specimens from Iceland). — In the larger specimens at hand the umbonal region is generally rather eroded. Some of the young specimens had Foraminifera attached to their shells.

Distribution: W. Greenland, E. Greenland, Spitzbergen, Novaya Zemlya, Franz Joseph Land, the Barents Sea, the Murman Coast and Sea, the White Sea, the Kara Sea, the Bering Strait and the Bering Sea, N. of America, Parry Islands, Grinnell Land, Baffinland, the Hudson Bay, Labrador, Newfoundland, the Gulf of St. Lawrence, Nova Scotia, and Iceland. To the S. the species reaches N. Japan, the Aleutians, Puget Sound, Cape Cod, S. Iceland, and the E. Finmark. Main distribution: Panarctic, circumpolar. Vertical range: From 2 m (Spitzbergen) down to 677 m (W. Greenland). Dead shells are known from the Norwegian Sea down to 2465 m.

Biology: According to THORSON (1936) the species is a distinctly protandric hermaphrodite and spawns at N.E. Greenland at the end of July and the beginning of August. On account of the egg-size THORSON (l. c., p. 55) also assumes that the larva has a lecithotrophic development and an extremely short or quite absent pelagic stage. However, this assumption seems rather improbable for the following reasons: Apparently ripe eggs (from animals preserved in alcohol, mouth of Dusénfjord, 16—20 m, 12-8-32) measured about 115 μ, but the yolk mass alone was found to be only about 100 μ in diameter, being surrounded by a light, gelatinous membrane. Moreover, the yolk mass was not particularly rich in nutrient matter and, on the whole, the eggs were much like those of species with a planktotrophic, pelagic larval development, e. g. the eggs of *Hiatella arctica* and *Mya truncata*. Further, 11 measurements of prodissoconch I of young specimens from Iceland varied from 151 to 158 μ across, with a mean of 154 μ, and 11 measure- of prodissoconch II varied from 315 to 347 μ across, with a mean of 327 μ. These data indicate that the larval development is actually planktotrophic and has a pelagic stage of some length. Cardiid-larvae were not, it is true, recognised at N.E. Greenland. It should be borne in mind, however, that our knowledge of the larval development of lamellibranchs was rather limited at the time THORSON made his investigations in N.E. Greenland.

38. *Cardium* (*Cerastoderma*) *elegantulum* (BECK) MØLLER (cf. pl. 2, fig. 6).

Cardium elegantulum G. O. SARS 1878, pl. 5, figs. 5a—b.

East Greenland records:

Cardium elegantulum JENSEN 1905, pp. 352—353.
Cardium elegantulum JENSEN 1912, p. 84.

Occurrence at East Greenland (cf. the map fig. 23, p. 183):

Sydøstkyst Area: Tasîssaq near Angmagssalik, 38—56 m, stony bottom, few algae, 1 adult animal (with embryos in the brood pouches, 23-5-99); Napassorssuaq N. of Kap Tordenskjold, 38 m, muddy sand, 8 adult (one with embryos in the brood pouches, another with eggs and oocytes in its gonads and developing brood pouches, 25-6-35) and 4 half-grown animals; Lindenows Fjord, outer part, 52 m, sand, 1 young animal — 60—70 m, sand, gravel, 1 adult animal (with embryos in the brood pouches, 16-7-35); Lindenows Fjord, middle part, 27—33 m, sand, *Laminaria*, remnants of algae, 2 adult, 1 half-grown, and 2 young animals (3 finds) — 45 m, sand, 1 adult animal — 40—50 m, clay, 21 adult, half-grown, and young animals (2 finds) — 65 m, fine sand, 1 half-grown shell; Lindenows Fjord, inner part, 25—50 m, clay, 3 adult animals (1 with embryos in the brood pouches, 22-7-35), 1 adult shell; Lindenows Fjord, innermost part, 25 m, sand, little algae, 1 adult animal (with embryos in the brood pouches, 21-7-35); Qeqertatsiaq, 50 m, sand, dead bryozoans, 1 half-grown animal — 60—70 m, sand, gravel, dead bryozoans, 7 adult (1 with empty brood pouches, 13-7-35), 14 half-grown and 4 young animals (3 finds).

Thus at East Greenland the species occurs only along the S.E. coast, where it ranges vertically from 25 down to 60—70 m. It has been found to live on both sandy and clayey bottom.

Remarks: As regards the proportions of the shell, the specimens from E. Greenland vary a god deal, as will appear from the measurements of the ten largest specimens at hand (length × height × breadth of shell): $13.4 \times 10.4 \times 7.2$ — $13.1 \times 10.1 \times 7.7$ — $12.5 \times 10.3 \times 7.1$ — $12.4 \times 9.5 \times 7.1$ — $12.3 \times 10.1 \times 7.0$ — $11.1 \times 9.1 \times 6.2$ — $10.8 \times 9.0 \times 6.7$ — $10.8 \times 8.7 \times 6.1$ — $10.4 \times 8.4 \times 5.2$ and $10.4 \times 8.3 \times 5.6$ mm, respectively. In all the larger specimens present the umbonal and the central parts of the shell is rather eroded. Two specimens had Foraminifera attached to their shells.

Distribution: Besides from S.E. Greenland, the species is known from Labrador (off Hamilton Inlet), W. Greenland (from Thule in the N. to Julianehaab in the S.), the N. and E. coasts of Iceland, off N. Norway, from the Finmark southward to Tromsø, and the Murman Coast. Main distribution: Low-arctic (in the N. Atlantic sector only). Vertical range: From about 25 m (S. E. Greenland, N. Iceland) to 470 m (W. Greenland).

Biology: Reproduction of the species is described from the eastern Murman Coast by MATVEEVA (1953), who reports the species to be viviparous. The eggs develop in brood pouches formed by folds of the ventral parts of the mantle, and the young hatch as fully developed bottom-stages then reaching a shell-length of 1.2 mm. Further, according to MATVEEVA, the species grows to an age of 6 years and the females become mature in their third year of life, measuring 6—8 mm in length

at that time. — As stated in the list of the finds, some of the specimens from S. E. Greenland had embryos in their brood pouches. The largest embryos present measured only about 480 μ in length and thus were not yet in the hatching stage. A few adults had mature eggs measuring 320×250 μ in their gonads.

[*Venus* (*Ventricola*) *casina* LINNÉ.

Venus casina JEFFREYS 1869 V, pl. 38, fig. 5.

LAMY (1913a, p. 23) records one single valve of this species from S. of Jan Mayen, 70°52′ N. 10°33′ W., 180 m, grey, volcanic mud. However, the species does not live at present at W. Greenland and Norway N. of Lofoten, and only some shells and valves are known from S. and W. Iceland. Therefore, it appears certain that the species in question cannot belong to the fauna of the region dealt with here].

39. *Gomphina* (*Liocyma*) *fluctuosa* (GOULD) (cf. pl. 2, fig. 9).

Aenus fluctuosa GOULD 1841, p. 87, fig. 70.

East Greenland records:

Venus astartoides MÖBIUS 1874, p. 252.
Venus fluctuosa POSSELT 1895, p. 74.
Venus fluctuosa POSSELT & JENSEN 1898, p. 82.
Venus fluctuosa HÄGG 1904, p. 49.
Venus (*Liocyma*) *fluctuosa* JENSEN 1905, p. 351.
Liocyma fluctuosa ODHNER 1915, p. 114.
Venus fluctuosa THORSON 1936, p. 54 et sequ.; on reproduction.

Occurrence at East Greenland (cf. the map fig. 20, p. 181):

Nordøstkyst Area: Shannon, 7.5—56 m (MÖBIUS, as *Venus astartoides*); S. of Lille Pendulum, 74°35′ N. 18°23′W., 18—21 m, sandy mud, algae, 1 adult and 1 young animal; Sabine Ø, depth?, *Laminaria*, 20 adult and half-grown animals, 2 adult and 1 young shells (all drilled by *Natica*), 1 adult valve (drilled by *Natica*) — 5.5—9.5 m, 1 young animal, 1 adult valve.

Kejser Franz Josephs Fjord Area: Kap Borlase Warren, 74°20′ N. 19° W., 19 m, *Laminaria*, 1 half-grown animal; Eskimonæs, on Clavering Ø, 6—10 m, clayey sand, various brown and green algae, 2 adult and 1 half-grown animals, 1 half-grown shell; Kap Stosch, ca. 15 m, 18 adult animals; Jackson Ø, 7.5—56 m, (MÖBIUS, as *Venus astartoides*); Mackenzie Bugt, 12—18 m, mud, 3 adult and 2 young animals (HÄGG); Nordfjord, off the Danish house, 8 m, very fine, grey clay, 1 adult animal; Nordfjord, off the river, 10—25 m, loose clay, 1 adult animal; Eleonore Bugt, at the anchoring place, 23 m, fat clay with some stones, 2 half-grown and 5 young animals; Eleonore Bugt, 15—27 m, clay, *Laminaria*, *Desmarestia*, and a few red algae, 9 adult animals — 130 m, tough clay with pebbles, 1 young animal; Karl Jakobsens Bugt, Ymers Ø, 14 m, clay, 1 adult and 2 half-grown animals.

Scoresby Sund Area: Off Kap Hope, 7—9 m, sand, stones, algae, 1 adult and 2 young animals (3 finds) — 9—15 m, sand, about 400 adult, half-grown,

and young animals, 1 adult and 2 half-grown shells (all drilled by *Natica*) (12 finds) — 20 m, sand, about 60 adult, half-grown, and young animals (3 finds); Off the mouth of Hurry Inlet, 20—30 m, sand, stones, *Laminaria*, red algae, about 30 adult, half-grown, and young animals (2 finds); The mouth of Hurry Inlet, 14—21 m, sand, detritus of algae, 1 half-grown and 2 young animals (2 finds) — 28 m, sand, stones, algae, 2 half-grown and 1 young animal; Hurry Inlet, 1 mile inside the mouth, 6—9 m, sand, about 25 adult, half-grown, and young animals — 13—16 m, sand, about 85 adult, half-grown, and young animals, 1 young shell (drilled by *Natica*) (10 finds); E. side of Hurry Inlet, 2 miles inside the mouth, 7—10 m, sand, stones, algae, 2 adult, 4 half-grown, and 1 young animals, 3 adult valves (all drilled by *Natica*); Hurry Inlet, at Constable Pynt, 7—10 m, sand, 1 young animal; Hurry Inlet, at Fame Øer, 18—22 m, soft, muddy clay, 1 adult animal; "Hurry Fjord", 19 m, clay, 1 adult, 2 half-grown, and 3 young animals; Kap Stewart, 70°27′ N. 22°35′ W., 13—18 m, mud, stones, algae, 1 adult, 1 half-grown, and 1 young animal; Off Kap Hooker, 20 m, sand, 30 adult, half-grown, and young animals, 3 shells (all drilled by *Natica*); 8 miles W. of Kap Hooker, 12—14 m, sand mixed with clay, 53 adult, half-grown, and young animals (9 finds); Turner Sund, ca. 5.5 m, about 280 adult, half-grown, and young animals, about 40 valves (5 drilled by *Natica*); Kap Dalton, 13—21 m, clay, 2 young animals.

Kangerdlugssuaq Area: Mikis Fjord, 3.5—4 m, sandy clay, 4 adult, 13 half-grown and young animals (2 finds) — 7—8 m, sandy clay, 1 adult, 3 half-grown, and 1 young animals — 15 m, sandy clay, 2 half-grown animals.

Sydøstkyst Area: Fjord inside Kûngmiut, 10—15 m, 1 adult animal — 20 m, sandy clay, small quantities of *Desmarestia*, 3 adult, 7 half-grown and young animals; Sermilik, 2nd E.fjord, 5—12 m, sandy clay, stones, about 60 adult, half-grown, and young animals (3 finds) — 25 m, clay, 1 adult and 2 half-grown animals.

Thus at E. Greenland the species is known to occur from Shannon in the N. to Sermilik in the S., with a vertical range from 3.5—4 m (Mikis Fjord) to 130 m (Eleonore Bugt). The latter depth, however, is exceptional and applies to a young animal which may have been carried out from the littoral zone, as the species is chiefly met with at depths between 5 and 30 m. It lives predominantly on sandy bottom and at E. Greenland it is associated with places near the open sea. The *Gomphina fluctuosa* community[1]) is described from such localities in Scoresby Sund (Thorson 1934b), where the species may be exceedingly abundant, e. g. off Kap Hope, 9—20 m, sand, it was found in an average number of 176 individuals per m^2, with a weight of 21.3 gr., the total weight of the bottom fauna averaging 372 gr. per m^2 (Thorson 1934b).

Remarks: The shape of the shell in the specimens from E. Greenland varies considerably. Most specimens are more or less oblique-

[1]) Originally named *Venus fluctuosa* community by Thorson. The change of the name does not, of course, effect its character of being an arctic parallel to the boreal *Venus* communities.

triangular in outline, whereas in some specimens at hand the posterior part is rather elongated with the dorsal and ventral margins nearly parallel. The colour of the periostracum is waxen or, more rarely, with a brownish tinge. Chestnut patches near the edges may occur. Apart from the smallest ones, all the specimens have the umbonal region irregularly eroded. The ten largest specimens from E. Greenland measure (length × height × breadth of shell): 23.3 × 17.5 × 10.5 — 22.4 × 15.7 × 9.6 — 21.0 × 14.8 × 9.1 — 20.3 × 15.6 × 10.4 — 20.2 × 14.6 × 9.1 — 20.1 × 15.4 × 9.6 — 19.6 × 14.7 × 8.5 — 19.2 × 13.7 × 9.0 — 19.1 × 15.0 × 9.2 and 18.4 × 13.3 × 8.7 mm, respectively.

Distribution: W. Greenland, E. Greenland, Spitzbergen, Franz Joseph Land, Novaya Zemlya, the White Sea (shells only), the Kara Sea, the Siberian Ice Sea, the Sea of Okhotsk, the Bering Strait and Sea, Alaska, Labrador, Newfoundland, the Gulf of St. Lawrence, Nova Scotia, Maine, and E. Iceland. Main distribution: Panarctic, probably truly circumpolar. Vertical range: From about 2 m (Spitzbergen) to 228 m (Alaska, Point Barrow).

Biology: The egg-size is known from N.E. Greenland (Thorson 1936). The yolk mass of the eggs measures 320—250 μ in diameter, and a lecithotrophic and non-pelagic larval development must therefore be assumed. — Even in very young specimens the prodissoconch was found to be rather indistinctly delimited. Ten measurements of what appeared to be the prodissoconch varied from 508 to 540 μ across, with a mean of 525 μ.

[*Spisula elliptica* (Brown).

Mactra solida var. *elliptica* Jeffreys 1869 V, pl. 43, fig. 2a.

A single valve is recorded by Lamy (1913a, p. 23, as *Mactra* (*Oxyperas*) *elliptica*) from S. of Jan Mayen, 70°52′ N. 10°33′ W., 180 m, grey, volcanic mud. — The valve in question may be subfossil, or it may have been subject to transport. The species occurs all around Iceland and is otherwise of a distinctly boreal distribution. At any rate it appears certain that at the present day *Spisula elliptica* does not live within the region dealt with here].

40. *Macoma calcaria* (Chemnitz) (cf. pl. 2, fig. 10).

Macoma calcaria G. O. Sars 1878, pl. 6, figs. 2a—b.
Tellina (*Macoma*) *calcaria* Jensen 1905, p. 342, figs. 2a—b.

East Greenland records:

Macoma calcaria Posselt 1895, p. 74 (except var. *subovalis*).
Tellina (*Macoma*) *calcaria* Posselt & Jensen 1898, p. 86 (except var. *subovalis*).
Tellina (*Macoma*) *calcaria* Jensen 1904, p. 33.

Tellina (Macoma) calcaria Jensen 1905, pp. 342—343.
Macoma calcarea Odhner 1915, p. 111.
Macoma calcaria Thorson 1936, p. 51 et sequ. (in part); on reproduction.

Occurrence at East Greenland (cf. the map fig. 17, p. 178):

Nordøstkyst Area: Jørgen Brønlund Fjord, 13 m, clay, 3 adult and 1 young animals, 1 adult shell (2 finds); Danmarks Havn, 0—9.5 m, soft bottom, *Laminaria*, 1 adult animal, 2 adult shells, 1 fragment (3 finds) — 7.5—15 m, mud, stones, algae, 4 adult shells, 4 adult, worn valves (3 finds) — 28 m, mud, *Delesseria*, 1 adult valve; Øresund at Danmarks Havn, 38—56 m, hard bottom, 1 fragment; Stormbugt at Danmarks Havn, 9.5—19 m, soft bottom, *Laminaria*, 3 adult and 1 half-grown animals, 2 adult valves — 19—38 m, hard bottom, *Delesseria*, 2 adult, worn valves; Hvalrosodden at Danmarks Havn, on the shore, 4 adult valves; Off the Eskimoruin at Danmarks Havn, 0—7.5 m, sandy mud, shells, algae, 1 adult animal, 2 adult, worn valves.

Kejser Franz Josephs Fjord Area: Zackenberg Bugt, Wollaston Forland, on the shore, 1 adult valve (perhaps subfossil); Kejser Franz Josephs Fjord, 73°16′ N. 23°15′ W., 28—36 m, clay, shells, stones, gravel, 1 adult animal; The mouth of Duséns Fjord opposite Kap Graah, 15—30 m, clay, *Desmarestia*, a few red algae, 8 adult and 1 half-grown animals (2 finds) — 26—40 m, clay, stones, *Desmarestia*, 6 adult animals; Duséns Fjord, at the anchoring place, 10 m, loose clay, *Desmarestia*, 6 adult and 1 half-grown animals — 20—25 m, loose clay, *Desmarestia*, 7 young animals, 2 young shells; Duséns Fjord, inner part, 4—10 m, soft clay, *Desmarestia*, about 300 adult, half-grown, and young animals; The head of Duséns Fjord, 5—19 m, clay, *Desmarestia*, 12 adult animals (3 finds); Moskusoksefjord, 15 m, 5 adult animals, 1 adult shell (drilled by *Natica*); Moskusoksefjord, off Ankerbjerg valley, 19—23 m, clay, a few big stones, 1 half-grown animal; Eleonore Bugt, 15—27 m, clay, *Laminaria*, *Desmarestia*, 1 half-grown animal; Karl Jakobsens Bugt, Ymers Ø, 13—19 m, clay, 20 adult and half-grown animals (6 finds) — 20—30 m, clay, 9 adult, 1 half-grown, and 1 young animals (6 finds); Isfjord, off Haredalen, 2.5—5 m, *Fucus*, *Laminaria*, green algae, 2 adult animals — 9—15 m, loose, greyish-brown clay, 23 adult, half-grown, and young animals — 27—35 m, loose, brown clay, 21 adult and half-grown animals (2 finds); Inner part of Kejser Franz Josephs Fjord, off Engdalen, 13—18 m, fine, loose, grey clay, 2 adult and 3 half-grown animals — 27—34 m, loose, brown clay, 1 half-grown animal — 36—45 m, loose, brown clay, *Laminaria*, 1 adult animal; Inner part of Kejser Franz Josephs Fjord, 73°06′ N. 27°17′ W., 3—9 m, mud with sand, algae, 4 adult and 5 young animals; Solitærbugt, Ella Ø, 3—8 m, clay, brown algae, *Desmarestia*, 14 adult and half-grown animals (3 finds) — 9—25 m, clay, shells, stones, *Desmarestia*, about 500 adult, half-grown, and young animals (at least 10 finds) — 20—52 m, clay, shells, pebbles, about 45 adult, half-grown, and young animals (at least 4 finds) — 55—95 m, 1 adult animal; Kap Hedlund, 4—27 m, clay, shells, stones, *Desmarestia*, about 340 adult and half-grown animals (at least 10 finds) — 20—53 m, about 25 adult and half-grown animals — 76—90 m, 1 half-grown animal; Röhss Fjord, 72°43′ N. 26°38′ W., 35—60 m, mud, 1 adult animal.

Scoresby Sund Area: The mouth of Hurry Inlet, 55—57 m, muddy clay, 2 adult animals (2 finds); Hurry Inlet, off Constable Pynt, 24 m, clay, 1 adult and 1 young animal (2 finds); Hurry Inlet, at Fame Øer, 15 m, very tough clay, 1 adult animal — 15—24 m, soft clay, *Laminaria*, red algae, 6 adult

and 1 half-grown animals (4 finds); Fame Øer, 70°50′ N. 22°33′ W., 5—8 m, mud, 1 adult and 3 young animals; Off Kap Hooker, 67 m, sand mixed with clay, 1 adult animal; Nordbugten in Nordvestfjord, 21 m, loose clay, 1 adult animal; The bay opposite Rødeø in Rødefjord, 13—18 m, soft clay, gravel, 1 adult animal.

Sydøstkyst Area: Angmagssalik, ca. 25 m, 1 adult animal; Tasîssaq near Angmagssalik, 38—56 m, rocky bottom, algae, 1 adult and 1 half-grown shell (both drilled by *Natica*); Off Tasîssaq, 65°40′ N. 35°32′ W., 47—75 m, clay with small stones, "1 specimen" (Posselt, Jensen) — 245 m, clay with stones "4 specimens" (Posselt, Jensen); Fjord inside Kûngmiut, 20 m, sandy clay, small quantities of *Desmarestia*, 22 adult and half-grown animals; Ikerasaussaq, 0—10 m, *Fucus*, *Laminaria*, 2 adult animals; Sermilik, 2nd E. fjord, 50 m, clay, 7 adult animals; Sermilik, settlement Ipîtâlaq, 5—7 m, muddy clay, 1 adult animal; Napassorssuaq N. of Kap Tordenskjold, 36—38 m, muddy sand, 1 adult and 1 half-grown animal (2 finds); Nanûseq N. of Lindenows Fjord, 22 m, ooze, decaying algae, 6 adult animals; Lindenows Fjord, outer part, 25 m, gravel, clay, *Laminaria*, 1 half-grown animal — 52—70 m, sand, gravel, 5 adult and 1 half-grown animals, 1 adult shell (2 finds) — 90 m, clay, 3 adult animals, 1 adult shell; Lindenows Fjord, middle part, 25—32 m, gravel and sand, *Laminaria*, 1 adult and 1 half-grown animal (2 finds) — 40 m, clay, 1 adult animal — 45—65 m, sand, 1 half-grown and 1 young animal, 2 adult shells (both drilled by *Natica*) (3 finds) — 125—150 m, clay, 1 adult animal; Lindenows Fjord, inner part, 25—50 m, clay, sand, gravel, 2 adult, 2 half-grown, and 1 young animals (3 finds).

Jan Mayen Area: [S. of Jan Mayen, 69°31′ N. 7°06′ W., 2465 m, 2 fragments of 2 valves. These are of a fossil appearance and had probably been carried out from shallower water. Live animals of the species have apparently not been met with at Jan Mayen].

The species is thus of common occurrence at E. Greenland, where it has been taken from Jørgen Brønlund Fjord in the N. to Lindenows Fjord in the S., with a vertical range for live specimens from 3 m (Solitærbugt, Ella Ø) to 245 m (off Tasîssaq near Angmagssalik). However, it has not hitherto been found in the Kangerdlugssuaq area. It is mainly a fjord form, living generally in shallow water on a bottom consisting of clay or mud, which may be mixed with sand, gravel, and stones. Strange to say, it appears to be comparatively scarce in Scoresby Sund, where it was taken in much smaller numbers than *M. moësta* and *M. loveni*. Actually, most of the records of *M. calcaria* in Thorson 1934b from Scoresby Sund as well as part of those from Kejser Franz Josephs Fjord in Thorson 1933 should be referred to *M. moësta*.

In the inner parts of Kejser Franz Josephs Fjord the species has been met with in considerable numbers, there playing an important rôle in the composition of the infauna of the clay bottom at smaller depths. Thus, in Solitærbugt at Ella Ø, 3 m to about 12—14 m, *M. calcaria* was represented in an average number of 90 individuals per m^2, with a weight of 35—40 gr. (Thorson 1933).

Remarks: The majority of the specimens from E. Greenland are of a shape typical of the species. In some specimens, however, the posterior part is very short with the margins fairly rounded, whereas the shells of some others are remarkably truncate. In almost all of the adult and half-grown specimens the umbonal and central regions of the shell are highly eroded, just as the periostracum is very often worn off from the greater portion of the surface. The ten largest specimens at hand measure (length × height × breadth of shell): 43.5 × 31.2 × 13.6 — 42.4 × 29.7 × 14.1 — 40.3 × 29.7 × 12.7 — 40.3 × 28.3 × 12.7 — 40.0 × 29.5 × 12.5 — 38.9 × 26.5 × 12.2 — 38.6 × 27.5 × 12.3 — 38.5 × 28.5 × 12.4 — 38.2 × 26.4 × 11.5 and 37.9 × 26.8 × 11.5 mm, respectively. — Some of the specimens from Lindenows Fjord had hydroids attached to the posterior part of their shells.

Distribution: W. Greenland, E. Greenland, Spitzbergen, Franz Joseph Land, Novaya Zemlya, the Finmark, the Murman Coast, the White Sea, the Barents Sea, the Kara Sea, the Siberian Ice Sea, the Bering Strait and the Bering Sea, the Sea of Okhotsk, the American Arctic coast, Baffinland, the Hudson Strait and Hudson Bay, and Labrador. In the Pacific the species extends southward to N. Japan, the Aleutians, and Monterey (California), and in the N. Atlantic southward to Long Island Sound, S. Iceland, the Faroes, the North Sea, the Kattegat and the Belt Sea, and in the Baltic to E. of Bornholm. Main distribution: Panarctic, circumpolar, with boreal outposts. Vertical range: From 0—1 m (Iceland) to 677 m (W. Greenland, living?).

Biology: According to THORSON (1936), the species spawns at N.E. Greenland at the end of July or the beginning of August. The statement in THORSON (l. c., p. 54) as to the egg-size of this species is, however, hardly correct, as the samples examined by THORSON proved to comprise both *M. calcaria* and *M. moësta*. Actually, it is the latter species which has large and adhesive eggs with a yolk mass of about 170 μ in diameter. This correction also agrees with the unpublished drawings, executed by THORSON, of some egg stages which were referred —in part erroneously—to *M. calcaria*.

However, the material also contains adult animals of *M. calcaria* with ripe eggs or sperm, and THORSON's conclusion as to the spawning season at N.E. Greenland is in all probability correct.

Apparently mature eggs (from animals preserved in alcohol, Solitærbugt, Ella Ø, 4—16 m, 3-8—5-8-33) measured about 95 μ in outer diameter, being surrounded by a thin membrane. These eggs much resembled the eggs of lamellibranch species which are known to have a pelagic and planktotrophic larval development, and the larval development of *M. calcaria* is probably of this type.

41. *Macoma moësta* (Deshayes) (cf. pl. 2, fig. 13).

Tellina (*Macoma*) *moesta* Jensen 1904, pl. 1, figs. 4a—f.
Tellina (*Macoma*) *moesta* Jensen 1905, p. 346, figs. 4a—c.

East Greenland records:

Macoma calcaria var. *subovalis* Posselt 1895, p. 74 (in part).
Tellina (*Macoma*) *calcaria* var. *subovalis* Posselt & Jensen 1898, p. 87 (in part).
Tellina calcaria var. *subovalis* Hägg 1904, p. 47.
Tellina (*Macoma*) *moesta* Jensen 1904, pp. 41—42.
Tellina (*Macoma*) *moesta* Jensen 1905, pp. 346—348.
Macoma moesta Odhner 1915, p. 112.

Occurrence at East Greenland (cf. the map fig. 18, p. 179):

Nordøstkyst Area: Danmarks Havn, 0—9.5 m, sandy mud with algae, 1 adult animal — 5.5—11 m, soft bottom, *Laminaria*, 9 adult (in part fragmentary) and 1 young shell (2 finds); Stormbugt, Danmarks Havn, 9.5—19 m, soft bottom, *Laminaria*, 2 adult and 1 half-grown animals; S. of Lille Pendulum, 74°35′ N. 18°23′ W., 18—21 m, sandy mud, algae, 1 half-grown animal; Sabine Ø, 5.5—9.5 m, *Laminaria*, 1 adult animal, 1 adult valve.

Kejser Franz Josephs Fjord Area: Eskimonæs, Clavering Ø, 10—14 m, 1 adult animal; Kap Stosch, ca. 15 m, 2 adult shells; Knudshoved (Karlshavn), 8—10 m, muddy bottom, 1 adult and 2 half-grown animals, 1 adult shell; Mackenzie Bugt, 12—18 m, mud, 1 animal (Hägg) — 12—35 m, mud, 33 animals (Hägg); Kejser Franz Josephs Fjord, 73°16′ N. 23°15′ W., 28—36 m, clay, shells, stones, sand, 2 adult animals; The mouth of Duséns Fjord, opposite Kap Graah, 15—30 m, clay, *Desmarestia*, some red algae, 1 adult animal, 2 adult shells (1 drilled by *Natica*) (2 finds); Duséns Fjord, at the anchoring place, 10 m, loose clay, 1 adult animal — 20—25 m, loose clay, *Desmarestia*, 1 adult, 1 half-grown, and 2 young animals; Duséns Fjord, inner part, 4—10 m, soft clay, *Desmarestia*, 20 adult, half-grown, and young animals — 15—20 m, *Laminaria*, *Fucus*, 2 adult animals; The head of Duséns Fjord, 5—19 m, clay, *Desmarestia*, 3 adult animals (3 finds); Nordfjord, off Strindbergs Land, 19 m, clayey bottom, 1 adult animal; Nordfjord, off the river, 10—25 m, loose clay, 1 adult animal; Moskusoksefjord, 15 m, 2 adult animals; Eleonore Bugt, 3.5—12 m, clay, *Fucus*, *Laminaria*, *Desmarestia*, 2 adult animals — 130 m, tough clay, pebbles, 1 adult animal; Karl Jakobsens Bugt, Ymers Ø, 2—4 m, clay, 3 young animals (2 finds) — 13 m, clay, 1 adult animal — 20—30 m, clay, 7 adult animals, 2 adult shells (5 finds); Isfjord, off Haredalen, 2.5—5 m, stones, *Fucus*, *Laminaria*, green algae, 1 adult animal — 9—15 m, loose, greyish-brown clay, 5 adult animals — 27—30 m, loose, brown clay, *Desmarestia*, 1 adult animal; Inner part of Kejser Franz Josephs Fjord, off Engdalen, 13—18 m, fine, loose, grey clay, 18 adult animals — 27—37 m, loose, brown clay, 26 adult and half-grown animals (2 finds) — 36—45 m, loose, brown clay, *Laminaria*, 2 half-grown animals — 50—55 m, loose, brown clay, 3 adult animals; Inner part of Kejser Franz Josephs Fjord, 73°06′ N. 27°17′ W., 3—9 m, mud with sand and algae, 14 adult, half-grown, and young animals; Solitærbugt, Ella Ø, 3—7 m, *Fucus*, *Desmarestia*, 2 adult and 1 half-grown animals — 2—25 m, about 80 adult, half-grown, and young animals, 5 adult shells (several finds) — 26 m, stones, shells, some *Desmarestia*, 2 adult animals — 20—52 m, 9 adult, 1 half-grown, and 2 young animals, 2 adult shells (1 drilled by *Natica*) (several finds); Kap Hedlund, 14—20 m,

clay, shells, stones, red algae, about 45 adult and half-grown animals, 4 adult shells (5 finds) — 4—27 m, about 80 adult, half-grown, and young animals (several finds) — 20—53 m, 14 adult and half-grown animals, 3 adult shells (at least 2 finds).

Scoresby Sund Area: Kap Stewart, 70°27′ N. 22°35′ W., 13—18 m, mud, stones, algae, 2 adult animals; Hurry Inlet, 19 m, clay, 2 adult animals; Hurry Inlet, at Constable Pynt, 7—10 m, sand, 8 half-grown and young animals, 1 adult and 1 half-grown shell — 18—22 m, very soft clay, 2 young animals; Hurry Inlet, off Constable Pynt, 21—24 m, clay, 10 adult, 4 half-grown, and 2 young animals (8 finds); E. side of Hurry Inlet, off Constable Pynt, 31 m, clay, 1 adult animal; Hurry Inlet, at Fame Øer, 12 m, very soft clay, 3 adult and 2 young animals — 15—18 m, soft clay, *Laminaria*, red algae, 13 adult and 2 young animals (2 finds) — 18—25 m, clay, gravel, algae, 8 adult and 3 half-grown animals (4 finds); Fame Øer, 70°50′ N. 22°33′ W., 5—8 m, mud, 3 adult animals — 9 m, mud, algae, 1 half-grown animal — 23—25 m, clay, 3 adult and 1 young animals; Off Kap Hooker, 60—72 m, sand mixed with clay, 3 adult, 2 half-grown, and 2 young animals (4 finds); 8 miles W. of Kap Hooker, 13—14 m, sand mixed with clay, 3 adult, 6 half-grown, and 7 young animals, 5 adult shells (3 drilled by *Natica*) (9 finds); W. coast of Jameson Land, opposite Kap Leslie, 21—22 m, sandy, glittering clay, 5 adult animals (3 finds); Kap Leslie, 54—62 m, glittering clay, 1 adult, 2 half-grown, and 2 young animals, 1 adult valve (2 finds); W. coast of Jameson Land, opposite Bjørneøer, 10 m, loose, sandy clay, 2 half-grown animals; Bjørneøer, 18—28 m, stones, gravel, red algae, 1 adult animal; Nordbugten in Nordvestfjord, 10—18 m, very loose, light grey clay, 1 half-grown animal — 28—29 m, loose clay, 5 adult animals, 1 adult shell (3 finds); Hekla Havn, Danmarks Ø, depth?, 6 adult and 2 half-grown animals; N.E. of Danmarks Ø, 18—20 m, soft clay, stones, *Desmarestia*, 11 adult and 3 half-grown animals (6 finds); S.E. of Danmarks Ø, 20 m, soft clay, 8 adult animals, 1 young valve — 27—30 m, soft clay with gravel, 4 adult animals; The bay opposite Rødeø in Rødefjord, 13—18 m, soft clay with gravel, about 25 adult and half-grown animals — 18—26 m, clay, *Laminaria*, 1 adult animal; Turner Sund, 5.5 m, about 55 adult, half-grown, and young animals; Kap Dalton, 13—21 m, 1 half-grown animal.

Kangerdlugssuaq Area: Mikis Fjord, depth?, 1 adult and 1 half-grown animal, 1 adult valve — 3.5—4 m, sandy clay, 2 adult, 3 half-grown, and 3 young animals; Uttentals Sund, 12—15 m, clay, 1 young animal.

Sydøstkyst Area: Sermilik, settlement Íkáteq, 200 m, stony bottom, a little clay, 1 adult animal; Sermilik, 2nd E. fjord, 5 m, sandy clay, stones, 13 adult and half-grown animals — 50 m, clay, 1 adult animal; Kap Tordenskjold, 12 m, black clay, 1 adult animal; Nanûseq N. of Lindenows Fjord, 58 m, gravel and clay, 2 adult animals — 150—175 m, clay, 1 adult animal; Lindenows Fjord, the mouth, 125—150 m, gravel, clay, 1 adult animal; Lindenows Fjord, outer part, 10 m, grey clay, 1 adult animal — 48—50 m, dark grey clay, 5 adult animals (2 finds) — 52—84 m, clay, sand, gravel, about 40 adult, half-grown and young animals (3 finds) — 90—100 m, clay, 4 adult, 1 half-grown, and 1 young animals, 1 adult shell (3 finds); Lindenows Fjord, middle part, 27—32 m, sand, remnants of algae, *Laminaria*, 3 adult, 1 half-grown, and 1 young animals (2 finds) — 120 m, clayey sand, 1 young animal; Lindenows Fjord, inner part, 25—30 m, gravel, *Laminaria*, 1 adult animal — 91 m, clay, 1 adult animal.

Thus the species has been found from Danmarks Havn in the N. to Lindenows Fjord in the S. It appears to be commoner in places near the outer coast than is the case with *M. calcaria*, together with which it has otherwise very often been taken. In Scoresby Sund the species seems to be by far the commonest Tellinid. The species ranges vertically from 2 m (Karl Jakobsens Bugt, Ymers Ø) to 200 m (Sermilik). However, apart from the southern coast stretch of E. Greenland, it occurs mainly at depths less than about 50 m. It has been met with on various types of bottom, viz. soft clay, sandy clay, mud, sand, gravel, and stony bottom.

Remarks: The specimens from E. Greenland show some variation in the proportions of their shells. The ten largest of them measure (length × height × breadth of shell): 30.1 × 20.8 × 9.0 — 27.5 × 19.2 × 8.5 — 26.9 × 19.4 × 8.4 — 26.3 × 19.2 × 8.0 — 25.8 × 18.2 × 8.2 — 25.2 × 18.2 × 7.9 — 25.0 × 17.8 × 7.7 — 24.9 × 18.2 × 7.3 — 24.8 × 18.7 × 7.7 and 24.2 × 17.2 × 7.8 mm, respectively. HÄGG gives the size of a specimen from Mackenzie Bugt as 28 × 19.8 × 9.1 mm. The maximum size of the species is 34.5 mm in length (specimen from the Siberian Ice Sea). The umbonal region in the larger specimens present is generally rather much eroded, and brownish incrustations on the posterior part of the shell are frequently found. Some of the specimens from Lindenows Fjord had hydroids attached to the posterior part of their shells.

Macoma oneilli DALL (1919, p. 20A, pl. 2, fig. 1) from Dolphin and Union Strait may turn out to be identical with the present species, and if so, it should be added to the synonyms of *M. moësta* already listed by JENSEN (1904, 1905).

Distribution: W. Greenland, E. Greenland, Spitzbergen, Novaya Zemlya, the Kara Sea, the Siberian Ice Sea, the Bering Sea, the Aleutians, the Shumagin Islands, Alaska, Jones Sound, and Baffinland. Main distribution: High-arctic and circumpolar. Vertical range: From 2 m (E. Greenland) to about 270 m (W. Spitzbergen).

Biology: A total of about 125 animals, obtained mainly from various localities in Kejser Franz Josephs Fjord and Scoresby Sund, were examined as to the state of their gonads. Most of these contained mature or premature sexual products, 65 animals being females and 60 males. The smallest female with ripe eggs found measured 10.5 mm in length, while the smallest male with ripe sperm was about 11 mm long. Only in a few animals seemed spawning to have come to an end, and the whole material examined suggests that at N.E. Greenland the main spawning takes place later than the end of August or the beginning of September. The yolk mass of ripe, almost globular eggs, measures

160—170 μ in diameter and is surrounded by a mucous membrane about 15 μ thick (material preserved in alcohol). The prodissoconch of 6 young specimens varied from 315 to 325 μ across, with a mean of 320 μ. According to the egg-size and the size of the prodissoconch, a lecithotrophic development of the larva, with a very short or no pelagic stage, must be assumed.

42. *Macoma loveni* (STEENSTRUP) JENSEN (cf. pl. 2, fig. 11).

Tellina (*Macoma*) *Loveni* JENSEN 1904, pl. 1, figs. 5a—h.
Tellina (*Macoma*) *Loveni* JENSEN 1905, p. 349, figs. 5a—e.

East Greenland records:

Macoma calcaria var. *subovalis* POSSELT 1895, p. 74 (in part).
Tellina (*Macoma*) *calcaria* var. *subovalis* POSSELT & JENSEN 1898, p. 87 (in part).
Tellina (*Macoma*) *Loveni* JENSEN 1904, pp. 48—49.
Tellina (*Macoma*) *Loveni* JENSEN 1905, pp. 348—350.
Macoma moësta THORSON 1934a, p. 7.

Occurrence at East Greenland (cf. the map fig. 18, p. 179):

Nordøstkyst Area: Danmarks Havn, 5.5—11 m, soft bottom, *Laminaria*, 1 young shell — 19—28 m, hard bottom, red algae, 1 adult animal; Stormbugt at Danmarks Havn, 19—28 m, hard bottom, *Delesseria*, 1 adult valve (drilled by *Natica*); S.E. of Sabine Ø, 207 m, fine clay, stones, gravel, 3 adult and 1 young animals.

Kejser Franz Josephs Fjord Area: S.E. of Clavering Ø, 74°10′ N. 20°08′ W., 25—40 m, mud, many shells and small stones, 6 adult animals; Eskimonæs, Clavering Ø, 53—55 m, clay with many small and big stones, some red algae, 1 adult and 1 young animal; Vinterøer, at the mouth of Duséns Fjord, 15—30 m, stones and algae, 2 adult animals, 1 adult shell; Kejser Franz Josephs Fjord, 73°16′ N. 23°15′ W., 28—36 m, clay, shells, stones, gravel, 1 half-grown animal; Eleonore Bugt, 15—27 m, clay, *Laminaria*, *Desmarestia*, 1 adult animal; Solitærbugt, Ella Ø, 2—24 m, 15 adult and half-grown animals, 2 adult shells (1 drilled by *Natica*) (several finds) — 25—27 m, stones, shells, *Laminaria*, *Desmarestia*, 2 adult animals (2 finds) — 20—52 m, 43 adult, half-grown, and young animals, 8 adult shells (1 drilled by *Natica*) (several finds) — 55—95 m, 1 adult animal; Röhss Fjord, 72°43′ N. 26°38′ W., 35—60 m, mud, 1 adult shell; Kap Hedlund, 14—17 m, 1 adult animal — 4—27 m, 4 adult animals, 4 adult and 1 half-grown shells (several finds) — 20—53 m, 10 adult and 1 half-grown animals, 4 adult shells (several finds).

Scoresby Sund Area: Scoresby Sund, 19—30 m, 1 half-grown animal; Off Kap Hope, 10—13 m, sand, 1 young animal; Off the mouth of Hurry Inlet, 30 m, sand, stones, *Laminaria*, red algae, 1 adult animal — 55 m, clayey sand, 1 adult animal; The mouth of Hurry Inlet, 14 m, sand, detritus of algae, 1 young animal — 28 m, sand, stones, algae, 1 young animal — 55 m, sandy clay, 1 adult animal; Hurry Inlet, 0—13 m, sand and clay, 1 half-grown shell — 19 m, clay, 2 adult animals — 94 m, sand and clay, 1 adult animal; Hurry Inlet, at Constable Pynt, 7—10 m, sand, 1 adult animal — 12—18 m, very soft clay, 1 adult and 1 half-grown animals; Hurry Inlet, off Constable Pynt, 21—24 m, clay, 8 adult and 4 half-grown animals (8 finds); Hurry Inlet,

off Fame Øer, 25 m, soft clay with gravel, 3 adult animals; At Fame Øer, 15—25 m, soft or tough clay, *Laminaria*, red algae, 7 adult and 4 half-grown animals (6 finds); Fame Øer, 70°50′ N. 22°33′ W., 23—25 m, clay, 2 adult animals; Off Kap Hooker, 65 m, sand, 2 adult and 1 half-grown animals — 57—72 m, sand mixed with clay, 3 adult, 5 half-grown, and 9 young animals (8 finds); 8 miles W. of Kap Hooker, 12—14 m, claeyey sand, 1 adult and 1 half-grown animal, 1 adult shell (3 finds); W.coast of Jameson Land opposite Kap Leslie, 22 m, sandy, glittering clay, 1 adult animal; W.coast of Jameson Land opposite Bjørneøer, 30 m, tough clay, 1 adult valve; Bjørneøer, 18—28 m, stones, gravel, red algae, 2 adult and 1 half-grown animals; Nordbugten in Nordvestfjord, 28—30 m, loose clay, 2 adult and 2 young animals, 1 adult shell (3 finds) — 58 m, soft clay, 1 adult animal; Hekla Havn, Danmarks Ø, depth?, 1 adult animal; N.E. of Danmarks Ø, 19 m, soft clay, 1 adult animal; S.E. of Danmarks Ø, 27—30 m, soft clay with gravel, 1 adult animal; The bay opposite Rødeø in Rødefjord, 13—18 m, soft clay with gravel, 8 adult and 2 half-grown animals — 18—26 m, clay, *Laminaria*, 1 adult animal — 30—35 m, soft clay with many big stones, 1 adult animal; Turner Sund, 5.5 m, 10 adult, 6 half-grown, and 2 young animals, 1 adult shell, 1 adult valve.

Kangerdlugssuaq Area: Uttentals Sund, 4—5 m, 7 adult animals, 3 adult shells — 8—10 m, 4 adult animals, 3 adult shells — 10—20 m, grey clay, 18 adult and half-grown animals, 6 adult shells (4 finds) — 20—40 m, clay, 8 adult animals, 6 adult shells (1 drilled by *Natica*) (4 finds) — 50—60 m, clay, 5 adult animals (2 finds) — 75—100 m, clay, 1 adult animal; Kangerdlugssuaq, depth?, 3 adult animals, 3 adult shells (erroneously referred to *M. moësta* in THORSON 1934a) — 50 m, 1 adult shell (erroneously referred to *M. moësta* in THORSON 1934a).

Sydøstkyst Area: Angmagssalik, depth?, 1 half-grown shell; Lindenows Fjord, outer part, 90 m, clay, 1 adult animal; Qeqertatsiaq, 60—70 m, sand, gravel, dead bryozoans, 1 adult animal, 1 adult shell (2 finds).

At E. Greenland the species is thus known to occur from Danmarks Havn in the N. to Qeqertatsiaq in the S., with a vertical range for living specimens from 4—5 m (Uttentals Sund) to 207 m (S.E. of Sabine Ø). It appears to be evenly distributed in the inner fjords as well as in places near to the open sea, and has been taken from various types of bottom, viz. clay, mud, sand, gravel, and stony bottom. However, compared with the preceding species of *Macoma*, *M. loveni* seems to prefer a bottom which is richer in coarser components.

Remarks: The specimens from E. Greenland are subject to some variation in the shape of the shell, and the larger ones are very often rather much eroded. The ten largest specimens at hand measure (length × heigh × breadth of shell): $16.7 \times 12.1 \times 6.8$ — $16.7 \times 12.0 \times 7.1$ — $15.4 \times 10.9 \times 6.3$ — $15.4 \times 10.6 \times 7.2$ — $15.2 \times 11.3 \times 6.5$ — $15.2 \times 11.0 \times 5.9$ — $15.2 \times 10.6 \times 6.2$ — $15.0 \times 10.6 \times 6.4$ — $14.8 \times 10.7 \times 5.7$ and $14.4 \times 9.8 \times 5.5$ mm, respectively. The species thus seems to attain its maximum size at E. Greenland.

Distribution: W. Greenland, E. Greenland, Spitzbergen, the Kara Sea, Jones Sound, Baffinland, the Gulf of St. Lawrence, and off N.E. America from 47°40′ N. 47°35′30″ W. to 40°03′ N. 70°31′ W. (as *Macoma inflata*, VERRILL & BUSH 1898). Main distribution: High-arctic with low-arctic outposts (in the N. Atlantic sector only). Vertical range: From 4—5 m (E. Greenland) to about 375 m (off N.E. America).

Biology: The gonads of 68 individuals, derived from various East Greenland localities, were examined. However, only a few of them contained nearly mature eggs, the yolk mass of which measured 210—260 μ in diameter, being surrounded by a mucous and adhesive membrane (material preserved in alcohol). At E. Greenland the species does not seem to spawn within the period from the end of June to the end of September. Perhaps spawning occurs very late in the year, but no definite statement as to this can be made at present. The prodissoconch of 8 young specimens measured from about 420 to about 460 μ across, with a mean of about 440 μ. The egg-size as well as the size of the prodissoconch suggest that the larval development is lecithotrophic with the pelagic stage very short or entirely absent.

43. *Macoma torelli* (STEENSTRUP) JENSEN (cf. pl. 2, fig. 12).

Tellina (*Macoma*) *Torelli* JENSEN 1904, pl. 1, figs. 3a—i.
Tellina (*Macoma*) *Torelli* JENSEN 1905, p. 344, figs. 3a—h.

East Greenland records:

Tellina (*Macoma*) *Torelli* JENSEN 1904, pp. 36—37.
Tellina (*Macoma*) *Torelli* JENSEN 1905, pp. 343—345.

Occurrence at East Greenland (cf. the map fig. 26, p. 186):

Nordøstkyst Area: S.E. of Sabine Ø, 74°30′ N. 19°45′ W., 5.5—9.5 m, 1 adult shell.

Sydøstkyst Area: Lindenows Fjord, outer part, 60—70 m, clay, gravel, 1 half-grown animal — 90 m, clay, 4 adult and 1 half-grown animals; Lindenows Fjord, inner part, 77 m, clay, 1 adult animal.

The species has not previously been recorded in a living state from E. Greenland. The shell from Sabine Ø looks rather fresh but may nevertheless be of a considerable age. As the species does not seem to be included in the large collections from Kejser Franz Josephs Fjord and Scoresby Sund, it appears questionable whether it does at present live in these areas.

Remarks: All the specimens obtained from Lindenows Fjord are of an appearance typical of the species. The three largest of them measure (length × height × breadth of shell): 13.6 × 10.8 × 5.8 — 13.2 × 10.4 × 5.0 and 12.9 × 10.2 × 5.7 mm, respectively. The shell from Sabine Ø is unusually much compressed and measures 17.2 × 13.3 × 5.7 mm.

Distribution: Jones Sound, W. Greenland (probably lacking at the south-western coast), E. Greenland, Spitzbergen, and the Kara Sea. The scarce records seem to indicate that the species has a high-arctic main distribution and is restricted to the N. Atlantic sector. Vertical range: From 16 m (Jones Sound) to 90 m (E. Greenland).

Biology: One adult animal from Lindenows Fjord had large oocytes in its gonads (16-7-35), and another very large one had apparently premature eggs (23-7-35). These were slightly oval and surrounded by a fairly thick membrane, their yolk masses measuring from 260 to 320 μ in the longer diameter. In fully mature eggs the membrane is probably mucous and adhesive. The largest diameter of what seemed to be the prodissoconch of the two half-grown animals was about 530 and 550 μ, respectively. Thus, the larval development is no doubt lecithotrophic, the pelagic stage being very short or quite suppressed.

44. *Hiatella arctica* (Linné).

Saxicava arctica G. O. Sars 1878, pl. 20, figs. 8a—c.
Saxicava pholadis G. O. Sars 1878, pl. 20, figs. 7a—c.

East Greenland and Jan Mayen records:

Saxicava rugosa Möbius 1874, p. 252.
Saxicava arctica and *Saxicava pholadis* Becher 1886, pp. 71—72.
Saxicava arctica Posselt 1895, p. 76.
Saxicava arctica Posselt & Jensen 1898, p. 95.
Saxicava arctica Friele 1902, p. 4.
Saxicava arctica Hägg 1904, pp. 58—59.
Saxicava arctica Jensen 1905, pp. 357—359.
Saxicava arctica Lamy 1913a, p. 23.
Saxicava arctica and *Saxicava pholadis* Lamy 1913b, p. 600.
Saxicava arctica Odhner 1915, p. 129.
Saxicava pholadis Lamy 1926, pp. 179—180.
Saxicava arctica and *Saxicava pholadis* Remy 1928, p. 224.
Saxicava arctica Thorson 1934a, p. 7.
Saxicava arctica Thorson 1936, p. 51 et seq.; on reproduction.
Saxicava arctica (Jensen in) Thorson 1951, p. 85.

Occurrence at East Greenland:

Nordøstkyst Area: Jørgen Brønlund Fjord, 21 adult and 3 half-grown animals, partly digested, from esophagus and gizzard of 4 *Somateria spectabilis* — depth?, 1 half-grown and 1 young animal — ca. 10—13 m, clay, 6 half-grown and 9 young animals, 3 adult, 2 half-grown, and 1 young shells (3 finds) — 21—46 m, clayey bottom, 1 half-grown and 2 young animals (2 finds); N. of Syttenkilometernæsset, about 76°50′ N., on the shore, 1 adult, fragmentary valve; Kap Bismarck, on the shore, 1 adult valve, 1 fragment; Øresund at Danmarks Havn, 28—38 m, stones, shells, hydroids, red algae, 2 half-grown animals (2 finds); Between "Renskær" and "Måtten" near Danmarks Havn, ca. 47—94 m, hard bottom, hydroids, 4 adult and 1 half-

grown animal (2 finds); Danmarks Havn, on the shore, 3 adult valves — 5.5—11 m, soft bottom, *Laminaria*, 22 adult, half-grown, and young animals, 4 adult shells (7 finds) — 9.5—15 m, *Laminaria*, *Delesseria*, 3 adult and 2 half-grown animals, 1 adult shell, 3 adult valves (3 finds) — 19—28 m, mud, *Delesseria*, red algae, 1 adult animal, 1 adult shell (2 finds); Stormbugt, Danmarks Havn, 9.5—19 m, soft bottom, *Laminaria*, about 40 adult, half-grown, and young animals, 1 adult shell — 19—38 m, stones, shells, *Delesseria*, 38 adult, half-grown, and young animals, 7 shells, 2 valves (5 finds); Off the Eskimohouse ruin, Danmarks Havn, 0—7.5 m, sandy mud, shells, algae, 1 adult shell; Hvalrosodden near Danmarks Havn, on the shore, about 60 adult valves; The mouth of Mørkefjord, 2 m, sand and clay, *Laminaria*, 3 adult and 5 young animals, 2 adult valves; E. coast of Koldewey, 76°20′ N. 18°26′ W., on the shore, 1 half-grown shell, 12 adult valves, 3 fragments; Shannon, 56.5 m (MÖBIUS); S. of Lille Pendulum, 74°35′ N. 18°23′ W., 18—21 m, sandy mud, algae, 1 adult and 1 young animal; S.E. of Hvalrosø, 74°30′ N. 18°40′ W., 80—100 m, mud and stones, 2 animals (HÄGG); Sabine Ø, depth?, *Laminaria*, 1 adult animal.

