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Meroplankton in Jørgen Brønlund Fjord, North Greenland

Ole G. Norden Andersen

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Gert Steen Mogensen, Botanical Museum, Gothersgade 130, DK-1123 Copenhagen K. Telephone +45.1.111744.

Editor – Zoology
Jean Just, Zoological Museum, Universitetsparken 15, DK-2100 Copenhagen Ø. Telephone +45.1.354111.

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Ole G. Norden Andersen

Contribution from
The Danish Peary Land Expeditions
Leader: Eigil Knuth

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Meroplanktonic larvae of at least 42 species of bottom invertebrates in Jørgen Brønlund Fjord, North Greenland (82°10'N, 30°30'W) are described with respect to species identification, occurrence, reproduction, development, growth, settlement, and relations to depth, light, hydrography, and primary production. A few holoplankters and some "pseudoplanktonic" nematodes are included. The occurrence of such a large number of species with pelagic larvae does not invalidate "Thorson's rule" of 1950, stating that the number of species having pelagic larval development decreases, as one moves from the equator to the pole, but it does lead to a less strict interpretation of it. Several species have lecithotrophic pelagic development. The short period of primary production, however meager, seems vital to many of the planktotrophic larvae, in promoting growth and settling, although the spawning of many species is not strictly linked to this period. Larvae of *Hiatella striata* (Fleuriau) seem able to live in the plankton for a year, even surviving the long, dark winter.

Ole G. Norden Andersen, Zoological Museum, Copenhagen, Universitetsparken 15, DK-2100 Copenhagen Ø, Denmark.

Introduction

On the Fifth Peary Land Expedition to Jørgen Brønlund Fjord (J.B.F.) (82°10'N, 30°30'W) in the summer of 1968 temperature, salinity, transparency and primary production was measured (Andersen 1977), and zooplankton was collected in this higharctic fiord. The aim was to study the meroplankton component with respect to composition and ecology. A few holoplanktonic species and some benthic, non-marine nematodes are included. It is the first work published on zooplankton from the fiord. Only part of the bottom fauna has been investigated (Andersen 1971, 1973, Just 1970 b–e, Lützen 1970, Ockelmann 1958, Tendal 1970), a fact which contributes to the difficulty in identifying the bottom invertebrate larvae in the plankton. For further information on bathymetry and hydrography see Høy (1970) and Just (1970a).

Material and methods

The zooplankton investigations in J.B.F. (Fig. 1) are based primarily on vertical hauls from various depths in the upper 50 m to the surface (Fig. 2). From 2 to 8 hauls were made at each station (Table 9). 80μ mesh nets, 30 cm in diameter were hauled at ca. 0.5 m per second. Despite the semi-quantitative nature of this sampling procedure, the results are dealt with quantitatively, since the sparse population of phyto- as well as zooplankton is assumed to have afforded a minimum of clogging of the nets. Results are given per 10 hauls, corresponding to 0.7 m^3 × the hauling distance in m, and are grouped as 12 m, 25 m, and 50 m hauls, including hauls from other depths as shown in Table 9. Corrections have been made, assuming an even distribution. The samples were fixed immediately by pouring into 20% formaldehyde and adding seawater to a concentration of 2%. This procedure seems to have caused some of the turbellarians and some of the polychaetes (*Phalachrophorus borealis*) to contract and rupture, but has otherwise proven satisfactory. All descriptions and measurements apply to fixed material, and colours are as seen in transmitted light, if nothing else is mentioned. All scales in Figs 3–10 represent 0.1 mm.

Systematic part

A short description and/or a diagnosis is given of each species, and in so far as Tables 9 and 10 are inadequate, there are also remarks on occurrence, distribution (with respect to depth, light, and hydrography), reproduction, development, growth, settlement and mortality in

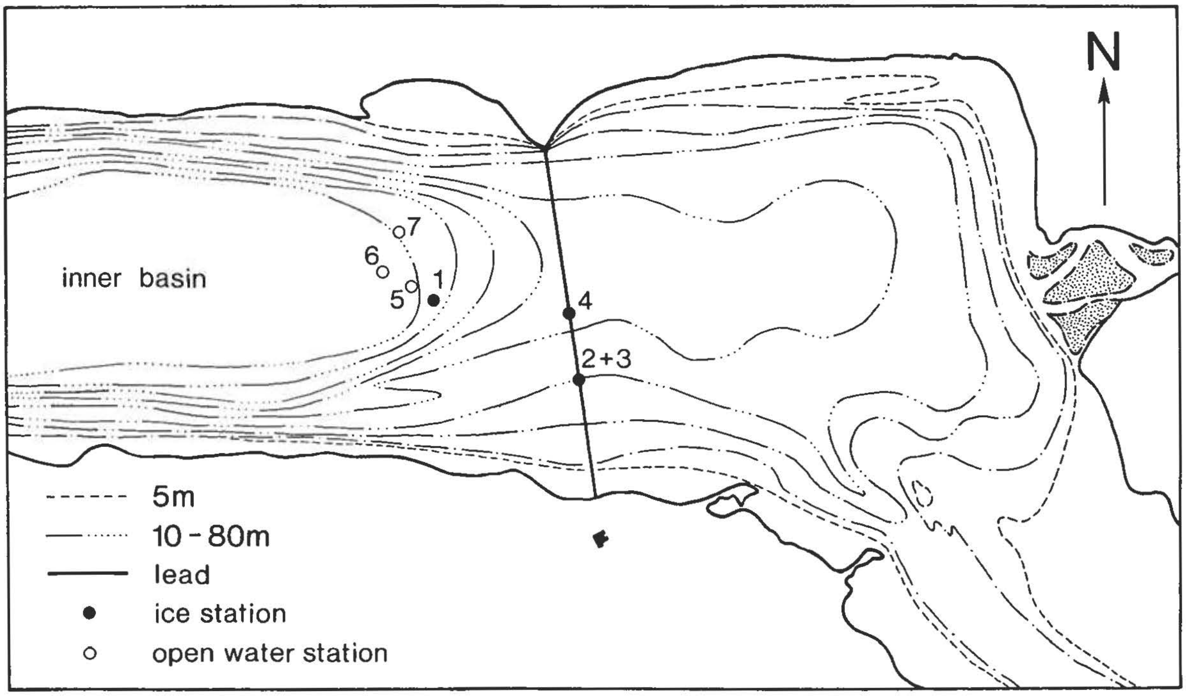

Fig. 1. Vertical zooplankton sampling stations in the inner basin of Jørgen Brønlund Fjord in 1968. Map redrawn from Høy (1970).

J.B.F. By reproduction is meant the emission of progeny in the form of eggs or young, be it into the plankton or otherwise. Mortality due to predation is assumed, when a reduction in numbers occurs which cannot be attributed to settling or removal by currents.

Coelenterata

The samples contain at least 2 species of larval coelenterates, including 4 hydrozoan planulae and 14 ceriantharian larvae.

Planula (Fig. 3A)

Description. – The planulae are 600μ to 1100μ long, 400μ wide and roughly pear-shaped. One of the larvae (from 12 August) is elongated as if about to settle (Fig. 3A1). They are very similar to larvae of *Sertularella tricuspidata* (Alder), a common arctic species studied by the author in West Greenland (unpubl.), both in size and in having a yellowish ectoderm. The *Sertularella* planulae are more egg shaped, however. They are ready to settle only a few hours after release.

Synarachnactis brachiolata (Agassiz) ? (Fig. 3B)

Description. – The larvae presumed to belong to this north-occidental ceriantharian (Leloup 1963) range in size from 400μ wide and 700μ high to 500μ wide and 1400μ high. All have 4 marginal tentacles 300μ to 2000μ long, and the largest also have 2 short labial ones, one on each side of the mouth slit. Two short mesenteries have thickened margins, and are armed with nematocysts. The youngest specimens contain a vitelline mass, whereas the oldest often have ingested bivalve or pteropod larvae up to 400μ in greatest dimension.

Distribution. – Principally in the deep water.

Reproduction. – A short period, probably in May.

Development. – The primarily planktotrophic development, perhaps following a short lecithotrophic phase, occurs synchronously and takes about a month, terminating prior to the main phytoplankton bloom.

Growth. – Lengthening of body and tentacles roughly doubles the volume from 0.13 mm^3 to 0.24 mm^3 in 24 days.

Mortality. – No predation is apparent.

Turbellaria

Small acoelomarian (Fig. 3C)

Description. – 200μ × 150μ × 40μ to 400μ × 225μ × 60μ, semitransparent with an anteriorly located statocyst.

Distribution. – Transitional and deep water, below compensation depth.

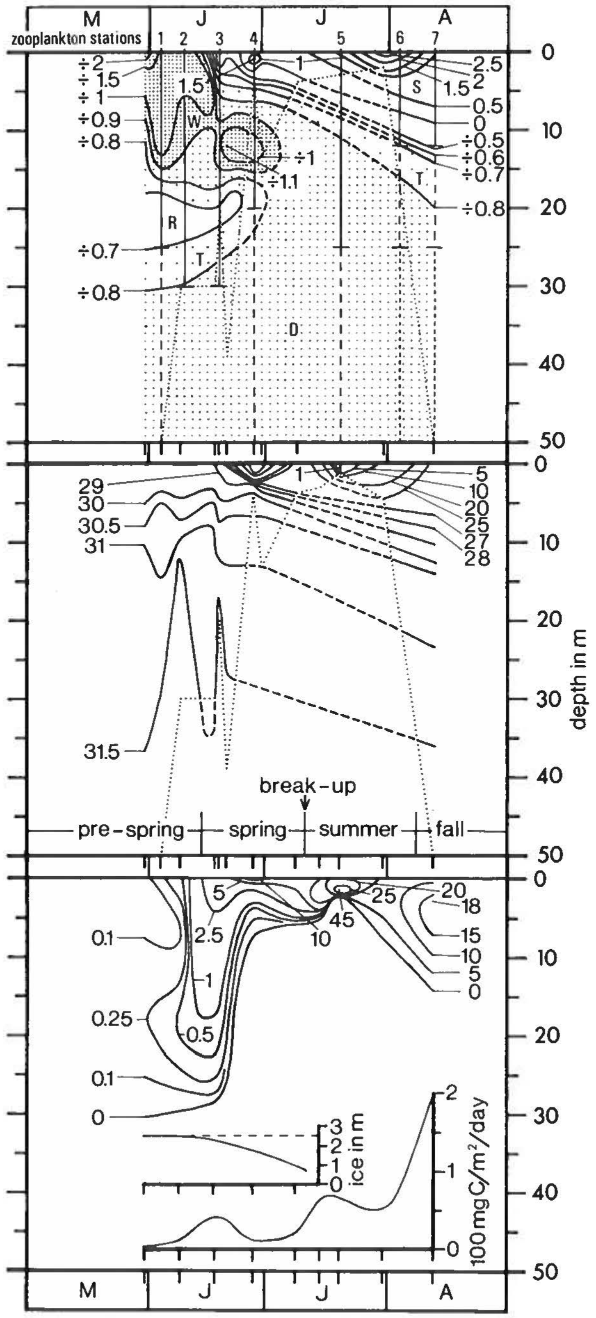

Fig. 2. **Top:** Temperature (°C) isopleth diagram where the deepest measurements are joined by a dotted line. Shading depicts the cold winter layer (W) of <–0.9°C, the cool deep water (D) of –0.9°C to –0.8°C, summer transitional temperatures (T) of –0.8°C to –0.7°C, a sub-surface summer remnant (R) and transitional layer (T) of –0.8°C to –0.65°C, and a warmed summer surface layer of fiord water (S) of > –0.7°C referred to in Table 10. Verticals mark the plankton hauls from various depths to the surface. **Centre:** Salinity (‰) isopleth diagram with seasons referred to in the text marked at the bottom. Pre-spring is before surface heating and diluting sets in in mid June, spring follows till the ice breaks just prior to mid July, and summer lasts till surface cooling sets in in early August, marking the beginning of fall in the marine environment of the fiord. **Bottom:** Phytoplankton primary production is shown as an isopleth diagram (mg C/m³/day) with the zero line marking the compensation depth, and as a curve (mg C/m²/day). Ice thickness in m is shown above the curve.

Brown turbellarian (Fig. 3D)

Description. – Light brown (smallest: 500μ × 250μ × 150μ) to nearly black (largest: 850μ × 450μ × 200μ), with a more transparent area midanteriorly.

Distribution. – Principally in the surface layer.

Rhabdocoelomarian (Fig. 3E)

Description. – A pale, plump, "hunch-backed" larva 300μ × 120μ × 100μ to 500μ × 200μ × 150μ, densely ciliated with fine cilia and bundles of larger cilia, especially anteriorly, and with numerous rhabdites, especially posteriorly. These have usually been extruded, making the preserved larvae very sticky. A pair of inverse eyes with a pigment cup of several cells is located laterally. The larvae seem to be contracted, and are often ruptured dorsally.

Distribution. – Principally or exclusively in the upper 25 m, where temperature and salinity change the most.

Growth. – A general increase in size to about double volume from early June to early August may indicate growth, or perhaps an increase in the size of the larvae released into the plankton.

Nemertini

Pilidium (Fig. 3F)

Description. – Typical pilidii of quite similar appearance, and probably belonging to the same species.

Distribution: Around the transitional layer, below the compensation depth in the summer and fall.

Nematoda

Nematodes occurred in remarkable numbers evenly distributed in the water mass during the massive out-flow of fresh water in late June as well as in mid August. Eleven species were found. Three of these, including 2 tylenchids and 1 plectid, are typical plant parasites or soil dwellers. Three, including one with annulate cuticula and flagelliform tail, are limnic/terrestric. Five, including *Chromadorita guidoschneideri, Adoncholaimus aff. thalassophygas*, a *Chromadorita* sp., *Theristus* sp., and *Acanthonchus* sp., are mainly marine/brackish water species.

