BLUMEA 33 (1988) 141–180

THE XANTHOPHYCEAE AND CHLOROPHYCEAE OF THE WESTERN ROSS SEA, VICTORIA LAND, ANTARCTICA AND MACQUARIE ISLAND COLLECTED UNDER THE DIRECTION OF PROF. DR. J. S. ZANEVELD (1963–1967)

H. P. WAGNER* & J. S. ZANEVELD**

SUMMARY

During the austral summer seasons of 1963–1964 and 1964–1965, and during the austral winter season of 1967 Prof. Dr. J.S. Zaneveld made collection expeditions to the western Ross Sea. In 1965 collections were also made from the U.S.C.G. icebreaker 'Glacier', around the western Ross Sea and around the Balleny Islands. During the same cruise Macquarie Island was visited. Most collecting was carried out by means of scuba-diving. Prof. Zaneveld was accompanied on these expeditions by W.I. Simmonds (1963–1964), J.M. Curtis (1964–1965), J.K. Fletcher (1964–1965), D.M. Bresnahan (1967), and L.L. Nero (1967), during these periods students at Old Dominion University, Norfolk, Virginia, U.S.A.

In the harsh Antarctic environment the algae discussed in the present paper occur in aquatic habitats (freshwater, brackish water, and saline water) be it covered with ice or not, in melted snow and on icebergs.

Identification and synonymy of the eleven taxa reported is based mainly on the Antarctic and sub-Antarctic literature. One of the algal taxa mentioned belongs to the Xanthophyceae and ten to the Chlorophyceae. Several of these taxa are newly recorded for the area or part of it under discussion.

Some critical notes are made concerning the Antarctic Ulotrichales, as well as a short discussion on the correct name of the type species of the genus *Klebsormidium*. A new species of this genus is described.

The species collected are *Heterococcus moniliformis* Vischer, 1937; *Chlamydomonas* aff. *ballenyana* Kol in Kol & Flint, 1968, *Stichococcus nivalis* Chodat, 1917; *Klebsormidium drouetii* Wagner & Zaneveld, nov. spec.; *Ulothrix implexa* (Kützing) Kützing, 1849; *Ulothrix australis* Gain, 1911; *Urospora penicilliformis* (Roth) Areschoug, 1874; *Monostroma hariotii* Gain, 1911; *Prasiola crispa* (Lightfoot) Meneghini, 1837 var. *antarctica* (Kützing) Knebel, 1935 forma *antarctica* (Kützing) Knebel, 1935; *Chaetomorpha mawsonii* Lucas, 1919; and *Lola irregularis* Zaneveld, 1966.

The remarkable vertical distribution of the chlorophyte *Monostroma hariotii* in the Ross Sea, Antarctica, i.e. from the lower eulittoral down to 348 meters indicates again that the factor 'light' is only *one* of the many features influencing the vertical distribution of marine algae.