Kejser Franz Josephs Fjord Area: Kap Borlase Warren, 19 m, *Laminaria*, 2 adult and 4 half-grown animals; Sand Ø, Tyrolerfjord, depth?, 15 adult valves — 8 m, 1 adult and 3 young animals; Zackenberg Bugt, Wollaston Forland, on the shore, 6 adult valves; Kap Mary, Clavering Ø, on the shore, 2 adult valves; S.E. of Clavering Ø, 74°10′ N. 20°08′ W., 25—40 m, mud, many shells and pebbles, 2 adult and 2 half-grown animals; Kap Stosch, ca. 15 m, 1 half-grown animal; Loch Fyne, on the shore, 1 adult and 3 half-grown valves; 4 miles E. of Holland Ø, 130 m, clay with gravel, big stones, 2 adult animals; Mackenzie Bugt, 3—10 m, mud and sand with *Laminaria*, 1 animal (HÄGG) — 12—18 m, mud, 3 animals (HÄGG) — 12—35 m, mud, 44 animals, 1 shell (HÄGG); Kap Bennet, 73°26′ N. 21°13′ W., 9—11 m, sandy mud, algae, 1 adult animal; 73°20′ N. 21°20′ W., 70 m, mud, some pebbles and shells, 2 adult animals; Kejser Franz Josephs Fjord, 73°16′ N. 23°15′ W., 28—36 m, clay, shells, stones, gravel, sand, 1 adult animal; Between Kap Graah and Vinterøer, 56 m, tough, greyish-brown clay with stones, 5 adult animals; The mouth of Duséns Fjord, opposite Kap Graah, 15—40 m, clay, stones, *Desmarestia*, a few red algae, 28 adult, half-grown, and young animals (3 finds); Duséns Fjord, at the anchoring place, 10 m, loose clay, *Desmarestia*, 2 adult animals — 20—25 m, loose clay, *Desmarestia*, 1 half-grown animal — 25—47 m, tough clay, 3 young animals (3 finds); Inner part of Duséns Fjord, 4—10 m, soft clay, *Desmarestia*, about 150 adult, half-grown, and young animals — 15—20 m, *Laminaria*, *Fucus*, 11 adult, half-grown, and young animals; The head of Duséns Fjord, 5—19 m, clay, *Desmarestia*, 2 adult animals (2 finds); Nordfjord, Strindberg Land, 19 m, clayey bottom, 1 adult and 1 young animal, 5 adult valves; Moskusoksefjord, off Ankerbjerg valley, 17—23 m, red clay with big stones, 975 adult, half-grown, and young animals (2 finds); Moskusoksefjord, 15 m, about 40 adult and half-grown animals; Eleonore Bugt, 3.5—12 m, clay, *Fucus*, *Laminarie*, *Desmarestia*, about 50 adult, half-grown, and young animals — 15—27 m, clay, some stones, *Laminaria*, *Desmarestia*, about 180 adult, half-grown, and young animals (2 finds) — 38—65 m, clay, 2 adult and 2 half-grown animals; Isfjord, 27—30 m, soft brown mud, 1 half-grown animal, about 7 mm long, in stomach of *Ophiocten sericeum* (personal information from Prof. THORSON); Off Haredalen, Isfjord, 9—15 m, loose, greyish-brown clay, 18 adult, half-grown, and young animals

— 27—35 m, loose, brown clay, about 100 adult, half-grown, and young animals (2 finds) — 55—59 m, loose, brown clay, 1 adult animal; Inner part of Kejser Franz Josephs Fjord, off Engdalen, 13—18 m, fine, loose, grey clay, 1 adult animal — 27—45 m, loose, brown clay, about 220 adult, half-grown, and young animals (3 finds) — 50—55 m, loose, brown clay, about 50 adult, half-grown, and young animals; Inner part of Kejser Franz Josephs Fjord, 73°06′ N. 27°17′ W., 3—9 m, mud with sand and algae, 7 adult, 1 half-grown, and 2 young animals; Karl Jakobsens Bugt, Ymers Ø, 4—5 m, clay, algae, 4 young animals (2 finds) — at all depths from 6 to 27 m, clay, about 70 adult, half-grown, and young animals (15 finds); Solitærbugt, Ella Ø, 3 m, clay, brown algae, about 500 animals, almost all of them young—at all depths from 2 to 52 m, mainly clayey bottom with stones, gravel, or shells, various algae, about 1000 adult, half-grown, and young animals (at least 25 finds)—50—95 m, clay, stones, 6 adult and 2 young animals (at least 3 finds); Solitærbugt, off Kap Oswald, 3—10 m, stones, *Fucus*, *Desmarestia*, about 70 animals, mainly young ones (2 finds)—10—15 m, *Fucus*, about 20 young animals—30—35 m, clay, *Fucus*, 2 adult and 1 young animals; E. part of Vega Sund, 72°45′ N. 22°56′ W., 1—3 m, sand with brown algae, 1 half-grown and 1 young animal—35—60 m, mud, some stones, 1 adult animal; Röhss Fjord, 72°43′ N. 26°38′ W., 35—60 m, mud, 6 adult, 2 half-grown and 2 young animals; Kap Hedlund, 4—27 m, clay, stones, algae, about 150 adult, half-grown, and young animals (at least 6 finds)—20—53 m, clay, stones, brown algae, about 125 adult, half-grown, and young animals (at least 5 finds); Off the mouth of Rhedins Fjord, 25—30 m, clay, 1 young animal; Forsblads Fjord, 94—170 m, clay with stones, 1 adult and 1 young animal, 1 half-grown and 1 young shell; Antarctics Havn, 72°01′ N. 23°03′ W., 32—40 m, mud, 2 adult animals. [Between East Greenland and Jan Mayen, 72°42′ N. 14°49′ W., 2000 ooze with Foraminifera, 1 shell (Hägg)].

Scoresby Sund Area: Rosenvinges Bugt, Scoresbysund, depth?, 2 valves (Lamy)—28—30 m, rocky bottom, 2 animals and 6 animals (Remy, as *S. pholadis* and *S. arctica*, respectively)—70 m, tough, bluish mud on rocks, 1 dead specimen (Remy)—8—12 m, stones, algae, 4 adult and 1 young animals (2 finds); Hvalrosbugt, Scoresby Sund, 30—35 m, sand and clay, 1 adult and 1 young animal; Amdrups Havn, Scoresby Sund, 3—5 m, stony bottom, algae, 2 adult animals—6—10 m, *Laminaria*, red algae, 1 half-grown animal—22—33 m, *Laminaria*, red algae, about 20 adult, half-grown, and young animals (2 finds); Scoresbysund, at the station, 7—11 m, *Laminaria*, *Fucus*, 2 young animals; Off Kap Hope, 4.5—12 m, sand, algae, 1 half-grown and 4 young animals (3 finds); The mouth of Hurry Inlet, 14—16 m, sand, algae, detritus of algae, 5 young animals (2 finds)—19 m, clay, 10 adult and half-grown animals, 2 adult shells; Hurry Inlet, 1 mile inside the mouth, 3.5—4.5 m, sand, stones, 13 adult, half-grown, and young animals—12—13 m, sand with many stones, 1 half-grown animal—35—38 m, sand, stones, *Laminaria*, *Fucus*, red algae, 3 half-grown animals; E. side of Hurry Inlet, 2 miles inside the mouth, 14—15 m, *Laminaria*, 4 young animals; Hurry Inlet, 0—13 m, 2 adult and 3 half-grown animals—94 m, clay with stones, 2 half-grown animals; Hurry Inlet, at Constable Pynt, 7—10 m, sand, 1 adult and 1 young animal; Off Constable Pynt, 23—24 m, clay, 2 adult animals (2 finds)—31—35 m, clay, 4 adult animals (2 finds); Hurry Inlet, at Fame Øer, 4—6 m, gravel, algae, 10 young animals—15—27 m, soft clay, gravel, *Laminaria*, red algae, 63 adult, half-grown, and young animals, 1 half-grown

shell, 1 adult valve (8 finds); Fame Øer, 70°50′ N. 22°33′ W., ca. 9 m, mud, algae, 2 adult, 1 half-grown, and 1 young animals; Kap Stewart, 13—18 m, mud, stones, algae, 3 adult and 4 young animals; W. coast of Jameson Land opposite Kap Leslie, 22 m, sandy, glittering clay, 1 half-grown animal; Kap Leslie, 54—62 m, glittering clay, 22 adult, half-grown, and young animals (5 finds); Noa Vig, Milne Land, 10—15 m, very soft clay, 6 adult animals, 1 adult shell; W. coast of Jameson Land opposite Bjørneøer, 6—13 m, stones, gravel, red algae, about 80 adult, half-grown, and young animals—18—28 m, stones, gravel, red algae, 11 adult and half-grown animals; Nordbugten in Nordvestfjord, 2—3 m, loose clay, *Fucus* and other algae, 2 adult and 6 young animals—10—18 m, very loose, light-grey clay, about 25 adult, half-grown, and young animals—28—37 m, loose clay, 2 adult, 1 half-grown, and 2 young animals (2 finds); Danmarks Ø, 9.5 m, mud, *Fucus*, *Desmarestia*, 1 young animal; Hekla Havn, Danmarks Ø, 9.5 m, mud, about 20 adult and half-grown animals, 10 valves; N.E. of Danmarks Ø, 18—22 m, soft clay, stones, *Desmarestia*, 60 adult, half-grown, and young animals (10 finds); S.E. of Danmarks Ø, 10—17 m, soft clay, gravel, 7 adult and 3 half-grown animals—27—30 m, soft clay, gravel, 8 adult animals; Gaaseland, depth?, 2 adult animals; The bay opposite Rødeø in Rødefjord, 4—10 m, clay, *Fucus*, 36 animals, mainly young ones (2 finds)—30—35 m, soft clay, many big stones, 3 adult animals; Turner Sund, ca. 5.5 m, 1 half-grown animal, 3 adult shells; Henry Land, 38 m, 5 young animals; Kap Dalton, depth?, 2 adult valves—17—21 m, clay 3 adult and 1 half-grown animals, 6 adult shells.

Kangerdlugssuaq Area: Mikis Fjord, 175 m, 1 half-grown animal; Uttentals Sund, 8—10 m, 1 adult animal — 10—15 m, 2 adult animals (2 finds); — 20—25 m, 4 adult animals — 30—45 m, 14 adult and half-grown animals, 1 adult shell (3 finds) — 50—60 m, 3 adult animals (2 finds); Kangerdlugssuaq, depth?, 1 half grown animal — 20—25 m, muddy clay, stones, 2 adult animals, 3 adult valves (3 finds); — 50—70 m, stony bottom, gravel, 4 adult animals, 1 adult shell (3 finds) — 80—100 m, stones, 2 adult shells.

Sydøstkyst Area: Off Angmagssalik, 47—75 m, clay with small stones, "several specimens" (POSSELT & JENSEN, JENSEN); Angmagssalik, depth?, sand, brown algae, 1 adult and 2 half-grown animals; Tasîssaq near Angmagssalik, 15—20 m, red algal limestone, some clay, 1 adult and 1 half-grown animal — 25—30 m, 4 adult and 2 half-grown animals — 9.5—38 m, stony bottom with algae, 6 adult animals, 1 adult and 1 half-grown shell (both drilled by *Natica*) — 38—56 m, stony bottom with algae, 3 adult and 1 half-grown shell (2 drilled by *Natica*); Tasîssaqfjord, depth?, 11 adult animals; Kungmiut near Angmagssalik, depth?, 2 adult animals; Angmagsivik, 65°58′ N. 37°02′ W., 1—9.5 m, 1 half-grown animal; Tiniteqilâq, ca. 2 m, 1 young animal; Sermilik, settlement Íkáteq, 25 m, clay, 1 young animal; Skjoldunge Fjord, 63°32′ N. 41°50′ W., 2.5—20 m, clay, 1 adult animal, 3 adult shells; Kap Tordenskjold, 11 m, rocks, *Laminaria*, 1 adult animal; Nanuseq N. of Lindenows Fjord, 46 m, sand, algae, 1 adult and 2 young animals — 150—175 m, clay, 1 adult animal; Lindenows Fjord, the mouth, 11 m, gravel, *Laminaria*, 1 young animal — 20—30 m, gravel, *Laminaria*, 1 half-grown animal; Lindenows Fjord, outer part, clay with gravel, 1 adult animal; Lindenows Fjord, middle part, 10—16 m, sand, remnants of algae, *Laminaria*, 1 half-grown and 1 young animal (2 finds) — 26—27 m, sand, gravel, clay, *Laminaria*, 1 adult and 1 young animal (2 finds) — 40—55 m, clay, fine sand, 1 adult and 4 young animals (4 finds) — 125—150 m, clay,

1 young animal; Lindenows Fjord, inner part, 25—30 m, clay, gravel, sand, 2 adult and 3 young animals (2 finds) — 25—50 m, clay, 2 adult, 3 half-grown, and 1 young animals, 1 adult shell (2 finds) — 64—91 m, clay, 1 young animal, 1 adult shell (2 finds); Lindenows Fjord, innermost part, 15—35 m, gravel, clay, *Laminaria*, 25 adult, half-grown, and young animals (3 finds) — 45 m, clay, 1 adult animal.

Jan Mayen Area: Jan Mayen, 28 m, *Laminaria*, 20 adult and half-grown animals, 3 adult shells, about 200 adult valves — 104 m, mud with coarser material, 1 adult animal, 3 adult valves; N. of Jan Mayen, 140—270 m, "9 specimens", and "4 specimens and some dead shells" (BECHER, as *S. arctica* and *S. pholadis*, respectively); 70°48′ N. 7°30′ W., 100 m (FRIELE); S. of Jan Mayen, 70°57′ N. 10°39′ W., 37 m, volcanic gravel, 1 dead specimen (LAMY); S. of Jan Mayen, 70°52′ N. 10°33′ W., 180 m, grey, volcanic mud, 1 dead specimen (LAMY); 70°40′ N. 8°40′ W., 40 m, 7 animals, 25 valves (LAMY, as *S. pholadis*); 70°40′30″ N. 8°36′ W., 75 m, 9 animals (LAMY);Jan Mayen, Jameson Bay, depth?, 12 valves (LAMY, as *S. pholadis*); 2 miles S.E. of Jameson Bay, depth?, 4 animals (LAMY, as *S. pholadis*); 70°59′ N. 8°40′ W., depth?, 3 valves (LAMY, as *S. pholadis*); 70°57′20″ N. 8°50′ W., depth?, 4 valves (LAMY, as *S. pholadis*); E. coast of Jan Mayen near Friele Glacier, 25—30 m, volcanic gravel, "numerous animals" (REMY, as *S. pholadis*).

The species is one of the commonest bivalves at East Greenland, where it has been met with in most of the localities hitherto investigated from Jørgen Brønlund Fjord in the N. to Lindenows Fjord in the S. It is also very common around Jan Mayen at depths from 25—30 to 140—270 m. The vertical range at E. Greenland for living specimens is from a few metres below the shore line down to 175 m (Mikis Fjord). However, it occurs mainly at depths between 5—10 m and 50—60 m. The species is a member of the epifauna. In shallow water large numbers of young animals were found attached to the algae. Thus, in Solitærbugt, Ella Ø, 3 m, vast numbers of *Desmarestia*, 511 juveniles were taken in a single dredge haul (THORSON 1933). The adults were often found to be attached to stones and other coarser components of the level sea-bottom. Peculiar is the formation of coherent lumps by numbers of individuals exclusively attached to each other. These lumps may attain an enormous size. For instance, in Moskusoksefjord, off Ankerbjerg valley, 17—21 m, red clay with fairly big stones, a single dredge haul yielded 974 individuals all of which were completely entangled with each other by byssus threads. The greater part of these specimens were young and half-grown animals (THORSON 1933). The *Hiatella* epifauna is especially well developed in the Kejser Franz Josephs Fjord, whereas in Scoresby Sund and the areas south of this fjord it seems to be of minor importance (THORSON 1934b, BERTELSEN 1937a).

Remarks: Interpretations as regards the taxonomy of the North Atlantic species of *Hiatella* DAUDIN 1801 [= *Saxicava* BELLEVUE 1802] are divergent. LAMY (1923), for instance, in a study on the Saxicavidae

distinguishes between three species occurring in the N. Atlantic, viz. *Saxicava arctica* L., *S. rugosa* L., and *S. pholadis* L. WINCKWORTH (1932) also mentions three species as occurring in British waters, namely *Hiatella arctica*, *H. gallicana*, and *H. pholadis*, the latter, however, as a doubtful species. On the other hand AD. JENSEN (in THORSON 1951) regards all specimens living at Greenland, Jan Mayen, Iceland, and the Faroes as belonging to one species only, viz. *Saxicava arctica* L., whereas LAMY mentions all his three species from Iceland, and two of them even as occurring at Greenland.

In this connection the results arrived at by HUNTER, in a study of the structure and the boring habits of the British forms of *Hiatella*, seem of special interest. HUNTER writes (1949, p. 273): "It is wrong to state that the *H. gallicana* form alone bores and is restricted to that habit, and that *H. arctica* never bores. The shell form is extremely modified in relation to the particular environment, and the only consistent shell form is that of the one group of individuals having precisely the same environment, namely the adult borers. No genotypic structures exist to differentiate the adult borers from the non-borers."

However, two different forms of *Hiatella* larvae are known to occur in the N. Atlantic. These two forms have been observed in the Adriatic Sea (ODHNER 1914), at Plymouth (LEBOUR 1938), at Denmark (JØRGENSEN 1946), and in the Clyde Sea Area (HUNTER 1949), and besides these, REES (1950, p. 99, pl. V, fig. B) describes one further type of larvae from the North Sea which, according to REES, may belong to *H. pholadis*. At any rate, two forms of *Hiatella* larvae are known with certainty from the areas mentioned above, whereas only one type of *Hiatella* larvae was found to occur at N.E. Greenland (THORSON 1936). This type of larva agrees well with that described by ODHNER, LEBOUR, JØRGENSEN, and REES, being attributed to *H. gallicana* [= *Saxicava rugosa*] by these authors. In Malpeque Bay, E. Canada, the same form of *Hiatella* larva has been observed by *Sullivan* (1948), who, however, refers it to *Saxicava arctica*.

At present it seems impossible to refer the adults of *Hiatella* occurring in the N. Atlantic and the Mediterranean to reasonably defined, different species. There may be one, two, or perhaps even three of them, if the two or perhaps three (cf. REES, loc. cit.) different larval forms of *Hiatella* are taken into consideration. But, if we regard the existence of different larval forms as evidence of actually different species of *Hiatella*, the question arises at once whether it is justifiable and correct to attribute the *Hiatella* larvae with the more rounded and thinner shells to the *H. gallicana* form of the adult, and the larvae with the more angular shells to the *H. arctica* form of the adult. This will be stressed by the following citations from HUNTER (1949, pp. 273—274): "In the

Clyde Sea Area no difference was found between the breeding seasons of borers and non-borers, or between those of individuals with different adult shell forms." Here, however, it should be mentioned that differences in the occurrence of the two larval forms were observed by LEBOUR, JØRGENSEN, and REES (1951, 1954). HUNTER also states that both larval forms of *Hiatella* occur in the Clyde Sea Area and writes: "These are easily distinguished, ... and can be separated to a certain extent after metamorphosis, but become indistinguishable in shell form after about two weeks of post-larval growth. The larvae attributed to *H. gallicana* do not necessarily become borers, those to *H. arctica* may settle and begin to bore. The character of the larva does *not* determine the boring or non-boring habit of the adult. That is determined by the nature of the substratum upon which settlement takes place." Thus, a reverse attribution of the two forms of *Hiatella* larvae to the forms of the adults seems just as correct as that applied at present. The possibility of regarding the two different larval forms observed in the N. Atlantic *Hiatella* as non-genetic modifications cannot be accepted, because of the differences in distribution of these larval forms, and also because of the apparent lack of intermediate larval forms.

As mentioned above, only one form of *Hiatella* larvae has been observed at East Greenland. Hence all the specimens of *Hiatella* from the area in question seem to belong to one and the same species, here referred to *H. arctica* (L.).

The specimens at hand from E. Greenland and Jan Mayen show an extreme variation. Both the *H. arctica* shell form and the *H. gallicana* form are common, besides a number of specimens which are intermediate, and others with very irregularly developed shells. Many specimens, especially some of those derived from Danmarks Havn, Kejser Franz Josephs Fjord, and Scoresby Sund, have very thick and heavy shells, whereas others, often derived from the same localities, are rather thin-shelled. On the whole, hardly two adult specimens of exactly the same appearance seem to be present in the material. The species attains a considerable size at E. Greenland; the largest specimens at hand measure (length × height × breadth of shell): 52.7 × 23.4 × 19.5 — 49.7 × 23.7 × 17.4 — 48.2 × 25.4 × 22.1 — 46.3 × 21.4 × 22.0 — 44.8 × 22.4 × 20.1 — 44.0 × 23.4 × 19.5 — 43.0 × 20.4 × 15.5 — 42.2 × 22.3 × 23.5 — 41.4 × 20.9 × 19.7 and 41.3 × 25.6 × 22.7 mm, respectively. — Some specimens had crusts of bryozoans and *Spirorbis*-tubes attached to their shells.

Distribution: The species (*H. arctica* incl. of *H. gallicana* and *H. pholadis*) is widely distributed, being known from nearly all Arctic areas hitherto investigated, viz. W. Greenland, E. Greenland, Jan Mayen, Spitzbergen, Franz Joseph Land, Novaya Zemlya, the Finmark, the

Murman Coast and the Murman Sea, the Barents Sea, the White Sea, the Kara Sea, the Siberian Ice Sea, the Bering Sea and Strait, the seas N. of America, Baffinland, the Hudson Strait and the Hudson Bay, Labrador, Newfoundland, Iceland, etc. It occurs throughout the boreal regions in the N. Atlantic and the N. Pacific and is reported to extend —especially in deeper water—into the warmer parts of the large oceans. However, it may be doubted whether it actually is a cosmopolite, since confusion with other, closely related species has occurred. Furthermore, reservation must be made as to future separations of the *Hiatella* forms occurring in the northern hemisphere into valid species. Main distribution: Panarctic-boreal, circumpolar, Mediterranean-Atlantic, cosmopolitan? Vertical range: Primarily in shallow water, from about 0 m down to 2190 m? (W. of Ireland, live animals?). Dead shells have been found in the N. Atlantic at great depths, down to about 2380 m.

Biology: The reproduction of the species at N.E. Greenland has been studied by THORSON (1936). There the species was found to spawn mainly from May to the beginning of July. The egg is 70—80 μ in diameter. According to THORSON, the larvae of this species make up by far the greater part of the bivalve veligers in the plankton at N.E. Greenland, and some stages of these are figured (l. c., pp. 60—61).

It is thus a fact that the larval development of this species at E. Greenland, too, is planktotrophic and with a prolonged pelagic stage.

[*Panopea norvegica* (SPENGLER).

Saxicava Norvegica JEFFREYS 1869 V, pl. 51, fig. 2.
Panopea norvegica G. O. SARS 1878, pl. 6, figs. 12a—b.

LAMY (1913a, p. 23, as *Saxicava* (*Panomya*) *norvegica*) records a single valve of this species from S. of Jan Mayen, 70°52′ N. 10°33′ W., 180 m, grey, volcanic mud. — The valve in question, however, may be subfossil, just as empty shells and valves of the species have been found at W. Greenland and N. and W. Iceland, where it is now extinct. The species has its northern limit at S. Iceland and N. Norway, and it seems safe to state that it does not belong to the recent fauna of Jan Mayen and East Greenland].

45. *Cyrtodaria kurriana* DUNKER (cf. pl. 2, fig. 14).

Cyrtodaria kurriana HÄGG 1904, pl. 1, figs. 13—14 (half-grown specimen).

East Greenland and Jan Mayen records:

Cyrtodaria siliqua FRIELE 1878, p. 224.
Cyrtodaria siliqua FRIELE & GRIEG 1901, p. 45.
Cyrtodaria kurriana HÄGG 1904, p. 62.

Cyrtodaria Kurriana JENSEN 1905, p. 356.
Cyrtodaria siliqua LAMY 1913a, p. 23.
Cyrtodaria siliqua LAMY 1926, p. 180.

Occurrence at East Greenland (cf. the map fig. 21, p. 182):

Nordøstkyst Area: Sabine Ø, depth?, *Laminaria*, 1 young animal, 3 adult shells.

Kejser Franz Josephs Fjord Area: Kap Stosch, ca. 15 m, 2 half-grown animals, 1 adult and 2 half-grown shells.

Scoresby Sund Area: Off Kap Hope, 7.5—10 m, sand, 12 young animals, 1 young shell (drilled by *Natica*), 1 adult valve (5 finds) — 10—13 m, sand, 10 young animals, 2 adult shells, 4 adult valves (4 finds) — 20 m, sand, 10 young animals, 1 adult shell (3 finds); Off the mouth of Hurry Inlet, 55 m, clayey sand, 1 young shell; The mouth of Hurry Inlet, 14 m, sand, detritus of algae, 1 young animal; Hurry Inlet, 1 mile inside the mouth, 6—9 m, sand, 1 adult shell (drilled by *Natica*) — 13—15 m, sand, 2 young animals, 1 adult shell (3 finds); E. side of Hurry Inlet, 2 miles inside the mouth, 7—10 m, sand, stones, algae, 1 adult valve; Jameson Land, on the shore, 1 adult valve; Off Kap Hooker, 20 m, sand, 1 young animal.

Sysøstkyst Area: Tasîssaq near Angmagssalik, 1—9.5 m, 4 half-grown animals; Kap Tordenskjold, 8 m, sandy clay, 3 young animals.

Jan Mayen Area: 70°59′ N. 8°40′ W., depth?, 4 valves (LAMY, as *C. siliqua*); Jan Mayen, 19—56 m, "2 larger and some smaller specimens" (FRIELE & GRIEG, as *C. siliqua*); Jan Mayen, 19—38 m, 1 adult shell, 4 half-grown valves; Jan Mayen, Mary Muss-bugten, 7—9 m, sand and algae, 9 half-grown and young animals; Jan Mayen, Hvalrosbugten, 16—18 m, black sand, 4 adult, 7 half-grown and young animals; Drifvedsbugten, 70°55′ N. 8°30′ W., 14—21 m, black sand, 7 half-grown and young animals; E. coast of Jan Mayen, 30 m, sand, 1 animal (HÄGG); S. off Jan Mayen, 70°57′ N. 10°39′ W., 37 m, volcanic gravel, 1 animal (LAMY, as *C. siliqua*). [69°31′ N. 7°06′ W., 2465 m, 1 half-grown shell, 3 half-grown valves, 1 fragment (probably subfossil)].

At E. Greenland the species has thus been found from Sabine Ø in the N. to Kap Tordenskjold in the S. and seems to be restricted to places along the outer coast, where it burrows in sandy bottom at depths from 1—9.5 m to 20 m. Further, it is of common occurrence near Jan Mayen.

Remarks: The species resembles *Cyrtodaria siliqua* (SPENGLER) of the N.E. American coast, and has been treated as a synonym of this latter e.g. by FRIELE 1878, FRIELE & GRIEG 1901, DAUTZENBERG & FISCHER 1912, and LAMY 1913a, 1926. It must be maintained, however, that the two species are distinct. Among other things, the maximum length of *C. kurriana* is only about 38 mm, whereas *C. siliqua* may attain a length of more than 90 mm, and the former is comparatively more elongated than the latter (cf. JENSEN 1905, p. 356), which in addition has heavier shells.

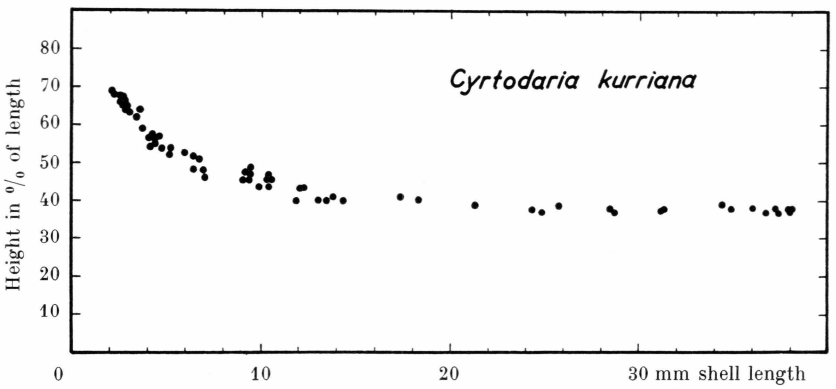

Fig. 10. Diagram showing the proportional decrease of shell height (H) with increasing shell length (L) in *Cyrtodaria kurriana* DUNKER. Based upon the whole material at hand from East Greenland and Jan Mayen.

In *C. kurriana* the height-length ratio of the shell decreases with increasing length, as illustrated by the diagram (fig. 10, p. 144). This is probably the case in *C. siliqua* too, but apparently at another rate; however, this could not be settled definitely, as the material of *C. siliqua* at my disposal is rather sparse.

Distribution: W. Greenland, E. Greenland, Jan Mayen, Spitzbergen, Novaya Zemlya, the Siberian Ice Sea, the Bering Strait, Alaska S. to Norton Sound, Baffinland, the Hudson Strait, and Ungava Bay. Main distribution: High-arctic, probably circumpolar. Vertical range: From 1—9.5 m (E. Greenland) to 19—56 m (Jan Mayen).

Biology: Reproduction unknown.

46. *Mya truncata* LINNÉ.

Mya truncata JENSEN 1900, figs. 2—8.
Mya truncata var. *uddevallensis* ODHNER 1915, pl. 1, figs. 23—24.

East Greenland and Jan Mayen records:

Mya truncata MÖBIUS 1874, p. 252.
Mya truncata var. *Uddevallensis* BECHER 1886, p. 71.
Mya truncata POSSELT 1895, p. 76.
Mya truncata POSSELT & JENSEN 1898, p. 101.
Mya truncata HÄGG 1904, pp. 55—56.
Mya truncata JENSEN 1905, pp. 354—356.
Mya truncata GRIEG 1909, p. 535.
Mya truncata var. *uddevallensis* LAMY 1913b, p. 600.
Mya truncata and *Mya truncata* var. *uddevallensis* ODHNER 1915, p. 123 and pp. 125—126, respectively.
Mya truncata var. *uddevallensis* LAMY 1926, p. 180.
Mya truncata var. *uddevallensis* REMY 1928, p. 223.

Mya truncata THORSON 1934a, p. 7.
Mya truncata THORSON 1936, p. 51 et sequ.; on reproduction.

Occurrence at East Greenland:

Nordøstkyst Area: Jørgen Brønlund Fjord, ca. 10 m, 2 half-grown animals — ca. 13 m, clay, 2 half-grown animals, 1 half-grown valve (2 finds); N. of "Syttenkilometernæsset", about 76°50′ N., on the shore, 2 adult valves; Kap Bismarck, on the shore, 3 fragments; "Renskæret" near Danmarks Havn, on the ice at a seal hole, 1 adult valve; Off Maroussia, 10 soft parts of adult animals, from stomach of *Trichechus rosmarus;* Øresund at Danmarks Havn, 38—56 m, hard bottom, hydroids, 1 adult valve; Danmarks Havn, 0—11 m, mud, stones, sand, *Laminaria* and other algae, about 40 adult, half-grown, and young animals, 12 shells, several valves and fragments (9 finds) — 9.5—19 m, soft bottom, *Laminaria*, 5 young animals, 6 adult and 3 half-grown valves (2 drilled by *Natica*) (2 finds); Stormbugt near Danmarks Havn, 9.5—19 m, soft bottom, *Laminaria*, 1 adult and 12 half-grown animals, 1 adult valve — 19—38 m, stones, shells, *Delesseria*, 4 adult and 1 young valves, 2 fragments (3 finds); Farsund near Danmarks Havn, on the ice, 1 adult shell with remnants of soft parts; Hvalrosodden near Danmarks Havn, on the shore, 15 adult valves, 10 fragments — 0—5.5 m, mud mixed with sand, stones, algae, 1 adult and 1 young animal, 4 adult valves (2 finds); Off the Eskimohouse ruins at Danmarks Havn, 0—7.5 m, mud mixed with sand, algae, 8 young animals, 6 adults valves, 3 fragments; The mouth of Mørkefjord, 2 m, sand, clay, stones, *Laminaria*, 1 half-grown shell; Koldewey, 76°28′ N. 18°20′ W., on the shore, 1 young, dead animal, 1 adult and 1 half-grown shell, 1 adult valve; Koldewey, 76°20′ N. 18°26′ W., on the shore, 5 adult valves, 20 fragments; Near Kap Arendts, Koldewey, "2 specimens from stomach of *Trichechus rosmarus*" (GRIEG); S. of Lille Pendulum, 74°35′ N. 18°23′ W., 18—21 m, sandy mud, algae, 2 half-grown animals; Sabine Ø, depth?, *Laminaria*, 1 half-grown valve — 19—38 m (MÖBIUS).

Kejser Franz Josephs Fjord Area: Kap Borlase Warren, 19 m, *Laminaria*, 3 adult valves; Sandø in Tyrolerfjord, on the shore, 6 adult valves, some fragments; Zackenberg Bugt, Wollaston Forland, on the shore, 6 adult valves — ca. 3—4 m, sandy mud, 1 young shell; Kap Mary, Clavering Ø, on the shore, 7 adult valves; Eskimonæs, Clavering Ø, 4—6 m, coarse gravel, brown and green algae, 1 half-grown and 2 young animals — 10—14 m, sandy, black clay, 1 half-grown animal; Kap Stosch, ca. 15 m, 1 half-grown shell (drilled by *Natica*); 8 km N. of Loch Fyne, on the shore, 3 adult valves; Loch Fyne, on the shore, 4 adult valves; Mackenzie Bugt, 12—18 m, mud, 1 animal (HÄGG) — 12—35 m, mud, 3 animals (HÄGG); Kap Bennet, 73°26′ N. 21°13′ W., 9—11 m, sandy mud, algae, 1 young animal; The mouth of Duséns Fjord opposite Kap Graah, 15—30 m, clay, *Desmarestia*, 1 adult and 3 young animals (2 finds); Duséns Fjord, at the anchoring place, 10 m, loose clay, *Desmarestia*, 3 young animals; Inner part of Duséns Fjord, 4—10 m, soft clay, *Desmarestia*, about 100 animals, mainly young ones; The head of Duséns Fjord, 5—19 m, clay, *Desmarestia*, 12 adult and half-grown animals (3 finds); Off Strindbergs Land, Nordfjord, 19 m, clayey bottom, 4 adult animals; Nordfjord, off the Danish House, 8 m, very fine, grey clay, 1 young animal; Nordfjord, off the river, 10—25 m, loose clay, 2 adult and 1 half-grown animals; Moskusoksefjord, 15 m, 27 adult animals, 6 adult and 1 half-grown

valves (1 drilled by *Natica*); Moskusoksefjord, off Ankerbjerg valley, 17—21 m, red clay with fairly big stones, 1 young animal; Eleonore Bugt, 15—27 m, clay, *Laminaria*, *Desmarestia*, 1 half-grown animal; Karl Jakobsens Bugt, Ymers Ø, 2—7 m, clay, 4 half-grown and 90 young animals (13 finds) — 13—20 m, clay, 3 adult and 5 young animals (4 finds); Isfjord, off Haredalen, 9—15 m, loose, greyish-brown clay, 1 adult and 1 half-grown animal — 27—35 m, loose, brown clay, 1 adult and 5 half-grown animals (2 finds); Inner part of Kejser Franz Josephs Fjord, off Engdalen, 32—45 m, loose, brown clay, 3 adult and 3 half-grown animals (3 finds); Inner part of Kejser Franz Josephs Fjord, 73°06′ N. 27°17′ W., 3—9 m, mud with sand and algae, 6 adult, 20 half-grown and young animals; Eastern part of Vega Sund, 72°45′ N. 22°56′ W., 1—3 m, sand, brown algae, 2 young animals; Off Kap Oswald, Ella Ø, 7—9 m, *Fucus*, 1 young animal; Solitærbugt, Ella Ø, 3—10 m, clay, *Fucus*, *Desmarestia*, about 280 animals, mainly young ones (5 finds) — 2—24 m, about 200 adult, half-grown, and young animals (at least 5 finds) — 20—52 m, clay, stones, shells, algae, about 80 adult, half-grown, and young animals (at least 5 finds); Off the mouth of Rhedin Fjord, 25—30 m, clay, 1 half-grown animal; Kap Hedlund, 4—27 m, clay, shells, stones, about 125 adult, half-grown, and young animals (at least 6 finds) — 20—53 m, 22 adult, half-grown, and young animals (at least 2 finds).

Scoresby Sund Area: Rosenvinges Bugt, Scoresby Sund, depth?, 1 half-grown shell — depth?, 2 valves (LAMY) — 10—12 m, 1 young animal — 28—30 m, rocky bottom, 1 shell (REMY); Off Kap Hope, 7—11 m, sand, 1 adult and 3 young animals (2 finds) — 20 m, sand, 2 young animals (2 finds); Off the mouth of Hurry Inlet, 20—28 m, sand, stones with algae, 2 young animals; The mouth og Hurry Inlet, 57 m, sandy clay, decaying algae, 1 young animal; Hurry Inlet, 1 mile inside the mouth, 14 m, sand, 3 young animals (2 finds); Hurry Inlet, 0—13 m, sand and clay, 1 young animal — 19 m, clay, 1 adult, 2 half-grown, and 1 young animals, 1 adult valve; Hurry Inlet, at Constable Pynt, 7—10 m, sand, 1 adult and 2 young animals; Hurry Inlet, at Fame Øer, 4—7 m, clay, gravel, algae, 4 half-grown and 1 young animals (2 finds) — 8—12 m, gravel, stones, *Laminaria*, 2 young animals — 15—19 m, clay, red algae, *Laminaria*, 1 half-grown and 5 young animals (2 finds); Fame Øer, 70°50′ N. 22°33′ W., 5—8 m, mud, 1 half-grown and 1 young animal; Kap Stewart, 70°27′ N. 22°35′ W., 13—18 m, mud, stones, algae, 1 young animal; Off Kap Hooker, 67 m, clay mixed with sand, 1 young animal; 8 miles W. of Kap Hooker, 12—14 m, sand mixed with clay, 1 adult and 4 young animals, 3 shells (2 drilled by *Natica*) (5 finds); W. coast of Jameson Land opposite Kap Leslie, 22 m, sandy, glittering clay, 1 young animal; Kap Leslie, 54—59 m, glittering clay, 3 half-grown and 5 young animals (4 finds); Bjørneøer, 6—13 m, stones, gravel, red algae, 1 adult and 2 half-grown animals — 18—28 m, stones, gravel, red algae, 4 half-grown and 2 young animals; Nordbugten in Nordvestfjord, 2—3 m, loose clay, *Fucus*, and other algae, 20 adult, half-grown, and young animals — 10—18 m, very loose, light-grey clay, 2 adult, 35 halg-grown and young animals — 30—37 m, very loose, light-grey clay, 1 half-grown animal; Hekla Havn, Danmarks Ø, 9.5 m, mud, 3 adult, 10 half-grown and young animals, 3 half-grown shells (2 drilled by *Natica*); The bay opposite Rødeø in Rødefjord, 4—10 m, clay, *Fucus*, 2 adult, 56 half-grown and young animals (2 finds) — 13—18 m, soft clay with gravel, 30 adult, half-grown, and young animals; Turner Sund, 0—4 m, 1 adult valve — 5.5 m, "a siphon of a large

specimen" (JENSEN); Henry Ø, 38 m, 2 young valves; Kap Dalton, depth?, 6 young animals, 1 adult valve — 13—21 m, fine clay with small stones, 5 young animals, 1 young shell.

Kangerdlugssuaq Area: Kangerdlugssuaq, 8—10 m, muddy bottom, 2 adult valves, one of them with remnant of siphon (2 finds) — 20—25 m, 1 adult valve — ca. 50 m, gravel, 1 fragment (THORSON).

Sydøstkyst Area: Off Angmagssalik, 47—75 m, clay with small stones and shells, 4 valves (POSSELT, JENSEN); Angmagssalik, 1—9.5 m, 8 adult valves — 20 m, sand, 2 adult and 1 young animal; Tasîssaq near Angmagssalik, depth?, 7 adult valves — 5—8 m, 4 half-grown animals, 1 half-grown and 1 young shell (2 finds) — 10—12 m, 1 half-grown animal — 38—56 m, rocky bottom, algae, 1 half-grown valve; Tasîssaq, depth?, 1 adult animal; Tasîssârssik, 5—7 m, 1 half-grown animal; Îmíkêrteq, 65°45′ N. 36°58′ W., 9.5—19 m, 1 young animal; Tiniteqilâq, 65°56′ N. 37°40′ W., 9.5—19 m, "3 specimens and 3 valves" (JENSEN); Angmagsivik, 65°58′ N. 37°02′ W., depth?, 8 adult valves; Sermilik, settlement Ipîtâlaq, 5—7 m, 1 half-grown animal; Sermilik, 2nd E. fjord, 25 m, clay, 13 young animals; Kap Dan, 65°32′ N. 37° W., 19—28 m, rocky bottom with algae, 1 adult animal; Ikerasârssik, 65°32′ N. 38°50′ W., depth?, 1 young shell; Skjoldunge Fjord, 63°32′ N. 41°50′ W., 2.5—20 m, clay, 4 half-grown animals, 3 half-grown shells; Napassorssuaq, 26 m, glittering sand and gravel, *Laminaria*, 1 young animal; Kap Tordenskjold, 26—32 m, clay, 2 young animals, 1 fragment of a siphon; Kangerdluluk, about 61°05′ N., depth?, 1 adult valve; Nanûseq N. of Lindenows Fjord, 1—4 m, sand, 9 adult animals (2 finds) — 8 m, sand, mud, algae, 1 adult and 2 young animals — 30—46 m, sand, clay, gravel, algae, 89 half-grown and young animals, 1 young shell (3 finds); Lindenows Fjord, the mouth, 8—12 m, gravel, *Laminaria*, 2 half-grown animals, 1 young shell (2 finds) — 23—35 m, sand, gravel, *Laminaria*, 1 young animal, 1 young shell (2 finds); Lindenows Fjord, outer part, 10 m, sand, 1 young animal — 15—25 m, clay, mud, gravel, sand, *Laminaria*, 1 half-grown and 1 young animal, 1 half-grown shell (3 finds); Lindenows Fjord, middle part, 10—20 m, sand, remnants of algae, *Laminaria*, 10 half-grown and young animals, 3 young shells (4 finds) — 20—30 m, sand, gravel, remnants of algae, *Laminaria*, 1 half-grown and 4 young animals, 2 half-grown and 1 young shell (4 finds) — 32—37 m, sand, rocks, *Laminaria*, 4 young animals (3 finds) — 40—50 m, clay, 1 half-grown and 4 young animals, 1 half-grown and 1 young shell (4 finds) — 117 m, clayey sand, 1 half-grown animal; Lindenows Fjord, inner part, 15 m, sand, 1 young animal — 25—50 m, gravel, clay, sand, *Laminaria*, 5 half-grown and 10 young animals, 1 half-grown and 1 young shell (6 finds) — 100—150 m, clay, 1 young shell; Lindenows Fjord, innermost part, 14 m, gravel, 1 young animal — 15—30 m, gravel, sand, clay, 14 young animals, 1 half-grown and 1 young shell (drilled by *Natica*) (3 finds); Qeqertatsiaq, 60 m, sand, gravel, dead bryozoans, 3 young animals, 1 young shell (drilled by *Natica*) — 75—90 m, gravel, stones, 1 young shell.

Jan Mayen Area: Jan Mayen, 70°59′ N. 8°40′ W., depth?, 1 valve (LAMY); 70°40′ N. 8°40′ W., 40 m, 20 valves (LAMY); 70°40′30″ N. 8°36′ W., 75 m, 1 valve (LAMY); Jan Mayen, 150 m, sand and stones with algae, "1 specimen" (BECHER).

The species has thus been taken from Jørgen Brønlund Fjord in the N. to Qeqertatsiaq in the S., being of common occurrence both in the

inner ramifications of Kejser Franz Josephs Fjord and Scoresby Sund and in places near the open sea. It is remarkable that adult animals are comparatively sparsely represented in the material from E. Greenland, and as to the frequency of larger animals, most of the finds mentioned do not seem to be representative. Probably, the grab and the dredge are often insufficient for catching the larger, deeply burrowing animals. The vertical range for living specimens at E. Greenland is from 1 m (Nanûseq N. of Lindenows Fjord) to 117 m (Lindenows Fjord). However, finds from depths exceeding 50 m are uncommon. The species has been found to live on almost all kinds of bottom, viz. mud, clay, sand, gravel, and stony bottom. The adult animals belong to the infauna of the bottom, whereas the young ones are often found attached to algae, where they may occur in large numbers. Thus, a dredge haul in Solitærbugt, Ella Ø, 4—8 m, clay, large numbers of *Desmarestia*, yielded 154 juveniles of the species (THORSON 1933).

Remarks: The specimens from E. Greenland are very variable as regards the shape of their shells, and both the typical form and f. *uddevalensis* FORBES as well as specimens approaching forma *ovata* JENSEN are represented. The latter has been raised to species rank by SCHLESCH (1931, pp. 136—137, as *Mya pseudoarenaria*). However, after an examination of the large collections of recent *Mya* from West Greenland and Iceland in the Copenhagen Museum, the present author feels convinced that *Mya pseudoarenaria* SCHLESCH (= *M. truncata* f. *ovata* JENSEN) is not a distinct species, probably not even a reasonably defined subspecies. Between f. *ovata* and the typical *M. truncata* all grades of transitional stages occur. The East Greenland specimens referable to f. *uddevalensis* are also connected with the typical form by the occurrence of intermediates and have therefore not been treated separately in the preceding pages. The subjoined table gives the measures of the largest specimens and valves present in the material from E. Greenland:

f. *uddevalensis*			f. *uddeval.* × f. *typica*			f. *typica*			Specimens appr. f. *ovata*		
L	H	B	L	H	B	L	H	B	L	H	B
63.3	52.1	—	67.8	47.3	—	66.5	43.3	—	43.1	28.6	—
63.2	49.8	—	64.5	45.2	27.3	60.5	43.0	—	41.7	28.8	16.8
56.5	41.5	34.6	63.5	41.4	28.3	59.1	39.8	—	39.9	26.6	15.6
55.7	44.2	—	61.1	40.2	—	50.6	35.6	—	36.6	26.2	15.5
55.5	44.7	—	52.9	39.5	—	44.6	27.8	17.3	36.3	25.8	13.5
51.3	36.6	—	49.3	37.4	26.1	41.6	28.0	15.5	35.8	23.3	14.7
45.6	34.7	22.8	43.7	33.8	19.5	37.6	26.7	16.8	35.3	23.4	15.7
43.5	34.8	18.4	43.1	30.8	18.3	37.4	26.0	16.4	34.7	23.6	13.8

The smaller maximum size of the specimens approaching f. *ovata* is probably due to these being of relatively sparse occurrence. A few specimens had hydroid colonies, crusts of bryozoans, or algae attached to their shells.

Distribution: Widely distributed in the Arctic, e. g. W. Greenland, E. Greenland, Jan Mayen, Spitzbergen, Franz Joseph Land, Novaya Zemlya, the Finmark, the Barents Sea, the Murman Coast and the Murman Sea, the White Sea, the Kara Sea, the Siberian Ice Sea, the Bering Strait and the Bering Sea, the Aleutians, Kamchatka, the Seas N. of America, Baffinland, the Hudson Strait, Labrador, Newfoundland, the Gulf of St. Lawrence, Nova Scotia, etc. In the N. Pacific the species reaches south to Hakodadi (Japan), and Port Orchard (Washington), and in the N. Atlantic southward to Nahant (Massachusetts), La Rochelle (France), and into the Western Baltic. Main distribution: Panarctic-boreal and circumpolar. Vertical range: From 0 m to about 625 m (W. Greenland), but mainly at smaller depths only. Empty shells are known from the N. Atlantic at depths down to 2374 m.

Biology: At N.E. Greenland the reproduction of *Mya truncata* was studied by THORSON (1936), who found the species to spawn from (May) June to the beginning of July. The eggs measure 70—80 μ in diameter, and larvae referable to this species were observed in the summer plankton. The species is normally unisexual, the development of the larva being planktotrophic with a long pelagic stage (cf. also LEBOUR 1938, JØRGENSEN 1946, and REES 1950).

47. *Lyonsia arenosa* (MØLLER).

Lyonsia arenosa G. O. SARS 1878, pl. 34, figs. 2a—b.
Lyonsia arenosa var. *sibirica* LECHE 1883, pl. 32, figs. 3—4.

East Greenland and Jan Mayen records:

Lyonsia arenosa POSSELT 1895, p. 75.
Lyonsia arenosa POSSELT & JENSEN 1898, p. 92.
Lyonsia arenosa HÄGG 1904, pp. 62—63.
Lyonsia arenosa JENSEN 1905, pp. 359—360.
Lyonsia arenosa ODHNER 1915, p. 132.
Lyonsia arenosa THORSON 1934a, p. 7.
Lyonsia arenosa THORSON 1936, pp. 55, 56 and 62; on reproduction.

Occurrence at East Greenland (cf. the map fig. 19, p. 180):

Nordøstkyst Area: Danmarks Havn, 9.5—19 m, 2 adult animals; Stormbugt near Danmarks Havn, 9.5—19 m, soft bottom, *Laminaria*, 1 adult animal; S. of Lille Pendulum, 74°35′ N. 18°23′ W., 18—21 m, sandy mud, algae, 1 adult (with almost mature eggs and mature sperm, 6-7-99), and 2 half-grown animals.

Kejser Franz Josephs Fjord Area: Kap Borlase Warren, 19 m, 1 adult shell; S.E. of Clavering Ø, 74°10′ N. 20°08′ W., 25—40 m, mud, many shells and pebbles, 4 adult animals (all with mature or almost mature eggs and sperm, 17-7-99); Eskimonæs, Clavering Ø, 45 m, clayey, coarse gravel, a few algae, 1 young animal; Mackenzie Bugt, 12—35 m, mud, 8 adult and 2 young animals (HÄGG); Kejser Franz Josephs Fjord, 73°16′ N. 23°15′ W., 28—36 m, clay, shells, stones, gravel, sand,1 adult animal (with mature eggs and sperm, 29-8-99); Moskusoksefjord, 15 m, 2 adult animals; Moskusoksefjord, off Ankerbjerg valley, 19—23 m, clay with some big stones, 3 adult animals; Eleonore Bugt, 15—27 m, clay, stones, *Laminaria*, *Desmarestia*, a few red algae, 8 adult and 1 half-grown animals, 4 adult and 1 half-grown shells (2 finds); Off Haredalen, Isfjord, 9—15 m, loose, greyish-brown clay, 2 adult animals; Solitærbugt, Ella Ø, 13 m, *Desmarestia*, 1 adult animal — 25—27 m, shells, stones, *Desmarestia*, *Laminaria*, 4 adult animals — 5—24 m, 18 adult and half-grown animals (several finds) — 20—52 m, 11 adult and half-grown animals (at least 3 finds); Forsblads Fjord, 5.5—26 m, 1 young shell, 1 young valve.

Scoresby Sund Area: Off Kape Hope, 10—13 m, sand, 1 adult animal; Off the mouth of Hurry Inlet, 20—28 m, stones, sand, algae, 1 half-grown animal; Hurry Inlet, 0—13 m, sand and clay, 4 adult animals, 5 adult shells — 19 m, clay, 1 adult and 1 half-grown animal; Hurry Inlet, off Constable Pynt, 7—10 m, sand, 1 adult and 2 young animals, 1 adult shell — 46 m, tough clay, 1 young animal; Hurry Inlet, at Fame Øer, 15—22 m, soft and tough clay, *Laminaria*, red algae, 4 adult and 2 half-grown animals (3 finds); Fame Øer, 70°50′ N. 22°33′ W., 5—8 m, mud, 1 adult animal (with almost mature eggs and sperm, 4-8-99); Off Kap Hooker, 65 m, sand, 1 young animal; 8 miles W. of Kap Hooker, 13—14 m, sand mixed with clay, 2 adult and 1 half-grown animal, 1 adult shell (drilled by *Natica*) (4 finds); Nordbugten in Nordvestfjord, 10—18 m, very soft, light-grey clay, 2 adult animals; Turner Sund, ca. 5 m, 2 adult and 1 young shells (JENSEN); Kap Dalton, 17—21 m, clay, 1 adult and 1 young animal — 30 m, clay with stones, "1 dead animal" (THORSON).

Kangerdlugssuaq Area: Mikis Fjord, 3.5—4 m, 2 adult and 2 half-grown animals — 7—8 m, 1 half-grown animal; Uttentals Sund, 14—15 m, 3 adult animals; Kangerdlugssuaq, 50 m, gravel, 1 adult animal, 1 adult shell.

Sydøstkyst Area: Sermilik, 2nd E. fjord, 5 m, sandy clay, stones, 3 adult animals — 25 m, clay, 2 adult and 2 half-grown animals; Nanûseq N. of Lindenows Fjord, 50—60 m, clay with gravel, 1 half-grown animal; Lindenows Fjord, outer part, 60—70 m, sand, gravel, 1 adult animal; Lindenows Fjord, middle part, 27 m, sand, remnants of algae, *Laminaria*, 1 half-grown animal — 40—50 m, clay, 2 half-grown animals — 50 m, fine sand, 1 adult animal — 60—80 m, clay, 1 adult animal; Qeqertatsiaq, 50 m, sand, dead bryozoans, 1 young animal, 1 young shell (drilled by *Natica*) — 60—70 m, sand, gravel, dead bryozoans, 11 adult and half-grown animals, 1 half-grown shell (2 finds).

Jan Mayen Area: Jan Mayen, 2 adult shells (1 fragmentary), collected on the ice; Jan Mayen, 94—113 m, mud, 1 adult valve.

The species is thus known to occur from Danmarks Havn in the N. to Qeqertatsiaq in the S. with a vertical range for living specimens

from 3.5—4 m (Mikis Fjord) to 60—80 m (Lindenows Fjord). It was found to live on various kinds of bottom, viz. mud, clay, sand, gravel, and stony bottom, and at E. Greenland it seems to be just as common in the inner parts of the large fjords as in places near the open Sea.

Remarks: The East Greenland specimens show some variation in the proportions of their shells. Most of them are referable to var. *sibirica* LECHE [= *Lyonsia gibbosa* HANCOCK], but in some specimens the anterior portion of the shell is rather short and bent abruptly downwards, as is the case in the typical form. The five largest specimens present measure (length × height × breadth of shell): 24.6 × 14.9 × 10.3 — 24.6 × 12.8 × 8.9 — 22.1 × 12.0 × 8.3 — 21.8 × 12.4 × 9.1 and 21.3 × 12.5 × 8.2 mm, respectively. AD. JENSEN (1905) gives the size of two specimens from Turner Sund as 29.5 × 18.5 × 13.2 and 29.5 × 17.3 × 13 mm, and HÄGG (1904) that of an animal from Mackenzie Bugt as 34 × 19 × 12.8 mm. In most of the specimens at hand the umbonal region is fairly much eroded. — *Lyonsia granulifera* VERRILL & BUSH (1898, p. 818, pl. 95, fig. 1) seems to belong to this species.

Distribution: West Greenland, East Greenland, Jan Mayen (shells only), Spitzbergen, Novaya Zemlya, the Murman Coast, the White Sea, the Kara Sea, the Siberian Ice Sea, the Bering Sea, the Arctic American coast, Grinnell Land, Jones Sound, Baffinland, Labrador, Newfoundland, the Gulf of St. Lawrence, and Nova Scotia. To the south the species reaches Japan, the Sea of Okhotsk, the Aleutians, the Kodiak Islands (Alaska), Cape Ann (Massachusetts), N. and E. Iceland, and the Western Finmark. Main distribution: Panarctic and circumpolar. Vertical range: From 3 m (Novaya Zemlya) to about 200 m (W. Greenland). An empty shell was found W. of Spitzbergen at 2374 m.