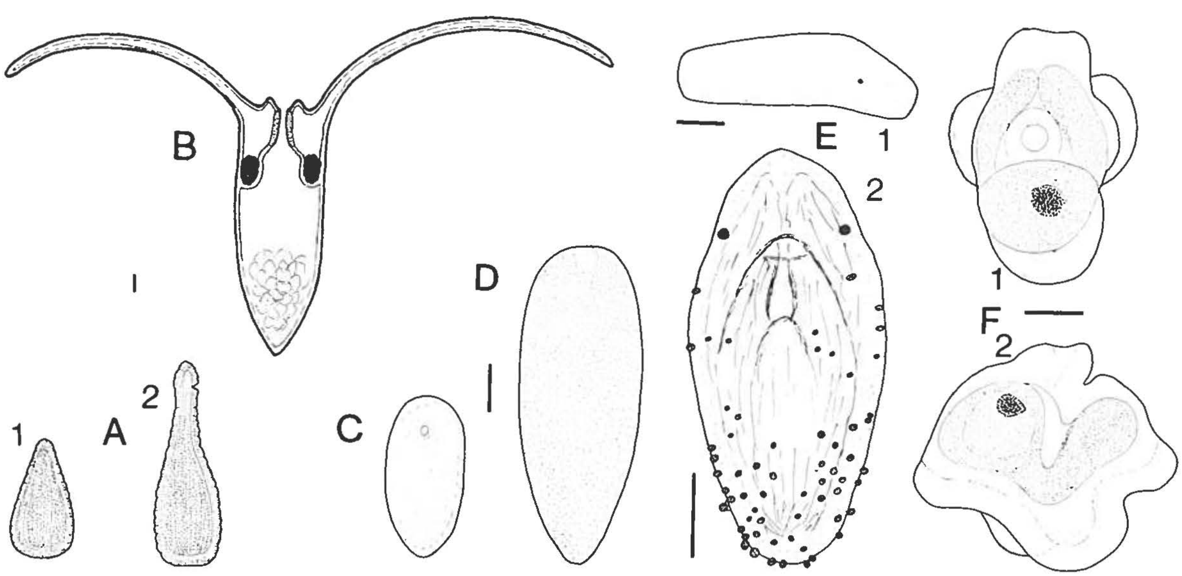

Fig. 3. **A:** Hydrozoan planulae, 1: from 19 July, and 2: from 12 August. **B:** *Synarachnactis brachiolata* ?, largest larva from 27 June. **C:** Small acoelomarian Turbellaria with statocyst from 3 August, dorsal view. **D:** Large brown Turbellaria from 3 August, dorsal view. **E:** Rhabdocoelomarian Turbellaria, 1: in right lateral view, and 2: in dorsal view. **F:** Pilidium, 1: in apical, and 2: in lateral view.

Polychaeta

This is the most diverse group, with at least 19 meroplanktonic and 1 holoplanktonic species. In abundance the polychaetes are only surpassed by the bivalves, except on 3 June (see Table 9).

Gattyana cirrosa (Pallas) ? (Fig. 4A)

Description. – The trochophoral stages have deep purple intestines. The unsegmented stages vary greatly in size, roughly from 160μ to 600μ in diameter. The largest nectochaetae (Fig. 4A) are up to 915μ long, with 8 setigers and setation as shown in Table 1. Like in Thorson's (1946) polynoid C = *G. cirrosa* ? from the Øresund, there is no median tentacle. *G. cirrosa* is widely distributed in the Arctic and is considered rather common along the whole East Greenland coast in littoral water, and in fairly deep water in the fiords (Wesenberg-Lund 1953).

Table 1: *Gattyana cirrosa* ?, setae, cirri and elytra in a 9-setiger nectochaeta.

	setae		cirri		
setiger	notopodial	neuropodial	dorsal	ventral	elytra
1	0	4 thick	0	0	0
2	6 short	8 long	0	1	1
3	5 "	11 "	0	1	1
4	6 "	10 "	0	1	1
5	8 "	6 "	0	1	1
6	6 "	3 "	1	1	0
7	3 "	2 "	0	1	1
8	2 "	5 "	1	1	0
9	1 "	6 "	0	1	1

Distribution. – In pre-spring the metatrochophorae I and younger stages are found primarily below the coldest surface water. Later they gradually move up above 25 m, keeping below the warmest fiord water, as do the metatrochophorae II. The nectochaetae seem to keep to the deep cool water below 25 m.

Reproduction. – Sets in before June, is greatest in June, and continues well into August.

Development. – Planktotrophic, probably with an initial lecithotrophic phase of varying duration.

Growth. – The volume is roughly tripled in about a month, from the metatrochophora I to the nectochaeta stage. 80μ peridinians occur in the digestive tract.

Mortality. – Predation seems heavy.

Lagisca ? sp. (Fig. 4B)

Description. – The 2 nectochaetae found resemble Milcikovsky's (1969) lecithotrophic larvae of *Lagisca hubrechti* (McIntosh), but have different setae. The larvae are 550μ long, have 8 setigers, no eyes, and a prostomium of the *Harmothoë* type (Thorson 1946), with one median and a pair of lateral tentacles. Palps and tentacular cirri are not discernible. The only *Lagisca* in East Greenland is *L. extenuata* Grube which is found along the entire east coast, mostly in the fiords, occurring from tidal pools to more than 1000 m depth (Wesenberg-Lund 1953).

Harmothoë ? sp. (Fig. 4C)

Description. – The setae and type of prostomium of a 500μ long and 450μ wide metatrochophora II with 6

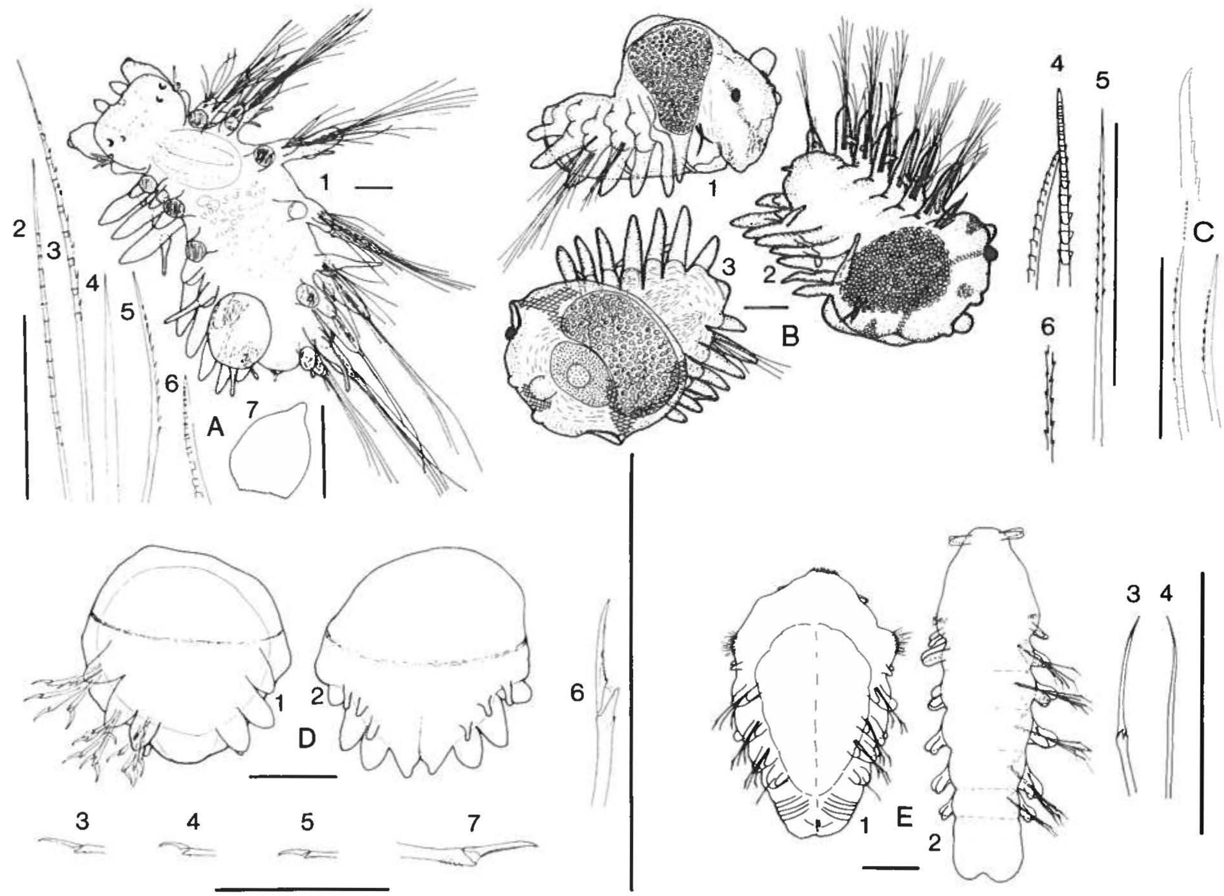

Fig. 4. **A:** *Gattyana cirrosa* ?, 1: 9-setiger nectochaeta from 19 July in dorsal view, with setae on the right side, and an elytrum on setiger 7 shown; 2: notopodial seta, 3: supraacicular and 4: subacicular neuropodial setae, and 5: aciculum, all from setiger 4; 6: seta from setiger 1; 7: anal cirrus of metatrochophora II. **B:** *Lagisca* ? sp., 1: 8-setiger nectochaeta right lateral view with a few setae shown, 2: ventral view with the setation on the right side shown, and 3: dorsal view with a few setae shown, and those on setiger 1 hidden. The black spot is adhering matter 4: Setae from setiger 1; 5: notopodial seta; 6: part of neuropodial seta. **C:** *Harmothoë* ? sp., neuropodial setae of a metatrochophora II-nectochaeta from 18 June. **D:** *Pholoë minuta*, 1: 3-setiger nectochaeta in dorsal view with the setae on the left side shown, and 2: in ventral view; 3–5: composite setae of same; 6: seta 5 enlarged; 7: seta of adult from the fiord. **E:** *Eteone longa*, 1: 4-setiger lecithotrophic metatrochophora, and 2: 5-setiger planktotrophic nectochaeta, both in dorsal view; 3: composite, and 4: capillary setae, both of setiger 4.

setigers, 4 small elytra and a pair of conical caudal cirri suggest a *Harmothoë*. Among several species, *H. imbricata* (L.) is the most common and widely distributed in East Greenland (Wesenberg-Lund 1953).

Pholoë minuta Fabricius ? (Fig. 4D)

Description. – All larvae are metatrochophorae with only 3 setigers, 260μ to 320μ long, and without eyes, elytra or appendages other than a pair of conical caudal cirri. The setae resemble those of P. minuta described by Sveshnikov (1960) from the White Sea as well as setae from adult specimens of what are assumed to be *P. minuta* from the fiord, although these setae are 2.5 times as large (Fig. 4 D7).

Development. – Seems to be lecithotrophic, as seems to be the case for *P. minuta* studied by Sveshnikov (1960) and for *P.*sp. in the Øresund (Ockelmann pers. comm.).

Phyllodoce ? sp.

Description: A large typical phyllodocid metatrochophora, ca. 1 mm long and with about 10 segments was found on 19 July.

Eteone longa (Fabricius) (Fig. 4E)

Description. – The larvae, up to 600μ long with 4 to 5 setigers, each with a larval capillary seta and 4, 4, 4, 4 and 2 composite setae on each side, closely resemble Thorson's (1946) larvae from the Øresund.

Development. – Seems to be lecithotrophic.

Growth. – There is a slight general increase in length from late June to August, from plump lecithotrophic larvae (Fig. 4 E1) to slender ones (Fig. 4 E2), but no increase in volume.

Phalachrophorus borealis (Reibisch)

Description. – Achaete lecithotrophic juveniles that float in 2% formaldehyde in seawater to multisetiger adults that often are ruptured dorsally in the pharyngeal region.

Nereimyra aphroditoides (Fabr.) ? (Fig. 5A)

Description. – Trochophorae and nectochaetae are pale green. They resemble larvae from Eskimonæs, East Greenland, described and figured rather superficially by Thorson (1936), as well as his *Eteone (Mysta) barbata* Malmgren (= *Castalia (Nereimyra) punctata* Müller, according to Banse 1956) from the Øresund (1946). Also Banse's *Castalia (Nereimyra) puncta* from Kieler Bucht (1956) and Sveshnikov's *Castalia (Nereimyra) punctata* (1959) are very similar. Trochophores of different sizes (180μ to 300μ long) are found adhering to each other, 2 or 4 together, as if derived from a common egg mass. The largest nectochaetae have a total length of 570μ, and have 5 setigers, a pair of cylindrical, 2-segmented anal cirri and a minute unpaired one. Without the caudal appendages they are 500μ long, compared to 400μ to 425μ in Banse's (1956) *N. punctata*. Setation and parapodial characteristics are shown in Table 2. No eyes are present. Like in Banse's nectochaetae, the dorsal cirrus on segment 2 (setiger 1) is longer than the rest, and the largest nectochaetae lack the ventral cirrus on setiger 2. There is always a pair of capillary setae above the dorsal cirrus in each setiger, and not 2 to 3 as in Banse's larvae. The composite neurosetae resemble those of Banse's *N. punctata*. The most ventral ones are shorter and have shorter blades than the most dorsal ones. Banse (1956) did not show this. Among the composite setae are 1 or 2 capillary setae (Fig. 5 A6), shorter and stouter than the dorsal ones and finely serrate near the tip. Such setae have neither been figured nor mentioned by any of the authors mentioned above. They can have been mistaken for early composite setae, since in adult specimens of *N. punctata* longbladed composite setae are often found, with only the blade protruding. The parapodial and the dorsal capillary setae are larval setae, not found in the adults. The larvae from J.B.F. as well as those from Eskimonæs are most likely *N. aphroditoides*, the only common hesionid in East Greenland (Wesenberg-Lund 1953).

Table 2: *Nereimyra aphroditoides* ?, setae and cirri (dorsal and ventral lobes) in a 5-setiger nectochaeta.

setiger no.	0	1	2	3	4	5
dorsal lobe present (+), long (L)	+	L	+	+	+	+
ventral lobe present (+), absent (-)	+	+	-	+	+	+
no. of dorsal capillaries	0	2	2	2	2	2
no. of lateral capillaries	0	1	2	2	2	1
no. of composite setae	0	6	9	9	6	4

Development. – Planktotrophic, possibly with an initial lecithotrophic phase.

Growth. – The larvae roughly doubled to tripled in size during the sampling period, becoming longer and only slightly bigger around.

Mortality. – Predation is apparent and heavy.

Syllid ? A (Fig. 5B)

Description. – The trochophores are compressed, greenish yellow spheres, all of the same size and shape (215μ × 200μ) with acrotroch and prototroch and a tough, persisting sculptured egg membrane with pores and ridges arranged in a hexagonal manner very similar to the persisting egg membranes found in certain spionids like f. ex. *Nerine*. Egg-shaped metatrochophores, 345μ long and with 3 setigers, still have the persisting egg membrane. The setae resemble those of several species of *Syllis* (McIntosh 1908, 1910, Fauvel 1923), of which a number occur in East Greenland (Wesenberg-Lund 1953), and of *Exogone hebes* Webst. & Ben. found in West Greenland (Wesenberg-Lund 1947).

Development. – Probably lecithotrophic followed by a planktotrophic phase.

Nereis pelagica L. (Fig. 5C)

Description. – The 2 nectochaetae found have 4 setigers, and resemble those described by Wilson (1932), Thorson (1946) and Rasmussen (1956) in every detail.

Nepthys ? sp (Fig. 5D)

Description. – Small transparent trochophorae and metatrochophorae I without setae, and often with a diatom or other food items in the digestive tract, have been referred to this genus in accordance with Fewkes (1883), Thorson (1946), and Rasmussen (1973).

Distribution. – Preferably in deep water in prespring, later to rise above 25 m, but probably not to the fiord water.

