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KAP FARVEL EKSPEDITIONEN 1970

MARINE, BENTHIC ALGAE FROM SOUTHERNMOST GREENLAND

BY

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WITH 20 FIGURES, 1 TABLE AND 7 PLATES

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Abstract

One hundred and twenty-four species of marine algae from South Greenland are dealt with, of which 11 belong in the Cyanophyceae, 28 in the Rhodophyceae, and 1 each in the Chrysophyceae, Dinophyceae, and Xanthophyceae, respectively, 49 in the Phaeophyceae and 33 in the Chlorophyceae. Of the 11 Cyanophyceae 4 have not previously been reported from Greenland: *Aphanothece* sp., *Nostoc minutum*, *Hydrocoleum lyngbyaceum* and *Lyngbya infixa*. Further, new observations are presented concerning cell divisions, which resulted in daughter cells of uneven size, in *Pleurocapsa amethystea*, and two new host plants, *Rhodochorton purpureum* and *Ulothrix speciosa*, are reported for *Sarcinastrum urosporae* in Greenland. All the red algae are well known from literature, but additional information are given especially with regard to reproductive structures. Antheridia-like cells were observed in *Rhodochorton spetsbergense* and in *Audouinella membranacea* in plants that also bore tetrasporangia. The present data support the combining of *Rhodochorton penicilliforme* with *Rhodochorton spetsbergense*. For *Rhodophysema elegans* some details concerning the formation of tetrasporangia and the presence of branched paraphyses are reported. Female gametophytes as well as a presumed male gametophyte of *Antithamnion boreale* have been found for the first time in nature in Greenland. It is suggested that this species has a typical *Polysiphonia*-type of life history in this part of its distribution. This suggestion is supported also from observations from cultures recently established. *Callocolax neglectus*, presently known as a red algal parasite on *Callophyllis laciniata*, was found and further described growing on *Callophyllis cristata*, which is a new host for this parasite. The known distribution for Greenland of *Halosacciocolax kjellmanii*, previously known from the type locality in Scoresby Sund only, has been considerably extended.

The brown algae *Myriactula clandestina* and *Streblonema chordariae* are reported from Greenland for the first time, the latter from an old collection by ROSENVINGE. A new find of *Phaeostroma parasiticum* is reported and the relation to *P. pustulosum* is discussed. Additional information are given on *Porterinema fluviatile*, including a new host plant, *Delamarea attenuata*. In some cases supplementary information have been added from culture studies of algae from the Godthåbsfjord, West Greenland. Thus the development of hairs in *Phaeostroma pustulosum* has been followed, and the taxonomic reliability of this character confirmed. The presence of a microthallus and hair-like structures in the life history of *Elachista fucicola* has been demonstrated, and it is suggested to give up the combination *Myriactula lubrica*. The culture studies also support the assumption that *Pilayella littoralis* and *P. varia* are conspecific, and suggest a removal of *Litosiphon filiformis* from the genus *Litosiphon*.

All the green algae found are well known to science. It is suggested to remove *Entoderma wittrockii* from the flora of Greenland. Culture studies indicate that *Chlorochytrium inclusum* is connected with *Acrosiphonia* (possibly *A. sonderi*) in Greenland, while *Chlorochytrium cohnii* is an independant species.

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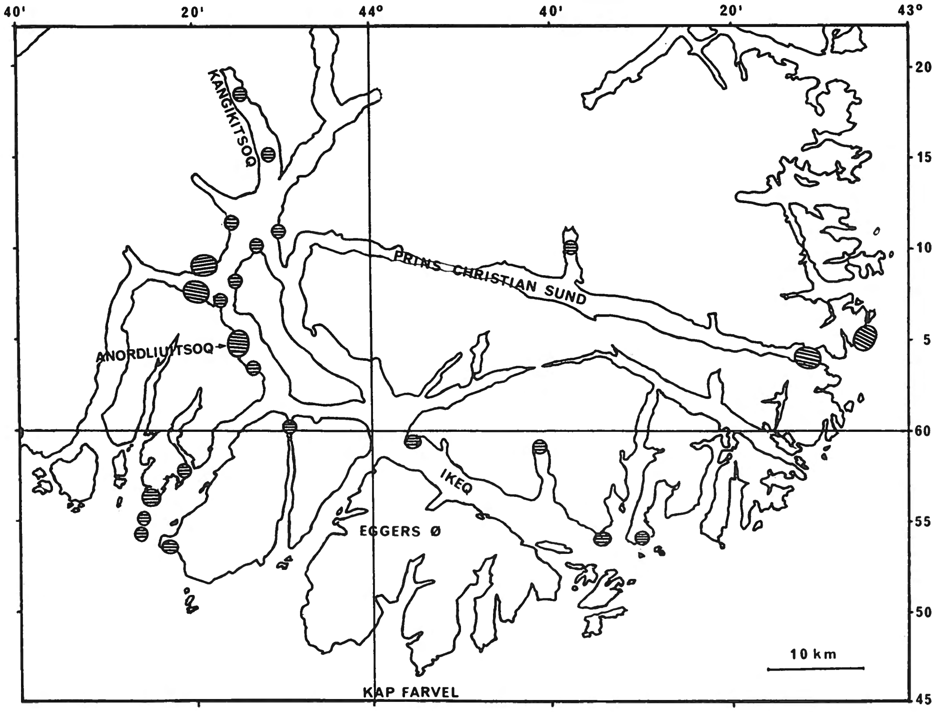


Map of southernmost Greenland (roughly sketched) showing the main areas of investigation.

INTRODUCTION

With regard to the marine, benthic vegetation, the Kap Farvel area of Greenland — which has been briefly characterized with regard to main types of shore, substratum, ice conditions at the collection time, sea temperature and influence of sediment in this paper—has been completely uninvestigated until now. According to Jónsson (1904) the nearest stations for available herbarium material were the islands of Kitsigsut (about 60°02′N) on the west coast and Ikerasagssuaq (60°02′N) on the east coast.

In the most relevant works by Rosenvinge (1893 & 1898) and Lund (1959) important data concerning previous investigations of marine algae from Greenland are presented. Since 1959, only two other phycologists have published papers on the algal flora of Greenland, prior to the present study.

Based on visits to Greenland in 1957 and 1958, Tyge Christensen reported on algae found at the Godthåbsfjord and on the island of Disko (1971 & 1975, respectively). Further, marine algae from the west coast of Greenland (based on his visits there in 1959, 1960, 1965 and 1967) were described by Wilce (1960, 1962–63, 1964, 1969, and 1970, respectively). A preliminary note of the present investigation was published by Pedersen (1973).

In the light of the present discussions on possible oil-extraction in Greenland, it is imperative to investigate the marine vegetation intensively before possible disturbances occur.

I owe my best thanks to the leader of the Kap Farvel Expedition, Ulrik Røen and to my companions for good fellowship. Further, the great help in many ways and never failing interest in my work shown by Tyge Christensen is very much appreciated. Patricia Walne has kindly corrected the English language. Aase Kristiansen is acknowledged for useful suggestions, and Ruth Nielsen has kindly determined the shell-boring algae. Finally the owner of the cutter, "Kistara", Simon Hansen, is thanked for very skilful dredgings.

The expedition was financially supported by the Danish Natural Science Research Council and the Ministry of Greenland. The Botanisk Museum and Institut for Sporeplanter have provided me with necessary collecting equipment, and a grant from the University of Copenhagen has enabled me to work up the material. I wish to express my sincere thanks to these institutions.

MATERIAL AND METHODS

The material for this study was collected between 11 July and 7 September 1970, as part of the program of the Kap Farvel Expedition 1970.

All the dredgings were made from the cutter "Kistara" of Narssaq using a triangular dredge with teeth and a rectangular dredge without teeth. For collecting from the shore a hand-dredge resembling a fruit-picker was sometimes used.

Depths were measured by means of the echo sounder system of the cutter, 1 fathom being converted to 2 meters. A statement of depth, e.g., 20–30 meter, indicates only the vertical extent of the dredging, and not in which part of the haul the greatest and smallest depth is situated. Specimens were labelled "littoral" only when found out of the water at the time of collecting.

All the drawings were made by the author using a Reichert Biozet microscope with a Zeiss Jena camera lucida.

Most of the material was preserved in 4 $^0/_0$ solution of commercial formaldehyde, adjusted to pH about 8–9 by borax. After preservation the material was kept in darkness to prevent bleaching. The remaining specimens were dried and microscopic slides of smaller epiphytes were made immediately after collecting by gradual replacement of sea water by glycerol. Some shell-boring algae were mailed to Copenhagen, and some were brought home in the living state at the end of the expedition.

Additional information has been obtained from notes on cultures brought home from Godthåbsfjord, West Greenland, in July and August, 1973. The algal material will be deposited at the Botanisk Museum, Copenhagen, together with special maps drawn from Søkortarkivet nr. 1103, Kap Farvel, and a list of stations with precise latitudes and longitudes referring to this map.

RESULTS

Shore types, substratum and influence of sediment

Two main shore types could be distinguished in the area.

I. A protected shore in shallow bays with a fully developed littoral vegetation, which consists mainly of *Ascophyllum nodosum* and *Fucus vesiculosus*. The vertical distribution of these species at Anordliuitsoq on the island of Pamiagdluk extends to 1,9 meter. *A. nodosum* dominates the upper 20 cm of the vegetation, whereas over a distance of 90 cm the two species grow mixed together. The lowest 80 cm are completely occupied by *F. vesiculosus. Hildenbrandia prototypus* forms crusts under these brown algae, which occasionally also leave space for a scattered growth of *Ulvopsis grevillei*, that is particularly frequent in the lower littoral zone in places where the bottom is unfit for large brown algae because of pebbles. The bottom of this particular bay is not suitable for benthic vegetation because of heavy sedimentation from a river. Instead, a community of loose-lying algae is dominated by large fronds of *Ulvaria obscura* and the flaccid form of *Dictyosiphon foeniculaceus*. Scattered specimens of *Laminaria* and *Alaria*, where suitable substratum is found, are present in the sublittoral zone.

II. A shore exposed to current, but only occasionally to wave action. This is the main type of shore at insound localities where, as a rule, the land falls rather precipitously to the bottom of the very deep sounds. The littoral zone in this case is strongly influenced by the action of ice. A closed perennial vegetation of *A. nodosum* and *F. vesiculosus* is not possible. These algae are found only in fissures in the rocks where they exist as reduced forms, i.e., a few centimeters high in the winter or spring, and in the summer they appear as mechanically damaged specimens. The littoral vegetation is dominated by various species of annual, filiform green algae, *Urospora penicilliformis*, *Ulothrix* spp., *Monostroma groenlandicum* and, in lower littoral zone, *Porphyra miniata*. The upper part of the sublittoral zone is dominated by annual brown algae, *Pilayella littoralis*, *Scytosiphon lomentaria*, including forma *complanata* and *Delamarea attenuata*. Further, a regeneration of *Dictyosiphon foeniculaceus* and *Chordaria flagelliformis* occurs. Some green algae may also be found together with these brown algae, e.g., *Acrosiphonia sonderi* and *Ulvopsis grevillei*. The typical sublittoral vegetation, as studied a few hundred meters from the protected shore mentioned above, starts at a depth of 1,5 meter at the time of measurement. It is composed of the large Laminariales, *Agarum cribrosum*, *Laminaria*, *Alaria* and scattered specimens of *Saccorhiza dermatodea*. This kelp forest extends down to a considerable depth, being exposed only locally to the wearing action of the moving ice. This type of shore is modified at the outer coast by increased wave action and the grinding effect of the ice, which can be closely packed along the coast during storms. The exposed outer coast is characterized by an almost-bare littoral zone with algal vegetation largely restricted to rock crevices and depressions.

The rapakivi granites (Allart, Bridgwater & Henriksen, 1969) so common in the Kap Farvel area serve as a substratum for the benthic vegetation. Occasionally, at sites where scree-material falls directly into the sea, such granite is an unstable substratum for larger benthic algae. Such conditions can, however, favour development of crustose

Corallinaceae. Further, the substratum may be made unsuitable for algae because of sedimentation. This is especially the case in the inner fiords, as observed in Kangikitsoq and Kangerssuneq qíngordleq, which are closely connected to the ice-cap by large rivers carrying considerable sediment, creating a situation with soft bottom and limited transparency. Among the kelps, *Agarum cribrosum* penetrates deepest into such fiords, often together with presumably loose-lying *Desmarestia* and *Chaetomorpha melagonium.* A similar situation is found in the glacier fiord, Kangerdluk at the northern side of Prins Christian Sund.

Temperature

The following measurements of temperature conditions in the sea have been made with a reversible water collector. I. 25 August, 1970. Prins Christian Sund, just outside the eastern entrance of the sound. II. 28 August 1970. Ilua, outside Augpilagtoq. III. 29 August, 1970. Qagssialik, an island in the southern part of the area. The measurements were made at nearly the same time in the afternoon and under nearly identical weather conditions (Table 1).

Table 1.

Depths in m	Temperature in °C I	II	III
0	1,20	1,40	2,30
2	1,95	0,90	2,10
10	1,60	0,85	1,80
15	0,95	0,85	1,65
25	–0,015	0,85	1,50
50	–0,45	0,18	0,30
100	–1,20	–0,54	–0,48
325	–1,10	–0,60	1,12

The figures show that the whole Kap Farvel area is strongly influenced by the cold East Greenland Current. It is also of interest to note, that the water temperature at Prins Christian Sund becomes negative at depths of 15–25 meters. At this locality algae are found down to about 50 meters, and the species in question consequently must live at temperatures below zero possibly throughout their lives. The area is also influenced by the Irminger Current as suggested by the positive value obtained at a depth of 325 meters in locality III.

Ice conditions

The terminology used in describing various types of ice agrees with that used by Armstrong, Roberts & Swithinbank (1966).

From observations in nature it is obvious that the ice has a marked influence on the development and composition of the marine, benthic flora in the Kap Farvel area, especially in the littoral and upper sublittoral zones. On the other hand it is difficult to say at what time of the year this influence is strongest and what type of ice exerts an effect, based only on observations made during the summer in a single year, 1970. Thus, the following statements are limited to the ice conditions that particular year, and the ensuing suggestions are based on information in the literature. The summer ice of the area is floating ice that follows the East Greenland Current, passing Kap Farvel, and generally reaching Frederikshåb, but the distribution and the amount show considerable variation from year to year. In 1970 there was a rather long period with open to close pack ice when floes (ice cakes and small floes) were blown into the sounds and fiords by storms from an unfavourable direction. In such a situation the ice is pressed against the shore at exposed sites especially along the outer coast, causing considerable damage to the vegetation, if present, due to the tidal rise and fall. A similar situation has been described in detail by WILCE (1959). In 1970, after arrival of the ice in the sounds, the weather was calm and the floes had no or little effect on the vegetation, only locally scratching the rocks now and then. Icebergs also were observed and could influence the sublittoral vegetation. Grounded icebergs, if they are not too big, may damage the vegetation by the tidal movements. Bergy bits could have a similar effect, maybe even more pronounced, since they do not draw so much water. In all circumstances the damage on the sublittoral vegetation is only local, and regeneration from nearby plants occurs easily. According to the Danish Meteorological Institute (1970) and to VALEUR (pers. com.) first-year ice is not formed in the area. The presence of an icefoot is thus excluded, and consequently, it can be stated that the floating ice or "storis" influences the vegetation only.

No information is available on "storis" icecover in the sounds and fiords on an annual basis. The maps published yearly by The Danish Meteorological Institute in "The iceconditions in the Greenland waters" indicate the distribution and icecover around the Kap Farvel area. In 1963 (The Danish Meteorological Institute, 1970) the ice was present from first January to the middle of August, reappearing in the middle of November. The most frequent icecover reported, indicated in tenths of total sea surface, was 5/10 through 7/10 and 8/10 through 9/10. In 1970 (VALEUR, 1973) the ice appeared about the first January after a 10-day period with "forerunners". The ice period lasted about 240 days and about 15 days with sporadic occurrence. The ice was thus present the whole winter and spring that year, and winds from several directions could press it into the sounds, preparing the littoral and upper sublittoral zones for growth of annual species of algae as observed in the summer.

SYSTEMATIC PART

Cyanophyceae

This taxon has been given relatively little attention by phycologists occupied with marine, benthic algae from Greenland. ROSENVINGE (1893 & 1898) mentioned 6 species of blue-greens from the west coast, and JÓNSSON (1904) reported 3 species from the east coast, all of which were also included in ROSENVINGE's lists. This number remained unchanged until quite recently, when CHRISTENSEN (1975) added 2 more species. The treatment below includes 11 species and does not pretend to be complete. Four of these species have not previously been recorded from Greenland, but as they are all well known (at least at the generic level) this only reflects the earlier lack of attention. A preliminary investigation of samples from the Godthåbsfjord has revealed several species new to Greenland. These will be reported in a later paper.

Chroococcales

Chroococcaceae.

Aphanothece sp.

This is the first report of the genus from Greenland. Small colonies of variable morphology grow together with other blue-green algae, *Rhizoclonium riparium* and *Vaucheria* sp. on soil, only submersed at HWS, in a protected creek. The outer wall is mucous with a rather undefined surface. The diameter of the cells is 2,5–3,8 μm and the length between 4,2–6,3 μm (pl. 1, fig. a).

Gloeocapsa crepidinum BORNET & THURET

This species grows on rocks and boulders together with *Calothrix scopulorum*, *Plectonema battersii*, *Blidingia minima*, *Urospora penicilliformis* and *Bangia fuscopurpurea* in the littoral zone.

Pleurocapsales

Scopulonemataceae.

Sarcinastrum urosporae LAGERHEIM

This tiny parasite was reported from Greenland by PEDERSEN (1973), who also mentioned its occurrence on *Rhodochorton purpureum* from Denmark. To the host spectrum in Greenland shall further be added *Ulothrix speciosa* (pl. 1, fig. b), which shows the same enlargement of infected cells as do the other host plants, and *Rhodochorton purpureum* (pl. 1, fig. c). *R. purpureum* with *Sarcinastrum* was collected near Kapisigdlit in the Godthåbsfjord on 26 July 1973.

Pleurocapsaceae.

Pleurocapsa amethystea ROSENVINGE

This species is dealt with in the sense of ROSENVINGE (1893), but with some hesitation, as I am not convinced that the description includes one taxon only. FRÉMY (1934) also wrote: "Espèce fort douteuse, appartenant peut-être au genre *Chroococcopsis* Geitler". Further studies are needed before the correct systematic position can be determined, perhaps with an amendment of the description.

Dense aggregations of hemispherical or subglobose cells are frequently found on *Rhizoclonium riparium* var. *validum*, growing on rock in the littoral zone. Cell aggregations resembling those shown in fig. 57b of ROSENVINGE (1893) have been observed. The uneven size can be explained by unequal cell divisions observed in this material. Stages of these divisions are shown in pl. 1, figs d–f and in pl. 1, fig. h. Pl. 1, figs e, f are of particular interest since they show that the daughter cells may be of different sizes. The surface of the outer wall is firm as shown from fractures in the older wall (pl. 1, fig. h). Specimens resembling fig. 57D, E, F, G in ROSENVINGE (1893) grow mixed with cells exhibiting the morphology just mentioned (pl. 1, fig. g), but transitions between the two types have not been observed.

Nostocales

Nostocaceae.

Nostoc minutum BORNET & FLAHAULT

This species is new to Greenland. It grows in the same habitat as mentioned for *Aphanothece* sp. and is composed of small spherical or subspherical colonies with yellowish outer walls and with diameters of trichomes and heterocysts 3 μm and 5 μm (pl. 1, fig. i), respectively.

Oscillatoriaceae.

Hydrocoleum lyngbyaceum GOMONT

This species has not previously been recorded from Greenland. ROSENVINGE (1893) mentioned a record by ZELLER of *H. glutinosum* from Sabine Ø, but later (1898) omitted this find, regarding the determination as doubtful.

The material of *H. lyngbyaceum* has 1–3 trichomes (diameter 9–11 μm) within a common sheath (pl. 1, fig. j). It grows together with *Aphanothece*, *Nostoc*, *Spirulina* and *Rivularia.*

Lyngbya infixa FRÉMY

This species has not been recorded previously from Greenland. Specimens referable to this species were common on larger algae and were attached to them by their ends. The very thin trichomes (diameter 2 μm) had clearly visible cross walls and cells a little longer than broad.

Spirulina subsalsa Gomont

A few filaments have been found in the soil community of blue-green algae (cf. *Aphanothece*) (pl. 1, fig. k).

Plectonema battersii Gomont

This is a very common epilithic and epiphytic alga in the littoral zone, growing together with the other species characteristic for that zone.

Rivulariaceae.

Calothrix scopulorum Bornet & Flahault

Mostly occurring on rock, but always scattered and in insignificant quantities. Also noticed on soil.

Rivularia atra Bornet & Flahault

This species forms small hemispherical cushions on soil (cf. *Aphanothece*).

Rhodophyceae

Bangiophycidae, Bangiales

Bangiaceae.

Bangia fuscopurpurea (Dillw.) Lyngbye

This species is not particularly frequent in the area, and although it has been found only in small quantities in a few sites, it is quite well developed. It grows together with *Monostroma groenlandicum*, *Urospora penicilliformis*, *Rhodochorton purpureum*, *Rhizoclonium riparium* var. *validum* and *Rosenvingiella polyrhiza* on rocks in the littoral zone.

Sommerfeld & Nichols (1973) studied the influence of photoperiod and temperature on the morphology and reproduction of the *Bangia* phase. At the lowest temperature tried (9°C) the spore type produced was determined by the photoperiod, with short-day conditions producing monospores, and long-day conditions, carpospores. Further, the differentiation of spore types was found to depend upon the conditions at the time of sporogenesis. The culture conditions used by these authors differ from the conditions in Greenland, but as pointed out by the authors, isolates of *Bangia* from different parts of its distribution area may require rather different conditions. Future experiments may elucidate the requirements of the Greenland plants, which have always been found with monospores.

Porphyra miniata (C. Ag.) C. Ag.

A rather common species in the lower littoral and upper sublittoral zones growing epilithically as well as epiphytically on *Fucus vesiculosus* and *Chaetomorpha melagonium*, for example. Monostromatic plants, referable to forma *abyssicola* (KJELLMAN) ROSENVINGE, occur, but most represent the distromatic forma *miniata*. It was demonstrated by CHEN, EDELSTEIN, OGATA & McLACHLAN (1970) that *P. miniata* has a *Conchocelis* stage like other representatives of this genus. In the Kap Farvel area the plants are fertile in the summer with α-spores and β-spores on separate plants. HOLLENBERG (1972) has shown that monoecious plants exist on the Atlantic and Pacific Coasts of North America.

Conchocelis stages are very commonly found both in *Mya*-shells, calcified parts of *Balanus* together with *Eugomontia sacculata*, *Gomontia polyrhiza* and *Ostreobium quekettii*.

Florideophycidae, Nemaliales

Acrochaetiaceae.

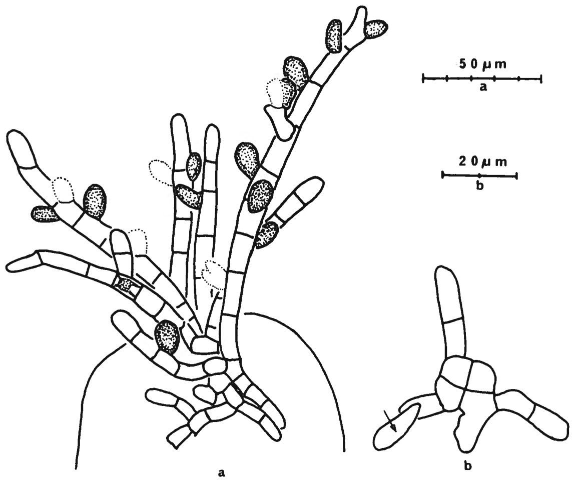
The taxonomical systems most usually applied to this family are those of KYLIN (1944) and of PAPENFUSS (1945) and are based primarily on the morphologies of the basal parts of the plants and of the chloroplast, respectively. KYLIN'S system has proved to be more or less insufficient as shown by recent culture studies by WEST (1968), who demonstrated the presence in *Acrochaetium pectinatum* (KYLIN) HAMEL of gametophytes and tetrasporophytes with unicellular and multicellular bases, respectively. Chloroplast morphology is somewhat variable also, depending upon developmental stage. The proposal by WOELKERLING (1971) to use the presence or absence of sexual reproduction as a criterion for separation at the generic level has not yet been followed. It is unsatisfactory to have a from genus, *Colaconema*, defined by absence of sexual reproduction, as increased knowledge may, in many cases, result in shifting from *Colaconema* to *Audouinella*, adding a further synonym to the long list. I have chosen to follow PAPENFUSS (1945).

Chromastrum secundatum (LYNGBYE) PAPENFUSS
Chromastrum virgatulum (HARVEY) PAPENFUSS
Chantransia secundata (LYNGBYE) THURET; ROSENVINGE 1893 & 1898.
Chantransia virgatula (HARVEY) THURET; ROSENVINGE 1893 & 1898.

ROSENVINGE (1909) and WOELKERLING (1973a) have been followed in considering *C. secundatum* and *C. virgatulum* as conspecific.

Even in this broad sense the species seems to be rather rare in South Greenland, as only a few specimens have been found, growing epiphytically on *Acrosiphonia sonderi* in the upper sublittoral zone.