Biology: The species is hermaphroditic, with distinct male and female gonads (THORSON 1936). THORSON states the nutritive matter of the egg to be 120—140 μ in diameter. However, an examination of some specimens of the present material (preserved in alcohol) showed that mature eggs have an outer diameter of 205—210 μ with the yolk mass measuring about 190 μ in diameter, surrounded by a rather solid, light-brown membrane. It must thus be assumed that the larval development is lecithotrophic, the pelagic stage being very short or quite absent. The state of the gonads of the specimens examined suggests that at E. Greenland spawning occurs later than the end of August.

48. *Pandora (Kennerleya) glacialis* LEACH.

Pandora glacialis LECHE 1878, pl. 1, figs. 1a—b.

East Greenland records:

Pandora (Kennerleyia) glacialis JENSEN 1905, p. 361.
Pandora glacialis ODHNER 1915, p. 131.
Pandora glacialis THORSON 1936, pp. 55, 56 and 62; on reproduction.

Occurrence at East Greenland (cf. the map fig. 24, p. 184):

Nordøstkyst Area: Sabine Ø, depth?, *Laminaria*, 5 adult animals.

Kejser Franz Josephs Fjord Area: Kap Stosch, ca. 15 m, 7 adult animals; Vinterøer, at the mouth of Duséns Fjord, 15—30 m, stones, algae, 2 adult animals; Duséns Fjord, at the anchoring place, 20—25 m, loose clay, *Desmarestia*, 1 adult and 1 young animal; Nordfjord, off the Danish House, 8 m, very fine, grey clay, 1 adult animal; Nordfjord, 3 miles S.E. of the Danish House, 205 m, fine, grey clay, 1 young animal; Moskusoksefjord, 15 m, 1 adult animal; Moskusoksefjord, off Ankerbjerg valley, 19—23 m, clay with some big stones, 1 adult animal; Karl Jakobsens Bugt, Ymers Ø, 18—20 m, clay, 1 adult and 1 half-grown animal (2 finds).

Scoresby Sund Area: Off Kap Hope, 9—12 m, sand, 3 adult and 2 half-grown animals (3 finds); Off the mouth of Hurry Inlet, 20—28 m, stones, sand, algae, 1 adult and 1 young animal; The mouth af Hurry Inlet, 16 m, sand and algae, 1 half-grown animal; Hurry Inlet 1 mile inside the mouth, 6—9 m, sand, 20 adult and half-grown animals — 14—16 m, sand, 4 adult, 4 half-grown and 4 young animals, 1 adult shell (6 finds); E. side of Hurry Inlet 2 miles inside the mouth, 7—10 m, sand, stones, algae, 1 half-grown animal, 1 adult shell; Hurry Inlet, 0—13 m, sand and clay, 1 adult shell — 19 m, clay, 13 adult animals; Hurry Inlet, at Constable Pynt, 7—10 m, sand, 3 adult and 3 young animals; Hurry Inlet, at Fame Øer, 12 m, very soft clay, 3 adult and 1 half-grown animals — 15—18 m, soft clay, *Laminaria*, red algae, 8 adult animals; Fame Øer, 70°50′ N. 22°33′ W., 5—8 m, mud, 1 adult and 2 half-grown animals — ca. 9 m, mud, algae, 4 adult and 1 half-grown animals; Kap Stewart, 70°27′ N. 22°35′ W., 13—18 m, mud, stones, algae, 5 adult animals; Off Kap Hooker, 20 m, sand, 1 half-grown animal — 60 m, sand mixed with clay, 1 adult animal; 8 miles W. of Kap Hooker, 12—14 m, sand mixed with clay, 6 adult and 3 half-grown animals, 1 adult shell and 6 adult valves (both drilled by *Natica*) (8 finds); W. coast of Jameson Land opposite Kap Leslie, 22 m, sandy, glittering clay, 1 adult animal; Nordostbugt, 4 miles from the mouth of Schucherts Flod, 29 m, light-grey mud, 1 adult animal; Nordbugten in Nordvestfjord, 29—30 m, loose clay, 1 adult animal, 2 half-grown shells (1 drilled by *Natica*) (2 finds); N.E. of Danmarks Ø, 18 m, soft clay, *Desmarestia*, 1 adult animal; Turner Sund, ca. 5.5 m, 6 adult animals, 2 adult and 2 half-grown shells; Kap Dalton, 17—21 m, clay 2 young animals — 30 m, clay with stones, 1 adult animal.

At E. Greenland the species is thus known to occur from Sabine Ø in the N. to Kap Dalton in the S. To all appearance it prefers places not too far from the open sea and avoids the innermost ramifications of the large fjords. It ranges vertically from 5.5 m (Turner Sund) to 205 m (Nordfjord). Only two finds, however, derived from depths exceeding

30 m. Apparently the species is commonest on sand and clayey sand, but it was also found to live on mud, clay, or stony bottom.

Remarks: In the specimens from E. Greenland the outline and the proportions of the shell vary somewhat, just as the valves may be fairly thin and translucent or relatively solid and calcareous. Generally, the periostracum is lacking from the greater portion of the surface, and the umbonal region is often very much eroded. The seven largest specimens at hand measure (length × height × breadth of shell): 27.3 × 16.7 × 6.1 — 25.7 × 14.9 × 6.9 — 24.3 × 13.0 × 4.2 — 24.1 × 14.6 × 5.0 — 24.1 × 14.2 × 5.0 — 23.7 × 14.3 × 4.8 and 23.3 × 13.5 × 4.4 mm, respectively. Several animals contained *Metopa groenlandica* H. J. Hansen in their mantle chamber or between the gills and the body (cf. Stephensen & Thorson 1936).

Distribution: E. Greenland, Spitzbergen, Franz Joseph Land, Novaya Zemlya, the Murman Coast, the White Sea, the Kara Sea, the eastern part of the Siberian Ice Sea, the Bering Strait, from Alaska southward to Puget Sound? (fig. 2, pl. 4, in Oldroyd 1924, differs somewhat from our specimens and represents perhaps another form), Jones Sound, Baffinland, the Hudson Bay, and the Gulf of St. Lawrence. Not known from W. Greenland and Iceland. Main distribution: High-arctic, probably circumpolar. Vertical range: From 2 m (Franz Joseph Land) to 205 m (E. Greenland).

Biology: Reproduction partly known from N.E. Greenland. Thorson (1936) states that the species is a hermaphrodite with distinct male and female gonads, and that the nutritive matter of the eggs varies from 120 to 140 μ in diameter. — Twenty animals of the material (preserved in alcohol) were examined, all of which contained mature or nearly mature sexual products in their gonads. Ripe eggs were found to measure about 175 μ in outer diameter, while the yolk mass alone was 140—145 μ in diameter, being surrounded by a rather thick, gelatinous membrane. Probably, the larval development is lecithotrophic and the pelagic stage very short or entirely lacking. Further, the material examined suggests that at N.E. Greenland spawning takes place later than the middle of August.

49. *Thracia* (*Crassithracia*) *septentrionalis* Jeffreys (cf. pl. 3, fig. 1).
[*Thracia truncata* Mighels & Adams, non Brown].

Thracia crassa Becher 1886, p. 71, figs. 1—1c.
Thracia (*Crassithracia*) *septentrionalis* Soot-Ryen 1941, pl. 1, figs. 9—10; pl. 2, fig. 2; pl. 8, fig. 3.

East Greenland and Jan Mayen records:
Thracia septentrionalis Friele 1878, p. 224.
Thracia crassa Becher 1886, p. 71.

Thracia septentrionalis FRIELE & GRIEG 1901, p. 43.
Thracia septentrionalis JENSEN 1905, pp. 360—361.
Thracia (Crassithracia) septentrionalis SOOT-RYEN 1941, pp. 20—22, and 38.

Occurrence at East Greenland (cf. the map fig. 21, p. 182):

Nordøstkyst Area: Hvalrosodden, near Danmarks Havn, on the shore, 1 adult valve (possibly subfossil).

Scoresby Sund Area: Off Kap Hope, 9 m, sand, 1 adult, 1 half-grown, and 8 young animals (3 finds) — 10—12 m, sand, 1 young animal, 1 half-grown shell (2 finds) — 20 m, sand, 5 young animals (3 finds); Hurry Inlet, 1 mile inside the mouth, 13—16 m, sand, 1 adult,47 half-grown and young animals, 1 adult valve (9 finds).

Sydøstkyst Area: Tasîssaq near Angmagssalik, 1—9.5 m, 2 adult animals, 1 adult valve (drilled by *Natica*).

Jan Mayen Area: Jan Mayen, "five specimens, dead shells on the shore" (BECHER, as *T. crassa*); Jan Mayen, 19—28 m, 5 young animals, 5 valves (FRIELE, FRIELE & GRIEG, SOOT-RYEN); Jan Mayen, 19 m, 2 valves, (SOOT-RYEN); Jan Mayen, 40—60 m, 6 valves (SOOT-RYEN); Jan Mayen, Hvalrosbugten, 16—18 m, black sand, 14 adult, 46 half-grown and young animals, 1 adult shell—ca. 36 m, black sand, 3 half-grown animals, 1 adult shell; Drifvedsbugten, 70°55′ N. 8°30′ W., 14—21 m, black sand, 1 half-grown, and 8 young animals.

At E. Greenland the species is thus of scattered occurrence and seems to be restricted to places along the outer coast, where it lives on sandy bottom at depths between 1—9.5 m and 20 m. On the other hand, it is fairly common at Jan Mayen, where living specimens were taken at depths from 16—18 m to 36 m.

Remarks: The two largest animals from E. Greenland measure (length × height × breadth of shell) $16.4 \times 12.5 \times 8.0$, and $11.0 \times 8.3 \times 4.0$ mm, and the largest valve 25.7×18.9 mm, while the five largest specimens at hand from Jan Mayen measure $25.8 \times 17.9 \times 9.1$ — $24.1 \times 17.5 \times 8.5$ — $24.0 \times 16.4 \times 7.9$ — $23.4 \times 16.3 \times 8.3$, and $21.0 \times 14.4 \times 7.3$ mm, respectively. According to SOOT-RYEN (1941), the species attains a length of 31.0 mm at Jan Mayen. All of the specimens from Jan Mayen have rather compressed and thick shells, being referable to f. *crassa* BECHER, which, according to SOOT-RYEN, may be a special form.

Distribution: W. Greenland, E. Greenland, Jan Mayen (f. *crassa*), Spitzbergen, N. Iceland, Jones Sound, and the Canadian Arctic Sea as far as New England (S. to Block Island), lacking at the Eurasian coasts proper. Main distribution: Panarctic (in the N. Atlantic sector only). Vertical range: From 9 m (E. Greenland) to 113 m (W. Greenland).

Biology: Three adult animals (preserved in alcohol) from Jan Mayen (Hvalrosbugten, 22-6-99) proved to contain both ripe and premature eggs, spermatozoa, and spermatocytes. Mature eggs were found to be spherical with a fairly solid, light brown, outer membrane, the

yolk mass measuring 160 μ in diameter, and the diameter of the entire egg about 210 μ. Thus, the species is a hermaphrodite and its larval development presumably lecithotrophic with the pelagic stage very short or entirely suppressed.

50. *Thracia* (*Thracia*) *myopsis* (Beck) Møller (cf. pl. 3, fig. 4).

Thracia truncata forma *typica* G. O. Sars 1878, pl. 6, figs. 10a—b.
Thracia (*Thracia*) *myopsis* Soot-Ryen 1941, pl. 2, figs. 1—4; pl. 6, fig. 3; pl. 8, fig. 4.

East Greenland and Jan Mayen records:

Thracia myopsis Friele 1878, p. 224.
Thracia truncata Friele & Grieg 1901, p. 43.
Thracia truncata Jensen 1905, p. 360 (in part).
Thracia myopsis Odhner 1915, p. 134 (in part).
Thracia (*Ixartia*) *myopsis* Lamy 1926, pp. 179—180.
Thracia (*Thracia*)*myopsis* Soot-Ryen 1941, p. 23, and p. 39.

Occurrence at East Greenland cf. the map fig. 11, p. 157):

Nordøstkyst Area: Stormbugt near Danmarks Havn, 9.5—19 m, soft bottom, *Laminaria*, 1 half-grown shell; Sabine Ø, depth?, *Laminaria*, 1 half-grown and 1 young animal — 5.5—9.5 m, 1 young animal.

Scoresby Sund Area: Off Kap Hope, 9 m, 1 half-grown and 3 young animals (3 finds) — 10—13 m, sand, *Laminaria*, 1 young animal, 1 half-grown shell (2 finds); Hurry Inlet, 1 mile inside the mouth, 13—16 m, sand, 2 half-grown and 12 young animals, 2 young shells (both drilled by *Natica*) (6 finds); 8 miles W. of Kap Hooker, 13 m, sand mixed with clay, algae, 1 young animal — 12—14 m, sand mixed with clay, 2 adult (with ripe eggs and sperm, 15-7-33), 2 half-grown, and 2 young animals (3 finds); Kap Dalton, 17—21 m, fine clay with pebbles, 1 young animal.

Sydøstkyst Area: Tasîssaq near Angmagssalik, 38—56 m, stony bottom, algae, 1 adult valve.

Jan Mayen Area: Jan Mayen, 70°59′ N. 8°40′ W., depth?, 2 valves (Kamy); 70°57′20″ N. 8°50′ W., depth?, 2 valves (Lamy); Jan Mayen, 19—28 m, 1 animal, 1 valve (Friele, Friele & Grieg, Soot-Ryen); Drifvedsbugten, 70°55′ N. 8°30′ W., 14—21 m, black sand, 1 adult (with almost mature eggs and mature sperm, 12-6-99), and 25 half-grown an young animals, 1 young shell (drilled by *Natica*); Jan Mayen, Mary Muss-bugten, 23 m, black sand, 2 adult animals (both with ripe and premature eggs, ripe sperm and spermatocytes, 19-6-99).

The species is thus of scattered occurrence at E. Greenland, where it has been taken alive from Sabine Ø in the N. to Kap Dalton in the S. at depths between 5.5—9.5 m and 17—21 m, being restricted to sandy bottom in places near the open sea. It seems to be fairly common at Jan Mayen.

Remarks: The largest specimen from E. Greenland measures only 22.3 mm in length and the largest one from Jan Mayen 25.2 mm. Friele (1878) gives the size of a specimen from Jan Mayen as 33 mm in length

and 26 mm in height. — All of the specimens at hand agree with the description and the figures in SOOT-RYEN (1941), where the specific differences between this species and *Thracia devexa* are pointed out.

Distribution: W. Greenland, E. Greenland, Jan Mayen, Spitzbergen, Novaya Zemlya, the Kara Sea, the Barents Sea, Norway from Varangerfjord southward to Ofoten, Bergen (empty shell only), Iceland, the Faroes, Labrador, and New England S. to Massachusetts. Main distribution: Panarctic (in the Atlantic sector only). Vertical range: From 2 m (Spitzbergen) to 350 m (W. Greenland).

Biology: Like the preceding one, this species is a hermaphrodite. Apparently mature eggs measure about 240 μ in diameter and are surrounded by a solid, light brown, outer membrane. The diameter of the yolk mass is about 170 μ. It may thus be safe to assume a lecithotrophic development of the larva, with the pelagic stage very short or entirely lacking.

51. *Thracia* (*Thracia*) *devexa* G. O. SARS (cf. pl. 3, fig. 5).

Thracia myopsis var. *devexa* G. O. SARS 1878, pl. 6, figs. 11a—b.
Thracia (*Thracia*) *devexa* SOOT-RYEN 1941, pl. 2, figs. 5—10; pl. 6, fig. 4; pl. 9, fig. 5.

East Greenland records:

Thracia truncata JENSEN 1905, p. 360 (in part).
Thracia myopsis ODHNER 1915, p. 134 (in part).
Thracia truncata THORSON 1936, p. 62; on reproduction.
Thracia (*Thracia*) *devexa* SOOT-RYEN 1941, p. 25.

Occurrence at East Greenland (cf. the map fig. 11, p. 157):

Kejser Franz Josephs Fjord Area: Kejser Franz Josephs Fjord, 73°16′ N. 23°15′ W., 28—36 m, clay, shells, stones ,gravel, sand, 1 adult animal (with mature eggs and sperm, 29-8-99); Duséns Fjord, at the anchoring place, 20—25 m, loose clay, *Desmarestia*, 1 half-grown animal—25 m, tough clay, 1 young animal; Solitærbugt, Ella Ø, 22—35 m, red algae, 1 adult shell (drilled by *Natica*) — 20—52 m, 5 young animals, 2 adult shells (1 drilled by *Natica*), 2 valves (both drilled by *Natica*), some fragments (some finds); Kap Hedlund, 4—27 m, 1 adult animal; Forsblads Fjord, ca. 94 m, clay with stones, 1 half-grown animal.

Scoresby Sund Area: Hurry Inlet, 19 m, clay, 1 adult animal, Hurry Inlet, near Fame Øer, 20 m, very tough clay, 1 young animal; Off Kap Hooker, 57 m, sand mixed with clay, 1 adult animal; Noa Vig, Milne Land, 10—15 m, very soft clay, 1 adult, and 1 half-grown animal; W. coast of Jameson Land opposite Bjørneøer, 30—31 m, tough clay, 1 half-grown animal, 1 half-grown valve (2 finds); Nordbugten, Nordvestfjord, 28—30 m, loose clay, 3 half-grown and 1 young animals, 2 half-grown shells (1 drilled by *Natica*) (3 finds) — 59 m, soft clay, 1 adult shell.

Kangerdlugssuaq Area: Uttentals Sund, 10—14 m, 1 worn, half-grown shell (erroneously referred to *Macoma torelli* in BERTELSEN 1937 a).

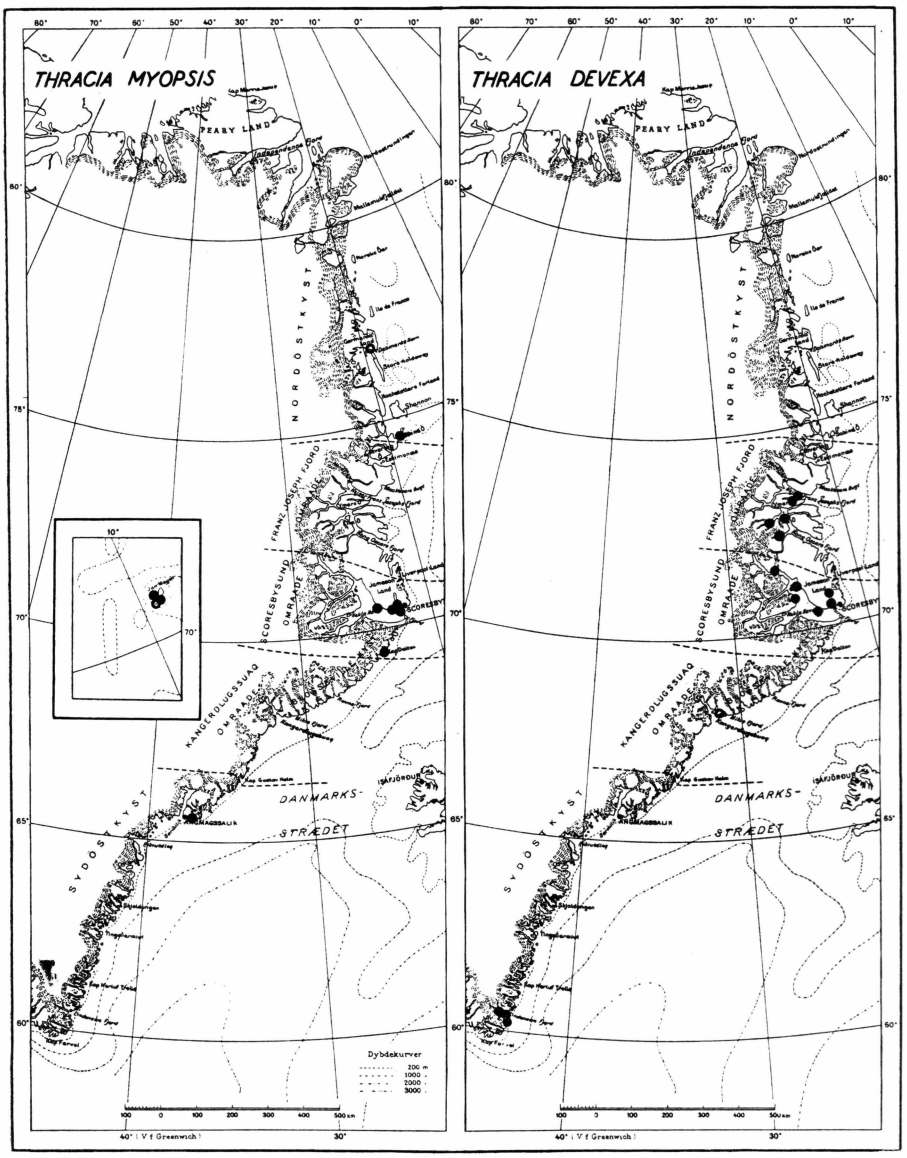

Fig. 11. Distribution of *Thracia myopsis* (Beck) Møller and of *Thracia devexa* G. O. Sars along East Greenland and at Jan Mayen. — Full circles: Living animals. Open circles: Shells or valves only.

Sydøstkyst Area: Lindenows Fjord, outer part, 52 m, sand, 1 half-grown animal — 142 m, clay, 1 young shell; Lindenows Fjord, middle part, 40—50 m, clay, 1 adult animal (with ripe eggs and sperm, 25-7-35); Qeqertatsiaq, 60 m, sand, gravel, dead bryozoans, 1 half-grown and 1 young animal.

The species seems to be of a somewhat scattered occurrence at E. Greenland, where it has been found from N. of the mouth of Duséns

Fjord southward to Qeqertatsiaq with a vertical range for living specimens from 10—15 m to 95 m. Unlike *T. myopsis* the present species penetrates into the inner parts of the large East Greenland fjords and seems to prefer a clayey bottom.

Remarks: The specimens at hand agree well with the description and the figures given by Soot-Ryen (1941). The largest animal (from Lindenows Fjord) measures about 40 mm in length. Three other specimens measure (length × height × breadth of shell): 34.1 × 24.5 × 14.3 — 28.2 × 20.6 × 12.1 and 26.4 × 20.2 × 11.5 mm, respectively.

Distribution: The distribution of this species may be wider than stated below, as confusion with the preceding species may have occurred. At present it is known to live at E. Greenland, Spitzbergen, and Novaya Zemlya; dead specimens were found in Northern Norway from Varangerfjord southward to Skjerstadfjord (Soot-Ryen). Main distribution: Probably high-arctic (only in the N. Atlantic sector). Vertical range: From 10—15 m to about 95 m (E. Greenland).

Biology: The species is a hermaphrodite (Thorson 1936, as *Thracia truncata*). Mature eggs measure about 275 μ in outer diameter, the yolk mass alone measuring 170 μ in diameter. The outer membrane is fairly solid and colourless (material preserved in alcohol). According to the egg size, a lecithotrophic development of the larva and a very short or entirely lacking pelagic stage must be assumed.

52. *Lyonsiella abyssicola* M. Sars (cf. pl. 3, fig. 2).

Pecchiola abyssicola G. O. Sars 1878, pl. 20, figs. 5a—d.

East Greenland records:

Lyonsiella abyssicola Jensen 1905, p. 360.

Occurrence at East Greenland (cf. the map fig. 26, p. 186):

Kejser Franz Josephs Fjord Area: Forsblads Fjord, 94—169 m, clay with stones, 2 adult animals (with mature eggs, oocytes, and oogonia, but without mature sperm or spermatocytes in the ♂-gonads, 30-8-00), 1 adult shell.

Scoresby Sund Area: Nordbugten, Nordvestfjord, 330 m, loose clay, 1 adult valve.

Jan Mayen Area: [S. of Jan Mayen, 70°05′ N. 8°26′ W., 698 m, 1 adult and 2 half-grown valves].

Remarks: The specimens from Forsblads Fjord measure (length × height × breadth of shell): 5.3 × 4.2 × 4.0 — 4.5 × 3.8 × 3.6 and 4.4 × 3.7 × 3.5 mm, respectively. The valve from Nordvestfjord is 5.9 mm in length.

Distribution: Baffin Bay, W. Greenland, E. Greenland, Jan Mayen (valves only), off N.E. Iceland, Spitzbergen, the Barents Sea,

the N. and W.coasts of Norway, the Faroes, the Channel, off W. Ireland, the Bay of Biscay, reaching southward to S. of Martha's Vineyard (Massachusetts), off Fernandina (valves only), and the Azores. Main distribution: Panarctic-boreal, and abyssal (in the N. Atlantic only). Vertical range: From 38 m (W. Greenland) down to about 2000 m (the Bay of Biscay).

Biology: PELSENEER (1890, 1891) states the genus to be hermaphroditic with distinct male and female gonads. — Apparently mature eggs from the animals from Forsblads Fjord measured about 160 μ in outer diameter, the yolk mass measuring about 150 μ. Accordingly, a lecithotrophic development of the larva, with the pelagic stage very short or entirely suppressed, must be assumed. This assumption would be in good accordance with the species living preferably in deep water.

[*Lyonsiella jeffreysi* FRIELE.

Lyonciella Jeffreysi FRIELE 1886, p. 38, pl. 12, figs. 15—16.

The Ingolf Expedition found 2 adult and 1 young animals, 1 half-grown shell, 2 adult valves, and 25 fragments of adult valves of this species S. of Jan Mayen, 69°31′ N. 7°06′ W., 2465 m depth.

Besides from places near Jan Mayen, it is hitherto known only from W. of Bear Island (fragment of 1 valve only), and off N. Norway (valves and fragments only). Further, the collections of the Copenhagen Museum contain some animals, shells, and valves obtained from some stations off N.E. Iceland by the Ingolf Expedition. The species seems to be restricted to the depths of the Norwegian Sea (cf. FRIELE 1902)].

53. *Poromya granulata* (NYST & WESTENDORP) (cf. pl. 3, fig. 3).

Poromya granulata JEFFREYS 1869 V, pl. 49, fig. 1.
Poromya granulata G. O. SARS 1878, pl. 5, figs. 6a—b.

Occurrence at East Greenland (cf. the map fig. 26, p. 186):

Scoresby Sund Area: Section between Kap Leslie and Jameson Land, 284 m, soft clay, 1 half-grown animal (length × height × breadth of shell 6.0 × 4.6 × 3.2 mm).

This specimen has been compared with some others derived from Iceland and the Faroes and seems to be of an appearance typical of the species. Its tubercles are in part worn off, and it had one Foraminifer attached to its shell.

The species is "new" not only to East Greenland, but also to the fauna of the Greenland shelf as a whole (see also the hitherto unpublished finds from S.W. Greenland mentioned below). Its occurrence at greater

depths in the outer part of Scoresby Sund is somewhat surprising, as the species otherwise seems to avoid truly arctic regions. Presumably the present find is associated with the influx of oceanic water of high salinity and slightly positive temperature into the outer part of Scoresby Sund.

Distribution: S.W. Greenland and Davis Strait (66°35′ N. 56° 38′ W., 599 m, + 3.9° C., 11 animals, 1 valve; 66°22′ N. 57°16′ W., 686 m, 1 animal, 1 valve; 65°16′ N. 55°05′ W., 682 m, + 3.6° C., 6 animals, 1 shell, 1 valve), E. Greenland, N., W., and S. Iceland, the Faroes, along the European W.coast from the Finmark southward to Madeira, and into the Mediterranean, and along the coast of N.E. America from the Gulf of Maine southward to the West Indies. Main distribution: Low-arctic-boreal, Mediterranean-Atlantic, and abyssal. Vertical range: From about 30 m down to 2650 m (N. Atlantic).

Biology: Apparently mature eggs of an animal taken off S.W. Iceland (63°21′ N. 25°21′ W., 320 m, mid-June 1896) measured 210 μ in diameter, the yolk mass alone being 175 μ in diameter. The outer membrane was very thick and brownish. Thus, the larval development must be assumed to be lecithotrophic, the pelagic stage being very short or quite suppressed. — The species is a hermaphrodite.

54. *Cuspidaria obesa* (LOVÉN) (cf. pl. 3, fig. 6).

Neæra obesa G. O. SARS 1878, pl. 6, figs. 4a—c.
Cuspidaria obesa VERRILL & BUSH 1898, pl. 75, fig. 7.

East Greenland records:

All previous records seem to be erroneous and must be referred to *C. glacialis* (G. O. SARS), and *C. subtorta* (G. O. SARS), respectively (which see).

Occurrence at East Greenland cf. the map fig. 22, p. 183):

Sydøstkyst Area: Lindenows Fjord, inner part, 425 m, clay, 1 adult animal (shell badly broken, about 11 mm long; with ripe sperm, 22-7-35).

The single find from Lindenows Fjord suggests that the species is restricted to the southernmost coast of E. Greenland.

Remarks: *C. obesa* is specifically distinct from *C. glacialis*, *C. arctica*, and *C. subtorta*. In adult males and females of the present species the gonads are clearly branched, and this is not the case in the other three species mentioned. Also, in *C. obesa* the lateral tooth is remarkably small, short, and triangular. — The specimen at hand is of an appearance typical of the species, apart from its valves being somewhat thicker than usual.

Distribution: W. Greenland (animals are present from 66°35′ N. 56°38′ W., 599 m, and 65°14′ N. 55°42′ W., 791 m, shells only from

65°16′ N. 55°05′ W., 682 m; probably not living at N.W. Greenland and in Baffin Bay; the records in Posselt & Jensen 1898 are suspicious and may conceal *C. arctica*, *C. glacialis*, and perhaps also *C. subtorta*), S.E. Greenland, S.W. Iceland (the records from N.W., and N. Iceland in J. Madsen 1949 are erroneous and refer to *C. subtorta* and *C. arctica*), along the Norwegian coast northward to the North Cape, Bohuslän (Sweden), the Skagerak, the Kattegat, S. of Ireland, the Gulf of St. Lawrence, the Bay of Fundy, from New England southward to the West Indies, W. of Morocco, the Azores, and the western part of the Mediterranean. The species seems to be absent from truly Arctic seas. Main distribution: Subarctic-boreal, Mediterranean-Atlantic, and abyssal. Vertical range: From 18 m (W. coast of Norway) down to 4336 m (S. of Ireland), mainly in deep water.

Biology: The yolk mass of apparently mature eggs was found to be 115—120 μ in diameter, being surrounded by a fairly thick membrane (from animals from 66°35′ N. 56°38′ W., 599 m, 11-7-95, preserved in alcohol). The prodissoconch of a young specimen measured about 190 μ across. Thus, the larval development is probably lecithotrophic and the pelagic stage very short or quite suppressed.

55. *Cuspidaria subtorta* (G. O. Sars) (cf. pl. 3, fig. 9).

Neæra subtorta G. O. Sars 1878, pl. 6, figs. 6a—c.

East Greenland records:

Neaera obesa var. *glacialis* Hägg 1904, p. 53 (in part).
Neara obesa var. *glacialis* Jensen 1905, p. 361 (in part).
Cuspidaria glacialis Odhner 1915, p. 135 (in part).

Occurrence at East Greenland (cf. the map fig. 19, p. 180):

Nordøstkyst Area: S.E. of Shannon, 74°52′ N. 17°16′ W., 350 m, clayey mud, a little sand, pebbles, 1 adult animal; S.E. of Sabine Ø, 207 m, fine clay, stones, gravel, 1 adult and 1 half-grown animal.

Kejser Franz Josephs Fjord Area: Eskimonæs, Clavering Ø, 45 m, coarse, clayey gravel, a few algae, 1 adult animal — 50—55 m, clay, gravel, stones, a few red algae, 9 adult animals (2 finds); Mackenzie Bugt, 12—35 m, mud, 1 adult animal (Hägg, as *Neaera obesa;* revised by the author); 4 miles E. of Holland Ø, 130 m, clay with gravel and big stones, 1 adult shell; Duséns Fjord, at the anchoring place, 20—25 m, loose clay, *Desmarestia*, 1 adult animal; Off Zoologdalen, Ymers Ø, 160 m, clay mixed with sand, 1 adult animal; Moskusoksefjord, off Ankerbjerg, 95 m, fat clay with big stones, 1 adult animal; Moskusoksefjord, off Høgboms Bjerg, 200 m, fat clay, 1 adult valve; Inner part of Kejser Franz Josephs Fjord, 73°06′ N. 27°17′ W., 40—70 m, mud, stones, 1 half-grown animal; In the middle of Antarctics Sund, 540 m, fat, grey clay, 1 adult animal; Solitærbugt, Ella Ø, 20 m, clay, 1 adult animal — 31 m, clay, 2 adult animals — 5—24 m, 11 adult animals, 3 adult shells (all drilled by *Natica*) (several finds) — 20—52 m, 14 adult

animals, 3 adult shells (1 drilled by *Natica*) (several finds); Off the mouth of Rhedins Fjord, 25—30 m, clay, *Fucus*, red algae, 1 adult animal; Kap Hedlund, 4—27 m, 1 adult valve; The mouth of Forsblads Fjord, 5.5—26 m, 1 adult animal; Forsblads Fjord, 94—170 m, clay with stones and gravel, 2 adult animals, 1 adult shell.

Scoresby Sund Area: Section between Kap Tobin and Kap Brewster, 340 m, fine, soft clay, 2 adult animals; Off the mouth of Hurry Inlet, 72 m, clay with stones, 1 adult animal — 145 m, brown clay, gravel, 1 adult animal; The mouth of Hurry Inlet, 140 m, clay, 1 adult animal; Hurry Inlet, 0—13 m, sand and clay, 5 adult animals — 94 m, clay, 3 adult animals, 2 adult shells; Hurry Inlet, at Constable Pynt, 18—22 m, very soft clay, 1 adult animal; Hurry Inlet, off Constable Pynt, 22—23 m, clay 2 adult animals (2 finds); Fame Øer, 70°50′ N. 22°33′ W., 23—25 m, clay, 1 adult animal; Off Kap Hooker, 57 m, sand mixed with clay, 1 adult animal; W. coast of Jameson Land opposite Kap Leslie, 22 m, sandy, glittering clay, 1 adult animal; Section between Kap Leslie and Kap Stevenson, 143 m, soft clay, 2 adult animals; Off Kap Leslie, 260 m, loose clay, gravel, 2 adult animals; Kap Leslie, 82 m, glittering clay, 1 adult animal; W. coast of Jameson Land opposite Bjørneøer, 30—31 m, tough clay, 4 adult animals, 1 adult shell (drilled by *Natica*) (4 finds); Nordbugten in Nordvestfjord, 25—30 m, loose clay, 4 adult and 1 half-grown animals, 4 adult shells (7 finds).

Kangerdlugssuaq Area: Uttentals Sund, 40—50 m, clay, 2 adult animals, 3 adult shells (3 finds) — 50—60 m, grey clay, 1 adult animal, 2 adult shells.

Sydøstkyst Area: Lindenows Fjord, inner part, 100—150 m, clay, 1 adult animal; Lindenows Fjord, innermost part, 90 m, 1 adult animal.

Jan Mayen Area: Jan Mayen, 94—113 m, 2 adult and 1 young animals, 3 adult valves (2 finds); 70°50′ N. 8°29′ W., 162 m, 2 adult, 7 half-grown and young animals, 10 adult shells.

The species seems to be rather common at E. Greenland, where it is known to occur from S.E. of Shannon in the N. to Lindenows Fjord in the S. with a vertical range for living specimens from 0—13 m (Hurry Inlet) to 540 (Antarctics Sund). It lives on a soft or tough clay bottom, which may be mixed with coarser material. At Jan Mayen it has been met with at depths between about 100 and 162 m.

Remarks: The specimens from E. Greenland vary somewhat in the proportions of the shell, as will appear from the measurements of the ten largest specimens at hand (length × height × breadth of shell): $8.4 \times 5.5 \times 4.6$ — $7.2 \times 4.8 \times 4.3$ — $6.8 \times 4.3 \times 3.7$ — $6.4 \times 4.3 \times 3.7$ — $6.4 \times 4.3 \times 3.6$ — $6.4 \times 4.1 \times 3.6$ — $6.0 \times 4.0 \times 3.4$ — $6.0 \times 3.9 \times 3.3$ — $6.0 \times 3.7 \times 3.3$ and $5.3 \times 3.7 \times 2.8$ mm, respectively. The species seems thus to reach its maximum size at E. Greenland. — Foraminifera, small eggs, bivalve veligers, ostracods, copepods, small *Cylichna* spec. and even insect limbs were found in the gastric contents of some animals, and some specimens had Foraminifera attached to their shells.

A comparison of a few *Cuspidaria pellucida* (STIMPSON) from New England with the material of *C. subtorta* showed a striking resemblance

between them. Perhaps, in comparisons of a larger material, they may turn out to be synonymous, and if so, *C. pellucida* will have the priority. At present, however, no final decision was arrived at as to this point. On the other hand, it is doubtful whether the specimen referred to *C. subtorta* by VERRILL & BUSH (1898, p. 806) is actually this species. A distinct tooth-like tubercle in the left valve, as described by VERRILL & BUSH, is not found in the specimens of *C. subtorta* at hand including some of G. O. SARS's original specimens.

Distribution: W. Greenland (recorded as a fossil only; however, some of the records of *C. obesa* in POSSELT & JENSEN 1898 possibly represent *C. subtorta*), E. Greenland, Jan Mayen, Spitzbergen, the Barents Sea, the Kara Sea, the Murman Coast, N. Norway southward to Bergen? (acc. to FRIELE & GRIEG 1901, p. 40, the latter record may be due to a mistake), Iceland (animals are present from Isafjardardjup, off Hnifsdalur, 115 m; 66°50′ N. 20°02′ W., 366 m; 67°19′ N. 15°52′ W., 552 m; these were referred to *C. obesa* in J. MADSEN, 1949; further, 65°00′ N. 11°16′ W., 584 m, 1 shell), between the Hebrides and the Faroes, and possibly at N.E. America (cf. Remarks). Main distribution: Panarctic (in the N. Atlantic only). Vertical range: From 0—13 m (E. Greenland) to 990 m (between the Hebrides and the Faroes).

Biology: Several of the animals from E. Greenland proved to contain mature or premature sexual products in their gonads (material preserved in alcohol). Apparently mature eggs (from Uttentals Sund, 18-8-33, and Solitærbugt, Ella Ø, 10 to 19-9-31) had a thick, gelatinous membrane, the diameter of the entire egg being 160—170 μ, while the yolk mass alone measured 115—120 μ in diameter. The gonads of one animal, 4.2 mm long, contained about 80 mature or nearly mature eggs. The prodissoconch of 11 young specimens varied from 153 to 162 μ across, with a mean of 158 μ. Thus, the larval development must be assumed to be lecithotrophic with the pelagic stage very short or entirely lacking.

[*Cuspidaria exigua* (JEFFREYS).

Neaera exigua JEFFREYS 1876b, p. 496 (description only, apparently not yet figured).

Some specimens which seem to belong to this species were taken near Jan Mayen, viz. 70°05′ N. 8°26′ W., 698 m, 1 adult animal, 1 adult shell, 1 adult valve; and 71°12′ N. 8°38′ W., 1275 m, grey clay, 6 adult animals. The three largest specimens measure (length × height × breadth of shell): 8.2 × 4.7 × 3.9 — 7.8 × 4.3 × 3.6 and 6.4 × 3.7 × 3.0 mm, respectively. They agree very well with the original description by JEFFREYS, which is based on valves and fragments from S.E. of Kap Farvel, 2650 m ("Valorous", stat. 12). Further, FRIELE & GRIEG (1901, p. 40) mention

the species from ten stations, between Jan Mayen, S. of Spitzbergen, and off Norway, at depths between 640 m and 1836 m. Thus it seems to live primarily in deep water. Although it appears to be distinct from both *C. obesa* and *C. subtorta*, further studies of its morphology would seem desirable].

56. *Cuspidaria glacialis* (G. O. SARS) (cf. pl. 3, fig. 10).

Neæra glacialis G. O. SARS 1878, pl. 6, figs. 8a—c.
Cuspidaria glacialis VERRILL & BUSH 1898, pl. 71, fig. 9; pl. 73, fig. 5; pl. 9, fig. 9.

East Greenland records:

Neaera obesa POSSELT 1895, pp. 74—75.
Neaera obesa POSSELT & JENSEN 1898, p. 88.
Neaera obesa var. *glacialis* HÄGG 1904, p. 53 (in part).
Neaera obesa var. *glacialis* JENSEN 1905, pp. 361—362 (in part).
Neæra obesa var. *glacialis* GRIEG 1909a, p. 535.
Cuspidaria glacialis ODHNER 1915, p. 135 (in part).
Cuspidaria obesa var. *glacialis* GRIEG 1916, p. 8.

Occurrence at East Greenland.

Nordøstkyst Area: The Greenland Sea, 77°08′ N. 16°00′ W. 220—280 m, clay, a little gravel, shells, 1 adult valve; The Greenland Sea off Bessels Fjord, 75°58′30″ N. 14°08′ W., 300 m, brown and grey clay, 2 empty shells, 1 fragment (GRIEG); S.E. of Shannon, 74°52′ N. 17°16′ W., 350 m, clayey mud, a little sand, pebbles, 4 adult and 1 half-grown animals, 2 adult shells; S.E. of Sabine Ø, 207 m, fine clay, stones, gravel, 1 adult animal, 1 adult shell.

Kejser Franz Josephs Fjord Area: Kejser Franz Josephs Fjord S.W. of Kap Franklin, 320 m, clay and stones, 1 adult animal, 1 adult shell, 5 adult valves, 3 fragments; The mouth of Kejser Franz Josephs Fjord, 200—300 m, mud, 5 animals, 1 valve (HÄGG); Between Kap Weber and Ymers Ø, 400 m, clay, big stones, 1 adult shell, 2 adult valves, 1 fragment; Inner part of Moskusoksefjord, 100 m, clay, 2 adult animals, 1 adult shell; 5 miles S. of Bontekoe Ø, 245 m, very tough clay, gravel, stones, 1 adult shell (drilled by *Natica*); Forsblads Fjord, 94—169 m, clay with stones and gravel, 1 adult shell; 2 miles N. of Kap Wardlaw, 250 m, tough clay with big stones, 1 adult valve.

Scoresby Sund Area: W. coast of Jameson Land opposite Bjørneøer, 148 m, tough clay, 1 adult animal; Off Bjørneøer, 337 m, tough clay, 1 adult animal; Nordbugten in Nordvestfjord, 300—339 m, loose clay, 2 adult animals (2 finds); S.E. of Kap Brewster, 69°25′ N. 20°01′ W., 333 m, clay with big stones, 1 adult valve.

Sydøstkyst Area: Sermilik, "Fuglefjæld", 100 m, clay, 1 adult animal.

Jan Mayen Area: [S. of Jan Mayen, 70°05′ N. 8°26′ W., 698 m, 1 adult animal, 1 adult shell, 3 adult valves; 69°13′ N. 8°23′ W., 1890 m, 2 half-grown animals].

The species seems to be of a somewhat scattered occurrence at E. Greenland, where live specimens have been taken from S.E. of Shannon in the N. to Sermilik in the S. at depths between 100 m (Moskusokse-

fjord, and Sermilik) and 350 m (S.E. of Shannon). It occurred both along the outer coast and in the inner parts of the fjords, and seems to prefer a clayey bottom. Near Jan Mayen it has hitherto been met with only at depths exceeding 600 m.

Remarks: The specimens from E. Greenland and Jan Mayen vary somewhat, especially in the outline of their shells. In some of them the postero-dorsal margin is almost straight, while others show a distinctly upturned rostrum. The latter, however, is comparatively longer and not as broad at its tip as in *C. arctica*, to which the present species bears some resemblance. Also, the lateral tooth in the right valve may be more strongly developed. The six largest specimens from E. Greenland measure (length × height × breadth of shell): 28.4 × 18.5 × 15.5 — 24.5 × 14.5 × 12.5 — 23.4 × 14.6 × 11.8 — 23.0 × 14.6 × 11.3 — 20.1 × 12.4 × 10.4 and 19.3 × 12.3 × 10.4 mm, respectively. A single valve from Kejser Franz Josephs Fjord is about 30 mm in length. — A few shells had crusts of bryozoans, polychaete tubes, and Foraminifera attached to them.

Distribution: N. of Baffinland (Thorson 1951, as *C. obesa*), W. Greenland (animals are present from 68°17′ N. 58°14′ W., 410 m, and 70°51′ N. 52°01′ W., 733 m, as *C. obesa*, Thorson 1951; off Jakobshavn, 380—400 m, 1 half-grown animal; also some of the records of *C. obesa* in Posselt & Jensen 1898 may refer to *C. glacialis*), E. Greenland, Jan Mayen, Spitzbergen, Novaya Zemlya, the Barents Sea, the Kara Sea, the Siberian Ice Sea (116°E., shell only), the Finmark, N. and E. of Iceland (animals are present from 67°40′ N. 15°40′ W., 932 m, and 66°23′ N. 8°52′ W., 1090 m, shells only from 67°19′ N. 15°52′ W., 552 m), the Gulf of St. Lawrence, Nova Scotia, New England southward to Chesapeake Bay, ?Florida. Also recorded from off San Diego, California (Dall 1921). But the figure of this specimen (Dall 1925, pl. 20, fig. 4) differs so much from specimens from the N. Atlantic that it seems justifiable to disregard this record. Main distribution: Panarctic and abyssal (probably in the N. Atlantic only). Vertical range: From 71 m (E. Finmark) to about 1890 m (S. of Jan Mayen).

Biology: A few of the animals present (material preserved in alcohol from S.E. of Shannon, 4-7-99, Sermilik, 26-7-33, and S.W. of Kap Franklin, 13-8-32) contained mature or almost mature sexual products in their gonads. Apparently ripe eggs were slightly oval and with a thick, gelatinous membrane. The yolk mass of these measured about 180 × 150 μ in diameter. It must thus be assumed that the larval development is lecithotrophic and the pelagic stage very short or entirely suppressed.

57. *Cuspidaria arctica* (M. SARS) (cf. pl. 3, figs. 7—8).

Neæra arctica G. O. SARS 1878, pl. 6, figs. 5a—c.
Cuspidaria arctica VERRILL & BUSH 1898, pl. 71, fig. 2; pl. 74, fig. 7.

Jan Mayen records:

Neæra arctica FRIELE 1878, p. 224.
Neæra arctica FRIELE & GREIG 1901, p. 39.
Cuspidaria arctica ODHNER 1915, p. 135.

Occurrence at East Greenland (cf. the map fig. 26, p. 186):

Kejser Franz Josephs Fjord Area: Moskusoksefjord off Ankerbjerg, 95 m, fat clay with big stones, 1 adult animal (with sperm, 3-8-32); E. part of Vega Sund, 72°45′ N. 22°56′ W., 35—60 m, mud, some stones, 1 half-grown animal; Kap Hedlund, 67—90 m, 1 adult valve.

Jan Mayen Area: Jan Mayen, 70°54′ N. 8°24′ W., 128 m, dark-grey, sabulous clay, and 70°51′ N. 8°20′ W., 174 m, dark-grey, sabulous clay (FRIELE, FRIELE & GRIEG); Jan Mayen, 94—113 m, 1 adult valve, rather much eroded; 70°50′ N. 8°29′ W., 162 m, 1 young animal. [S. of Jan Mayen, 70°05′ N. 8°26′ W., 698 m, 2 half-grown animals, 4 adult and 1 half-grown shells, 3 valves, some fragments].

The species is "new" to the fauna of E. Greenland proper, where it seems to be of rather sparse occurrence.

Remarks: The broken shell of the specimen from Moskusoksefjord was about 19 mm in length, and the four largest specimens from Jan Mayen measured (length × height × breadth of shell): 26.1 × 17.6 × 13.8 — 25.8 × 17.4 × 14.3 — 24.3 × 16.5 × 13.2 and 21.9 × 15.5 × 12.1 mm, respectively. The species may attain a much larger size, a specimen 56 mm in length from N.E. Iceland being known (FRIELE 1902).

Distribution: W. Greenland (1 adult shell is present from Skovfjord, 300 m; the species is mentioned by HÄGG 1904, and ODHNER 1915; some of the records of *C. obesa* in POSSELT & JENSEN 1898 may have reference to this species), N.E. Greenland, Jan Mayen, Spitzbergen, the Barents Sea, the Murman Coast and the Murman Sea, Waigatsch, the Kara Sea, the Siberian Ice Sea (115°30′E., shell only), the Eastern Finmark to Nordland, off N. Norway, N. and E. of Iceland (animals are present from 67°40′ N. 15°40′ W., 932 m, 67°19′ N. 15°52′ W., 552 m, 65°00′ N. 11°16′ W., 584 m; shells only, from 68°08′ N. 16°02′ W., 1373 m; also mentioned by FRIELE 1902), the Gulf of St. Lawrence, Nova Scotia (valve only), New England, and off Fernandina (a single valve only). Main distribution: Panarctic? (in the N. Atlantic sector only). Vertical range: From 35—60 m (N.E. Greenland), or 44—55 m (Spitzbergen) to about 1190 m (off N. Norway).

Biology: Reproduction unknown.

III. GENERAL PART

ZOOGEOGRAPHICAL AND ECOLOGICAL REMARKS

The present paper mentions a total of 55 species of marine lamellibranchs as living at East Greenland at the present day. Of these, 10 species have not previously been found in that region, viz.

Yoldia thraciaeformis,
Portlandia lucida,
* — *subaequilatera*,

**Arca frielei*,
Lima subauriculata,
**Thyasira equalis*,
**Poromya granulata*,
Cuspidaria obesa (all previous records are erroneous),
— *subtorta*,
— *arctica*.

Four of these species—those marked with an asterisk—are "new" not only to E. Greenland, but to the whole Greenlandic shelf. Further, *C. subtorta* has hitherto only been known in the form of subfossil specimens from West Greenland.

The latest complete account of the lamellibranchs of East Greenland—namely that of Ad. Jensen (1905)—enumerates 41 species as belonging to its recent fauna. (Some of these were, it is true, listed as varieties of mainly boreal species which must now be regarded as distinct). Besides these and the 10 species mentioned above, the present study deals with 4 other species which have since been added to the fauna list of E. Greenland. These are (the first record being referred to in parentheses):

Yoldia hyperborea (Thorson 1934b), *Pecten islandicus* (Thorson 1933)
Portlandia fraterna (Odhner 1915), *Thracia myopsis* (Soot-Ryen1941).

Further, 2 species which were mentioned as empty shells only by Ad. Jensen, have since been found as specimens with the animals inside, viz.

Leda minuta (Bertelsen 1937a), and *Macoma torelli* (present paper).

Besides the 55 species now known from E. Greenland proper, two species, viz. *Turtonia minuta* (first record in this paper), and *Thyasira croulinensis* (recorded by Lamy 1913b), have been included. These two

are so far only known from Jan Mayen and only as dead specimens. It seems correct, however, to regard them as true inhabitants of the region dealt with here, and quite probably they will be found by future investigators to live along the south-eastern coast of Greenland. — Finally, two other species, viz. *Thyasira equalis* and *Cuspidaria subtorta*, have now been added to the shelf fauna of Jan Mayen, and table II, p. 194, gives the complete list of the Jan Mayen lamellibranchs so far known.

A. The composition of and the various types of distribution within the East Greenland lamellibranch fauna.

It is evident and generally accepted that the geographical distribution of a species is primarily dependent on its ecology. As to marine animals, especially the temperature conditions of the environment have proved to be of essential importance. On the other hand, precise knowledge of the distribution along with hydrographical observations may permit the drawing of certain conclusions as to the ecology of a species including its temperature requirements.

As to the opisthobranchs from E. Greenland, Lemche (1941) put forward a classification which, being a modification of that by Ekman (1935), is intended to express relations between the temperature requirements of vegetative as well as of propagative stages of the species found and their recorded distribution.

It would, in fact, be very tempting to apply this or a similar classification to the lamellibranch fauna of E. Greenland, also. If this were done, however, the possible existence of different subspecies and physiological races, each with its own temperature requirements and distribution, should be borne in mind (cf. e. g. Runnström 1930, and H. Madsen 1940, on *Mytilus edulis*). Furthermore, since metabolic rates are temperature-dependent, the amount of food available may be of decisive importance in regard to the temperatures tolerated and hence to the presence or absence of a species (cf. Spärck 1926). The main cause, however, at present preventing a general applicability of the kind of classification described above to the lamellibranch fauna of E. Greenland, is the lack of information on the reproductive season(s) for many of the species dealt with, especially information from other regions than E. Greenland. Investigations to remedy this want are thus highly desirable.

The analysis, then, to be undertaken below is primarily based upon the regional distribution of the species in question, the divisions used being as far as possible in agreement with those defined by Ekman (1953). It should, however, be noted that a natural distinction between different types of distribution may in some cases be difficult. Thus, the

group of species to which a "panarctic" distribution is here assigned is not quite homogeneous. There seem to exist species with a distribution intermediate between a typical high-arctic (e. g. in *Portlandia arctica*, *Pandora glacialis*) and a panarctic distribution (e. g. in *Portlandia intermedia*, *Thyasira gouldi*, *Thracia myopsis*), as usually conceived. Thus, for instance, *Propeamussium groenlandicum* and *Thracia septentrionalis* seem to be of such an intermediate distribution. The distinction between different types of geographical distribution employed here does not necessarily imply that species placed within the same group are considered to have identical temperature requirements. Further, since our present knowledge of the intraspecific systematics of arctic and boreal lamellibranchs is often far from stabilised, we have in the main to be content with an analysis and comparisons on the species level, and in a few instances, only, it appeared both necessary and justifiable to account for the distribution of different subspecies. These, then, are treated as if they were distinct species.

Although there are thus some restrictions as regards the classification applied, this is nevertheless believed to elucidate characteristic features of the composition of the lamellibranch fauna of East Greenland.

In the following analysis and the subsequent comparisons with the fauna of adjacent regions only species which have been met with alive will be considered.

As to zoogeographical types, the 55 living species of the lamellibranch fauna of East Greenland prove to consist of the following elements:

The arctic element (46 species: $83^1/_2$ % of the total number), which can be divided into the following groups (the species marked with an asterisk occur along the American as well as the Eurasian coasts of the N. Atlantic. If not marked with an asterisk, the species is only known from the Eurasian coasts):

Species of a predominantly panarctic distribution (23 species: 42 % of the total number), viz.