Ophryotrocha sp. (Fig. 5E)

Description. – The setae and oral armament refer this larva to the eunicidean genus *Ophryotrocha*, much resembling *O. puerilis* Claparède & Metschkow, also described by Korschelt (1894), Braem (1894) and Åkesson (1967), except that the labrum is twice as wide and long, and there are no caudal appendages. The genus has not been observed in East Greenland.

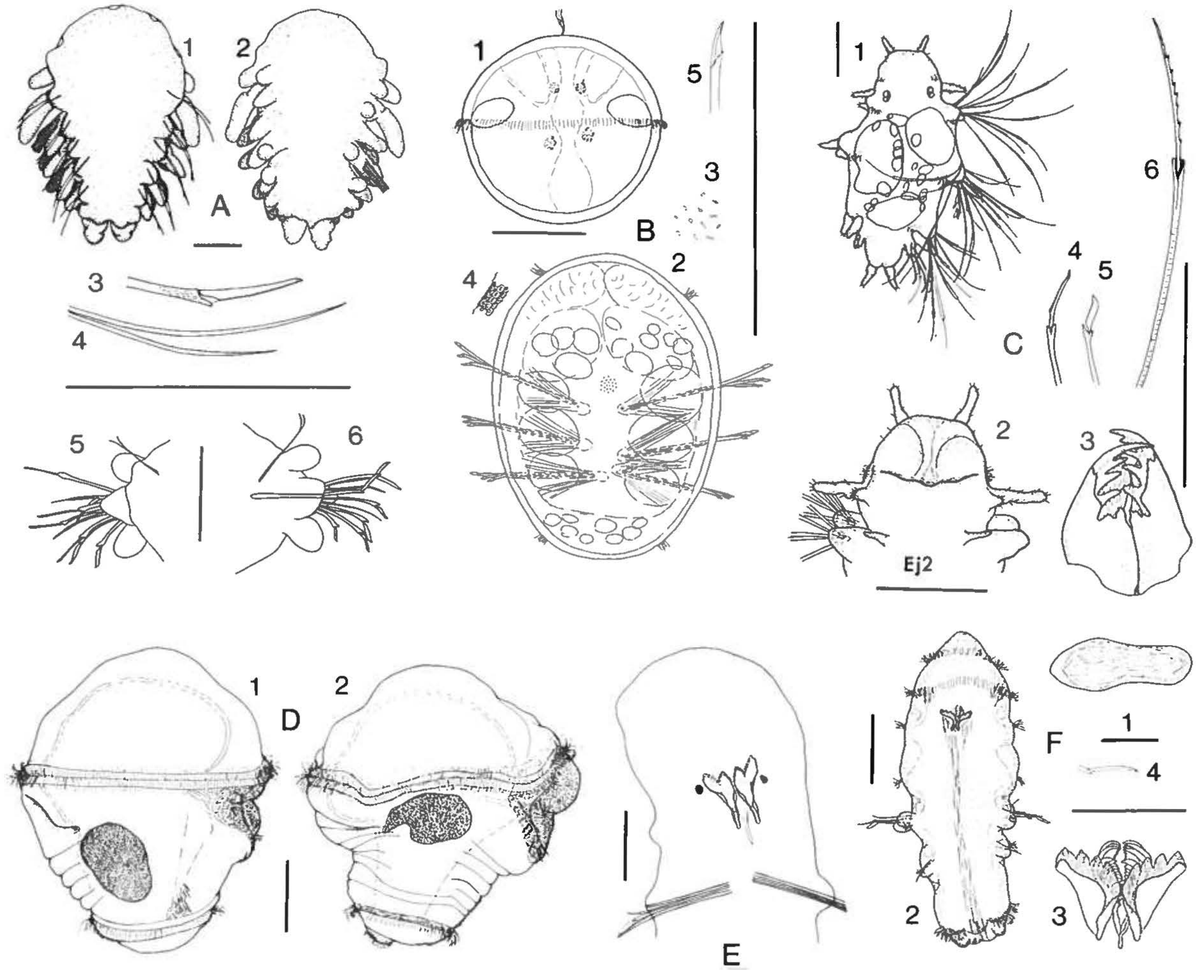

Fig. 5. **A:** *Nereimyra aphroditoides* ?, 1: 5-setiger nectochaeta in dorsal view, showing a notopodial aciculum in each parapodium, the pairs of capillary notosetae, and the position of the left composite setae on setiger 2; 2: ventral view of same, showing the position of left composite setae on setiger 3; 3: composite, and 4: capillary setae; 5: anterior view of right parapodium of setiger 3; 6: posterior view of similar parapodium with neuropodial aciculum shown. **B:** Syllid ? A, 1: trochophora, and 2: metatrochophora, both cleared in glycerol, and the latter with part of the surface structure viewed from above shown near the centre; 3: same surface enlarged to scale, and 4: surface structure viewed partly in profile, enlarged free hand; 5: seta. **C:** *Nereis pelagica,* 1: 4-setiger nectochaeta in dorsal view, with setation of the right side shown; 2: anterior end, and 3: oral armature of same in ventral view; 4 and 5: neurosetae; 6: notoseta. **D:** *Nephthys* ? sp., two trochophores. **E:** *Ophryotrocha* sp., 4-setiger nectochaeta, dorsal view of anterior part showing mandibles and labrum. **F:** *Schistomeringos* sp., 1: early larva supposedly belonging to this species; 2: 2-setiger larva, and 3: oral armature of same, both in dorsal view; 4: composite seta of same.

Schistomeringos sp. (Fig. 5F)

Description. – Two species, an early and a late spawning one, may be included here. The youngest stages may even include a number of indistinguishable species. These unsegmented, finely ciliated larvae, which in their smallest stages are radially symmetric in transverse section and later become slightly "hunch-backed" (perhaps due to preservation) (Fig. 5 F1), occur early (June) and late (August). The most advanced segmented larvae have 2 setigers with dorsal and ventral parapodial rami, and setae and oral armaments (Fig. 5 F3) that refer them to the genus *Schistomeringos,* (Oug 1978). They occur from June to August. The larvae float in 2% formaldehyde in seawater.

Development. – Planktotrophic: the stage of longest duration in the plankton seems to be the unsegmented, non-setose one (Table 3).

Growth. – Length measurements (Table 3) show that in 2 months the largest segmented and setose larvae have attained a length which is about 100% to 150% greater than the smallest larvae. Their volume has increased about 600% from ca 0.0012 mm^3 to 0.0085 mm^3.

Mortality. – Predation seems evidenced by the marked drop in numbers with increasing age and size of the larvae. Settling at varying stages may, however,

Table 3: *Schistomeringos* sp., length measurements of larvae from 25 m to 0 m hauls and from 50 m to 0 m hauls (in brackets). Late larvae are marked with an s.

date	unsegmented		segmented			
			without setae		with setae	
	no.	length in µ	no.	length in µ	no.	length in µ
June 3	78	180-280				
" 9	122	240-290	6	230-270		
" 18	12	260-310	20	280-430		
" 27	(1)	300	3	310-440		
July 19	(1)	260	6	340-440	(3)	380-400
Aug. 3	9s	200-260			1	500
" 12	1s	260				

explain this. Absence from the upper at least 12 m excludes any major removal of the larvae with the current out of the fiord.

Polydora coeca (Oersted) (Fig. 6A)

Description. – The youngest larvae, 320µ long, are greatly arched and have a brownish yellow gut, 4 pairs of eyes, and larval setae which are retained till a length of ca. 1500µ is reached. The setae of the 5th setiger as well as the dorsal pigmentation of the largest larvae (up to 2000µ long) coincide with Hannerz (1956).

Reproduction. – Larvae of all sizes occur together, indicating an extended period of reproduction.

Mortality. – Predation seems apparent.

Prionospio malmgreni Claparède ? (Fig. 6B)

Description. – The youngest larvae, 350µ to 600µ long, are colourless and transparent. They are often hunched, and have only larval capillary setae (Fig. 6 B1-B3). Larger larvae have ingested matter in the digestive tract, and slight brown pigmentation occurs ventrally on the first setiger (Fig. 6 B4). Larvae with about 15 setigers or more are usually S-shaped, being hunched anteriorly and with an upturned posterior end. The setation of the largest specimen is shown in Table 4. The first setiger which is usually elongate, and setigers 2 to 9 which are short and wide, have capillary setae only. The following setigers, until the last few very short ones next to the anal segment, are usually elongate and have 1 to 3 short hooked setae and a stout, curved "sabre" seta (Fig. 6 B7) ventrally from setiger 10, and 1 to 2 long hooked setae dorsally from setigers 12 to 17 on. The smallest larvae have 2 pairs of caudal appendages, and the largest have 3 pairs, of which the most lateral ones are longest (Fig. 6 B4). Larvae with ca 18 setigers or more have gill buds on setiger 3. The lack of pigmentation and the lack of specialized ciliation adjacent to the hardly discernible ciliated pit located between setigers 1 and 2 refer the larvae to *P. malmgreni* according to Hannerz (1956). Another possibility, if some of the ciliation has been missed, is *P. cirrifera* Wirén, believed to occur in the fiord (M. E. Petersen pers. comm.), and reported from Jan Mayen (Wesenberg-Lund 1953).

Distribution. – In the upper 25 m, except in late summer and fall, when the advanced larvae then occurring go deeper.

Table 4: *Prionospio malmgreni* ?, length measurements.

date	no.	length in µ
June 3	12	400-760
" 9	12	430-800
" 18	14	380-900
" 27	28	350-1300
July 19	8	1100-1600
Aug. 3	2	700- 850
" 12	4	1500-2050

Table 5: *Prionospio malmgreni* ?, setae and gills of the longest (2.05 mm) larva with 21 setigers.

	notopodial setae			neuropodial setae			
setiger	larval capillary	capillary	hooked	capillary	hooked	sabre	gill bud
1	0	0	0	2	0	0	-
2	0	6	0	6	0	0	-
3	0	5	0	5	0	0	+
4	0	4	0	5	0	0	-
5	0	5	0	6	0	0	-
6	0	4	0	6	0	0	-
7	1	4	0	5	0	0	-
8	0	6	0	5	0	0	-
9	0	2	0	5	0	0	-
10	0	2	0	3	1	1	-
11	0	3	0	1	2	1	-
12	0	3	0	1	2	1	-
13	0	3	0	1	2	1	-
14	0	4	1	1	3	1	-
15	0	2	1	1	3	1	-
16	0	2	1	1	3	1	-
17	0	2	1	0	3	0	-
18	0	2	1	0	3	0	-
19	0	1	1	0	2	0	-
20	0	2	1	0	1	0	-
21	0	2	0	0	0	0	-

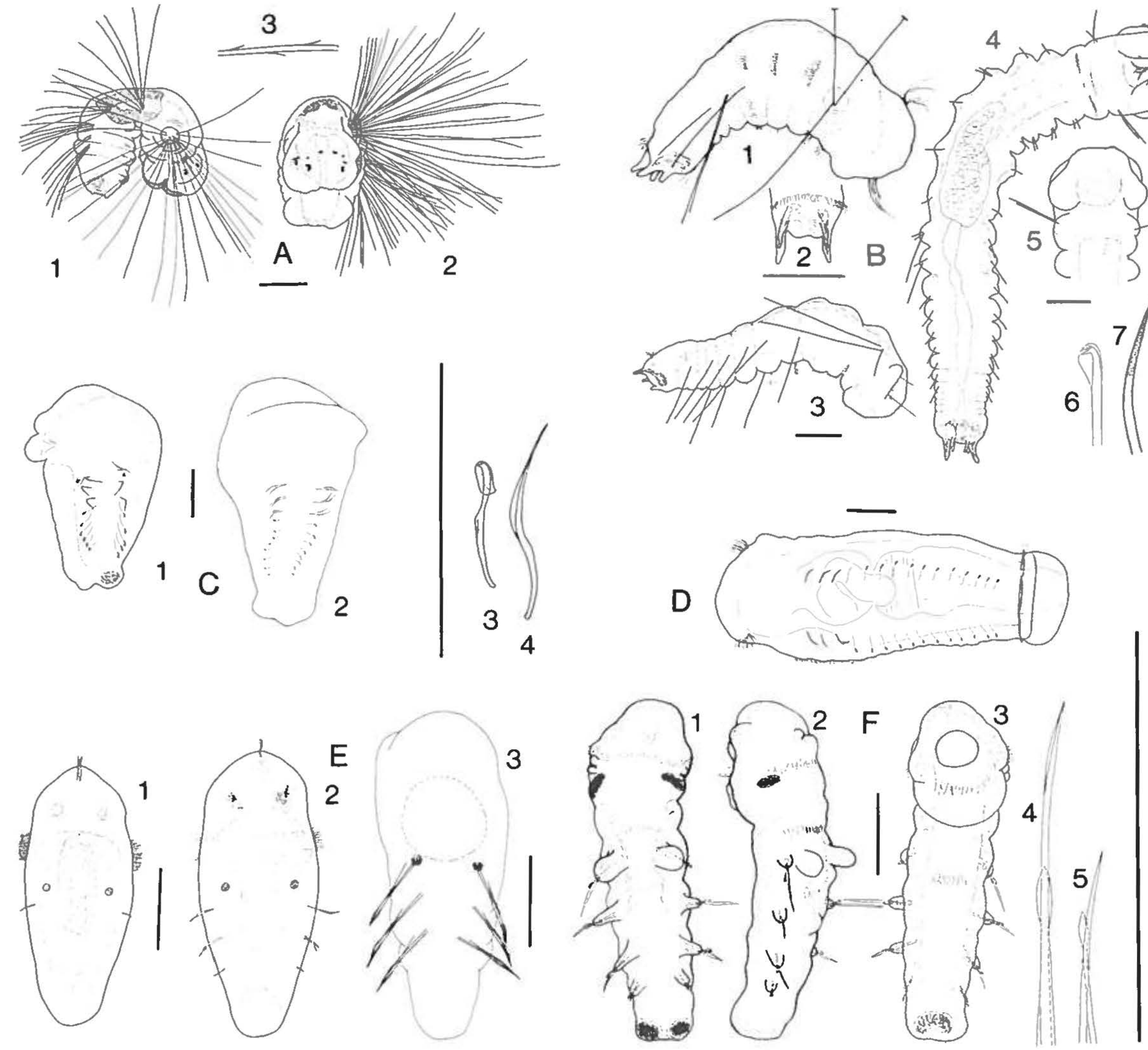

Fig. 6. **A:** *Polydora coeca,* 1: 6-setiger larva with larval setae only, in right lateral view, and 2: in frontal view with setae on the left side shown; 3: part of seta, not to scale. **B:** *Prionospio malmgreni* ?, 1: 4-setiger larva with larval setae only, in right lateral view; 2: anal region of same in ventral view; 3: 8-setiger larva with larval setae only, in right lateral view; 4: 16-setiger larva with capillary, hooked, and a few larval setae, in ventral view (hooked setae not shown); 5: anterior end of same in dorsal view; 6: hooked, and 7: stout ventral (sabre) setae of oldest larva, not to scale. **C:** Capitellid A, 1: larva with 8, 4 and 4 capillaries on setigers 1, 2 and 3, followed by 5 setigers with 4 hooked setae each and a setiger with just 2 ventral ones, in left lateral view; 2: older larva with 8 capillaries on each of setigers 1 to 3, followed by 8 setigers, each with 4 hooked setae; 3: capillary, and 4: hooked setae of same. **D:** Capitellid B, 15-setiger larva with only 4 capillaries on each of setigers 1 to 3, and 4 hooked setae on each of the 12 following. **E:** *Chone* sp., 1: 1-setiger, 2: 3-setiger, and 3: oldest larva found, in dorsal view with ciliation, setae, and statocysts shown. **F:** Terebellid A, 1: 4-setiger larva with dorsal cirri or gills on setiger 1, in dorsal, 2: dorso-lateral, and 3: ventral view; 4: setae on setiger 2, and 5: setiger 4.