As the material differs somewhat from what is considered typical by WOELKERLING (1973a), a further description is given. The thalli are always very small – upright filaments not exceeding 250 μm. Few-celled (1–3) laterals are present, usually terminated by a monosporangium, which is the only reproductive structure observed. Otherwise, the mono-

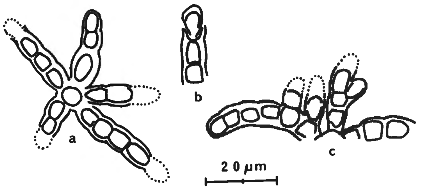


Figs 1a, b. Different stages of *Chromastrum secundatum*. Fig. 1a. Plant with nearly unbranched upright filaments and mostly sessile, scattered, occasionally opposite monosporangia. Fig. 1b. Young basal system with initial cell of upright filament (arrow).

sporangia are sessile, scattered, occasionally opposite on unbranched or nearly unbranched filaments (fig. 1a). In other details the specimens agree with the description by Woelkerling. From a few-celled initial pseudoparenchyma (fig. 1b), prostrate filaments develop and later form a loose pseudoparenchymatous disc from which the upright filaments originate. These are in a single instance terminated by a hair. The diameter of the filaments is 8,0–9,5 µm and the cell length $1^1/_2$–$2^1/_2$ times the diameter. The dimensions of the monosporangia, 9,0–10,0 µm × 13,0–14,0 (16,0) µm, also fall within the range of previous information.

Chromastrum microscopicum (Nägeli) Papenfuss
Chantransia microscopica (Nägeli) Foslie; Rosenvinge 1893 & 1898, Jónsson 1904.
Chantransia microscopica var. *collopoda* Rosenvinge 1898.
Chantransia collopoda (Rosenvinge) Rosenvinge

This species is conceived in the sense of Woelkerling (1972), regarding *C. microscopica* and *C. collopoda* as synonyms. Lund (1959) has deleted *C. microscopicum* s.s. from the flora of Greenland, regarding all earlier identifications as erroneous. In the sense of Lund *C. microscopicum* should have only one filament from the basal cell, as was also illustrated by Nägeli (1861). Consequently, he referred previous as well as his own collections from Greenland to *Acrochaetium parvulum* (Kylin) Hoyt. Woelkerling (1972) re-investigated the type collection of *C. microscopicum* and found "one or occasionally several erect fila-



Figs 2a–c. *Chromastrum microscopicum.* Fig. 2a. Entire plant with unbranched, upright filaments and terminal monosporangia. Fig. 2b. Successive generations of monosporangia from the same supporting cell. Fig. 2c. Detail of plant bearing few-celled laterals with terminal monosporangia.

ments from the basal cell". In conclusion it seems justified to re-establish this species in the marine flora of Greenland.

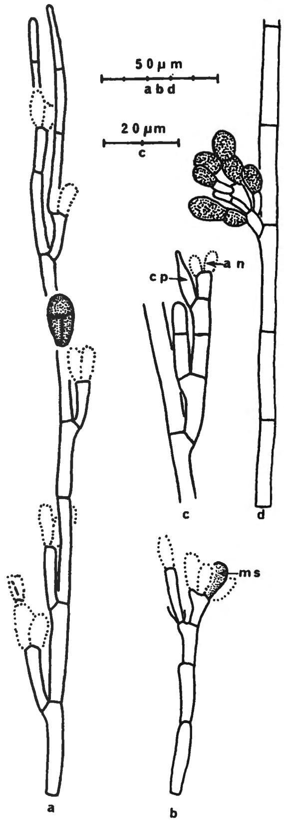
A few specimens have been found, growing on the old part of a specimen of *Polysiphonia arctica* from a depth of 20–30 m. From a single basal cell with a diameter of about 12 µm and a rather thick cell wall (about 3 µm), up to five upright filaments radiate each with a diameter of about 6,5 µm. These filaments consist of no more than six isodiametric to short rectangular cells. Occasionally they have lateral branches not exceeding two cells, with the apical cell converted into a monosporangium, like the apical cells of unbranched upright filaments (figs 2a, c). Successive generations of monosporangia may be formed from the same supporting cell (fig. 2b). No other reproductive structures have been observed, nor have terminal hairs.

Audouinella efflorescens (J. Ag.) Papenfuss
Chantransia efflorescens (J. Ag.) Kjellman; Rosenvinge 1898.

This species has been found in a single locality from a depth of 20–40 m, growing on a stipe of *Agarum cribrosum.*

Gametophytes, monosporophytes and tetrasporophytes grow together, with gametophytes predominating. All developmental stages of reproductive structures were observed in the gametophyte (figs 3c, d), from carpogonia to gonimoblasts with mature and empty carposporangia, mostly in series of two (fig. 3d). Antheridia are formed on the same branch system as the carpogonium (fig. 3c). The tetrasporophyte material mainly had empty sporangia, but a single cruciate sporangium, measuring 11,0 µm ×21,0 µm, was noticed (fig. 3a). Also an undivided sporangium, 9,5 µm × 16,0 µm, was found, together with empty sporangia of similar size (fig. 3b). These are interpreted as monosporangia since the size agrees with the figures given by Rosenvinge (1909).

Audouinella membranacea (Magnus) Papenfuss
Rhodochorton membranaceum Magnus; Rosenvinge 1893 & 1898, Jónsson 1904.

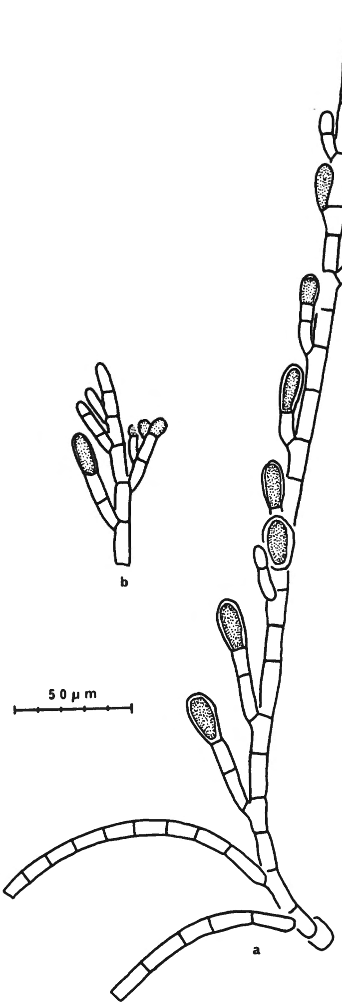


Figs 3a–d. Details of reproductive structures in *Audouinella efflorescens*. Fig. 3a. Part of tetrasporophyte with 3-parted tetrasporangium and empty tetrasporangia. Fig. 3b. Part of monosporophyte with mature monosporangium (ms). Fig. 3c. Part of female gametophyte with carpogonium (cp) and antheridia (an). Fig. 3d. Part of female gametophyte with gonimoblast. Carpospores dotted.

The life history of this species has been studied by WEST (in press), who shows an asexual reproductive process with the offspring from germinating tetraspores also bearing tetrasporangia. The basal systems, when cultured in a medium without chitin, are very different in appearance from those grown in a chitin containing medium.

The Greenland specimens are common in hydroids, often together with *Rhodochorton spetsbergense*. The two species are easily separated, however, as *A. membranacea* has thinner upright filaments (6–7 µm in diameter) and an irregular basal system. The vertical extent is from the upper sublittoral zone down to 40 meters.

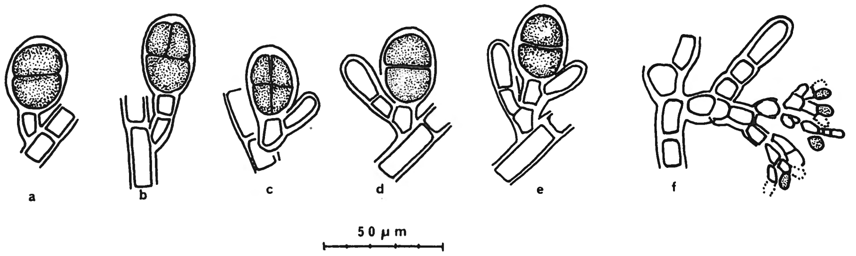
The morphology of the upright filaments is rather variable, as was also observed by ROSENVINGE (1893) and by LUND (1959). Some are very short, unbranched, and often terminated by a cruciate tetrasporan-



Figs 4a, b. *Audouinella membranacea.* Fig. a. Long upright filament with long laterals from the lower cells and tetrasporangia. Fig. b. Antheridia-like cells terminal on branches of a specimen also bearing tetrasporangia.

gium. Others are much longer with long laterals originating from the lower cells and with scattered tetrasporangia, often in unilateral series, sessile or short-stalked (fig. 4a), measuring 12,5–16,0 μm × 17,5–22,5 μm.

Antheridia-like cells have been observed in one specimen. They are terminal on branches of a specimen that also bears tetrasporangia (fig. 4b). Similar cells have previously been observed in culture by West (in press).



Figs 5a–f. *Rhodochorton spetsbergense.* Figs 5a–e. Differences in the position of the tetrasporangia in one plant. Figs 5c, d. Showing the position said to be typical of *Thamnidium spetsbergense.* Fig. 5f. Antheridia-like cells terminal on a lateral branch system.

Rhodochorton spetsbergense (Kjellman) Kjellman
Rhodochorton mesocarpum (Carm.) Kjellman var. (?) *penicilliforme* Kjellman; Rosenvinge 1893.
Rhodochorton penicilliforme (Kjellman) Rosenvinge 1894 & 1898, Jónsson 1904, Lund 1959.

This species has been found growing rather abundantly on various substrata such as *Microporina* (Bryozoa), hydroids, stalks of *Boltenia* (Ascidia), *Chaetomorpha melagonium*, *Rhodophyllis dichotoma*, *Polysiphonia arctica* and fronds of *Alaria.* The vertical extent is great, ranging from the upper sublittoral zone down to a depth of 40 m.

The position of the tetrasporangia is of interest since this was used as a very important character by Kjellman (1875) in describing *Thamnidium spetsbergense.* According to the literature (Kjellman, 1883; Rosenvinge, 1923–24 and Lund, 1959) and from observations of other material from Sarfat (64°01′N), West Greenland, placed at my disposal by Tyge Christensen, the tetrasporangia of *R. penicilliforme* are mostly terminal on short stalks. This is usually also the case in my own collections, but this character shows considerable variation, even in the same specimen, as shown in figs 5a, b, c, d, e. Figs 5c, d are of particular interest because they show the major character of *T. spetsbergense.* Consequently, my observations support the combining of *R. spetsbergense* with *R. penicilliforme*, with priority to *spetsbergense* as suggested by Woelkerling (1973b). The tetrasporangia measure 19,0–22,5–(26,0) µm × (26,0)–30,0–32,5–(35,0) µm. In addition to those borne on lateral branches, tetrasporangia are also frequently terminal on short stalks from the disc.

Antheridia-like cells terminal on a lateral branch system have been observed (fig. 5f). This is the first report of such structures from Greenland, but their appearance closely agrees with fig. 327D of Rosenvinge (1923–24).

It is likely that the life history of *R. spetsbergense* is the same as *R. concrescens* (West, 1970), a species very close to *R. spetsbergense*, if not conspecific with it. This would imply a non-sexual life history and a possible apomeiosis in the tetrasporangium.

Further, it should be mentioned that fig. 6 of Edelstein, McLachlan & Craigie (1967a), said to show *R. penicilliforme*, is, instead, a female gametophyte of *Audouinella efflorescens*.

Rhodochorton purpureum (Lightf.) Rosenvinge
Rhodochorton rothii (Turton) Nägeli; Rosenvinge 1893 & 1898, Jónsson 1904.

This species is particularly common in shady localities on rocks and boulders in the littoral zone, and is found only occasionally down to a depth of 2 m. It grows together with various filamentous algae e.g., *Rosenvingiella polyrhiza*, *Urospora penicilliformis*, *Ulothrix speciosa* and *Calothrix scopulorum.*

All of the material collected is sterile. In one specimen growing on *Balanus* the erect filaments occasionally terminate in swollen, undivided cells, some of which appear empty. As they are rather thick-walled they could possibly be caused by fungal infection.

Until rather recently the gametophytes of this species were unknown, but culture studies by Knaggs (1968) and by West (1969) have demonstrated reduced gametophytes in certain clones. It seems likely that the specimens from Greenland correspond with those from Alaska (Amchitka Island) (West, 1969) and show a one-generation life history. Culture experiments with material from Greenland may further elucidate this.

Cryptonemiales

Squamariaceae.

Halosacciocolax kjellmanii Lund

This inconspicuous epiphyte/endophyte was found in one locality on *Halosaccion ramentaceum* forming wart- or cushion-like outgrowths or bands surrounding the host plant completely. The depth was 1–2 m.

The species is provisionally maintained in the Squamariaceae, as the female gametophyte is still unreported, although *Halosacciocolax* is reported to occur commonly at Nova Scotia, Canada, (Edelstein & McLachlan, 1968). My specimens from Greenland are all sterile or with tetrasporangia, (22,5)–25,5–30,5 μm × 33,0–38,5 μm. Division of the sporangium is normally cruciate, occasionally irregular. This is only the second report from Greenland, but a careful examination of host plants will quite possibly show a more common occurrence.

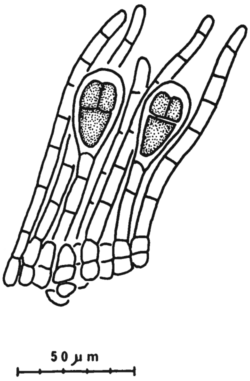


Fig. 6. *Rhodophysema elegans*. Transect showing stalked tetrasporangia and disc cells of varying morphology.

A new species, *H. lundii* Edelstein, was described growing on *Palmaria palmata* from Nova Scotia (Edelstein, 1972), and was later rediscovered on the same host from Anglesey, Wales (Guiry, 1974a). A search for this species in my collections of *Palmaria* material proved negative.

Rhodophysema elegans (J. Ag.) Dixon
Rhododermis elegans J. Ag.; Rosenvinge 1898, Jónsson 1904, Lund 1959.

This species is not particularly common in Greenland and is known only from very scattered localities from the east and west coasts growing on stones (Lund, 1959).

In contrast to previously reported habitats I have found it on stipes of *Laminaria* sp. and *Agarum cribrosum* in depths of 8–28 m.

The disc is 2–5 cells thick, with some cells being shorter than broad, others longer than broad (fig. 6). The material is fertile with the disc-surfaces extensively covered by tetrasporangia and paraphyses. The paraphyses are considerably longer than previously reported from Greenland by Rosenvinge (1898) and by Lund (1959). Paraphyses in fully developed nemathecia, consist of 5–9 cells and are 60–120 µm long. Occasionally they may have scattered, 1-celled laterals near the apex (pl. 2, figs e, f). The tetrasporangia are either terminal on disc filaments, in some cases side by side with a paraphysis on the same supporting cell (pl. 2, fig. c), or they are borne on 1–3-celled stalks (fig. 6). Successive generations of tetrasporangia are formed from the same supporting cell, either growing out through the empty sporangium or developing in a position lateral to it (pl. 2, figs a, b). The sporangial development may also include a lengthening of the stalk as shown in pl. 2, fig. d, which shows four generations of sporangial walls with remnants of the oldest wall adhering to the cell beneath the present supporting cell. Measurements of 3–4-parted tetrasporangia vary: (16,0)–19,0–24,0–(30,5) μm × (35,0)–41,5–49,5–(61,0) μm. Antheridia as described by ROSENVINGE (1910) have not been observed.

Hildenbrandiaceae.

Hildenbrandia prototypus NARDO

This species has not been sampled, but crusts were noticed under a dense cover of *Ascophyllum nodosum* and *Fucus vesiculosus* at Anordliuitsoq, Pamiagdluk, in the littoral zone.

Corallinaceae.

Leptophytum laeve (STRÖMFELT) ADEY
Lithothamnion laeve (STRÖMFELT) FOSLIE; ROSENVINGE 1898, JÓNSSON 1904, LUND 1959.
Lithothamnion tenue ROSENVINGE 1893.

Most of the collection of crustose Corallinaceae belongs in this species, which is easily identified by its large conceptacles. Multipored asexual conceptacles with very large zonate tetrasporangia as well as unipored sexual conceptacles are frequent in the collection. No attempts have been made to determine whether the sexual conceptacles were female or male. Growing on hand-sized stones at depths of 30–40–(70 ?) m.

Lithothamnion glaciale KJELLMAN

Only a single crust of this species was collected. This had simple branches not exceeding 3–4 mm in length. Numerous white speckles interrupted the reddish colour of the crust. On stone at 30–40 m depth.

Kallymeniaceae.

Callophyllis cristata (C. AG.) KÜTZING
Euthora cristata (C. AG.) J. AG.; ROSENVINGE 1893 & 1898, JÓNSSON 1904, LUND 1959.

This species is rather variable with regard to density of branching, width of thallus from 0,3–2 mm and total heights of 2–8 cm.

The vertical extent of the species is considerable. It is common in deeper water at depths of 20–40 m together with *Rhodophyllis dichotoma*, *Ptilota serrata*, *Polysiphonia arctica* and *Phycodrys rubens*, and also grows on various animals such as *Balanus*, *Microporina*, hydroids and stalks of *Boltenia*. It is also collected in the upper sublittoral zone between the haptera of *Laminaria*. There is a gap between these typical habitats, but this is undoubtedly connected with the development of a kelp forest from 2–20 m in South Greenland. Many specimens are fertile, either

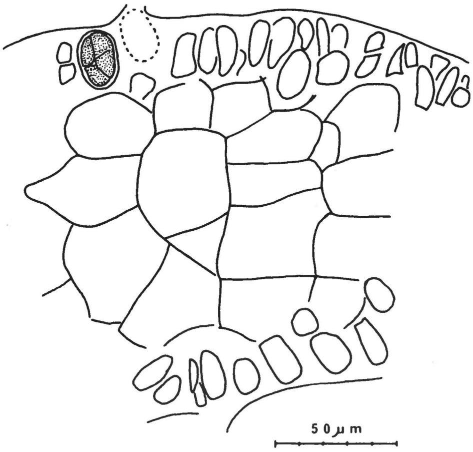


Fig. 7. *Callocolax neglectus*. Transect of specimen on *Callophyllis cristata* showing the anatomy, one cruciate and one empty sporangium.

with gonimoblasts forming lateral swellings, or with immersed, cruciate tetrasporangia.

The author citation for *E. cristata* follows DIXON & PARKES (1968).

Callocolax neglectus SCHMITZ

Two specimens of *Callophyllis cristata* (tetrasporophytes) from two localities (depth 30–50 m) were found with lateral outgrowths very similar to what is known in *Callophyllis laciniata* (HUDS.) KÜTZING and presently considered to be a rhodophycean parasite, *Callocolax neglectus*. Comparison with material of the latter collected at Salcombe east of Plymouth, U.K., by AASE KRISTIANSEN, has shown complete morphological identity. ROSENVINGE (1910) observed similar structures in a specimen from Lille Koldewey, but since the material was insufficient he reported it as *Choreocolax*? (sic.).

The outgrowths in *C. cristata* are of a lighter colour than the host plants in the dry state. The supposed parasite and its host are anatomically alike, as is also the case with *C. laciniata*. Only the cortical cells of the parasite differ slightly in having their longest dimension radially (fig. 7), while those of *C. cristata* are nearly isodiametrical. Immersed, cruciate tetrasporangia have been observed (fig. 7).

These outgrowths may be only tumours, but if they represent a separate species, there is no reason why they should not grow in *C. cristata* considering the close taxonomical relation with *C. laciniata*.

Coreocolacaceae.

Harveyella mirabilis (REINSCH) REINKE

This small parasite forms wart-like outgrowths on *Rhodomela*

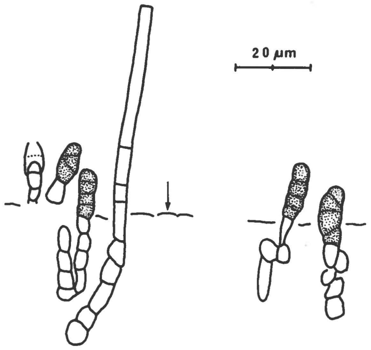


Fig. 8. *Streblonema immersum?* Uniseriate plurilocular sporangia and a hair penetrating the surface (arrow) of *Harveyella mirabilis.*

lycopodioides collected in the upper sublittoral zone. In formaldehyde the parasite is light brownish-red, the colour being restricted to the thick outer wall and perhaps caused by the preservative used.

The great majority of examined specimens are tetrasporophytes with cruciate sporangia. Only a single female gametophyte was observed with carpogonial branches prolonged into trichogynes. ROSENVINGE (1893) was unable to find tetrasporophytes among West Greenland summer collections, whereas LUND (1959) reported all reproductive phases from East Greenland. *H. mirabilis* is often rather densely covered with epiphytes, the most frequently observed being *Pringsheimiella scutata.* Further, an endophytic brown alga was observed with filaments mainly creeping in the outer wall, but also penetrating the walls of the radiating filaments of *Harveyella.* As I am uncertain as to whether these plants represent a distinct species or a microthallus, their presence is just reported. Only plurilocular sporangia with few loculi and hairs (4 μm across) penetrate the surface of the host (fig. 8). Thus the plants resemble *Streblonema immersum* LEVRING.

Gigartinales

Solieraceae.

Turnerella pennyi (HARVEY) SCHMITZ
Turnerella septemtrionalis (KJELLMAN) SCHMITZ; ROSENVINGE 1893.
Cruoria arctica SCHMITZ; ROSENVINGE 1893 & 1898, JÓNSSON 1904, LUND 1959. (Including *Cruoria firma* KJELLMAN).

It was shown by SOUTH, HOOPER & IRVINE (1972) that the foliose gametophytes of *T. pennyi* alternated with crustose tetrasporophytes previously referred to be the names *Cruoria arctica/rosea.*

In South Greenland the foliose stage is mainly found at depths of 25–50 m. Several specimens were found growing on barnacles, *Micropo-*

rina and rock, often together with *Ptilota serrata*, *Callophyllis cristata*, *Phycodrys rubens* and *Rhodophyllis dichotoma*. The size of these attached specimens is relatively small, compared to detached thalli, hardly exceeding 50 cm^2. Small thalli are characteristically kidney-shaped, but become more irregularly lobed. The detached thalli attain dimensions up to 10 dm^2 and are darker red.

The *Cruoria* stage grows on calcareous substrata such as crustose Corallinaceae and barnacles, and generally occurs at the same depths as the foliose stage. In a single locality it has been found on a stipe of *Agarum* and in two shady localities even in the littoral zone overgrowing barnacles and an unidentified member of the Corallinaceae. Radial, longitudinal sections through several specimens show transitions between a monostromatic and at least a distromatic basal layer. These observations support LUND (1959), who considered *C. arctica* and *C. firma* conspecific.

The material was sterile, thus providing no phenological information. Vegetative, marginal regeneration of a loose-lying foliose thallus was observed and in another such thallus a number of small dark discs were noted. In transection the last-mentioned structures resemble the *Cruoria* stage. In the light of the report by SOUTH, HOOPER & IRVINE (1972) of carpospores germinating *in situ*, it seems likely that these discs are young tetrasporophytes.

Rhodophyllidaceae.

Rhodophyllis dichotoma (LEPECH.) GOBI

This species is very common from the upper sublittoral zone down to a depth of about 50 m. It shows some variation in morphology ranging from foliaceous thalli to very narrow forms resembling those shown in pl. 11, fig. B of forma *setacea* KJELLMAN in WILCE (1959). The narrow type has been encountered only in the upper sublittoral zone. Gonimoblasts and mature tetrasporangia are found in lateral foliaceous proliferations.

Phyllophoraceae.

Phyllophora truncata (PALLAS) ZINOVA f. *truncata*

Phyllophora brodiaei (TURN.) J. AG. f. *interrupta* (GREVILLE) ROSENVINGE; ROSENVINGE 1893 & 1898, JÓNSSON 1904, LUND 1959.

This is mainly a deep-water species growing attached to rocks and barnacles at depths between 26–50 m, but it also enters the community of loose-lying algae in glacier fiords and in fiords with heavy sedimentation as previously reported from Greenland (LUND, 1951). Nemathecia are the only reproductive structures observed by me. The results from cultures obtained by NEWROTH (1971) strongly support the assumption by Rosenvinge (1931) of an abbreviated life history, but there are still some open questions since the cultures are not yet complete. Similar investigations from certain parts (including Greenland) of the distribution range are needed.

The parasite *Ceratocolax hartzii* Rosenvinge, known from several localities in Greenland, was not found.

Rhodymeniales

Recently, Guiry (1974b) proposed a new family, Palmariaceae, to contain certain anomalous entities from the Rhodymeniaceae as defined in Kylin's classification (1956). This proposal is followed here.

Palmariaceae.

Halosaccion ramentaceum (L.) J. Ag.

This is a very common species, growing abundantly in tidepools and in the upper sublittoral zone, especially at sites where it is protected from the ice. Only now and then specimens presumably loose-lying were found at depths greater than 2 m.

The morphology is quite variable, with several forms being named in older literature. The thallus is very often heavily covered by epiphytes, especially *Elachista fucicola*, which is found almost exclusively on the fertile parts. These parts also normally have a greenish tinge from an endophyte that was previously called *Chlorochytrium inclusum*. Cultures from the Godthåbsfjord, previously mentioned, indicate a connection between *C. inclusum* and *Acrosiphonia sonderi* in Greenland.