**Portlandia intermedia*,
— *lenticula*,
* — *fraterna*,
**Arca pectunculoides grandis*,
* — *glacialis*,
**Dacrydium vitreum*,
**Modiolaria discors laevigata*,
**Propeamussium groenlandicum*,
**Astarte borealis*,
**Astarte crenata* s. l.,
**Thyasira gouldi*,
* — *equalis*,
**Axinopsis orbiculata*,
**Serripes groenlandicus*,
**Cardium ciliatum*,
**Gomphina fluctuosa*,
**Macoma calcaria*.
**Lyonsia arenosa*,

Thracia septentrionalis[1]), * — *glacialis*,
* — *myopsis*, * — *arctica*.
**Cuspidaria subtorta*,

Species of a high-arctic distribution (11 species: 20 % of the total number), viz.

**Portlandia arctica*, **Macoma moësta*,
?* — *frigida*, * — *loveni*,
Arca frielei, * — *torelli*,
**Propeamussium imbriferum*, **Cyrtodaria kurriana*,
**Lima hyperborea*, **Pandora glacialis*,
Thracia devexa.

Species of a low-arctic distribution (2 species: 3½ % of the total number), viz.

**Yoldia hyperborea*, **Cardium elegantulum*.

Species of a subarctic distribution (2 species: 3½ % of the total number), viz.:

Yoldia thraciaeformis[2]), **Pecten islandicus*.

Species of a panarctic-boreal distribution (8 species: 14½ % of the total number), viz.:

**Nucula tenuis* s. l., **Astarte montagui*,
**Leda pernula* s. l., * — *elliptica*,
?**Portlandia subaequilatera*, **Mya truncata*,
**Modiolaria nigra*, **Lyonsiella abyssicola*.

The predominantly low-arctic-boreal element (2 species: 3½ % of the total number), viz.:

**Leda minuta*, **Crenella decussata*.

The element comprising species with a wide distribution, i. e. throughout the boreal-lusitanian, and sometimes the mauretanian regions. According to their mode of distribution in typical arctic seas, this element may be divided into

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[1]) Not known from the Eurasian coasts excl. of Spitzbergen, but from north-eastern America.

[2]) Purely American, not known from European coasts.

Species with a wide distribution, including typical high-arctic sea areas (1 species: 2 % of the total number), viz.

**Hiatella arctica.*

Species with a wide distribution, but lacking from typical high-arctic sea areas (6 species: 11 % of the total number), viz.:

**Portlandia lucida,* *Astarte sulcata,*
**Mytilus edulis,* **Poromya granulata,*
**Lima subauriculata,* **Cuspidaria obesa.*

The zoogeographical composition of the lamellibranch fauna of the five areas of East Greenland is shown in the subjoined table:

	Arctic element						Low-arctic boreal element	Wide distribution		Total number of species
	Pan-arctic	High-arctic	Low-arctic	Sub-arctic	Pan-arctic boreal	Total for arctic-element		incl. of high-arctic	excl. of high-arctic	
	spp. %	spp. %	spp. %	spp. %	spp. %	spp. %	spp. %	spp. %	spp. %	
Nordøstkyst Area	19:53	8:23½	0:0	0:0	6:17½	33:97	0:0	1:3	0:0	34
Franz Josephs Fjord Area ...	21:51	10:24	0:0	1:2½	8:20	40:97½	0:0	1:2½	0:0	41
Scoresby Sund Area	22:53½	9:22	1:2½	0:0	7:17	39:95	0:0	1:2½	1:2½	41
Kangerdlugssuaq Area	13:59	5:23	0:0	0:0	3:13½	21:95½	0:0	1:4½	0:0	22
Sydøstkyst Area	20:46½	5:12	2:4½	2:4½	6:14	35:81½	2:4½	1:2	5:12	43
Total number of species at East Greenland....	23:42	11:20	2:3½	2:3½	8:14½	46:83½	2:3	1:2	6:11	55

From this analysis it will be evident that the arctic element constitutes by far the greater part of the lamellibranch fauna in all the five areas, the percentages of it being very high and almost equal in the four northernmost areas, but markedly smaller at the southern coast of East Greenland. Further, as regards the three northernmost areas the analysis shows almost equal percentages for all the components, while the Kangerdlugssuaq area has a slightly larger percentage of panarctic and a slightly smaller percentage of panarctic-boreal species, but otherwise it is very similar to the areas to the N. of it. From this, however, the composition of the lamellibranch fauna of the Sydøstkyst area differs markedly. Here, the percentage of high-arctic species is distinctly smaller, whereas the percentages of species which are absent from or at least very rare in high-arctic regions show a remarkable increase. For each of the five areas the percentages of such species are (low-

arctic, subarctic, low-arctic-boreal together with species of a wide distribution except in high-arctic regions): Nordøstkyst area 0 %, Kejser Franz Josephs Fjord area 2½ %, Scoresby Sund area 5 %, Kangerdlugssuaq area 0 %, and Sydøstkyst area 25½ %. It is thus evident that the greatest change in the composition of the lamellibranch fauna takes place from the Kangerdlugssuaq area to the Sydøstkyst area.

The comparatively small number, in all 22 species, now known to live in the Kangerdlugssuaq area seems at first surprising. This may in part be due to the fact that especially the areas of Kejser Franz Josephs Fjord and Scoresby Sund, both with a species number of 41, have been more thoroughly investigated; future collecting in the Kangerdlugssuaq area may be expected to secure one or the other of the following infauna species: *Nucula tenuis*, *Portlandia fraterna*, *Thyasira gouldi* and *T. equalis*, *Serripes groenlandicus*, *Cardium ciliatum*, *Macoma calcaria*, *Cyrtodaria kurriana*, *Mya truncata*, and *Cuspidaria glacialis*. However, this area must nevertheless already now be regarded as fairly well examined, large series of dredge hauls having been made here by two Danish expeditions. Therefore, the main cause of the paucity of species must be sought in the ecological conditions prevailing in the Kangerdlugssuaq area. Now, the influence of the relatively warm Irminger Current, though only slight, seems to be sufficient to prevent some of the typical high-arctic lamellibranch species from inhabiting this area. On the other hand, this influence is apparently not strong enough to alter the hydrographical conditions so much as to enable species of a more southerly main distribution to live here. The complete absence of such species from the area concerned is, in fact, remarkable, the more so because a few species, the main distribution of which is low-arctic and subarctic, viz. *Yoldia hyperborea* and *Pecten islandicus*, are able to survive in certain places to the north of it. This seems to indicate that the ecological conditions in the Kangerdlugssuak area are more monotonous than is the case within the Kejser Franz Josephs Fjord and the Scoresby Sund areas (cf. the information on the hydrography of the area in BERTELSEN 1937a, p. 10). Such a monotony of the ecological conditions may also be responsible for the absence of some other species which are otherwise known to occur both to the N. and to the S. of the Kangerdlugssuaq area. Since there is still a considerable component of high-arctic species, its lamellibranch fauna may on the whole be characterised as an impoverished, high-arctic one. From the analysis, then, it becomes evident that zoogeographically the Kangerdlugssuaq area must be regarded as a marine transitional area.

Since the lamellibranch fauna of Jan Mayen has not been considered in the above, but is, nevertheless, of interest in this connection, an analysis of its composition is subjoined.

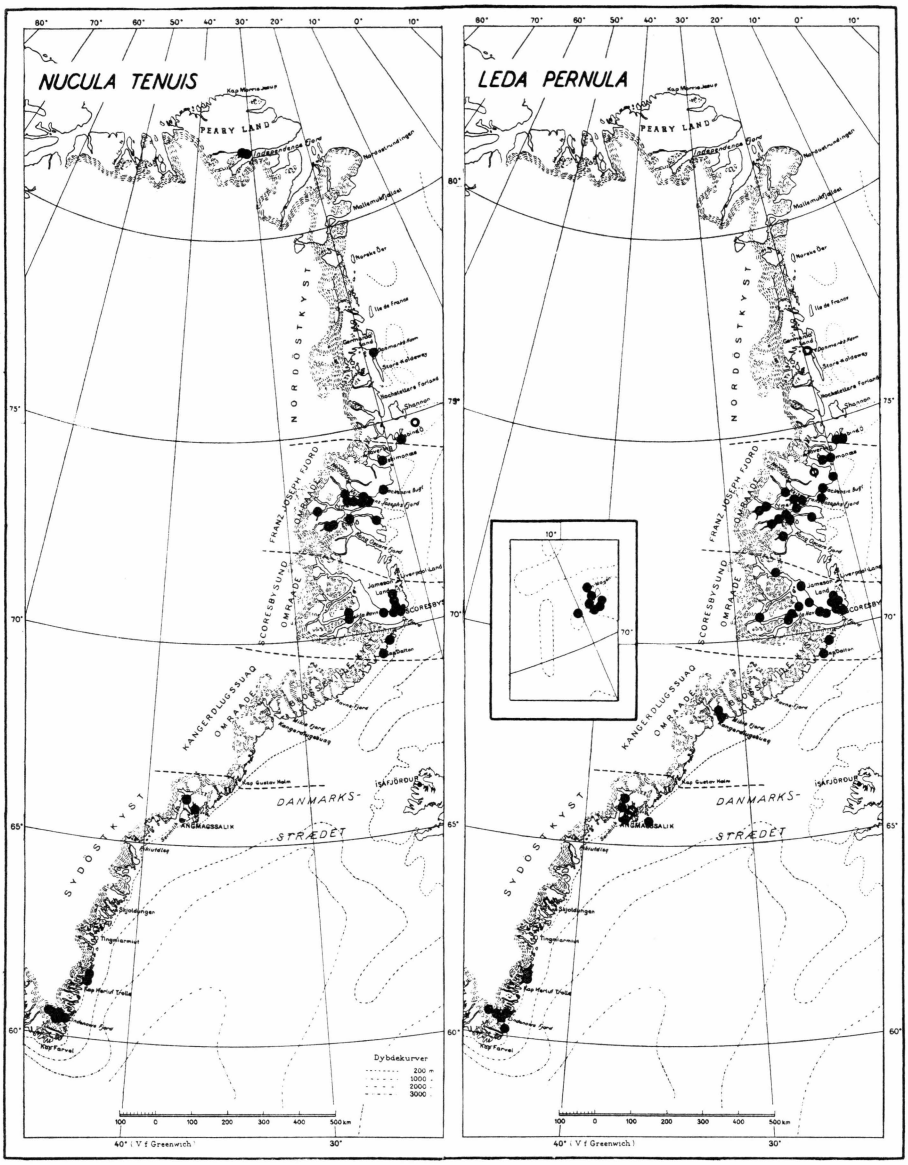

Fig. 12. Species distributed along the whole East Greenland coast, viz. *Nucula tenuis expansa* Reeve, and *Leda pernula costigera* Leche. — Full circles: Living animals. Open circles: Shells or valves only.

The marine fauna of Jan Mayen down to 400 m depth numbers 27 living lamellibranch species so far known. Of these, 24 species (about 89 % of the total number) belong to the arctic element. The latter is composed of 16 panarctic, 3 high-arctic, 1 subarctic, and 4 panarctic-boreal species (about 59, 11, 4, and 15 % of the total number,

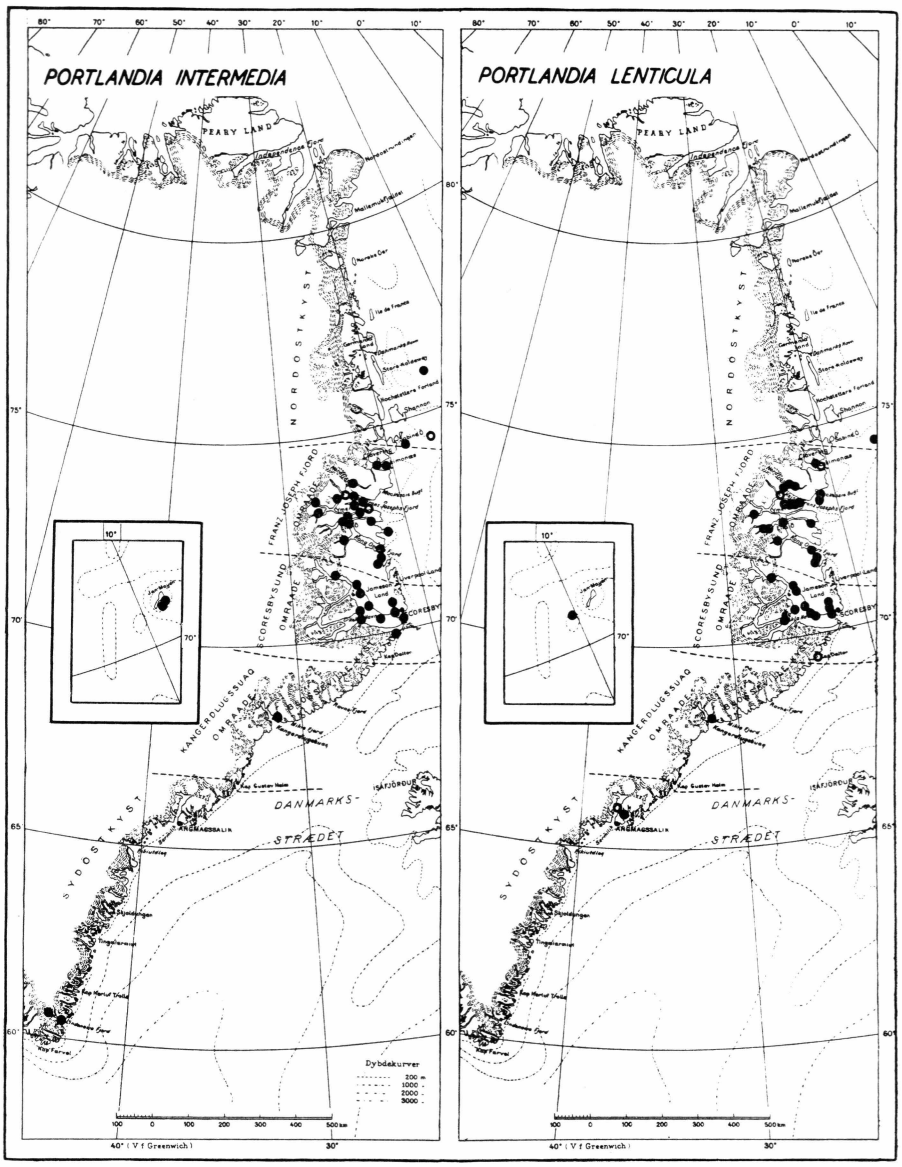

Fig. 13. Continued from fig. 12. *Portlandia intermedia* (M. SARS), and *Portlandia lenticula* (MØLLER). — Full circles: Living animals. Open circles: Shells or valves only.

respectively). Further, Jan Mayen harbours 1 bivalve species of a low-arctic-boreal main distribution, 1 species of a wide distribution including high-arctic seas, and 1 species with a wide distribution except in high-arctic seas (each about 4 % of the total number).

A comparison of these data with those from the five coast areas of East Greenland (cf. p. 171) shows that as to its composition of zoo-

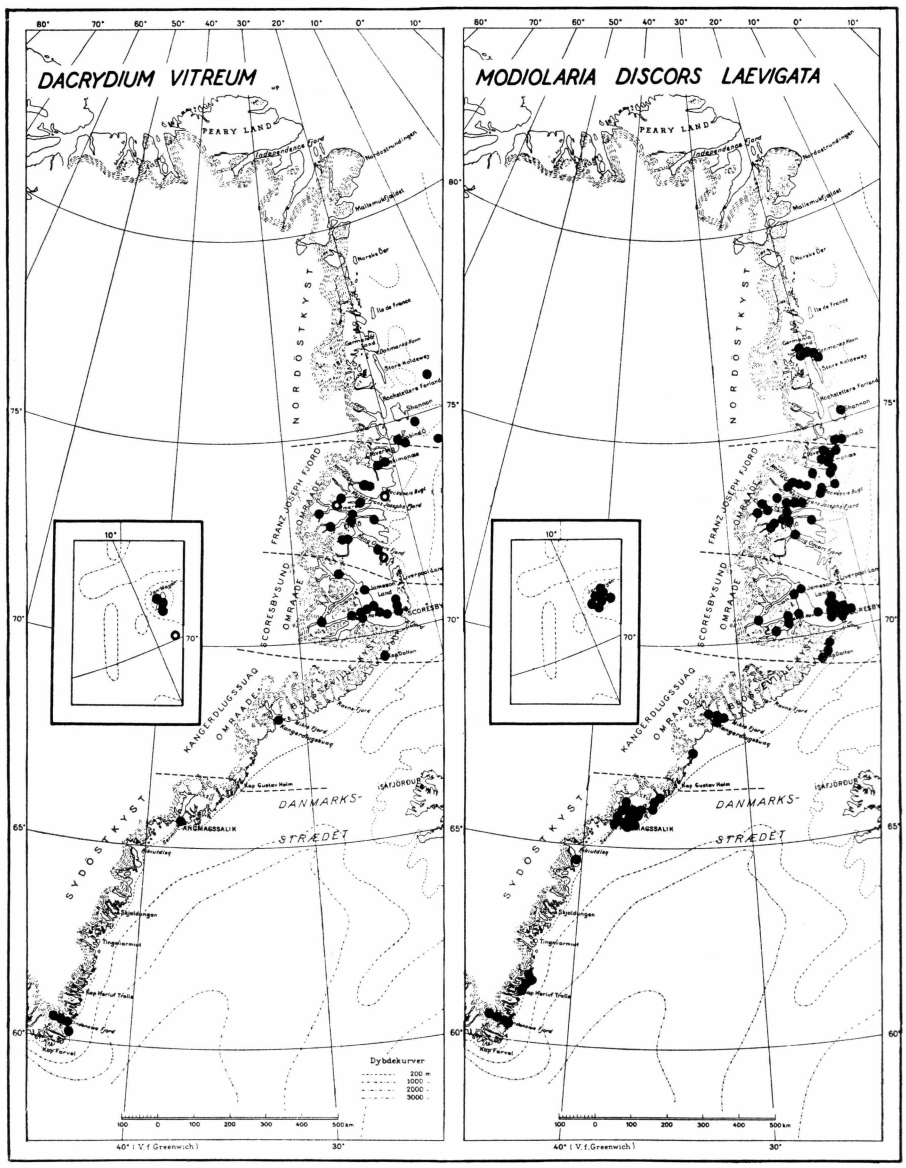

Fig. 14. Continued from the preceding figures. *Dacrydium vitreum* (MØLLER), and *Modiolaria discors laevigata* (GRAY) (including f. *substriata*). — Full circles: Living animals. Open circles: Shells or valves only.

geographical elements, the lamellibranch fauna of Jan Mayen ranges intermediately between those of the Kangerdlugssuaq and the Sydøstkyst areas. Apparently, however, a comparison of the Jan Mayen fauna with that of East Greenland is of limited value owing to the less intensive investigation of the former. Even though several expeditions have col-

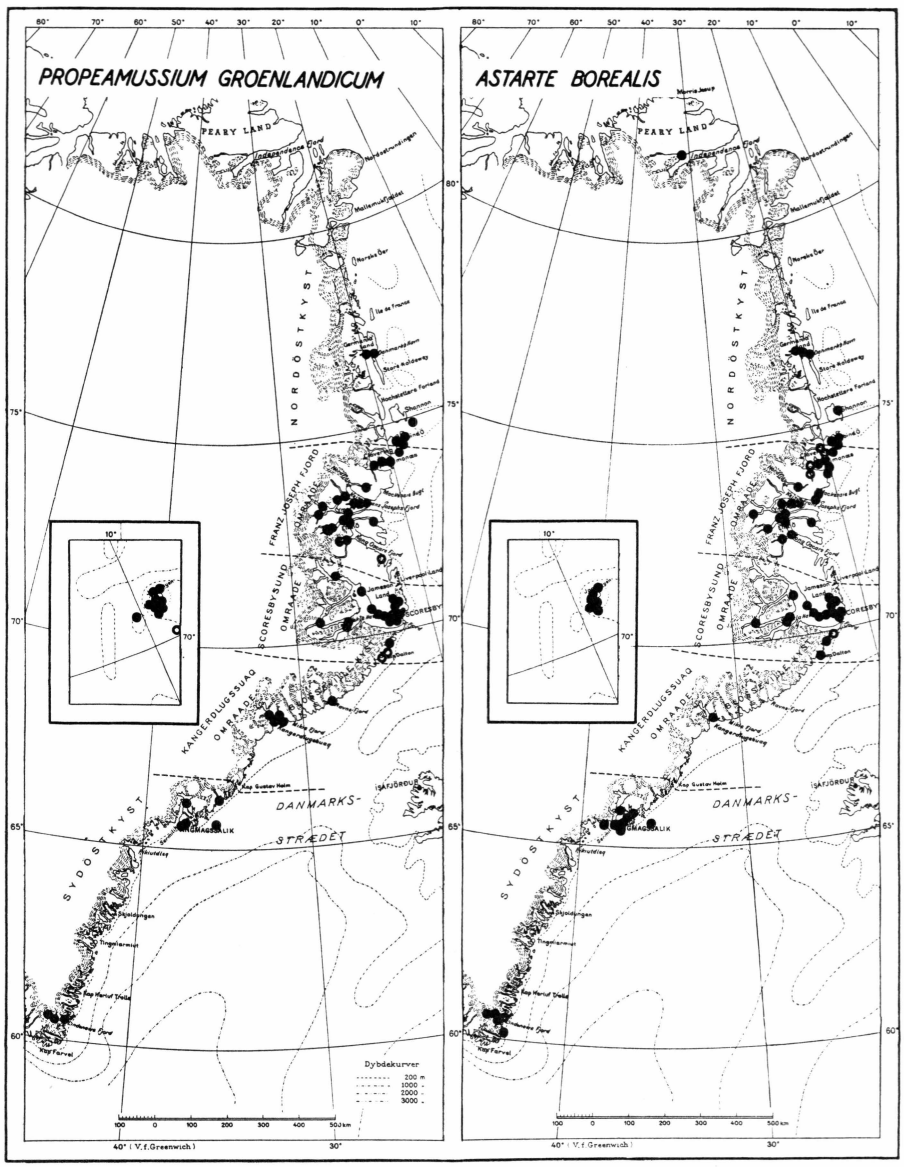

Fig. 15. Continued from the preceding figures. *Propeamussium groenlandicum* (SOWERBY), and *Astarte borealis* (CHEMNITZ). Full circles: Living animals. Open circles: Shells or valves only.

lected marine molluscs around Jan Mayen, the shallow-water fauna of this island seems still to have been imperfectly examined. Nevertheless the composition of its lamellibranch fauna, as analysed above, shows some characteristic features. Thus, the percentage of high-arctic species

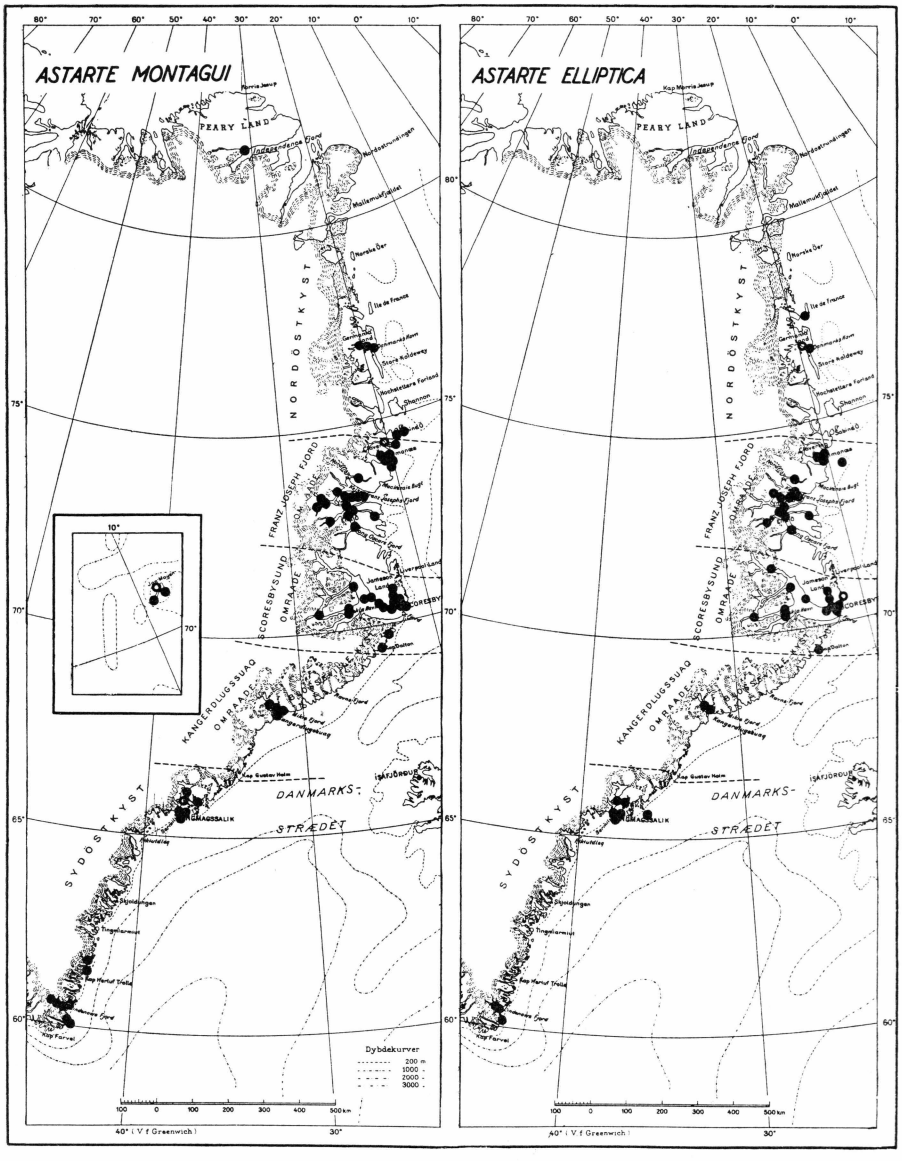

Fig. 16. Continued from the preceding figures. *Astarte montagui* (Dillwyn), and *Astarte elliptica* (Brown). — Full circles: Living animals. Open circles: Shells or valves only.

is not greater than that for the Sydøstkyst area. Also, Jan Mayen harbours a fairly considerable percentage of lamellibranch species, which avoid truly high-arctic waters, viz. 3 species (about 11 % of the total), while from the Sydøstkyst area, down to 400 m, 9 such species (22½ %

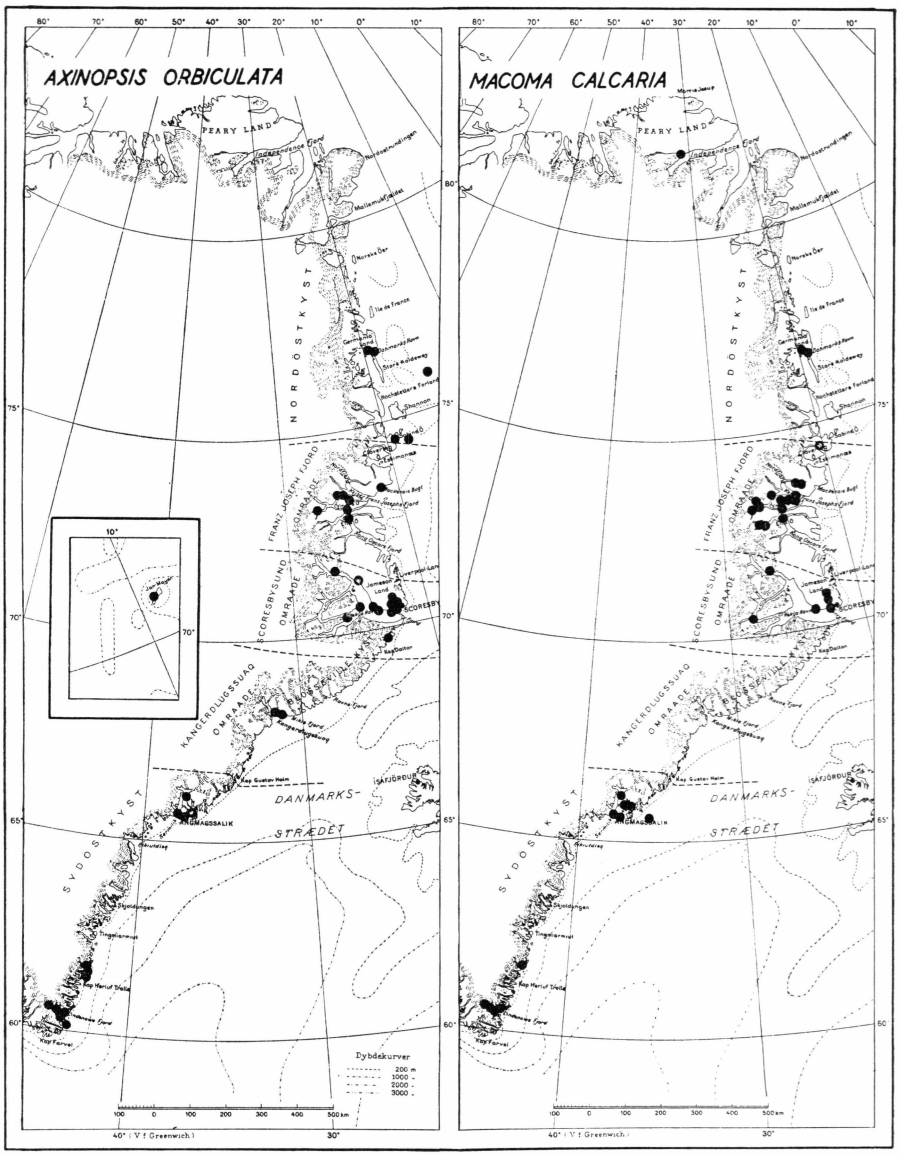

Fig. 17. Continued from the preceding figures. *Axinopsis orbiculata* G. O. SARS, and *Macoma calcaria* (CHEMNITZ). Full circles: Living animals. Open circles: Shells or valves only.

of the total) are known. Two of the species, occurring at Jan Mayen, are at East Greenland restricted to the Sydøstkyst area, viz. *Leda minuta*, and *Mytilus edulis*.

Furthermore, the finding of a valve of *Turtonia minuta* and a dead specimen of *Thyasira croulinensis* at Jan Mayen, both species so far

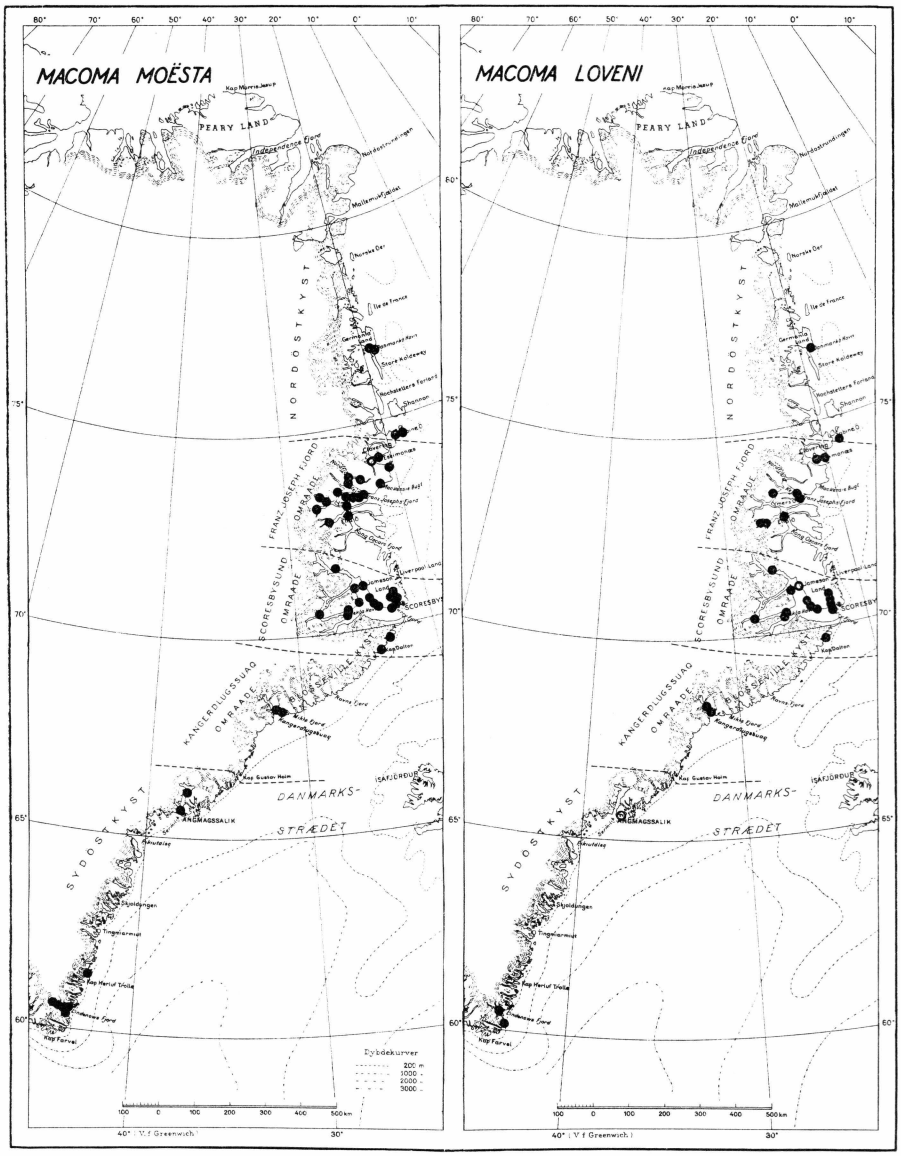

Fig. 18. Continued from the preceding figures. *Macoma moësta* (Deshayes), and *Macoma loveni* (Steenstrup) Jensen. — Full circles: Living animals. Open circles: Shells or valves only.

unknown from E. Greenland but known from both W. Greenland and Iceland, indicate that the island probably harbours some other low-arctic-subarctic-boreal lamellibranch species. This suggestion also agrees with the fact that the upper water layers around Jan Mayen down to below 50 m attain comparatively high summer temperatures (cf. Iver-

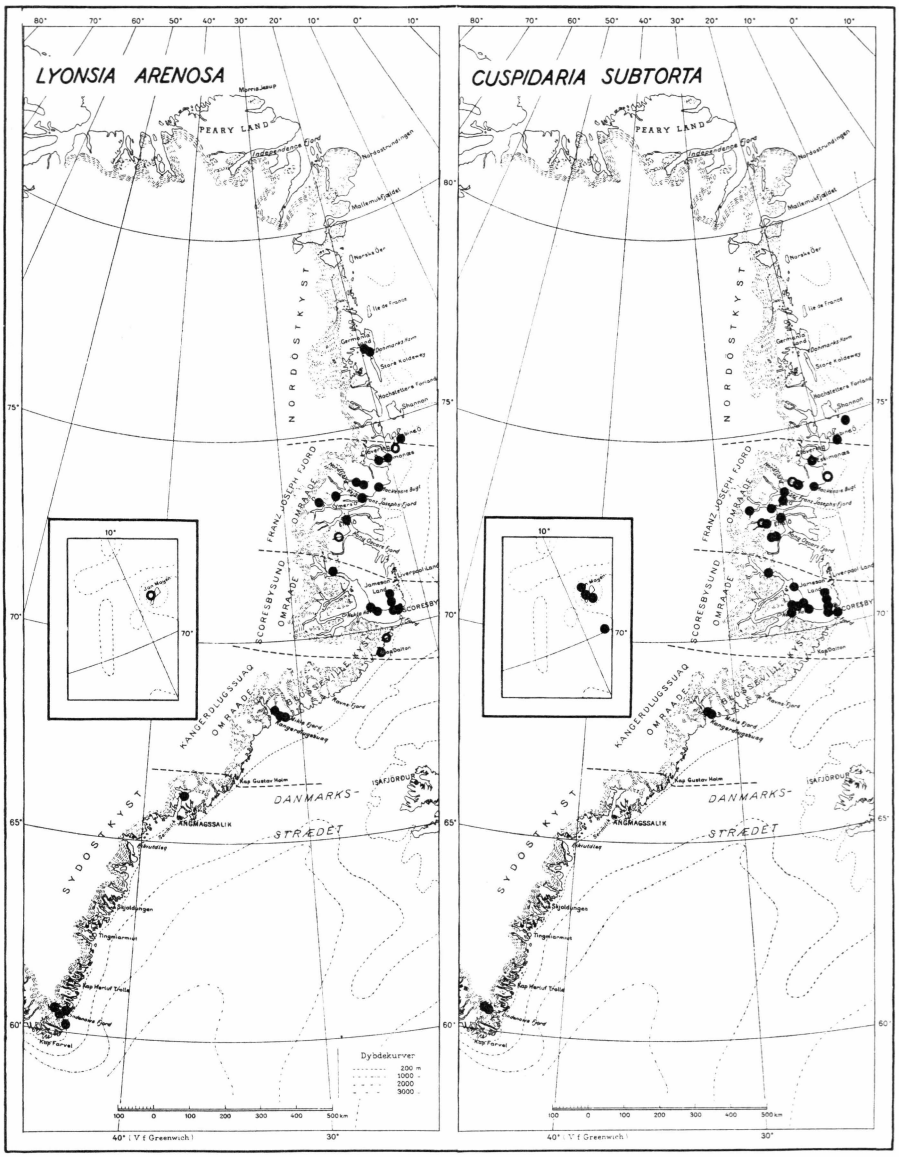

Fig. 19. Continued from the preceding figures. *Lyonsia arenosa* (MØLLER), and *Cuspidaria subtorta* (G. O. SARS). — Full circles: Living animals. Open circles: Shells or valves only.

SEN 1936, p. 158 ff.). Yet the somewhat isolated geographical position of the island (about 500 km from E. Greenland and a little more from Iceland) may also be of some importance for the composition of its lamellibranch fauna. An indication of this is probably the comparatively small total number of lamellibranch species known from the Jan Mayen shelf.

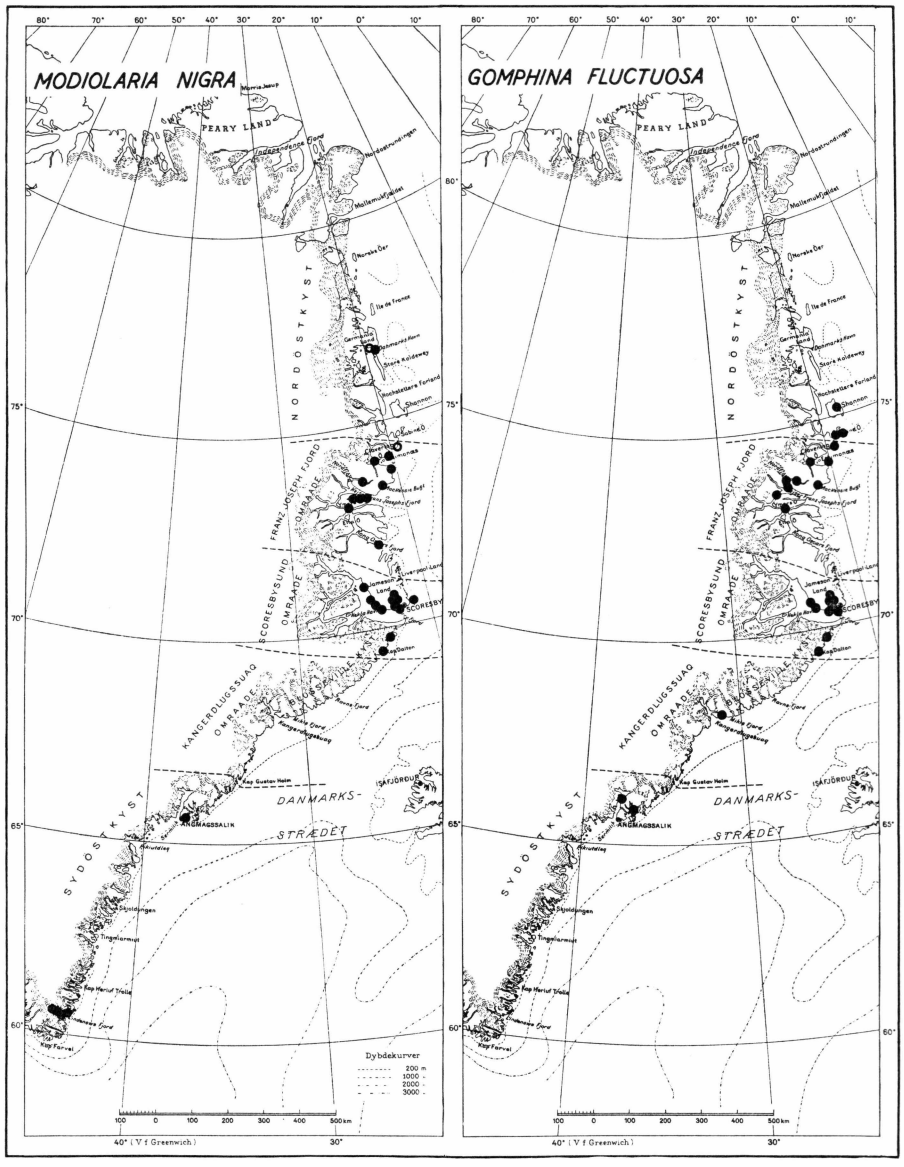

Fig. 20. Species distributed along the whole outer coast of East Greenland, but avoiding the inner parts of the large fjords, viz. *Modiolaria nigra* (GRAY), and *Gomphina fluctuosa* (GOULD). — Full circles: Living animals. Open circles: Shells or valves only.

However this may be, it seems safe to conclude that the lamellibranch fauna of Jan Mayen shows distinctly arctic features and, as to its composition of zoogeographical elements, the closest resemblance to that of the south-eastern coast of Greenland.

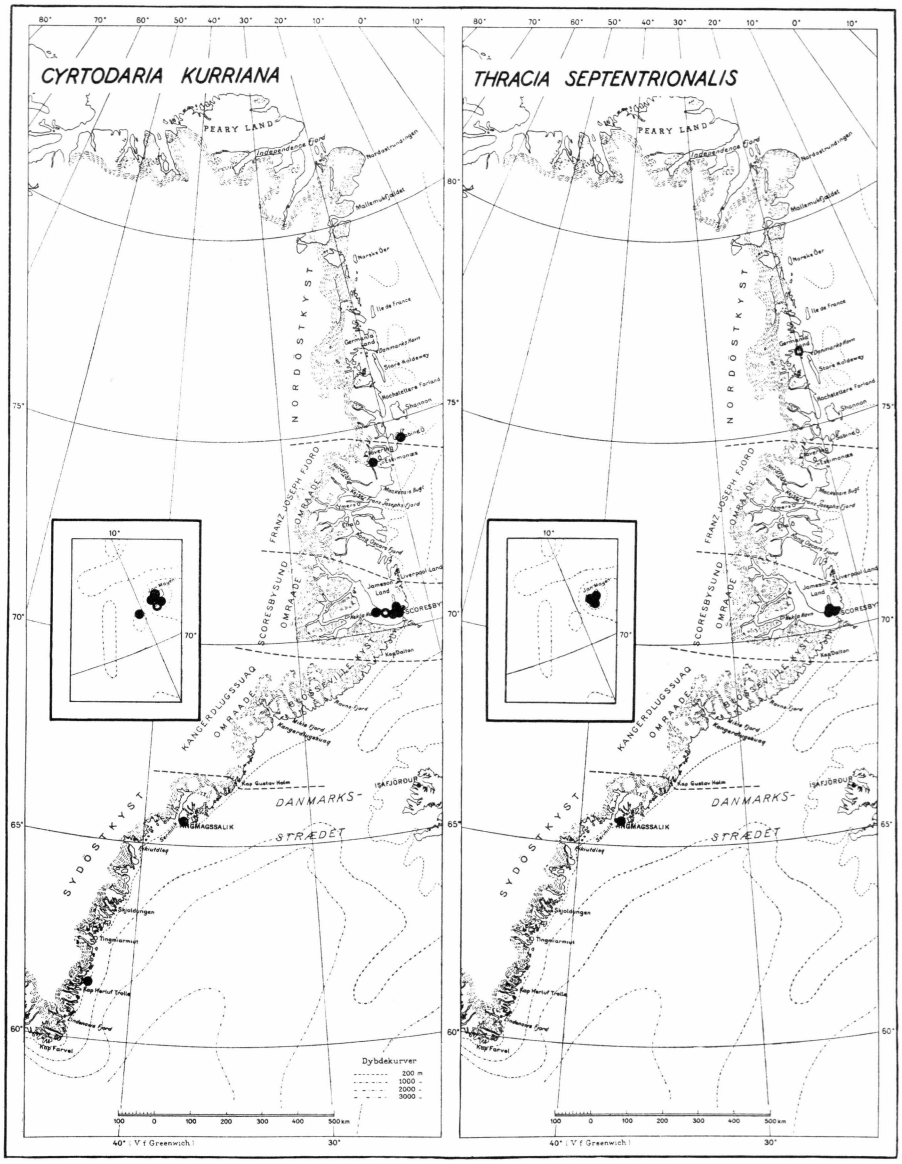

Fig. 21. The distribution at East Greenland and Jan Mayen of species restricted to the outer coasts, viz. *Cyrtodaria kurriana* DUNKER, and *Thracia septentrionalis* JEFFREYS. — Full circles: Living animals. Open circles: Shells or valves only.

The various types of horizontal distribution along the East Greenland coasts, as exhibited by the various lamellibranch species, are shown on the maps, figs. 3, 5, 6, 8, and 11—26. Full symbols indicate specimens found alive, while open symbols mean that only empty shells or dead specimens have been found in the locality in question.

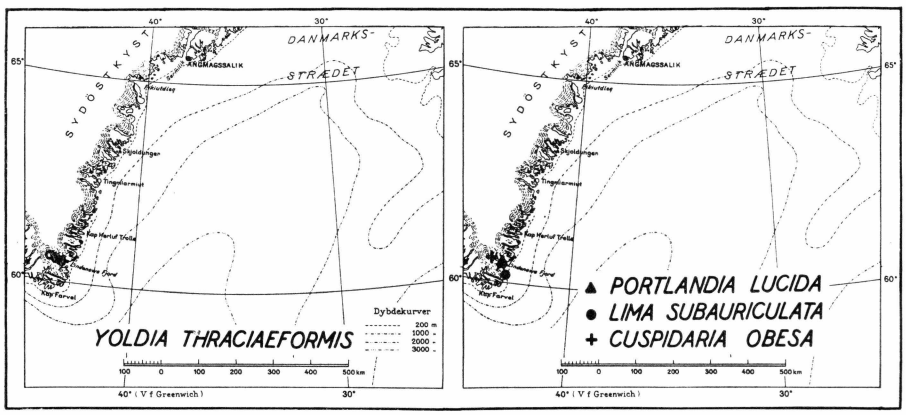

Fig. 22. Species occurring only along the southernmost part of the Sydøstkyst area, viz. *Yoldia thraciaeformis* (STORER), *Portlandia lucida* (LOVÉN), *Lima subauriculata* MONTAGU, and *Cuspidaria obesa* (LOVÉN). — Full symbols: Living animals. Open symbols: shell only.

A considerable number of species have been found alive along the whole coast of East Greenland, occurring in all five areas, both at the outer coast and in the inner parts of the large fjords. Such species are: *Leda pernula*, *Portlandia intermedia*, *P. lenticula*, *Arca pectunculoides*

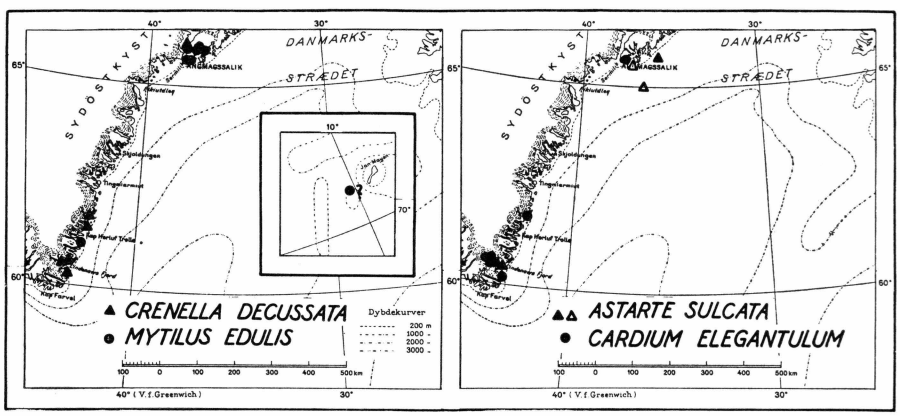

Fig. 23. Species distributed along the whole Sydøstkyst area, but absent from the coasts N. of Angmagssalik, viz. *Crenella decussata* (MONTAGU), *Mytilus edulis* L., *Astarte sulcata* (DA COSTA), and *Cardium elegantulum* (BECK) MØLLER. — Full symbols: Living animals. Open symbols: Shells or valves only.

grandis, *A. glacialis*, *Dacrydium vitreum*, *Modiolaria discors laevigata*, *Propeamussium groenlandicum*, *Astarte borealis*, *A. montagui*, *A. elliptica*, *A. crenata* (with subspecies), *Axinopsis orbiculata*, *Macoma moësta*, *M. loveni*, *Hiatella arctica*, *Lyonsia arenosa*, and *Cuspidaria subtorta* (fig. 5, p. 95, and figs. 12—19, pp. 173—180). Further, the following

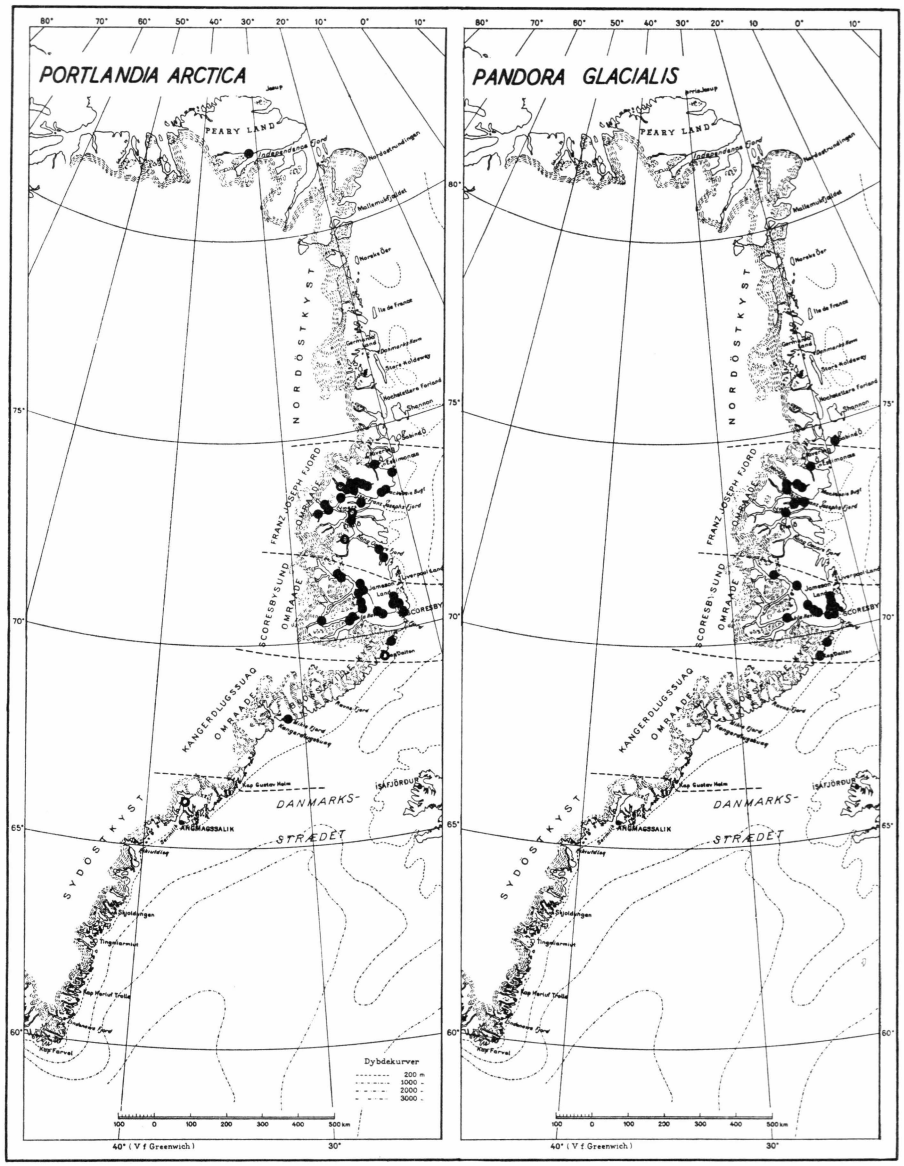

Fig. 24. Species distributed along the four northernmost areas, viz. *Portlandia arctica* (GRAY), or the three northernmost areas of the East Greenland coasts, viz. *Pandora glacialis* LEACH. — Full circles: Living animals. Open circles: Shells or valves only.

species, which have not hitherto been found alive in all the five East Greenland areas, no doubt have a similar type of distribution: (The numerals 1 to 5 designate the areas in which the particular species has been found, in an order from north to south. Parantheses enclosing a single numeral indicate that only empty shells are known from the area

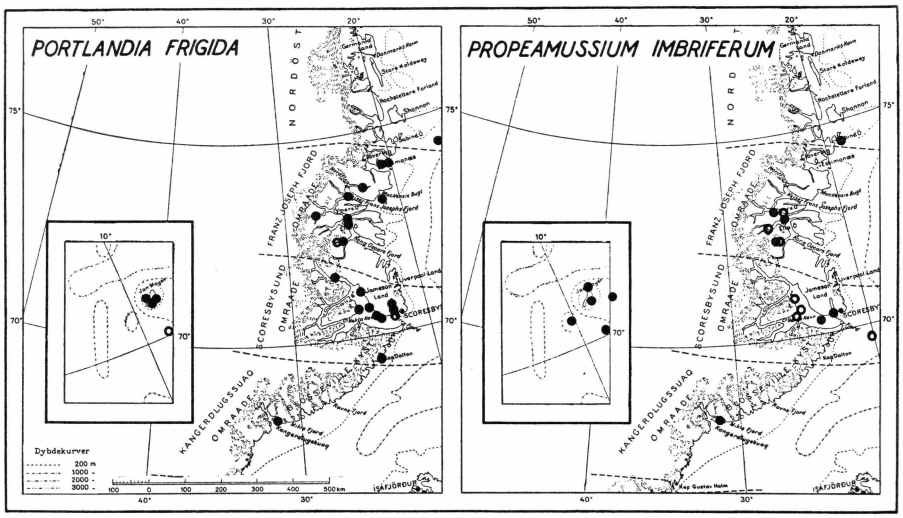

Fig. 25. Species distributed along the four northernmost areas of the East Greenland coasts, viz. *Portlandia frigida* (TORELL), and *Propeamussium imbriferum* (LOVÉN). — Full circles: Living animals. Open circles: Shells or valves only.

in question) *Nucula tenuis* (1—2—3—5) fig. 12, p. 173), *Thyasira gouldi* (1—2—3—(4)—5), and *T. equalis* (1—2—3—5) (fig. 6, p. 105), *Serripes groenlandicus* (1—2—3—(4)—5), and *Cardium ciliatum* ((1)—2—3—5) (fig. 8, p. 000), *Macoma calcaria* (1—2—3—5) (fig. 17, p. 178), *Mya truncata* (1—2—3—(4)—5), *Thracia devexa* (2—3—(4)—5) (fig. 11, p. 157), and *Cuspidaria glacialis* (1—2—3—5). Probably also *Portlandia fraterna* ((1)—2—3) has the same type of distribution, having been overlooked along the coasts south of Scoresby Sund.