Reproduction. – Probably sets in later than in *Polydora coeca,* and is of shorter duration.

Growth. – As shown in Table 5 there is a general increase in size, especially from late spring.

Spionid A

Description. – A large, 800μ long, plump larva without pigmentation or palps and very much like an *Aonides* occurred on 18 June.

Capitellid A (Fig. 6C)

Description. – These larvae have fewer segments than those of *Capitella capitata* (Fabr.) described by Claparède & Metschnikoff (1869), Fewkes (1883), Häcker (1897), Eisig (1899) and Thorson (1946), but the setae (Fig. 6 C3+C4) closely resemble those of this species which is the only common capitellid in East Greenland, according to Wesenberg-Lund (1953). The youngest larvae, 240μ to 400μ long have 8 setigers, 3

Table 6: Terebellid A, length measurements.

date	early larvae		late larvae			
			<175 μ		>175 μ	
	no.	length in μ	no.	length in μ	no.	length in μ
June 3	11	140-360				
" 9	20	200-370				
" 18	6	300-400				
" 27	14	200-410				
July 19			40	140-170	13	180-240
Aug. 3			79	160-170	32	180-200
" 12			9	170	65	180-230

with 4 capillaries each followed by 5 with 4 hooked setae each. Older larvae, up to 500μ long with up to 11 setigers, have 8 capillaries on each of the first 3 setigers and 4 hooked setae on each of the following.

Development. – The pelagic phase is probably short, as indicated by Thorson (1946) regarding *C. capitata,* and the larvae may not even feed in the plankton.

Mortality. – Predation seems heavy, or perhaps the drop in numbers stems from a lowered reproduction rate in connection with a short pelagic phase.

Capitellid B (Fig. 6D)

Description. – A single larger capitellid, 660μ long, has slightly different setae, and resembles Thorson's (1946) *C. capitata* even more. Like Thorson's newly metamorphosed larva from the Øresund, it has 15 setigers with only 4 capillaries on each of the first 3, and 4 hooked setae on each of the remaining 12, and it has a clearly differentiated digestive tract.

Chone sp. (Fig. 6E)

Description. – The larvae are 240μ to 380μ long, and have a pair of statocysts and 0 to 3 setigers with setae which refer them to the sabellid genus *Chone.* They resemble Okuda's (1946) *C. teres* Bush and Fauvel's (1927) *C. filicaudata* Southern, none of which have been recorded from East Greenland. A likely candidate is *C. duneri* Malmgren, a polychaete of particularly frequent occurrence in the grey clay bottom of J.B.F. between 8 m and 30 m (according to Lund 1951). Three-setiger larvae have an acrotroch and a prototroch which is interrupted in the mouth region (Fig. 6 E2). The single non-setiger larva on 3 August may represent a different species.

Reproduction. – Probably occurs over an extended period, since all sizes occur together, and there is no change in mean length from 3 to 18 June.

Growth. – It probably takes about a week to reach metamorphosis.

Mortality. – The concentration of the larvae in the upper 25 m or most likely less tends to rule out predation as the cause for the sudden reduction in numbers. Outgoing surface currents in connection with quick development through a short pelagic phase, and a stop in propagation is probably the most likely explanation.

Terebellid A (Fig. 6 F)

Description. – Larvae 140μ to 410μ long with 0 to 4 setigers and uniramous parapodia have setae which refer them to the Terebellidae. The oldest larvae have a pair of short dorsal cirri or gills on the first setiger (Fig. 6 F1–F3). Two species may be involved.

Reproduction. – As shown in Table 6, early and late larvae from 2 separate periods of reproduction show a slight increase in mean length.

Mortality. – Predation is not apparent.

Mollusca

Gastropoda

10 (or 12) species of larval gastropods occur in the samples, including 2 prosobranchs and 8 (or 10) opisthobranchs, of which 1 is a tectibranch, 3 are holoplanktonic pteropods, 1 is a saccoglossan and 5 (or 7) are nudibranchs. The helicoid larvae have been measured in their greatest dimension while placed aperture down, and the egg-shaped opisthobranchs while placed on their left side.

Prosobranchiata

Trichotropis conica (Møller) ? (Fig. 7A)

Description. – These larvae have extended velar lobes, a pair of eyes, a protruding foot, and a striated shell very similar in shape and size to the *T. conica* described by Thorson (1935) from egg capsules found in East Greenland. The unsculptured protoconch measures 425μ across, and the larvae measure 430μ to 900μ, having 1 to 1.8 whorls.

Reproduction. – Judging from the size variation, there is an extended period of reproduction surpassing the developmental time shown by Thorson (1935).

Development. – Thorson (1935) described *T. conica* as having direct development. However, the finding of planktonic larvae of considerable size, presumably belonging to this species, indicates that development in the egg capsule is, or at least can be, followed by a pelagic and perhaps planktotrophic phase. There is no change in mean size, which may indicate that veligers are released as well as settle at different sizes.

Trichotropis borealis Brod. & Sowb. (Fig. 7B)

Description. – These larvae resemble Thorson's (1935) *T. borealis* larvae from egg capsules in East Greenland, both in shape and size, and in possessing conchioline ridges. The veligers measure 750μ to 1100μ across and

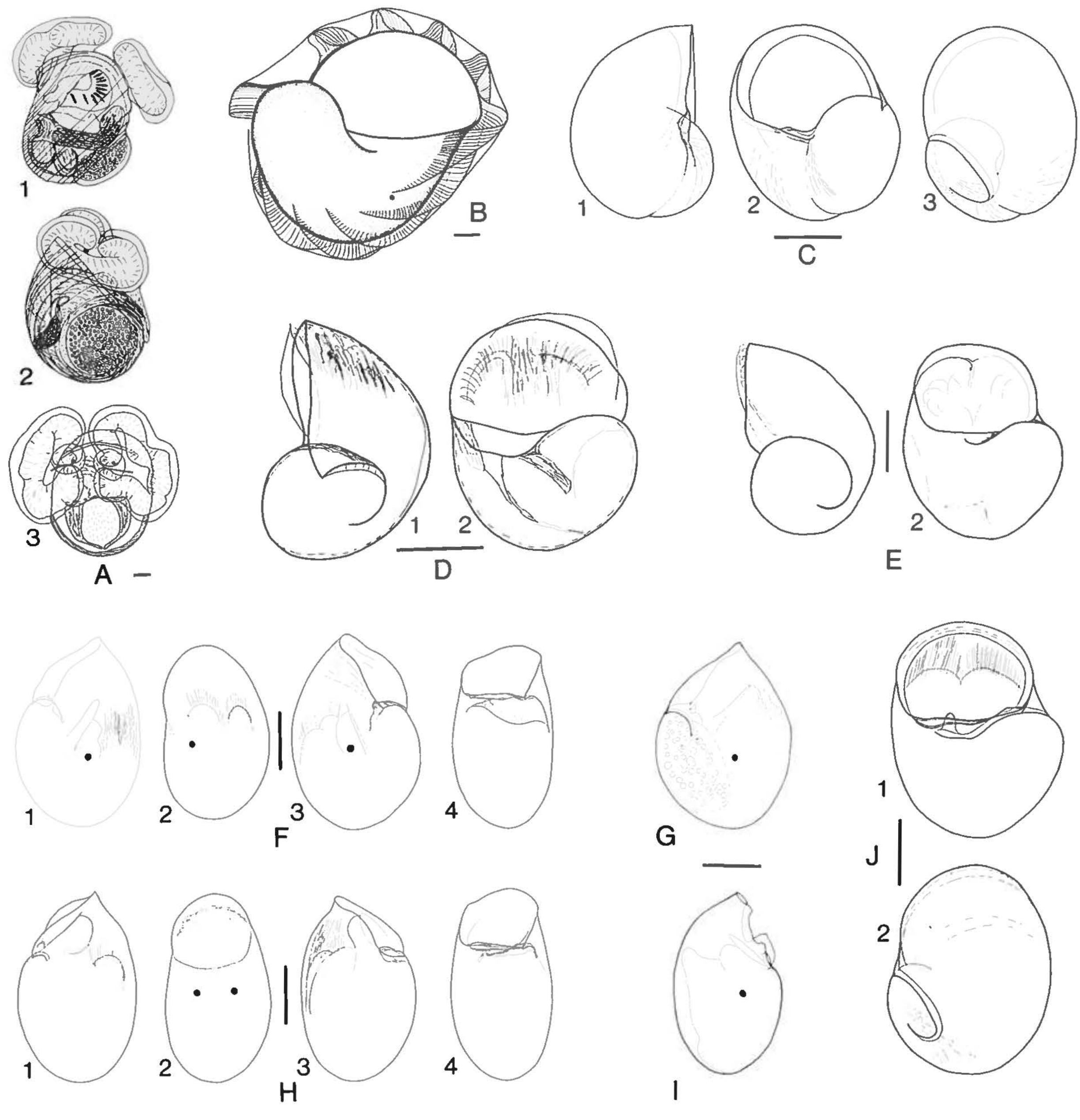

Fig. 7. **A:** *Trichotropis conica* ?, 1: dorsal, 2: lateral, and 3: frontal view of same larva. **B:** *Trichotropis borealis* in aperture view. **C:** *Diaphana minuta*?, 1: right, 2: aperture, and 3: dorsal view of same larva. **D:** *Limacina helicoides* ?, 1: left, and 2: aperture view of same larva. **E:** *Alderia* ? sp., 1: left, and 2: aperture view of same larva. **F:** *Dendronotus* ? sp. 1, 1: left, 2: frontal, 3: right, and 4: posterior view of different larvae. Growth increment lines are shown in 3, and a statocyst in 1, 2, and 3. **G:** *Dendronotus* ? sp. 2?, left side view with one statocyst shown. **H:** *Cratena* ? sp. 1, 1: left, 2: frontal, 3: right, and 4: posterior view of different larvae; both statocyst are shown in 2. **I:** *Cratena* ? sp. 2?, right side view with one statocyst shown. **J:** *Coryphella* ? sp., 1: aperture, and 2: dorsal view of same larva.

have 5 ridges (as opposed to 3 in Thorson's larvae) supporting an outer conchioline membrane, like in the trichotropid *Trichosirius inornatus* (Hutton) (Pilkington 1976), where the number of ridges increases with age. *T. borealis* is very common in the fiord (J. Just pers. comm.). Unlike *T. conica,* the veligers of *T. borealis* all have their velum and foot contracted inside the shell.

Reproduction. – Spawning occurs in May-June, as found by Thorson (1935) in East Greenland. There is no increase in mean size.

Development. – As in *T. conica.*

Opisthobranchiata

Tectibranchiata

Diaphana minuta Brown ? (Fig. 7C)

Description. – A single larva resembling larvae of *D. hyalina* Turton from the Øresund (Thorson 1946) and *D. minuta* from the White Sea (Mileikovsky 1962) is tentatively referred to *D. minuta* found in East Greenland (Lemche 1941).

Pteropoda

Limacina helicina Phipps

Description. – Juveniles of this pteropod occur in all sizes. There are few adults, as found by Ussing (1938) in East Greenland fiords. The first half primary whorl measures ca 50μ across, and is uncoloured.

Distribution: Primarily in the upper 12 m to 25 m, but on 12 Aug. also in considerable numbers below 25 m.

Limacina helicoides Jeffreys ? (Fig. 7D)

Description. – Juveniles of a pteropod with a larger, brown first half primary whorl measuring ca 100μ across may belong to this cosmopolitan, primarily bathypelagic species (Spoel 1972).

Distribution. – Possibly slightly deeper than *L. helicina*.

Clione limacina Phipps

One juvenile found.

Saccoglossa

Alderia ? sp. (Fig. 7E)

Description. – No saccoglossans have been reported from East Greenland, and only one species, *Alderia* sp. (det. Lemche) with pelagic larvae similar to this one, without a collumellar tooth and with no differentiation of the inner lip, has been observed and brought through metamorphosis in West Greenland (pers. obs., unpubl.). The larvae and young bottom stages are very similar to those of *Limapontia capitata* (Müller) described by Thorson (1946) and Mileikovsky (1958).

Nudibranchiata

No nudibranchs have been reported from J.B.F., but 2 (or 4) species of egg-shaped larvae (Thorson's type C, 1946, = Thompson's type 2, 1961), and 1 helicoid larva (Thorson's type B = Thompson's type 1) occur in the plankton. All are withdrawn into their shell, and the egg-shaped larvae have a pair of statocysts. Egg-shaped larvae are known in the Dendronotidae, Coryphellidae (some), Eubranchidae, Cuthonidae (= Tergipedidae), Fionidae and Calmidae (Thompson 1961), but Thorson's nudibranch sp. larva (1946, fig. 160), possibly a *Dendronotus*, is the only larva, that I have been able to find in the literature, attaining a size comparable to the exceptionally large larvae from J.B.F.

Dendronotus ? sp. 1 (Fig. 7F)

Description. – These, the most common nudibranch larvae in the fiord plankton, are comparatively plump (215μ to 240μ long and 330μ to 360μ high, or 1.44 to 1.59 times as high as long). They have a comparatively long suture reaching to about midway between the top and the outer lip. The profile of the shell is slightly concave next to the outer lip, where growth increment lines are visible. Viewed posteriorly the aperture is wide and slightly oblique. There is a folded inner lip running at right angles to the longest axis of the shell. At the right end of the lip is a small tooth, and inside the lip, about 1/3 of the length of the lip from the former tooth is a low, obtuse collumellar tooth. The operculum is always pulled far inside the shell. The larvae differ from those of *D. frondosus* Ascanius (Hurst 1968), a species found in East Greenland, but may belong to *D. robustus* Verrill, known from Iceland and Spitzbergen (Lemche 1941).

Distribution. – Primarily in the upper 25 m, but not taken in the fiord water layer above 12 m.

Growth. – Very little shell growth is apparent, and the mean size did not change during the sampling period.

Dendronotus ? sp. 2 ? (Fig. 7G)

Description. Possibly younger specimens of *D.* ? sp. 1, since they are of the same length (240μ), but they are not as high (330μ to 340μ, which is 1.38 to 1.42 times the length), and have a long suture.