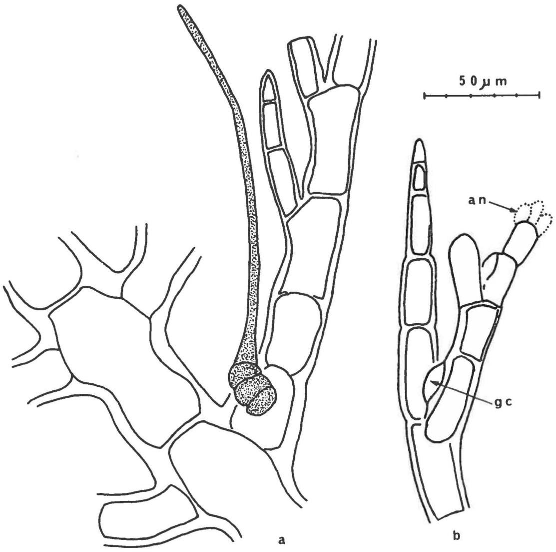
The fertile specimens are without exception tetrasporophytes with cruciate tetrasporangia. Jónsson (1901) reported antheridia, but the female gametophytes are still unknown and may not exist.

Palmaria palmata (L.) Stackhouse

Rhodymenia palmata (L.) Greville; Rosenvinge 1893 & 1898, Jónsson 1904, Lund 1959.

The investigation by Guiry (1974b) has lead to generic separation of this species from the type species of the genus *Rhodymenia*, *R. palmetta* sensu Greville = *R. pseudopalmata* (Lamouroux) Silva. It is shown that the anatomy and reproduction come closer to *Halosaccion* and *Leptosarca*.

Palmaria grows on rocks in the lower littoral and upper sublittoral zones at moderately exposed places along shores where there is protection from scouring ice and no dense cover of *Ascophyllum* and *Fucus*. It occurs in two forms, one very broad with few branches, the other relatively narrow with many branches. The fertile thalli are tetrasporophytes.



Figs 9a, b. *Antithamnion boreale*. Fig. 9a. Four-celled carpogonial branch developing laterally from the basal cell of a branch of the first order. Fig. 9b. Terminal antheridia (an) on plant also bearing tetrasporangia and a gland cell (gc).

Ceramiales

Ceramiaceae.

Antithamnion boreale (GOBI) KJELLMAN

This is a pronounced deep-water species occurring in rather small quantities on *Microporina* and on hydroids at depths ranging from 14–40 m. In addition, it was found in a single dredging from 4–10 m.

The specimens are referable to var. *corallina* (RUPRECHT) SUNDENE with 3–4 branches in whorls on the main axis, but opposite branches may be observed, especially at the apical parts of the thalli. Long-celled rhizoids grow from the basal cell of branches of first order in lower parts of the thalli. Glandular cells are present in varying numbers.

SUNDENE (1962) has cultivated plants from various parts of its distribution range and has found only reproduction by tetraspores. Antheridia were observed on tetrasporic plants of his Spitsbergen strain, as well as in nature by ROSENVINGE (1923–24) and by LUND (1959) in plants from Denmark and Greenland, respectively. To my knowledge the female gametophyte has only been mentioned by TAYLOR (1957), who states that the gonimoblasts are single or paired.

In South Greenland tetrasporic plants are predominant, but at a single station I found some female gametophytes. The carpogonial branch is 4-celled, developing laterally from the basal cell of a branch of first order (fig. 9a), always in unilateral series (pl. 3, fig. a). The subsequent development shows a naked gonimoblast (pl. 3, fig. b), not surrounded by involucral filaments as in *A. plumula* (Ellis) Thuret.

Terminal antheridia have been found in nature on plants that also bear tetrasporangia (fig. 9b), and a presumed old male gametophyte. The assumed presence of male gametophytes has been confirmed in culture with material from the Godthåbsfjord, West Greenland. Pl. 3, fig. c shows material from culture with antheridial clusters, quite similar to those of *A. plumula*, but situated on both the abaxial and adaxial sides of the branch, as well as on short laterals issuing from the main axis. In consequence, *A. boreale* must be assumed to have a *Polysiphonia*-type of life history, at least in part.

Ptilota serrata Kützing
Ptilota pectinata (Gunn.) Kjellman; Rosenvinge 1893 & 1898, Jónsson 1904, Lund 1959.

As shown by Dixon (pers. com.) the combination *Ptilota pectinata* (Gunn.) Kjellman is a later homonym of *Ptilota pectinata* Harvey and therefore untenable.

This is a very common species from the upper sublittoral zone down to 50 m growing epilithically, epiphytically and epizoically. Rather large specimens (about 25 cm long) are obtained at greater depths.

Female gametophytes and tetrasporophytes occur abundantly.

Delesseriaceae.
Phycodrys rubens (L.) Batters
Delesseria sinuosa (G. & W.) Lamouroux; Rosenvinge 1893 & 1898.

The material from South Greenland falls into two forms. One has narrow fronds (about 1 cm across), and is almost exclusively restricted to the upper sublittoral zone, growing on rocks, boulders (under side) and between haptera of kelps. The other has broad fronds (about 5 cm) and is found at great depths.

All fruiting specimens are tetrasporophytes as reported in previous literature from Greenland.

Pantoneura baerii (Postels & Ruprecht) Kylin
Delesseria baerii (Postels & Ruprecht) Ruprecht; Rosenvinge 1893 & 1898, Jónsson 1904.

This species was found largely as an epiphyte on stipes of *Alaria* in dredgings along the outer coast at depths between 25–40 m, where maximum development is reached, but smaller and sterile specimens also occur in the upper sublittoral zone.

The fertile material consists of tetrasporophytes with tetrahedrically divided, immersed sporangia causing a marked swelling of the fertile branch, as well as a female gametophyte with lateral gonimoblasts.

Membranoptera denticulata (MONT.) KYLIN
Delesseria montagnei KJELLMAN; ROSENVINGE 1893 & 1898.

This species extends from the upper sublittoral zone down to about 40 m, growing epilithically, epiphytically and epizoically. As in *Callophyllis cristata*, *Ptilota serrata* and *Pantoneura baerii*, the most luxuriant growth occurs at greater depths. Small specimens may also be found in the kelp forest in the holes of *Agarum*.

One female gametophyte with gonimoblasts on the mid rib and one tetrasporophyte with immersed, tetrahedrically divided sporangia have been found.

Rhodomelaceae.
Polysiphonia arctica J. AG.

This is a very common alga from the upper sublittoral zone down to 40–50 m. It has no specific substratum, for it grows on rocks, various algae and animals. The plants are secondarily fastened by rhizoids, which develop a terminal disc when contact is established with the substratum. Fragments of darker colour attached to other algae by rhizoids, with subsequent development of new filaments of lighter colour have been observed several times. This suggests that vegetative propagation by detached fragments is important, especially since the species is usually sterile. In culture rhizoids may even develop rather close to the apical cell.

Female gametophytes with young and mature gonimocarps were previously reported by PEDERSEN (1973). KJELLMAN (1883), ROSENVINGE (1893) and JAASUND (1965) reported young sporocarps, incompletely developed cystocarps and procarps, respectively. Plants with mature tetrasporangia were also found, but the male gametophyte is still unreported.

Rhodomela lycopodioides (L.) C. AG.

This is a widely distributed and variable species in South Greenland, and is found on rocks and between haptera of *Laminaria* in the upper sublittoral zone. The material contains tetrasporophytes and female gametophytes with gonimocarps in all stages of development.

Dinophyceae

Dinococcales

Phytodiniaceae.
Rufusiella foslieana (HANSGIRG) CHRISTENSEN
Urococcus foslieanus HANSGIRG

CHRISTENSEN (1975) has established the new combination *Rufusiella foslieana* after the genus *Rufusiella* was established by LOEBLISH (1967) to contain the dinophycean part of *Urococcus* in its old sense.

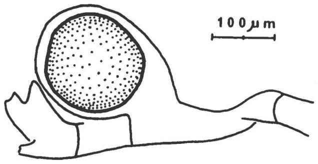


Fig. 10. *Vaucheria subsimplex.* Terminal antheridium and subterminal oogonium on a tube.

In a few samples from the littoral zone several cells with the characteristic tail of wall fragments have been found growing together with such various filamentous red and green algae as *Bangia fuscopurpurea*, *Rhizoclonium riparium* var. *validum*, *Ulothrix speciosa* and *Rosenvingiella polyrhiza.* A conspicuous red cover as reported by Christensen (1975) has not been seen.

Chrysophyceae

Phaeosacciaceae.

Phaeosaccion collinsii Farlow

A few specimens have been found growing epilithically on *Acrosiphonia sonderi* in a single locality. All developmental stages, from uniseriate filaments to fertile parenchymatous thalli up to 1 cm long, have been observed. Depth $^1/_2$–2 m.

The systematic position has been a matter of debate for some years. The alga was described as a brown alga and treated as such by Rosenvinge (1893), but more recently was removed to the Chrysophyceae by Parke & Dixon (1964). Ultimate conclusions could not be drawn from studies on its life history by McLachlan, Chen & Edelstein (1971) who reported a simple mode of reproduction with heterokont zoospores, which produced plants similar to the parent generation. A study of pigments, polysaccharides and photosynthetic products by Craigie, Leigh, Chen & McLachlan (1971) supported its placement in the Chrysophyceae by showing absence of alginate. These data are further strengthed by a recent study of zoospore ultrastructure (Chen, McLachlan & Craigie, 1974), showing apically inserted flagella with conventional heterokont fine structure, and a pyrenoid penetrated by a thylakoid.

Xanthophyceae

Vaucheriaceae.

Vaucheria subsimplex Crouan frat.

Vaucheria sphaerospora Nordst.; Rosenvinge 1898.

In a shallow bay near Nanortalik, this species formed mats on a sandy substratum exposed to the air at low water. It grew together with marine species, *Dictyosiphon foeniculaceus* and *Ectocarpus siliculosus*; however, species characteristic to salt-marches, *Percursaria percursa* and

Rhizoclonium riparium, were also present. Antheridia terminate the siphons and oogonia are formed just beneath them (fig. 10).

Phaeophyceae

Ectocarpales

Ectocarpaceae.

Ectocarpus siliculosus (Dillw.) Lyngbye
Ectocarpus confervoides (Roth) Le Jolis; Rosenvinge 1893 & 1898, Jónsson 1904.
Ectocarpus confervoides (Roth) Kjellman; Lund 1959.
Ectocarpus penicillatus (C. Ag.) Kjellman; Rosenvinge 1893 & 1898.

This species was found rather frequently in the upper sublittoral zone as an epiphyte on various algae e.g., *Rhodomela lycopodioides*, *Rhodophyllis dichotoma*, *Ulvaria obscura*, and *Coilodesme bulligera*. In addition, it was observed epilithically together with *Pilayella littoralis* and *Isthmoplea sphaerophora*. Less commonly it was found in the lower littoral zone and in tide pools.

The plants are mostly small, only rarely exceeding 1 cm. The plurilocular sporangia, the only reproductive structures found, have no hair-like prolongations. They are in size, 41,5–137,5 μm × 16,0–35,0 μm, and also vary considerably with regard to position on the filaments, from being sessile on the main axis to terminating laterals of different lengths and orders.

Giffordia ovata (Kjellman) Kylin
Ectocarpus ovatus Kjellman; Rosenvinge 1893 & 1898, Jónsson 1904.
Ectocarpus holmii Rosenvinge 1893.
Ectocarpus ovatus Kjellman f. *holmii* Rosenvinge 1898.

This species was found in only a few localities, but in rather great quantities, at depths generally from 4–20 m, and in a single dredging from 24–28 m. It was growing epiphytically on stipes of *Agarum cribrosum*, *Alaria* sp., and *Laminaria* sp., together with *Pilayella littoralis*, *Laminariocolax tomentosoides*, and *Leptonematella fasciculata*. In a single locality it was also found on the frond of a *Laminaria*.

This is a highly variable species. The morphology of the upright filaments changes considerably. Unbranched or nearly unbranched filaments, resembling f. *holmii*, grade into the typical form. The plants referable to f. *holmii* have sessile, scattered plurilocular sporangia, whereas f. *ovata* has opposite plurilocular sporangia (on the main axis and on the laterals of first order), as well as sporangia opposite to laterals. The sporangia measure 29,0–77,0 μm × 13,0–19,0 μm.

Unilocular sporangia have been found on two fragments of upright

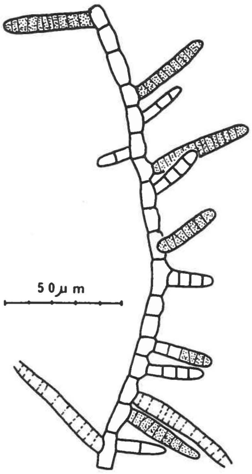


Fig. 11. *Laminariocolax tomentosoides.* Part of upright filament with unilateral series of uniseriate plurilocular sporangia.

filaments in the same general position as the plurilocular sporangia. Two mature unilocular sporangia measure 32,0 µm × 25,5 µm.

The high degree of variation shown by the upright filaments is probably due to competition with other algae, including diatoms, which often formed dense coverings on the stipes of the host plants. A similar variation is often observed in crowded cultures of brown algae. In the opinion of KORNMANN (1954) *G. ovata* and *G. fuscata* (ZANARDINI) KUCKUCK are synonyms. This view has been received with some reservation by authors working with North Atlantic marine algae (e.g., LUND, 1959; JAASUND, 1965) and is also questioned by KORNMANN (1961b).

Laminariocolax tomentosoides (FARLOW) KYLIN
Ectocarpus tomentosoides FARLOW; ROSENVINGE 1893 & 1898.

This species was rather common in the area. It was found as an epiphyte on fronds and stipes of *Laminaria* and on a stipe of *Alaria*, in all cases together with *Pilayella littoralis*, *Giffordia ovata*, and *Leptonematella fasciculata.* The best development was observed at depths of 6–20 m, but the species was also collected at 24–28 m. These findings differ considerably from those of RUSSEL (1964), who states that on the Isle of Man the plant is restricted to the infralittoral fringe and to the upper sublittoral zone.

From the endophytic part upright filaments penetrate the surface of the host. Some of these branches are short with terminal, uniseriate, plurilocular sporangia. Others are longer with a distinct main axis with few-celled laterals and sessile (rarely short-stalked), uniseriate,

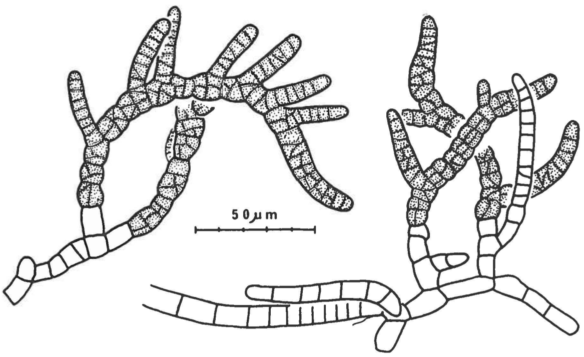


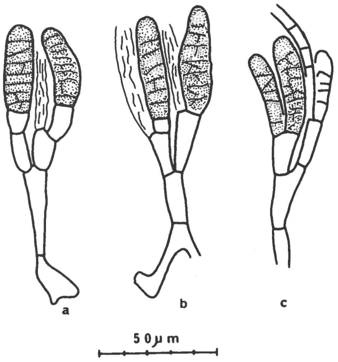
Fig. 12. *Streblonema fasciculatum* in *Eudesme virescens*. Details of plants with siliquose, branched plurilocular sporangia and basally sheathed hair.

plurilocular sporangia. The latter are nearly perpendicular to the axis, scattered, but often in unilateral series (fig. 11). They measure 41,5–57,5 µm × 6,5–7,0 µm. Ascocyst-like cells, as observed by Lund (1959) in specimens from East Greenland, are not present in this material.

Herponema desmarestiae (Gran) Cardinal
Feldmannia desmarestiae (Gran) Kylin; Lund 1959.
Ectocarpus desmarestiae Gran; Pedersen 1973.

As previously reported (Pedersen, 1973), this species was found as an endophyte in *Desmarestia viridis* at depths of 10–20 m. It is very inconspicuous and is possibly of more common occurrence than is suggested by this single find.

The generic designation has been a matter of debate; therefore, I have previously preferred the name *Ectocarpus desmarestiae* originally used by Gran (1897). Kylin (1947) proposed the new combination *Feldmannia desmarestiae*. He reproduced the illustrations of Gran without comments in spite of the fact that the genus *Feldmannia* Hamel (1939) was clearly defined by the presence of a meristematic zone, whereas Gran stated that in *Ectocarpus desmarestiae* "the growth is in all circumstances completely intercalary, not localised". Furthermore, maintainance of the genus *Feldmannia* seems doubtful, as some species within this genus are contained in the life history of *Acinetospora*. Knoepffler-Péguy (1970) does not make any clear statement as to the type species of this genus. The combination *Herponema desmarestiae* (Cardinal, 1964) is accepted with hesitation, since this genus was also defined by Hamel (1939) as having a meristematic zone. One filament illustrated by Cardinal (1964) shows some indication of such a zone without giving any very convincing evidence. In Gran's material, as in Lund's, growth seems to be diffuse. In the South Greenland collection



Figs 13a–c. *Streblonema chordariae* in *Chordaria flagelliformis*. Figs 13a, b. Parts of basal filaments with subdichotomously branched upright systems. The plurilocular sporangia are situated side by side or, in fig. 13c, laterally to a hair.

only occasional upright filaments are present. These are very short (not exceeding 10 cells), unbranched, and with diameters of 8,0–9,5 μm.

The plurilocular sporangia may terminate upright filaments, but grow mostly from the endophytic parts, thus appearing to be sessile on the surface of the host.

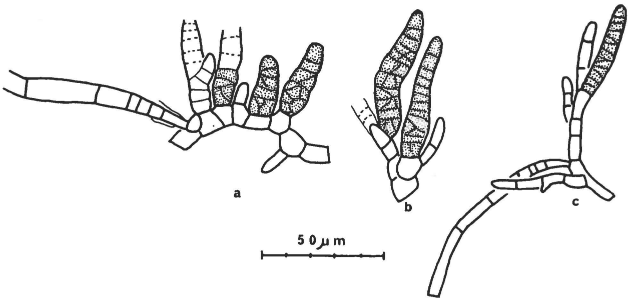
Streblonema fasciculatum THURET

This species has been found as an endophyte in *Eudesme virescens* collected in a tide pool near Nanortalik.

The plant (fig. 12) matches completely both the description given by LE JOLIS (1863) in having ramified, siliquose plurilocular sporangia, and the illustrations by JAASUND (1965). According to the literature (e.g., ROSENVINGE & LUND, 1941; KUCKUCK, 1954), this species occurs in various host plants, in some cases without branching of the plurilocular sporangia.

Streblonema chordariae (WOLLNY) COTTON

For comparison with the Nanortalik collection of *Streblonema fasciculatum* a re-investigation has been undertaken of specimens previously reported from Greenland by ROSENVINGE (1893) as *Ectocarpus pringsheimii* REINKE var. *simplex* REINKE in *Chordaria flagelliformis* (LKR no. 605, 12 June 1886, Frederikshaab, deposited at Botanisk Museum, Copenhagen) and regarded by ROSENVINGE & LUND (1941) as conspecific with *S. fasciculatum*. In this old collection the plants creep between the assimilating filaments of the host. They consist of basal filaments from which subdichotomously branched systems arise. The distal parts of these branched systems are transformed to plurilocular sporangia, two side by side (figs 13a, b), and one lateral of a hair (fig. 13c). These plants are rather similar to *S. chordariae* as illustrated by



Figs 14a–c. *Streblonema fasciculatum* var. *simplex* and *Streblonema* sp. in *Chordaria flagelliformis*. Figs 14a, b. *S. fasciculatum* var. *simplex* with sessile or short-stalked plurilocular sporangia and basally sheathed hair. Fig. 14c. *Streblonema* sp. with uniseriate plurilocular sporangium and a hair.

Kuckuck (1954). It is, of course, quite likely that Rosenvinge's material also contains *E. pringsheimii* var. *simplex* for I have found at least two different *Streblonema*-like plants in one specimen of *Chordaria* in my own collection (see below). The *Chordaria* endophyte illustrated in fig. 26A of Rosenvinge (1893) and referred by him to *Ectocarpus stilophorae* Crouan frat. also appears very similar to *S. chordariae*.

Jaasund (1963) discusses the possible relationship between *S. chordariae* and *C. flagelliformis* on the basis of the culture experiments of Caram (1955), who suggested a diplo-haplontic life history with reduced gametophytes. Kornmann (1962a) considered *S. chordariae* as a distinct species.

A revision of *Streblonema* in Greenland is undoubtedly necessary; however, this may be a satisfactory study only if culture studies are included, as several of the taxa described probably represent microthalli of other algae.

Streblonema fasciculatum Thuret var. *simplex* Reinke

In a collection of *Chordaria flagelliformis* some *Streblonema*-like filaments have been found at a depth of $1^1/_2$–2 m. The plants consist of branched filaments from which sessile or short-stalked plurilocular sporangia originate. The sporangia measure 32,0–55,0 μm × 9,5–11,5 μm. The hairs are 6,5–8,0 μm in diameter and slightly attenuate against the base, which shows a distinct sheath (figs 14a, b). They resemble fig. 4B of Kuckuck (1954), and also the microthalli of *Delamarea attenuata* pictured by Pedersen (1974).

Streblonema sp.

In the *Chordaria* plant just mentioned, a few filaments of another *Streblonema*-like plant have also been found. This plant differs from the

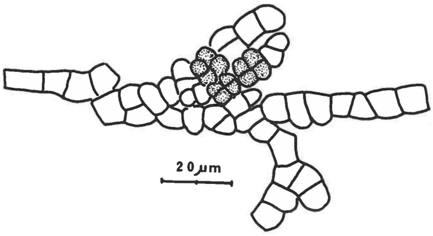


Fig. 15. *Microsyphar polysiphoniae.* Detail of pseudoparenchymatous part. The plurilocular sporangia have 4 loculi.

above by having more narrow hairs (diameter 5,0 µm) and filaments and uniseriate plurilocular sporangia (fig. 14c).

Microsyphar polysiphoniae KUCKUCK

This endophyte has been found once in the old parts of a specimen of *Polysiphonia arctica* growing between the haptera of a *Laminaria* plant at a depth of $1^1/_2$–2 m.

The endophytic filaments are branched, 6,5–8,5 µm broad often close together forming a pseudoparenchyma. No hairs have been observed. Plurilocular sporangia are formed by divisions of a vegetative cell into 4 loculi (fig. 15).

This is the second report of this species from Greenland. JÓNSSON (1904) mentioned it in *Polysiphonia urceolata* (DILLW.) GREVILLE from Ivigtut.

Myrionemataceae.

Myrionema aecidioides (ROSENVINGE) SAUVAGEAU

Entonema aecidioides (ROSENVINGE) KYLIN; LUND 1959.

Ectocarpus aecidioides ROSENVINGE 1893 & 1898, JÓNSSON 1904.

This endophyte was found in the frond of a *Laminaria* sp. plant collected in the upper sublittoral zone in a protected creek.

The plants typically form aecidium-like structures in the host. All fertile plants have uniseriate plurilocular sporangia, measuring 16,0–35,0 µm × 6,5–8,0 µm. Unilocular sporangia as illustrated by ROSENVINGE (1893) have not been found. The sporangia are sessile on the basal disc, from which hairs with diameters of 8,0–9,5 µm also originate. Scattered among these sporangia-bearing plants are some other plants with ascocyst-like cells (fig. 16). Independent of the size of such cells, their contents are always homogeneous, as in the plant illustrated by SETCHELL & GARDNER (1922) under the name *Streblonema aecidioides* (ROSENVINGE) FOSLIE f. *pacificum* SETCHELL & GARDNER. Similar cells were also observed by LUND (1959).

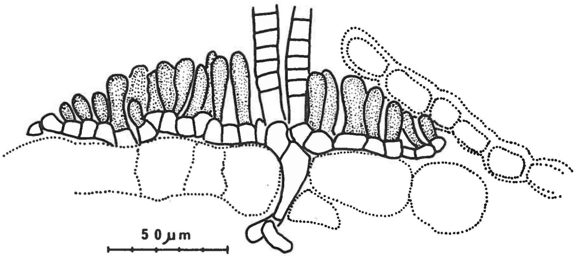


Fig. 16. *Myrionema aecidioides*. Transect of *Laminaria* frond with *Myrionema* forming aecidium-like structures and ascocyst-like cells.

Dermatocelis laminariae ROSENVINGE

A preliminary report about this species was published by PEDERSEN (1973).

The inconspicuous endophyte creeps in the outer wall of *Laminaria* fronds. When sterile the species is monostromatic, but it becomes distromatic when the plants are fertile. Horizontal division of a disc cell initiates the formation of a unilocular sporangium. The upper cell swells to a sporangium, while the lower cell (in rare cases two cells) serves as a supporting cell from which successive generations of sporangia may be formed.

There is no information in the literature concerning the chloroplast of this species, and it has been difficult to determine whether there is a single, lobed, platelike chloroplast or, whether there are several disc-shaped chloroplasts.

Phaeostroma pustulosum KUCKUCK

This is a very common epiphyte on various algae such as *Scytosiphon lomentaria*, *Dictyosiphon foeniculaceus*, *Chordaria flagelliformis*, *Delamarea attenuata*, *Laminaria* (on the frond), and *Saccorhiza dermatodea* (on the frond). The vertical extent is great, ranging from the upper sublittoral zone down to about 30 m.

The morphology is highly variable depending on the substratum, as also emphasized by JAASUND (1963 & 1965). When growing on the fronds of kelps, it develops a pseudoparenchymatous disc. In other cases it becomes more or less filamentous, especially when growing between the paraphyses of *Delamarea attenuata*.

Unilocular and plurilocular sporangia are found on separate plants. The plurilocular sporangia are formed by subdivisions of cells along the filaments or in few-celled laterals (fig. 17).