Two species, viz. *Modiolaria nigra*, and *Gomphina fluctuosa*, seem to avoid the innermost parts of the large fiords, and are most abundant in places near the open sea (fig. 20, p. 181). They are otherwise widely distributed along the whole coast.

The distribution of three species, viz. *Cyrtodaria kurriana*, *Thracia septentrionalis*, and *T. myopsis*, is largely restricted to the outer coast (fig. 11, p. 157, and fig. 21, p. 182).

Four species, viz. *Yoldia thraciaeformis*, *Portlandia lucida*, *Lima subauriculata*, and *Cuspidaria obesa*, are only known from Lindenows Fjord and vicinity (fig. 22, p. 183), and another five species, viz. *Leda minuta*, *Crenella decussata*, *Mytilus edulis*, *Astarte sulcata*, and *Cardium elegantulum*, have their northern limit of distribution a little to the north of Angmagssalik, otherwise occurring along the whole Sydøstkyst area (fig. 3, p. 20, and fig. 23, p. 183). It should be noted, however, that *Astarte sulcata* generally seems to live only at some distance from

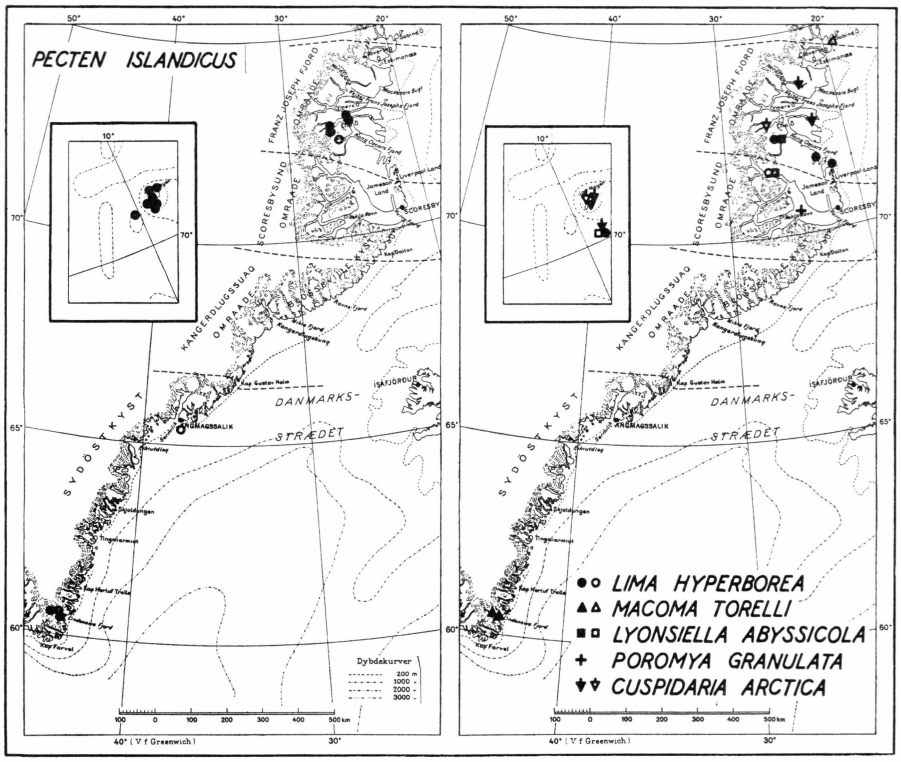

Fig. 26. Map showing the distribution of *Pecten islandicus* O. F. MÜLLER, and the localities along East Greenland and round Jan Mayen where some sparsely occurring species were taken, viz. *Lima hyperborea* (JENSEN), *Macoma torelli* (STEENSTRUP) JENSEN, *Lyonsiella abyssicola* M. SARS, *Poromya granulata* (NYST & WESTENDORP), and *Cuspidaria arctica* (M. SARS). — Full symbols: Living animals. Open symbols: Shells or valves only.

the coast of the Sydøstkyst area, in this respect differing from the other four species of the group.

Yoldia hyperborea also occurs along the whole Sydøstkyst area and, in addition, in the vicinity of the mouth of Scoresby Sund (fig. 3, p. 20).

Fig. 24, p. 184, and fig. 25, p. 185, show the distribution of *Portlandia arctica*, *P. frigida*, *Propeamussium imbriferum*, and *Pandora glacialis*, all of which at present seem to be restricted to the three or four northernmost areas of East Greenland. The same applies to *Arca frielei* and perhaps also to *Lima hyperborea* (fig. 26, p. 186).

The distribution of *Pecten islandicus* at East Greenland is remarkable, as this species, besides along the south-eastern coast, occurs in an isolated area in the inner parts of Kejser Franz Josephs Fjord, probably as a relict from a warmer period (fig. 26, p. 186).

Finally, fig. 26, p. 186, also shows the position of the finds of some species which were only occasionally met with and the distribution of

which along the East Greenland coasts cannot yet be characterised with reasonable accuracy.

The subjoined table summarises the types of distribution of the 55 lamellibranch species known from East Greenland:

Distribution along E. Greenland.....	Species distributed along the whole coast	Species restricted to the 3 or 4 northernmost areas	Species known from the Syd-østkyst area only	Species known from the Scoresby Sund and the Sydøstkyst areas only	Species known from the Kejser Franz Josephs Fjord and the Sydøstkyst areas only	Species with an insufficiently known distribution	Total number of species
Main distribution:							
Panarctic.....	20	—	—	—	—	3	23
High-arctic	4	5	—	—	—	2	11
Low-arctic.....	—	—	1	1	—	—	2
Subarctic.....	—	—	1	—	1	—	2
Panarctic-boreal.....	6	—	—	—	—	2	8
Low-arctic-boreal.....	—	—	2	—	—	—	2
Wide, incl. of the high-arctic	1	—	—	—	—	—	1
Wide, excl. of the high-arctic	—	—	5	—	—	1	6
Total number of species...	31	5	9	1	1	8	55

From the table it will be evident that the three dominating elements within the lamellibranch fauna of East Greenland are: A group of predominantly panarctic species, including the majority of the panarctic-boreal and part of the high-arctic species, occurring along the whole coast; a group of low-arctic, subarctic, low-arctic-boreal, and widely distributed—except in high-arctic regions—species restricted to the Sydøstkyst area; and a group of predominantly high-arctic species which are restricted to the 3 or 4 northernmost areas of East Greenland.

B. The lamellibranch fauna of East Greenland compared with those of the neighbouring regions.

Table I, pp. 189—191, shows which of all the lamellibranch species hitherto known from East Greenland do or do not occur along the coasts of the surrounding Arctic and North Atlantic regions. In order to form a more suitable basis for the following comparisons is seems correct to

exclude the species which cannot be regarded as members of the shelf fauna of the region in question; therefore, those not found alive at depths down to 400 m in that region will not be considered. Thus, e. g. *Portlandia lucida* and *Cuspidaria obesa*, which at E. Greenland are hitherto known only from depths exceeding 400 m, will not be regarded as true members of the East Greenland shelf fauna.

This restriction being made, it will appear from table I that of the 53 living East Greenland species known from depths down to 400 m, 46 are known from West Greenland, 45 from Spitzbergen, 35 from N. and E. Iceland, and 40 species from Norway N. of Lofoten. The lamellibranch fauna of E. Greenland has thus by far the majority of its species in common with those of the surrounding regions. It seems somewhat surprising that N. Norway has a larger number of species in common with E. Greenland than have N. and E. Iceland. Yet the latter region most likely harbours some more species known from both E. Greenland and N. Norway, but which have not hitherto been met with alive on the shelf of N. and E. Iceland, e. g. *Portlandia lenticula*, *P. frigida*, *Arca pectunculoides grandis*, *Propeamussium imbriferum*, and *Cuspidaria glacialis*. Nevertheless, the figures given above agree fairly well with what might be expected, considering the geographical situation of East Greenland.

Summing up the species which are common to the shelf faunas of all the five regions concerned, a number of 29 species is reached. These represent about 55 per cent. of all the lamellibranch species known from the East Greenland shelf. As to its zoogeographical composition, this group consists predominantly of species with a panarctic and a panarctic-boreal distribution. Thus, this group forms the stock of lamellibranchs common to all Arctic coasts of the North Atlantic sector. This group of species, however, is of gradually decreasing importance to the specific composition towards low- and subarctic areas (cf. the table, p. 203).

The relations between the lamellibranch faunas of Arctic N.E. America, W. Greenland, E. Greenland, Spitzbergen, N. and E. Iceland, and Norway N. of Lofoten, are graphically illustrated by fig. 27, p. 192, which is based upon table II, pp. 194—201.

As to the fauna of Arctic N.E. America (graph A), the percentage of lamellibranch species occurring at West Greenland also is the largest. This is what might have been expected *a priori* according to the geographical situation of W. Greenland. One might have presumed a still larger percentage of species living at both Arctic N.E. America and W. Greenland. The comparison, however, seems to be affected by a much less intensive examination of the marine fauna of the former region. The fact that several lamellibranch species are known to live

Table I. Synopsis of the distribution of the lamellibranchs occurring along East Greenland, and at depths less than 400 m around Jan Mayen. Species which are only known from Jan Mayen, are placed in brackets.

+ = living specimens; O = empty shells; ( ) = from depths exceeding 400 m only.

Species	Jan Mayen	Parry Islands to Labrador	West Greenland	Spitzbergen	N. and E. Iceland	Norway N. of Lofoten	Further distribution
Nucula tenuis s. l.	..	+	+	+	+	+	Medit.?, Florida, California, Japan.
Leda pernula s. l.	+	+	+	+	+	+	Channel, Cape Cod, Bering Sea.
— *minuta*	+	+	+	+	+	+	Bretagne, Maine, California, Japan.
Yoldia hyperborea s. l.	..	+	+	+	+	+	S. Iceland, Lofoten, Alaska, Nova Scotia?
— *thraciaeformis*	..	..	+	..	..	..	New England, Bering Strait, Oregon.
Portlandia arctica	..	+	+	+	..	..	White Sea, Norton Sound, Hudson Bay.
— *intermedia*	+	(+)	+	+	+	+	Bohuslän, Shetlands, Norton Sound.
— *lucida*	..	..	+	+	+	+	Medit., Brit. Isles, Novaya Zemlya.
— *lenticula*	+	..	+	+	..	+	S. of Lofoten, Faroes, Siberian Ice Sea.
— *subaequilatera*	+	..	(+)	+	(+)	(+)	Azores?, off N. America,, Kara Sea.
— *frigida*	+	..	+	+	(O)	+?	Kara Sea, Gulf of St. Lawrence?
— *fraterna*	..	..	+	+	+	+	Novaya Zemlya, "the Minch", off Georgia.
Arca pectunculoides grandis (with *septentrionalis*)	+	(+)	+	+	(+)	+	N. of the Shetlands, Gulf of St. Lawrence, Nova Scotia.
— *frielei*	(+)	..	..	(+)	(+)	(+)	Faroe Channel, off Norway.
— *glacialis*	+	+	+	+	+	+	Siberian Ice Sea, the Shetlands, Union Strait, Gulf of St. Lawrence.
Dacrydium vitreum	+	+	+	+	+	+	Faroes, Nova Scotia, Gulf of St. Lawrence.
Crenella decussata	..	+	+	+	+	+	Novaya Zemlya, Medit?, Cape Hatteras, California, Korea.
Modiolaria discors laevigata	+	+	+	+	+	+	New York, Puget Sound, Japan.
— *nigra*	..	+	+	+	+	+	Holland, Cape Hatteras, Oregon, Japan.
Mytilus edulis	+	+	+	..	+	+	Novaya Zemlya, Baltic, Medit., Japan, N. Carolina, California.
Pecten islandicus	+	+	+	+	+	+	Faroes, Cape Cod, Bering Sea, Puge Sound, Japan.
Propeamussium imbriferum	+	..	(+)	+	(+)	+	Kara Sea, N. of the Faroes.
— *groenlandicum*	+	+	+	+	+	+	Siberian Ice Sea, Gulf of St. Lawrence, off Newfoundland.
Lima hyperborea	(+)	..	+	+	..	?	Kara Sea, N. of the Faroes.
— *subauriculata*	..	+	+	..	+	+	Mediterranean, Florida, Bering Sea, California.
Astarte borealis	+	+	+	+	+	+	Kattegat, Baltic, New England, Alaska, Japan, Siberian Ice Sea.
— *montagui*	+	+	+	+	+	+	Bay of Biscay, W. Baltic, New England, Aleutians, Siberian Ice Sea.

(*continued*)

Table I (cont.).

Species	Jan Mayen	Parry Islands to Labrador	West Greenland	Spitzbergen	N. and E. Iceland	Norway N. of Lofoten	Further distribution
Astarte elliptica	..	+	+	+	+	+	France, W. Baltic, Kara Sea, New England.
— *crenata* s. l.	+	+	+	+	+	+	Hebrides, Maine, Siberian Ice Sea, Alaska.
— *sulcata*	..	..	+	..	..	+	N.W. Africa, Mediterranean, W. Iceland, Murman Coast.
[*Turtonia minuta*]	O	..	+	+	+	+	Mediterranean, White Sea, New England, Bering Strait, California.
Thyasira gouldi	O	+	+	+	+	+	Siberian Ice Sea, Alaska, Korea, Brit. Columbia, New England, the Faroes.
— *equalis*	+	..	+	+	+	+	Kara Sea, off W. Norway, N.E. of the Faroes, Nova Scotia, Chesapeake Bay.
[— *croulinensis*]	O	+	+	+	..	+	Azores, Mediterranean, Murman Coast, New England, off Bermuda.
Axinopsis orbiculata	+	+	+	+	+	+	Hebrides, N. of Cape Cod, Siberian Ice Sea.
Serripes groenlandicus	+	+	+	+	+	+	W. Iceland, Cape Cod, Puget Sound, N. Japan.
Cardium ciliatum	..	+	+	+	+	+	S. Iceland, Cape Cod, Puget Sound, N. Japan.
— *elegantulum*	..	+	+	..	+	+	Murman Coast.
Gomphina fluctuosa	..	+	+	+	+	..	Siberian Ice Sea, Sea of Okhotsk, Alaska, Nova Scotia, Maine.
Macoma calcaria	..	+	+	+	+	+	W. Baltic, Faroes, New York, N. Japan, California.
— *moësta*	..	+	+	+	..	..	Novaya Zemlya, Siberian Ice Sea, Alaska.
— *loveni*	..	+	+	+	..	..	Kara Sea, Gulf of St. Lawrence.
— *torelli*	..	+	+	+	..	..	Kara Sea.
Hiatella arctica	+	+	+	+	+	+	Mediterranean, Bering Sea, W. Indies?, Panama?
Cyrtodaria kurriana	+	+	+	+	..	..	Novaya Zemlya, Siberian Ice Sea, Alaska.
Mya truncata	+	+	+	+	+	+	N.W. France, Baltic, New England, Puget Sound, N. Japan.
Lyonsia arenosa	O	+	+	+	+	+	Kara Sea, New England, Alaska, Sea of Okhotsk.
Pandora glacialis	..	+	..	+	..	..	Murman Coast, Gulf of St. Lawrence, Alaska, Brit. Columbia?
Thracia septentrionalis	+	+	+	+	+	..	New England.
— *myopsis*	+	+	+	+	+	+	Faroes, Novaya Zemlya, New England.
— *devexa*	..	..	..	+	..	O	Novaya Zemlya.
Lyonsiella abyssicola	(O)	..	+	(+)	(+)	+	Bay of Biscay, Faroes, Barents Sea, New England.

(*continued*)

Table I (cont.).

Species	Jan Mayen	Parry Islands to Labrador	West Greenland	Spitzbergen	N. and E. Iceland	Norway N. of Lofoten	Furter distribution
Poromya granulata	..	..	(+)	..	+	+	Mediterranean, Madeira, Gulf of Maine, W. Indies.
Cuspidaria obesa	..	..	(+)	..	..	+	Mediterranean, Azores, Gulf of St. Lawrence, W. Indies.
— *subtorta*	+	..	?	+	+	+	Kara Sea, between the Hebrides and the Faroes, off Nova Scotia?
— *glacialis*	(+)	(+)	+	+	(+)	+	Kara Sea, New England, Florida?
— *arctica*	+	..	+?	+	+	+	Kara Sea, off N. Norway, New England.

both at W. Greenland and along the coasts of N.E. America S. of Labrador, but are so far not recorded from Parry Islands to Labrador, supports this suggestion. On the other hand, the element of purely American species known from W. Greenland is, indeed, rather inconsiderable, as only three such species, viz. *Yoldia thraciaeformis*, *Modiolaria faba*, and *Montacuta planulata*, occur in the latter region. This relative paucity of American species within the lamellibranch fauna of W. Greenland must primarily be due to the south-moving cold Labrador Current, which acts as a barrier to most of the American species with a pelagic larval development which might be assumed to find suitable conditions at S.W. Greenland. The percentages of Arctic N.E. American species known from E. Greenland, Spitzbergen, and Norway N. of Lofoten, are somewhat smaller and are mutually almost equal. As regards the latter region the lack of purely American species as well as of most of the high-arctic species is copiously compensated for mainly by some predominantly boreal species which, being quite or at least in part absent from the intermediate regions, live both at Labrador and Norway N. of Lofoten, e. g. *Modiolus modiolus*, *Mytilus edulis*, *Anomia squamula*, *Macoma balthica*, *Panopea norvegica*, *Mya arenaria*, and *Zirphaea crispata*. Finally, the smaller percentage of species occurring also at N. and E. Iceland mainly results from the absence of some of the species just mentioned as well as from the apparent lack of some high- and panarctic species from the latter region.

The percentages of West Greenland species (graph B) occurring also at E. Greenland, Spitzbergen, and Norway N. of Lofoten, respectively, are large and mutually fairly equal, viz. 74—79 %. As to the latter region, the absence of the few purely American species known from W. Greenland as well as of several high-arctic species is chiefly com-

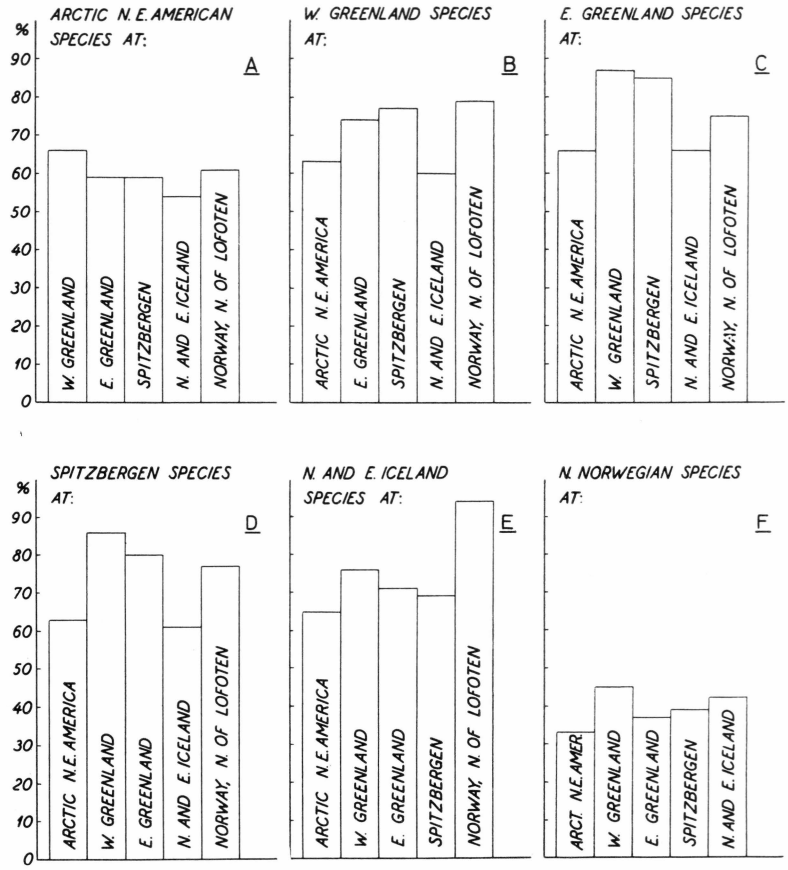

Fig. 27. Graphs showing the percentage of lamellibranch species known from the shelf region of Arctic N.E.America (graph A), W. Greenland (graph B), E. Greenland (graph C), Spitzbergen (graph D), N. and E. Iceland (graph E), and N. Norway (graph F) which occur also in each of the other regions mentioned. — Cf. the comments in the text.

pensated for by a group of widely distributed, primarily alittoral species, which, following the major branch of the Gulf Stream, have been able to invade the Norwegian shelf N. of Lofoten and also to reach the shelf of S.W. Greenland, where relatively warm Atlantic water exerts a distinct influence. The percentages of West Greenland species occurring also at Arctic N.E. America and N. and E. Iceland, respectively, are markedly smaller, though mutually almost equal. The reasons of this, however, are different. N. and E. Iceland, it is true, harbour several species of a predominantly boreal or of a wide distribution outside truly arctic seas. Most of these, however, are associated with the relatively warm upper water layers and have a pelagic larval development, and do not occur at W. Greenland. Naturally the south-going East Green-

land Polar Current is the most important factor in rendering a westward distribution of these species difficult. On the other hand, at N. and E. Iceland there are comparatively few alittoral species with a wide distribution except in truly arctic seas. An explanation of this is offered by the fact that the shelf of N. and E. Iceland faces the icy cold depths of the Norwegian Sea and, furthermore, is interrupted by deep submarine fjords, whereas the deeper parts of the S.W. Greenland shelf are in a much more open connection with the N. Atlantic. Since, also, some panarctic as well as predominantly high-arctic species are unknown from the shelf of N. and E. Iceland (see, however, the remarks on p. 188), but known from W. Greenland, a relatively small percentage of W. Greenland species occurring at N. and E. Iceland, results. The surprisingly small percentage of W. Greenland species occurring at Arctic N.E. America is probably mainly due to the less intensive exploration of the latter region (see the remarks on graph A). Only very few predominantly East Atlantic species seem to extend their north-western limit of distribution to S.W. Greenland, e. g. *Astarte sulcata*, and *Psammobia ferroensis*[1]).

Graph C shows the very large percentage of East Greenland species occurring at W. Greenland, viz. 87 %, and an almost equal percentage of such species known from Spitzbergen, viz. 85 %. The percentage of species also occurring along the Norwegian coast N. of Lofoten, is still fairly large, viz. 75 %, but nevertheless markedly smaller, chiefly due to the absence of several predominantly high-arctic species from the shelf of N. Norway. The same seems to apply to the shelf of N. and E. Iceland. Here also, however, some panarctic species have not hitherto been found. Hence the still smaller percentage of species occurring also at N. and E. Iceland, viz. 66 %, which is quite equal to that of E. Greenland species known from Arctic N.E. America. However, the estimate of the latter seems to be far less reliable (cf. remarks on graph A).

Graph D, illustrating the percentage of Spitzbergen species known from the other regions concerned, is strikingly similar to that for the E. Greenland species (graph C). This is not accidental, but in reality an expression of the very close similarities of the lamellibranch faunas of these two regions, both as regards the total number of species and the specific composition. Also graph B resembles graphs C and D in a great degree, the most obvious difference being a markedly smaller percentage of W. Greenland species occurring at E. Greenland. Within all the three regions the variation of the hydrographical conditions is essentially similar, viz. ranging from typically high-arctic conditions along the northernmost coast of W. Greenland, N.E. Greenland, and N. and E.

[1]) This species is perhaps a new-comer, having only recently been observed at S.W. Greenland (recorded by Horsted & Smidt, 1956).

of Spitzbergen, to those distinctly influenced by relatively warm water of Atlantic origin at S.W. Greenland, S.E. Greenland, and W. and S. of Spitzbergen. Of course, this mutual resemblance is also evident from the large number of species common to the shelves of the three regions, viz. in all 43 species. However, there remain also some dissimilarities, especially due to a smaller proportion of high-arctic species within the shelf fauna of W. Greenland, which, on the other hand, comprises a both relatively and absolutely larger component of predominantly southern lamellibranch species. This is in good agreement with the fact that at S.W. Greenland the influence of the Atlantic water is more pronounced than in the other two regions.

Table II. Synopsis of the marine lamellibranchs of N.E. America, Greenland, Jan Mayen, Spitzbergen, Iceland, Norway, and the Faroes, including the deep-water species occurring near Greenland, Jan Mayen, Spitzbergen, and Iceland.

+ = living specimens; o = empty shells; ( ) = from depths exceeding 400 m only.

Species	Newfoundland to Cape Cod	Parry Islands to and including Labrador	West Greenland	East Greenland	Jan Mayen	Spitzbergen	N. and E. Iceland	S., W. and NW. Iceland	Norway N. of Lofoten	Norway S. of and including Lofoten	The Faroes
Nucula tenuis (MONTAGU) s. l.	+	+	+	+	..	+	+	+	+	+	+
— *nucleus* L.	..	..	..	..	..	..	..	..	..	+	+
— *turgida* LECKENBY & MARSHALL	..	..	..	..	..	..	..	..	..	o	..
— *sulcata* BRONN	..	..	..	..	..	..	..	..	..	+	..
— *proxima* SAY	+	..	..	..	..	..	..	..	..	..	..
— *delphinodonta* MIGHELS & ADAMS	+	+	+	..	..	+	..	..	+	+	(+)
— *tumidula* MALM	..	..	..	..	..	..	..	+	+	+	..
— *cancellata* JEFFREYS	(+)	..	(+)	..	..	..	..	..	..	..	..
— *groenlandica* POSSELT	..	..	+	..	..	..	..	..	..	..	..
Neilonella subovata VERRILL & BUSH	+	..	..	..	..	..	..	(+)	..	..	..
Maletia obtusa (M. SARS)	(+)	..	..	..	..	..	..	..	..	+	..
— *excisa* (PHILIPPI)	..	..	(+)	..	..	..	..	..	..	..	..
— *cuneata* JEFFREYS	..	..	(+)	..	..	?	..	..	..	(+)	..
Microyoldia regularis (VERRILL)	+	..	..	..	..	..	..	..	..	..	..
Pristigloma nitens (JEFFREYS)	..	..	(+)	..	..	..	..	..	..	..	..
Ledella messanensis (SEGUENZA)	(+)	..	(+)	..	..	..	..	..	..	(+)	..
Leda pernula (O. F. MÜLLER) s. l.	+	+	+	+	+	+	+	+	+	+	+
— *minuta* (O. F. MÜLLER)	+	+	+	+	+	+	+	+	+	+	+
— *tenuisulcata* (COUTHOUY)	+	..	..	..	..	..	..	..	..	..	..
— *jacksoni* (GOULD)	+	+	..	..	..	..	..	..	..	..	..
Yoldia limatula (SAY)	+	..	..	..	..	..	..	..	..	..	..
— *sapotilla* (GOULD)	+	+	..	..	..	..	..	..	..	..	..
— *hyperborea* (LOVÉN) TORELL s. l.	?	+	+	+	..	+	+	+	+	+	..
— *myalis* (COUTHOUY)	+	+	..	..	..	..	..	..	..	..	..

(continued)

Table II (cont.).

Species	Newfoundland to Cape Cod	Parry Islands to and including Labrador	West Greenland	East Greenland	Jan Mayen	Spitzbergen	N. and E. Iceland	S., W. and NW. Iceland	Norway N. of Lofoten	Norway S. of and including Lofoten	The Faroes
Yoldia thraciaeformis (STORER)	+	..	+	+	..	..	..	..	..	..	..
Portlandia arctica (GRAY)	..	+	+	+	..	+	..	..	..	..	..
— *intermedia* (M. SARS)	..	(+)	+	+	+	+	+	..	+	..	..
— *kolthoffi* HÄGG	..	..	..	..	(+)	..	..	..	..	..	..
— *lucida* (LOVÉN)	+	..	+	(+)	..	+	+	+	+	+	..
— *iris* (VERRILL & BUSH)	+	..	..	..	..	..	..	+	..	..	..
— *lenticula* (MØLLER)	O	..	+	+	+	+	..	..	+	+	+
— *subaequilatera* (JEFFREYS)	(+)	..	(+)	+	+	+	(+)	..	(+)	(+)	(+)
— *jeffreysi* (HIDALGO)	..	..	(+)	..	..	..	..	..	..	..	..
— *tenuis* (PHILIPPI)	..	..	..	..	..	..	..	..	+	+	+
— *expansa* (JEFFREYS)	(+)	..	(+)	..	..	(+)	..	..	+	..	..
— *frigida* (TORELL)	+?	..	+	+	+	+	(O)	..	+?	..	..
— *fraterna* (VERRILL & BUSH)	+	..	+	+	..	+	+	..	+	+	(+)
— *inconspicua* (VERRILL & BUSH)	(+)	..	(O)?	..	..	..	..	O?	+?	+?	(+)?
— *pusio* (PHILIPPI)	..	..	(+)	..	..	..	..	..	..	..	..
— *pustulosa* (JEFFREYS)	..	..	(+)	..	..	..	..	..	+	(+)	..
— *subangulata* (VERRILL & BUSH)	+	..	..	..	..	..	..	..	..	..	..
Solemya borealis TOTTEN	+	..	..	..	..	..	..	..	..	..	..
— *velum* SAY	+	..	..	..	..	..	..	..	..	..	..
Arca p. pectunculoides SCACCHI	+	?	+	..	..	..	+	+	+	+	(+)
— *pectunculoides grandis* LECHE with *septentrionalis* G. O. SARS	+	(+)	+	+	+	+	(+)	..	+	..	(+)
— *frielei* (JEFFREYS) FRIELE	..	..	..	+	(+)	(+)	(+)	..	(+)	(+)	(+)
— *glacialis* GRAY	+	+	+	+	+	+	+	O	+	..	(+)
— *nodulosa* O. F. MÜLLER	..	..	..	..	..	..	..	+	..	+	+
— *tetragona* POLI	..	..	..	..	..	..	..	..	..	+	+
— *obliqua* PHILIPPI	..	..	..	..	..	..	..	..	..	+	..
Glycymeris glycymeris (L.)	..	..	..	..	..	..	..	..	..	+	+
Limopsis minuta PHILIPPI	+	..	..	..	..	+	..	(+)	+	+	+
— *aurita* (BROCCHI)	..	..	(+)	..	..	..	..	..	..	..	..
Idasola argentea (JEFFREYS)	..	..	..	..	..	..	..	(+)	..	..	..
Dacrydium vitreum (MØLLER)	+	+	+	+	+	+	+	..	+	?	(+)
— spec. a	..	..	..	..	(+)	..	..	..	..	(+)	..
— spec. b	..	..	..	..	..	..	..	(+)	..	..	..
— spec. c	..	..	..	..	..	..	..	+	..	+	(+)
Brachyodontes demissus (DILLWYN)	+	..	..	..	..	..	..	..	..	..	..
Crenella decussata (MONTAGU)	+	+	+	+	..	+	+	+	+	+	+
— *pectinula* (GOULD)	+	..	..	..	..	..	..	..	..	..	..
— *glandula* (TOTTEN)	+	..	..	..	..	..	..	..	..	..	..
Modiolaria faba (O. F. MÜLLER)	+	+	+	..	..	..	..	..	..	..	..
— *discors discors* (L.)	..	..	..	..	..	..	..	..	..	+	..
— — *laevigata* (GRAY)	+	+	+	+	+	+	+	+	+	..	..

(*continued*)

Table II (cont.).

Species	Newfoundland to Cape Cod	Parry Islands to and including Labrador	West Greenland	East Greenland	Jan Mayen	Spitzbergen	N. and E. Iceland	S., W. and NW. Iceland	Norway N. of Lofoten	Norway S. of and including Lofoten	The Faroes
Modiolaria nigra (GRAY)	+	+	+	+	..	+	+	+	+	+	+
— *corrugata* (STIMPSON)	+	+	+	..	..	+	..	..	+	..	..
— *marmorata* (FORBES)	..	..	..	..	..	..	..	..	+	+	..
Modiolus modiolus (L.)	+	+	..	..	..	..	+	+	+	+	+
— *phaseolinus* (PHILIPPI)	..	..	..	..	..	..	..	+	+	+	+
Mytilus edulis L.	+	+	+	+	+	..	+	+	+	+	+
Adula simpson MARSHALL	..	..	..	..	..	..	..	..	..	O	..
Propeamussium lucidum (JEFFREYS)	..	..	..	..	..	..	..	(+)	..	..	..
— *frigidum* (JENSEN)	..	..	..	(+)	(+)	(+)	(+)	..	(+)	..	(+)
— *undatum* (VERRILL & SMITH)	..	..	..	..	..	..	..	(O)	..	..	..
— *testae* (BIVONA)	..	..	..	..	..	..	..	+	..	+	+
— *simile* (LASKEY)	..	..	..	..	..	..	..	+	+	+	+
— *vitreum* (CHEMNITZ)	+	..	+	..	..	+	..	+	+	+	(+)
— *imbriferum* (LOVÉN)	..	..	(+)	+	+	+	(+)	..	+	..	(+)
— spec. a.	..	..	..	..	..	..	..	+	..	+	+
— *pustulosum* (VERRILL)	+	..	..	..	..	..	..	..	..	..	..
— *subimbriferum* (VERRILL & BUSH)	+	..	..	..	..	..	..	..	..	..	..
— *groenlandicum* (SOWERBY)	+	+	+	+	+	+	+	..	+	..	(+)
— spec. b.	..	..	..	..	..	..	..	(+)	..	?	(+)
Pecten maximus (L.)	..	..	..	..	..	..	..	..	O	+	O
— *islandicus* O. F. MÜLLER	+	+	+	+	+	+	+	+	+	+	+
— *opercularis* (L.)	..	..	..	..	..	..	..	..	+	+	+
— *varius* L.	..	..	..	..	..	..	..	..	..	+	..
— *tenuicostatus* MIGHEL & ADAMS	+	+	..	..	..	..	..	..	..	..	..
— *aratus* GMELIN	..	..	..	..	..	..	..	+	..	+	(+)
— *septemradiatus* O. F. MÜLLER	..	..	..	..	..	..	O	+	+	+	+
— *tigrinus* O. F. MÜLLER	..	..	..	..	..	..	..	+	+	+	+
— *striatus* O. F. MÜLLER	..	..	..	..	..	..	O	+	+	+	+
— *irradians* LAMARCK	+	..	..	..	..	..	..	..	..	..	..
— *pusio* (L.)	..	..	..	..	..	..	..	+	+	+	+
Lima hians GMELIN	..	..	..	..	..	..	..	..	..	+	..
— *loscombi* SOWERBY	..	..	..	..	..	..	..	..	..	+	O
— *excavata* (FABRICIUS)	..	..	..	..	..	..	..	+	O	+	..
— *gwyni* SYKES [*L. elliptica* JEFFREYS]	..	..	..	..	..	..	..	O	..	+	O
— *hyperborea* JENSEN	..	..	+	+	(+)	+	..	..	?	..	(+)
— *subauriculata* MONTAGU	+	+	+	+	..	..	+	O	+	+	+
— *similis* JENSEN	..	..	..	..	..	..	..	+	..	..	(+)
— *ingolfiana* JENSEN	..	..	..	..	..	..	..	(+)	..	..	..
— *jeffreysi* FISCHER	..	..	..	..	..	..	..	(O)	..	..	..
— *gibba* JEFFREYS	..	..	(O)	..	..	..	..	..	..	..	..
— *sarsi* LOVÉN	..	..	..	..	..	..	..	O	+	+	O
— *subovata* JEFFREYS	(+)	..	(+)	..	..	..	..	(+)	..	..	(+)

(*continued*)

Table II (cont.).

Species	Newfoundland to Cape Cod	Parry Islands to and including Labrador	West Greenland	East Greenland	Jan Mayen	Spitzbergen	N. and E. Iceland	S., W. and NW. Iceland	Norway N. of Lofoten	Norway S. of and including Lofoten	The Faroes
Anomia patelliformis L.	..	..	..	..	..	..	..	+	+	+	+
— *squamula* L.	+	+	..	..	..	..	+	+	+	+	+
— *simplex* D'ORBIGNY	+	..	..	..	..	..	..	..	..	..	..
Crassostrea virginica (GMELIN)	+	..	..	..	..	..	..	..	..	..	..
Ostrea edulis L.	..	..	..	..	..	..	..	..	..	+	..
Astarte borealis (CHEMNITZ)	+	+	+	+	+	+	+	+	+	+	?
— *montagui* (DILLWYN)	+	+	+	+	+	+	+	+	+	+	+
— *elliptica* (BROWN)	+	+	+	+	..	+	+	+	+	+	+
— *castanea* (SAY)	+	..	..	..	..	..	..	..	..	..	..
— *quadrans* GOUDL	+	..	..	..	..	..	..	..	..	..	..
?— *undata* GOULD	+	+	?	..	..	..	..	..	..	..	..
— *sulcata* (DA COSTA)	..	..	+	+	..	..	..	+	+	+	+
— *crenata* (GRAY) s. l.	+	+	+	+	+	+	+	+	+	+	(+)
Venericardia borealis (CONRAD)	+	+	..	..	..	..	..	..	..	..	..
Kelliella miliaris (PHILIPPI)	..	..	..	..	..	..	..	..	+	+	..
Isocardia humana L.	..	..	..	..	..	..	..	+	..	+	..
Cyprina islandica (L.)	+	..	..	..	..	..	+	+	+	+	+
Turtonia minuta (FABRICIUS)	+	..	+	..	O	+	+	+	+	+	+
Diplodonta torelli JEFFREYS	..	..	..	..	..	+	..	..	..	..	..
Thyasira flexuosa (MONTAGU)	..	..	..	..	..	..	..	?	?	+	+
— *gouldi* (PHILIPPI)	+	+	+	+	O	+	+	+	+	?	+
?— *plana* (VERRILL & BUSH)	+	..	..	..	..	..	..	..	..	..	..
?— *inequalis* (VERRILL & BUSH)	+	..	..	..	..	..	..	..	..	..	..
— *sarsi* (PHILIPPI)	?	..	?	..	..	..	..	+	?	+	..
?— *insignis* (VERRILL & BUSH)	+	..	..	..	..	..	..	..	..	..	..
— *trisinuata* (D'ORBIGNY) [*T. obesa* (VERRILL)]	+	+	..	..	..	..	..	..	..	..	..
— *equalis* (VERRILL & BUSH)	+	..	+	+	+	+	+	O	+	(+)	(+)
— spec. a.	..	..	+	..	..	..	..	..	+	+	..
— *granulosa* (MONTEROSATO)	..	..	..	..	..	..	..	..	..	+	..
— *croulinensis* (JEFFREYS)	+	+	+	..	O	+	..	+	+	+	+
Axinulus ferruginosus (FORBES)	+	..	+	..	..	+	..	+	+	+	..
— *cycladius* (S. WOOD)	..	..	(+)	..	..	..	..	..	..	..	..
— *eumyarius* (M. SARS)	..	..	(+)	..	..	..	..	+	..	+	..
— *pygmaeus* VERRILL & BUSH	+	..	..	..	..	..	..	+	..	..	..
— *subovatus* (JEFFREYS)	..	..	..	..	..	..	..	+	..	..	..
Leptaxinus incrassatus (JEFFREYS)	..	..	(+)	..	..	..	..	..	..	..	..
Axinopsis orbiculata G. O. SARS	+	+	+	+	+	+	+	+	+	+	..
Phacoides filosus (STIMPSON)	+	..	..	..	..	..	..	..	..	..	..
Lucina borealis (L.)	..	..	..	..	..	..	..	..	+	+	+
— *spinifera* (MONTAGU)	..	..	..	..	..	..	..	..	..	+	..
Kellya [*Lasaea*] *rubra* (MONTAGU)	..	..	..	..	..	..	+ ?	..	..	+	O

(*continued*)

Table II (cont.).

Species	Newfoundland to Cape Cod	Parry Islands to and including Labrador	West Greenland	East Greenland	Jan Mayen	Spitzbergen	N. and E. Iceland	S., W. and NW. Iceland	Norway N. of Lofoten	Norway S. of and including Lofoten	The Faroes
Tellimya suborbicularis (MONTAGU)	+	..	..	..	..	..	..	+	+	+	..
— *pumila* (S. WOOD)	..	..	..	..	..	..	..	(+)	..	(+)	..
— *symmetros* (JEFFREYS)	..	..	(+)	..	..	(+)	..	..	(+)	(+)	..
Lepton nitidum TURTON	..	..	..	..	..	..	..	..	..	+	+
— *squamosum* (MONTAGU)	..	..	..	..	..	..	..	..	..	+	..
?Asbjörnsenia striata FRIELE	..	..	..	..	..	..	..	..	..	(○)	..
Montacuta substriata (MONTAGU)	..	..	..	..	..	..	..	+	+	+	..
— *ferruginosa* (MONTAGU)	..	..	..	..	..	..	+	+	+	+	○
— *bidentata* (MONTAGU)	..	..	..	..	..	..	+	+	+	+	○
— *maltzani* VERKRÜZEN	..	..	..	..	..	+	+	..	+	..	..
— *planulata* (STIMPSON)	+	..	+	..	..	..	..	..	..	..	..
— *dawsoni* (JEFFREYS)	+	..	+	..	..	+	..	..	..	+	..
— *tumidula* JEFFREYS	..	..	..	..	..	..	..	..	..	+	..
— *ovalis* (G. O. SARS)	..	..	..	..	..	..	..	..	..	+	..
— *elevata* STIMPSON	+	..	..	..	..	..	..	..	..	..	..
— *vöringi* FRIELE	..	..	..	..	..	..	..	..	..	(○)	..
Laevicardium mortoni (CONRAD)	+	..	..	..	..	..	..	..	..	..	..
— *norvegicum* (SPENGLER)	..	..	..	..	..	..	..	..	..	+	..
Serripes groenlandicus (BRUGUIÈRE)	+	+	+	+	+	+	+	+	+	..	+
Cardium echinatum L.	..	..	..	..	..	..	..	+	+	+	+
— *Cardium edule* L.	..	..	..	..	..	..	..	..	+	+	+
— *minimum* (PHILIPPI)	..	..	..	..	..	..	..	+	+	+	+
— *fasciatum* MONTAGU	..	..	..	..	..	..	+	+	+	+	+
— *exiguum* GMELIN	..	..	..	..	..	..	..	..	+	+	..
— *nodosum* TURTON	..	..	..	..	..	..	..	..	+	+	+
— *aculeatum* L.	..	..	..	..	..	..	..	..	..	+	..
— *ciliatum* FABRICIUS	+	+	+	+	..	+	+	+	+	..	○
— *elegantulum* (BECK) MØLLER	..	+	+	+	..	..	+	..	+	..	..
— *pinnatulum* CONRAD	+	+	..	..	..	..	..	..	..	..	..
Gafrarium [*Gouldia*] *minimum* (MONTAGU)	..	..	..	..	..	..	..	..	..	+	..
Pitar morrhuana (LINSLEY)	+	..	..	..	..	..	..	..	..	..	..
Dosinia lincta (PULTENEY)	..	..	..	..	..	..	..	+	+	+	+
— *exoleta* (L.)	..	..	..	..	..	..	..	..	+	+	..
Mercenaria mercenaria (L.)	+	..	..	..	..	..	..	..	..	..	..
Venus ovata PENNANT	..	..	..	..	..	..	..	+	+	+	+
— *casina* L.	..	..	..	..	..	..	..	○	..	+	+
— *gallina* L.	..	..	..	..	..	..	..	..	+	+	+
— *fasciata* (DA COSTA)	..	..	..	..	..	..	..	..	..	+	+
Gomphina fluctuosa (GOULD)	+	+	+	+	..	+	+	..	..	..	..
Gemma gemma (TOTTEN)	+	+	..	..	..	..	..	..	..	..	..
Venerupis decussata (L.)	..	..	..	..	..	..	..	..	..	+	..
— *pullastra* (Montagu)	..	..	..	..	..	..	..	..	+	+	..

(*continued*)

Table II (cont.).

Species	Newfoundland to Cape Cod	Parry Islands to and including Labrador	West Greenland	East Greenland	Jan Mayen	Spitzbergen	N. and E. Iceland	S., W. and NW. Iceland	Norway N. of Lofoten	Norway S. of and including Lofoten	The Faroes
Venerupis edulis (CHEMNITZ)	..	..	..	..	..	..	..	..	..	+	+
— *aurea* (GMELIN)	..	..	..	..	..	..	..	..	..	+	..
Lucinopsis [*Mysia*] *undata* (PENNANT)	..	..	..	..	..	..	..	..	..	+	+
Petricola pholadiformis LAMARCK	+	..	..	..	..	..	..	..	..	..	..
Mesodesma arctata (CONRAD)	+	..	..	..	..	..	..	..	..	..	..
— *deaurata* (TURTON)	+	..	..	..	..	..	..	..	..	..	..
Mulinia lateralis (SAY)	+	..	..	..	..	..	..	..	..	..	..
Spisula solidissima (DILLWYN)	+	+	..	..	..	..	..	..	..	..	..
— *polynyma* (STIMPSON)	+	+	..	..	..	..	..	..	..	..	..
— *solida* (L.) (incl. of *S. elliptica*[1]) BROWN)	..	..	..	..	..	..	+	+	+	+	+
— *subtruncata* (DA COSTA)	..	..	..	..	..	..	..	..	+	+	..
Lutraria lutraria (L.)	..	..	..	..	..	..	..	..	..	+	..
Donax vittatus DA COSTA	..	..	..	..	..	..	..	..	..	+	..
Psammobia ferroensis (CHEMNITZ)	..	..	+	..	..	..	..	O	+	+	+
— *vespertina* (GMELIN)	..	..	..	..	..	..	..	..	..	+	..
— *tellinella* LAMARCK	..	..	..	..	..	..	..	+	+	+	+
— *costulata* TURTON	..	..	..	..	..	..	..	..	..	..	+
Tagelus divisus (SPENGLER)	+	..	..	..	..	..	..	..	..	..	..
Solecurtus antiquatus (PULTENEY)	..	..	..	..	..	..	..	..	..	+	..
— *candidus* (RENIER)	..	..	..	..	..	..	..	..	..	O	O
Cumingia tellinoides (CONRAD)	+	..	..	..	..	..	..	..	..	..	..
Abra [*Syndosmya*] *alba* (WOOD)	..	..	..	..	..	..	..	..	..	+	+
— *tenuis* (MONTAGU)	..	..	..	..	..	..	..	..	..	+	+
— *prismatica* (MONTAGU)	..	..	..	..	..	..	..	+	+	+	+
— *longicallus* (SCACCHI)	..	..	..	..	..	..	..	..	..	+	..
— *nitida* (O. F. MÜLLER)	..	..	..	..	..	..	..	+	+	+	+
Scrobicularia plana (DA COSTA)	..	..	..	..	..	..	..	..	..	+	..
Gastrana fragilis (L.)	..	..	..	..	..	..	..	..	..	?	..
Macoma calcaria (CHEMNITZ)	+	+	+	+	..	+	+	+	+	+	+
— *balthica* (L.)	+	+	+	..	..	..	..	..	+	+	..
— *moësta* (DESHAYES) [*M. krausei* DALL]	..	+	+	+	..	+	..	..	..	..	..
— *loveni* (STEENSTRUP) JENSEN [*M. inflata* DAWSON]	+	+	+	+	..	+	..	..	..	..	..
— *torelli* (STEENSTRUP) JENSEN	..	+	+	+	..	+	..	..	..	..	..
— *tenta* (SAY)	+	..	..	..	..	..	..	..	..	..	..
Tellina tenera SAY	+	..	..	..	..	..	..	..	..	..	..
— *fabula* GRONOVIUS	..	..	..	..	..	..	..	..	+	+	+
— *pusilla* PHILIPPI	..	..	..	..	..	..	..	..	+	+	+
— *tenuis* DA COSTA	..	..	..	..	..	..	..	..	+	+	..
— *crassa* (GMELIN)	..	..	..	..	..	..	..	..	..	+	..

[1]) *S. solida* and *S. elliptica* are probably distinct species. Yet the morphological differences and the actual distribution of them require further investigation.

(*continued*)

Table II (cont.).

Species	Newfoundland to Cape Cod	Parry Islands to and including Labrador	West Greenland	East Greenland	Jan Mayen	Spitzbergen	N. and E. Iceland	S., W. and NW. Iceland	Norway N. of Lofoten	Norway S. of and including Lofoten	The Faroes
Siliqua costata (SAY)	+	..	..	..	..	..	..	..	..	..	..
— *squama* (BLAINVILLE)	+	..	..	..	..	..	..	..	..	..	..
Cultellus [*Phaxas*] *pellucidus* (PENNANT)	..	..	..	..	..	..	..	..	+	+	..
Solen vagina L.	..	..	..	..	..	..	..	..	..	+	..
Ensis ensis (L.)	..	..	..	..	..	..	..	..	+	+	+
— *siliqua* (L.)	..	..	..	..	..	..	..	..	+	+	..
— *directus* (CONRAD)	+	..	..	..	..	..	..	..	..	..	..
Hiatella arctica (L.) (incl. of *H. gallicana* (LAM.), and *H. pholadis* (L.))	+	+	+	+	+	+	+	+	+	+	+
Saxicavella plicata (MONTAGU)	..	..	..	..	..	..	..	○	..	+	..
Panopea norvegica (SPENGLER)	+	+	..	..	..	○	○	+	+	+	..
Cyrtodaria siliqua (SPENGLER)	+	..	..	..	..	..	..	..	..	..	..
— *kurriana* DUNKER	..	+	+	+	+	+	..	..	..	..	..
Corbula [*Aloidis*] *gibba* (OLIVI)	..	..	..	..	..	..	..	..	+	+	..
Mya arenaria L.	+	+	..	..	..	..	..	..	+	+	?
— *truncata* L.	+	+	+	+	+	+	+	+	+	+	+
Barnea truncata (SAY)	+	..	..	..	..	..	..	..	..	..	..
— *candida* (L.)	..	..	..	..	..	..	..	..	..	+	..
Zirphaea crispata (L.)	+	+	..	..	..	..	+	+	+	+	..
Pholas dactylus L.	..	..	..	..	..	..	..	..	..	+	..
Xylophaga dorsalis TURTON	..	..	..	..	..	..	..	+	+	+	..
— *atlantica* RICHARDS	+	..	..	..	..	..	..	..	..	..	..
— *praestans* SMITH	..	..	..	..	..	..	..	..	..	+	..
Teredo dilatata STIMPSON	+	..	..	..	..	..	..	..	..	..	..
— *norvegica* SPENGLER	+	..	..	..	..	..	?	+	+	+	?
— *navalis* L.	+	..	..	..	..	..	..	..	..	+	..
— *novangliae* BARTSCH	+	..	..	..	..	..	..	..	..	..	..
— *megotara* FORBES & HANLEY [*T. nana* TURTON]	+	..	+	..	..	○	+	+	+	+	+
Xylotrya bipinnata (TURTON)	?	..	..	..	..	..	..	..	..	?	+
Lyonsia arenosa (MØLLER)	+	+	+	+	○	+	+	..	+	..	..
— *norvegica* (CHEMNITZ)	..	..	..	..	..	..	○	+	..	+	+
— *hyalina* (CONRAD)	+	..	..	..	..	..	..	..	..	..	..
Pandora glacialis LEACH	+	+	..	+	..	+	..	..	..	..	..
— *gouldiana* DALL	+	..	..	..	..	..	..	..	..	..	..
— *inornata* (VERRILL & BUSH)	+	..	..	..	..	..	..	..	..	..	..
Pholadomya loveni JEFFREYS	..	..	..	..	..	..	..	..	..	+	..
Thracia conradi COUTHOUY	+	+	..	..	..	..	..	..	..	..	..
— *septentrionalis* JEFFREYS	+	+	+	+	+	+	+	..	..	..	..
— *myopsis* (BECK) MØLLER	+	+	+	+	+	+	+	+	+	+	+
— *devexa* G. O. SARS	..	..	..	+	..	+	..	..	○	○	..
— *phaseolina* (LAMARCK) [*T. papyracea* (POLI)]	..	..	..	..	..	..	..	..	○	+	○

(continued)

Table II (cont.).

Species	Newfoundland to Cape Cod	Parry Islands to and including Labrador	West Greenland	East Greenland	Jan Mayen	Spitzbergen	N. and E. Iceland	S., W. and NW. Iceland	Norway N. of Lofoten	Norway S. of and including Lofoten	The Faroes
Thracia villosiuscula (MacGillivray)	..	..	..	..	..	..	..	+	..	+	O
— *rectangularis* Soot-Ryen	..	..	..	..	..	..	..	..	..	+	..
— *convexa* (Wood)	..	..	..	..	..	..	..	..	..	+	+
— *distorta* (Montagu)	..	..	..	..	..	..	..	..	O	+	..
Periploma fragilis (Totten)	+	+	..	..	..	..	..	..	..	..	..
— *abyssorum* (Verrill) Bush	..	+	..	..	..	..	..	..	..	..	..
Cochlodesma leanum (Conrad)	+	..	..	..	..	..	..	..	..	..	..
— *praetenue* (Pulteney)	..	..	..	..	..	..	..	+	..	+	+
Lyonsiella abyssicola M. Sars	..	..	+	+	(O)	(+)	(+)	..	+	+	(+)
— *jeffreysi* Friele	..	..	..	..	(+)	(O)	(+)	..	(O)	..	..
Poromya granulata (Nyst & Westendorp)	+	..	(+)	+	..	..	+	+	+	+	+
Cuspidaria cuspidata (Olivi)	..	..	..	..	..	..	..	..	?	+	..
— *rostrata* (Spengler)	..	..	..	..	..	..	..	+	+	+	O
— *obesa* (Lovén)	+	..	(+)	(+)	..	..	..	+	+	+	+
— *pellucida* (Stimpson)	+	..	..	..	..	..	..	..	..	..	..
— *subtorta* (G. O. Sars)	?	..	?	+	+	+	+	+	+	?	(+)
— *exigua* (Jeffreys)	..	..	..	..	(+)	(+)	..	..	(+)	(+)	..
— *glacialis* (G. O. Sars)	+	(+)	+	+	(+)	+	(+)	..	+	..	..
— *arctica* (M. Sars)	+	..	+	+	+	+	+	..	+	..	..
— *formosa* Verrill & Bush	(O)	..	(+)	..	..	..	..	..	..	..	..
— *lamellosa* (M. Sars)	(+)	..	(+)	..	..	..	..	+	+	+	(+)
— *abbreviata* (Forbes)	..	..	..	..	..	..	..	..	..	+	..
— *costellata* (Deshayes)	..	..	..	..	..	..	..	..	O	..	+
— *striata* (Jeffreys)	..	..	..	..	..	..	..	(+)	..	..	(+)

	Recorded from depths down to 400 m:
130 living and 1 dead spp. along the whole American coast N. of Cape Cod.	123 living and 1 dead spp.
	59 living spp.
69 living spp. round the whole Greenlandic coast	62 living spp.
	53 living spp.
	27 living and 4 dead spp.
	56 living and 2 dead spp.
92 living and 6 dead spp. round the whole Icelandic coast.	49 living and 4 dead spp.
	78 living and 9 dead spp.
175 living and 5 dead spp. along the whole Norwegian coast.	109 living and 6 dead spp.
	154 living and 3 dead spp.
	73 living and 12 dead spp.