Cratena ? sp. 1 (Fig. 7H)

Description. – These larvae are slimmer than those of *Dendronotus* ? (200μ to 215μ long and 330μ to 360μ high, or 1.58 to 1.71 times as high as long, and they have a narrower aperture and a shorter suture. As in *Dendronotus* ? a small tooth is situated at the right end of the inner lip, but the lip slants relative to the longest axis of the shell, the collumellar tooth is longer and narrower, collumellar structures protrude above the lip on the left side, and the small operculum is always lodged on the collumellar tooth. In profile the shell is more concave next to the outer lip, where increment growth lines show below an anterior "hump". The slim shape, profile, suture, inner lip, and the location of the operculum make it resemble larvae of *C. albocrustata* Macfarland (Hurst 1968). A likely species is *C. olriki* (Mörch) found in East Greenland (Lemche 1941).

Growth. – Very little shell growth is apparent, and the mean size did not change during the sampling period.

Cratena ? sp. 2 ? (Fig. 7I)

Description. – Resembles *C.* ? sp. 1, except that the shell is not concave in profile next to the outer lip, although it is "humpbacked". The 2 larvae found are 190μ and 200μ long and 340μ high. They may be of the same species as *C.* ? sp. 1.

Coryphella ? sp. (Fig. 7J)

Description. – This larva closely resembles those of a *Coryphella* sp. (det. Lemche) brought through metamorphosis in West Greenland (pers. obs., unpubl.). Also Mileikovsky's (1958, 1962) *Tergipes despectus* Johnston, from the White Sea, brought through metamorphosis, is very similar in coloration and shape, but is smaller, and has a smaller first half primary whirl. It is possible, however, that Meleikovsky's larva is not a *Tergipes,* since Lankester (1875) found, that a *T.* sp. at Naples has egg-shaped larvae, and Pelseneer (1911) found, that *T. despectus* has egg-shaped larvae. Finally, the larva pictured by Thorson (1946) and tentatively named *Elysia viridis* (Montagu) shows considerable resemblance to the present specimen in general shape and in having a folded inner lip and a collumellar tooth, but it is ca 50% larger.

Bivalvia

The bivalves is the most abundant group, only surpassed by the polychaetes on 3 June. Three species have been recognized. A few unidentified specimens may belong to the Cardiidae (not reported from J.B.F.).

Macoma calcarea (Chemnitz)

Description. – Very similar to *M. baltica* (L.) (Sullivan 1948), and very sticky as the larvae assumed to be *M. baltica* by Jørgensen (1946). Ockelmann (1958) suggests that *M. calcarea* has planktotrophic development, since the eggs are only 95μ in outer diameter, whereas *M. loveni* (Steenstrup), also occurring in J.B.F. (Ockelmann, pers. comm.), has large eggs, 210–260μ, and probably a very short pelagic stage, if any.

Distribution. – Principally in the upper 25 m, and in the summer and fall mostly in the fiord water and transitional layer above 12 m.

Reproduction. – There is a short spawning period in late May and June and the larvae reach metamorphosis in August.

Development. – The larvae show signs of lecithotrophic development with undifferentiated soft parts and large, smooth valves.

Growth. – Size variation and growth are shown in Table 7. The length is roughly doubled, and the volume increased by a factor 5.

Table 7: *Macoma calcarea,* length measurements.

date	no.	no. per length group (length in μ) 140	150	160	170	180	190	200	210	220	-260
June 3	48	19	16	12	1						
" 9	38	11	14	10	3						
" 18	36	1	20	10	4	1					
" 27	60	2	13	28	14	3					
July 19	26		3	5	7	4	6	1			
Aug. 3	3						2	1			
" 12	12			1		1	3	2	1	2	2

Mya truncata (L.)

Larvae of this species occurred regularly, but in very small numbers, and were often difficult to distinguish from *Hiatella striata* with which they have probably been confused in several cases.

Hiatella striata (Fleuriau)

Description. – These larvae resemble Sullivan's (1948) *Saxicava arctica* (L.) (= *Hiatella gallicana* (Lamarck) = *S. rugosa* (L.)), but they should, according to Ockelmann (pers. comm.) be called *H. striata* (= *H. byssifera* (Fabr.)). They measure 100μ to 450μ in length.

Reproduction. – Measurements of all larvae 200μ or more in length and at least 500 of the smaller larvae in each series (Fig. 8) reveal 3 distinct size groups, representing 3 reproductive periods, between which, however, reproduction does not seem to cease completely. A group of old larvae (group 1) 190μ to 380μ long (280μ mode) were found on 3 June. Most of these reached a settling stage at a length of 360μ to 370μ or more before 12 August. Judging from growth estimates (see below), these larvae may have been spawned the previous summer and fall. A main reproductive period occurred in May, the larvae from which (group 2) were 110μ to 130μ long (110μ mode) on 3 June. The next burst of reproduction set in in late June, yielding a few 100μ larvae (group 3) on 27 June, and larvae up to 220μ long (160μ mode) by 12 August, when new larvae 100μ long were still appearing. No group 3 larvae were found in the surface samples from 12 July, which contained almost exclusively group 2 larvae.

Distribution. – The larvae were primarily concentrated in the upper 25 m, except on 12 August, when the smallest and largest (groups 3 and 1 respectively) were to a great extent found below 25 m. The size group in between (group 2) was, at least from about mid July to mid August, almost the only one to be found above 12 m, in the freshened and warmed fiord water. An upward migration of the young stages and a downward migration of the old stages seemed to occur in the upper 25 m, while the larvae in general were found deeper late in the season, as the fiord water layer thickened.

Growth. – The group 2 larvae grew faster than the older larvae of group 1, and an overlap between these two first occurring size groups was apparent by late July (Fig. 8). In the first 3½ weeks from 3 June to 27 June,

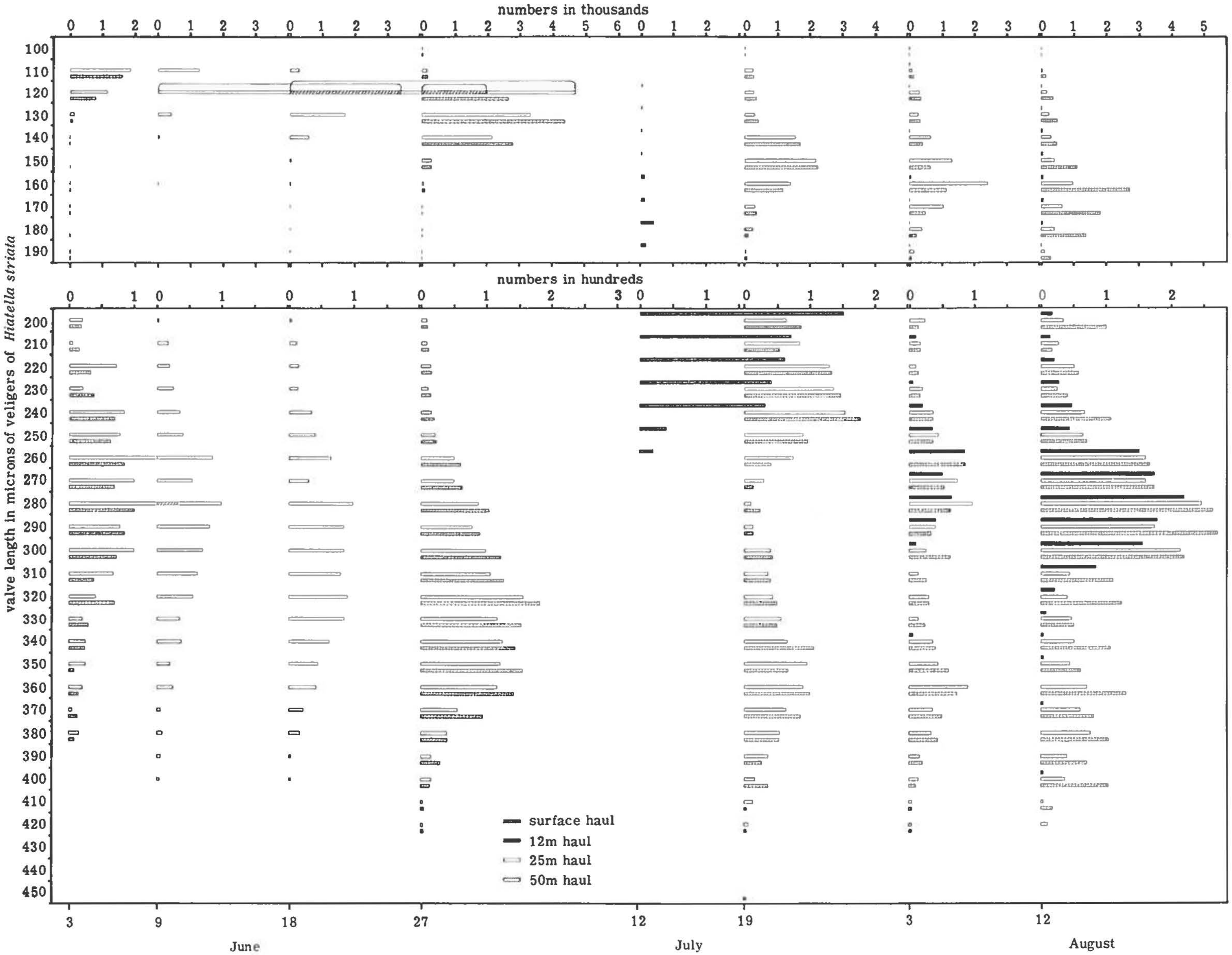

Fig. 8. *Hiatella striata*, length measurements of veligers (see text).

the modal increase in length was about 18% for both groups, or from 110μ, to 130μ for group 2, and from 280μ to 330μ for group 1. The two youngest groups show greater length increments in the three weeks from 27 June to 19 July. The group 2 larvae had their greatest relative growth rate from 12 July, when only this group was caught, to 19 July, in a period, when the primary production was at its greatest (Fig. 2 and Andersen 1977). During this three week period the relative increase in length was greatest for the group 2 larvae which increased their modal length by ca 85% from 130μ to 240μ, while the group 3 larvae increased their modal length by 50% from 110μ to 150μ. In the last week alone the group 2 larvae increased their modal length by 30%. The increase in the modal length of group 1 larvae, however, was only ca 15% due to settling. In the following 3½ weeks from 19 July to 12 August, growth was again slower, being ca 7% (150μ to 160μ), and 20% (240μ to 290μ) respectively for groups 3 and 2. In August the growth of the smallest (group 3) larvae was so reduced, that it seems reasonable to assume that they could reach a size comparable to the length of group 1 on 3 June, by the same time the following year, since a relative length increase of only 5% per 3½ weeks is needed.

Mortality. – Seems remarkably slight in the plankton.

Ectoprocta

Electra ? sp. (Fig. 9A)

Description. – All cyphonautes larvae presumably belong to a single species. They fall into 3 groups, primarily according to size (Table 8). Although the smallest, short larvae are exceptionally short compared to their height, their outlines fit into the growth lines of the larger larvae. With age, the sloping ends become concave in outline, and the posteroventral part more prominent. The large larvae show some variation in outline. Figures 9 A2 and A3 demonstrate variations in curvature of the shell edges and in the size of the posteroventral bulge which tapers off towards the centre of the valve. Except for this bulge and an elevated part running in a curved line from the opening for the apical tuft to about half way from the posteroventral corner, the valves are largely flat to slightly concave with turned in edges. The bulge is the youngest part of the valve, from where growth exclusively occurs anteriorly and dorsally, as indicated by growth increment lines, and the afore mentioned trace from the apical opening. A number of more prominent growth increment lines turn more to the posterior in a narrow zone along the ventral margin. The valves are transparent and are held 10μ to 20μ apart by an opaque body. Opacity is characteristic of *Electra pilosa* L. as opposed to species of *Membranipora* which are thin and transparent (Levinsen 1917) and comparatively longer relative to height (Ryland 1965). No bryozoans thought to posses cyphonautes larvae have been found in J.B.F. (Andersen 1973). The only species found eligible on the east coast of Greenland is *E. catenularia* James (Levinsen 1917). Another possibility is *M. serrulata* (Busk) recorded from Kane Basin (Busk 1880).

Table 8: *Electra* ? sp., valve measurements of 3 size and length categories of cyphonautes larvae.

date	group	no.	μ high	μ long	length : height
June 3	large	4	290-300	310-340	1.03 - 1.07
" 18	large	4	310-330	340-360	1.10 - 1.13
" 27	large	8	300-320	320-360	1.06 - 1.13
July 19	small, short	1	180	180	1.00
	large	10	300-330	340-380	1.06 - 1.17
Aug. 3	small, short	2	170-180	180	1.00 - 1.06
	small, long	7	210-280	230-300	1.04 - 1.20
	large	2	310	330	1.06
" 12	small, short	2	220	170	0.77
	small, long	10	240-260	260-300	1.04 - 1.20
	large	7	300-340	330-350	1.00 - 1.13

Reproduction. – There seems to be 2 main spawning periods, one before June and one from about mid July.

Growth. – Seems slow, as suggested by Marcus (1940) and Thorson (1946). The valves have numerous more or less complete concentricly arranged lines, possibly denoting daily growth increments not hitherto noted in cyphonautes larvae. The fine growth bands of fish otoliths were first interpreted as daily growth increments by Panella (1971), who even grouped the bands into weekly, bimonthly and monthly periods, as well as into winter and summer zones. Kristensen (1980) found similar lines in cephalopod statoliths, supposedly grouped into fortnightly and monthly patterns. The cyphonautes larvae in J.B.F. have up to 165 lines, but although there is a variation in the prominence of the lines, there seems to be no periodicity. The supposedly daily increment lines are often obscured by wider bands near the outer margin of the valves.