The typical *Phaeostroma*-hairs are frequently present. The elongated basal cells vary considerably in length, measuring 15–93 µm, but always show the characteristic morphology. The taxonomic use of the elongated

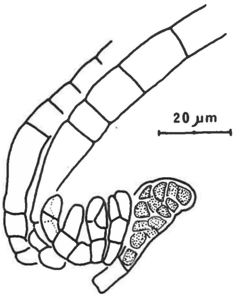


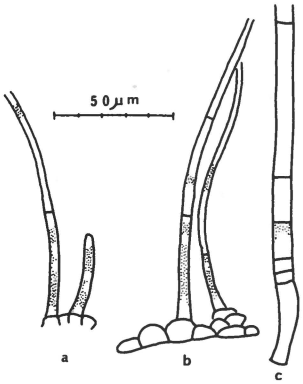
Fig. 17. *Phaeostroma pustulosum.* Detail of plant showing transformation of few-celled laterals into plurilocular sporangia. Two *Phaeostroma*-hairs are seen.

basal cell at a generic level has been a matter of debate (cf. Levring, 1940; Jaasund, 1951). I have observed the development of hairs in culture. Initially they are tube-like structures rich in cytoplasm (fig. 18a). The subsequent divisions produce very long cells which contain little cytoplasm except for the basal cell (fig. 18b). Finally the typical hair develops (fig. 18c), and at this stage the cytoplasm of the basal cell is highly vacuolated. In my opinion this feature may well be used as a taxonomic character.

Phaeostroma parasiticum Børgesen

This peculiar endophyte was found at a single locality, ENE of Prins Christian Sund Radio Station, in the frond of a *Laminaria* plant from a depth of 20–30 m.

The information on this species in the literature is scarce. It was described by Børgesen (1902) growing in *Laminaria færoensis* Børgesen and later refound by Lund (1959) in *L. saccharina.*



Figs 18a–c. Development of hairs on *Phaeostroma pustulosum* in culture. Fig. 18a. Initial, tube-like structure rich in cytoplasm. Fig. 18b. Hairs formed of very long cells with little cytoplasm except for the basal cell. Fig. 18c. The typical *Phaeostroma*-hair.

The plants from South Greenland form small pseudoparenchymatous discs, up to 1 mm in diameter, with free filaments only at the edge of the disc. This is in contrast to previous observations. Only the central parts of the plants are endophytic. When young they form bulges on the host (pl. 4, fig. a), but later burst the surface and send out horizontal filaments. These adhere to the substratum by means of rhizoids (pl. 4, fig. b, inserted), but are easily loosened when sectioned giving the transect the exact appearance shown in fig. 83a of BØRGESEN (1902). The horizontal filaments creep irregularly over and in between one another. The large plurilocular sporangia occur in the central areas of the disc (pl. 4, fig. b). Hairs have not been observed.

LEVRING (1937) suggests that *P. parasiticum* and *P. pustulosum* may be the same species. I find this rather unlikely. *P. pustulosum* is not an endophyte – cf. pl. 4, fig. b and pl. 4, fig. c – of the two species from the same station both on *Laminaria*. These figures also show the differences in the mode of growth and the dimensions of the filaments. Further, hairs have never been observed in *P. parasiticum*.

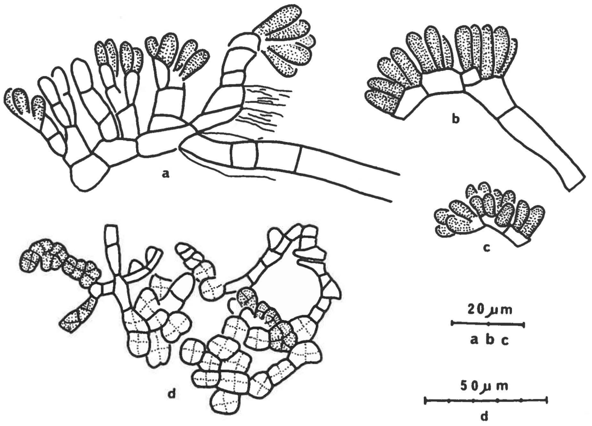
Lithodermataceae.
Porterinema fluviatile (PORTER) WÆRN
Porterinema marina JAASUND

This species was reported for the first time from Greenland by PEDERSEN (1973), growing in the basal parts of *Ulvopsis grevillei* from a depth of 0–2 m. Later, well-developed plants were found between the paraphyses of *Delamarea attenuata*, together with *Phaeostroma pustulosum* from the same locality and the same depth.

P. marina JAASUND (1965) is considered synonymous with *P. fluviatile*, in agreement with WILCE, WEBBER & SEARS (1970). As an endophyte in *Ulvopsis grevillei*, *Porterinema* consists of branched filaments 4,0–6,5 µm in diameter. The proximal parts of the plants often become pseudoparenchymatous and later are completely transformed into the characteristic 4-parted plurilocular sporangia (fig. 19d). Hairs with no visible basal sheath occur abundantly.

The plants between the paraphyses of *Delamarea* are of a different type, similar to those illustrated by WÆRN (1952) with crown-like, branched sporangial stands and basally sheathed hairs (fig. 19a). Fertile unbranched filaments are also present (figs 19b, c).

WÆRN (1952) discusses the possible relation between the genera *Porterinema* and *Phaeostroma*. I agree with him that they are clearly distinct taxa. Most important is the peculiar formation of sporangia in *Porterinema*. Initially the sporangia are bulges from the sporangial mother cell, and may or may not be closed off by a wall (figs 19a–c); at maturity each sporangium has a separate opening. Thus they are



Figs 19a–d. *Porterinema fluviatile.* Figs 19a–c. *P. fluviatile* between paraphyses of *Delamarea attenuata.* Fig. 19a. Plant with crown-like, branched sporangial stands, empty sporangia, and basally sheathed hair. Figs 19b, c. Fertile unbranched filaments. The sporangia may or may not be closed off by a wall. Fig. 19d. Detail of plant growing endophytically in *Ulvopsis grevillei.* Complete transformation of the pseudoparenchymatous part into 4-parted plurilocular sporangia.

completely different from the plurilocular sporangia of *Phaeostroma.* When emptied they collapse (fig. 19a), while rigid sporangial walls are left in *Phaeostroma.*

Symphyocarpus strangulans Rosenvinge

This species was found at a single locality (Imerdlugtoq at Ilua) growing on a stipe of *Agarum* together with *Audouinella efflorescens* at a depth of 20–40 m.

The appearance of the plants agrees exactly with Rosenvinge's (1893) description and illustrations. Short, loosely connected upright filaments with diameters of 10–14 μm originate from the pseudoparenchymatous basal layer. Hairs have not been observed.

The material is fertile with the terminal cell of an upright filament transformed into a sorus of plurilocular sporangia (pl. 4, fig. d). The type of plurilocular sporangia illustrated by Lund (1959) has not been observed either by me or by Jaasund (1963). The development of the sporangia can easily be followed. The initial division of the terminal cell is longitudinal and is followed by longitudinal division of the daughter cells perpendicular to the first division. A surface view shows the four cells within a common wall (pl. 4, fig. f) and later they are subdivided transversally into a relatively low number of loculi, occasionally with further (1 or 2) longitudinal divisions. A similar process takes place at formation of unilocular sporangia in *Pseudolithoderma rosenvingii* (Wærn) S. Lund (cf. fig. 66a of Wærn, 1952). The upright filaments of *Symphyocarpus* that do not form sporangia are terminated by ascocyst-like cells (pl. 4, fig. e).

ROSENVINGE (1893) suggests a similarity between the sporangia of *S. strangulans* and those of *Coelocladia arctica* ROSENVINGE. A study of the development of plurilocular sporangia in *C. arctica* in culture in conjunction with the present investigation indicates, that the sporangia of the two genera are fundamentally different.

Petroderma maculiforme (WOLLNY) KUCKUCK

A find on *Balanus* is reported by PEDERSEN (1973). In addition the algal material contains a crust of *Petroderma* growing on a stalk of *Fucus vesiculosus* from the littoral zone. It is easily distinguished from other brown crusts by the separable upright filaments and the terminal unilocular sporangia with their characteristic morphology.

Sorapion kjellmanii (WILLE) ROSENVINGE
Lithoderma kjellmanii WILLE; ROSENVINGE 1893.

Plants unquestionably referable to this species were found on *Balanus* in a tide pool. The crusts were partly covered by *Bolbocoleon piliferum*. The upright filaments are occasionally terminated by the characteristic pyriform unilocular sporangia, which measure 16,5–25,5 μm × 25,5–33,0 μm. Branched vertical filaments as illustrated by LUND (1959), figs 14B–D, also occur abundantly.

Pseudolithoderma
Lithoderma; ROSENVINGE 1893 & 1898, JÓNSSON 1904.

Crusts belonging to this genus were found together with *Leptophytum laeve* growing on stones from greater depths. Unfortunately, the material is sterile, which precludes specific determination.

Elachistaceae.
Leptonematella fasciculata (REINKE) SILVA
Leptonema fasciculatum REINKE; ROSENVINGE 1893, JÓNSSON 1904.
Elachista fasciculata (REINKE) GRAN; ROSENVINGE 1898.

This species is particularly frequent as an epiphyte on the fronds of kelps, *Laminaria*, *Agarum*, and *Alaria*. It grows together with *Pilayella littoralis*, *Laminariocolax tomentosoides*, and *Rhodochorton spetsbergense*. In two localities it is also found on the stipes of *Alaria* and *Agarum*, together with *Giffordia ovata*. The vertical extent is great, ranging from 4–30 m, which approximately corresponds with that of the kelps.

The assimilating filaments are unbranched with diameters of 6,5–12,0 μm in the sterile condition, always tapering somewhat towards the apex. The fertile filaments are generally broader, 6,5–16,0 μm, but even thin filaments obviously sometimes become fertile. Unilocular sporangia, as observed by LUND (1959), are not present in this material. DANGEARD (1966) reports true hairs to occur in this species and suggests a removal to the Myrionemataceae. I have not found such structures either in nature or in culture, which agrees with the findings of WYNNE (1969).

Elachista fucicola (VELLEY) ARESCHOUG
Elachista lubrica RUPRECHT

This is a very common epiphyte on various algae, e.g., *Halosaccion ramentaceum*, *Coilodesme bulligera*, *Chordaria flagelliformis*, *Ptilota serrata*, *Porphyra miniata*, *Dictyosiphon foeniculaceus*, *Ascophyllum nodosum*, *Fucus vesiculosus*, *F. distichus*, *Chaetomorpha melagonium*, *Scytosiphon lomentaria*, and *Rhodophyllis dichotoma*. It occurs in the littoral and upper sublittoral zones.

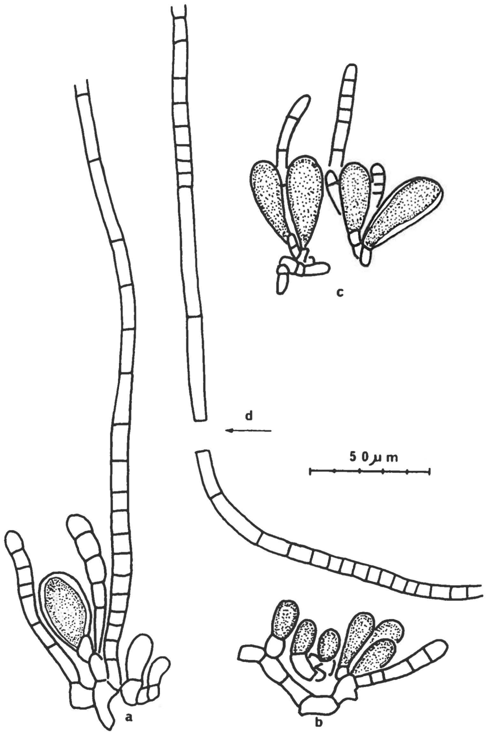
All fertile plants bear unilocular sporangia. In one plant some cells of the assimilating filaments have been found to be subdivided (pl. 4, fig. h). Such divided cells have previously been observed by various authors (e.g., ROSENVINGE, 1893; JÓNSSON, 1904; LUND, 1959; JAASUND, 1960a) and are generally interpreted as plurilocular sporangia. I doubt this interpretation, however, for I have not seen a single empty cell in my material from South Greenland or in material from Godthåb, West Greenland, nor does JAASUND (1960a, fig. 2) show empty cells.

The maintenance of the taxa *E. fucicola* and *E. lubrica* has been a matter of debate for many years. ROSENVINGE (1893) and LUND (1959) consider *E. lubrica* as a variety of *E. fucicola*. EDELSTEIN, CHEN & McLACHLAN (1971) use the name *E. lubrica* with reservation. JAASUND (1960a) describes a myrionemoid stage, resembling *Microspongium globosum* REINKE, connected physically with *E. lubrica*. This myrionemoid stage has hairs and consequently JAASUND makes the new combination *Myriactula lubrica* (RUPRECHT) JAASUND.

Culture studies of several clones of *E. fucicola* from the Godthåbsfjord, West Greenland, have demonstrated the presence of a microthallus (pl. 4, fig. g). The plurilocular sporangia in this stage are quite different from those illustrated by KORNMANN (1962b). Further, the cultures have consisted of long-celled filaments (pl. 4, fig. i) at an initial stage of development of the macrothalli. To interpret these long-celled filaments as hairs is, however, not possible, as they contain chloroplasts. Consequently, I doubt the validity of the combination *Myriactula lubrica*, and suggest retention of the designation.

Myriactula clandestina (CROUAN frat.) J. FELDMANN

This species is recorded for the first time from Greenland. It was found as an endophyte in *Fucus vesiculosus* collected at low water line in a protected bay at Anordliuitsoq on the island of Pamiagdluk.



Figs 20a–d. *Myriactula clandestina.* Fig. 20a. Detail of plant with assimilating filament, paraphyses and unilocular sporangium. Figs 20b, c. Unilocular sporangia formed before erect filaments are present. Fig. 20d. Structure regarded as an assimilator because of the meristem inserted above long hyaline cells (6 long cells omitted at the arrow).

In most details the plants from South Greenland agree with the illustrations by Crouan frat. (1867) and by Hamel (1935). Long-celled endophytic filaments penetrate the surface of the host and form short branches from which paraphyses, assimilating filaments, and unilocular sporangia originate (fig. 20a). The sporangia may be formed even before erect filaments are present (figs 20b, c). A distinct "stratum basale" is not present.

The genus *Myriactula* is defined by the presence of hairs. Hair-like structures are present in my material. They have a rather long basal meristem, from which the cells grade into long hyaline cells (fig. 20a). It is impossible, however, to interpret these filaments as hairs because in some cases a new meristem has been observed above long hyaline cells (fig. 20d). Consequently, these long erect filaments are assumed to be assimilators.

Chordariaceae.
Chordaria flagelliformis (O. F. Müller) C. Ag.

This species is very common in the area. It often occurs together with various Phaeophyceae, *Dictyosiphon foeniculaceus*, (also epiphytic on *Chordaria*), *Scytosiphon lomentaria*, *Delamarea attenuata*, *Pilayella littoralis*, and *Ectocarpus siliculosus*, in the upper sublittoral zone along insound coasts exposed to current. Furthermore, it may occur in the lower littoral zone and in tide pools. The species is fertile in the summer.

Eudesme virescens (Harvey) J. Ag.
Castagnea virescens (Carm.) Thuret; Rosenvinge 1898.

The species was found only at two sites in the Kap Farvel area. In one locality it occurred on rocks at a depth of $1^1/_2$–2 m together with *Dictyosiphon foeniculaceus* and *Scytosiphon lomentaria.* In the other case it grew epiphytically on *Rhodomela lycopodioides* in a rock crevice at a depth of about 1 m. The most abundant growth was observed outside the main area of investigation in a tide pool near Nanortalik, where it occurred epiphytically on *Fucus.*

The plants are up to 10 cm long with few, short laterals. Unilocular sporangia are abundant, while plurilocular sporangia as reported by Lund (1959) have not been observed.

Papenfussiella callitricha (Rosenvinge) Kylin
Myriocladia callitricha Rosenvinge 1893 & 1898.

The South Greenland finds reported by Pedersen (1973) comprise the total localities in which this species was found.

Wilce (1969) suggests a more southern distribution of this species than Godthåb and Sukkertoppen. This suggestion has been confirmed by the present investigation, and recently it has been reported from Newfoundland (R. Hooper, pers. comm.).

Desmarestiales

Desmarestiaceae.
Desmarestia aculeata (L.) Lamour.

This species was found at greater depths, 24–40 m, together with *Alaria*, *Agarum*, *Laminaria*, and occasionally also with *D. viridis.* It was found able to grow in a fiord with heavy sedimentation (Kangikitsoq). The plants from this locality were possibly loose-lying, together with also loose-lying *Chaetomorpha melagonium* (long plants) and *Agarum.*

A plant collected in the middle of July and one at the end of August still had hairs. The rest of the collection showed the typical summer morphology.

Desmarestia viridis (O. F. Müller) Lamour.

This species also occurs mainly at greater depths, 20–40 m, together with *Alaria*, *Agarum*, *Laminaria*, and in some cases with species found only in the lowermost part of the vegetation zone, e.g., *Omphalophyllum ulvaceum* and *Turnerella pennyi*. At two sites, both exposed to current, it has been collected at depths of 4–10 m and 10–20 m, respectively.

All plants examined have unilocular sporangia.

Sphacelariales

Sphacelariaceae.

Sphacelaria arctica Harvey

Sphacelaria racemosa Greville var. *arctica* (Harvey) Reinke; Rosenvinge 1893 & 1898, Jónsson 1904.

Plants, up to 2 cm long, of this species occur rather frequently on the rock and on or between the haptera of Laminariaceae in the upper sublittoral zone. At the head of Kangerdluk, it is common on stones covered by a thin layer of sediment here growing together with *Chaetomorpha melagonium*, *Pilayella littoralis*, *Ectocarpus siliculosus*, and *Rhodochorton purpureum*.

The material is sterile except for very few plants with empty unilocular sporangia terminal on a sporangial branch. The species is recognized, however, by the rhizoidal cortex (cf. Wærn, 1952).

Sphacelaria plumosa Lyngbye

Chaetopteris plumosa (Lyngbye) Kützing; Rosenvinge 1893 & 1898, Jónsson 1904, Lund 1959.

The species is common on rock and stones, and between haptera of various kelps in the upper sublittoral zone. Plants from greater depths are also found, but these are possibly loose-lying.

In agreement with older observations from Greenland, this species is sterile in the summer.

Scytosiphonales

Scytosiphonaceae.

Scytosiphon lomentaria (Lyngbye) Link var. *lomentaria*

Scytosiphon lomentaria (Lyngbye) Link var. *complanatus* Rosenvinge.

This species (including both varieties) occurs commonly on rocks and stones in the lower littoral zone and particularly in the upper sublittoral zone. In the upper sublittoral zone it grows together with *Dictyosiphon foeniculaceus*, *Delamarea attenuata*, *Chordaria flagelliformis* and *Coilodesme bulligera* often with *Pilayella littoralis* at their bases.

The var. *lomentaria* is characterized by the presence of paraphyses between the plurilocular sporangia and by a tubular thallus with or without constrictions. The longest thalli, up to $^1/_2$ m long, were found generally in more sheltered localities, but the plant also occurred along shores exposed to strong current together with var. *complanatus*.

The var. *complanatus* is characterized by lack of paraphyses and by flattened, hollow, non-constricted thalli. It was found mainly along shores exposed to current. The thalli of this variety show considerable variation in width, ranging mostly between $^1/_2$ and 2 mm, as shown in pl. 5, figs a–c. Even very narrow thalli may become fertile as observed in a plant not exceeding 190 μm in diameter including the sporangia (pl. 5, fig. e). Hairs occur singly or in tufts, and situated in depressions when the organism is fertile (pl. 5, fig. d). These observations reduce the differences between *S. dotyi* WYNNE (1969) and the present variety. The life histories of the two taxa will be compared in a later paper.

Petalonia fascia (O. F. MÜLLER) KUNTZE
Phyllitis fascia (O. F. MÜLLER) KÜTZING; ROSENVINGE 1893 & 1898, JÓNSSON 1904.
Ralfsia bornetii KUCKUCK
Ralfsia clavata (HARVEY) CROUAN frat.; ROSENVINGE 1893 & 1898, JÓNSSON 1904.
Ralfsia tenuis KYLIN; LUND 1959.

Petalonia blades were found once near Nanortalik growing on rocks in the littoral zone. The plants were fertile. Plants referable to *R. clavata* and *R. bornetii* were more common, occurring mainly on *Balanus* and on stones in the littoral and upper sublittoral zones. They were also found in a littoral pool on *Patella* and on the lower parts of *Fucus*. All specimens examined had unilocular sporangia.

Ralfsia fungiformis (GUNNERUS) SETCHELL & GARDNER
Ralfsia deusta (C. AG.) J. AG.; ROSENVINGE 1893 & 1898.

This species is not common in South Greenland, but when it occurs, it always forms extensive growths of aphyllophoralean morphology in tide pools. ROSENVINGE (1893) is of the opinion, that it belongs mainly in the kelp forest adhering closely to the rocks and consequently is rarely detached by dredging. In my opinion the typical habitat in Greenland is tide pools, in agreement with observations from Canada by EDELSTEIN, CHEN & McLACHLAN (1968).

All plants studied are sterile. Probably the species is fertile in winter, as observed for Canadian plants by EDELSTEIN, CHEN & McLACHLAN (1968). These authors have found uni- and plurilocular sporangia on separate plants as well as on the same plant.

Ralfsia verrucosa (ARESCHOUG) J. AG.

A single crust with the characteristic ascending filaments has been found on a stone in a tide pool on the small skerries Umiagssat qeqertai. The unilocular sori have paraphyses about 100 μm long, and the disc is about 120 μm thick.

Dictyosiphonales

Tilopteridaceae.

Pilayella littoralis (L.) KJELLMAN

Pilayella varia KJELLMAN

Ectocarpus littoralis (L.) LYNGBYE; ROSENVINGE 1893 & 1898, JÓNSSON 1904.

This is the most common algal species of the area. The vertical extent ranges from the littoral zone to a depth of approximately 28 m. It grows epilithically, epiphytically, and epizoically on various substrata. At greater depths it occurs mainly on stipes and fronds of various kelps.

The species shows considerable variation with regard to branching as well as morphology of unilocular and plurilocular sporangia. Two varieties can be distinguished, *littoralis* and *varia* (KJELLMAN) KUCKUCK. The var. *varia* was originally described as a distinct species and was treated as such by various authors (JAASUND, 1965; EDELSTEIN & McLACHLAN, 1967b). I have examined so much material and have found so many transitions from var. *littoralis* to var. *varia*, that I do not hesitate to refer these entities to one species. Examples of the great variation of the unilocular sporangia—even placed on rhizoidal filaments—in var. *varia* are shown in pl. 6, figs a–c. The same plant may also bear both plurilocular and unilocular sporangia with varying morphology, and even with the two types of intercalary sporangia on the same branch (pl. 6, figs d–f). Longitudinal divisions in connection with formation of unilocular sporangia is very frequent also in var. *littoralis* (pl. 6, fig. g), which normally shows long chains of such sporangia. My assumption of one very variable species is further supported by cultural material from West Greenland, likewise showing intercalary and lateral sporangia on the same plant (pl. 6, fig. h). Figs 22, 23 of EDELSTEIN & McLACHLAN (1967b) must show unilocular sporangia, not plurilocular as said in the legend, and the large cell seen in their fig. 20 may be one parasitised by a phycomycete.

Haplospora globosa KJELLMAN

Scaphospora arctica KJELLMAN; ROSENVINGE 1898.

This species was found only once on a rock exposed to current at a depth of 2–10 m. It is presumably very rare in Greenland, being previously known only from Danmarks Ø (Rosenvinge, 1898) and from Scoresby Sund and Kejser Franz Josephs Fjord (Lund, 1959). The plants from South Greenland were gametophytes with oogonia and antheridia. Sexual reproduction by oogamy was suspected already by Reinke (1889a). This assumption was later partially substantiated by Sundene (1966).

Isthmoplea sphaerophora (Harvey) Kjellman

This species was commonly found in the littoral and upper sublittoral zones, often growing together with *Pilayella littoralis.*

All examined upright filaments bear unilocular sporangia opposite or in whorls depending on the degree of development of the parenchyma. Plurilocular sporangia as illustrated by Jaasund (1960b) are not observed.

The life history of this species has been studied by Edelstein, Chen & McLachlan (1971), by Rueness (1974) and by Pedersen (1975). The plants from Canada and Greenland show the same life history, including formation of plurilocular sporangia in the prostrate system, whereas the strain from the Oslofjord never formed such sporangia. I have not observed fertile prostrate systems in nature in Greenland.

My count of 8 chromosomes in all stages of the Greenland strain, together with the demonstration by Rueness (1974) of 24 chromosomes in the Norwegian strain suggest a polyploid sequence in this species.

Striariaceae.

Stictyosiphon tortilis (Ruprecht) Reinke *sensu* Rosenvinge

Several well-developed plants of this species were found (presumably loose-lying) in a shallow bay near Nanortalik. Further, some small epiphytes on an *Alaria* frond collected at a depth of 2 m are thought to be young *Stictyosiphon* plants.

The surface cells of the Nanortalik plants are, to a considerable extent, transformed into plurilocular sporangia that protrude slightly from the surface. The presumed young plants have plurilocular sporangia in the monosiphonous parts of the thallus (pl. 6, fig. i), which agrees with fig. 8D of Rosenvinge (1935).

Delamareaceae.

Delamarea attenuata (Kjellman) Rosenvinge

This species is rather common at insound localities exposed to the wearing action of the moving ice. It grows in the upper $2^1/_2$ m of the sublittoral zone together with *Scytosiphon lomentaria*, *Dictyosiphon foeniculaceus*, *Chordaria flagelliformis* and *Acrosiphonia sonderi.*

The plants are fertile with unilocular and plurilocular sporangia on separate plants. Plants with both unilocular and plurilocular sporangia as observed by Caram & Jónsson (1972) have not been found.