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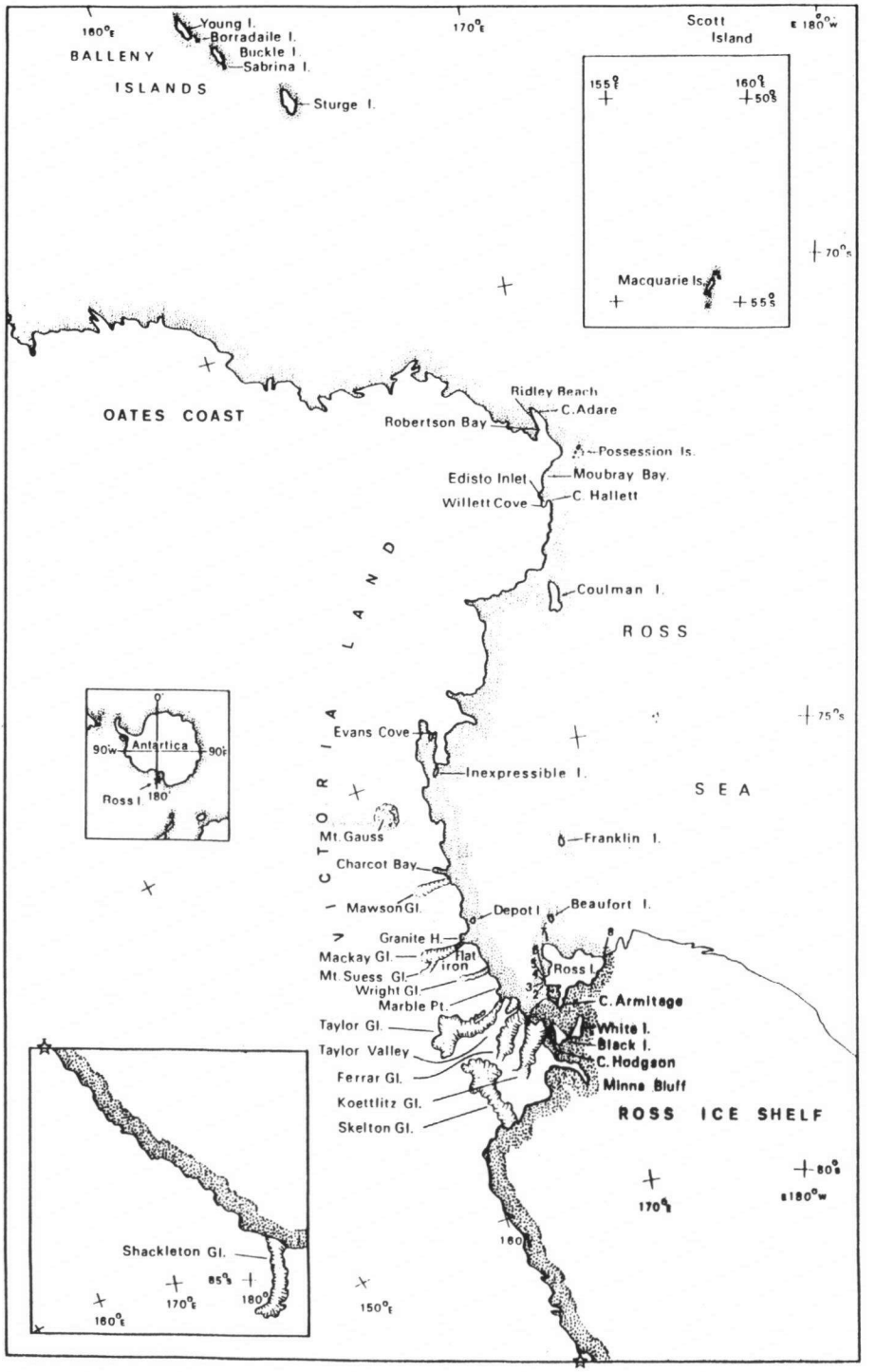

Young I.
Borradaile I.
Buckle I.
Sabrina I.
BALLENY
ISLANDS
Sturge I.
180°E
170°E
Scott Island
E 180°W
155°E
160°E
50°S
70°S
Macquarie Is.
55°S
OATES COAST
Ridley Beach
C. Adare
Robertson Bay
Possession Is.
Edisto Inlet
Moubray Bay.
Willett Cove
C. Hallett
Coulman I.
ROSS
SEA
VICTORIA LAND
Antartica
90W
90E
Ross I.
180°
75°S
Evans Cove
Inexpressible I.
Mt. Gauss
Franklin I.
Charcot Bay
Mawson Gl.
Depot I.
Beaufort I.
Granite H.
Mackay Gl.
Flat Iron
Mt. Suess Gl.
Wright Gl.
Marble Pt.
Ross I.
C. Armitage
White I.
Black I.
C. Hodgson
Minna Bluff
Taylor Gl.
Taylor Valley
Ferrar Gl.
Koettlitz Gl.
Skelton Gl.
ROSS ICE SHELF
80°S
170°W
180°W
160°
Shackleton Gl.
85°S
170°E
180°
160°E
150°E

INTRODUCTION

The present paper which describes a number of Antarctic Xanthophyceae and Chlorophyceae, is a continuation of the earlier published algae by the senior author. The algae were collected by him and his students in the western Ross Sea, on and around the Ross Sea islands, and on and off the coastal part of Victoria Land during the austral summer seasons of 1963–1964 and 1964–1965, and during the austral winter season of 1967. Samples collected during the scientific cruise of the U.S.C.G. 'Glacier' on and around the Balleny Islands and Macquarie Island in the first three months of 1965 are also reported. Therefore, the total area covered by the present paper includes the coastal and offshore regions of Victoria Land and the islands and offshore areas of the Ross Sea islands. Thus, the area investigated starts near the Shackleton Glacier at 84° 35' S, 176° 15' W and extends northward to include the islands and the sea some degrees north of the Antarctic Circle, 66° 32' S (maps 1 & 2).

The collections made consist mainly of specimens taken by hand while scuba-diving and in areas offshore deeper than 30 meters by means of trawling from one of the U.S. icebreakers. Therefore, the exact depths of the specimens collected were read from the ship's depth recorder.