Entoprocta

Loxosomatid A (Fig. 9B)

Description. – The larvae are all in the contracted state, into which live larvae have been observed to revert immediately, when disturbed. The prototroch is constricted and involuted with the hyposphere into a posteroventral cavity. The more or less circular outline of the live larva viewed apically thus changes to an oval to pear shape, 280μ to 480μ long. On the episphere are a number of largely laterally located protuberances, each containing a globular vesicle, perhaps analoguous to the stalked vesicles of Jägersten's type B larva (1964) and of *Loxosoma pectinaricola* (Nielsen 1967). They are arranged in groups, as shown in Jägersten's larva, and a few of them are open at the top and are filled with fibrillary material, as in Jägersten's "vesicular sense organs", whereas the majority are clear and possibly

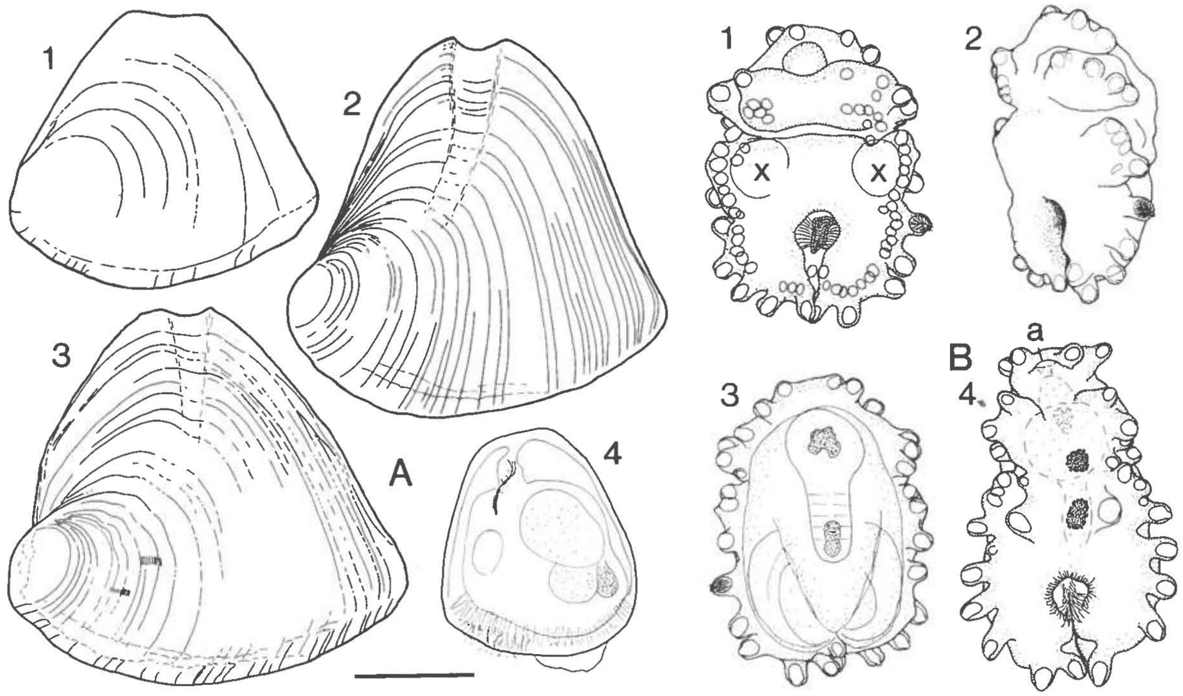

Fig. 9. **A:** *Electra* ? sp., valves of 1: small, long, and 2 and 3: large cyphonautes (see Table 8); 4: smallest larva found; in 3 are shown what are supposedly daily growth increment lines. **B:** Loxosomatid A, 1: short and wide larva in "ventral", 2: "ventrolateral", and 3: "dorsal" view; 4: long and slim larva; a = supposedly apical organ, x = location of internal budding; ingested matter is shown in 3 and 4.

filled with liquid. Smaller vesicles are closely packed below the protuberances (Fig. 9 B1) which are arranged in a way, so the body can be divided into 4 sections. Posteriorly is a row of protuberances on each side running longitudinally around to the posterior border of the ventral indentation. Next are 2 progressively more oblique rows, and finally a few are directed anteriorly to anterolaterally. An apical organ is sometimes discernible at the anterior end (a in Fig. 9 B4). No external cilia are visible. Dark ingested matter can be seen in intestines and stomach (Fig. 9 B3 and B4). Internal budding is apparent in som larvae (× in Fig. 9 B1). Unidentified entoprocts, presumably *Loxosomella* species judging from Prenant and Bobin (1956), have been found on scales and setae of *Harmothoë imbricata* (L.) in East Greenland, and on *Praxillura longissima* Arwidsson north of Jan Mayen (Wesenberg-Lund 1953).

Growth. – Mean length increased insignificantly during the sampling period.

Echinodermata

Ophiuroidea

Ophiocten sericeum (Forbes) (Fig. 10A)

Description. – Identified after Thorson (1934). As pointed out by Thorson, the larval skeleton can vary considerably, and in J.B.F. it is the rule rather than the exception. It is especially the transverse and end rods that vary, and they can be very bizarre (Fig. 10 A5 and A6). The posterolateral rods are formed first followed by the anterolateral, the postoral, and the posterodorsal ones. The young larvae are markedly compact in appearance (Fig. 10 A1x) with their long, slightly inward curving posterolateral rods and 3 pairs of short rods in between. Later they become more elegant, as the posterolateral rods lengthen, curving their ends outward, and the tips of the other rods almost reach out in line with these (Fig. 10 A1y and A1z). During metamorphosis the inner rods are the first to be resorbed, and last are the basal parts of the posterolateral rods, where they join the transverse and end rods (Fig. 10 A4). The first plates to be formed are the central dorsal plate, the five radials, and a long terminal plate in each arm, followed by a pair of side plates and an axial element in each arm (Fig. 10 A2 and A3). Finally the first pair of spines in each arm is formed (Fig. 10 A4).

Occurrence. – The occurrence of the different stages described below is shown in Table 9. The pelagic phase seems to last a month to a month and a half.

Distribution. – Growing larvae and larvae ready to settle are found primarily below 25 m, whereas metamorphosing larvae seem to live primarily above 25 m (except on 27 June), and even above 12 m, in the fiord water layer.

Reproduction. – Occurred all through the sampling

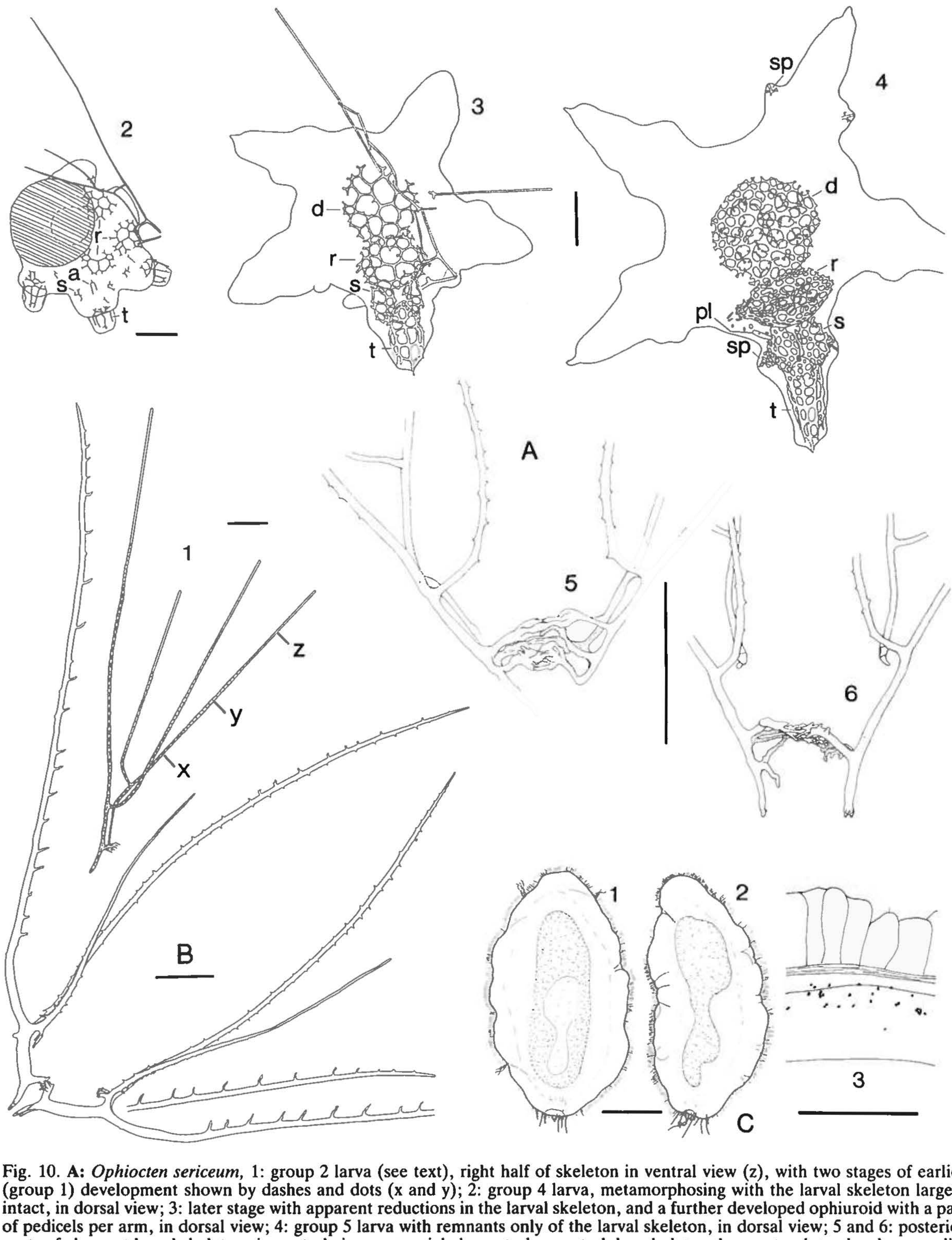

Fig. 10. **A:** *Ophiocten sericeum,* 1: group 2 larva (see text), right half of skeleton in ventral view (z), with two stages of earlier (group 1) development shown by dashes and dots (x and y); 2: group 4 larva, metamorphosing with the larval skeleton largely intact, in dorsal view; 3: later stage with apparent reductions in the larval skeleton, and a further developed ophiuroid with a pair of pedicels per arm, in dorsal view; 4: group 5 larva with remnants only of the larval skeleton, in dorsal view; 5 and 6: posterior parts of aberrant larval skeletons in ventral view; a = axial element, d = central dorsal plate, pl = posterolateral rod, r = radial plate, s = side plate, sp = spine, t = terminal plate. **B:** *Ophiopluteus mancus,* larval skeleton in ventral view. **C:** *Myriotrochus* ? sp., 1: dorsal, and 2: lateral view of same larva; 3: transect of body wall showing tall, ciliated epiderm cells and grains of subepidermal red pigment.

period, and set in at least a month earlier than the short spawning period in late July found by Thorson (1934, 1936) in Kejser Franz Joseph Fjord, East Greenland, where a spawning period also occurred in November-December.

Growth and development. – The larvae are tentatively divided into the following "stages" of development (Table 9):

1: Less than 1 mm long, with undeveloped internal organs.
2: Larger, with organs developing, but externally symmetrical and with no signs of beginning metamorphosis.
3: Asymmetrical due to beginning metamorphosis, but with no skeletal reductions, and without pedicels.
4: Metamorphosing, with a pair of pedicels on each arm, and new skeletal elements, but still with the larval skeleton largely intact.
5: Fully or nearly metamorphosed, with few or no remnants of the larval skeleton, and with 2 pairs of pedicels on each arm.

Ophiopluteus mancus (Mortensen) (Fig. 10B)

Description. – Identified after Mortensen (1924) and his larvae, still in the Zoological Museum, Copenhagen. *O. mancus* is the larva of *Amphiura filiformis* (Müller), but only 2 species, other than *O. sericeum,* have been found in the fiord, namely *Ophiacantha bidentata* (Bruzelius) and *Ophiopleura borealis* Dan. & Kor. (Andersen 1971), and they both have large eggs, and are considered as having direct development.

Asteroidea

Asteroid A

Description. – Two white, opaque larvae, ca 1 mm long and 0.5 mm wide and slightly compressed are referred to the Asteroidea on the basis of Hyman (1955). In external morphology they much resemble the lecithotrophic larvae of *Solaster endeca* Forbes described by Gemmill (1912), but they are only half as large. They are most likely larvae of *Ctenodiscus crispatus* (Retz.) or *Urasterias lincki* (Müller & Troschel), both very common in the fiord, and the eggs of which are ca. 0.6 mm in diameter compared to 1.2 mm in *Solaster* sp. in Balsfiorden, northern Norway (Falck-Petersen 1982). The larvae are lighter than the medium, as are eggs and larvae of the species mentioned.

Echinoidea

Strongylocentrotus pallidus (G. O. Sars)

Description. – Three larvae are presumed to belong to this species, one stage I (4-armed) and two stage II (6-armed). *S. droebachiensis* (Müller) is the only other echinoid (less common) in the fiord (Margit Jensen, pers. comm.). The morphology of the distal ends of the body rods is generally like that most commonly found in *S. pallidus,* and the length of the body rods (230μ) is equal to the maximum length in *S. pallidus* (*S. droebachiensis* reaches 215μ), according to Strathmann (1978).

Holothurioidea

Myriotrochus ? sp. (Fig. 10C)

Description. – Four dolioliform larvae, 400μ to 600μ long, densely ciliated with fine cilia, and with coarser cilia at each end and in 5 bands around the body, were found. They are possibly *M. rinki* Steenstrup or *M. eurycyclus* Heding, both occurring in the fiord (Andersen 1971). The only other holothurioid recorded from J.B.F. is *Elpidia glacialis* Théel, which has large eggs and therefore presumably direct development (Thorson 1936).

Eggs

Two to three types of non-copepodan eggs, probably from polychaetes, are of frequent occurrence, and several others are scarce (Table 9).

Summary and discussion

At least 57 species are treated. Eleven of these are essentially non-pelagic nematodes of terrestric, limnic and marine origin, 4 are holoplankters, and 42 are meroplankters. Most diverse among the meroplankters are the polychaetes with 19 species, followed by the gastropods with 7 species, the echinoderms with 5 species, the bivalves with 3 species, and a number of groups with 3 species or less. The bivalves, however, are far the most abundant, followed by the polychaetes (which dominated on 3 June) and the echinoderms, and a number of groups of sparse, though often regular occurrence (see Table 9).

Occurrence

Of the 42 meroplankters recorded, 15 species (= 36%) presumably occurred throughout the sampling period. Eleven of these (26%) occurred on all the sampling dates. Most of the species (35 = 83%) including the ones mentioned above, occurred in June. The only exceptions are a number of rare species, the small acoelomarian, and the late larvae of *Schistomeringos* sp. and terebellid A. Ten species (24%) occurred exclusively in June, but only 5 (12%), viz., *Synarachnactis brachiolata, Polydora coeca, Trichotropis borealis,* and the early larvae of *Chone* sp. and terebellid A, occurred in such numbers, that metamorphosis can be considered largely completed by mid July, or in other words prior to the main phytoplankton bloom. Another 2 species (5%), viz., *Schistomeringos* sp. and capitellid A, occurred mainly in June, prior to the main phytoplankton

Table 9: Catch per 10 hauls from standard depths to the surface, calculated from actual hauls, assuming, if necessary, even distribution.