As shown in graph E, it seems quite natural that a very large percentage of N. and E. Iceland species also occur at Norway N. of Lofoten, viz. 94 %. These two regions have several predominantly southern species in common, which are, as a rule, absent from the other regions concerned, where 65—76 % of the N. and E. Iceland species occur. On the other hand, graph F shows that the largest percentage of the species of Norway N. of Lofoten does not occur at N. and E. Iceland (42 %), but at W. Greenland (45 %). The reasons of this, however, have already been suggested in the comments on graph B (p. 191). Otherwise, graph F shows a regular decrease in the percentages of N. Norwegian species from N. and E. Iceland to Arctic N.E. America. Yet these are significantly smaller than those of the preceding graphs. The fauna of Norway, N. of Lofoten, comprises a total number of 109 lamellibranch species the majority of which are predominantly southern. Consequently, the panarctic and panarctic-boreal species, apart from the very few high-arctic ones, are of much less importance to the composition of the lamellibranch fauna of N. Norway. The basis for this rich mixed fauna is represented by the great variation of the hydrographical conditions at N. Norway as well as by uninterrupted connections with the boreal coast stretches of W. Norway and the low-arctic areas to the N. and E.

The table on p. 203 based upon table II, pp. 194—201, is a survey of the zoogeographical components within the lamellibranch faunas of Arctic N.E. America, W. Greenland, E. Greenland, Spitzbergen, Iceland, and Norway N. of Lofoten. Furthermore, a special analysis is given for Baffinland and the American coast to the N., S.W. Greenland (Julianehaab to Sukkertoppen), N.W. Greenland (arbitrarily defined as the coast from Umanak to Thule-Etah), N. and E. Iceland, and S., W., and N.W. Iceland. Records from depths exceeding 400 m have not been considered.

The table clearly shows that the arctic element dominates within all the lamellibranch faunas from Arctic N.E. America to N. and E. Iceland, whereas this element totals only 32 and 31 per cent. within the faunas of the Iceland area as a whole and Norway N. of Lofoten, respectively. The latter two regions furthermore differ by a mutually very similar percentage for the southern element, which accounts for as much as 62 and 66 per cent, respectively. Especially the group of boreal-lusitanian species constitutes a considerable part within the lamellibranch faunas of these two regions.

The table further shows that the zoogeographical composition of the East Greenland lamellibranch fauna is very similar to those of Baffinland and adjacent northern areas, N.W. Greenland, and Spitzbergen. For all these regions the percentages of the arctic element are very high, viz. 80—86 %, which include large and almost equal pro-

Region	Arctic N. E. America		W. Greenland			East Greenland total	Spitzbergen total	Iceland			Norway N. of Lofoten, total
	Parry Isl. to and incl. Labrador	N. of and incl. Baffinland	W. Greenland total	Julianehaab to Sukkertoppen	Umanak to Thule-Etah			N. and E. Iceland	S., W., and S. Iceland	Iceland total	
Number of living species known from the region	59	35	62	51	40	53	56	49	78	92	109
	%	%	%	%	%	%	%	%	%	%	%
Arctic element: panarctic	29	43	39	43	47½	43	43	41	13	22	20
Arctic element: high-arctic	10	17	11	2	10	20	20	0	0	0	2
Arctic element: low-arctic	5	3	5	6	5	4	2	4	1	2	2
Arctic element: subarctic	3	3	3	4	5	4	2	2	1	1	1
Arctic element: panarctic-boreal	10	17	11	13½	15	15	13	12	8	7	6
Wide distr. + high-arctic	2	3	2	2	2½	2	2	2	1	1	1
Southern element: Wide, excl. of high-arctic.	7	5½	18	19½	7½	8	10	15	14	13	15
Southern element: low-arctic-boreal	5	5½	5	4	7½	4	5	4	3	2	3
Southern element: boreal	25	0	0	0	0	0	0	8	12	10	6
Southern element: boreal-lusitanian[1]	2	0	3	4	0	0	0	10	42	37	42
Poorly known distribution	2	3	3	2	0	0	3	2	5	5	2
Total percentage	100	100	100	100	100	100	100	100	100	100	100
Total for arctic element	57	83	69	68½	82½	86	80	59	23	32	31
Total for southern element	39	11	26	27½	15	12	15	37	71	62	66

[1]) boreal-temperate for American species.

portions of panarctic species, viz. 43—47½ %, and relatively large and constant percentages of the panarctic-boreal species, viz. 13—17 %. As regards the relative size of the last two components, N. and E. Iceland resemble the typically arctic regions; since, however, the high-arctic component is lacking, the southern element still being important, the lamellibranch fauna of N. and E. Iceland must be described as a subarctic transitional fauna. Also the zoogeographical composition of the lamellibranch fauna of S.W. Greenland reflects less arctic conditions.

In spite of the high degree of similarity exhibited by the lamellibranch faunas of East Greenland and the adjacent regions, there still remain some significant dissimilarities. On comparing E. Greenland with W. Greenland and Spitzbergen, i. e. the two regions which show the

closest relations to E. Greenland, it will be found that the shelves of these two regions have 8 lamellibranch species in common which are so far unknown from E. Greenland, viz. *Nucula delphinodonta*, *Portlandia lucida* (which, however, is known from below 400 m at S.E. Greenland) *Modiolaria corrugata*, *Propeamussium vitreum*, *Turtonia minuta*, *Thyasira croulinensis*, *Axinulus ferruginosus*, and *Montacuta dawsoni*. The majority of these species seem to avoid truly arctic waters and have only been found at those parts of W. Greenland and Spitzbergen where an influence of relatively warm Atlantic water is traceable. Still, one species, *Modiolaria corrugata*, is of a typically panarctic distribution, which, apart from the space between W. Greenland and Spitzbergen, is also continuously circumpolar. This species, however, is absent not only from E. Greenland, but also from Jan Mayen and Iceland, whereas it is fairly common at both W. Greenland and Spitzbergen. It may therefore be supposed to be of American origin, and possibly its distribution started from the Bering Sea region. This agrees with the suggestion put forward by ODHNER (1915, p. 76), that it is a late immigrant into the Icefjord, Spitzbergen, where in recent times it seems to have partly ousted the closely related *M. discors laevigata*. According to MACGINITIE (1955), *M. corrugata* reproduces by means of large yolky eggs, which remain inside the byssal nest of the parent until they develop into young bivalves. Such a mode of reproduction no doubt greatly reduces the possibilities for spreading and may contribute to the fact that *M. corrugata* has not yet been able to invade the coasts of E. Greenland.

W. Greenland furthermore harbours 7 lamellibranch species which are unknown from both E. Greenland and Spitzbergen, viz. *Nucula groenlandica*, *Modiolaria faba*, *Thyasira* spec. a, *Montacuta planulata*, *Psammobia ferroensis*, *Macoma balthica*, and *Teredo megotara*. Also *Arca p. pectunculoides* may be mentioned. This and most of the other species are more or less restricted to the southern coasts of W. Greenland and thus bear evidence of the distinct influence exerted by the Atlantic water on the marine fauna of S.W. Greenland. Among the species just mentioned, however, *Modiolaria faba* might presumably find suitable conditions at E. Greenland, also, as it occurs along the whole West Greenland coast from Thule in the N. (VIBE 1950) to Ivigtut in the S. (JENSEN 1912) and has a panarctic distribution at N.E. America. Thus it would seem that the absence of this species from E. Greenland is a matter of factors of dispersal rather than of factors indispensable for its existence.

It seems quite natural that almost all the lamellibranch species known from the Sydøstkyst area of E. Greenland also occur in one or the other part of W. Greenland. However, on comparing the well-investigated Lindenows Fjord and vicinity with the Julianehaab area,

i. e. those areas which form the southernmost coasts of Greenland and in addition are connected with each other by the about 100 km long Prins Christians Sund, their lamellibranch faunas will be found to show well-marked differences. Thus, Lindenows Fjord harbours 4 high-arctic species, viz. *Macoma moësta*, *M. loveni*, *M. torelli*, and *Thracia devexa*, whereas not a single high-arctic lamellibranch species is known from the Julianehaab area, which moreover has some predominantly southern species, e. g. *Montacuta planulata*, *Macoma balthica*, and *Psammobia ferroensis*, quite unknown from E. Greenland, and thus also from Lindenows Fjord and vicinity. These differences must be due, in the main, to differences between the hydrographical conditions prevailing in S.E. and S.W. Greenland, respectively.

Even along the southernmost coast of E. Greenland the Polar Current water is easily traceable and rather sharply separated from that of the underlying Irminger Current. Broadly speaking, in contrast to this, a gradual mixing of these water masses takes place at S.W. Greenland N. of Kap Farvel, resulting in the formation of the West Greenland Current, which then looses the characteristic features of a polar current. In consequence of the shifting current systems of different water masses, local heating or cooling, and the topography of the sea bottom, a considerable variation within the hydrographical conditions is found at S.W. Greenland, in both space and time. This means that the temperature requirements of predominantly southern species for maturation of their sexual products, spawning, and successful larval development, may very well be fulfilled at one time or the other, whereas relatively high temperatures, say above 3—5°C., even if these occur only occasionally, are likely to be fatal not only to the reproductive, but also to the vegetative stages of the high-arctic species. These, then, are prevented from inhabiting the coast of W. Greenland.

The ecological differences between E. and W. Greenland are further accentuated by three high-arctic species, viz. *Arca frielei*, *Pandora glacialis*, and *Thracia devexa*, which occur on the East Greenland shelf, but are entirely unknown from W. Greenland. (The latter two species are also known from the Spitzbergen shelf). Four other E. Greenland species are unknown from the shelf of W. Greenland, where, however, 3 of them, viz. *Portlandia subaequilatera*, *Propeamussium imbriferum*, and *Poromya granulata*, occur at depths exceeding 400 m, and one, viz. *Cuspidaria subtorta*, is likely to occur there also in deep water. Thus, on the whole, the number of species occurring at E. Greenland but not at W. Greenland, is rather small, and these few species bear evidence of the high-arctic marine climate prevailing along the greater part of the E. Greenland coast. Also Spitzbergen harbours only relatively few lamellibranch species by which its fauna is positively

distinguished from that of W. Greenland, and in this respect resembles E. Greenland.

THORSON (1944) pointed out that most of the high-arctic prosobranchs of E. Greenland seem to be restricted to the Greenland Sea and adjacent coasts, thereby contrasting with the low-arctic prosobranchs. This, however, apparently applies to the high-arctic lamellibranchs in a much less degree. At any rate, out of the 11 high-arctic lamellibranch species known from E. Greenland the following inhabit a circumpolar area of distribution: *Portlandia arctica*, *Macoma moësta*, *Cyrtodaria kurriana*, and probably also *Pandora glacialis*. Further, the distribution of 5 other high-arctic species may roughly be described as covering the arctic regions from N.E. America or Baffin Bay to the Eurasian shelf, whereas only two E. Greenland lamellibranchs seem to inhabit a fairly limited area of distribution, viz. *Arca frielei*, which seems to be restricted to the depths of the Norwegian Sea and the shelf of N.E. Greenland, and *Thracia devexa*, which is known to live only at E. Greenland, Spitzbergen, and Novaya Zemlya, and thus may be called east-arctic. Two of the low- or subarctic lamellibranchs known from E. Greenland have a discontinuous circumpolar distribution, occurring along both the W. and the E. coasts of N. America and moreover at N.W. Europe, viz. *Yoldia hyperborea* and *Pecten islandicus*, while *Yoldia thraciaeformis* occurs at both sides of the N. American continent, but is absent from the Eurasian coasts. On the other hand, *Cardium elegantulum* is restricted to the N. Atlantic, occurring from N.E. America to N.W. Europe. Naturally, almost all of the panarctic and the panarctic-boreal lamellibranch species occur at both sides of the N. Atlantic and more than half of these are also circumpolar.

However, it has not been sufficiently emphasised above that the whole area of distribution of an arctic species may be, and certainly often is, inhabited by several smaller population units, although this need not be apparent from a distribution chart. This, of course, may also be true of boreal species, but an essential difference between an arctic lamellibranch fauna and a boreal one is the predominance of a non-pelagic larval development within the former (cf. p. 243). Thus, distributional barriers, such as great depths and currents of unfavourable qualities, will become effective over comparatively short distances for many arctic lamellibranch species. It must therefore be supposed that generally the separation of the whole area of distribution into more or less isolated smaller areas is more pronounced for arctic than for boreal lamellibranch species. These conditions may explain the remarkable morphological intraspecific variation found in several arctic species, such as *Nucula tenuis*, *Portlandia arctica*, the *Astarte* species, etc. These remarks are considered necessary to avoid misconception of the terms

"continuously" and "discontinuously circumpolar" employed in the present paper; it will now be obvious that these two terms merely designate different degrees of discontinuity.

The preceding analysis and comparisons may be summarised as follows: (1) As to species number the lamellibranch fauna of E. Greenland is one of the poorest in the North Atlantic. (2) It has by far the majority of its species in common with the surrounding arctic and subarctic regions, viz. from 87 per cent. of its species also occurring at W. Greenland to 66 per cent. occurring in Arctic N.E. America, and at N. and E. Iceland. (3) As to zoogeographical composition the East Greenland lamellibranch fauna is very similar to that of Spitzbergen, N.W. Greenland, and Arctic N.E. America N. of and including Baffinland. East Greenland and Spitzbergen have 86 and 80 per cent. of arctic species, and 12 and 15 per cent., respectively, of species absent from or uncommon in high-arctic seas. (4) Although the largest number of East Greenland species occur in West Greenland, also, the latter region is remarkable for a significantly larger proportion of predominantly southern species and the total lamellibranch fauna of W. Greenland is thus less arctic than those of both E. Greenland and Spitzbergen. (5) N. and E. Iceland harbour a still larger proportion of southern species than does W. Greenland; further, at N. Norway, which has the richest fauna of all the regions considered, the number of southern species is more than twice as large as the number of arctic species. (6) The severe high-arctic marine climate which marks the greater part of the East Greenland coast is distinctly reflected by the composition of its lamellibranch fauna.

C. Hydrography, and vertical distribution of the species along the East Greenland coast.

Before discussing the vertical distribution and ecology of the East Greenland lamellibranchs, it seems convenient to summarise our knowledge of the hydrographical conditions governing the marine life at East Greenland.

The water masses along the coast of East Greenland consist of three different layers: "The Fjord water layer" (1) at the surface, below this a layer of "The Polar Current" (2), and below the latter "The Atlantic undercurrent" (3).

1) The Fjord water layer is entirely absent during the greater part of the year, at N.E. Greenland for instance from September—October to about the end of June. It is formed in early summer when the fjord ice breaks up and the thaw sets in, and disappears again in the autumn when the surface water begins to freeze. It is a mixture of Polar

Current water and fresh water from rivers and melting ice. Accordingly, the salinity is reduced, ranging as a rule between 25 and 30 per mille, but it may be much lower in its uppermost part. Its low specific gravity stabilises it as a typical surface layer. On account of insolation during the summer it attains positive temperatures and thus becomes still more different from the underlying Polar Current water. Normally the Fjord water layer reaches its largest extent and the highest temperature by the middle of August. Although its thickness may vary considerably, depending on local conditions as well as on climatic fluctuations from year to year, it is as a rule thickest in the inner parts of the fjords where the most important affluxes of fresh water are found. In such cases the highest surface temperatures will often be met with in the central parts of the fjords. Spreading towards the mouth of the fjords and further towards the outer coast, the surface layer is gradually mixed up with Polar Current water and decreases in thickness. Generally the surface water attains its maximum temperatures of about 5—8° C. in the inner parts of the large fjords, but may even reach 10—12° C. in certain places. However, there is a very marked temperature gradient, the temperature at 5 m depth being only 2—4° C. at the same time. In places near the outer coast the surface water generally reaches 2—5° C. in the middle of August, and the lowest maximum temperatures are as a rule met with at the outer coasts, where the wave action is stronger.

The following information on the thickness of the Fjord water layer in different parts of E. Greenland is available (if not otherwise stated, the data are from August): In 77° N. l. no surface layer was observed at all, and at Danmarks Havn it was only 1—2 m thick (Trolle 1913, pp. 317, 332—333). In the inner and the middle parts of Kejser Franz Josephs Fjord it is about 20 to 25 m, decreasing towards the outer parts to 10—15 m (Spärck 1933, pp. 19—24, 38). Off Gael Hamkes Bugt it is 10 m (middle of July, Amdrup 1902, p. 347); S.E. of Bontekoe Ø 9 m (Spärck l. c., p. 38); Off Geographical Society Ø about 10 m (late July, Ryder 1895, p. 262).—In the inner parts of Scoresby Sund it is 10—15 m thick, decreasing to about 10 m off the mouth of Scoresby Sund (Ussing, in Thorson 1934b, pp. 10—17).—Off the Blosseville Kyst, 69°18′ N. 23°37′ W., it was about 10 m (Ryder l. c., p. 278), and in Uttentals Sund, Kangerdlugssuaq, 10—15 m (Bertelsen 1937a, p. 10). —In the Angmagssalik Fjord it is more than 25 m, and at the mouth of Tasîssaq positive temperatures were found down to 40—50 m (ibid., p. 9). At Kap Tordenskjold it is less than 5 m (late June), in the mouth of Lindenows Fjord it varies from 10 to about 25 m, while at the head of this fjord it is up to 50 m thick (Thomsen 1937, pp. 104—106).

2) The Polar Current follows the whole coast of E. Greenland in a direction from N. to S., and has negative temperatures from 0° to

—1.7° C. all the year round and salinities of about 32 to 34.5 per mille. Along the three northernmost coast areas it is about 220 to 400 m thick, both along the outer coast and in the large fjords, and further forms a 200 km broad belt extending eastward into the Greenland Sea. Moreover, depending on the threshold depths of the fjords, the deeper water layers of the latter may consist of Polar Current water right down to the bottom (cf. the bathymetrical charts in Spärck 1933, and Thorson 1934b). From the Kangerdlugssuaq area to the S. the Polar Current decreases considerably in thickness and extent. Along the Sydøstkyst area it becomes more and more squeezed in between the coast and the waters of the Atlantic undercurrent, so that off Lindenows Fjord it is often only about 50 m thick and 10—20 km broad and may here even be split up into parallel branches[1]).

3) The Atlantic undercurrent runs parallel with and below the Polar Current along the outer coasts of E. Greenland. It is a mixture of Polar Current water and smaller or larger portions of Atlantic water and is characterised by positive temperatures from 0° to about 3° C. (at N.E. Greenland) and salinities of about 34.7 to 35 per mille. It covers the deeper parts of the outer shelf of E. Greenland and through submarine fjords fills up most of the large fjords from the lower limit of the Polar Current water down to the bottom. While the heating effect of the water of Atlantic origin is only slight at N.E. Greenland, the Atlantic undercurrent gains its major importance to the Greenland shelf S. of the Iceland-Greenland ridge, which has a threshold depth of about 565 m. The greater depths off S.E. Greenland thus contrast to the depths off N.E. Greenland, which, below the Atlantic undercurrent, are filled with water of a high salinity and temperatures constantly below zero.[1])

The hydrographical conditions outlined in the preceding pages imply that species of a practically concordant horizontal distribution along East Greenland, may nevertheless live under and be associated with quite different ecological conditions, in accordance with the vertical zone inhabited. This fact has already been emphasised by Lemche (1941, p. 36), for the opisthobranchs, and Thorson (1944, p. 161), for the prosobranchs, and is of equal importance to an understanding of the composition of the East Greenland lamellibranch fauna.

The following division of the lamellibranchs into groups of different vertical distribution and temperature requirements is mainly, though not solely, based upon the material at hand from Kejser Franz Josephs Fjord and Scoresby Sund, the hydrographical conditions of which have been fairly well examined. As to a few species, however, the finds from

[1]) See also the illustrative hydrographical sections through the water masses off the Greenland coast from the Blosseville Kyst to the S. in Iversen 1936, p. 63 ff.

E. Greenland are too scarce and the hydrographical information too scanty to allow of a reliable valuation of their proper range in East Greenland waters.[1]) Moreover, since in marine invertebrates the reproduction phenomena as well as the earliest larval stages are known to be more sensitive to extreme temperatures than are the older larvae and the adult animals (cf. e. g. Pelseneer 1901, Appellöf 1912, Orton 1920, Runnström 1927, and Thorson 1950), the classification gives wider rather than too narrow limits, as, of necessity, it is chiefly based upon the vertical distribution of the vegetative stages.

As to vertical distribution and temperature requirements, the East Greenland lamellibranch fauna may be divided into 5 groups: 1) Species associated with the tidal zone; 2) Species associated with the Fjord water layer (positive summer temperatures); 3) Species associated with the Polar Current water (constantly negative temperatures); 4) Species associated with both the Fjord and the Polar Current waters; and 5) Species associated with the Atlantic undercurrent water (positive temperatures, high salinities, and as a rule considerable depths).

1) Species associated with the tidal zone. The only tidal lamellibranch known from E. Greenland is *Mytilus edulis*, which is restricted to the Sydøstkyst area, with its northern limit of distribution a little N. of Angmagssalik. This limit coincides with the northern limits of some other tidal species (cf. e. g. H. Madsen 1936, Bertelsen 1937 a, and Thorson 1944), and the possible causes of this are discussed at length by H. Madsen, who concludes (l. c., p. 48, and 1940, p. 9) that the decisive factors must be sought in the sublittoral conditions rather than in those of the tidal zone itself. In this connection he also emphasises the importance of the productivity of the sea. The standing crop has been shown by Bertelsen (1937 a) to be considerably larger at Angmagssalik than along the more northerly coasts of E. Greenland. However, Bertelsen (l. c., p. 51) correlates this with the climatic differences, i. e. a greater precipitation at Angmagssalik than in the areas to the north, whereas H. Madsen (1936, p. 49, and 1940, p. 9) assumes that the interaction of the Irminger Current with the Polar Current is the chief cause of improved food conditions. However this may be, the more favourable food conditions in the waters of Angmagssalik is a fact.[2]) As regards the mussel it should also be pointed out that different temperature conditions seem insufficient to explain its absence from N.E.

[1]) Also some of the finds from Jan Mayen are difficult to estimate because of the variation of the hydrographical conditions round this island (see e. g. Iversen 1936, p. 157 f.).

[2]) Probably, more favourable light conditions, i. a. the lack of a dark time as found at N.E. Greenland, are decisive.

Greenland, since adult animals will tolerate freezing to a considerable degree (cf. MADSEN 1940, and especially the results arrived at by KANWISHER 1955), and since the species seems to be able to complete its larval development at about 0°C. (N.W. Greenland, cf. MADSEN 1940, p. 19). Neither the extent of brackish surface water nor the amount of ice formed at the shore can be decisive, although, to be sure, the ice conditions are much less severe at Angmagssalik than at N.E. Greenland. Yet the mussel is able to live sublittorally, e. g. along the S.W. coast of Novaya Zemlya and in the Baltic, but nevertheless it is totally absent from the four northernmost areas of E. Greenland. Thus it would seem —at least as regards the distribution of the species at E. Greenland— that the food conditions are of major importance, as suggested by H. MADSEN. This is furthermore supported by the very slow growth of the mussel at its northern limits of distribution (cf. MADSEN 1940, VIBE 1950, and this paper, p. 62). However, the whole question can hardly be regarded as definitely solved. As to this problem investigations into the duration of the larval life of the mussel near its northern limits as well as detailed knowledge of the currents along the coasts of the Kangerdlugssuak area might be valuable.

It has already been mentioned that the four northernmost areas of E. Greenland are devoid of typical tidal lamellibranchs. In that region no lamellibranchs will, as a rule, be found from the shore down to 3 m depth. This may be readily explained by the action of the ice during the greater part of the year. However, as pointed out by THORSON (1933, pp. 16—17), on account of the greatly reduced salinity of the upper water layers during the break of the frost and the melting of the ice and the snow in the summer, the animal life in the large fjords is also poor just below the ice-foot down to 5—6 m depth (cf. also MADSEN 1936, BERTELSEN 1937a, and THORSON 1944). Naturally, these conditions particularly affect the sessile and the slow-moving species, thus also the majority of the lamellibranchs. It is a characteristic feature that still at 5—10 m depth often only young bivalves have been met with, while permanent populations occurred still farther down.

2) Species associated with the Fjord water layer. To this group belong *Modiolaria discors laevigata*, *M. nigra*, *Astarte borealis*, and *Serripes groenlandicus*. All of these are very common along East Greenland with their maximum occurrence in the Fjord water layer, although they may also live in the upper strata of the Polar Current water. Of the two epifauna species, *Modiolaria discors laevigata* and *M. nigra*, the former, in particular, dominates the belt with growths of *Desmarestia*, *Laminaria*, and *Fucus*, while *Astarte borealis* and *Serripes groenlandicus* are both common infauna species at similar depths. Thus it seems certain that the greater part of the populations of these species experience

positive temperatures during one or two summer months. It is noteworthy, therefore, that out of these 4 species, the two *Modiolaria* species are known to spawn in the summer and with a maximum intensity in August. Probably *Serripes groenlandicus* spawns at the same time, but this has not yet been ascertained (cf. p. 118). On the other hand, *Astarte borealis* contains ripe sexual products throughout the summer, but does not spawn till late in the autumn (cf. THORSON 1936, p. 50). Nevertheless, at least as regards the first mentioned 3 species, an increased summer temperature may be indispensable for successful propagation by conditioning the production of eggs and sperm, the spawning or/and the development of the earliest larval stages. Of the species mentioned, all occur mainly at smaller depths throughout their geographical range, 3 having a panarctic and one, *M. nigra*, a panarctic-boreal main distribution.—Besides, some further species seem to belong to the present group, all of which, however, at E. Greenland are restricted to certain parts of the coast, viz. the low-arctic-boreal *Leda minuta* and *Crenella decussata*, the low-arctic *Cardium elegantulum*, and the subarctic *Pecten islandicus*. The first-mentioned three live along the Sydøstkyst area and preferably at depths where positive summer temperatures may occur. *Pecten islandicus*, which is known from Lindenows Fjord, furthermore inhabits an isolated area in the inner parts of Kejser Franz Josephs Fjord. No doubt the occurrence of this lamellibranch—the only subarctic one so far known from N.E. Greenland—precisely in this place—can be correlated with the relatively high summer temperatures found in this area. Thus, temperatures up to 12°C. were observed at Kap Hedlund, where many young *P. islandicus* were secured and, very characteristically, all from depths between 7 and 30 m. Moreover, the species has pelagic larvae and, accordingly, must be assumed to spawn in the summer at E. Greenland (cf. p. 65). This apparent dependence of its reproduction on positive temperatures agrees in the main with its vertical distribution in Lindenows Fjord.

3) Species associated with the Polar Current water. The species of this group constitute a considerable fraction of the East Greenland lamellibranch fauna. They are: *Portlandia arctica* (sometimes also in Fjord water), *P. lenticula*, *P. frigida*, *P. fraterna*, *Arca frielei*, *Propeamussium imbriferum*, *P. groenlandicum* (sometimes also in Fjord water), *Lima hyperborea*, *Pandora glacialis*, *Thracia devexa*, *Cuspidaria glacialis*, and *C. arctica*. Further the following species, which occasionally occur in Atlantic undercurrent water: *Portlandia intermedia*, *Arca pectunculoides grandis* (with A. p. *septentrionalis*), *A. glacialis*, *Dacrydium vitreum*, *Astarte crenata* with subspecies (of which especially *A. c. subaequilatera* seems to be associated with Atlantic undercurrent water), and *Thyasira equalis*. Zoogeographically, all of these species have either a panarctic (11 species)

or a high-arctic distribution (7 species), and most of them are characteristic by having a large vertical range. So far as is known, none of them reproduces by means of small eggs developing into planktotrophic larvae. The reproduction of *Propeamussium groenlandicum* and *Astarte crenata* at N.E. Greenland seems to take place in the late autumn, and spawning at about the same time is indicated in some more species, e. g. *Dacrydium vitreum*, *Propeamussium imbriferum*, *Thyasira equalis*?, *Pandora glacialis*?, *Thracia devexa*? On the whole, we may suppose that most of the species belonging to this group spawn outside the summer season, at which time actually only two are known to spawn, viz. *Portlandia arctica* and *Arca glacialis*. As to these two, however, we do not know whether or not spawning in deep water also occurs in the summer. At any rate, we may safely conclude that all of the species mentioned spawn at negative temperatures at E. Greenland, and that probably their larval development depends directly on water temperatures about and below zero, whereas the adult animals may show a somewhat wider temperature range. All the species of this group thus contrast in several important respects with the species dealt with under 2).

4) Species associated with both the Fjord and the Polar Current waters. This group, too, comprises a considerable number of the East Greenland species, but it is more heterogeneous than the preceding one. The following panarctic species belong to this group: *Thyasira gouldi*, *Axinopsis orbiculata*, *Cardium ciliatum*, *Gomphina fluctuosa*, *Macoma calcaria* (mainly in Fjord water), *Lyonsia arenosa*, and *Cuspidaria subtorta* (mainly in Polar Current water); and further the panarctic-boreal species *Nucula tenuis*, *Leda pernula* (mainly in Polar Current water), *Astarte montagui*, *A. elliptica*, and *Mya truncata*; the high-arctic *Macoma moësta*, and *M. loveni* (mainly in Polar Current water); the low-arctic *Yoldia hyperborea* (mainly in Fjord water); and the widely distributed *Hiatella arctica*. Four of all these species are known, or must be assumed, to have pelagic, plankton-feeding larvae, spawning taking place in the summer. However, in two of them, viz. *Mya truncata* and *Hiatella arctica*, spawning already commences in the early summer when the temperatures in the upper water layers are still below zero (cf. THORSON 1936). Hence it must be inferred that some other factor(s) than an increase in temperature induce(s) spawning, and this suggests physiological differences between arctic and boreal populations of these two species. On the other hand, both *Cardium ciliatum* and *Macoma calcaria* seem to spawn in N.E. Greenland when the Fjord water is warmest. And, since *C. ciliatum* has a considerable part and *M. calcaria* the greater part of its population within Fjord water depths, spawning can be correlated with, and possibly depends on, an increased temperature. This may also apply to the low-arctic *Yoldia hyperborea*, which produces large

eggs and seems to spawn at S.E. Greenland at the end of July or later.—As to the remaining 11 species of this group, all reproducing by means of large yolky eggs, no direct relation between their spawning seasons, their vertical distribution, and increases in the temperature of the upper water layers is evident. So far known, in N.E. Greenland these species either spawn in August (*Nucula tenuis*, *Gomphina fluctuosa*?), in August-September (*Thyasira gouldi*, *Axinopsis orbiculata*?), or still later (*Leda pernula*?, *Astarte montagui*, *A. elliptica*, *Macoma moësta*, *M. loveni*?, *Lyonsia arenosa*?, and *Cuspidaria subtorta*?). Accordingly it seems that most, if not all, of these last-mentioned species are able to spawn and to develop at negative temperatures. In this connection the panarctic-boreal species are of special interest, as physiological differences seem to exist between their arctic and boreal populations. This is also suggested by the fact that in arctic waters *Nucula tenuis*, *Leda pernula* as well as *Astarte montagui* occur in forms which are distinctly morphologically different from their representatives in boreal waters.

In connexion with this group, some species may be mentioned which do not fit in easily with the present classification. These are the high-arctic *Cyrtodaria kurriana*, and the panarctic *Thracia septentrionalis* and *T. myopsis*. All these species have in common an occurrence which at E. Greenland is largely restricted to places near the outer coast, where they live on sand bottom at depths of about 1—10 m to 20 m. Accordingly they may experience slightly positive temperatures in the summer. However, what seems to be decisive for their vertical distribution at E. Greenland is the type of bottom and possibly the food conditions prevailing along the outer coast. (All three species are suspension feeders).

5) Species associated with the Atlantic undercurrent water. Only a few East Greenland lamellibranchs belong to this group; examples are: *Yoldia thraciaeformis*, *Portlandia lucida*, *Astarte sulcata*, and *Cuspidaria obesa*, all restricted to either the whole Sydøstkyst area or the southernmost part of E. Greenland only. The last-mentioned three have a wide distribution in the N. Atlantic, where they occur predominantly in deep water with temperatures some centigrades above zero, but are absent from truly arctic waters. This is also true of their occurrence at E. Greenland. Similarly, the subarctic *Yoldia thraciaeformis* was met with only in deeper water of slightly positive temperatures in Lindenows Fjord.—On account of their main distribution *Lima subauriculata* and *Poromya granulata* may also be reckoned to this group. At E. Greenland the former has only been found in the southernmost locality investigated, while of the latter only a single animal was obtained from deep water from the outer part of Scoresby Sund.

According to THORSON (1944, pp. 166—168), at E. Greenland the largest number of prosobranch species are found in the upper layers of the Polar Current just below the Fjord water layer. This is also true as regards the lamellibranchs, and the table below was calculated in the same way as was that for the prosobranchs by THORSON. It shows the number of lamellibranch species occurring at different depths for each of the five East Greenland areas. The vertical range for a given species was calculated as follows: When samples of living specimens were taken from e. g. 25 m and 100 m depths, the species was considered to occur at all depths between 20—30 m as the shallowest and 50—100 m as the deepest interval. Further, when it was taken in dredge-hauls from 10—25 m depth as the shallowest and 80—120 m as the deepest zone, it was taken to occur at all depths between 20—30 m as the shallowest and 50—100 m as the deepest interval, but not from the 10—20 m to the 100—200 m interval. Moreover, it seems justifiable to exclude some casual finds derived from markedly greater depths than are normally inhabited by the species in question. This applies to the following species (the depths of the finds to be excluded are added in parantheses): *Modiolaria discors laevigata* (below 100 m), *Modiolaria nigra* (below 100 m), *Astarte montagui* (385 m), *Gomphina fluctuosa* (130 m), *Macoma calcaria* (below 200 m), *Hiatella arctica* (below 100 m), *Mya truncata* (below 50 m), and *Pandora glacialis* (205 m). The wave-lines in the table indicate the approximate limit between Fjord and Polar Current waters in the summer.

Depths m	Nordøstkyst area	Kejser Franz Josephs Fj. area	Scoresby Sund area	Kangerdlugssuaq area	Sydøstkyst area
0— 5	8	9	6	9	7
5— 10	~~ 15 ~~	18	~~ 25 ~~	~~ 12 ~~	19
10— 20	19	~~ 25 ~~	32	12	~~ 21 ~~?
20— 30	15	32	31	10	23
30— 40	12	28	30	11	22
40— 50	11	24	29	9	~~ 25 ~~?
50—100	10	25	28	8	30
100—200	10	20	15	6	16
200—300	14	18	10	..	7
>300	8	12	9	..	8

The table clearly shows that the greatest numbers of lamellibranch species are found at or more often just below the lower limit of the Fjord water. However, before beginning a more detailed discussion, it should be noted that the estimated figures also reflect the intensivity of investigation of the various areas at different depths. Thus, the total number of samples taken in the Nordøstkyst area is comparatively

small, and a large fraction thereof originated from depths exceeding 200 m. Accordingly the table shows a fairly large number from below this depth. Similarly, the rather large number from Kejser Franz Josephs Fjord at depths from below 100 m is in part an expression of the very large number of samples derived from deep water. On the other hand, in the Kangerdlugssuaq area no samples at all were secured from depths exceeding 175 m, and this area as a whole was not as thoroughly examined as were the Kejser Franz Josephs Fjord, Scoresby Sund, and Sydøstkyst areas. Naturally, also the size of the intervals chosen is of some influence on the estimated figures. Despite of this, the table reveals some characteristic features which must be regarded as real. Apart from the Kangerdlugssuaq area, it will be seen that the species number for the 0—5 m interval is comparatively small in all areas, being equal to or even smaller than the number found at depths exceeding 300 m. This is, above all, due to the ice-action and the brackish surface water (cf. p. 211). When also the Sydøstkyst area is left out of consideration, it is seen that in the three northernmost areas the species number increases considerably below 5 m depth and is largest just below the lower limit of the Fjord water layer. Then it decreases gradually again towards deeper water. This may be explained in the following way: As elsewhere the production of phytoplankton is largest in the upper water layers and decreases rapidly towards greater depths (e.g., at Ella Ø the production below 50 m seems to be quite inconsiderable, cf. Thorson 1936, p. 89). At E. Greenland, however, this productive layer must also be assumed to depend on the position of the limit between Fjord and Polar Current water. At the outset, it seems probable that the richest production of phytoplankton takes place in the uppermost layers of the Polar Current water (with its nutrient salts), although no information is available as to this. At the same time, the limit between Fjord and Polar Current water, which by nature is a distinct spring-layer, will be decisive for the depths at which horizontal currents touch the bottom. Consequently, and in conjunction with the assumption just mentioned, the food supply for plankton-feeding bottom-dwellers will be more plentiful just below the lower limit of the Fjord water than at any other depth. These conditions, then, seem sufficient to explain the fact that the largest numbers of plankton-feeding species and specimens (i.a. the majority of the lamellibranchs) occur precisely here. And, naturally, also the carnivores as a whole will find their best food conditions at these depths (i. a. the majority of the prosobranchs). Thus it seems unnecessary to assume, with Thorson (1944, p. 167), that the relative abundance of species just below the lower limit of the Fjord water layer results from a compromise between food requirements and temperature tolerance. If this were so, it would have to be ascertained that the largest

production of phytoplankton actually takes place in the Fjord water, not farther down.

THORSON (1936, pp. 112—14, and 1944, p. 167) also quotes some very interesting observations on *Propeamussium groenlandicum*. This species is very common at N.E. Greenland, where it was found to crowd in large numbers in the uppermost strata of the Polar Current water. THORSON further showed (1936, p. 114, fig. 28) that it has a comparatively high rate of respiration and accordingly must be assumed to require much food. This statement is certainly correct, although the experimental results do not allow of definite conclusions as to the actual rate of metabolism of the species under natural conditions. The species is a suspension-feeder and is especially remarkable on account of its ability to swim. Thus, unlike most other lamellibranch species, it may be much more capable of moving to depths where the food conditions are the most favourable. Hence it becomes understandable why precisely this species in a most striking manner seems to reflect the food conditions at different depths, and this crowding of it need not be the result of a compromise of the nature mentioned above. Of course, it is not claimed that metabolic rates are independent of the temperature. Most likely, a decrease in salinity may be of an even larger effect than an increase in temperature, all within the range of hydrographical variation found at N.E. Greenland. And within the Fjord water layer, these factors will further intensify each other as to their effect on metabolism (cf. KINNE 1956). But, in discussions of the vertical distribution in relation to food conditions at N. E. Greenland, for most lamellibranchs in the vegetative stage, these factors will seem to be of subordinate importance as soon as one goes below the brackish surface water. Actually, even such an active and apparently exacting species as *Propeamussium groenlandicum* sometimes occurs outside the Polar Current water.

As regards the Kangerdlugssuaq area, the table shows fairly small species numbers for all the intervals. This seems to be due in part to less intensive investigations, as has already been supposed, but partly also to the ecological conditions prevailing in this area (cf. p. 172). It is remarkable that the species numbers found just above and just below the lower limit of the Fjord water layer are quite equal. This may indicate less pronounced differences between that layer and the Polar Current water in this area. It also agrees with the hydrographical observations by BERTELSEN (1937a, p. 10) and is further supported by the fact that in the Kangerdlugssuaq area 3 high-arctic lamellibranch species have been found at depths of less than 10 m, viz. *Portlandia arctica*, *Macoma moësta*, and *M. loveni*, while there are only comparatively few species which show some dependence on the presence of a distinct Fjord water layer.

On considering the figures in the table for the Sydøstkyst area, the fairly large variation of the hydrographical conditions along this coast stretch should be kept in mind. Therefore the upper wave-line in the table is drawn to indicate the lower limit of the Fjord water layer at the mouth of Lindenows Fjord, while the lower line is intended to indicate conditions found off Angmagssalik as well as in the inner parts of Lindenows Fjord. Consequently, the numbers from below the 10—20 m interval down to below 100 m depth comprise Fjord water as well as Polar Current species, while already in the 50—100 m interval there is a further contribution of species living in the Atlantic undercurrent water. This may be part of the explanation why the figure for the 50—100 m interval is the largest. However, the latter also seems to reflect the fact that about one-fourth of all the bottom samples and dredge hauls from Lindenows Fjord are derived from depths between 50 m and 100 m. Nevertheless as regards the Sydøstkyst area it would seem that the crowding of lamellibranch species in the upper water layers is less pronounced than along the coasts of N.E. Greenland. Probably this is ultimately due to a larger production of phytoplankton in the former area. Then, summarising the preceding considerations, we may conclude that at least in the three northernmost areas of E. Greenland, i. e. its most high-arctic coasts, where food conditions as a whole are extremely poor, the largest number of lamellibranch species occur in the uppermost zone of the Polar Current water at depths where the access to the phytoplankton-producing layers seems the most favourable. However, as will be shown later (p. 233), this applies only to the majority of the suspension-feeders, whereas the vertical distribution of the deposit-feeders and the scavengers among the lamellibranchs does not show such a direct dependence on the position of the food-producing water layers.

Thorson (1944, pp. 168—69) shows that a considerable number of the prosobranch species dealt with by him at E. Greenland seem to occur at smaller depths than recorded from any other place within their area of distribution. He also points out that the occurrence of arctic species in quite shallow water indicates high-arctic conditions within the area in question. The same seems to be true of the lamellibranchs of E. Greenland, though it is sometimes impossible to decide from the literature whether or not a given species has been found at smaller depths in regions other than E. Greenland. However, the following lamellibranch species appear to have been taken alive at E. Greenland at the smallest depths yet recorded (the locality and depth being added in parantheses): *Portlandia arctica* (Nordvestfjord, 2—3 m), *P. lenticula* (Hurry Inlet, 0—13 m), *P. fraterna* (Turner Sund, 5.5 m), *Arca frielei* (Lille Pendulum, 18—21 m), *Dacrydium vitreum* (Sabine Ø, 5.5—9.5 m), *Propeamussium groenlandi-*

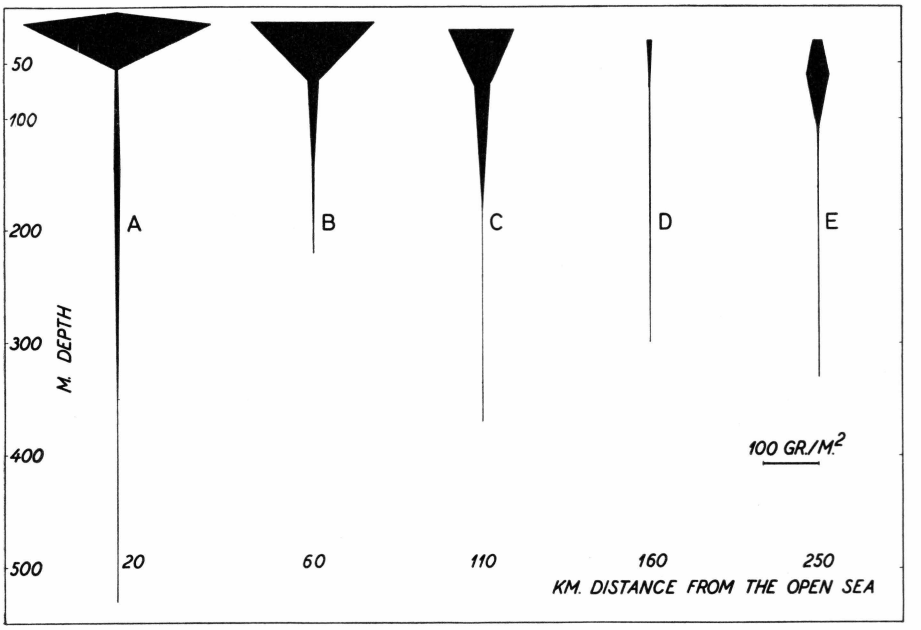

Fig. 28. Graphs showing the average weight per m² of lamellibranchs at different depths at five sections in Scoresby Sund.

A: Off Kap Hope (ca. 20 km from the open sea); B: Off Kap Hooker (ca. 60 km from the open sea); C: Between Kap Leslie and Jameson Land (ca. 110 km from the open sea); D: Off Bjørneøer (ca. 160 km from the open sea); and E: Nordbugt, Nordvestfjord (ca. 250 km from the open sea). — Cf. the text.

cum (Uttentals Sund, 4—5 m), *Astarte elliptica* (Solitærbugt, Nordvestfjord, 2—3 m), *Thyasira gouldi* (Nordvestfjord, 2—3 m), *T. equalis* (Milne Land, 10—15 m), *Macoma moësta* (Karl Jakobsens Bugt, 2 m), *M. loveni* (Uttentals Sund, 4—5 m), *Cyrtodaria kurriana* (Tasîssaq, 1—9.5 m), *Thracia septentrionalis* (Kap Hope, 9 m), *T. devexa* (Milne Land, 10—15 m), and *Cuspidaria subtorta* (Hurry Inlet, 0—13 m). These 15 species constitute about 27 per cent. of the whole lamellibranch fauna of E. Greenland, where most of them are largely associated with the Polar Current water. Besides, the finds of some other lamellibranch species from E. Greenland range among those from the smallest depths hitherto recorded. Most of these as well as of those mentioned above are from the three northernmost areas where food conditions must be supposed to be poorest. It will also be noted that the majority of the finds originate from places along the outer coast or in the outer parts of the large fjords, e. g. those areas where the brackish surface water layer is known to be thinnest. However, some of the finds from the smallest depths are from the inner parts of the fjords, but, characteristically enough, almost all from localities close to the outfalls of large rivers.

In such cases upwelling Polar Current water presumably accounts for the presence of lamellibranch species at unusually small depths.

In the preceding pages the vertical distribution of the species and their association with different water layers has been discussed. Still it is possible to give a general picture of the quantitative distribution of the lamellibranchs as a group found at different depths, at least as regards the Scoresby Sund area. Thus fig. 28 shows the average weight per m^2 of lamellibranchs taken with the PETERSEN grab at different depths at five sections in Scoresby Sund. The graphs are based upon tables 2, 4, 6, 7, 9, 12, 15, 16, 17, 18, and 19 in THORSON 1934b; as to the value for 55 m depth in graph A, unpublished data from the journal of the "Three-Year-Expedition" have been used. In most cases (graphs B, C, D, E) no bottom samples were secured from quite shallow water; otherwise from 6 to 10 samples were taken with the $^1/_{10}$ m^2 grab at depths down to 50 m, while from 2 to 4 samples were taken with the $^1/_5$ m^2 grab at the depths exceeding 50 m. The five sections are: **A**: Off Kap Hope, off the mouth of Hurry Inlet, and between Kap Tobin and Kap Brewster, i. e. about 20 km from the open sea; **B**: Off Kap Hooker, i. e. about 60 km from the open sea; **C**: Off Kap Leslie, between Kap Leslie and Jameson Land, and Jameson Land opposite Kap Leslie, i. e. about 110 km from the open sea; **D**: Off Bjørneøer, and Jameson Land opposite Bjørneøer, i. e. about 160 km from the open sea; **E**: Nordbugten in Nordwestfjord, i. e. about 250 km from the open sea.

Apart from minor—and uncertain—differences the graphs clearly show a very pronounced decrease of the average weight per m^2 of lamellibranchs from shallower water of depths less than 50 m towards the deep parts of the fjord. There is further a significant decrease of the quantity of lamellibranchs at smaller depths with increasing distance from the open sea. In both cases an explanation must primarily be sought in a parallel decrease of the food supply with increasing depths and increasing distance from the open sea, and conditions in other parts of N.E. Greenland must be supposed to follow a similar line.

D. Distribution of the species in relation to different types of bottom.

The bottom deposits within Kejser Franz Josephs Fjord have been dealt with in some detail by SPÄRCK (1933, pp. 12—19). Since similar conditions to those found in this large fjord complex must be assumed to prevail also along the greater part of the other East Greenland coasts, it seems possible to give a general characteristic of the different types of bottom, their distribution, and the causal factors.

The bathymetrical conditions must be of very great influence on the bottom deposits. In many East Greenland fjords, especially those of the inner Kejser Franz Josephs Fjord and the inner parts of Scoresby Sund, the sea bottom slopes very steeply from the shore towards greater depths (cf. the bathymetrical charts in SPÄRCK 1933, and THORSON 1934b). Accordingly, the shallow water zone is here of very limited extent. Moreover, the water movements in the fjords are, as a rule, very inconsiderable, in particular no swell of importance is found. Consequently, the sorting carried out by the water is only slight and restricted to short distances. Thus it is understandable why sand and gravel bottoms are quite subordinate in these fjords. Only locally do these occur in the inner fjords, where their presence is principally due to the deposition of coarser material just off the mouths of larger rivers. Also, because of the small afflux of water throughout the greater part of the year, no large quantities of coarser erosion material is carried by the rivers into the fjords. And most of this material will soon be deposited, owing to the slight motion of the fjord water. According to these conditions only two main types of bottom are widely distributed within the inner parts of the large fjords, viz. solid rocks and clayey bottoms. The latter are common in many places even at quite small depths and occur almost everywhere in the deeper regions. However, as to grain size and consistency (and probably other qualities) these clayey deposits may vary considerably from place to place (cf. SPÄRCK, 1933). Towards the outer coast, bottom types with a considerable component of sand and gravel become, as a rule, more frequent at smaller depths. But it is only near and along the outer coast that an almost pure sandy bottom is commonly met with, due to the significantly stronger surf and swell here as compared with conditions in the inner parts of the large fjords. Consequently, species which are especially associated with this type of bottom will in the main be restricted to the outer coasts of East Greenland.

According to SPÄRCK (loc. cit.), the content of organic matter in the deposits of larger depths within Kejser Franz Josephs Fjord is on the whole small, and moreover it decreases proportionally from the outer coast towards the inner ramifications of the fjord complex. The principal causes of this are partly the fact that the greater part of the erosion material from the rivers is deposited in the fjords themselves, only a smaller portion of it being carried on to the coastal shelf, partly the more intensive production of organic matter at the outer coast, while the supply of the latter from land is only small. Similar conditions probably also prevail within the Scoresby Sund complex and in the remaining large fjords of East Greenland. In general, this decreasing proportion of organic matter in the bottom deposits with increasing

distance from the open sea is likely to be of special importance to the deposit-feeding species.

A very characteristic feature of almost every kind of level sea bottom in E. Greenland is the presence of a certain amount of unsorted material, such as stones, gravel, pebbles, etc. This material is transported from the land and the shore by icebergs and ice-floes, and gradually as the ice melts, it sinks to the bottom. Thus, large stones as well as other coarser constituents occur in and on clay and other types of bottom from quite shallow water down to the deepest regions of the fjords. These conditions, which are characteristic of a glaciated coast like that of E. Greenland, are of special importance to many epifauna species, which thus find a suitable substratum almost everywhere within the fjords.

As a rule only limited information is available as regards the bottom from which the samples with lamellibranchs originate. Accordingly, the effect of smaller—though not necessarily unimportant—differences of the deposits on the various lamellibranch species cannot be ascertained. However, on considering the collecting data for the material at hand, it appears that fairly many species are able to thrive on very different kinds of bottom. Still some major differences may be noted. In the first place, the species which are largely associated with sandy bottoms, *Gomphina fluctuosa*, *Cyrtodaria kurriana*, *Thracia septentrionalis*, and *T. myopsis* must be mentioned. Of these, *G. fluctuosa* is, indeed, very characteristic of (as are the other three species) and frequent on sandy bottoms, though it may occasionally occur on clayey bottoms as well. Further, *Serripes groenlandicus* (cf. fig. 9, p. 117) and *Pandora glacialis* seem to have their main occurrence on bottoms consisting of sand mixed with clay, and sand. This seems also to apply to *Crenella decussata* and to *Axinopsis orbiculata*. Of other species common on not too pure sandy bottoms, to which, however, they are by no means restricted, *Astarte borealis*, *A. montagui*, *Thyasira gouldi*, *Macoma moësta*, *M. loveni*, *Mya truncata*, and *Lyonsia arenosa* may be mentioned. These as well as the majority of the remaining species seem to have their main occurrence on clayey or muddy bottoms with or without an admixture of coarser material. The species of the following genera belong to this group: *Nucula*, *Leda*, *Yoldia*, *Portlandia*, *Astarte*, *Thyasira*, *Cardium*, *Macoma*, and *Cuspidaria*; and also *Mya truncata*, *Lyonsia*, *arenosa*, *Thracia devexa*, *Poromya granulata*, and *Lyonsiella abyssicola*. A pronounced relation between the maximum occurrence of some epifauna species and the presence of coarser constituents as a substratum for byssal attachment is found in *Dacrydium vitreum*, *Arca glacialis*, and *Hiatella arctica*, all of which were met with in largest numbers on bottoms with stones, gravel, shells, etc. The same applies to *Propeamussium groenlandicum* and *P. imbriferum*, but it is not known whether the presence of coarser constituents

on the sea bottom is an indispensable condition for these two species (cf. p. 71, and p. 67). Similarly, for most of the other epifauna species from E. Greenland a dependence on coarser material and a comparative independence on the finer components of the deposits may be supposed (*Arca pectunculoides grandis*, *A. frielei*, *Modiolaria nigra* which, however, according to the collecting data, was commonest on clay and mud bottoms, adult *Pecten islandicus*, *Lima hyperborea*, and *L. subauriculata*). Also the lamellibranch species which attach themselves to algal growths are probably only indirectly dependent on the nature of the bottom. This applies especially to *Modiolaria discors laevigata*, which, being common on almost every kind of bottom at small depths, is very frequently found attached to algae, and this condition is also often found in the young of *Mytilus edulis*, *Pecten islandicus*, *Hiatella arctica*, and *Mya truncata*. Finally, it is obvious that only the epifauna species are able to live normally on submerged rocks.