In the material from nature swarmers frequently germinate *in situ* (pl. 6, fig. j). This observation further supports my previous assumption that *Streblonema*-like plants between the paraphyses of the macrothalli are identical with the microthalli found in culture (Pedersen, 1974).

Zinova (1954) includes *Coelocladia arctica* Rosenvinge in the Delamareaceae. *C. arctica* from the Godthåbsfjord, West Greenland, is now in unialgal cultures. Observations from these cultures seem to indicate that this genus does not naturally belong here.

Punctariaceae.
Litosiphon filiformis (Reinke) Batters
Pogotrichum filiforme Reinke; Rosenvinge 1893 & 1898.

This species has been found at a single locality growing epiphytically on the frond of a *Laminaria* plant collected from a depth of 20–30 m.

Most plants in question are young and sterile, but one plant has plurilocular sporangia in the prostrate system and in the erect filament. However, the species is easily identified because of the segmented parenchyma and the lack of hairs.

Two strains of this species, one from West Greenland and one from Denmark, are presently being studied in culture. Preliminary observations from these cultures suggest removal of the species from the genus *Litosiphon*.

Omphalophyllum ulvaceum Rosenvinge

This species, with a rather unique morphology for a brown alga, has been found at several localities. Most frequently it grows on *Microporina* and on hydroids, but it has also been found on the haptera of a kelp, on a mussel shell, and on stones. It nearly always occurs at greater depths, mostly 30–40 m – in a single dredging at only 10–20 m. The dredgings otherwise contained the various species characteristic for such depths e.g., *Callophyllis cristata*, *Polysiphonia arctica*, *Rhodophyllis dichotoma*, *Turnerella pennyi*, *Agarum cribrosum*, and *Desmarestia viridis*.

Developmental stages as illustrated by Lund (1959) have been observed again. All fertile plants bear immersed unilocular sporangia.

The species is provisionally placed within the Punctariaceae as originally suggested by Rosenvinge (1893). It differs, however, from other representatives of this family by the absence of hairs. Investigations of the life history are needed before the correct systematic position can be ascertained.

Dictyosiphonaceae.

Dictyosiphon foeniculaceus (Huds.) Greville
Dictyosiphon hispidus Kjellman; Rosenvinge 1893 & 1898.
Dictyosiphon hippuroides (Lyngbye) Kützing; Rosenvinge 1893 & 1898.
Dictyosiphon corymbosus Kjellman; Rosenvinge 1893 & 1898.

This highly variable species has been commonly found in the upper sublittoral zone together with *Delamarea attenuata*, *Chaetomorpha melagonium*, *Chordaria flagelliformis*, and *Scytosiphon lomentaria*, also growing epiphytically on the two last-mentioned species. Further, it has been found in tide pools.

The species shows considerable morphological variation in South Greenland as elsewhere. No attempt has been made to refer the plants to the various forms described, except that special mention should be made of the unusual f. *flaccidus* Areschoug. This form, characterized by the flaccid, inflated thallus, is particularly frequent in shallow bays and forms large, loose-lying, entangled masses. The species forms unilocular sporangia in the summer.

Dictyosiphon chordaria Areschoug

I have referred to this species some plants found along the outer coast in the littoral zone. The locality is protected from the ice, but is exposed to waves.

The morphology of the plants is very similar to the red alga, *Dumontia incrassata* (O. F. Müll.) Lamour. The main axes are short with long, somewhat-inflated laterals of first order. Unilocular sporangia are present.

Coilodesmaceae.

This family is placed provisionally within the Dictyosiphonales. It was established by Setchell & Gardner (1925) to include the genera *Coilodesme* and *Phaeostrophion*. Other authors included *Coilodesme* in the Punctariaceae (Mathieson, 1967) or in the Dictyosiphonaceae (Papenfuss, 1951; Lund, 1959; Christensen, 1966). Observations on cultures of *C. bulligera* from West Greenland suggest that it is not naturally included within either of these families, the development of the saccate macrothalli of *C. bulligera* being very different from what is known in any of them. The swarmers from the unilocular sporangia germinate into prostrate branched systems in which the filaments later coalesce. From these pseudoparenchymatous parts the new macrothalli are formed by bulging, as in *Ulvopsis grevillei*. These observations agree with those of Wynne (1972) on *C. bulligera* from the Aleutian Islands.

Coilodesme bulligera STRÖMFELT

This species is common in the area. It has been found in tide pools together with *Fucus distichus* and as an epiphyte on *Ralfsia fungiformis*. Most frequently it occurs epilithically in the upper sublittoral zone along shores exposed to drifting ice, together with *Dictyosiphon foeniculaceus*, *Chordaria flagelliformis*, *Ulvopsis grevillei*, *Ulvaria obscura*, and *Chaetomorpha melagonium*. Further, it grows epiphytically on *Fucus* and *Halosaccion*. The largest plants have been dredged at depths of 4–10 m on a rock exposed to strong current. They are up to 30 cm long, and one of them is branched (branches up to second order) in the apical part of the saccate thallus. Immersed unilocular sporangia are the only reproductive structures found.

Laminariales

Chordaceae.

Chorda filum (L.) STACKHOUSE

This species has only been found at a single protected locality (in the narrows between the islands Tôrnârssuk and Quvnerit) growing on stones in the upper sublittoral zone. Suitable sites are apparently not common in the Kap Farvel area.

The plants are rather small—not exceeding 35 cm in length—and still in the sterile condition. Very young unilocular sporangia, together with paraphyses, have been observed in one plant.

Halosiphon tomentosus (LYNGBYE) JAASUND

Chorda tomentosa LYNGBYE; ROSENVINGE 1893 & 1898, JÓNSSON 1904, LUND 1959.

This species, too, has been found only at a single locality on a rock exposed to current near Prins Christian Sund Radio Station. The depth is somewhat uncertain as the last quarter of the dredging was at depths of 12–18 m, the rest at depths of 24–28 m. According to ROSENVINGE (1893) the most common depths are 10–18 m.

Three thalli have been collected, one intact measuring 50 cm in length. The entire thalli are covered with brown filaments except for a few centimeters near the bases. At least one plant is fertile.

Laminariaceae.

WILCE (1964) recognizes 3 species of *Laminaria* within the section Simplices to occur in the North Atlantic and adjacent waters: *L. saccharina*, *L. longicruris*, and *L. solidungula*. The presence or absence of mucilage ducts in stipes and blades, previously used to distinguish species, is regarded by this author as valid to separate ecotypes of *L.*

saccharina and *L. longicruris*. CHAPMAN (1975) shows that this character is subject only to minimal genetic control, thus being of questionable value even to differentiate ecotypes.

Agarum cribrosum BORY
Agarum turneri POSTELS & RUPRECHT; ROSENVINGE 1893 & 1898, JÓNSSON 1904.

This is a very common species occurring at depths of 2–40 m. It is always one of the constituents of the kelp forest along the outer coast and the insound localities more or less exposed to current and occurs together with various Laminariaceae and *Alaria*. In addition, it is the only kelp found in a fiord (Kangikitsoq) with heavy sedimentation.

Laminaria saccharina (L.) LAMOUR.
Laminaria groenlandica ROSENVINGE 1893 & 1898, JÓNSSON 1904, LUND 1959.
Laminaria cuneifolia J. AG.; ROSENVINGE 1893.

This is a very common and highly variable species mainly collected at depths between 2 and 30 m, along the outer coast down to 40 m.

Laminaria solidungula J. AG.

This species is exclusively found at greater depths, from 14 to 40 m, mostly between 20 and 30 m. It is easily recognized by its discoidal holdfast and the rounded sorus, which appears as a whitish area in summer.

Laminaria nigripes J. AG.

One find has been made just above low water level; the rest are from the upper sublittoral zone.

Saccorhiza dermatodea (DE LA PYLAIE) J. AG.

This species has been found at depths of $^1/_2$–14 m.

Alaria

At least two types of sporophylls can be recognized in the Kap Farvel area. One is linear (resembling the *A. grandifolia* J. AG. type); the other is shorter cuneiform, lingulate. I prefer, however, not to give them specific rank until further information on this genus has been published.

The genus ranges from the upper sublittoral zone down to approximately 30 m and perhaps a little deeper at the outer coast.

Fucales

Fucaceae.

Ascophyllum nodosum (L.) Le Jol.

This species is common along protected shores particularly in shallow bays, where it forms a dense community together with *Fucus vesiculosus.* The upper part of this vegetation (at least at Anordliuitsoq on the island of Pamiagdluk) is dominated by *A. nodosum.* Receptacles are present in the summer.

Fucus distichus L.

Fucus inflatus L.; Rosenvinge 1893 & 1898, Jónsson 1904, Lund 1959.

This is a rather common species at sites with protection from the wearing action of drifting ice. It occurs in tide pools, the littoral and upper sublittoral zones. The species is fertile in summer.

Fucus vesiculosus L.

At the most protected localities this species grows together with *Ascophyllum nodosum* in the littoral zone. With increasing exposure, but still suitable for perennial vegetation, it is found alone in the littoral and upper sublittoral zones. Receptacles are present in the summer.

Chlorophyceae

Chlorococcales

Chlorococcaceae.

Sykidion droebakense Wille

This species was reported for the first time in Greenland by Pedersen (1973).

Endosphaeraceae.

Chlorochytrium cohnii Wright

This endophyte was found in "Schizonema" sheaths, most abundantly in protected sites in the littoral and upper sublittoral zones.

The cells are generally oval, 32,0–48,0 μm long, 19,0–22,5 μm high, and 25,5–32,0 μm broad. The cells contain the characteristic stellate, parietal chloroplast (pl. 7, fig. a) with a central pyrenoid. The "Schizonema" sheath is penetrated by a tap, through which the swarmers (16–32) are later released.

Jónsson (1967) suggests a connection between *C. cohnii* and *Acrosiphonia sonderi.* The stellate chloroplast of *C. cohnii*, however, is quite different from that of *Acrosiphonia* thus contradicting Jónsson's assumption. The same do culture experiments carried out with Greenland material. Released quadriflagellate swarmers from fertile cells (pl. 7, fig. c) develop into cells similar to the mother cell. The tap region is clearly visible at the juvenile stage (pl. 7, fig. b). Experimental studies in culture also indicate that the endophytism is not obligate.

Chlorochytrium dermatocolax REINKE

This endophyte is common in *Sphacelaria arctica* and *Sphacelaria plumosa* in the upper sublittoral zone.

The cells are 35,0–61,0 μm long, 22,0–35,0 μm broad, and 9,0–12,0 μm high. The tap is excentrically located in contrast to *C. cohnii* (pl. 7, fig. d) and the chloroplast reticulate. These cells may represent a developmental stage of another species.

Chlorochytrium inclusum KJELLMAN

This endophyte is very common in *Halosaccion ramentaceum* in the upper sublittoral zone.

In my opinion Greenland material registered as *C. inclusum* represents a developmental stage of a species of *Acrosiphonia* (possibly *A. sonderi*), for I have observed development of *A. sonderi* from *C. inclusum*-like cells brought into culture from West Greenland *Porphyra*. The connection between *C. inclusum*, *Codiolum petrocelidis* and various Acrosiphoniaceae has previously been demonstrated by FAN (1959) and KORNMANN (1964b). Until such connection has been clearly demonstrated in Greenland material, however, I prefer to maintain *C. inclusum* as a distinct taxon.

Both the morphology and the size of the cells vary considerably, ranging from round to oval and with diameters of 50–90 μm. Swarmers have been observed in some cells.

Phyllosiphonaceae.

Ostreobium quekettii BORNET & FLAHAULT

This shell-boring alga was found at greater depths, 10–50 m in *Mya*-shells and in the calcified parts of *Balanus* together with other shell-boring species such as *Eugomontia sacculata*, *Gomontia polyrhiza*, and *Conchocelis*-stages.

Prasiolales

Prasiolaceae.

Prasiola meridionalis SETCHELL & GARDNER

As previously reported by PEDERSEN (1973) this species was found in small quantities at two sites (near Augpilagtoq and at the entrance of the fiord, Tasiussaq) in rock crevices in the littoral zone. The genus

Prasiola is generally considered to be nitrophilous, but in these two places I have found no evidence of an especially rich nitrogen supply.

Bravo (1965) demonstrated a connection between *P. meridionalis* and *Rosenvingiella constricta* (Setchell & Gardner) Silva. Although plants of *Rosenvingiella* occur frequently, I have not found any that fit published descriptions of *R. constricta.*

Rosenvingiella polyrhiza (Rosenvinge) Silva
Gayella polyrhiza Rosenvinge 1893 & 1898.

This species (possibly a stage of *Prasiola*) was found rather commonly on rocks in the littoral zone together with *Urospora penicilliformis*, *Rhizoclonium riparium* var. *validum*, and *Rhodochorton purpureum.*

All stages are found, from uniseriate filaments 13,0–16,0–(19,0) μm wide with rhizoids occurring singly or in pairs, to well-developed parenchymatous thalli. Some of the latter are fertile with the apical parts transformed into sporangia leaving the thalli nearly hyaline after release of the cysts.

Ulotrichales

Ulvaceae.

Capsosiphon fulvescens (C. Ag.) Setchell & Gardner

As previously reported (Pedersen, 1973), this species was found for the first time in Greenland at Narssarssuaq, growing on stones together with *Ulothrix pseudoflacca* in the littoral zone near the outlet of a polluted brook.

Percursaria percursa (C. Ag.) Rosenvinge

This species was found on the sandy bottom (exposed at low water) of a shallow bay near Nanortalik, together with *Rhizoclonium riparium*, *Vaucheria subsimplex*, and further, with smaller amounts of loose-lying *Stictyosiphon tortilis* and *Dictyosiphon foeniculaceus.* The bay is surrounded by rocks covered with *Ascophyllum nodosum* and *Fucus vesiculosus.* All plants examined are sterile.

Blidingia minima (Kützing) Kylin var. *minima*
Enteromorpha intestinalis (L.) Link var. *micrococca* (Kützing) Rosenvinge 1893.
Enteromorpha intestinalis (L.) Link var. *minima* (Nägeli) Rosenvinge 1893.

This species is common in the littoral zone in rather different habitats. Along the exposed outer coast characterized by an almost bare littoral zone, it is restricted to rock crevices. It also occurs in very protected habitats – even where influenced by fresh water that oozes out of the rocks. It grows together with *Rosenvingiella polyrhiza*, *Calothrix scopulorum*, and often with *Plectonema battersii* at the base. Some of the plants are branched. The species is fertile in the summer.

Enteromorpha prolifera (O. F. Müller) J. Ag.

Some plants with highly variable morphology have been referred to this species. They were found on rock and stones in the lower littoral and uppermost sublittoral zones as well as in a tide pool. The habitat ranges from the exposed outer coast to very protected sites deep in the fiords. The plants from the outer coast are characterized by relatively narrow thalli, approximately 2 mm broad and 10 cm long with basal proliferations; those from protected sites are broader, approximately 8 mm in diameter and 15 cm long.

The cells, not exceeding 20 μm in their longest dimension, are generally arranged in longitudinal rows. The parietal chloroplast contains one pyrenoid. Young plants have been observed on *Acrosiphonia* in August.

Ulvaria obscura (Kützing) Gayral var. *blyttii* (Areschoug) Bliding
Monostroma fuscum (Postels & Ruprecht) Wittrock; Rosenvinge 1893 & 1898, Jónsson 1904, Lund 1959.

This species is a common component of the benthic vegetation in tide pools and in the upper sublittoral zone, in the latter case together with such plants as *Ulvopsis grevillei*, *Chaetomorpha melagonium*, *Acrosiphonia*, and *Coilodesme bulligera*. It also occurs at greater depths, possibly loose-lying, large and sterile thalli being very common on the bottom of shallow bays.

The species is fertile in the summer.

Monostroma groenlandicum J. Ag.
Enteromorpha groenlandica (J. Ag.) Setchell & Gardner; Lund 1959.

This species is one of the filamentous, annual green algae that occupies the littoral and upper sublittoral zones along shores exposed to drifting ice. It has been found together with *Ulothrix speciosa*, *Urospora penicilliformis*, and *Acrosiphonia*, and in a single case as an epiphyte on *Fucus vesiculosus*.

Kornmannia leptoderma (Kjellman) Bliding
Monostroma leptodermum Kjellman; Rosenvinge 1893 & 1898, Jónsson 1904, Lund 1959.

This species is rather uncommon in the Kap Farvel area. It has been found growing epilithically, epizoically, and epiphytically on

Chordaria flagelliformis, *Fucus vesiculosus*, and *Palmaria palmata* in the upper sublittoral zone. In one locality it was found on *Fucus distichus* in the littoral zone.

Most of the material consists of small plants not exceeding 1 cm in length. Only one plant is 6 cm long. The species is easily recognized, however, because of the small cells with chloroplasts without pyrenoids. Even some of the small plants are fertile, retaining rigid sporangial walls after release of swarmers.

Ulvopsis grevillei (THURET) GAYRAL

Monostroma grevillei (THURET) WITTROCK emend. ROSENVINGE 1893 & 1898, JÓNSSON 1904, LUND 1959.

This highly variable species was frequently found on the rocks in the upper sublittoral zone, (at a single station in the littoral zone), together with *Halosaccion ramentaceum*, *Fucus vesiculosus*, *Fucus distichus* (also as an epiphyte on these species), *Chordaria flagelliformis*, *Scytosiphon lomentaria*, *Ulvaria obscura*, *Chaetomorpha melagonium*, and *Acrosiphonia*. In addition, it was found on *Balanus*.

The species is conceived in the sense of ROSENVINGE (1893), and includes also *Monostroma arcticum* WITTROCK. The latter is considered a distinct species by BLIDING (1968), mainly with reference to the direct type of life history, but also on the assumption that differences in the shape of the cells a little above the bases constitute a constant distinctive feature. I have observed cells enclosed by a common wall, as pictured by BLIDING, in the basal regions of some of the plants. Since I am uncertain about the value of this character and have no information on the life history of my material from Greenland, I have referred all the material to one species. The plants vary between leafy, and saccate – to long *Enteromorpha*-like thalli. Many are fertile.

Gomontia polyrhiza (LAGERHEIM) BORNET & FLAHAULT

This species was found in the calcified parts of various animals, e.g., mussel shells, *Balanus*, and bryozoans, together with other shell-boring algae, *Eugomontia sacculata*, *Ostreobium quekettii*, and *Conchocelis*-stages, from the upper sublittoral zone to a depth of about 50 m.

The excrescences show morphological variation similar to that observed in the Danish material by NIELSEN (1972), who also found a disc, assumed to be the gametophyte of this species, in my material from Greenland (PEDERSEN, 1973).

Ulotrichaceae.

The species of *Ulothrix* are conceived in the sense of WILLE (1901), whose system is also adopted by JÓNSSON (1904) in his treatment of the

East Greenland species. However, this system, based mainly upon chloroplast characters, has been found rather unsatisfactory, especially with regard to the separation of *Ulothrix pseudoflacca* and *Ulothrix subflaccida*. Culture studies such as those undertaken by KORNMANN (1964a) are undoubtedly needed for the whole species complex.

Ulothrix consociata WILLE

This characteristic species often formed mats near the high water level and downwards in the littoral zone.

The filaments coalesce to a great extent. In diameter they vary from (9,5)–12,5 to 20,0 μm. Sporangia with 8 swarmers have been observed.

Ulothrix pseudoflacca WILLE
Ulothrix implexa KÜTZING; ROSENVINGE 1893 & 1898.

This species was commonly found on stones and rocks in the littoral zone, especially together with *Ulothrix speciosa* and *Urospora penicilliformis*, and also on rocks and as an epiphyte on *Acrosiphonia* in the upper sublittoral zone.

The cells of the filaments are highly variable in their length/width proportions (pl. 7, fig. e). I have found filaments with short cells in which the chloroplast fills the length of the cells, a condition regarded as typical for the species. However, filaments with cells longer than broad and longer than their chloroplasts, thus in agreement with f. *tenuior* JÓNSSON (1904), also occur. This form is very close to *Ulothrix subflaccida* WILLE, from which it differs usually by having the pyrenoid situated towards one end of the curved chloroplast band. I find this difference of minor importance, and consequently prefer to use the name *U. pseudoflacca* in a rather broad sense, including plants which might possibly be referred to *U. subflaccida*. The filaments are 6,5–21,0 μm in diameter, occasionally showing constrictions at regular intervals. Most of the plants examined are fertile.

Ulothrix scutata JÓNSSON

Some plants growing epiphytically on *Acrosiphonia* in the lower littoral and upper sublittoral zones have a scutate basal cell (pl. 7, fig. f), and are thus referable to this species. However, other *Ulothrix* filaments growing on *Acrosiphonia* lack such scutate basal cells, but in all other details resemble typical *U. scutata*. Their basal cells are often more narrow and elongate immediately above the expanded part, if such is present, than the other cells of the filaments, which measure (6,5)–9,5–13,0 μm in diameter. The filaments, some of them fertile, are often regularly constricted at intervals of 4 cells. Rhizoids as illustrated in fig. 8e by JÓNSSON (1904) have not been observed in this material. JÓNSSON also emphasized that this species is closely related to *U. pseudoflacca*, and I will not exclude the possibility that they are conspecific, finding it rather unnatural to refer some *Ulothrix* filaments on *Acrosiphonia* to *U. scutata* and others to *U. pseudoflacca* as JÓNSSON did.

Ulothrix speciosa (HARVEY) KÜTZING sensu KORNMANN
Ulothrix flacca (DILLW.) THURET; ROSENVINGE 1893 & 1898, JÓNSSON 1904, LUND 1959.

This species was found very frequently together with *Rhizoclonium riparium*, *Rosenvingiella polyrhiza*, *Urospora penicilliformis*, *Monostroma groenlandicum*, and *Rhodochorton purpureum* growing on rocks in the littoral zone. Occasionally, it was found as an epiphyte on *Fucus vesiculosus*, and sometimes it was entangled with other larger algae in the upper sublittoral zone.

The species is easily recognised because of the rather broad filaments, up to 77 μm in the fertile parts, which are twisted. In addition, the cells are very short, 1/3–1/4 of the diameter, often with more than one pyrenoid in the chloroplast, at least at a later stage of development.

Codiolaceae.
Urospora wormskioldii (MERTENS) ROSENVINGE

This species, one of the earliest algae described from Greenland in Flora Danica based upon the collections of WORMSKIOLD, was found in rather limited quantities. Plants were found at a depth of 1 m growing epilithically and epizoically (on *Microporina*), and also in a dredging from rock exposed to strong current at depths of 4–10 m.

The filaments from the upper sublittoral zone have diameters of 175–500 μm in the fertile parts, while the two plants collected at greater depth have extremely broad cells, 920 μm in the apical part, 335 μm just above the elongated basal cell. This is considerably broader than the maximum width hitherto reported, 400–500 μm by EDELSTEIN & MCLACHLAN (1966). However, there is no doubt about the generic identity, as one plant is fertile with the characteristic zoospores, some of which have been found to germinate on the mother plant (pl. 7, fig. g).

I have re-investigated the type material of *Urospora mirabilis* var. *elongata* ROSENVINGE (1893). I agree with KORNMANN (1961a), that this variety represents a developmental stage of *U. wormskioldii.*

Urospora penicilliformis (ROTH) ARESCHOUG
Urospora mirabilis ARESCHOUG; ROSENVINGE 1893 & 1898, JÓNSSON 1904.

This species was extremely frequent along shores exposed to waves and drifting ice in the littoral and upper sublittoral zones. It was growing together with various other annual Chlorophyceae, *Ulothrix pseudoflacca*, *U. speciosa*, *Blidingia minima*, *Monostroma groenlandicum*, and *Rosenvingiella polyrhiza.* It was also observed in a polychaete tube from a depth of 60 m and as the dominating fouling alga on the zinc plates of the cutter.

Most often the fertile cells are doliiform, but some are also longer than broad (pl. 7, fig. h), and the zoospores may germinate *in situ* (pl. 7, fig. i).

Acrosiphoniaceae.

The North Atlantic species of the genus *Acrosiphonia* require a monographic treatment. Consequently I have preferred only to refer the material of this genus provisionally to *Acrosiphonia sonderi* (KÜTZING) KORNMANN and to *A. arcta* (DILLW.) J. AG.

Chaetophoraceae.

Bolbocoleon piliferum N. PRINGSHEIM

This species was found only outside the main area of investigation, partly covering *Sorapion kjellmanii* and *Ralfsia clavata* from a barnacle in a tide pool near Nanortalik.

The plants are well-developed with sporangia and hairs.

Entocladia viridis REINKE

This species is reported from Greenland by PEDERSEN (1973). ROSENVINGE (1893) reported *Entoderma wittrockii* (WILLE) LAGERHEIM in *Polysiphonia* from the fiord, Ameralik, West Greenland. In a footnote he suggested that *E. wittrockii* and *E. viridis* might be conspecific. *E. wittrockii* has recently been transferred to the genus *Phaeophila* by NIELSEN (1972), while to date no hairs have been observed in *E. viridis*.

I have re-investigated the material studied by ROSENVINGE (collected by J. VAHL, July, 1831, and deposited at the Botanisk Museum, Copenhagen). There are two permanent slides with fragments of *Polysiphonia.* In the walls of this species I have observed only some pseudoparenchymatous discs, which could be a brown alga, possibly *Microsyphar.*

Eugomontia sacculata KORNMANN

This species was found together with various shell-boring algae *Gomontia polyrhiza*, *Ostreobium quekettii*, and *Conchocelis*-stages in mussel shells and in the calcified parts of *Balanus* from the upper sublittoral zone down to 50 m. The plants have the characteristic broad cross walls, and some have formed the typical saccate sporangia.