Station	1		2	3	4		5		6			7		
Month	June		June	June	June		July		August			August		
Day	3		9	18	27		19		3			12		
Depth in m	75		30	30	45		80		85			80		
No. of hauls	2	4	4	6	4+1	8	3	3	3	3	3	3	3	3
Sampling depth in m	24	50	30	30	20+14	45	25	50	12	25	50	12	25	50
Species / Standard depth in m	25	50	25	25	25	50	25	50	12	25	50	12	25	50
Coelenterata		5	4	4	3	11	3						3	
planula				1		1	3						3	
Synarachnactis brachiolata ?		5	4	3	3	10								
Turbellaria		3	10	7	8	3	13	16	15	63	70	3	16	24
small acoelomarian										20	33			
brown turbellarian						1	3	3	5	26	30		3	7
rhabdocoelomarian		3	10	7	8	1	10	13	10	17	7	3	13	17
Nemertini: pilidium				1			10	10		17	7		17	3
Nematoda			2	1	130	200				3	3	7	10	20
Polychaeta (- P. borealis)	5458	4678	5428	2474	4470	3615	404	120	5	236	265	7	136	176
Gattyana cirrosa ?	31	135	71	61	72	148	20	56		17	23		17	3
metatrochophora I	31	135	71	61	72	133	20	40		13	23		17	3
metatrochophora II						14		13		3				
nectochaeta						1		3						
Lagisca ? sp.		3		1										
Harmothoë ? sp.				1										
Pholoë minuta					11	7	13	10			3			
Phyllodoce ? sp.								3						
Eteone longa			2			3	13	7		3	3	3	7	
Phalachrophorus borealis	10	188	229	214	144	268	60	443		7	83		10	117
Nereimyra aphroditoides ?	4295	3766	3580	2147	4270	3306	198	189		10		3		7
metatrochophora I	4295	3763	3580	2140	1370	991	3	23				3		7
metatrochophora II		3		7	2900	2315	72	83		3				
nectochaeta					(a few above)		123	83		7				
syllid ? A				8	5	6		3			3			7
trochophora				8	5	6		3						7
metatrochophora											3			
Nereis pelagica					5									
Nephthys ? sp.		28	8	11	3		20	7						3
Ophryotrocha sp.		3												
Schistomeringos sp.	406	375	267	45	8	14	20	23		33	20		3	3
early unsegmented	406	375	254	17		1		3						
early segmented, non-setiger			13	28	8	13	20	10						
early 1- and 2-setiger								10		3	3			
late unsegmented										30	17		3	3
Polydora coeca	16	18	8	11	3	8								
Prionospio malmgreni ?	21	20	25	19	21	28	13	13			7		3	10
spionid A				2										
capitellid A	406	225	346	158	61	81		10	5	3	3			3
capitellid B			2											
Chone sp.	220	100	81	4						3				
non-setiger	42	25	35							3				
1-setiger	73	40	13	3										
2-setiger	42	20	17	1										
3-setiger	63	15	17											
terebellid A	63	5	42	8	11	14	107	80		167	203		106	140
early non-setiger	16	3	25	1	3	3								
1-setiger	5													
2-setiger	16		4	4	5	4								3
3-setiger	26	3	13		3	3								
4-setiger				3		4								
late, shorter than 175 microns							67	67		110	153		3	27
late, longer than 175 microns							30	13		57	50		103	113
Gastropoda (- Pteropoda)	16	25	40	46	46	45	83	63		20	53		33	20
Trichotropis conica ?	5	3	6	4	3	4	10				3			
T. borealis		3	4	14		15								
Diaphana minuta ?														3
Limacina helicina	3560	3415	3525	3565	4050	5040	2667	2757	175	2000	2123	260	2653	3833
L. helicoides ?	26	28	41	35	27	49	43	23		10	20	3	7	10
Clione limacina							3							
Alderia ? sp.							3							
Dendronotus ? sp. 1	5	18	23	23	32	21	63	53		17	30		30	17
D. ? sp. 2 ?		3	4	4	3	4		3		3				
Cratena ? sp. 1			2	1	8	1	7	7			10			
C. ? sp 2 ?	5												3	
Coryphella ? sp.											10			
Bivalvia	2933	3445	9853	12310	9349	13947	7927	8247	455	7313	4507	1363	4922	10110
Macoma calcarea	73	85	78	50	69	47	47	57	5	3	7	10	17	13
Hiatella striata	2860	3360	9775	12260	9280	13900	7880	8190	450	7310	4500	1353	4905	10097
Ectoprocta: Electra ? sp.		10		6	5	8	17	20		27	10		20	43
Entoprocta: loxosomatid A		20	2	7	5	24	13	27		7	17		3	30
Echinodermata	140	411	831	567	209	826	316	460		128	333	23	113	280
Ophiocten sericeum	140	408	831	567	206	825	316	460		128	333	20	106	277
stage 1	5	53	102	63	11	38	3	10		7	7			10
stage 2	135	355	725	500	176	748	267	383		97	273		73	213
stage 3 see text			4	1	8	32	13	17		10	13	3	20	30
stage 4				3	11	4	33	43		7	33	17	3	7
stage 5						3					7		10	17
Ophiopluteus mancus														
asteroid A			2			1								
Strongylocentrotus pallidus		3			3							3		
larval stage I					3									
larval stage II		3										3		
Myriotrochus ? sp.						1							7	3
eggs	135	188	304	266	306	263	180	173		144	326		17	126

bloom, and 6 additional species (14%), viz., *Gattyana cirrosa* ?, *Nereimyra aphroditoides* ?, *Nephthys* ? sp., *Prionospio malmgreni* ?, *Trichotropis conica* ?, and *Macoma calcarea*, occurred mainly in June and July, prior to and during the main phytoplankton bloom. Only 7 species (17%), viz., the Turbellaria, the pilidii, the late larvae of *Schistomeringos* sp. and terebellid A mentioned above, and a number of rare species, occurred mainly or exclusively in late July and/or in August following the main phytoplankton bloom, but perhaps benefiting from a fall bloom in early August (see Tables 9 and 10 and Fig. 2).

Distribution

A large majority of the larvae stayed in the upper 20 m to 30 m, and only a few species, viz., the small acoelomarians, *Gattyana cirrosa* ?, syllid A, *Trichotropis borealis*, and the cyphonautes larvae, were distributed evenly above and below 25 m. Above 12 m, in and adjacent to the turbid, warmed, and diluted fiord water layer existing in the summer and early fall, very few species occurred, and only the Turbellaria, *Macoma calcarea*, medium sized *Hiatella striata*, and *Strongylocentrotus pallidus* in fair numbers. Presumably due to the dilution of the surface layers, many species go deeper in the summer and fall, than earlier. Older larvae of *Gattyana cirrosa* ? and *Nereimyra aphroditoides* ? clearly go deeper than younger ones, and the youngest as well as the oldest larvae of *Hiatella striata* and *Ophiocten sericeum* go deeper than medium sized larvae (see Tables 9 and 10).

Reproduction

Only 6 species (14%) reproduce continually throughout the sampling period from primo June to mid August. Of 7 species (17%), some of which possibly include 2 species, reproducing disjunctly in the same period, 4 (10%) do it irregularly, and 3 (7%) in 2 periods: pre-spring/early spring + post-ice-break-up or pre-break-up + fall). Ten of these (24%) start reproducing before June, and 3 of them presumably continue to reproduce after mid August. Seven species reproduce from late pre-spring or earlier till mid summer (late July) and 1 (2%) till late spring (break-up). One reproduces solely in the spring, 1 in late summer and fall (from late July), 1 solely in early and mid summer (mid to late July), 2 (5%) in spring and summer (July), 2 in spring, summer and fall (from late June), 2 in late pre-spring and early spring (June) or earlier, and 9 (21%) in late pre-spring or earlier. In fact the majority, 32 species (76%), commence reproduction in pre-spring (before mid June), before surface heating sets in, 24 of these (57%) even before June. Another 2 start before surface temperatures reach 2°C, and 2 more between this and break-up. Only 2 species reproduce solely after break-up, whereas 3 (mentioned above) presumably have a second reproductive period after break-up, unless several species are involved (se table 10, and period terminology in Fig. 2).

Development

In 26 species of meroplankters the type of pelagic development can be determined. Thirteen of these (31% of the at least 42 species treated) definitely have lecithotrophic pelagic development (L in Table 10), 6 of which (14%) definitely become planktotrophic, while 6 may become planktotrophic in their later pelagic life (P and P? in Table 10). Another 13 species (31%) may initially have lecithotrophic pelagic development followed by planktotrophic pelagic development. In other words, at least 19 species (45.2 % of 42 species) have planktotrophic development. In 15 species the type of pelagic development cannot be determined (Table 10).

The finding of so many species with pelagic larvae in this high-arctic fiord is surprising, compared to the few larvae found by Thorson in East Greenland (1936). It does not, however, invalidate "Thorson's rule" (so named by Mileikovsky 1971) of 1950, stating that the number of species having pelagic larval development decreases as one moves from the equator to the poles, but it does lead to a less strict interpretation of it. In addition many species have lecithotrophic pelagic development, which was not found by Thorson in the Arctic (1936, 1950).

Growth

A rise in primary production (Andersen 1977 and Fig. 2) seems to promote a burst of larval growth, which is especially noticeable in *Hiatella striata*, as shown in Fig. 8, and thereby to accelerate metamorphosis and settling in many larvae somewhere between 27 June and 19 July. The removal of larvae by currents going out of the fiord can, however, give a false impression of this (see Table 9).

Settling

Many species (23) commence settling in early spring or earlier, 8 start in late spring, 5 in summer, and 3 (or 5) in early fall or later. Only a few species (6 or 8) settle entirely before summer (before break-up) and another 3 before fall, whereas 27 (or 29) extend settling to early

Table 10: Distributional and biological parameters in meroplankters of Jørgen Brønlund Fjord.

Species	a total no. taken	b no. in 10 hauls	c distribution in relation to: depth in metres 0 12 25 50	d light A C B	e water type W R S T D	f occurrence of larvae June: 3 9 18 27 · July: 19 · Aug.: 3 12	g period of reprod. J J A	h period of settling J J A	i development
planula	4	10	--- ---I---	(? ?) ?	? ? (? ? ?)				?
Synarachnactis brachiolata ?	14	25	--- ---I—	X X X	(? ?) ? ? X				L+P
small acoelomarian	16	53	÷ —I—	÷ ÷ X	/ / ÷ X X				?
brown turbellarian	24	78	—I— ---	? X X	? ? X X ?				?
rhabdocoelomarian	40	118	—I— ---	X X X	(? ?) X X ?				?
pilidium	20	65	--- —I ÷	X X X	? ? ÷ (? ?)				L?+P
Nematoda	214	376	—I— —	X X X	(? ?) X X X				
Gattyana cirrosa ?	313	654	--- ←I—	X X X	(? ?) ÷ X X				L+P
metatrochophora I	296	620	÷ ←I—	X X X	(? ?) ÷ X X				
metatrochophora II	15	30	--- ←I—	? ? X	? ? ? X X				
nectochaeta	2	4	--- --- ---I	? ? ?	? ? (? ? ?)				
Lagisca ? sp.	2	4	--- ---I---	(? ?) ?	(? ? ? ?) ?				L+P?
Harmothoë ? sp.	1	1	--- ---I---	(? ?) ?	(? ? ? ?) ?				L+P?
Pholoë minuta	17	44	--- —I ÷	X X ?	? ? ? X ?				L+P?
Phyllodoce ? sp.	1	3	--- ---I---	? ? ?	/ / (? ? ?)				?
Eteone longa	13	36	—I--- ÷	X X ?	? ? X X ?				L+P?
Phalachrophorus borealis	804	1773	÷ —I—	X X X	(? ?) ÷ X X				
Nereimyra aphroditoides ?	9690	21771	—I— ÷	X X ?	(? ?) X X ?				L?+P
metatrochophora I	6815	16175	—I— ÷	X X ?	(? ?) X X ?				
metatrochophora II	2811	5383	--- ---I ÷	X X ?	? ? (? ? ?)				
nectochaeta	64	213	--- ---I ÷	X X ?	/ / ? X ?				
syllid ? A	16	32	--- ---I---	X X X	(? ? ? ?) ?				L+P?
trochophora	15	29	--- ---I---	X X X	(? ? ? ?) ?				
metatrochophora	1	3	--- --- ---I	? ? ?	/ / ? ? ?				
Nereis pelagica	2	5	--- ---I---	? ? ?	? ? ? ? ?				?
Nephthys ? sp.	33	80	--- ←I—	X X X	(? ?) ? X X				L?+P
Ophryotrocha sp.	1	3	--- --- ---I	? ? ?	? ? / / ?				?
Schistomeringos sp.	432	1217	--- —I---	X X X	(? ?) ? X ?				L?+P
early unsegmented	364	1056	--- ---I ÷	X X X	(? ?)(? ? ?)				
early segmented, non-setiger	47	92	--- ---I ÷	X X X	(? ?)(? ? ?)				
early 1-and 2-setiger	5	16	÷ ---I---	X X X	/ / ? ? ?				
late unsegmented	16	53	÷ —I ÷	÷ ? X	/ / ÷ X ÷				
Polydora coeca	29	64	--- —I—	X X X	(? ?) ? ? ?				L?+P
Prionospio malmgreni ?	80	180	÷ —I-→-	X X X	(? ?) ÷ X ?				L?+P
capitellid A	532	1301	—I— ---	X X X	(? ?) X X ?				L?+P
Chone sp.	125	408	--- ---I ÷	X ? ?	(? ?) ? ? ÷				L?+P
non-setiger	36	105	--- ---I ÷	X ? ?	(? ?) ? ? ÷				
1-setiger	38	129	--- ---I ÷	X ? ÷	(? ?) ? / ÷				
2-setiger	25	80	--- ---I ÷	X ? ÷	(? ?) ? / ÷				
3-setiger	26	95	--- ---I ÷	X ? ÷	(? ?) / / ÷				
terebellid A	302	946	--- —I—	X X X	(? ?) ? X X				L?+P
early non-setiger	20	52	--- ---I---	X ? ?	(? ?) ? ? ?				
1-setiger	1	5	--- ---I ÷	X ? ?	(? ?) / / ?				
2-setiger	14	36	--- ---I ÷	X ? ?	(? ?) ? ? ?				
3-setiger	15	48	--- ---I ÷	X ? ?	(? ?) / ? ?				
4-setiger	5	7	--- ---I---	X ? ?	(? ? ? ?) ?				
late, shorter than 175 microns	128	427	—I→—	? X X	/ / ÷ X X				
late, longer than 175 microns	110	366	—I---	? X ÷	/ / ÷ X ÷				
Trichotropis conica ?	16	38	--- —I---	X ? ?	(? ?) ? ? ?				L?+P
T. borealis	24	36	--- —I→—	X X X	(? ?) ÷ ? X				L?+P
Diaphana minuta ?	1	3	--- --- ---I	? ? ?	/ / ? ? ?				?
Limacina helicina	16416	39623	—I—--→—	X X X	(? ?) X X X				
L. helicoides ?	141	322	—I—--→—	X X X	(? ?) X X X				
Clione limacina	1	3	--- ---I---	? ? ?	/ / ? ? ?				
Alderia ? sp.	1	3	--- ---I---	? ? ?	/ / ? ? ?				?
Dendronotus ? sp. 1	125	332	---→←I—	X X X	(? ?) ÷ X X				?
D. ? sp. 2 ?	12	24	--- ---I---	X ? ?	(? ?) ? ? ?				?
Cratena ? sp. 1	13	36	--- —I—	X X X	(? ?) ÷ ? ?				?
C. ? sp. 2 ?	2	8	--- ---I---	X ? ?	(? ?) ? ? ?				?
Coryphella ? sp.	3	10	--- --- ---I	? ? ?	/ / ? ? ?				?
Macoma calcarea	229	561	—I— ÷	X ? ?	(? ?) X ? ÷				L+P?
Hiatella striata	42348	96120	—I—--→—	X X X	(? ?) X X X				L+P
Electra ? sp.	57	166	—I—	X X X	(? ?) ÷ X X				L?+P
loxosomatid A	58	155	÷ —I—	X X X	(? ?) ÷ X X				L?+P
Ophiocten sericeum	2067	4617	—I— —	X X X	(? ?) X X X				L+P
stage 1	159	309	--- —I—	X X X	(? ?) ÷ ? X				
stage 2	1879	3945	--- —I—	X X X	(? ?) ÷ X X				
stage 3 see text	61	146	—I— —	X X X	(? ?) X X X				
stage 4	52	161	←I— —	X X X	(? ?) X X X				
stage 5	12	37	--- —I—	? ? X	? ? ÷ X X				
Ophiopluteus mancus	1	3	—I--- ---	X ? ?	/ / X ? ?				L+P
asteroid A	2	4	--- ---I---	(? ?) ?	? ? ? ? ?				L
Strongylocentrotus pallidus	3	9	—I--- ---	X ? ?	? ? X ? ?				L+P
larval stage I	1	3	--- ---I---	? ? ?	(? ? ? ?) ?				
larval stage II	2	6	—I--- ---	X ? ?	? ? X ? ?				
Myriotrochus ? sp.	4	11	--- ---I---	? ? ?	? ? (? ? ?)				?
eggs	1026	2428	÷ —I→—	X X X	(? ?) – X X				