E. Infauna and epifauna lamellibranchs. Animal communities.

The terms infauna and epifauna, which were introduced by C. G. J. Petersen, are certainly useful for a general description of the marine bottom fauna, as they group the various animal forms according to some important similarities of their habits and habitats and, moreover, because this distinction coincides in a fair degree with a division of larger systematical units into smaller ones (cf. Thorson 1952)[1]).

Infauna species. Concerning the lamellibranchs from E. Greenland the majority of them belong to the infauna, i. e. they live burrowing into the bottom deposits. According to the organisation of the particular species (and the size attained), the infauna species may be roughly classified with reference to the depth to which they penetrate into the bottom. Thus all of the Nuculids and the Ledids of E. Greenland seem to inhabit the uppermost layers of the deposits of their habitat. This is probably also true of the members of the genera *Astarte*, *Thyasira*, *Axinopsis*, *Serripes*, *Cardium*, *Gomphina*, *Lyonsia*, *Pandora*, *Lyonsiella*, *Poromya*, and *Cuspidaria*. All of these either have relatively short and not very extensile siphons or these have not at all developed. An intermediate stage is represented by the E. Greenland species of *Thracia* which have moderately long siphons. However, as shown by Yonge (1937), the boreal-lusitanian *T. pubescens* is able to construct a mucus-

[1]) It should be noted, however, that for the study of the productivity of the sea-bottom, food relationships, and competition of species, the distinction between epifauna and infauna species is often irrelevant.

lined siphonal tube, by which the animal can burrow to depths exceeding the length of its siphons. It would therefore be interesting to know whether similar habits occur in other members of the genus. The species of *Macoma*, owing to their very long, separate, and mobile siphons, are able to burrow more deeply into the bottom, and both *Cyrtodaria kurriana* and especially adult *Mya truncata* are typical deep-burrowers.

Further, differences in the organisation, in particular of the foot and the shell, indicate differences of the ability of moving horizontally. Thus *Cuspidaria* and *Poromya* seem to be comparatively mobile and rapid horizontal-burrowers (cf. YONGE 1928b), and the same is probably true of *Lyonsiella*. Also most of the protobranchs seem capable of fairly rapid horizontal burrowing (cf. YONGE 1939), though *Yoldia*, according to DREW (1899), normally assumes a vertical position. In contrast to these, the species of several other genera seem to be of a much more stationary habit, as for instance those of *Astarte*, *Serripes*, *Cardium*, *Gomphina*, *Lyonsia* and *Pandora*, while the *Macoma* species may be regarded as intermediates in this respect (cf. the observations on the Tellinacea by YONGE (1949)). It is quite reasonable that also the deep-burrowers, *Mya* and *Cyrtodaria*, will only occasionally show horizontal movements, whereas the long and vermiform foot, with a distal swelling in *Thyasira* and *Axinopsis*, suggests relatively rapid movements of these two species. However, closer studies are still wanting.

Epifauna species. These comprise the East Greenland lamellibranchs which either live byssally attached to objects on the sea bottom (stones, shells, algae, etc.) or are normally resting on it. East Greenland species which, except during their larval development, live bysally attached throughout their life, are the *Arca* species and all of the mytilids, of which *Dacrydium vitreum* and the two *Modiolaria* species are able to build nests. Further, *Hiatella arctica* occurs in E. Greenland in large numbers, bysally attached. It is unknown, however, to what extent *Hiatella* may here bore into soft rocks, also, as it is known to do in boreal regions. Both adult *Propeamussium imbriferum* and *P. groenlandicum* have been found bysally attached to coarser bottom constituents. But, as previously mentioned, it is unknown whether this or an unattached resting on the bottom is the normal habit of these two species. The younger bottom-stages of *Pecten islandicus* are mainly found attached to algal growths, while the adults appear to rest freely on the bottom; the latter habits may apply to *Lima hyperborea* and *L. subauriculata*, too. The young of *Mya truncata* also live byssally attached, but soon change to the burrowing habit of the adults. Possibly, byssal attachment of the youngest bottom-stages may be a common condition in some other East Greenland species (*Gomphina*?), though no investigations into this question have as yet been made.

On considering the habits of the adult animals, it will be found that the lamellibranch fauna of East Greenland comprises 41 infauna and 14 epifauna species, i. e. about 74 % and 26 %, respectively, of the total number of species. Obviously, within the group of infauna species different types of feeding are represented, viz. suspension- as well as deposit-feeders, and scavengers, while all the epifauna lamellibranchs of East Greenland are suspension-feeders.

Animal communities. As on other coastal shelves, the lamellibranchs play an important rôle within the bottom fauna of East Greenland waters. At present a fairly extensive literature on the animal communities of this region is available (Spärck 1933, Thorson 1933 and 1934b, Madsen 1936, and Bertelsen 1937a), while as yet only a brief article on the coastal communities of Jan Mayen has been published (Parat & Devillers 1936). The chief results attained by these studies still remain valid. However, in accordance with the present investigation some comments seem appropriate, as misidentifications of some lamellibranch species and misinterpretations of the habits of some others have occurred in the literature. Otherwise, a brief description of the different communities is given below, with special reference to the lamellibranchs, and of the vertical and horizontal distribution of these communities as known from the region concerned. The material now at hand further allows of some additions in this respect (cf. p. 228).

The infauna communities of E. Greenland and Jan Mayen established so far comprise: 1) The Arctic *Macoma* community; 2) The *Gomphina fluctuosa* community; 3) The *Portlandia arctica* community; 4) The *Astarte crenata* community; and 5) The Foraminifera community.

1) The Arctic *Macoma* community. This term is used in the present paper in preference to the original "*Macoma calcaria* community" of Spärck, Thorson, and other authors, because *Macoma calcaria* was found to occur rarely e. g. in the whole Scoresby Sund complex (at least in 1933 when most of the samples were taken). Here, in localities entirely corresponding to those inhabited by the community in Kejser Franz Josephs Fjord, *M. moësta* was actually the dominant *Macoma* species. Moreover, in Kejser Franz Josephs Fjord the two species mentioned were commonly met with together; and *M. moësta*, though as a rule not dominant as to weight, appeared to be at least just as evenly distributed in East Greenland throughout this community as *M. calcaria*. There exist, however, notable differences in the regional distribution (*M. calcaria* has a circumpolar, panarctic, and *M. moësta* a circumpolar, high-arctic main distribution) and the larval development of the two species and, accordingly, modifications of the community which they characterise may occur. Nevertheless, the name of the community

here applied seems to be in better agreement with conditions at E. Greenland than the designation "*Macoma calcaria* community". Possibly, the fairly sparse occurrence of *M. calcaria* in some of the coastal areas of E. Greenland is a consequence of the planktotrophic larval development of this species (cf. p. 242).

The community is typically developed on clay (and sandy clay) bottoms from about 4 m to about 45 m depth and is common throughout Kejser Franz Josephs Fjord and Scoresby Sund (cf. Thorson 1933, 1934b); it was also ascertained in the inner fjords at Angmagssalik at depths from 4—5 m down to 50 m (cf. Bertelsen 1937a). Besides the characteristic species already mentioned, the following usually occur: *Nucula tenuis*, *Leda pernula*, *Astarte borealis*, *A. montagui*, *A. elliptica*, *Thyasira gouldi* (not *T. flexuosa*), *Axinopsis orbiculata*, *Cardium ciliatum*, *Macoma loveni*, *Mya truncata*, and *Cuspidaria subtorta* (not *C. obesa*). Thorson (op. c.) subdivided this community into some zones of different range. Of these, the *Astarte borealis* zone, of common occurrence at N.E. Greenland from about 4 m to about 15 m depth, may be mentioned. It is in this zone that fairly high water temperatures occur in the summer. Also Parat & Devillers (1936) report an *Astarte borealis-Macoma calcaria* association occurring at Jan Mayen down to 90 m depth. As far as we know, however, no *Macoma* species has hitherto been taken alive at this island.

Compared with other arctic marine communities, the Arctic *Macoma* community is fairly rich both as regards number of species and weight of animals per m^2. Thus, in Kejser Franz Josephs Fjord and Scoresby Sund its total fresh weight usually amounts to 100—200 gr per m^2, while at Angmagssalik a significantly greater number of individuals and a larger weight per m^2 are indicated; the latter compares with conditions in Icelandic fjords at similar depths (cf. Bertelsen 1937a).

2) The *Gomphina fluctuosa* community: This was first described by Thorson (1934b, as *Venus fluctuosa* community), who found it in places near the open sea in Scoresby Sund at depths between 7 m and about 20 m. It is associated with sandy bottoms and corresponds to the Arctic *Macoma* community on clayey bottoms at similar depths. Besides *Gomphina fluctuosa*, some other lamellibranch species are characteristic members of this community, viz. *Cyrtodaria kurriana*, *Thracia septentrionalis*, *T. myopsis* (= part of *T. truncata* in Thorson 1934b, and 1936), and *Pandora glacialis*. Of common occurrence are further *Serripes groenlandicus*, *Astarte borealis*, *A. montagui*, and *Axinopsis orbiculata*. The community has moreover been found in a modification in the Angmagssalik area near river mouths in the inner fjords from 4—5 m to at any rate 25 m depth, and in the Kangerdlugssuaq area in Mikis Fjord from 3—4 m to at least 15 m (cf. Bertelsen 1937a).

Compared with the Arctic *Macoma* community, the *Gomphina fluctuosa* community occupies much more limited areas in E. Greenland. On the other hand, in places with a typical and rich *Gomphina fluctuosa* community the number of animals and the weight per m^2 are larger in the latter community than in the former. This is the case at Kap Hope, where a total fresh weight of about 370 gr. per m^2 was found, and at Angmagssalik the sample distinctly indicating this community showed about 980 gr. per m^2. Probably, this difference between the two communities is primarily due to more favourable food conditions in the localities inhabited by the *Gomphina fluctuosa* community (stronger water motion, presumably larger production of phytoplankton). The considerably larger weight per m^2 at Angmagssalik—though based on a rather sparse material—is quite parallel to conditions found in the Arctic *Macoma* community, and similarly it indicates a much better food supply in this than in the more northerly areas of E. Greenland.

3) The *Portlandia arctica* community: The characteristic species, *P. arctica*, has its southern limit of distribution somewhere between Kangerdlugssuaq and Angmagssalik. Accordingly, the community which it characterises, is only found along the north-eastern coasts. Even within Kejser Franz Josephs Fjord and Scoresby Sund the community is of limited distribution, being associated with loose, muddy bottoms off glaciers and river mouths from 10—15 m to 50—60 m depth (cf. Thorson 1934b), and *Portlandia arctica* appears to be specially adapted to the ecological conditions remarkable of such localities (i. a. heavy sedimentation of inorganic matter and scarce food supply; cf. p. 26). Some of the bivalves of the other East Greenland shallow water communities may occur in small numbers. But on the whole this community is extremely poor as to species number and also the weight is only about 40 gr. per m^2.

4) The *Astarte crenata* community: This arctic community was found to be of common occurrence both in the inner fjords and on the outer shelf, on clayey bottoms from about 45 m to about 200 m in Kejser Franz Josephs Fjord (cf. Spärck 1933, Thorson 1933), and from 40—50 m to at least 550 m in Scoresby Sund (cf. Thorson 1934b). Further, it was met with in a somewhat modified form from 25—30 m to at least 50 m depth at Kangerdlugssuaq (cf. Bertelsen 1937a), and Parat & Devillers (1936) report it from Jan Mayen from depths exceeding 90 m, however, partly mixed with the Foraminifera community. Also in the outer parts of Scoresby Sund a mixed community was found (cf. Thorson 1934b). Besides *Astarte crenata* s. l. the following lamellibranch species usually occur frequently enough to deserve mention: *Nucula tenuis*, *Portlandia intermedia*, *P. lenticula*, *P. frigida*, *P. fraterna*, *Thya-*

sira equalis (not *T. flexuosa*), *Cuspidaria subtorta* (not *C. obesa*), and *C. glacialis*. *Astarta elliptica* is often found in the upper parts of this community and, besides, some other species with their main occurrence in the shallow-water communities may occasionally be met with in the upper parts.

Generally, the number of individuals and species, and the total weight per m^2 are only small, the latter ranging most often between 5 gr. and 50 gr. As shown by Thorson (1934b), this community contrasts with the shallow-water communities of N.E. Greenland by the lamellibranchs forming less than 50 % of the total weight, the remainder being formed especially by the polychaetes and the ophiurans. *Arca glacialis*, which has a similar range at E. Greenland as *Astarte crenata* s. l. and which has been used to characterise this community (by Spärck 1933, Thorson 1933, 1934b, 1936, a. o.), is unfit for this purpose, since it is actually an epifauna lamellibranch.

5) The Foraminifera community: Below the preceding one, another community characterised by the dominance of Foreminifera (*Rhabdamina cornuta*, *Miliolina bucculenta*, and other species) exists, which is widely distributed in deeper water, viz. from 50 m or, most often, from about 200 m to 780 m in Kejser Franz Josephs Fjord (cf. Spärck 1933), and from 50 m to at least 550 m in Scoresby Sund (cf. Thorson 1934b). In the outer parts of the latter area, however, it often occurred mixed with the *Astarte crenata* community, while in the innermost parts of both fjord complexes the Foraminifera community was not found at all. Generally, the lamellibranchs as a group are only sparsely represented, whereas the polychaetes may be dominants. As regards the infauna lamellibranchs, most of the species of the *Astarte crenata* community may occur in smaller numbers. Especially the smaller species of *Portlandia*, *Thyasira equalis*, and *Astarte crenata* (with subspecies) may be mentioned. The total weights per m^2 within the Foraminifera community usually average 30—40 gr.

Additions to the infauna communities. The lamellibranchs collected in Jørgen Brønlund Fjord (ca. 82°10′ N. 31°30′ W.) by P. Johnsen, "Dansk Pearyland Ekspedition", deserve some interest, as they contribute to our knowledge of the marine fauna of the northernmost coasts of E. Greenland. The material consists of in all 5 quantitative samples taken by means of the Ekman bottom sampler (225 cm^2) and 4 dredge-hauls, and may thus serve as a qualitative indication of the composition of the bivalve fauna (the other groups have not yet been worked up). The lamellibranchs in the samples were distributed as follows:

11 m, fat, grey clay, 27-8-48, 1×225 cm², and 13 m, clay, 28-5-49, 2×225 cm²: 60 *Nucula tenuis*, 1 *Portlandia arctica*, 5 *Astarte montagui*, 4 *Macoma calcaria*, 1 *Mya truncata*.

About 10—11 m, 7-8-47, 1 dredge-haul, and about 13 m, 12-8-49, 1 dredge-haul: 5 *Nucula tenuis*, 9 *Portlandia arctica*, 8 *Astarte borealis*, 1 *Astarte montagui*, 1 *Thyasira gouldi*, 15 *Hiatella arctica*, 3 *Mya truncata*.

About 25 m, clayey bottom, 8-8-48, 1 dredge-haul: 2 *Astarte borealis*, 2 *Hiatella arctica*.

21—46 m, 12-8-49, 1 dredge-haul: 4 *Astarte borealis*, 5 *Astarte montagui*, 1 *Hiatella arctica*.

28.5 m, clay, 1-6-49, 2×225 cm²: 6 *Arca glacialis*, 1 *Astarte borealis*.

All of these samples were taken in the vicinity of the wintering station of the expedition in Jørgen Brønlund Fjord. This fjord is remarkable by having a threshold of only 10—12 m depth at its mouth and, further, a considerable afflux of fresh-water from two large and several smaller rivers contributing to the melting of the ice in the spring. Further, the tide is inconsiderable and the salinity about 30 ‰ (JOHNSEN 1953). The samples indicate an *Astarte borealis* zone of the Arctic *Macoma* community occurring from at least 10—11 m to 13 m depth. This zone, however, is modified by the presence of *Nucula tenuis* and *Portlandia arctica* in considerable numbers, probably as a consequence of the special ecological conditions in this fjord. It seems noteworthy, also, that the epifauna species, *Arca glacialis*, appears already at 28.5 m depth. But on the whole the composition of the bivalve fauna in Jørgen Brønlund Fjord does not, apparently, deviate very much from that found under similar conditions in Kejser Franz Josephs Fjord and Scoresby Sund.

The *Gomphina fluctuosa* community has not hitherto been recorded from any place N. of Scoresby Sund[1]). In the present material, however, there are two samples which indicate its occurrence in certain localities of the Nordøstkyst and the Kejser Franz Josephs Fjord areas. The first sample originates from Sabine Ø, 12/13-7-00, from a bottom with *Laminaria* growths (the depth and the type of bottom were not recorded, but probably the sample is from shallow water and a sandy bottom). It comprises the following animals:

1 *Dacrydium vitreum* (very young), 9 *Modiolaria discors laevigata*, 4 *Propeamussium groenlandicum*, 2 *Axinopsis orbiculata*, 1 *Serripes groenlandicus*, 20 *Gomphina fluctuosa*, 1 *Hiatella arctica*, 1 *Cyrtodaria kurriana*, 5 *Pandora glacialis*, and 2 *Thracia myopsis*.

The other sample is from Kap Stosch (Kejser Franz Josephs Fjord area, opposite Clavering Ø), about 15 m depth, 4-8-30 (the type of bottom was not recorded), and it comprises:

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[1]) VIBE (1939), it is true, states the presence of this community in a place S. of Clavering Ø, but without giving any details.

27 *Portlandia arctica*, 4 *Modiolaria nigra*, 1 *Propeamussium groenlandicum*, 1 *Serripes groenlandicus*, 18 *Gomphina fluctuosa*, 1 *Hiatella arctica*, 2 *Cyrtodaria kurriana*, and 7 *Pandora glacialis*.

The first sample thus seems to indicate a typical *Gomphina fluctuosa* community at Sabine Ø, while the other sample indicates a modification of this community at Kap Stosch by the presence of *Portandia arctica* in considerable numbers, but otherwise it is of a fairly characteristic composition.

The material collected in Lindenows Fjord and vicinity during M/S "Thor's" cruise in 1935 has proved to be of considerable scientific value. This material was also intended to form the basis of an evaluation of the animal communities of the southernmost coast of E. Greenland. However, a collocation of the lamellibranchs collected[1]) showed that, in most cases, the numbers of quantitative samples from each station are insufficient to permit of safe conclusions as to the characteristic composition of the bottom fauna. This is probably connected with the great variation of the hydrographic—and consequently the ecological—conditions in Lindenows Fjord, whence the majority of the samples are derived. Nevertheless, it would seem that in this fjord neither the Arctic *Macoma* community nor the *Astarta crenata* community are developed in such a distinct form as they commonly exhibit in N.E. Greenland. On the other hand, the present material contains a series of quantitative samples which indicate a community not hitherto known from E. Greenland, viz. a *Yoldia hyperborea* community. This community was first described by SPÄRCK (1937) from some Icelandic fjords, where it occurs from about 45 m to 160 m depth. The samples mentioned above are from a small fjord (stat. XIX; cf. chart 2 in H. THOMSEN, 1937) situated at the S. side and a little inside the mouth of Lindenows Fjord. According to BERTELSEN (1937b), this small fjord has a threshold at its mouth of 18—20 m and an inner basin of a depth of about 60 m. In this basin rich deposits of clay and mud occurred, due to the calm water. Nine samples taken with the $^1/_{10}$ m² PETERSEN grab, from 45 m to 58 m depth, dark, greyish clay, 27-7-35, yielded the following lamellibranchs:

4 *Nucula tenuis*, 1 *Leda pernula*, 1 *Leda minuta*, 11 *Yoldia hyperborea*, 2 *Astarte montagui*, 2 *Thyasira gouldi*, 3 *Axinopsis orbiculata*, 1 young *Serripes groenlandicus*, 2 *Cardium ciliatum*, and 5 *Macoma moësta*.

Yoldia hyperborea was present in 7 out of the 9 samples. This and also most of the other accompanying species are to a fair degree reminiscent of the *Yoldia hyperborea* community, especially as this is developed at E. Iceland (cf. SPÄRCK, 1937, table V). Another series of 8 samples

[1]) Unfortunately, no complete list of the other animals in these samples is available.

were taken with the $^1/_{10}$ m² grab in the same fjord at depths from 10 m to 20 m, grey clay, 27-7-35. Here, the presence of an Arctic *Macoma* community might have been anticipated. However, the samples contained the following lamellibranchs:

1 *Nucula tenuis*, 9 *Yoldia hyperborea*, 62 *Astarte borealis*, 2 *Astarte montagui*, 2 *Thyasira gouldi*, 2 *Axinopsis orbiculata*, 1 *Macoma moësta*, and 1 *Mya truncata*.

It will be seen that *Astarte borealis* is by far the dominant bivalve (occurring in all the samples). Next comes *Yoldia hyperborea* (in 6 of the 8 samples), while the remaining species, inclusive of *Macoma moësta* constitute only a small fraction of the total. Since *Astarte borealis* is met with almost everywhere in shallow water along arctic coasts and cannot, therefore, be regarded as an indicator of a well-defined set of ecological conditions, and since the *Macoma* species are here quite subordinate, these samples seem to show the presence of a modified *Yoldia hyperborea* community rather than any of the other communities hitherto described from E. Greenland.

Epifauna communities. The different epifaunas described from E. Greenland may conveniently be divided into the following main categories: 1) the epifauna of the tidal zone. The occurrence of *Mytilus edulis* in this zone along the Sydøstkyst area has already been mentioned (cf. p. 210). 2) The epifauna of the vegetation. 3) The epifauna on rocks, stones, pebbles, etc., of the sea bottom. It should be noted at once, however, that the two last-mentioned categories correspond only in part with the distribution of the different epifauna lamellibranchs. This is especially exemplified by *Hiatella arctica*, which at N.E. Greenland is common within every type of epifauna zone down to 50—60 m depth, regardless of the presence or absence of algal growths. Moreover, since the different types of algal vegetation are very often confluent, their lamellibranch faunas may be dealt with collectively.

Within the zone with *Fucus* and *Laminaria* on rocks and stones and in the *Desmarestia* vegetation on clay bottom, *Modiolaria discors laevigata* is the dominant epifauna lamellibranch. Also *Hiatella arctica* is common, while in places with a sparser vegetation and usually not too far from the open sea *Modiolaria nigra* in addition occurs. The vegetation of the smallest depths in N.E. Greenland is especially remarkable by forming a substratum for large numbers of young *Modiolaria discors laevigata*, *Hiatella arctica*, and *Mya truncata* (cf. p. 56, 139, and 148). Further, in the inner Kejser Franz Josephs Fjord, near Ella Ø, and near Kap Hedlund, the *Fucus* vegetation was found to be the growth zone of young *Pecten islandicus*, while the adults occurred at somewhat greater depths in the red algae zone (cf. Thorson 1933). It should be

noted, however, that where these types of vegetation occurred in other East Greenland waters *Pecten islandicus* was not found. Along the Sydøstkyst area two more epifauna species appear in the *Fucus-Laminaria* vegetation, viz. *Mytilus edulis* found locally at smaller depths, and *Crenella decussata* occurring from this zone outwards. In general, the distribution of these epifaunas coincides with the upper zones of the Arctic *Macoma* community and with the *Gomphina fluctuosa* community.

At depths where the algal vegetation thins out (this is usually the case at about 25—35 m) the epifauna on stones, pebbles, etc., of the level sea bottom becomes dominant. The *Modiolaria* species are now inferior quantitatively, while the *Hiatella arctica* epifauna is present ("*Saxicava*" epifauna, cf. Thorson 1933, 1934b). Generally this ranges down to 50—60 m depth, thus corresponding to the deeper zones of the Arctic *Macoma* community and the uppermost part of the *Astarte crenata* community. The *Hiatella* epifauna was found to be especially abundantly developed in Kejser Franz Josephs Fjord, while it seems to be of smaller importance in Scoresby Sund and still less so at Kangerdlugssuaq and Angmagssalik. Of other species occurring in this epifauna, in particular *Propeamussium groenlandicum* should be mentioned. Other epifauna bivalves may be found as well, but these are, as a rule, quantitatively unimportant.

From about 50—60 m depth and farther out the *Hiatella* epifauna will have disappeared and an epifauna characterised by various species of Spongia and Ascidia is found at N.E. Greenland (cf. Spärck 1933). The most conspicuous epifauna lamellibranch of these depths is *Arca glacialis*, which, living byssally attached to the coarser constituents of the sea bottom, in itself offers a suitable substratum for various other epifauna species. Besides, *Dacrydium vitreum* has its main occurrence here, and the same may be true of *Propeamussium imbriferum*. On the whole, the Ascidia-Spongia epifauna corresponds to the *Astarte crenata* community.

At depths exceeding about 200 m another epifauna characterised especially by *Gorgonocephalus* species is encountered (cf. Spärck 1933). However, the lamellibranchs as a group are only sparsely represented at these depths. Of epifauna species *Arca glacialis* still occurs, and possibly its relatives *Arca pectunculoides grandis* and *Arca frielei* are particularly associated with the *Gorgonocephalus* epifauna of N.E. Greenland, which in its range seems to correspond to the Foraminifera community.—Finally, two epifauna species remain, viz. *Lima hyperborea* and *L. subauriculata*. However, their distribution at E. Greenland is so insufficiently known at present that a correlation with any special type of epifauna seems unwarranted.

F. Feeding habits and nutrition.

With regard to feeding type and food the Lamellibranchiata may be divided into the following groups (the classification here employed is chiefly a combination of those proposed by HUNT (1925) and YONGE (1928), with omission of the groups which are not represented within the lamellibranchs):

I. Lamellibranchs with mechanisms for dealing with small particles (this being essentially executed by ciliary means).

1) Suspension feeders (Filterers), i. e. those which feed on phytoplankton, smaller forms of zooplankton and/or detritus in suspension. To this group belong 33 of the East Greenland species, viz. the members of the genera *Arca*, *Dacrydium*, *Crenella*, *Modiolaria*, *Mytilus*, *Pecten*, *Propeamussium*, *Lima*, *Astarte*, *Thyasira*, *Axinopsis*, *Serripes*, *Cardium*, *Gomphina*, *Hiatella*, *Cyrtodaria*, *Mya*, *Lyonsia*, *Pandora*, and *Thracia* (approximately 60 % of the total number of species known from E.Greenland).

2) Deposit feeders, i. e. species which feed on organic particles deposited on and in the sea bottom together with the associated microorganisms. This group comprises 16 of the East Greenland species, viz. the members of the genera *Nucula*, *Leda*, *Yoldia*, *Portlandia*, and *Macoma* (approximately 29 % of the total number of species known from E. Greenland).

II. Lamellibranchs with mechanisms for dealing with large particles or masses. These are divided into:

3) Scrapers and Borers. Unknown from E. Greenland (example: *Teredo*).

4) Scavengers (Carnivores), i. e. such lamellibranchs as swallow smaller animals, either living or carrion. To this group belong 6 of the East Greenland species, viz. the members of the septibranchiate genera *Lyonsiella*, *Poromya*, and *Cuspidaria* (approximately 11 % of the total number of species known from E. Greenland).

III. Lamellibranchs with mechanisms for taking in fluid or soft tissues:

5) Parasites. Unknown from E. Greenland (example: *Entovalva*).

IV. Lamellibranchs with mechanisms for culturing algae and using them as food. These may be called:

6) Algae-cultivators. Unknown from E. Greenland (example: *Tridacna* which, besides filtering phytoplankton, "farms" zooxanthellae in its tissues and especially its mantle edge (cf. e. g. YONGE 1936, 1953)).

The subjoined table shows the number of species and the percentage belonging to the different feeding types as found at different depths along

the whole East Greenland coast (occasional finds outside the normal range of a given species are omitted, cf. p. 215):

Depths m	Suspension feeders	Deposit feeders	Scavengers	Number of species
	spp. %	spp. %	spp. %	
0— 10.....	22: 73	8: 27	..	30
10— 20.....	26: 66½	12: 31	1: 2½	39
20— 50.....	22: 63	12: 34	1: 3	35
50—100.....	23: 60½	13: 34	2: 5½	38
100—200.....	12: 41½	14: 48	3: 10½	29
>200	11: 40½	12: 44½	4: 15	27
Total...	33: 60	16: 29	6: 11	55

Proceeding from the shallow water zone towards deeper water, the table demonstrates a both absolutely and relatively significant decrease of the number of suspension-feeding species, a distinct relative increase of the deposit-feeding species, and a distinct increase, both absolute and relative, in the number of species living as scavengers. Of special interest is the remarkably smaller number of suspension-feeding species found at depths exceeding 100 m than found in the 50—100 m interval. This causes the sudden relative increase in the number of deposit-feeding species at depths of more than 100 m. However, the actual number of the latter is fairly constant in the different depth-zones, apart from the markedly smaller number found in the 0—10 m interval.

The lower limit of the phytoplankton-producing layer in East Greenland waters is probably found in the 50—100 m interval; consequently, at greater depths the food supply is too scarce for a number of suspension-feeding species. However, several species of this group are very common at depths exceeding 100 m, where some of them even seem to have their main occurrence (e.g. the *Arca* spp., *Dacrydium vitreum*, *Propeamussium imbriferum*, *Astarte crenata* s. l., and *Thyasira equalis*). Therefore, it must be assumed that the latter species are able to feed and thrive exclusively on suspended detritus with or without associated micro-organisms (propably especially bacteria). In contrast to these, the majority of the suspension feeders which are restricted to shallower water must be supposed to depend on living phytoplankton as a direct and most important source of food.

As already mentioned, the table indicates a relatively increasing importance of the deposit-feeding species with increasing depths. This, however, does not apply to all of them. Particularly the *Macoma* species only rarely occur at depths of more than 100 m, whereas several of the protobranchiate species extend to far greater depths (especially the

Portlandia spp.). This entirely agrees with the fact that the Tellinacea as a group are restricted to shallower water and are only rarely represented below the shelves, whereas the Nuculacea include many abyssal species. Although both *Macoma* and its allies and the Nuculacea on the whole feed on deposited organic matter, this takes place in two different ways. By means of the inhalent siphon the former suck up the organic matter which accumulates on the bottom, whereas the latter, by means of the palp proboscides, collect the bottom material and are enabled to utilise not only the organic matter from the surface of the substratum but also that which is imbedded in the latter. Thus a comparatively considerable deposition of organic matter seems to be a necessary condition for the mode of feeding which has eveloped within the Tellinacea. This may be the explanation why the latter as a group are restricted to relatively small depths in contrast to many of the Nuculacea. Besides, differences in the faculty of moving horizontally and of exploiting a larger area for food may be a contributive factor. There is some evidence that generally the Nuculacea are of less stationary habits than are the Tellinacea.

This account and the table given above so far only consider the number and the percentage of species of different feeding habits at different depths. However, with regard to the number of individuals belonging to any of the three types the picture need not be the same. An estimate of the percentage representation of the about 39,000 lamellibranchs hitherto collected at E. Greenland as living animals gives the following result: Suspension feeders 85.6 %, deposit feeders 14.1 %, and scavengers 0.3 %. As to the relative frequency at different depths it may be stated that of all the lamellibranchs derived from the 0—10 m interval, 89.5 % are suspension feeders, and 10.5 % are deposit feeders, while no scavengers are present at all. Descending to the 100—200 m interval, the composition has changed to: Suspension feeders 82.5 %, deposit feeders 16.7 %, and scavengers 0.8 %; and at depths exceeding 200 m (down to 780 m in the fjords and 400 m along the outer shelf) it is: Suspension feeders 78.6 %; deposit feeders 17 %, and scavengers 4.4 %. Although this estimate makes no allowance for the number of samples derived from each depth interval, or for which part of them were bottom samples and which were dredge-hauls, some general conclusions seem justifiable. Thus it will be seen that within the lamellibranch fauna of E. Greenland suspension feeding is by far the most common type. This is true, as a rule, even as regards the fauna of the deeper and deepest parts of the fjords and the outer shelf, though there is some decrease of its relative importance towards deep water with a corresponding relative increase of the deposit feeders and the scavengers. It is also evident that on the whole the scavengers occur in quite incon-

siderable numbers, and only at depths of more than 200 m do they seem to be of some quantitative importance.

A highly characteristic and important feature of the ecological conditions at E. Greenland is the limitation of the photosynthetic processes to a short period of the year (cf. THORSON 1936, and DIGBY 1953). This is primarily a consequence of the unfavourable light conditions, which are a function of the latitude and are further deteriorated by the ice-cover lingering during the greater part of the year and by the intransparency of the water during part of the summer due to the large amounts of suspended mud especially in the inner fjords. In addition, the scarcity of nutrient ions available for the algae in late summer seems to be a limiting factor. As a result, the phytoplankton production at N.E. Greenland almost entirely takes place within only 2—3 months each summer. Similarly, the growth of the benthos-algae must be restricted by these factors. Thus the nutrimental conditions at N.E. Greenland are very extreme for all species which depend on phytoplankton or living benthos-algae. It is not surprising, therefore, that a slow growth is indicated for those suspension-feeding lamellibranchs of E. Greenland which have been studied in that respect (cf. THORSON 1936, pp. 95—106, and this paper p. 62, and p. 118). The entire lack or extreme scarcity of phytoplankton during the greater part of the year is obviously also a factor of extreme importance to the reproduction of the species and the mode of larval development (which will be briefly discussed in the next chapter). Moreover, other activities as well are likely to be affected by the periodical change of the amount of phytoplankton (e. g. pumping rate, respiratory rate, and respiratory quotient). So far, however, no investigations whatever have been made as to this, nor as to what extent the suspension-feeding lamellibranchs of E. Greenland store nutrients in their tissues during the phytoplankton maximum, as do the marine copepods of N.E. Greenland (cf. USSING 1938).

With regard to the deposit feeders the food conditions at E. Greenland seem to be relatively less unfavourable. Probably the production of detritus and the transport of it is less strictly limited to a certain season of the year than the production of phytoplankton, even though the water motion is often slight, especially in the inner fjords. Moreover, the organic matter deposited on the sea bottom may retain its food-value for some time. Accordingly the nutrimental conditions for the deposit feeders will not change nearly as much in the course of the year as they must be assumed to do for the majority of the suspension-feeding lamellibranchs. However, food conditions for the deposit feeders are by no means uniform along the East Greenland coasts (cf. p. 221) and may even be decisive for the distribution of a species. As to the vertical distribution of the *Macoma* species the probably vital import-

ance of the amount of acculumating detritus has already been mentioned (p. 235); *Yoldia hyperborea* most likely represents an example of a deposit feeder whose horizontal distribution at E. Greenland is chiefly determined by the amount of nutriment on and in the bottom deposit (cf. p. 21).

It may be of some interest now to compare the number and the percentage of species of different feeding habits known from E. Greenland with those from some other N. Atlantic regions with less extreme conditions (cf. the table below). Furthermore, a comparison with the lamellibranch faunas from great depths may be included. For that purpose the records from depths between 400 m and 1000 m, and from more than 1000 m, respectively, from Greenland, Jan Mayen, Iceland, the Faroes, and S. Norway have been used (based mainly upon Friele & Grieg 1901, Jensen 1912, Posselt & Jensen 1898, J. Madsen 1949, Thorson 1951, and my own investigations). As to the shelf-faunas, a lower limit of 400 m has been adopted (cf. table II, p. 194; this means i. a. that *Portlandia lucida* and *Cuspidaria obesa* have not been included in the computation for E. Greenland).

Shelf region (< 400 m)	Suspension feeders	Deposit feeders	Scavengers	Borers	Number of species
	spp. %	spp. %	spp. %	spp. %	
E. Greenland ...	33: 62	15: 28½	5: 9½	.. ..	53
N.+E. Iceland..	37: 75½	8: 16½	3: 6	1: 2	49
S., W., + N.W. Iceland.....	60: 77	11: 14	5: 6½	2: 2½	78
The Faroes	51: 70	17: 23	3: 4	2: 3	73
S. Norway	111: 72	32: 21	8: 5	3: 2	154
Depth region					
400—1000 m ...	36: 55½	19: 29	10: 15½	.. ..	65
>1000 m	30: 52	20: 34½	8: 13½	.. ..	58

It will be seen that of the shelf-faunas of the regions considered the East Greenland fauna has the largest percentages of species which either feed on deposits or live as scavengers (and the smallest percentage of suspension-feeding species). The difference between E. Greenland and the other regions is especially evident when the percentages for the deposit feeders and the scavengers are considered collectively, resulting in 38 % for E. Greenland, compared with 22½ % for N. and E. Iceland, 20½ % for S., W. and N.W. Iceland, 27 % for the Faroes, and 26 % for S. Norway. This comparatively high percentage for E. Greenland of species of the said feeding types—precisely those types the relative importance of which increases distinctly towards the abyssal depths—

may be properly interpreted as a consequence of similarly extreme ecological features, especially as regards food conditions, prevailing in both arctic coastal regions and in the deep sea areas.

G. Reproduction and larval development.

The most important paper hitherto published on the reproduction of arctic marine lamellibranchs is that by Thorson (1936; cf. also Thorson 1935). It contains information on 22 different species; only a few more species occurring in the Greenland waters have been studied in this respect by other authors. The present paper contributes to our knowledge of the reproduction of 33 species, including remarks and corrections as to some species previously dealt with by other zoologists.

Although the larvae of a great number of arctic lamellibranch species have not yet been observed and described, it seems justifiable to give a general account of the reproduction and larval development of the lamellibranchs of the region concerned. With regard to the different types of larval development it is now possible to classify 47 out of the 55 species known to live at E. Greenland and Jan Mayen, based upon the size and appearance of their eggs and in some species upon the size of the prodissoconch as well. In most cases the observations were made on specimens from E. Greenland or Jan Mayen; but, as to some species, material from other regions (W. Greenland, Iceland, Spitzbergen) had to be used.

The eggs. At least 21 East Greenland species agree with the majority of marine lamellibranchs in spawning eggs with a thin and non-adhesive membrane and probably suspended in the water. In contrast to these, however, there are at least 8 species which produce eggs with a mucous and adhesive membrane, viz. *Astarte borealis*, *A. montagui*, *A. elliptica*, *A. crenata*, *A. sulcata*, *Macoma moësta*, *M. loveni*, and *M. torelli* (but probably not *M. calcaria*). Thus an attachment of their eggs to a substratum seems possible and even probable. Besides, several other species have eggs with a well developed membrane of some thickness, viz. *Cardium ciliatum*, *Lyonsia arenosa*, *Pandora glacialis*, *Thracia septentrionalis*, *T. myopsis*, *T. devexa*, *Lyonsiella abyssicola*, *Poromya granulata*, *Cuspidaria obesa*, *C. subtorta*, *C. glacialis*, and possibly also *Serripes groenlandicus*. As to the last-mentioned group, however, an adhesive property of the egg-membrane was not observed. Still it may have been present in mature eggs before preservation, and the function of these conspicuously thick membranes remains unknown (perhaps in some species it supports the floating of the egg, or serves as an additional food-supply for the embryo). Two species are known to spawn egg-

strings and attach them to a substratum, viz. *Modiolaria discors*, and *M. nigra*[1]), and in one species, *Cardium elegantulum*, the development is internal. The size of the eggs and their amount of yolk naturally leads to a discussion of:

The types of larval development. Of these the following are represented within the East Greenland lamellibranch fauna:

1) Species with planktotrophic larvae and a pelagic development (small eggs with a small amount of nutritive matter), viz. *Mytilus edulis*, *Pecten islandicus*, *Serripes groenlandicus*, *Cardium ciliatum*, *Macoma calcaria*, *Hiatella arctica*, and *Mya truncata*.

2) Species with lecithotrophic larvae and a short or entirely suppressed pelagic stage (large and yolky eggs)[2]), viz. *Nucula tenuis*, *Leda pernula*, *L. minuta*, *Yoldia hyperborea*, *Y. thraciaeformis*, *Portlandia arctica*, *P. lenticula*, *P. fraterna*, *Arca pectunculoides grandis*, *A. frielei*, *A. glacialis*, *Dacrydium vitreum*, *Crenella decussata*, *Modiolaria discors laevigata*, *M. nigra*, *Propeamussium imbriferum*, *P. groenlandicum*, *Astarte borealis*, *A. montagui*, *A. elliptica*, *A. crenata* (with subspecies), *A. sulcata*, *Thyasira gouldi*, *T. equalis*, *Axinopsis orbiculata*, *Gomphina fluctuosa*, *Macoma moësta*, *M. loveni*, *M. torelli*, *Lyonsia arenosa*, *Pandora glacialis*, *Thracia septentrionalis*, *T. myopsis*, *T. devexa*, *Lyonsiella abyssicola*, *Poromya granulata*, *Cuspidaria obesa*, *C. subtorta*, and *C. glacialis*.

3) Species with internal brood-protection and without any pelagic stage, viz. *Cardium elegantulum*, whose young develop in the brood-pouches of the parent and hatch in the bottom stage. (Possibly in *Thyasira gouldi* the first stages of larval development take place inside the parent, cf. p. 104).

From an ecological point of view it seems highly important to distinguish between larvae which are dependent on plankton-food and such as are not (i. e. planktotrophic larval development versus lecithotrophic larval development including internal brood-protection throughout the larval life). On applying this distinction, it will be seen that of the 47 lamellibranch species of E. Greenland the development of which can be classified, only seven (~ 15 %) have planktotrophic larvae, while 40 species (~ 85 %) have non-planktotrophic larvae. A very distinct predominance of the non-planktotrophic larval development is thus characteristic of the East Greenland lamellibranch fauna (cf. also fig. 29, p. 244). —There still remain 8 East Greenland species whose eggs and, accord-

[1]) *Turtonia minuta* also attaches a few of its eggs together to a substratum; but this species has not yet been found alive within the region in question. Cf. p. 99.

[2]) Barrel-shaped larvae with a short pelagic stage of dispersal are known to occur within the genera *Nucula*, *Yoldia*, and *Portlandia*.

ingly, type of larval development are unknown at present. However, 6 of these species have a considerable vertical range, and as regards *Portlandia intermedia* and *P. frigida* it moreover seems probable that at N.E. Greenland their spawning does not take place in the summer; hence their larval development must be supposed to be independent on the phytoplankton. There is thus some evidence that most, if not all, of these 8 species will prove to reproduce by means of large eggs developing into non-planktotrophic larvae.

Spawning seasons. (The spawning seasons of several species in relation to vertical distribution has already previously been dealt with; cf. pp. 211—214). Obviously the spawning of the species which have planktotrophic larvae must be correlated with the season of the phytoplankton production, e. g. at N.E. Greenland their spawning and larval development must be completed within a few summer months. Thus it has been shown that *Hiatella arctica* and *Mya truncata* start spawning in the early summer in N.E. Greenland and the veligers of both species were observed in the summer plankton, but not outside the summer season (cf. THORSON 1936). Similarly, spawning at the end of July and the beginning of August is indicated in *Pecten islandicus*, *Cardium ciliatum*, and *Macoma calcaria*, while as yet the observations on *Serripes groenlandicus* are too scarce (and on *Mytilus edulis* quite lacking) to allow a definite statement as to their actual spawning season in E. Greenland. There are also some species with a lecithotrophic larval development which seem to spawn in E. Greenland in the summer, viz. *Nucula tenuis*, *Yoldia hyperborea*, *Portlandia arctica*, *Arca glacialis*, *Modiolaria discors laevigata*, *M. nigra*, and perhaps *Gomphina fluctuosa*. Apparently, however, several other species with the same type of development do not, normally, spawn in N.E. Greenland in the actual summer season. Thus *Propeamussium imbriferum*, *Thyasira gouldi*, *Axinopsis orbiculata*, *Macoma moësta*, *Lyonsia arenosa*, and *Pandora glacialis* do not seem to spawn before the end of August, and, according to THORSON (1936), *Propeamussium groenlandicum*, *Astarte borealis*, *A. montagui*, *A. elliptica*, and *A. crenata* retain their mature sexual products till late in the autumn. Also *Leda pernula*, *Portlandia fraterna*, *Dacrydium vitreum*, *Thyasira equalis*, *Macoma loveni*, and *Cuspidaria subtorta* may be supposed to spawn in N.E. Greenland outside the summer. Hence a considerable portion of the East Greenland lamellibranch species which have lecithotrophic larvae appear to spawn at times when the conditions for phytoplankton production are extremely unfavourable. To what extent spawning in most of these species is confined to a certain period of the year, cannot yet be decided. At the outset, however, extrinsic factors are supposedly far less decisive for the spawning of these species than

for that of species with planktotrophic larvae, just as the brood-protecting *Cardium elegantulum* may be supposed to reproduce throughout the greater part of, or perhaps even the whole year. The fairly ill-defined 0- or 1-groups found by THORSON (1936, pp. 95—106) in some species with lecithotrophic larva may thus be due to a prolonged spawning period.

Hermaphroditism. It seems certain that within the East Greenland lamellibranch fauna all the Nuculacea, and further, *Mytilus edulis*, the *Macoma* species, *Hiatella arctica*, *Mya truncata*, and the *Cuspidaria* species are normally unisexual, i. e. about 42 % of the total number of species. Still, hermaphroditism has hitherto been ascertained in a considerable number of the remaining species. This applies to *Lyonsia arenosa*, *Pandora glacialis*, *Thracia septentrionalis*, *T. myopsis*, *T. devexa*, *Lyonsiella abyssicola*, and *Poromya granulata*, all of which have completely separated male and female gonads in the same adult individual, while sperm and eggs are formed in the same gonads in *Modiolaria discors*, *M. nigra*, *Pecten islandicus*, *Serripes groenlandicus*, and *Cardium ciliatum*, all of these being distinctly protandric. Hermaphroditic individuals have also been found in E. Greenland in some further species which may turn out to behave in the last-described way, viz. *Arca glacialis*, *Propeamussium groenlandicum*, *Astarte borealis*, *A. montagui*, *A. elliptica*, and *A. crenata*. In *Thyasira gouldi* (as *Axinus flexuosus* in THORSON 1936), too, hermaphroditic individuals occurred, and both this species and *Axinopsis orbiculata* (cf. p. 113) are perhaps protandric. Considering the difficulty of observing a sex-change in protandric species, it is hardly an exaggeration to say that more than 12 E. Greenland lamellibranch species are normally hermaphroditic. Consequently, more than 22 %, but less than 58 % of the total number of lamellibranch species of E. Greenland are hermaphrodites of one type or other.

Size and life-span at E. Greenland in species with planktotrophic larvae. An interesting feature of the East Greenland lamellibranchs with a planktotrophic larval development is the considerable size which is often attained by the adults. The largest diameter found in specimens from E. Greenland of such species is as follows: *Mytilus edulis* 83.7 mm, *Pecten islandicus* 91.5 mm, *Serripes groenlandicus* 78.3 mm, *Cardium ciliatum* 62.0 mm, *Macoma calcaria* 43.5 mm, *Hiatella arctica* 52.7 mm, and *Mya truncata* 67.8 mm, respectively. In contrast to these, the largest diameter attained by species with a non-planktotrophic larval development is less than 50 mm; only 5 of them are known to surpass 40 mm at E. Greenland, viz. *Yoldia hyperborea* 44.7 mm, *Y. thraciaeformis* 43.0 mm, *Modiolaria nigra* 47.5 mm, *Astarte borealis* 47.6 mm, and *Thracia devexa* 40.0 mm, while 7 species reach a maximum-

size of between 30 and 40 mm, and the remaining 28 species have a maximum-size of less than 30 mm. It is thus evident that at E. Greenland the species with planktotrophic larvae grow to a markedly larger size than their relatives with non-planktotrophic larvae. Since there is no reason to believe that growth is essentially more rapid in the former group than in the latter, it follows that the former may have a considerably longer life-span than the latter. Moreover, a comparatively slow growth is indicated for all East Greenland lamellibranch species which have been studied in this respect[1]). It must therefore be assumed that all the East Greenland lamellibranch species with planktotrophic larvae normally have a life-span of several years and, accordingly, their adults must be able to reproduce several times in spite of their probably late maturity. This is a condition very different from that found in many boreal species with planktotrophic larvae and with a normal life-span of 1—4 years and correspondingly few spawning seasons. The pronounced predominance of species with a non-planktotrophic larval development in itself stresses the difficulties of reproducing by means of planktotrophic larvae at E. Greenland, where, owing to minor climatic changes, the conditions may temporarily render a successful recruitment of such species quite impossible. Still a long life-span of the adult individuals must be supposed to remedy the consequences of adverse years and must be very important for the maintenance of the populations of such species in arctic waters.

The conditions discussed above may probably also contribute to an understanding of the relatively rare and irregular occurrence of *Macoma calcaria* in certain areas of E. Greenland. *M. calcaria* attains the smallest maximum-size of all the East Greenland species with planktotrophic larvae and possibly it also has a correspondingly shorter life-span. If this supposition is correct, it would more easily be locally extinguished than the other species with the same type of larval development. A hint in this direction is that exceedingly few young bottom stages of this species are present in the samples from E. Greenland, in spite of the presence of large numbers of adult and half-grown specimens, while e. g. fairly large numbers of young bottom stages of *M. moësta* were secured. It would thus seem that at E. Greenland *M. calcaria* either does not spawn every summer or its larval development may fail in certain years[2]).

The abundance of *Mya truncata* and especially *Hiatella arctica* along the East Greenland coasts is not in conflict with the preceding

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[1]) Actually, of the lamellibranchs studied by Thorson (1936) *Modiolaria discors laevigata* and *Propeamussium groenlandicum*, both having lecithotrophic larvae, showed the highest rate of O_2-consumption and a comparatively rapid growth.

[2]) In Danish waters *Mya truncata* is known to produce large numbers of spat often only at intervals of several years (cf. Thorson 1936, p. 61).

considerations, as these two species spawn at N.E. Greenland very early in the summer (this means that another factor than a rise in temperature must be the spawning stimulus). Accordingly they have a better chance to utilise the phytoplankton-maximum and to complete the larval development than have the other species with planktotrophic larvae, which seem to spawn later in the summer.

A further consequence of the large size attained by lamellibranchs with a planktotrophic larval development must be the production of enormous numbers of eggs. It is thus known that large individuals of *Mytilus edulis* may spawn up to 25 millions of eggs (cf. THORSON 1946, p. 441), while no information of the egg-numbers of the other East Greenland lamellibranchs of this group is available. However, it may be of some interest to compare a few of these species with their relatives with lecithotrophic larvae and to calculate their relative egg-numbers. Assuming similar proportions between shell and size of the gonads, an equal number of reproductive seasons per year, and equally densely packed eggs of the same shape, it follows that a 30 mm long adult of *Macoma calcaria* (egg-size 95 μ) produces 64 times as many eggs as a 15 mm long adult of *M. moësta* (egg-size 190 μ). Similarly, a 60 mm long adult of *Pecten islandicus* (egg-size 90 μ) produces about 100 times as many eggs as a 20 mm long adult of *Propeamussium groenlandicum* (egg-size 140 μ). Still, a relatively longer life-span is indicated for the East Greenland lamellibranchs with planktotrophic larvae, and this means even greater differences of the egg-numbers produced during life by individuals of the two groups. It seems probable that, besides a long life of the adult individuals, their faculty of producing enormous numbers of eggs is an important condition for the survival at East Greenland of those lamellibranch species which have a planktotrophic larval development.

Comparision of arctic with boreal lamellibranch faunas in relation to the main types of larval development. As was clearly demonstrated by THORSON for the prosobranch faunas of the N. Atlantic, the percentages of species with a pelagic larval development distinctly decreases from boreal towards arctic regions with a corresponding increase of the percentages for a non-pelagic larval development (cf. e. g. THORSON 1944). Conditions within the marine lamellibranch faunas are quite parallel. Thus fig. 29 shows the percentages of lamellibranch species with a planktotrophic (i. e. pelagic) and those with a non-planktotrophic (i. e. essentially non-pelagic) larval development within the shelf-faunas (lower limit 400 m depth) of E. Greenland, N. and E. Iceland, S., W., and N.W. Iceland, the Faroes, Norway S. of and including Lofoten, and Denmark (based upon information in JØRGENSEN 1946 (in THORSON 1946, which see for literature previous to 1946),

LEBOUR 1947, MACGINITIE 1955, MATVEEVA 1953, OLDFIELD 1955, OWEN 1953, REES 1950, 1951, and 1954, SULLIVAN 1948, THORSON 1936, WIBORG 1946, and author's own investigations). The graphs, indeed, show a very distinct and fairly regular change in the relative distribution of the two types of larval development from boreal towards arctic waters. Of special interest is the contrast between the two Icelandic regions which evidences

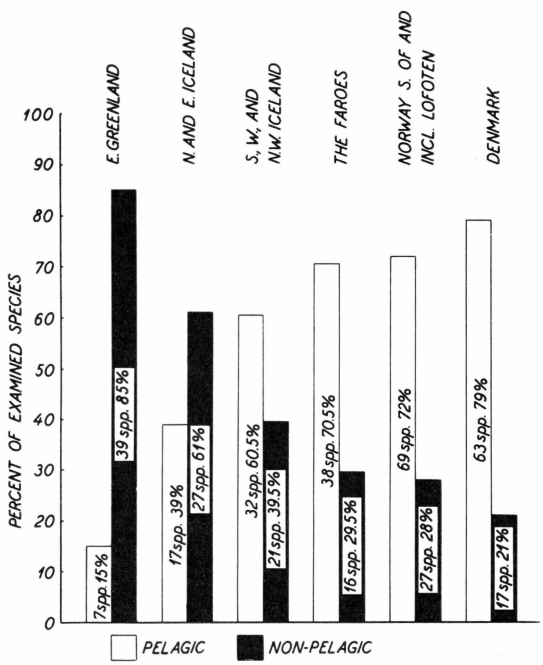


Fig. 29. Graphs showing the percentages of lamellibranch species with a pelagic (planktotrophic), and of those with a non-pelagic (non-planktotrophic) larval development within the shelf faunas of East Greenland, N. and E. Iceland, S., W., and N. W. Iceland, the Faroes, Norway S. of and including Lofoten, and Denmark.

once more the transitional zoogeographical position of Iceland. The main difference between the prosobranch and the lamellibranch faunas of the regions concerned is, generally, a comparatively larger percentage of species with non-planktotrophic larvae within the former. Thus not a single prosobranch species with pelagic larvae is known from E. Greenland (THORSON 1944), while still a few lamellibranch species with planktotrophic larvae are able to exist there.

The reproduction and larval development within the East Greenland lamellibranch fauna are thus characterised by: (1) A fairly large number of species producing adhesive eggs or laying egg-strings; (2) A distinct predominance of the non-planktotrophic larval development (in 40 out of the 47 species examined);

(3) Spawning outside the summer season within a considerable number of species with a non-planktotrophic larval development; (4) A considerable number of normally hermaphroditic species (more than 22 %, but less than 58 %, of the total number); and (5) Large size and, consequently, long life, several spawning seasons, and the production of large numbers of eggs in the species which have a planktotrophic larval development.