Epicladia flustrae Reinke

This species was found rather frequently on *Microporina*, often giving it a more or less green colour. In addition, some plants resembling this species were found on various red algae. The vertical extent ranged from 2 to 40 m.

The central parenchymatous cells are somewhat irregular and nearly isodiametric, 6,0–9,0 μm in diameter. Several of these cells are empty, apparently having released swarmers. In the marginal, free filaments, the cells are longer than broad.

Pseudendoclonium submarinum Wille

There is nothing to add to the previous report by Pedersen (1973).

Pseudopringsheimia fucicola (Rosenvinge) Wille
Ulvella fucicola Rosenvinge 1893 & 1898, Jónsson 1904.

Three plants of *Fucus*, one from a tide pool, one from the littoral zone and one from the upper sublittoral zone, were examined for this species. It was found in all cases and is probably common in the area.

Pringsheimiella scutata (Reinke) Marchewianka
Pringsheimia scutata Reinke; Rosenvinge 1893 & 1898, Jónsson 1904.

This species is a very common epiphyte in tide pools as well as in the littoral and upper sublittoral zones, growing on *Halosaccion ramentaceum*, *Rhodophyllis dichotoma*, *Rhodochorton purpureum*, *Rhodomela lycopodioides*, *Phycodrys rubens*, *Ptilota serrata*, *Membranoptera denticulata*, *Sphacelaria arctica*, *S. plumosa*, *Isthmoplea sphaerophora*, *Chaetomorpha melagonium* and *Acrosiphonia sonderi*. In addition, it has been found on barnacles and bryozoans. Initially the plants form flat discs, but later the central cells enlarge to the characteristic club-shape and are gradually transformed into sporangia. The swarmers from these sporangia are quadriflagellate as observed in culture material. The culture studies carried out by R. Nielsen and me suggest that pl. 25 in Reinke (1889b) includes two species.

Arthrochaete penetrans Rosenvinge
Arthrochaete phaeophila Rosenvinge 1910.

A repeated examination of the plants previously referred to this species (Pedersen, 1973) has left me with some uncertainty as to the correctness of my determination.

Siphonocladales

Cladophoraceae.

Chaetomorpha melagonium (WEB. & MOHR) KÜTZING

This species is common in the area on rocks (also in rock crevices) in the upper sublittoral zone. It was also found in three dredgings at depths of 10 m, 10–16 m, and 30–40 m, respectively, the first dredging bringing up *Chaetomorpha*, *Agarum cribrosum* and also loose-lying *Desmarestia* from a fiord with heavy silt sedimentation. In the East Greenland material studied by LUND (1959), the diameter of the filaments varied between 100 and 1000 μm. I have found the same variation in plants from the Kap Farvel area. Filaments from the upper sublittoral zone are generally broad, with only a few plants measuring 110–385 μm in diameter. Plants from greater depths are shorter (except loose-lying plants) and narrower with diameters of 45–250 μm. It should be noted that the latter range of variation was found in plants growing together.

Chaetomorpha capillaris (KÜTZING) BØRGESEN

Chaetomorpha tortuosa (DILLW.) KLEEN; ROSENVINGE 1893 & 1898, JÓNSSON 1904.

Chaetomorpha melagonium (WEB. & MOHR) KÜTZING pro parte; LUND 1959.

This species was observed in tide pools and in the upper sublittoral zone entangled with other algae. The filaments are 45–67 μm wide and the cells are 2–5 times as long. The material is sterile.

Rhizoclonium riparium (ROTH) HARVEY

The material of this species comprises two rather distinct entities previously referred to as var. *implexum* (DILLW.) ROSENVINGE and var. *validum* FOSLIE by ROSENVINGE (1893). According to NIENHUIS (1975) the morphology of this species is highly variable, and the morphological variation is not genotypically determined; hence, separation of varieties is not justified. Plants with filaments about 20 μm wide and with cells 1–2,5 times as long were found on the bottom of a shallow bay near Nanortalik, together with *Percursaria percursa* and *Vaucheria subsimplex.* They were also found on soil exposed to water only at HWS, together with various blue-green algae and a sterile specimen of *Vaucheria.* Plants with filaments about 35 μm wide, thicker cell walls, and shorter cells, 1–1,5 times the diameter were found on rocks and in rock crevices together with e.g., *Rosenvingiella polyrhiza* and *Bangia fuscopurpurea.* The material examined is sterile.

References

ALLART, J. H., D. BRIDGWATER & N. HENRIKSEN. 1969: Prequaternary geology of Southwest Greenland and its bearing on North Atlantic bearing problems. North Atlantic – geology and continental drift, *Memoir* **12**, 859–882.

ARMSTRONG, T., B. ROBERTS & C. SWITHINBANK. 1966: *Illustrated glossary of snow and ice.* Scott Polar Research Institute. Special Publications **4**, Cambridge.

BLIDING, C. 1968: A critical survey of European taxa in Ulvales, II *Ulva, Ulvaria, Monostroma, Kornmannia. Bot. Notiser* **121**, 535–629.

BRAVO, L. M. 1965: Studies on the life history of *Prasiola meridionalis. Phycologia* **4**, 177–194.

BØRGESEN, F. 1902: The marine algæ of the Færöes. *Botany Færöes* **2**, 339–532.

CARAM, B. 1955: Sur l'alternance de générations chez *Chordaria flagelliformis. Bot. Tidsskr.* **52**, 16–36.

CARAM, B. & S. JÓNSSON. 1972: Nouvel inventaire des algues marines de l'Islande. *Acta Bot. Isl.* **1**, 5–31.

CARDINAL, A. 1964: Études sur les Ectocarpacées de la Manche. *Beih. Nova Hedwigia* **15**, 1–86.

CHAPMAN, A. R. O. 1975: Inheritance of mucilage canals in *Laminaria* (section Simplices) in Eastern Canada. *Br. phycol. J.* **10**, 219–223.

CHEN, L. C.-M., T. EDELSTEIN, E. OGATA & J. MCLACHLAN. 1970: The life history of *Porphyra miniata. Can. J. Bot.* **48**, 385–389.

CHEN, L. C.-M., J. MCLACHLAN & J. S. CRAIGIE. 1974: The fine structure of the marine chrysophycean alga *Phaeosaccion collinsii. Can. J. Bot.* **52**, 1621–1624.

CHRISTENSEN, T. 1966: Alger. Pp. 1–180 *in* T. W. BÖCHER, M. Lange & T. SØRENSEN: *Systematisk Botanik* **2**, 2. Munksgaard, København.

— 1971: Havbundens planter. Pp. 184–192 *in* A. NØRREVANG, T. J. MEYER & S. CHRISTENSEN (Ed.): *Danmarks Natur* **10**, Grønland og Færøerne. Politikens Forlag, København.

— 1975: Some marine algae from West Greenland. *Bot. Tidsskr.* **70**, 143–146.

CRAIGIE, J. S., C. LEIGH, L. C.-M. CHEN & J. MCLACHLAN. 1971: Pigments, polysaccharides and photosynthetic products of *Phaeosaccion collinsii. Can. J. Bot.* **49**, 1067–1074.

CROUAN, P. L. & H. M. CROUAN. 1867: *Florule du Finistère.* F. Klincksieck, Paris.

DANGEARD, P. 1966: Sur la presence d'un pléthysmothalle chez le *Leptonematella fasciculatum* (REINKE) SILVA. *C. r. hebd. Séanc. Acad. Sci., Paris,* Sér. D **263**, 1692–1694.

DIXON, P. S. & H. M. PARKES. 1968: Miscellaneous notes on algal taxonomy and nomenclature, II. *Bot. Notiser* **121**, 80–88.

EDELSTEIN, T. & J. MCLACHLAN. 1966: Investigations of the marine algae of Nova Scotia I. Winter flora of the Atlantic Coast. *Can. J. Bot.* **44**, 1035–1055.

EDELSTEIN, T., J. MCLACHLAN & J. S. CRAIGIE. 1967a: Investigations of the marine algae of Nova Scotia II. Species of Rhodophyceae new or rare to Nova Scotia. *Can. J. Bot.* **45**, 193–202.

EDELSTEIN, T. & J. MCLACHLAN. 1967b: Investigations of the marine algae of Nova

Scotia III. Species of Phaeophyceae new or rare to Nova Scotia. *Can. J. Bot.* **45**, 203–210.

EDELSTEIN, T., L. C.-M. CHEN & J. McLACHLAN. 1968: Sporangia of *Ralfsia fungiformis* (GUNN.) SETCHELL et GARDNER. *J. Phycol.* **4**, 157–160.

EDELSTEIN, T. & J. McLACHLAN. 1968: Investigations of the marine algae of Nova Scotia. V. Additional species new or rare to Nova Scotia. *Can. J. Bot.* **46**, 993–1002.

EDELSTEIN, T., L. C.-M. CHEN & J. McLACHLAN. 1971: On the life histories of some brown algae from eastern Canada. *Can. J. Bot.* **49**, 1247–1251.

EDELSTEIN, T. 1972: *Halosacciocolax lundii*, sp. nov., a new red alga parasitic on *Rhodymenia palmata* (L.) GREV. *Br. phycol. J.* **7**, 249–253.

FAN, K.-C. 1959: Studies in the life histories of marine algae I. *Codiolum petrocelidis* and *Spongomorpha coalita*. *Bull. Torrey bot. Club* **86**, 1–12.

FRÉMY, P. 1934: Les Cyanophycées des côtes d'Europe. *Mém. Soc. natn. Sci. nat. math. Cherbourg* **41**, 1–234.

GRAN, H. H. 1897: Kristianafjordens algeflora I. Rhodophyceæ og Phæophyceæ. *Skr. VidenskSelsk. Christiania* Mat.-naturv. Kl. 1896(2), 1–56.

GUIRY, M. D. 1974a: The occurrence of the red algal parasite *Halosacciocolax lundii* EDELSTEIN in Britain. *Br. phycol. J.* **9**, 31–35.

— 1974b: A preliminary consideration of the taxonomic position of *Palmaria palmata* (LINNAEUS) Stackhouse = *Rhodymenia palmata* (LINNAEUS) GREVILLE. *J. mar. biol. Ass. U.K.* **54**, 509–528.

HAMEL, G. 1935: *Phéophycées de France* II. Paris.

— 1939: Sur la classification des Ectocarpales. *Bot. Notiser* 1939, 65–70.

HOLLENBERG, G. J. 1972: Phycological notes. VII. Concerning three Pacific Coast species, especially *Porphyra miniata* (C. AG.) C. AG. (Rhodophyceae, Bangiales). *Phycologia* **11**, 43–46.

Isforholdene i de Grønlandske Farvande **1963** (*The ice-conditions in the Greenland waters*). *Met. Aarb.* 1970, 1–24, 50 maps.

JAASUND, E. 1951: Marine algae from northern Norway I. *Bot. Notiser* 1951, 128–142.

— 1960a: *Elachista lubrica* Ruprecht and *Elachista fucicola* (VELLEY) ARESCHOUG. *Botanica mar.* **1**, 101–107.

— 1960b: *Fosliea curta* (FOSL.) REINKE and *Isthmoplea sphaerophora* (CARM.) KJELLM. *Botanica mar.* **2**, 175–182.

— 1963: Beiträge zur Systematik der norwegischen Braunalgen. *Botanica mar.* **5**, 1–8.

— 1965: Aspects of the marine algal vegetation of North Norway. *Bot. Gothoburg.* **4**, 1–174.

JÓNSSON, H. 1901: The marine algæ of Iceland. I. Rhodophyceæ. *Bot. Tidsskr.* **24**, 127–155.

— 1904: The marine algæ of East Greenland. *Meddr Grønland* **30**, 1–73.

JÓNSSON, S. 1967: Sur l'existance de générations mictohaploïdes issues de faux zygotes codioloïdes chez l'*Acrosiphonia sonderi* (KÜTZ.) KORNM. *C. r. hebd. Séanc. Acad. Sci., Paris*, Sér. D **264**, 1009–1012.

KJELLMAN, F. R. 1875: Om Spetsbergens marina, klorofyllförande thallophyter. *Bih. K. svenska Vetensk Akad. Handl.* **3** (7), 1–34.

— 1883: The algæ of the Arctic Sea. *K. svenska Vetensk Akad. Handl.* **20**(5), 1–350.

KNAGGS, F. W. 1968: *Rhodochorton purpureum* (LIGHTF.) ROSENVINGE. The morphology of the gametophytes and of the young carposporophyte. *Nova Hedwigia* **16**, 449–457.

KNOEPFFLER-PÉGUY, M. 1970: Quelques *Feldmannia* HAMEL, 1939 (Phaeophyceae-Ectocarpales) des côtes d'Europe. *Vie Milieu*, Sér. A **21**, 137–188.

KORNMANN, P. 1954: *Giffordia fuscata* (ZAN.) KUCK. nov. comb., eine Ectocarpacee mit heteromorphen, homophasischen Generationen. *Helgoländer wiss. Meeresunters.* **5**, 41–52.

— 1961a: Über *Codiolum* und *Urospora*. *Helgoländer wiss. Meeresunters.* **8**, 42–57.

— 1961b: Vorbemerkung des Herausgebers. P. 119 *in* P. KUCKUCK †: *Ectocarpaceen-Studien* VII *Giffordia. Helgoländer wiss. Meeresunters.* **8**, 119–152.

— 1962a: Die Entwicklung von *Chordaria flagelliformis*. *Helgoländer wiss. Meeresunters.* **8**, 276–279.

— 1962b: Plurilokuläre Sporangien bei *Elachista fucicola*. *Helgoländer wiss. Meeresunters.* **8**, 293–297.

— 1964a: Die *Ulothrix*-Arten von Helgoland. *Helgoländer wiss. Meeresunters.* **11**, 27–38.

— 1964b: Zur Biologie von *Spongomorpha aeruginosa* (LINNAEUS) VAN DEN HOEK. *Helgoländer wiss. Meeresunters.* **11**, 200–208.

KUCKUCK, P. † 1954: Ectocarpaceen-Studien II *Streblonema*. *Helgoländer wiss. Meeresunters.* **5**, 103–117.

KYLIN, H. 1944: Die Rhodophyceen der schwedischen Westküste. *Acta Univ. lund.* **40**(2), 1–104.

— 1947: Die Phaeophyceen der schwedischen Westküste. *Acta Univ. lund.* **43**(4), 1–99.

— 1956: *Die Gattungen der Rhodophyceen.* C. W. K. Gleerup, Lund.

LE JOLIS, A. 1863: *Liste des algues marines de Cherbourg.* J. B. Baillière, Paris.

LEVRING, T. 1937: Zur Kenntnis der Algenflora der norwegischen Westküste. *Acta Univ. lund.* **33**(8), 1–148.

— 1940: *Studien uber die Algenvegetation von Blekinge, Südschweden.* Ph. Lindstedt, Lund.

LOEBLISH, A. R., III. 1967: Notes on the divisions Chlorophyta, Chrysophyta, Pyrrophyta, and Xanthophyta and the family Paramastigaceae. *Taxon* **16**, 230–237.

LUND, S. 1951: Marine algae from Jörgen Brönlunds Fjord in eastern North Greenland. *Meddr Grønland* **128**(4), 1–26.

— 1959: The marine algae of East Greenland I. Taxonomical part. *Meddr Grønland* **156**, 1–247.

MATHIESON, A. C. 1967: Morphology and life history of *Phaeostrophion irregulare* S. et G. *Nova Hedwigia* **13**, 293–318.

McLACHLAN, J., L. C.-M. CHEN & T. EDELSTEIN. 1971: Observations on *Phaeosaccion collinsii* in culture. *Can. J. Bot.* **49**, 563–566.

NEWROTH, P. R. 1971: Studies in life histories in Phyllophoraceae. I. *Phyllophora truncata* (Rhodophyceae, Gigartinales). *Phycologia* **10**, 345–354.

NIELSEN, R. 1972: A study of the shell-boring marine algae around the Danish island Læsø. *Bot. Tidsskr.* **67**, 245–269.

NIENHUIS, P. H. 1975: *Biosystematics and ecology of Rhizoclonium riparium (Roth) Harvey (Chlorophyceae, Cladophorales) in the estuarine area of the rivers Rhine, Meuse and Scheldt.* Bronder offset B. V., Rotterdam.

NÄGELI, C. 1861: Morphologie und Systematik der Ceramiaceae. *Sber. bayer. Akad. Wiss.* 1861, 297–416.

PAPENFUSS, G. F. 1945: Review of the *Acrochaetium-Rhodochorton* complex of the red algae. *Univ. Calif. Publs Bot.* **18**, 299–334.

— 1951: Phaeophyta. Pp. 119–158 *in* G. M. SMITH: *Manuel of Phycology.* Chronica Botanica, Waltham.

PARKE, M. & P. S. DIXON. 1968: Check-list of British marine algae – second revison. *J. mar. biol. Ass. U.K.* **48**, 783–832.

PEDERSEN, P. M. 1973: Preliminary note on some marine algae from South Greenland. *Bot. Tidsskr.* **68**, 145–149.

— 1974: On the systematic position of *Delamarea attenuata* (Phaeophyceae). *Br. phycol. J.* **9**, 313–318.

— 1975: Culture studies on marine algae from West Greenland I. Chromosomal information relating to the life history of *Isthmoplea sphaerophora* (Phaeophyceae, Dictyosiphonales). *Br. phycol. J.* **10**, 165–168.

REINKE, J. 1889a: Ein fragment aus der Naturgeschichte der Tilopteriden. *Bot. Ztg* **47**, 101–118, 125–140, 155–158.

— 1889b: *Atlas deutscher Meeresalgen* I. P. Parey, Berlin.

ROSENVINGE, L. K. 1893: Grønlands havalger. *Meddr Grønland* **3**, 765–981.

— 1894: Les algues marines du Groenland. *Annls Sci. nat. ser.* 7, **19**, 53–164.

— 1898: Deuxième mémoire sur les algues marines du Groenland. *Meddr Grønland* **20**, 1–125.

— 1909: The marine algæ of Denmark I. Introduction. Rhodophyceæ I. *K. danske Vidensk. Selsk. Skr.* **7**, 1–150.

— 1910: On the marine algæ from North-East Greenland collected by the "Danmark-Expedition". *Meddr Grønland* **43**, 91–133.

— 1923–24: The marine algæ of Denmark III. Rhodophyceæ. III. *K. danske Vidensk. Selsk. Skr.* **7**, 287–486.

— 1931: The marine algæ of Denmark IV. Rhodophyceæ IV. *K. danske Vidensk. Selsk. Skr.* **7**, 492–627.

— 1935: On some Danish Phæophyceæ. *K. danske Vidensk. Selsk. Skr.* **4**(3), 1–40.

ROSENVINGE, L. K. & S. LUND. 1941: The marine algæ of Denmark II. Phæophyceæ. I. Ectocarpaceæ and Acinetosporaceæ. *Biol. Skr.* **1**(4), 1–79.

RUENESS, J. 1974: Life history in culture and chromosome number in *Isthmoplea sphaerophora* (Phaeophyceae) from southern Scandinavia. *Phycologia* **13**, 323–328.

RUSSEL, G. 1964: *Laminariocolax tomentosoides* on the Isle of Man. *J. mar. biol. Ass. U.K.* **44**, 601–612.

SETCHELL, W. A. & N. L. GARDNER. 1922: Phycological contributions V. New species of *Pylaiella* and *Streblonema. Univ. Calif. Publs Bot.* **7**, 385–396.

SETCHELL, W. A. & N. L. GARDNER. 1925: The marine algae of the Pacific coast of North America III. Melanophyceae. *Univ. Calif. Publs Bot.* **8**, 383–898.

SOMMERFELD, M. R. & H. W. NICHOLS. 1973: The life cycle of *Bangia fuscopurpurea* in culture. I. Effects of temperature and photoperiod on the morphology and reproduction of the *Bangia* phase. *J. Phycol.* **9**, 205–211.

SOUTH, G. R., R. G. HOOPER & L. M. IRVINE. 1972: The life history of *Turnerella pennyi* (Harv.) Schmitz. *Br. phycol. J.* **7**, 221–233.

SUNDENE, O. 1962: Reproduction and morphology in strains of *Antithamnion boreale* originating from Spitsbergen and Scandinavia. *Skr. norske Vidensk-Akad.* Mat.-naturv. Kl. **5**, 1–19.

— 1966: *Haplospora globosa* KJELLM. and *Scaphospora arctica* KJELLM. in culture. *Nature, Lond.* **209**, 937–938.

TAYLOR, W. R. 1957: *Marine algae of the Northeastern Coast of North America.* The University of Michigan Press, Ann Arbor.

VALEUR, H. H. 1973: Storisvariationer ved Grønlands vestkyst 1900–1972. (Polar ice variations of the Greenland Westcoast). Danish Meteorol. Inst., Charlottenlund. (Paper presented at the International Glaciological Society, 1973).

WEST, J. A. 1968: The morphology and reproduction of the red alga, *Acrochaetium pectinatum. J. Phycol.* **4**, 89–99.

— 1969: The life histories of *Rhodochorton purpureum* and *R. tenue* in culture. *J. Phycol.* **5**, 12–21.

West, J. A. 1970: The life history of *Rhodochorton concrescens* in culture. *Br. phycol. J.* **5**, 179–186.

— (in press): The life history of *Rhodochorton membranaceum*, an endozoic red alga. *Proc. Intl Seaweed Symp.* **8**.

Wilce, R. T. 1959: The marine algae of the Labrador Peninsula and Northwest Newfoundland (ecology and distribution). *Bull. natn. Mus. Can.* **158**, 1–103.

— 1960: Studies in the genus *Laminaria* II. *Laminaria groenlandica* L. K. Rosenv. *Bot. Notiser* **113**, 203–209.

— 1962–63: A new member of the Punctariaceae: *Platysiphon verticillatus*, gen. nov., sp. nov. *Bot. Tidsskr.* **58**, 35–42.

— 1964: Studies in the genus *Laminaria* III. A revision of the North Atlantic species of the Simplices section of *Laminaria*. *Bot. Gothoburg.* **3**, 247–256.

— 1969: *Papenfussiella callitricha:* New observations on a little-known brown alga from Southwest Greenland. *J. Phycol.* **5**, 173–180.

Wilce, R. T., E. E. Webber & J. R. Sears. 1970: *Petroderma* and *Porterinema* in the New World. *Mar. Biol.* **5**, 119–135.

Wille, N. 1901: Studien über Chlorophyceen I-VII. *Skr. VidenskSelsk. Christiania* Mat.-naturv. Kl. **6**, 1–46.

Woelkerling, W. J. 1971: Morphology and taxonomy of the *Audouinella* complex (Rhodophyta) in Southern Australia. *Aust. J. Bot.*, Suppl. Ser. Suppl. **1**, 1–91.

— 1972: Studies on the *Audouinella microscopica* (Naeg.) Woelk. complex (Rhodophyta). *Rhodora* **74**, 85–96.

— 1973a: The *Audouinella* complex (Rhodophyta) in the Wester Sargasso Sea. *Rhodora* **75**, 78–101.

— 1973b: The morphology and systematics of the *Audouinella* complex (Acrochaetiaceae, Rhodophyta) in Northeastern United States. *Rhodora* **75**, 529–621.

Wynne, M. J. 1969: Life history and systematic studies of some Pacific North American Phaeophyceae (brown algae). *Univ. Calif. Publs Bot.* **50**, 1–62.

— 1972: Culture studies of Pacific coast Phaeophyceae. *Bull. Soc. bot. Fr.* 1972, 129–144.

Wærn, M. 1952: Rocky-shore algae in the Öregrund archipelago. *Acta phytogeogr. suec.* **30**, 1–298.

Zinova, A. D. 1954: Novye semejstvo, rod i vid u burych vodoroslej. *Trudy̆ bot. Inst. Akad. Nauk SSSR*, **9**, 223–244.

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Species index

APPENDIX

Check-list and distribution of the marine algae of Greenland

This list includes 201 species, which with our present knowledge belong in the marine algal flora of Greenland. Of these 13 belong in the Cyanophyceae, 1 in the Dinophyceae, 1 in the Chrysophyceae, 3 Xanthophyceae, 48 Rhodophyceae, 80 Phaeophyceae, and 55 Chlorophyceae. The list summarizes the known distribution of the species and includes earlier papers as well as two in press. *Protectocarpus speciosus* (Børg.) Kuck. is reported from Greenland for the first time, being recently found in cultures from the Godthåbsfjord, West Greenland.

Abbreviations used: n.r. – not recorded
r.n. – redetermination necessary
d.d. – determination doubtful
w.s.l. – without statement of latitude

Explanation to statements of latitudes: 60°N–70°N, several stations between these latitudes; $70^{1}/_{2}$°N, $74^{1}/_{2}$°N, only known from these two latitudes, which in this case are stated more precisely; first column, distribution in West Greenland; second column, distribution in East Greenland; lack of records between 60°N and 65°N often reflecting lack of information rather than absence of the species in question. Species or genera followed by a question-mark are further commented on in a footnote.

Cyanophyceae

Chroococcales		
Aphanothece		
sp.	60°N	n.r.
Gloeocapsa		
crepidinum Born. & Thur.	60°N, 64°N	n.r.
Pleurocapsales		
Pleurocapsa		
amethystea Rosenv.	60°N–63°N	66°N
Sarcinastrum		
urosporae Lagerh.	60°N	n.r.
Nostocales		
Calothrix		
scopulorum Born. & Flah.	60°N–73°N	$70^{1}/_{2}$°N
Hydrocoleum		
lyngbyaceum Gom.	60°N	n.r.
Lyngbya		
infixa Frémy	60°N	n.r.