Legend. – **Column c:** I = depth of shallowest haul to the surface yielding specimens; — = present, --- = possibly present, and ÷ = absent in depth range; ⇢ = major shift, and → = minor shift in sampling period. **Column d:** A = above, C = at, and B = below compensation depth (Fig. 2); ( ) and X = present; ? = possibly present; ÷ = absent. **Column e:** W = winter layer (<–0.9°C, > 29‰S); R = summer remnant (–0.7°C to –0.65°C, > 31‰S); S = summer layer or fiord water (>–0.7°C, < 29–30‰S); T = transitional layer (–0.8°C to –0.7°C, > 31‰S) and summer transitional layer (–0.8°C to –0.7°C, 29–30.5‰S); D = deep layer (–0.8°C to –0.9°C, > 30.5‰S, Fig. 2); ( ) and X = present, ? = possibly present, ÷ = absent; / = absent when the type of water occurred. **Columns g and h:** — = verified; --- = presumed; < and > = outside period of investigation. **Column i:** L = lecithotrophic; P = planktotrophic; ? = unknown or presumed.

fall or later. The marked reduction in numbers from 27 June to 19 July is probably not solely due to settling, but may also be caused by a transport of larvae out of the fiord, aided by the fresh water outflow and wind driven currents out of the fiord.

Acknowledgements

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Meddelelser om Grønland, Bioscience

1979.

1. Erik L. B. Smidt:
   »Annual cycles of primary production and of zooplankton at Southwest Greenland«. 53 pp.

Annual hydrographic observations, measurements of primary production, and samplings of zooplankton were undertaken in Southwest Greenland waters in the 1950s and –60s. In the coastal area and at the entrance to Godthåbsfjord winter cooling normally extends to the bottom, resulting in a vertical mixing of the water and an effective replenishment of nutrients at the surface. The subsequent production rate is, therefore, high with an average annual gross production calculated to about 160 g C m^{-2}. In the inner fjord regions the stratification is normally much more stable with persisting warm bottom water, and the production is, therefore, lower here than in the coastal area. The seasonal variation in the relations between daylight, primary production, phosphate, and quantity of zooplankton is, presumably, representative of the coastal waters at SW Greenland. A maximum in primary production in spring is normally followed by another maximum in late summer. The number of animals in the microplankton samples from the upper 30 m (the productive layer) is at its maximum simultaneously with the second maximum of the primary production, while the maximum of the macroplankton biomass (taken by stramin net) extends until late autumn in the coastal and outer fjord regions.

A maximum of the macroplankton biomass during winter in the deep water layers in the inner Godthåbsfjord, caused by inflow of warm bottom water, stable stratification and cooled outflowing surface water acting as a barrier to the ascent of the animals, is assumed to be normal to the open, non-threshold, W Greenland fjords.

Seasonal vertical migration of the zooplankton is indicated by Hensen net hauls from different depths. There is a concentration of zooplankton in the upper water layers in April–September and a deeper concentration from autumn to spring.

Annual cycles of various animal groups are described for holoplankton and meroplankton, separately. Holoplankters are normally dominant, copepods being the most numerous group. Meroplankters, especially bottom invertebrate larvae, are relatively numerous in the microplankton in spring and summer with *Balanus* nauplii dominant in spring and lamellibranch larvae in the following months. In a special section on fish eggs and larvae it is shown *I.a.* that cod eggs and larvae are normally concentrated in the upper 50 m, where they are much exposed to temperature variations, while eggs and larvae of American plaice occur also in deeper water. This may partly explain why the cod stock is more vulnerable to low temperatures.

It is shown that the epipelagic plankton fauna in the survey area in terms of growth and mode of development is more similar to the arctic than to the boreal fauna. It could therefore be termed subarctic, which also corresponds to the environmental conditions in the area.

1980

2. Jean Just:
   »Amphipoda (Crustacea) of the Thule area, Northwest Greenland: Faunistics and Taxonomy«. 61 pp.

The material reported on was collected in the Thule area, NW Greenland, in 1968 and includes 105 species. Four of these, *Aceroides goesi, Bathymedon antennarius, Monoculodes vibei* and *Parametopa crassicornis,* are new to science. An additional 6 species are new to Greenland, while 9 species have previously been found in E Greenland but not in W Greenland. Four genera, *Lembos, Arrhinopsis, Arctopleustes* and *Parametopa,* are recorded from Greenland for the first time.

Specimens belonging to 15 additional taxa are for various reasons not referred to species. Major taxonomic problems, warranting broadly based revisions, are outlined in the genera *Byblis, Gitanopsis, Ischyrocerus, Tmetonyx, Monoculodes* and *Stenula.* Three different forms of *Paroediceros lynceus* are discussed.

All known amphipod species from the Thule area are included in an annotated list. Forty-nine taxa are discussed and figured.

1980

3. H. Meltofte, M. Elander and C. Hjort:
   »Ornithological observations in Northeast Greenland between 74°30' and 76°00' N. lat. 1976« 53 pp.

1981

4. Peter Milan Petersen:
»Variation of the population structure of Polygonum viviparum L. in relation to certain environmental conditions«. 19 pp.

1981

5. Ole G. Norden Andersen:
»The annual cycle of temperature, salinity, currents and water masses in Disko Bugt and adjacent waters, West Greenland«. 33 pp.

All available data on bathymetry, temperature, salinity and currents up until and including 1975 are used in describing the seasonal changes and dynamics of the hydrography of Disko Bugt, the Vaigat and adjacent glacier and non glacier fjords. From a winter situation with well mixed ÷1.75°C cold water in the upper c. 100 m, steep halo- and thermoclines develop during the summer between freshened and heated surface water leaving Disko Bugt and deeper more saline water entering from the West Greenland Current. Huge ice bergs have a decisive cooling effect upon the upper 150–200 m affecting the outflowing current as well as the inflowing water which is responsible for the high bottom temperatures and salinities (up to 3.5°C and 34–34.5‰ at 300–500 m) found the year round, and which contributes to raising the temperature in the upper 200 m in the summer, especially in the southern and eastern part of the bay and even into the Vaigat. Surface temperatures reach 12°C in the offshore waters of the bay where salinities may drop to 30‰, and inshore in the more diluted waters of Disko Fjord temperatures may even reach 14°C, whereas in the glacier fjords, where surface salinities come close to zero, 4°C is the highest temperature recorded and subzero temperatures are found even in July. An extensive upwelling of W Greenland water occurs in the northern part of the bay during the summer and fall and similar phenomena occur in Disko Fjord, driven by winds and apparently linked to tidal rhythms. Although TS diagrams show that deep Disko Bugt water and Baffin Bay water is of common origin, no water seems to enter Disko Bugt from Baffin Bay or from the Baffin Current.

1981

6. Ole G. Norden Andersen:
»The annual cycle of phytoplankton primary production and hydrography in the Disko Bugt area, West Greenland«. 65 pp.

The distribution and size of phytoplankton production and biomass in relation to physical and chemical parameters in the upper 50 m at Godhavn and in Kangikerdlak in the inner part of Disko Fjord was investigated through 2½ years (1973–75). Some data from other parts of Disko Bugt are presented.

In both locations the hydrography alternates between an unstable winter situation with isothermal (÷1.75°C) and isohaline (33.5–34.0‰) conditions throughout, and a highly stable summer situation when dilution and heating, especially of the upper 20–30 m, raise the temperature at the surface to 9.9°C and at 50 m to 3.8°C at Godhavn, and to 12°C and 3.5°C respectively in Kangikerdlak. Salinities drop correspondingly to 30.6‰ in Kangikerdlak.

The 1% depth for green light is greatly reduced beneath ice and snow. During the ice free period at Godhavn it varies from 12 m during the spring phytoplankton bloom to more than 60 m from Oct. through the winter. In Kangikerdlak the 1% depth reaches only 40 m in winter, and outflowing turbid fresh water creates 1% depths of as little as 4–5 m in June–Aug.

At Godhavn NO_3-N reaches highs of 10.05 µgat/liter and 10.15 µgat/liter at 0 and 50 m respectively in winter, whereas during the summer, depletion to less than 0.01 µgat/liter occurs in the upper 40 m and to 1.0 µgat/liter at 50 m. PO_4-P is similarly reduced from 0.8 µgat/liter and 1.1 µgat/liter to less than 0.01 µgat/liter in the upper 20 m and to 0.21 µgat/liter at 50 m. The N:P ratio drops from 13 to less than 0.01 in the upper 30 m and to 1.0 at 50 m. In Kangikerdlak depletion of NO_3-N is similar to conditions at Godhavn, whereas PO_4-P reaches a low of 0.1 µgat/liter only, while in mid summer it reaches 1.88 µgat/liter at the surface, giving an N:P ratio which is below 0.1 in the upper 5 m only.

At Godhavn primary production is about 90 gC $\cdot$ m^{-2} $\cdot$ yr^{-1} (75–104 g) with a maximum of about 5.5 gC $\cdot$ m^{-3} $\cdot$ yr^{-1} at 5–10 m, whereas in Kangikerdlak production was concentrated near the surface with about 6.0 gC $\cdot$ m^{-3} $\cdot$ yr^{-1} and a total of 35 gC $\cdot$ m^{-2} $\cdot$ yr^{-1} at most. Production at Jacobshavn off the glacier fjord is probably greater than at Godhavn, whereas at Christianshåb and Egedesminde it is definitely lower.

Phytoplankters larger than 56 µ contribute about 50% of annual and up to 90% of daily production.

Due to the great stability, production usually extends no deeper than compensation depth, and most of the chlorophyll is usually in the nutrient rich water below this depth, where it sinks, is consumed, or degrades into phaeopigment. P/B is highest where there is least chlorophyll. Light reduces production in the upper 5–10 m, and inhibition may extend to 30 m. Correlations between production, P/B, or P/B/light and nutrients reveal possible saturation values of 0.08–0.78 µgat NO_3-N/liter and 0.17–0.22 µgat PO_4-P/liter. PO_4-P seems to be the limiting nutrient in some cases, although NO_3-N is most quickly and thoroughly depleted.

Dark fixation at Godhavn is about 24 $gC \cdot m^{-2} \cdot yr^{-1}$, and at Kangikerdlak about 15 $gC \cdot m^{-2} \cdot yr^{-1}$. 55–60% of dark fixation is presumed to be biotic and 16–64% is associated with particulate matter larger than 56 µ.

Although oxygen is never at a minimum in Disko Bugt, saturation as well as absolute O_2 values and pH show profiles in the bay that clearly reflect the high degree of stratification compared to waters south of the bay.

1981

7. J. de Korte, C. A. W. Bosman & H. Meltofte:
»Observations on waders (Charadriidae) at Scoresby Sund, East Greenland«. 21 pp.

1982

8. Helge Abildhauge Thomsen:
»Planktonic choanoflagellates from Disko Bugt, West Greenland, with a survey of the marine nanoplankton of the area«. 35 pp.

Light and electron microscopy of whole mounts prepared from water samples collected in July and August 1977 at thirteen stations in the vicinity of Godhavn (Disko Bugt, West Greenland), has led to the enumeration of approximately 100 nanoplanktonic taxa. A full account is given of field and laboratory methods. The most conspicuous algal class was the Prymnesiophyceae with more than 38 species. Among the heterotrophic organisms listed the Choanoflagellida was the most important single group, comprising 28 species. Two new choanoflagellate taxa are described on the basis of West Greenland material: *Conion groenlandicum* gen. et sp.nov. and *Diaphanoeca undulata* sp.nov.

In order to facilitate immediate comparison of closely related taxa *Diaphanoeca sphaerica* sp.nov. is described on the basis of Danish material.

Thirteen of the loricate choanoflagellate species listed are new recordings for West Greenland. A summary of previous findings of the choanoflagellate species encountered in the Disko Bugt samples show that three species *(Conion groenlandicum, Pleurasiga caudata* and *Parvicorbicula serratula)* are so far known from arctic and subarctic localities only. A pronounced vertical distribution pattern of choanoflagellate species was observed at one station southeast of Godhavn. Three distinct species associations occurred in this particular water column (0–300 m).

1982

9. Eric Steen Hansen:
»Lichens from Central East Greenland«. 33 pp.

1982

10. F. J. A. Daniëls:
»Vegetation of the Angmagssalik District, Southeast Greenland, IV. Shrub, dwarf shrub terricolous lichens«, 78 pp.

1983

11. Tyge W. Böcher:
»The allotetraploid *Saxifraga nathorsti* and its probaple progenitors *S. aizoides* and *S. oppositifolia.*« 22 pp.

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The size of the smallest letters in illustrations should not be less than 1.5 mm. Intricate tables are sometimes more easily reproduced from line drawings than by type-setting.

Colour plates may be included at the author's expense, but the editor should be consulted before such illustrations are submitted.

Size. – The width of figures must be that of a column (77 mm), 1½ column (120 mm) or of a page (160 mm). Remember to allow space for captions below full page figures. Maximum height of figures (incl. captions) is 217 mm. Horizontal figures are preferred.

If at all possible, fold-out figures and tables should be avoided.

Caption. – Captions (two copies) to figures should be typed on separate sheets.

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