H. Enemies. Economic importance.

Enemies of the lamellibranch larvae. A general account of the enemies of pelagic larvae of marine bottom invertebrates is found in THORSON 1946, and 1950, to which the reader is referred. At present very little is known as to which animals actually feed on lamellibranch larvae at E. Greenland and in other arctic waters. However, a characteristic feature of the whole invertebrate fauna of the region is the scarcity of bottom-dwelling species with pelagic larvae (cf. THORSON 1936). Furthermore, as the studies by USSING (1938) and DIGBY (1953) indicate, the zooplankton of N.E. Greenland is generally dominated by copepods (which are known to feed chiefly on phytoplankton and other copepods). Possibly, *Limacina helicina* PHIPPS is an enemy to pelagic bivalve larvae at N.E. Greenland; there is a maximum of young *Limacina* from January to May, while adults occur rather sparsely all the year round (cf. USSING 1938, p. 47). On the whole, however, planktonic invertebrates seem to be of quantitatively slight importance as consumers of lamellibranch larvae as compared with boreal seas, whereas the fishes, especially their younger stages, may supposedly eat appreciable numbers of them. As regards the bottom-dwellers, the few cirriped species living in the region are probably of little importance at N.E. Greenland as consumers of lamellibranch larvae, while along the south-eastern coast, *Balanus balanoides* (L.) in the tidal zone may comb *Mytilus* and other pelagic bivalve larvae in quantity. However, a main cause of the waste of lamellibranch larvae must be sought in the activities of other bottom invertebrates. Very likely, the suspension-feeding lamellibranchs which are quantitative dominants in shallower water throughout the region, feed on, or at any rate kill, vast numbers of pelagic larvae, thus possibly their own offspring (cf. THORSON 1946, p. 470, on the effect of filtering in *Mytilus*). In this connection it may be noted that also *Cuspidaria* may swallow lamellibranch veligers (cf. p. 162); but the septibranchs are hardly of any quantitative significance in this respect.

Enemies of the settled lamellibranchs. While our present knowledge of the enemies of arctic lamellibranch larvae is very imper-

fect, somewhat more is known about the arctic animals which feed on lamellibranchs in the bottom stage. These enemies are as follows:

Echinoderms. A specimen of the brittle-star *Ophiocten sericeum* (FORBES) and a specimen of *Ophiacantha bidentata* (BRUZELIUS) have been found at N.E. Greenland with a relatively large specimen of *Hiatella arctica* and of *Modiolaria discors laevigata*, respectively, in their stomachs (cf. p. 136, and p. 54). Since notably the first-mentioned species is exceedingly common at E. Greenland, it is supposedly a principal enemy to smaller lamellibranchs. Also other East Greenland echinoderms may be assumed to be dangerous to lamellibranchs, especially to metamorphosing larvae and the youngest bottom stages.

Prosobranchs. The material at hand from E. Greenland and Jan Mayen includes shells and valves of 37 lamellibranch species which are drilled by *Natica*, viz. *Nucula tenuis* 2, *Leda pernula* 1, *L. minuta* 1, *Portlandia arctica* 4, *P. intermedia* 3, *P. lenticula* 5, *P. subaequilatera* 2, *P. frigida* 2, *Arca pectunculoides grandis* 1, *A. frielei* about 31, *A. glacialis* 2, *Dacrydium vitreum* 2, *Modiolaria nigra* 1, *Astarte borealis* 3, *A. montagui* 3, *A. elliptica* 1, *A. crenata* s. l. 4, *A. sulcata* 1, *Thyasira gouldi* 17, *T. equalis* about 35, *Axinopsis orbiculata* 3, *Serripes groenlandicus* 2, *Cardium ciliatum* 1, *Gomphina fluctuosa* 19, *Macoma calcaria* 7, *M. moësta* 2, *M. loveni* 4, *Hiatella arctica* 4, *Cyrtodaria kurriana* 2, *Mya truncata* 11, *Lyonsia arenosa* 2, *Pandora glacialis* 7, *Thracia septentrionalis* 1, *T. myopsis* 3, *T. devexa* 5, *Cuspidaria subtorta* 5, and *C. glacialis* 1. Most of these shells and valves are rather smaller. It is, of course, impossible to say how long they have been lying on the sea bottom before they were collected. However, considering the comparatively small number of specimens, *Natica* is not, apparently, a very important enemy, despite its common occurrence at E. Greenland.

Fishes. So far known, not a single lamellibranch is recorded from stomachs of fish from E. Greenland proper. It is known that the fish fauna of N.E. Greenland is very poor both in species and specimens, *Cottus scorpius* L., *C. quadricornis* L., *Gadus saida* LEPECHIN, and *Salmo alpinus* L. being the most frequent. However, in stomachs of specimens of the first-mentioned two species from Arctic America, marine gastropods have been found (DALL 1919), and possibly these cottids may take lamellibranchs as well. This is perhaps also true of *Somniosus microcephalus* SCHNEIDER, as a specimen from Angmagssalik had an adult *Buccinum groenlandicum* in its stomach (THORSON 1944) and the Greenland Shark is rather common at E. Greenland. Owing to the milder marine climate in recent years, the Common Cod (*Gadus callarias* L.) has appeared in large numbers off S. E. Greenland and near Jan Mayen.

This fish is known to feed partially on bottom invertebrates. T. IVERSEN (1936) lists *Mya truncata*, *Hiatella arctica*, and *Pecten* among the stomach contents of specimens from Jan Mayen, and GRIEG (1927) found *Leda pernula*, *Astarte crenata*, and *Macoma calcaria* in specimens from the Spitzbergen Banks. However, considering the poverty of the fish fauna of E. Greenland as a whole, the fishes do not seem to be important consumers of settled lamellibranchs.

Birds: Lamellibranchs are a main element in the diet of the Eider ducks. The present material includes specimens of *Portlandia arctica*, and *Hiatella arctica* eaten by *Somateria spectabilis* (cf. P. JOHNSEN 1953), and also *Portlandia arctica* from stomachs of *S. mollissima*, both from E. Greenland. J. MADSEN (1949) mentions *Mytilus edulis* swallowed by Eider ducks from Iceland. This as well as other shallow-water lamellibranchs may accordingly be consumed at E. Greenland by these birds. Gulls, and perhaps the Raven have also an opportunity of securing bivalves in the tidal zone of the south-eastern coast stretch. Still, the Eider ducks are absent from E. Greenland during the greater part of the year, when also the shores are covered with ice. Hence the part played by the birds as consumers of East Greenland lamellibranchs must be rather insignificant.

Mammals. According to VIBE (1950), the Walrus (*Trichechus rosmarus* L.) at N.W. Greenland feeds substantially on lamellibranchs, of which *Serripes groenlandicus*, *Cardium ciliatum*, *Mya truncata*, and *Hiatella arctica* are the most important. Further *Astarte borealis*, *A. montagui*, and *Macoma calcaria* may occur in its stomach contents. The present paper mentions remains of *Mya truncata* from walruses at E. Greenland, where also *Leda pernula* was found in the stomach of a specimen of *Phoca hispida* SCHREIBER. VIBE (l. c.) states that the Bearded Seal (*Erignathus barbatus* (FABRICIUS)) feeds only occasionally on lamellibranchs, and mentions *Hiatella arctica* from two specimens. This bivalve and, in addition, *Modiolaria discors laevigata* are recorded by DALL (1919) from stomachs of the same species of seal. However, the Bearded Seal and the Ringed Seal probably very rarely feed on lamellibranchs, whereas the Walrus may be regarded as an important consumer of them at E. Greenland.

Economic importance. AD. JENSEN (1905) writes that the Greenlanders of the Angmagssalik district collect and eat *Mytilus edulis* in large numbers whenever an opportunity offers, and that in former times the mussels, together with certain marine algae, have often saved the inhabitants from starvation in the spring when other food ran short. Besides, some other East Greenland lamellibranchs may be fit for human

consumption, i. a. *Serripes groenlandicus* and *Cardium ciliatum*. As will be evident from the preceding account, only two species which use lamellibranchs as a main element of their diet, are of importance to the Greenlanders, viz. the Walrus and the Eider duck. In agreement with the small standing crop of the sea bottom in N.E. Greenland, the fish fauna of these waters support no fishing industry. Although the standing crop of the sea bottom along S.E. Greenland is reported to be fairly large, fishery of any great importance is rendered difficult by other factors, e. g. ice and fogs. Moreover, here and around Jan Mayen the hydrographic conditions are rather unstable. Thus, taken as a whole, the economic importance—directly as well as indirectly as food for other animals—of the East Greenland lamellibranchs is very limited.

IV. LITERATURE

AMDRUP, G., 1902. Hydrografi fra Skibsekspeditionen til Grønlands Østkyst 1900. — Medd. Grønland, vol. 27, Kjøbenhavn.

AMIRTHALINGHAM, C., 1928. On lunar periodicity in reproduction of *Pecten opercularis* near Plymouth in 1927—28. — J. Mar. biol. Ass. Plymouth, n. s., vol. 15, pp. 605—641.

APPELLÖF, A., 1912. Über die Beziehungen zwischen Fortpflanzung und Verbreitung mariner Tierformen. — Verhandl. 8. intern. Zool.-Kongr. Graz, pp. 303—311.

BECHER, E., 1886. Mollusken von Jan Mayen. In: Die Intern. Polarforschung 1882—83. Die österreich. Polarstation Jan Mayen. Beob.-Ergebn. herausg. v. d. Akad. d. Wissensch., Bd. 3, Wien.

BECK, H., 1851. *Cardium grönlandicum*, *Modiolaria striatula* BECK, *M. laevis* BECK, *M. discors*, *M. faba*, in GAIMARD: Voyage en Islande et au Grœnland, Paris.

BERTELSEN, E., 1937a. Contributions to the animal ecology of the fjords of Angmagssalik and Kangerdlugssuaq in East Greenland. — Medd. Grønland, Bd. 108, Nr. 3, København.

— 1937b. Marinbiologiske Undersøgelser IV. Undersøgelser ved Grønlands Sydøstkyst. In: Beretning om M/S "Thor's" Havundersøgelsestogt 1935, pp. 73—95, København.

BRÖGGER, W. C., 1900—01. Om de senglaciale og postglaciale nivåforandringer i Kristianiafeltet (Molluskfaunaen). — Norg. geol. Undersøg., No. 31, Kristiania.

BROWN, TH., 1827. Illustrations of the Recent Conchology of Great Britain and Ireland. Edinburgh.

CARUS, V., 1889. Prodromus Faunae Mediterraneae Vol. II., Pars 1, Mollusca. Stuttgart.

COLLIN, J., 1887. Brachinopoder, Muslinger og Snegle fra Kara-Havet. Djimphna Togtets zoologisk-botaniske Udbytte, pp. 439—472. København.

DALL, W. H., 1886. Report on the Mollusca. Part I. Brachiopoda and Pelecypoda. In: Reports Res. Dredging M.S. Coast Survey Steamer "Blake". — Bull. Mus. Comp. Zoöl. Harvard, vol. 12, no. 6.

— 1889. A preliminary Catalogue of the shell-bearing marine Mollusks and Brachiopods of the Southeastern Coasts of the United States, etc. — Bull. U. S. nat. Mus., no. 37.

— 1900. Synopsis of the family Tellinidae and of the North American species. — Proc. U. S. nat. Mus., vol. 23, pp. 285—326.

— 1901. Synopsis of the Lucinacea and of the American species. — Ibidem, vol. 23, pp. 779—833.

— 1919. Mollusks, Recent and Pleistocene. In: Canad. Arctic-Exp., vol. 8, Ottawa.

— 1921. Summary of the marine shell-bearing mollusks of the Northwest Coast of America from San Diego, California, to the Polar Sea, etc. — Bull. U. S. nat. Mus., vol. 112, pp. 1—217.

DALL, W. H., 1925. Illustrations of unfigured Types of Shells in the Collection of the United States National Museum. — Proc. U. S. nat. Mus., vol. 66, pp. 1—41.

DAUTZENBERG, PH. & FISCHER, H., 1912. Mollusques provenant des campagnes de l'Hirondelle de la Princesse Alice dans les mers du Nord. Resultats des campagnes scientifiques accomplies sur son yacht par Albert I. Tome 37, Monaco.

DIGBY, P. S. B., 1953. Plankton production in Scoresby Sound, East Greenland. — J. Anim. Ecol., vol. 22, pp. 289—320.

DONS, C., 1929. Zoologiske Notiser IV. — K. norske vidensk. Selsk. Forhandl., Bd. 1, No. 57, Trondheim.

DREW, G. A., 1899. *Yoldia limatula*. — Mem. Biol. Lab. Johns Hopkins Univ., vol. 4, Baltimore.

DUNKER, W., 1862. Beschreibung neuer Mollusken. — Malakozool. Blätter, Bd. 8, pp. 35—45.

EKMAN, SV., 1935. Tiergeographie des Meeres. Leipzig. — 1953. Zoogeography of the Sea. London.

ELLIS, D. V., 1955. Some observations on the shore fauna of Baffin Island. — Arctic, vol. 8, pp. 224—236.

FABRICIUS, O., 1780. Fauna Groenlandica, Hafniae et Lipsiae.

FORBES, E. & HANLEY, S., 1853. A History of British Mollusca and their Shells, vol. 3, London.

FRIELE, H., 1877. Preliminary report on mollusca from the Norwegian North Atlantic Expedition in 1876. — Nyt Mag. Naturv., Bd. 23, pp. 1—10, Kristiania.

— 1878. Jan Mayen Mollusca from the Norwegian North Atlantic Exped. 1877. — Ibidem, Bd. 24, pp. 221—226, Kristiania.

— 1879. Catalog der auf der Norwegischen Nordmeer-Exp. bei Spitzbergen gefundenen Mollusken. — Jahrb. deutsch. malacozool. Ges., Jahrg. 6, pp. 264—286.

— 1886. The Norwegian North Atlantic Expedition 1876—78. Mollusca II, Kristiania.

— 1902. Mollusken der ersten Nordmeerfahrt des "Michael Sars". — Bergens Mus. Aarb., Bd. 1, Nr. 3, Bergen.

FRIELE, H. & GRIEG, J. A., 1901. The Norwegian North Atlantic Expedition 1876—78. Mollusca III, Kristiania.

FULLARTON, J. H., 1890. On the development of the common scallop (*Pecten opercularis*). — Sci. Invest. Fish. Scotl., (1889), pp. 297—98, Glasgow.

GOULD, A. A., 1841. Report on the Invertebrata of Massachusetts. Cambridge, Mass.

GOULD, A. A. & BINNEY, W. G., 1870. Report on the Invertebrata of Massachusetts. Boston.

GRAY, J. E., 1824. Shells, in: Supplement of Appendix of Captain PARRY's voyage for the discovery of a North West Passage in the year 1819—20, London.

— 1839. Molluscous Animals. The Zoology of Captain BEECHEY's Voyage, London.

GRIEG, J. A., 1909a. Invertébrés du fond. In: "Duc d'Orleans". Croisiére océanographique accomplie à bord de la "Belgica" dans la mer du Grönland 1905, Bruxelles.

— 1909b. Brachiopods and Molluscs. — Rep. of the Second Norw. Arct. Exp. in the "Fram" 1898—1902, No. 20, Kristiania.

— 1916. Mollusker fra Grønlands Nordøstkyst. — Nyt Mag. Naturv., Bd. 54, pp. 7—10, Kristiania.

— 1927. Evertebrater fra bankerne ved Spitsbergen. (Fiskenæring og bundfauna). — Bergens Mus. Aarb. (1926), naturv. række, no. 5.

HÄGG, R., 1904. Mollusca und Brachiopoda gesammelt von der schwedischen zoologischen Polarexpedition nach Spitzbergen, dem nordöstlichen Grönland und

Jan Mayen i. J. 1900. I. Lamellibranchia. — Ark. Zool., Bd. 2, No. 2, Stockholm.

Hägg, R., 1905. Mollusca und Brachiopoda etc. II. Scaphopoda, Gastropoda, Placophora und zwei vorher nicht erwähnte Lamellibranchiata. — Ibidem, Bd. 2, No. 13, Stockholm.

Hancock, A., 1846. List of Shells dredged on the West Coast of Davis Strait. — Ann. Mag. nat. Hist., vol. 18, no. 120, London.

Herzenstein, S., 1885. Beiträge zur Kenntnis der Fauna der Murman-Küste und des Weissen Meeres. 1. Mollusca, 182 pp. Petersburg.

Horsted, A. A. & Smidt, E., 1956. The Deep Sea Prawn (*Pandalus borealis* Kr.) in Greenland Waters. — Medd. Danmarks Fiskeri- og Havundersøgelser, n. s., bd. 1, no. 11, København.

Hunt, O. D., 1925. The food of the bottom fauna of the Plymouth fishing grounds. — J. Mar. biol. Ass., vol. 13, pp. 560—599, Plymouth.

Hunter, W. R., 1949. The structure and behaviour of *Hiatella gallicana* (Lamarck), and *H. arctica* (L.) with special reference to the boring habits. — Proc. Roy. Soc. Edinb., vol. 63 B, no. 3, pp. 271—289.

Iversen, T., 1936. Sydøstgrønland Jan Mayen-Fiskeriundersøkelser. — Fiskeridir. Skrift. ser. Havunders., Bergen (Rep. on Norw. Fishery and Mar. Invest., vol. 5, no 1).

Jeffreys, J. G., 1863—69. British Conchology, vol. II, III, and V, London.

— 1876a. Preliminary report of the biological results of a cruise in H.M.S."Valorous" in Davis Strait 1875. — Proc. roy. Soc., vol. 25, London.

— 1876b. New and peculiar Mollusca of the *Kellia*, *Lucina*, *Cyprina*, and *Corbula* Families procured in the "Valorous" Expedition. — Ann. Mag. nat. Hist., ser. 4, vol. 18.

— 1876c. On some species of Japanese marine Shells and Fishes, which inhabit also the North Atlantic. — J. Linn. Soc. (Zoology), vol. 12, London.

— 1877. On the Mollusca collected during the Arctic Expedition of 1875—76. — Ann. Mag. Nat. Hist., ser. 4, vol. 20, London.

— 1878—79—81. On the Mollusca procured during the "Lightning" and "Porcupine" Expeditions 1868—70, part 1, 2, and 3. — Proc. Zool. Soc. London, 1878—79—81.

— 1883. On the Mollusea procured during the cruise of H.M.S. "Triton" between the Hebrides and Faroes in 1882. — Ibidem, London 1883.

Jensen, Ad. S., 1900. Studier over nordiske Mollusker. I. *Mya*. — Vidensk. Medd. naturh. Foren., Bd. 62, pp. 133—158. Kjøbenhavn.

— 1902. Fortegnelse over Skaller af bivalve Grundtvandsmollusker fra store Havdyb mellem Jan Mayen og Island. — Ibidem, (1902). Kjøbenhavn.

— 1903. *Pecten frigidus* nomen Pectini profundorum maris polaris incolae novum datum. — Ibidem, (1904). København.

— 1904. Studier over nordiske Mollusker. III. *Tellina* (*Macoma*). — Ibidem, (1905). København.

— 1905. On the Mollusca of East Greenland. I. Lamellibranchiata. — Medd. om Grønland, vol. 29, pp. 289—362, Copenhagen.

— 1912. Lamellibranchiata I. — The Danish Ingolf Exp., vol. 2, part 5, Copenhagen.

— 1917. Quaternary Fossils Collected by the "Danmark" Expedition. — Medd. om Grønland, vol. 43, no. 21, København.

— 1942. Two new West Greenland localities for deposits from the Ice age and the post-glacial Warm Period. — Biol. Meddel. København, vol. 17, no. 4, pp. 1—34.

JENSEN, AD. S. & SPÄRCK, R., 1934. Saltvandsmuslinger. — Danmarks Fauna, Bd. 40, København.

JOHNSEN, P., 1953. Birds and mammals of Pearyland in North Greenland. — Medd. om Grønland, vol. 128, no. 6, København.

JOHNSON, C. W., 1915. Fauna of New England. List of the Mollusca. — Occ. Pap. Boston Soc. nat. Hist., vol. 7, no. 13.

— 1934. List of the Mollusca of the Atlantic coast from Labrador to Texas. — Proc. Boston Soc. nat. Hist., vol. 40, no. 1.

JØRGENSEN, C. B., 1946. Lamellibranch larvae. — Cf. THORSON 1946.

KANWISHER, J.W., 1955. Freezing in intertidal animals. — Biol. Bull. Woods Hole, vol. 109, no. 1.

KINNE, O., 1956. Über Temperatur und Salzgehalt und ihre physiologisch-biologische Bedeutung. — Biol. Zbl., Bd. 75, Heft 5/6, Leipzig.

KNIPOWITSCH, N., 1900. Zur Kenntnis der geol. Geschichte d. Fauna des Weissen und des Murman-Meeres. I. Recente Fauna. In: Verh. Russ. Mineral. Ges., Ser. 2, Bd. 38, Petersburg.

— 1901. Zool. Ergebnisse der russ. Expedition nach Spitzbergen, Mollusca und Brachiopoda. I. Über die in den Jahren 1899—1900 im Gebiete von Spitzbergen gesammelten recenten Mollusken und Brachiopoden. — Ann. Mus. Zool., vol. 6, no. 4, St. Petersbourg.

LAMY, ED., 1913a. Mollusques et Brachiopodes de la croisiére 1912 du "Pourquoi Pas?" dans les mers du Nord. — Bull. Mus. Hist. nat. Paris, 1913, pp. 21—24.

— 1913b. Mollusques testacés et Brachiopodes de la croisiére 1913 du "Pourquoi-Pas?" dans l'Atlantique et dans les mers boréales. — Ibidem, Paris, 1913, pp. 593—603.

— 1923. Révision des Saxicavidae vivants de muséum national d'histoire naturelle de Paris. — J. Conchyliol. Paris, vol. 68, pp. 218—248.

— 1926. Mollusques testacés de la croisére 1925 du "Pourquoi Pas?" dans l'Atlantique et les mers boréales. — Bull. Mus. Hist. nat. Paris 1926, pp. 179—181.

LA ROCQUE, A., 1953. Catalogue of the recent Mollusca of Canada. — Bull. nat. Mus. Ottawa, no. 129 (Biol. ser. no. 44).

LAURSEN, DAN, 1954. Emerged Pleistocene marine deposits of Peary Land (North Greenland). — Medd. om Grønland, vol. 127, no. 5, København.

LEBOUR, MARIA V., 1938. Notes on the breeding of some lamellibranchs from Plymouth and their larvae. — J. Mar. biol. Ass. Plymouth, vol. 23, no 1, pp. 119—145.

— 1947. Notes on the inshore plankton of Plymouth. — Ibidem, vol. 26, pp. 527—547.

LECHE, W., 1878. Öfversikt öfver de af Svenska Exped. till Novaja Semlja och Jenissej 1875 och 1876 insamlade hafsmollusker. — K. svenska Vetensk. Akad. Handl., Bd. 16, No. 2, Stockholm.

— 1883. Öfversickt öfver de af Vega-Expeditionen insamlade Arktiske Hafsmollusker. I. Lamellibranchiata. Vega-Exped. Vetensk. Iakttagelser, vol. 3, Stockholm.

LEMCHE, H., 1941. Gastropoda Opisthobranchiata. In: The Zoology of East Greenland. — Medd. om Grønland, vol. 121, no. 7, København.

LOCARD, A., 1898. Mollusques testacés. 2. Exped. Sci. Travailleur et Talisman.

MCANDREWS, R. & FORBES, E., 1847. Notices of new and rare British Animals observed during Cruises in 1845 and 1846. — Ann. Mag. nat. Hist., vol. 19, London.

MACGINITIE, G. E., 1955. Distribution and ecology of the marine invertebrates of Point Barrow, Alaska. — Smithson. misc. Coll., vol. 128, no. 9, Washington.

Madsen, F. Jensenius, 1949. Marine Bivalvia. — The Zoology of Iceland, vol. 4, part 63, 116 pp., Copenhagen.

Madsen, H., 1936. Investigations on the shore fauna of East Greenland with a survey of the shores of other arctic regions. — Medd. om Grønland, vol. 100, no. 8, København.

— 1940. A study of the littoral fauna of Northwest Greenland. — Ibidem, vol. 124, no. 3, København.

Matveeva, T. A., 1953. On modes of reproduction in marine bivalves. — Doklady Akademii Nauk SSSR, vol. 93, no. 5, pp. 923—24. (In Russian).

Melvill, J. C. & Standen, R., 1900. Rep. Mollusca of the "Jackson-Harmsworth" Exp. to Franz Joseph Land (1896—97) and of the "Andrew Coats" Cruise (1898) to Kolguev. — Mem. Manchester lit. phil. Soc. vol. 44, no. 4.

Meyer, H. A. & Möbius, K., 1872. Fauna der Kieler Bucht, Bd. 2, Leipzig.

Morse, Edw. S., 1919. Observations on living lamellibranchs of New England. — Proc. Boston Soc. nat. Hist., vol. 35, no. 5, pp. 139—196.

Möbius, K., 1874. Mollusken. In: Die zweite Deutsche Nordpolarfahrt 1869 u. 70 unter Koldewey. II. Zoologie, Part 7, Leipzig.

Møller, H. P. C., 1842. Index Molluscorum Groenlandiae. — Naturh. Tidskr., Bd. 4, (1842—43), pp. 76—97, Kjøbenhavn.

Mørch, O. L. A., 1857. Fortegnelse over Grønlands Bløddyr. In: Naturh. Bidrag til en Beskrivelse af Grønland af I. Reinhardt m. fl., Kjøbenhavn.

— 1877. Mollusca. In: Rink: Danish Greenland.

Nathorst, A. G., 1901. Bidrag til nordöstra Grönlands Geologi. — Geol. Fören. Förhandl., Bd. 23, Stockholm.

Noe-Nygaard, A., 1933. Remarks on *Mytilus edulis* L. in raised beaches in East Greenland. — Medd. om Grønland, vol. 95, no. 2, København.

Norman, A. M., 1902. Notes on the natural history of East Finmark. — Ann. Mag. nat. Hist., ser. 7, vol. 10, no. 59, London.

Ockelmann, W. K., 1954. On the interrelationship and the zoogeography of northern species of *Yoldia* Möller, s. str. (Mollusca, fam. Ledidae). — Medd. om Grønland, vol. 107, no. 7, København.

Odhner, N. H., 1914. Notizen über die Fauna der Adria bei Rovigno. Beiträge zur Kenntnis der marinen Molluskenfauna von Rovigno in Istrien. — Zool. Anz., Bd. 44, No. 4, pp. 156—170, Leipzig.

— 1915. Die Mollusken des Eisfjordes. Zool. Ergebn. d. Schwed. Exped. nach Spitzbergen 1908. — K. svenska Vetensk.-Akad. Handl., Bd. 54, No. 1, pp. 1—274, Stockholm.

Oldfield, E., 1955. Observations on the anatomy and mode of life of *Lasea rubra* (Montagu) and *Turtonia minuta* (Fabricius). — Proc. malacol. Soc., vol. 31, parts 5 and 6, London.

Oldroyd, I. S., 1924. Marine shells of Puget Sound and vicinity. — Pub. Puget Sd. Mar. biol. Sta., vol. 4, pp. 1—272, Seattle.

Orton, J. H., 1920. Sea-temperature, breeding and distribution of marine animals. — J. Mar. biol. Ass., vol. 12, pp. 339—366, Plymouth.

Owen, G., 1953. On the biology of *Glossus humanus* (L.) (*Isocardia cor* Lam.). — J. Mar. biol. Ass., vol. 32, pp. 85—106, Plymouth.

Parat, M. & Devillers, C., 1936. Sur les associations animales des côtes de l'île Jan Mayen. — C. R. Acad. Sci., vol. 202, pp. 90—92, Paris.

Pelseneer, P., 1890. Deus nouveaux Pelecypodes hermaphrodites. — C. R. Acad. Sci., vol. 110, pp. 1081—1083, Paris.

— 1891. Sur l'existence d'un groupe entier de Lamellibranches hermaphrodites. — Zool. Anz., Bd. 14, pp. 5—8, Leipzig.

PELSENEER, P., 1901. Sur le degré d'eurythermie de certaines larves marines. — Bull. Acad. Belg. Cl. Sci., pp. 279—292, Bruxelles.
— 1935. Essai d'ethologie d'apres l'étude des Mollusques. Pub. Fond. Agathon De Potter. Acad. Roy. Belgique, Cl. Sci., pp. 1—662, Bruxelles.
PETERSEN, C. G. JOH., 1913. Valuation of the Sea II. — Rep. Danish Biol. Station, vol. 21, Copenhagen.
POSSELT, H. J., 1895. Østgrønlandske Mollusker. — Medd. om Grønland, Bd. 19, pp. 59—93, Kjøbenhavn.
POSSELT, H. J. & JENSEN, AD. S., 1898. Grønlands Brachiopoder og Bløddyr. In: Conspectus Faunae Groenlandicae. — Medd. om Grønland, Bd. 23, 298 pp., Kjøbenhavn.
REES, C. B., 1950. The identification and classification of lamellibranch larvae. — Hull Bull. Mar. Ecol., vol. 3, no. 19.
— 1951. Continuous plankton records: First report on the distribution of lamellibranch larvae in the North Sea. — Ibidem, vol. 3, no. 20.
— 1954. The distribution of lamellibranch larvae in the North Sea, 1950—51. — Bull. Marine Ecol., (formerly Hull Bull. Mar. Ecol.), vol. 4, no. 27.
REEVE, L., 1855. Account of the shells. In: E. BELCHER: The last of Arctic Voyages, vol. 2, London.
REMY, P. 1928. Materiaux zoologiques récoltés par le "Pourquoi-Pas?" dans les mers arctiques en 1926. — Ann. Sci. nat., ser. 10, vol. 11, Paris.
RUNNSTRÖM, Sv., 1927. Über die Thermopathie der Fortpflanzung und Entwicklung mariner Tiere in Beziehung zu ihrer geographischen Verbreitung. — Bergens Mus. Aarb. (1927), Naturv. Rekke, No. 2.
— 1930. Weitere Studien über die Temperaturanpassung der Fortpflanzung mariner Tiere. — Ibidem, (1929), Naturv. Rekke, No. 10.
RYDER, C., 1895. Den østgrønlandske Expedition udført i Aarene 1891—92. Hydrografi. — Medd. om Grønland, Bd. 17, Kjøbenhavn.
SARS, G. O., 1878. Bidrag til Kundskaben om Norges Arktiske Fauna. I. Mollusca regionis arcticae Norwegiae. Christiania.
SARS, M., 1865. Om de i Norge forekommende fossile Dyrelevninger fra Quartærperioden. Kristiania.
SCHLESCH, H., 1931. Kleine Mitteilungen VII. — Arch. Molluskenk., Heft 4/5, Frankfurt a. M.
SMITH, A. E., 1877. On the Mollusca collected during the Arctic Expedition of 1875—76. — Ann. Mag. nat. Hist., ser. 4, vol. 20, London.
— 1878. Mollusca. In NARES: "Alert" and "Discovery". Narrative of a Voyage to the Polar Sea 1875—76. Vol. 2, London.
SOOT-RYEN, T., 1932. Pelecypoda. With a discussion of possible migrations of Arctic Pelecypods in Tertiary times. — Sci. Res. Norw. North Polar Exped. "Maud" 1918—25. Vol. 5, part 12, Bergen.
— 1941. Northern Pelecypods in the collection of Tromsø Museum I. — Tromsø Mus. Aarsheft, vol. 61 (1938), no. 1.
— 1951. New Records on the Distribution of Marine Mollusca in Northern Norway. — Astarte, no. 1, pp. 1—11, Tromsø.
SOWERBY, G. B., 1842—45—55. Thesaurus conchyliorum, vol. 1 and 2, London.
SPÄRCK, R., 1926. On the food problem in relation to marine zoogeography. — Physiol. papers dedicated to prof. AUGUST KROGH, pp. 268—283, Copenhagen.
— 1933. Contributions to the animal ecology of the Franz Joseph Fjord and adjacent waters I—II. — Medd. om Grønland, Bd. 100, No. 1, København.
— 1936. On the relation between metabolism and temperature in some marine

lamellibranchs and its ecological and zoogeographical importance. — Biol. Meddel. København, Bd. 13, No. 5.

Spärck, R., 1937. The Benthonic Animal Communities of the Coastal Waters. — The Zoology of Iceland, vol. 1, part 6, Copenhagen.

Stephensen, K. & Thorson, G., 1936. On the amphipod *Metopa groenlandica* H. J. Hansen found in the mantle cavity of the lamellibranchiate *Pandora glacialis* Leach in East Greenland. — Medd. om Grønland, Bd. 118, No. 4, København.

Sullivan, Charlotte M., 1948. Bivalve larvae of Malpeque Bay, P.E.I. — Bull. Fish. Res. Bd. Can., no. 77, pp. 1—36, Ottawa.

Thiele, J., 1929. Arktische Loricaten, Gastropoden und Bivalven. Fauna Arctica, Bd. 5, Jena.

— 1935. Handbuch der systematischen Weichtierkunde. II. Jena.

Thomsen, H., 1937. I. Hydrografiske Undersøgelser ved Østgrønland. In: Beretning om M/S "Thor's" Havundersøgelsestogt 1935, pp. 101—106, København.

Thorson, G., 1933. Investigations on shallow water animal communities in the Franz Joseph Fjord (East Greenland) and adjacent waters. — Medd. om Grønland, Bd. 100, No. 2, København.

— 1934a. Marine molluscs. In: The Scoresby Sound Committees 2nd East Greenland Expedition in 1932 etc. — Ibidem, Bd. 104, No. 17, København.

— 1934b. Contributions to the animal ecology of the Scoresby Sound Fjord Complex (East Greenland). Hydrography by H. Ussing. — Ibidem, Bd. 100, No. 3, København.

— 1935. Biologische Studien über die Lamellibranchier *Modiolaria discor* L. und *Modiolaria nigra* Gray in Ostgrönland. — Zool. Anz., Bd. 111, Heft 11—12, pp. 297—304, Leipzig.

— 1936. The larval development, growth and metabolism of Arctic marine bottom invertebrates etc. — Medd. om Grønland, Bd. 100, No. 6, pp. 1—155, København.

— 1944. Marine Gastropoda Prosobranchiata. In: The Zoology of East Greenland. — Ibidem, Bd. 121, No. 13, pp. 1—181, København.

— 1946. Reproduction and larval development of Danish marine bottom invertebrates. — Medd. Komm. Fiskeri- og Havundersøg., Ser. Plankton, Bd. 4, No. 1, 523 pp., København.

— 1950. Reproductive and larval ecology of marine bottom invertebrates. — Biol. Rev., vol. 25, pp. 1—45, Cambridge.

— 1951. Scaphopoda, Placophora, Solenogastres etc. In: The Godthaab Expedition 1928. — Medd. om Grønland, Bd. 81. No. 2, pp. 1—117, København.

— 1952. Zur jetzigen Lage der marinen Bodentier-Ökologie. — Verh. deutsch. Zool. Ges., in Wilhelmshaven 1951, pp. 276—327.

Torell, O., 1859. Bidrag till Spitzbergens Molluskfauna. Stockholm.

Trolle, Alf., 1913. Hydrographical Observations from the Danmark Expedition. Danmark Expeditionen til Grønlands Nordøstkyst 1906—08, Bd. 1, No. 2. — Medd. om Grønland, Bd. 41, København.

Ussing, H., 1934. Hydrography. Cf. Thorson 1934b.

— 1938. The biology of some important plankton animals in the fjords of East Greenland. — Medd. om Grønland, Bd. 100, No. 7, pp. 1—108, København.

Verrill, A. E., 1882. Catalogue of marine Mollusca added to the Fauna of New England during the past ten years. — Trans. Conn. Acad., vol. 5, part 2, pp. 447—587.

Verrill, A. E. & Bush, K. J., 1897. Revision of the genera of Ledidae and Nucu-

lidae of the Atlantic coast of the United States. — Amer. J. Sci., vol. 3, (4), pp. 51—63, New Haven.

VERRILL, A. E. & BUSH, K. J., 1898. Revision of deep-water Mollusca of the Atlantic coast of N. America. Part 1, Bivalvia. — Proc. U. S. nat. Mus., vol. 20, (No. 1139), Washington.

VIBE, CHR., 1939. Preliminary investigations on shallow water animal communities in the Upernavik- and Thule-districts (Northwest Greenland). — Medd. om Grønland, Bd. 124, No. 2, København.

— 1950. The marine mammals etc. — Ibidem, Bd. 150, No. 6, København.

WERNER, B., 1939. Über die Entwicklung und Artsunterscheidung von Muschellarven des Nordseeplanktons, unter besonderer Berücksichtigung der Schalenentwicklung. — Zool. Jahrb. (Anat.), Bd. 66, Heft 1, pp. 1—54, Jena.

WHITEAVES, J. F., 1872. Notes on a deep-sea exped. round the island of Anticosti, in the Gulf of St. Lawrence. — Ann. Mag. nat. Hist., ser. 4, vol. 10, no. 59, London.

— 1901. Catalogue of the Marine Invertebrata of Eastern Canada. — Geol. Survey of Canada, 272 pp., Ottawa.

WIBORG, K. F., 1946. Undersøkelser over oskjellet (*Modiola modiolus* (L.)). I. Alminnelig biologi, vekst og økonomisk betydning. — Rep. Norw. Fish. and Mar. Invest., vol. 8, no. 5, Bergen.

WINCKWORTH, R., 1932. The British Marine Mollusca. — J. Conch., vol. 19, pp. 211—252, London.

YONGE, C. M., 1928a. Feeding Mechanisms in the Invertebrates. — Biol. Rev., vol. 3, pp. 21—76, Cambridge.

— 1928b. Structure and Function of the Organs of Feeding and Digestion in the Septibranchs, *Cuspidaria* and *Poromya*. — Philos. Trans. London, vol. 216 B, pp. 221—263.

— 1936. Mode of life, feeding, digestion and symbiosis with zooxanthellae in the Tridacnidae. — Great Barrier Reef Exped. 1928—29. Sci. Reports, vol. 1, no. 11, pp. 283—321.

— 1937. The formation of siphonal openings by *Thracia pubescens*. — Proc. malacol. Soc., vol. 22, pp. 337—338, London.

— 1939. The protobranchiate mollusca, a functional interpretation of their structure and evolution. — Philos. Trans. London, vol. 230 B, pp. 79—147.

— 1949. On the structure and adaptations of the Tellinacea, deposit-feeding Eulamellibranchia. — Ibidem, vol. 234 B, pp. 29—76.

— 1953. Mantle chambers and water circulation in the Tridacnidae (Mollusca). — Proc. zool. Soc., vol. 123, pp. 551—561, London.

Færdig fra trykkeriet den 20. januar 1959.

PLATES

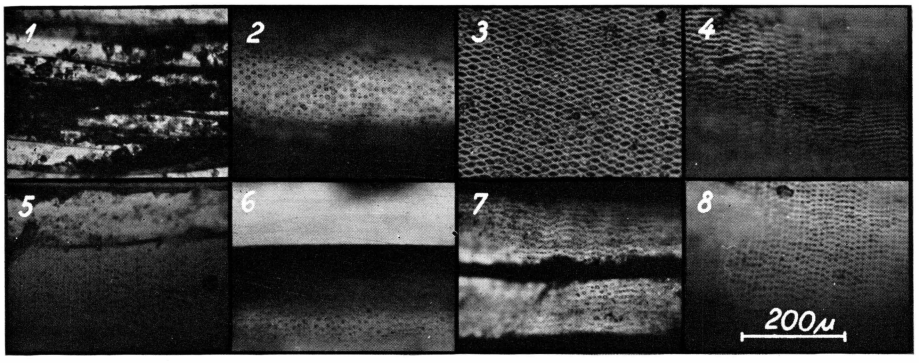
Plate 1.

Figs. 1—8. Microphotographs of the periostracum of the East Greenland species and subspecies of *Astarte*. Transillumination through the shell-substance. About 80 ×.

1. *Astarte borealis* (Chemnitz).
2. *Astarte montagui* (Dillwyn) f. *warhami*.
3. *Astarte elliptica* (Brown).
4. *Astarte sulcata* (da Costa).
5. *Astarte crenata* (Gray).
6. *Astarte crenata acusticostata* Jeffreys.
7. *Astarte crenata subaequilatera* Sowerby.
8. *Astarte crenata inflata* Hägg.

Figs. 9—21. Photographs of different lamellibranch species. r.v. = right valve, l.r. = left valve. The line below each figure indicates 5 mm at the same magnification.

9. *Leda pernula costigera* Leche, Kap Dalton, r.v.
10. *Leda minuta* (O. F. Müller), Imikêrteq, 65°45′ N. 36°58′ W., r.v.
11. *Yoldia thraciaeformis* (Storer), Lindenows Fjord, outer part, r.v.
12. *Portlandia intermedia* (M. Sars), Forsblads Fjord, l.v.
13. *Portlandia lenticula* (Møller), Forsblads Fjord, l.v.
14. *Portlandia frigida* (Torell), Forsblads Fjord, l.v.
15. *Portlandia fraterna* (Verrill & Bush), Hurry Inlet, l.v.
16. *Arca pectunculoides grandis* Leche, section between Kap Leslie and Jameson Land, l.v.
17. *Arca frielei* (Jeffreys) Friele, S. of Jan Mayen, 70°05′ N. 8°26′W., l.v.
18. *Arca glacialis* Gray, Forsblads Fjord, l.v.
19. *Dacrydium vitreum* (Møller), Forsblads Fjord, r.v.
20. *Astarte crenata crenata* (Gray), Hurry Inlet, r.v.
21. *Astarte crenata acusticostata* Jeffreys, Fleming Fjord, r.v.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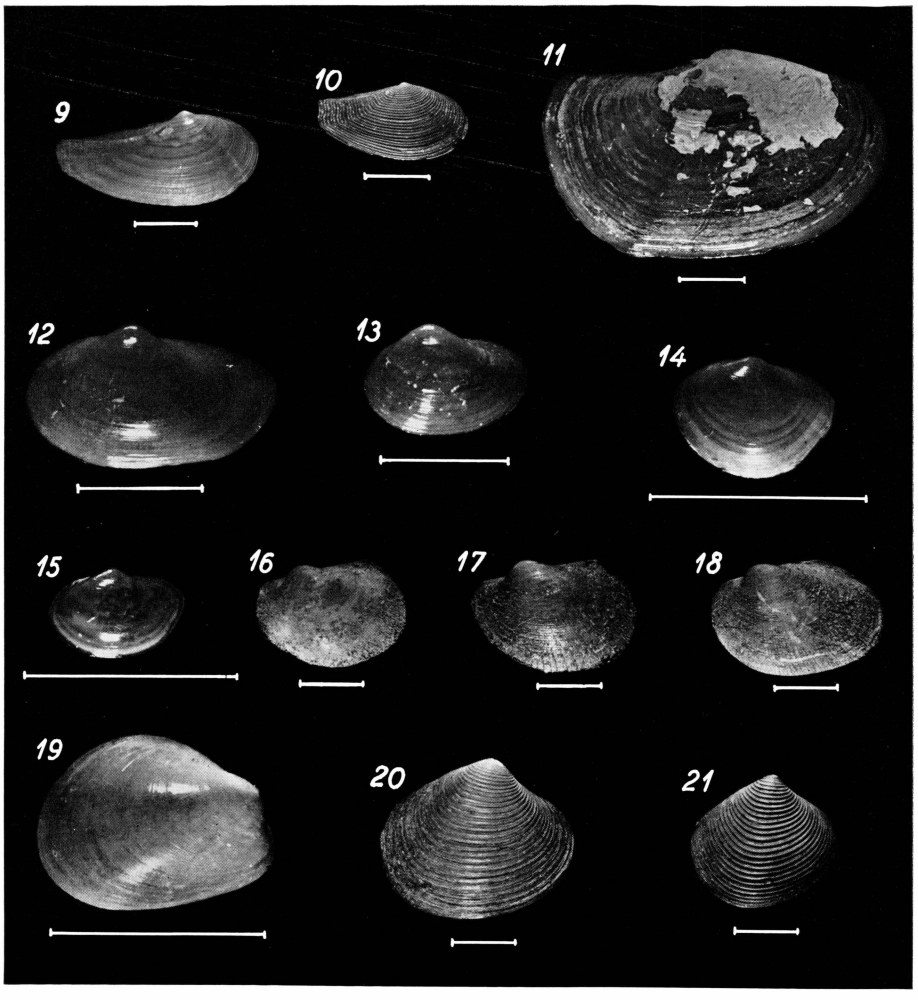
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Plate 2.

Figs. 1—14. Photographs. r.v. = right valve, l.v. = left valve. The line below each figure indicates 5 mm at the same magnification.

1. *Propeamussium imbriferum* (Lovén), Forsblads Fjord, l.v.
2. *Propeamussium groenlandicum* (Sowerby), Solitærbugt, Ella Ø, r.v.
3. *Lima hyperborea* (Jensen), Forsblads Fjord, r.v.
4. *Thyasira gouldi* (Philippi), Hekla Havn at Danmarks Ø, l.v.
5. The same, inner side.
6. *Cardium elegantulum* (Beck) Møller, Lindenows Fjord, inner part, r.v.
7. *Axinopsis orbiculata* G. O. Sars, Danmarks Havn, l.v.
8. The same, inner side.
9. *Gomphina fluctuosa* (Gould), off Kap Hope, r.v.
10. *Macoma calcaria* (Chemnitz), Solitærbugt, Ella Ø, l.v.
11. *Macoma loveni* (Steenstrup) Jensen, Kangerdlugssuaq, l.v.
12. *Macoma torelli* (Steenstrup) Jensen, Lindenows Fjord, outer part, l.v.
13. *Macoma moësta* (Deshayes), Kap Tordenskjold, l.v.
14. *Cyrtodaria kurriana* Dunker, off Kap Hope, r.v.

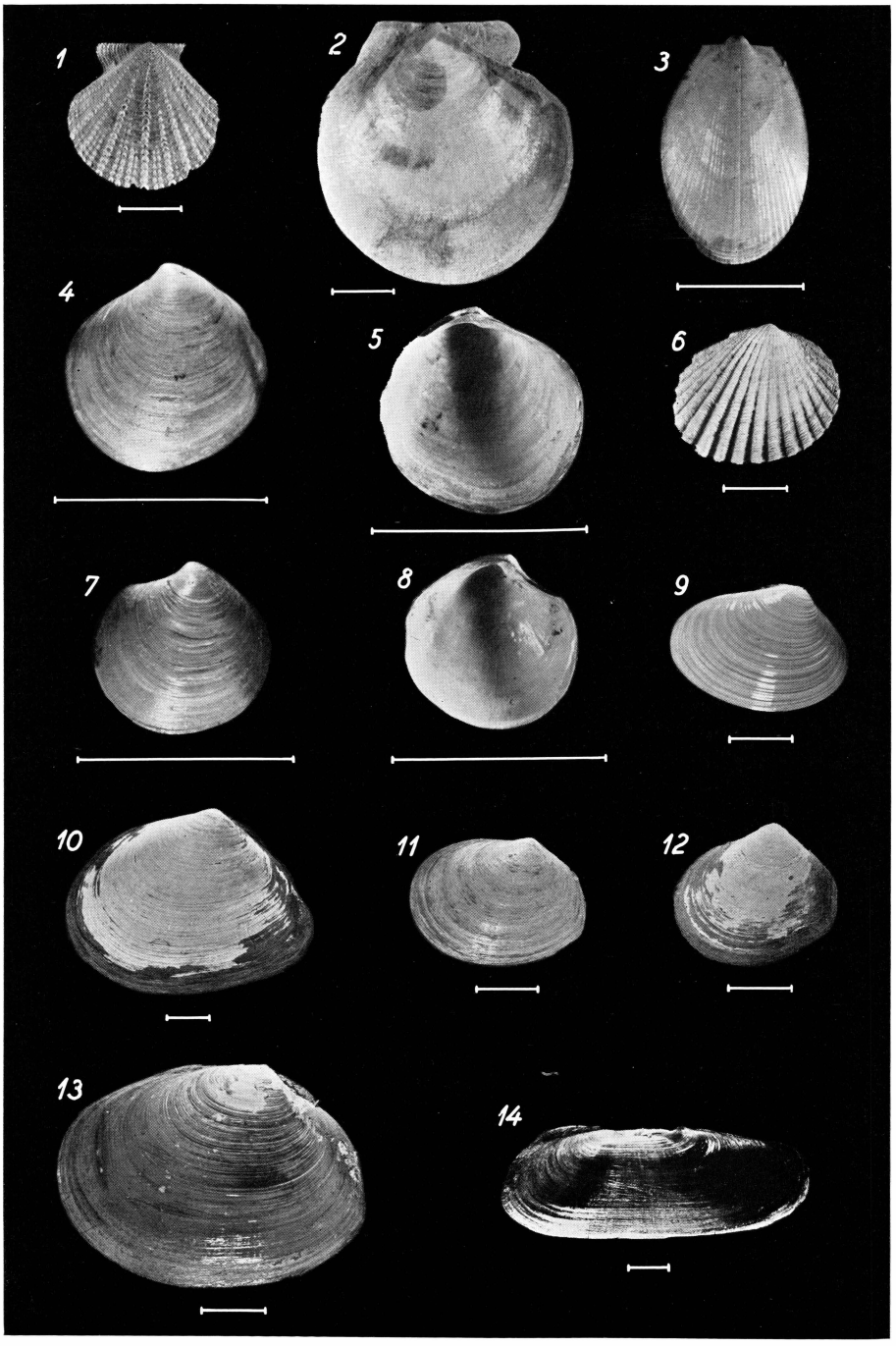
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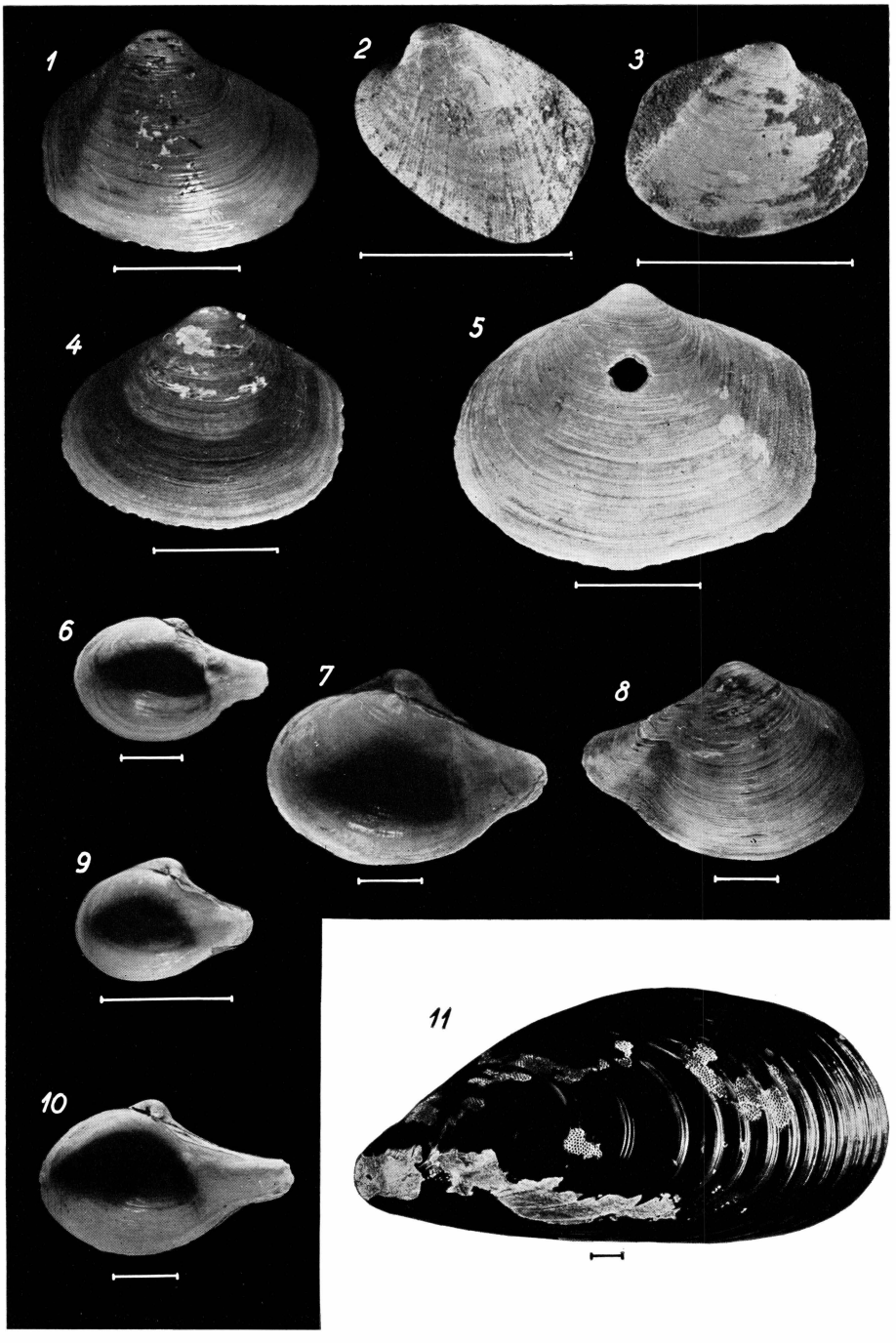
Plate 3.

Figs. 1—11. Photographs. r.v. = right valve, l.v. = left valve. The line below each figure indicates 5 mm at the same magnification.

1. *Thracia septentrionalis* JEFFREYS, Tasîssaq near Angmagssalik, r.v.
2. *Lyonsiella abyssicola* M. SARS, Nordbugten in Nordvestfjord, l.v.
3. *Poromya granulata* (NYST & WESTENDORP), section between Kap Leslie and Jameson Land, r.v.
4. *Thracia myopsis* (BECK) MØLLER, Sabine Ø, l.v., half-grown.
5. *Thracia devexa* G. O. SARS, Solitærbugt, Ella Ø, l.v.
6. *Cuspidaria obesa* (LOVÉN), West Greenland, 65°16′ N. 55°05′W., r.v., inner side.
7. *Cuspidaria arctica* (M. SARS), S. of Jan Mayen, 70°05′ N. 8°26′W., r.v., inner side.
8. The same, outer side.
9. *Cuspidaria subtorta* (G. O. SARS), Uttentals Sund, Kangerdlugssuaq, r.v., inner side.
10. *Cuspidaria glacialis* (G. O. SARS), between Kap Weber and Ymers Ø, r.v., inner side.
11. *Mytilus edulis* L., a large specimen from Tasîssaq near Angmagssalik, l.v.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