Nostoc		
minutum Born. & Flah.	60°N	n.r.
Oscillatoria		
amphibia (Gom.)Gom.	61°N	66°N
tenuis (Gom.)Gom.	60°N	n.r.
Plectonema		
battersii Gom.	60°N, 64°N	n.r.
Rivularia		
atra Born. & Flah.	60°N–69°N	n.r.
Spirulina		
subsalsa Gom.	60°N–61°N	n.r.

Dinophyceae

Dinococcales		
Rufusiella		
(Urococcus)		
foslieana (Hansgirg) Christensen	60°N, 64°N	n.r.

Chrysophyceae

Phaeothamniales		
Phaeosaccion		
collinsii Farlow	60°N–69°N	n.r.

Xanthophyceae

Vaucheriales		
Vaucheria		
coronata Nordst.	60°N–61°N	n.r.
intermedia Nordst.	60°N–61°N	n.r.
subsimplex Crouan frat. (sphaerospora)	60°N–61°N	n.r.

Rhodophyceae

Bangiales		
Bangia		
fuscopurpurea (Dillw.) Lyngb.	60°N–67°N	n.r.
Porphyra		
miniata (C. Ag.) C. Ag.	60°N–77°N	60°N–61°N, 65$^{3}/_{4}$°N
umbilicalis (L.) J. Ag.	61°N–67°N	n.r.
Nemaliales		
Audouinella		
(Chantransia, Rhodochorton)		
efflorescens (J. Ag.) Papenf.	60°N, 78$^{1}/_{2}$°N	66°N–82°N
membranacea (Magn.) Papenf.	60°N–66°N	66°N–73°N
Chromastrum		
(Acrochaetium, Chantransia)		
hallandicum (Kylin) Papenf.	n.r.	71°N
microscopicum (Näg.) Papenf. (incl. collopodum)	60°N, 68$^{3}/_{4}$°N, 72$^{3}/_{4}$°N	65$^{1}/_{2}$°N, 70$^{1}/_{2}$°N
secundatum (Lyngb.) Papenf. (incl. virgatulum)	60°N–64°N	n.r.

Rhodochorton		
purpureum (Lightf.) Rosenv.	60°N–77°N	65°N–77°N
(rothii)		
spetsbergense (Kjellm.) Kjellm.	60°N–77°N	65°N–77°N
(incl. penicilliforme)		
Cryptonemiales		
Callocolax		
(Choreocolax?, sic)		
neglectus Schmitz	60°N	$76^{1}/_{2}$°N
Callophyllis		
(Euthora)		
cristata (C. Ag.) Kütz.	60°N–73°N	65°N–71°N
Callymenia		
schmitzii De Toni	73°N	n.r.
(sanguinea)		
Clathromorphum		
(Lithothamnion)		
compactum (Kjellm.) Foslie	60°N–77°N	65°N–77°N
Corallina		
officinalis L.	$64^{1}/_{2}$°N	n.r.
Dilsea		
integra (Kjellm.) Rosenv.	$76^{1}/_{2}$°N	70°N–74°N
Halosacciocolax		
kjellmanii S. Lund	60°N	70°N
Harveyella		
mirabilis (Reinsch) Reinke	60°N, $68^{3}/_{4}$°N, $72^{3}/_{4}$°N	70°N–74°N
Hildenbrandia		
prototypus Nardo	60°N–77°N	66°N, 70°N–71°N
Leptophytum		
(Lithothamnion)		
foecundum (Kjellm.) Adey	$72^{1}/_{2}$°N, $72^{3}/_{4}$°N	68°N–77°N
laeve (Strömf.) Adey	60°N–73°N	66°N–77°N
(tenue)		
Lithothamnion		
glaciale Kjellm.	60°N–73°N	70°N–77°N
(varians, intermedium)		
investiens Foslie	n.r.	$70^{1}/_{2}$°N
tophiforme Unger	61°N–73°N	70°N–77°N
Peyssonellia		
rosenvingii Schmitz	64°N–73°N	70°N–73°N
Rhodophysema		
(Rhododermis)		
elegans (J. Ag.) Dixon	60°N, 64°N–67°N	70°N–77°N
Gigartinales		
Ahnfeltia		
plicata (Huds.) Fries	n.r.	$70^{3}/_{4}$°N
Ceratocolax		
hartzii Rosenv.	$60^{3}/_{4}$°N	65°N–82°N

Cruoriopsis		
hyperborea Rosenv.	n.r.	$76^{1}/_{2}$°N
Petrocelis		
polygyna (Kjellm.) Schmitz	n.r.	66°N–77°N
Phyllophora		
truncata (Pallas) Zinova	60°N–77°N	65°N–82°N
(brodiaei)		
Rhodophyllis		
dichotoma (Lepech.) Gobi	60°N–77°N	65°N–68°N
Turnerella		
pennyi (Harv.) Schmitz	60°N–77°N	65°N–77°N
(incl. septemtrionalis and Cruoria arctica)		
Rhodymeniales		
Halosaccion		
ramentaceum (L.) J. Ag.	60°N–77°N	60°N–77°N
Palmaria		
(Rhodymenia)		
palmata (L.) Stackh.	60°N–78°N	65°N–66°N
Ceramiales		
Antithamnion		
boreale (Gobi) Kjellm.	60°N, 65°N–79°N	65°N–77°N
floccosum (O. F. Müll.) Kleen?	$60^{1}/_{2}$°N	n.r.
pylaisaei (Mont.) Kjellm.?	61°N	n.r.
Ceramium		
rubrum (Huds.) J. Ag.	64°N–69°N	n.r.
Membranoptera		
(Delesseria)		
denticulata (Mont.) Kylin	60°N–69°N	n.r.
(montagnei)		
Pantoneura		
(Delesseria)		
baerii (Post. & Rupr.) Kylin	60°N–77°N	60°N–75°N
Phycodrys		
(Delesseria)		
rubens (L.) Batt.	60°N–77°N	65°N–77°N
(sinuosa)		
Polysiphonia		
arctica J. Ag.	60°N–77°N	60°N–82°N
nigrescens (Huds.) Grev.	$69^{1}/_{2}$°N	n.r.
schübeleri Foslie	64°N, 69°N	n.r.
urceolata (Dillw.) Grev.	61°N–73°N	68°N

? *Antithamnion floccosum* and *Antithamnion pylaisaei*. These species are very doubtful for the flora of Greenland. *A. floccosum* is reported by Agardh (1863, p. 29: Species genera et ordines algarum) on the basis of a collection by J. Vahl near Julianehåb in 1830. Most of Vahl's material is at the Botanical Museum, Copenhagen. Rosenvinge (1893) has referred it to *A. plumula* var. *pylaisaei*. I have studied it myself, and am rather convinced that it belongs to the *A. boreale* complex.

Ptilota		
serrata Kütz.	60°N–78°N	65°N–75°N
(pectinata)		
Rhodomela		
lycopodioides (L.) C. Ag.	60°N–77°N	60°N–82°N

Phaeophyceae

Ectocarpales		
Chordaria		
flagelliformis (O. F. Müll.) C. Ag.	60°N–78°N	60°N–73°N
Dermatocelis		
laminariae Rosenv.	60°N	$70^{1}/_{2}$°N
Ectocarpus		
fasciculatus Harv.	67°N	$65^{3}/_{4}$°N d.d.
(pycnocarpus)		
helephorus Rosenv.	n.r.	66°N, 70°N–73°N
siliculosus (Dillw.) Lyngb.	60°N–73°N	65°N–73°N
(confervoides, penicillatus)		
Elachista		
fucicola (Vell.) Aresch.	60°N–77°N	65°N–82°N
(incl. lubrica)		
Eudesme		
(Castagnea)		
virescens (Harv.) J. Ag.	60°N, 64°N–73°N	$70^{1}/_{2}$°N
Giffordia		
(Ectocarpus)		
intermedia (Rosenv.) S. Lund	n.r.	73°N
ovata (Kjellm.) Kylin	60°N–66°N	65°N–82°N
(holmii)		
Herponema		
(Ectocarpus, Feldmannia)		
desmarestiae (Gran) Cardinal	60°N	$70^{1}/_{2}$°N, 73°N
Jonssonia		
pulvinata S. Lund	n.r.	$70^{1}/_{2}$°N
Laminariocolax		
(Ectocarpus)		
tomentosoides (Farlow) Kylin	60°N–70°N	71°N, 73°N
Leptonematella		
(Leptonema)		
fasciculata (Reinke) Silva	60°N–73°N	65°N–82°N
Microsyphar		
polysiphoniae Kuck.	60°N, $61^{1}/_{4}$°N	n.r.
Myriactula		
clandestina (Crouan frat.) J. Feldmann	60°N	n.r.
Myrionema		
(Ectocarpus, Entonema)		
aecidioides (Rosenv.) Sauv.	60°N–67°N	70°N–73°N
Papenfussiella		
(Myriocladia)		
callitricha (Rosenv.) Kylin	60°N, 64°N–69°N	n.r.

Petroderma		
maculiforme (Wollny) Kuck.	60°N–77°N	n.r.
Pleurocladia		
(Ectocarpus, Kolderupia, Pilinia)		
lacustris	62°N–77°N	$76^{1}/_{2}$°N
(maritima)		
Pseudolithoderma		
(Lithoderma)		
extensum (Crouan frat.) S. Lund	n.r.	70°N–73°N, $76^{1}/_{2}$°N
(fatiscens)		
rosenvingii (Wærn) S. Lund	n.r.	69°N–75°N
Sorapion		
(Lithoderma)		
kjellmanii (Wille) Rosenv.	60°N–71°N	66°N–77°N
Sorocarpus		
micromorus (Bory) Silva	n.r.	73°N
(uvaeformis)		
Streblonema		
(Ectocarpus)		
chordariae (Wollny) Cotton	62°N	n.r.
fasciculatum Thur.	60°N, 62°N	n.r.
(pringsheimii)		
stilophorae (Crouan frat.) Hamel	62°N–69°N	n.r.
Symphyocarpus		
longisetus S. Lund	n.r.	73°N
strangulans Rosenv.	60°N, $69^{1}/_{4}$°N	70°N–73°N, $76^{1}/_{2}$°N
Waerniella		
lucifuga (Kuck.) Kylin	64°N	n.r.
(possibly identical with Pleurocladia lacustris)		
Dictyosiphonales		
Acrocytis		
groenlandica Rosenv.?	n.r.	68°N
Coelocladia		
arctica Rosenv.	64°N, 70°N	n.r.
Coilodesme		
bulligera Strömf.	60°N–66°N	60°N
Delamarea		
attenuata (Kjellm.) Rosenv.	60°N–77°N	60°N, $70^{1}/_{2}$°N
Dictyosiphon		
foeniculaceus (Huds.) Grev.	60°N–78°N	60°N–75°N
(hippuroides, hispidus, corymbosus)		
chordaria Aresch.	60°N, 61°N, 64°N	n.r.
Haplospora		
(Scaphospora)		
globosa Kjellm.	60°N	70°N–73°N
(arctica)		

? *Acrocytis groenlandica.* Incompletely known species. Provisionally placed in the Dictyosiphonales.

Hecatonema		
(Ascocyclus)		
foecundum (Strömf.) Loiseaux	n.r.	73°N, 76$^{1}/_{2}$°N
maculans (Coll.) Sauv.	n.r.	70$^{1}/_{2}$°N, 73°N
Isthmoplea		
sphaerophora (Harv.) Kjellm.	60°N–68°N	69$^{1}/_{2}$°N, 70$^{1}/_{2}$°N
Litosiphon		
(Kjellmania, Pogotrichum)		
filiformis (Reinke) Batt.	60°N–70°N	70$^{1}/_{2}$°N, 73°N
groenlandicus S. Lund	n.r.	82°N
mortensenii S. Lund	n.r.	73°N
setiformis (Rosenv.) Rosenv.	64°N, 65°N	n.r.
subcontinuus (Rosenv.) S. Lund	60$^{1}/_{2}$°N	70°N–73°N
Omphalophyllum		
ulvaceum Rosenv.	60°N–64°N	70°N–77°N
Pilayella		
(Ectocarpus, Pylaiella)		
littoralis (L.) Kjellm.	60°N–78°N	60°N–82°N
(incl. varia)		
Platysiphon?		
verticillatus Wilce	77$^{1}/_{2}$°N	n.r.
Punctaria		
glacialis Rosenv.	n.r.	70°N–82°N
plantaginea (Roth) Grev.	60$^{1}/_{2}$°N–73°N	70°N–73°N
Stictyosiphon		
tortilis (Rupr.) Reinke	60°N–78°N	65°N–82°N
Scytosiphonales		
Microspongium		
(Myrionema, Phycocelis)		
globosum Reinke	60$^{1}/_{2}$°N	70$^{1}/_{2}$°N, 73°N
Petalonia		
(Phyllitis)		
fascia (O. F. Müll.) Kuntze	60°N–70°N	65$^{1}/_{2}$°N
zosterifolia (Reinke) Kuntze	70°N, d.d.	n.r.
Ralfsia		
bornetii Kuck.	60°N	n.r.
(stage of Petalonia fascia at least in part)		
clavata (Harv.) Crouan frat.	60°N–69°N	65$^{1}/_{2}$°N
(stage of Petalonia fascia or Scytosiphon lomentaria at least in part)		
fungiformis (Gunn.) Setch. & Gardn.	60°N–68°N	60$^{1}/_{2}$°N
ovata Rosenv.	64°N	n.r.
tenuis Kylin (clavata modif.?)	–	–
verrucosa (Aresch.) J. Ag.	60°N–64°N	n.r.

? *Platysiphon*. The description of this genus is based on sterile plants.

Scytosiphon		
lomentaria (Lyngb.) Link	60°N–73°N	60°N–73°N
Desmarestiales		
Desmarestia		
aculeata (L.) Lamour.	60°N–81°N	65°N–82°N
viridis (O. F. Müll.) Lamour.	60°N–78°N	68°N–82°N
Sphacelariales		
Sphacelaria		
(Chaetopteris)		
arctica Harv.	60°N–77°N	65°N–82°N
(racemosa)		
britannica Sauv.	65$^{1}/_{2}$°N	69$^{1}/_{2}$°N
(olivacea)		
radicans (Dillw.) C. Ag.	61$^{1}/_{4}$°N, 68$^{3}/_{4}$°N	68°N, d.d.
(olivacea)		
plumosa Lyngb.	60°N–78°N	65°N–82°N
Laminariales		
Agarum		
cribrosum Bory	60°N–78°N	65°N–68°N
Alaria?		
esculenta (L.) Grev.?	n.r.	65$^{2}/_{3}$°N
(flagellaris)		
pylaii (Bory) J. Ag.	60°N–77°N	60°N–77°N
(incl. grandifolia)		
Chorda		
filum (L.) Stackh.	60°N–73°N	65°N–73°N
Halosiphon		
(Chorda)		
tomentosus (Lyngb.) Jaasund	60°N–70°N	68°N–82°N
Laminaria		
digitata (L.) Lamour.	60°N	70$^{1}/_{2}$°N, 74$^{1}/_{2}$°N
longicruris De la Pyl.	62$^{1}/_{2}$°N–81°N	65$^{1}/_{2}$°N
nigripes J. Ag.	60°N–78°N	60°N, 65°N–67°N
saccharina (L.) Lamour.	60°N–69°N	60°N, 65°N–82°N
(groenlandica, cuneifolia)		
solidungula J. Ag.	60°N–78°N	65°N–77°N
Saccorhiza		
dermatodea (Pyl.) J. Ag.	60°N–70°N	66°N, 70$^{1}/_{2}$°N
Fucales		
Ascophyllum		
nodosum (L.) Le Jol.	60°N–71°N	65°N–66°N
Fucus		
distichus L.	60°N–78°N	60°N–77°N
(inflatus)		
vesiculosus L.	60°N–73°N	60°N–69°N

? The genus *Alaria* in Greenland needs re-investigation. Only few specimens of *Alaria esculenta* are reported from the Angmagssalik area.

Chlorophyceae

Chlorococcales		
Chlorochytrium		
cohnii Wright	60°N–69°N	66°N
dermatocolax Reinke	60°N–69°N	65°N–73°N
inclusum Kjellm. (possibly a stage of Acrosiphonia sonderi)	60°N–77°N	65°N–82°N
schmitzii Rosenv.	$72^{1}/_{2}$°N	70°N–73°N, $76^{1}/_{2}$°N
Ostreobium		
queqettii Born. & Flah.	60°N–73°N	$70^{1}/_{2}$°N, $76^{1}/_{2}$°N
Sykidion		
droebakense Wille	60°N	n.r.
Prasiolales		
Prasiola		
meridionalis Setch. & Gardn.	60°N	n.r.
stipitata Suhr	64°N–67°N	n.r.
Rosenvingiella (Gayella)		
polyrhiza (Rosenv.) Silva	60°N, 64°N	n.r.
Ulotrichales		
Acrochaete		
parasitica Oltm.	$68^{3}/_{4}$°N	$65^{1}/_{2}$°N
Acrosiphonia? (Cladophora)		
arcta (Dillw.) J. Ag. (incurva)	60°N–78°N	65°N–73°N
sonderi (Kütz.) Kornm. (hystrix, penicilliformis)	60°N–78°N	65°N–69°N
Arthrochaete		
penetrans Rosenv.?? (phaeophila)	60°N?	70°N–73°N, $76^{1}/_{2}$°N
Blidingia		
marginata (J. Ag.) P. Dangeard	w.s.l.	n.r.
minima (Kütz.) Kylin	60°N–64°N	n.r.
Bolbocoleon		
piliferum N. Pringsh.	60°N, 64°N, 69°N	69°N–73°N
Capsosiphon		
fulvescens (C. Ag.) Setch. & Gardn.	61°N	n.r.
Chaetobolus		
gibbus Rosenv.	$68^{1}/_{2}$°N, 71°N	66°N, $70^{1}/_{2}$°N
Enteromorpha???		
clathrata (Roth) Grev.	n.r.	$70^{1}/_{2}$°N

? The genus *Acrosiphonia* needs re-investigation.

?? *Arthrochaete penetrans.* This species is recorded with some uncertainty as to the correctness of the determination (cf. Pedersen, 1976).

??? The genus *Enteromorpha* needs re-investigation.

compressa (L.) Grev.	60°N–69°N	60$^{1}/_{2}$°N
intestinalis (L.) Link	67°N, 69°N; 64°N r.n.	66°N
prolifera (O. F. Müll.) J. Ag.	60°N–78°N	73°N; 70°N, 73°N d.d.
Entocladia		
viridis Reinke	60°N	n.r.
Epicladia		
flustrae Reinke	60°N, 64°N, 65°N	70$^{1}/_{2}$°N, 76$^{1}/_{2}$°N d.d.
Eugomontia		
sacculata Kornm.	60°N	n.r.
Gomontia		
polyrhiza (Lagerh.) Born & Flah.	60°N–73°N	70$^{1}/_{2}$°N, 76$^{1}/_{2}$°N
Kornmannia		
(Monostroma)		
leptoderma (Kjellm.) Bliding	60°N–68°N	66°N
Monostroma		
(Enteromorpha)		
groenlandicum J. Ag.	60°N–69°N	60°N, 65$^{1}/_{2}$°N, 67$^{1}/_{4}$°N
undulatum Wittr.	61°N–67°N	n.r.
Oclochaete		
ferox Huber	60$^{1}/_{2}$°N, 68$^{1}/_{2}$°N	n.r.
Percursaria		
percursa (C. Ag.) Rosenv.	60°N–69°N	70°N
Pringsheimiella		
(Pringsheimia)		
scutata (Reinke) Marchew.	60°N–67°N	66°N, 73°N
Pseudendoclonium		
submarinum Wille	60°N	76$^{1}/_{2}$°N
Pseudopringsheimia		
(Ulvella)		
confluens (Rosenv.) Wille	64°N–70°N	66°N, 69$^{3}/_{4}$°N, 70$^{1}/_{2}$°N
fucicola (Rosenv.) Wille	60°N, 61°N, 68$^{3}/_{4}$°N	65$^{1}/_{2}$°N, 70$^{1}/_{2}$°N
Spongomorpha		
vernalis (Kjellm.) Jónsson	60$^{1}/_{2}$°N	70$^{1}/_{2}$°N
Ulothrix		
consociata Wille	60°N–65°N	70$^{1}/_{2}$°N, 76$^{1}/_{2}$°N
islandica (Jónsson) Printz (consociata modif.?)	61°N	66°N
pseudoflacca Wille	60°N–70°N	60°N–73°N
scutata Jónsson (pseudoflacca modif.?)	60°N–61°N	76$^{1}/_{2}$°N
speciosa (Harv.) Kütz. sensu Kornmann (flacca)	60°N–68°N	65°N–73°N, 76$^{1}/_{2}$°N
subflaccida Wille	60°N–61°N	n.r.
Ulva		
lactuca L.	67°N–69°N	n.r.
Ulvaria		
(Monostroma)		
obscura (Kütz.) Gayral (fuscum)	60°N–70°N, 78$^{1}/_{2}$°N	60°N–71°N

Ulvopsis		
(Monostroma)		
grevillei (Thur.) Gayral	60°N–70°N	60°N, 65°N–67°N
Urospora		
(Codiolum)		
penicilliformis (Roth) Aresch.	60°N–78°N	66°N, $67^1/_4$°N, $70^1/_2$°N
(mirabilis)		
wormskioldii (Mert.) Rosenv.	60°N–67°N	n.r.
(incl. crassa, hartzii)		
Siphonocladales		
Chaetomorpha		
capillaris (Kütz.) Børg.	60°N–73°N	65°N–73°N
(tortuosa)		
melagonium (Web. & Mohr) Rosenv.	60°N–77°N	65°N–82°N
Cladophora?		
flexuosa (O. F. Müll.) Kütz.	$68^1/_2$°N, $68^3/_4$°N	$65^1/_2$°N
(incl. hirta, gracilis)		
rupestris (L.) Kütz.	60°N–69°N	n.r.
sericea (Huds.) Aresch.	60°N	n.r.
(glomerata f. ?, sic)		
Rhizoclonium		
riparium (Roth) Harv.	60°N–73°N	$65^1/_2$°N, 73°N
pachydermum Kjellm.	w.s.l.	n.r.
Caulerpales		
Derbesia		
marina (Lyngb.) Sol.	64°N	n.r.

? The genus *Cladophora* needs re-investigation.

References

Bliding, C. 1963: A critical survey of the European taxa in Ulvales. *Opera Botanica* **8**(3), 1–156.

Christensen, T. 1975: Some marine algae from West Greenland. *Bot. Tidsskr.* **70**, 143–146.

Friedmann, I. 1969: Geographic and environmental factors controlling life history and morphology in *Prasiola stipitata* Suhr. *Österr. Bot. Z.* **116**, 203–225.

Jónsson, H. 1904: The marine algæ of East Greenland. *Meddr Grønland* **30**, 1–73.

Kuckuck, P. 1897: Meeresalgen von Sermitdlet und kleinen Karajakfjord. Pp. 28–39 *in* C. Luerssen & B. Frank (ed.): Botanische Ergebnisse der von der Gesellschaft für Erdkunde zu Berlin unter Leitung Dr. v. Drygalski's ausgesandten Grönlandexpedition nach Dr. Vanhöffens Sammlungen bearbejdet. A. Kryptogamen. *Bibliotheca Botanica* **42**.

Lund, S. 1933: The Godthaab Expedition 1928. The marine algae. *Meddr Grønland* **82**(4), 1–18.

— 1938: On *Lithoderma fatiscens* Areschough and *Lithoderma fatiscens* Kuckuck. *Meddr Grønland* **116**(5), 1–18.

— 1951: Marine algae from Jörgen Brönlunds Fjord in eastern North Greenland. *Meddr Grønland* **128**(4), 1–26.

— 1959: The marine algae of East Greenland I. Taxonomical part. *Meddr Grønland* **156**(1), 1–247.

Pedersen, P. M. 1973: Preliminary note on some marine algae from South Greenland. *Bot. Tidsskr.* **68**, 145–149.

— 1976: Marine, benthic algae from southernmost Greenland. *Meddr Grønland* **199**(3), 1–80.

Rosenvinge, L. K. 1893: Grønlands havalger. *Meddr Grønland* **3**, 765–981.

— 1894: Les algues marines du Groenland. *Annls Sci. nat. ser.* 7, **19**, 53–164.

— 1898: Deuxième mémoire sur les Algues marines du Groenland. *Meddr Grønland* **20**, 1–125.

— 1910: On the marine algæ from North-East Greenland, collected by the "Danmark-Expedition". *Meddr Grønland* **43** (4), 91–133.

— 1926: Marine algae collected by Dr. H. G. Simmons during the 2nd Norwegian Arctic Expedition in 1898–1902. *Rep. Second Norw. arctic Exp.* "Fram" 1898–1902, **37**, 1–40.

— 1933: Marine algæ from Kangerdlugssuaq. *Meddr Grønland* **104** (8), 1–13.

Wilce, R. T. 1960: Studies in the genus *Laminaria* II. *Laminaria groenlandica* L. K. Rosenv. *Bot. Notiser* **113**, 203–209.

— 1962: A new member of the Punctariaceae: *Platysiphon verticillatus*, gen. nov., sp. nov. *Bot. Tidsskr.* **58**, 35–42.

— 1963: Studies on benthic marine algae in North-West Greenland. *Proc. Intl. Seaweed Symp.* **4**, 280–287.

— 1966: *Pleurocladia lacustris* in Arctic America. *J. Phycol.* **2**, 57–66.

— 1969: *Papenfussiella callitricha*: New observations on a little-known endemic brown alga from Southwest Greenland. *J. Phycol.* **5**, 173–180.

Wilce, R. T., E. E. Webber & J. R. Sears 1970: *Petroderma* and *Porterinema* in the New World. *Mar. Biol.* **5**, 119–135.

PLATES

Plate 1

Plate 1. Figs a–k. Illustrations to Cyanophyceae, × 600. Fig. a. *Aphanothece* sp. Part of colony. Fig. b. *Sarcinastrum urosporae* on *Ulothrix speciosa.* Further development of the parasite, inserted figure. Fig. c. *Sarcinastrum urosporae* on *Rhodochorton purpureum.* Figs d–h. *Pleurocapsa amethystea.* Fig. d. Start of initial cell division (arrow). Fig. e. Later stage of cell division showing two daughter cells of unequal size within a common wall (arrow). Fig. f. Results of division. Fig. g. Subglobose cells and cluster of small cells growing together. Fig. h. Firm surface of older wall with fissures (arrow), dividing cell (arrow). Fig. i. Trichomes of *Nostoc minutum.* Fig. j. Two trichomes of *Hydrocoleum lyngbyaceum* within a common sheath. Fig. k. *Spirulina subsalsa.*

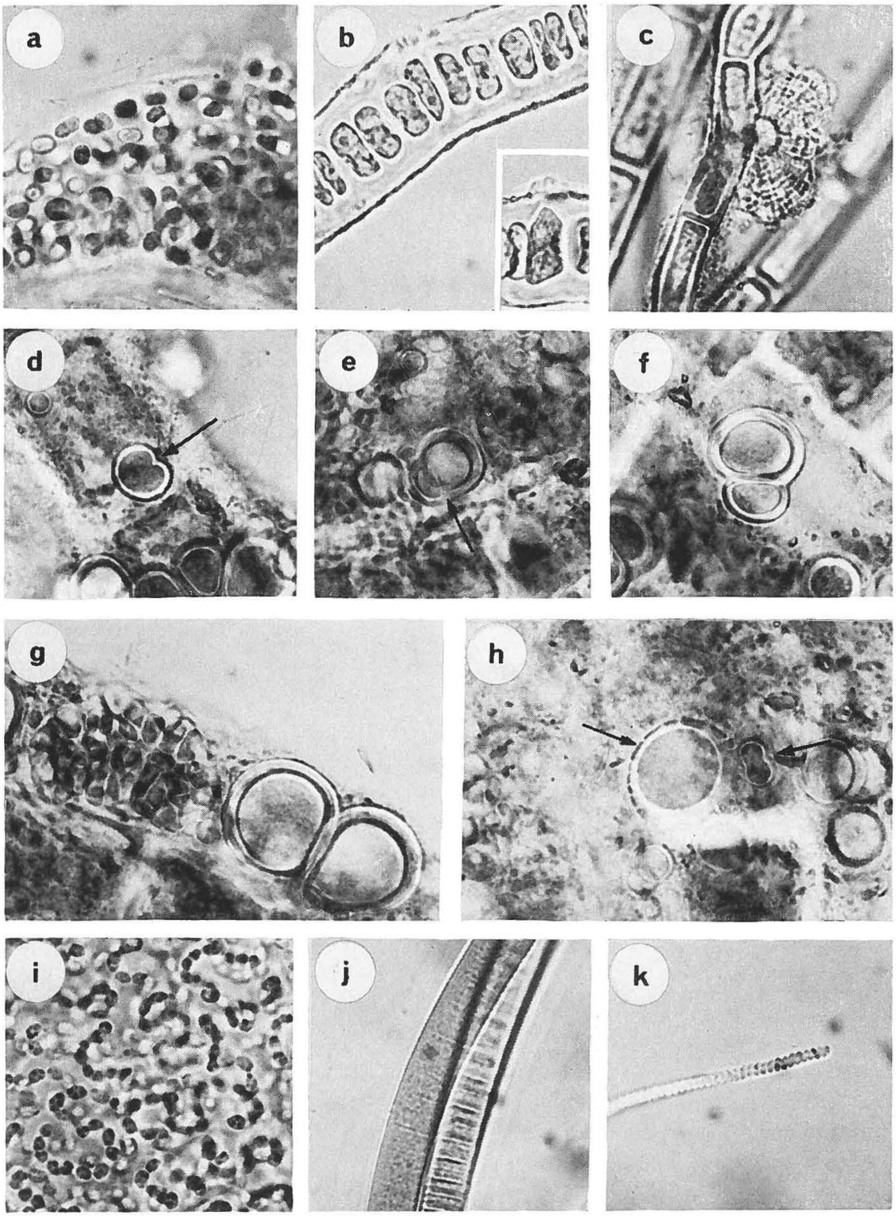
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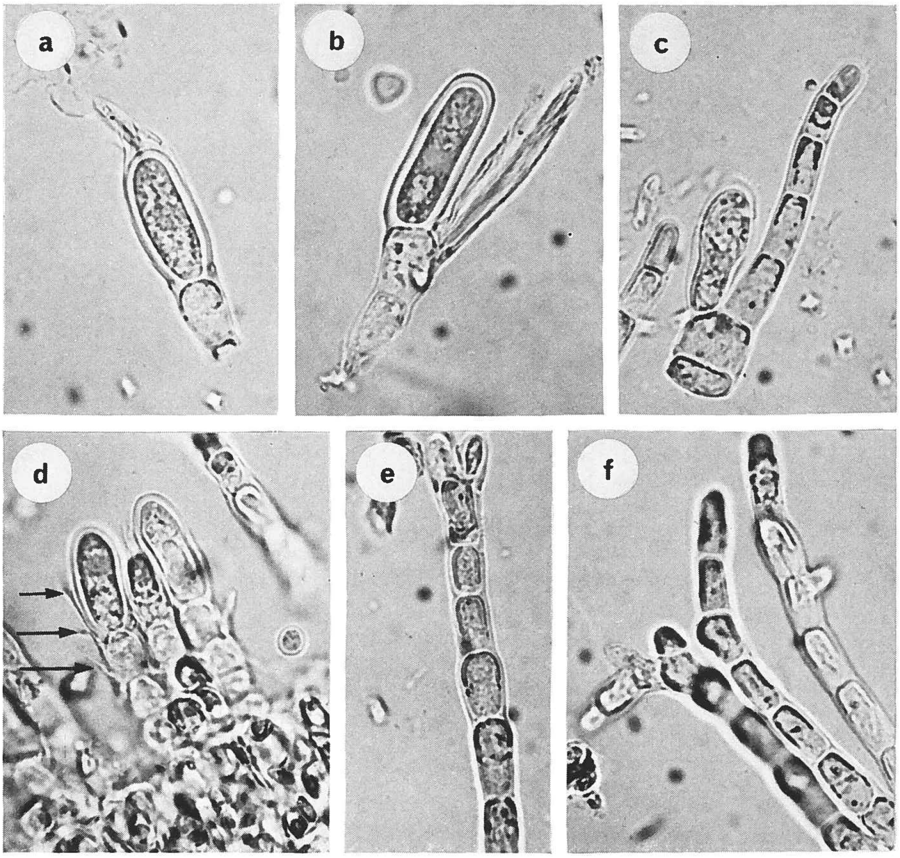
Plate 2

Plate 2. Figs a–f. *Rhodophysema elegans*, × 600. Figs a, b. Successive generations of tetrasporangia growing out through the empty sporangium or in a lateral position to this. Fig. c. Sporangium lateral to a paraphysis. Fig. d. Remnants of 3 generations of sporangial walls (arrows). Figs e, f. Paraphyses with scattered, 1-celled laterals near the apex.

Plate 3

Plate 3. Figs a–c. *Antithamnion boreale*, × 160. Fig. a. Female gametophyte with carpogonial branches (arrows) in unilateral series. A single trichogyne (arrow) is clearly visible. Fig. b. Naked gonimoblast. Fig. c. Male gametophyte from culture with antheridial clusters on the abaxial and adaxial side of the branch, and on short laterals on the main axis.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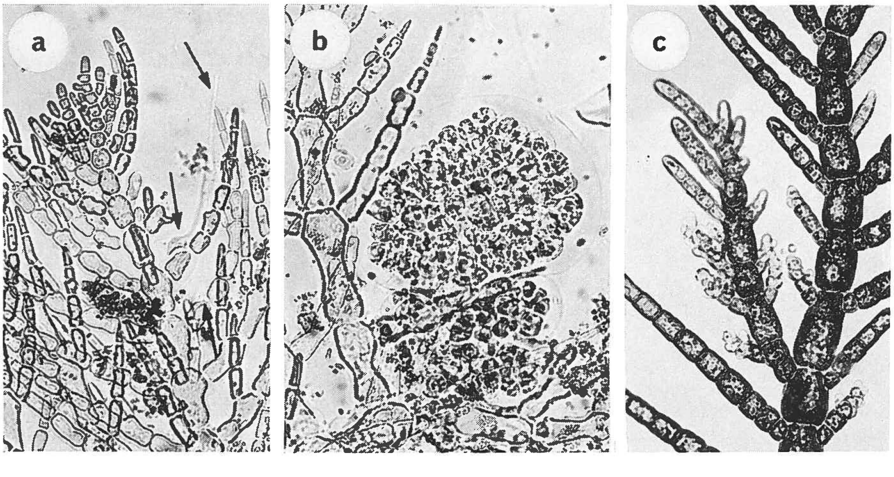
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Plate 4

Plate 4. Figs a, b. *Phaeostroma parasiticum* in transverse section of a *Laminaria* frond. Fig. a. Initial bulge on the host formed by the endophyte. × 160. Fig. b. Fully developed plant with endophytic filaments, horizontal filaments, and plurilocular sporangia. × 160. Inserted figure, rhizoid (arrow) from horizontal filament. × 500.

Plate 4. Fig. c. *Phaeostroma pustulosum* on transverse section of a *Laminaria* frond for comparison with *Phaeostroma parasiticum.* × 500.

Plate 4. Figs d–f. *Symphyocarpus strangulans.* Fig. d. Upright filament with terminal sorus of plurilocular sporangia. × 500. Fig. e. Detail of crust with ascocyst-like cell. × 500. Fig. f. Surface view of fertile erect filaments with four cells within a common wall. × 500.

Plate 4. Figs g–i. *Elachista fucicola.* Fig. g. Microthallus observed in culture. × 500. Fig. h. Subdivided cell of an assimilating filament in material from nature. × 500. Fig. i. Long-celled filament with chloroplasts (arrow) observed at an initial stage of development of the macrothallus in culture. × 500.

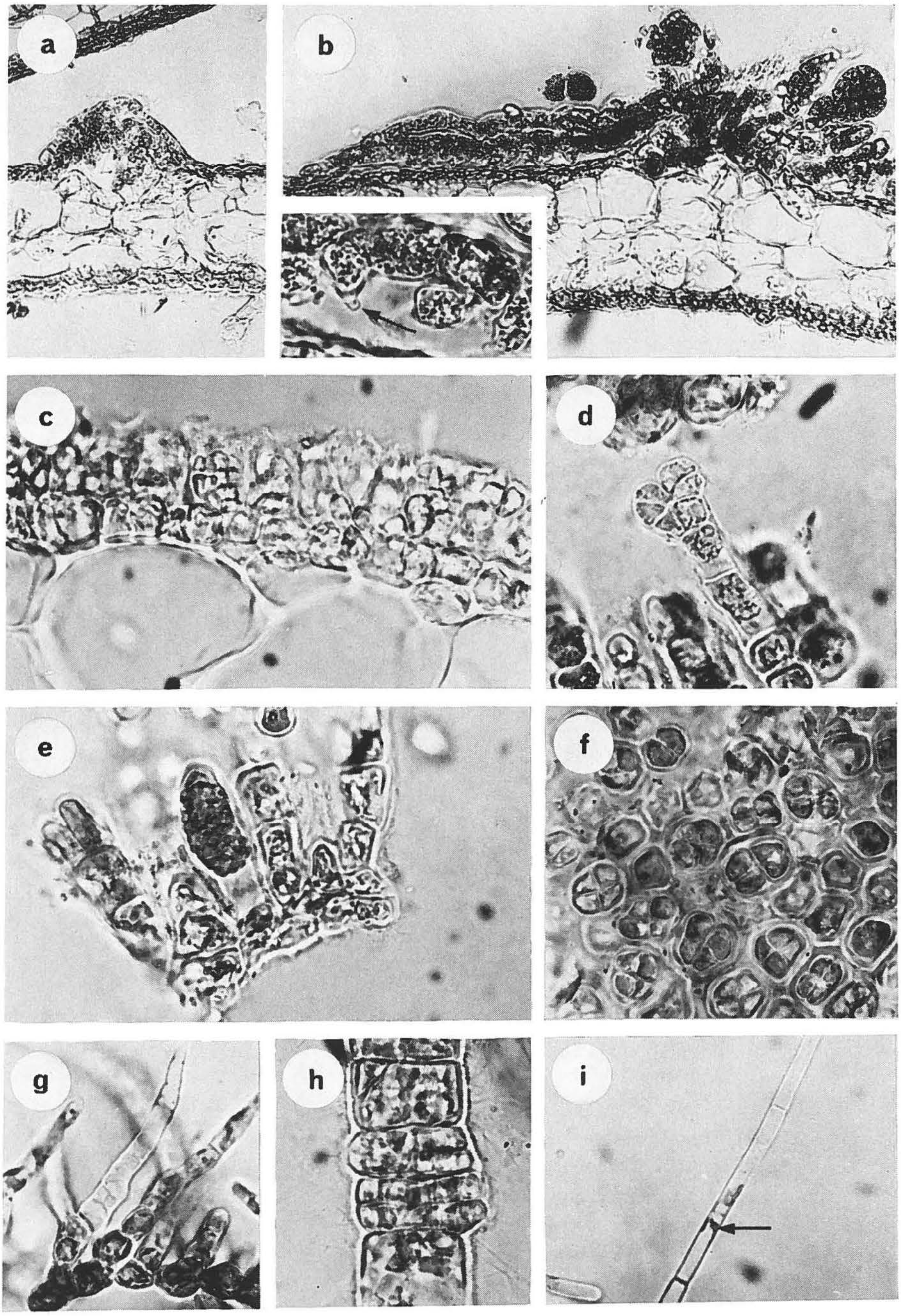
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Plate 5

Plate 5. Figs a–e. *Scytosiphon lomentaria* var. *complanatus*. Figs a–c. Photographs of herbarium specimens showing the variation in width of the thalli. Scale 2 cm. Fig. d. Transect of thallus showing hairs in a tuft (arrow). × 160. Fig. e. Narrow fertile thallus in optical section. × 160.

PLATE 5

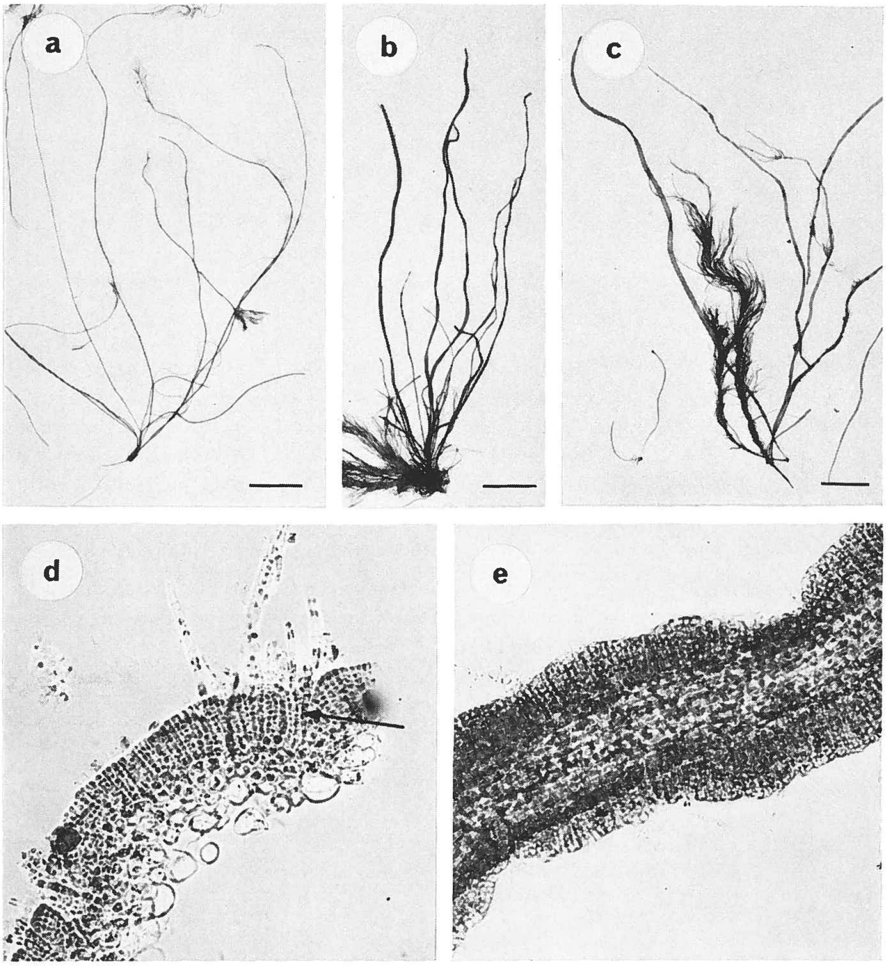


Plate 6

Plate 6. Figs a–h. *Pilayella littoralis.* Figs a–c. Examples of the great variation with regard to unilocular sporangia, even two placed on a rhizoid, fig. c. × 500. Figs d–f. Plurilocular and unilocular sporangia on the same plant, also formed in the same branch, fig. f. × 160, × 500 (fig. f). Fig. g. Longitudinal divisions in connection with formation of unilocular sporangia. × 160. Fig. h. Culture material showing intercalary and lateral unilocular sporangia. × 160.

Plate 6. Fig. i. *Stictyosiphon tortilis.* Presumed young plant with plurilocular sporangia in the monosiphonous part. × 160.

Plate 6. Fig. j. *Delamarea attenuata.* Germination *in situ* in a unilocular sporangium. × 500.

PLATE 6

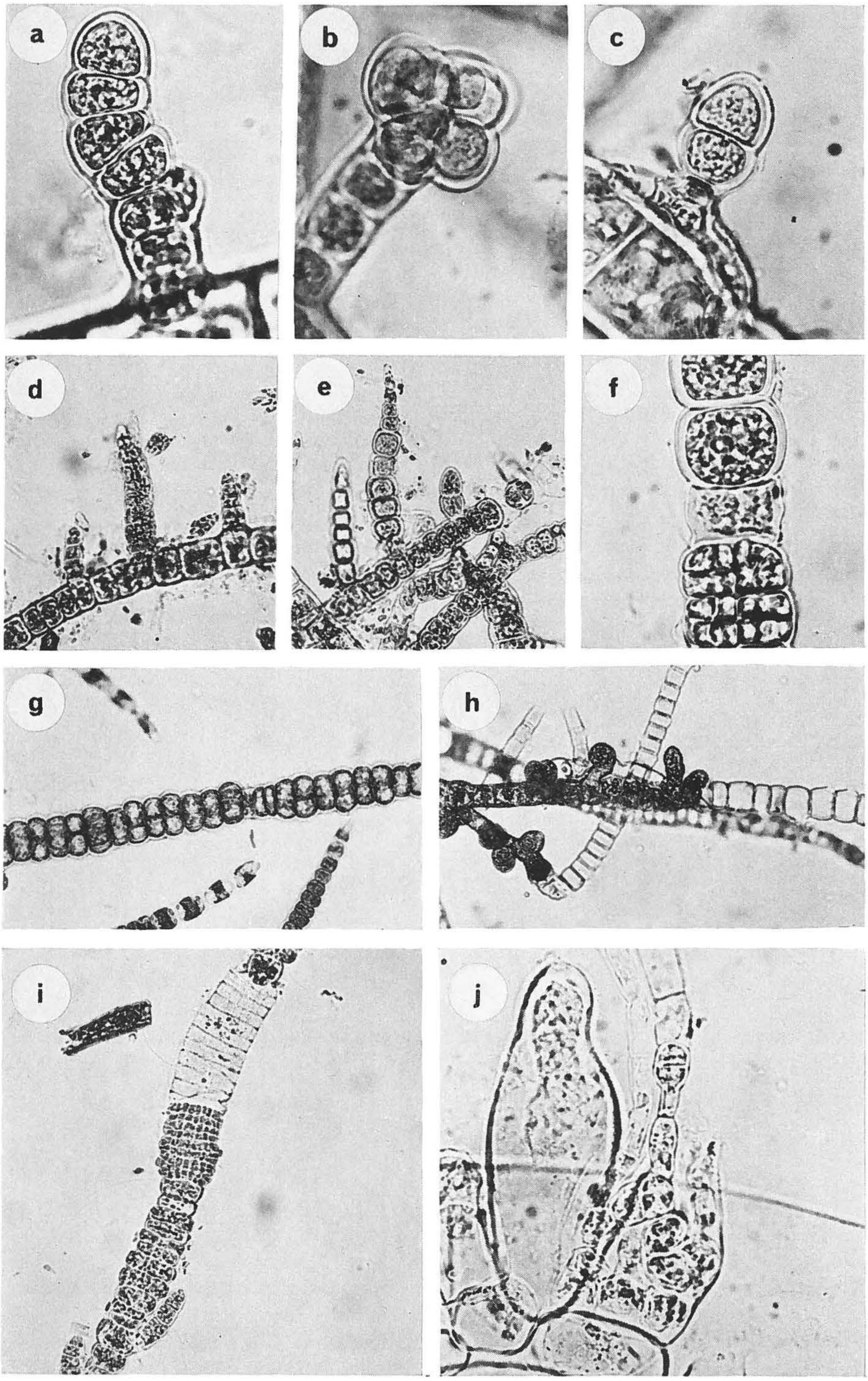
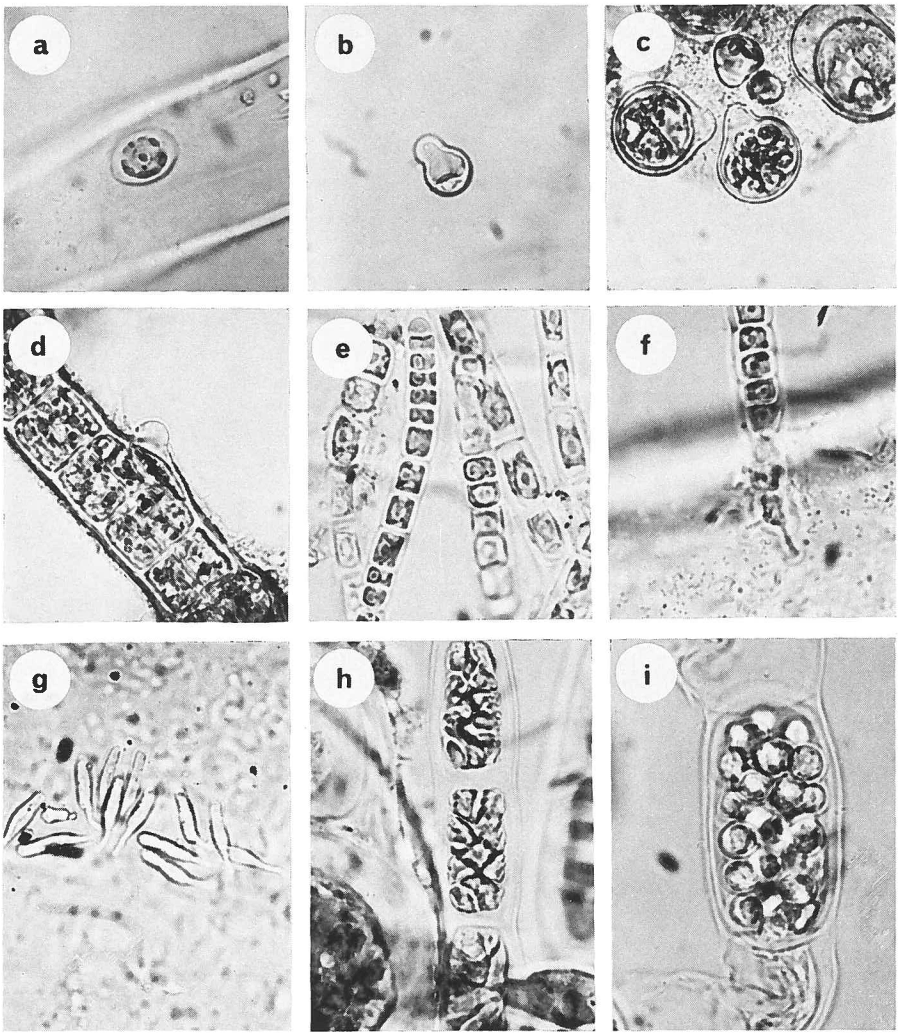


Plate 7

Plate 7. Figs a–i. Illustrations to Chlorophyceae. Figs a–c. *Chlorochytrium cohnii*. Fig. a. Cell in a "*Schizonema*" sheath. Surface view with clearly visible stellate chloroplast and central pyrenoid. × 500. Figs b, c. Culture material of *C. cohnii*. Fig. b. Young cell with tap region. × 500. Fig. c. Fertile cell. × 500. Fig. d. *Chlorochytrium dermatocolax* in *Sphacelaria*, the tap is excentrically located. × 500. Fig. e. *Ulothrix pseudoflacca*. Variation in the length/width proportion. × 600. Fig. f. *Ulothrix scutata*. Base of filament with proliferations from the basal cell. × 600. Fig. g. *Urospora wormskioldii*. Germination of swarmers on the mother plant. × 600. Figs h, i. *Urospora penicilliformis*. Fig. h. Fertile cells longer than broad. × 600. Fig. i. Germination *in situ*. × 600.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