During a collecting trip and a cruise the specimens were stored in bottles with a mixture of alcohol 70% and formaldehyde 4%. Returned at the McMurdo Station Biological Laboratory some specimens of each species (as far as possible) were dried and mounted on paper herbarium sheets. All material is extant in the Rijksherbarium of the Leiden University at Leiden, the Netherlands.

No efforts were made to collect plankton organisms, even not diatoms, although these microscopic plants often covered the macroscopic algae in such thick layers that they had to be removed first before the algae became visible. Samples frozen in the ice were placed in large jars and transported to the field laboratory where the actual thawing took place.

The geographical distribution for each of the taxa mentioned covers the area south of southern latitude 55° S. The geographical distribution north of this boundary can usually be found in the tables by Carlson (1913) and/or by Hirano (1965) (map 2).

In the extremely harsh environment of this Antarctic sector the terrestrial algal flora consists mainly of Cyanophyta and relatively few Chlorophyta. Articles about two groups of algae present in the same collections as described in the present paper have been published already, i.e., the Crustose Corallinaceous algae (Rhodophyta) by Zaneveld and Sanford in 1980, and the Cyanophyta by Zaneveld in 1988.

The Chlorophyceae and Xanthophyceae are dealt with in the present paper. The algae of these two groups occur either in aquatic habitats, be it freshwater, brackish water, or saline water with or without a permanent ice cover, or on snow and/or ice.

Map 1. Geographical map of the western Ross Sea and Macquarie Island showing the locations of the collecting sites discussed in the text. The numbers indicate the following place names: 1. Cape Armitage; 2. Cape Evans; 3. Backdoor Bay; 4. Cape Royds; 5. Blacksand Beach; 6. Horseshoe Bay; 7. Cape Bird; 8. Cape Crozier (from J.S. Zaneveld, 1988).

Map 2. Antarctic continent, Antarctic circle at 66° 32' S, and boundary of the Antarctic convergence (from J.S. Zaneveld, 1969).

Preliminary data about the composition and other characteristics of the lakes and ponds in our area were reported as early as 1910 by Murray; in 1911 by West & West; in 1912 by Fritsch and by Gain, and in 1924 by Wille. Detailed studies of these habitats were only made after the I.G.Y. (International Geophysical Year) 1957–1959, i.e. by Ball & Nichols (1960), Armitage & House (1962), Wilson & Wellman (1962), Angino & Armitage (1963), Angino et al. (1962, 1964), Goldman (1962, 1970), Goldman et al. (1963, 1967), Holm-Hansen (1963, 1964), Wilson (1965), Likens (1964), Korotkevich (1964), Zaneveld (1966b, 1968, 1969a), Cameron (1966, 1972, 1972a), Koob & Leister (1972), Parker (1977), Parker et al. (1973, 1978, 1980, 1981, 1982), and by Seaburg et al. (1979).

In the present paper eleven taxa are recognized; ten of these belong to the Chlorophyceae and one to the Xanthophyceae. Only one of the chlorophycean algae is unicellular (*Chlamydomonas* aff. *ballenyana*), the others are multicellular. Two of these

are 'leaf'-shaped (*Prasiola crispa* and *Monostroma hariotii*), whereas the remaining species are uni- or multiseriate filamentous forms. The filamentous algae often form cushion-like expanses or benthic mats on the substrate either by itself or in association with algae from one or more other species. *Ulothrix implexa,* for instance, forms mat-associations with the bluegreen algae *Schizothrix calcicola, Microcoleus vaginatus,* and *M. lyngbyaceus. Prasiola crispa,* however, seems to prefer an association with *Microcoleus vaginatus* only.

Finally, here are some remarks about the species collected.

The *Hormidium, Schizogonium,* and *Prasiola* stages of *Prasiola crispa* var. *antarctica* are all three present in the rich collections made of this species.

Chlamydomonas aff. *ballenyana* and *Stichococcus nivalis* are often found to be the cause of the green colour of meltwater and snow. In other cases, however, the green colour was caused by an over-abundance of *Klebsormidium drouetii* or *Prasiola crispa* var. *antarctica* specimens. The last named taxon has also been found to form horizontal green bands on steep sloping icebergs, perhaps indicating the height of a tidal level while the iceberg was located along the sea shore.

The remains of melted ice often consist of thick mats of interwoven filaments of some bluegreen algae and *Ulothrix implexa* (Zaneveld, 1988). Mat forming, intertwinement of filaments, and the formation of associations with other algae are all useful mechanism to protect the algae against the rigors of the Antarctic environment, such as the continuous low temperatures, the high salinity of the habitat, forceful winds and blizzards causing desiccation, absence of good water, and deficiency of organic material. Moreover, there is the lichenization and the occurrence of an *Hormidium* or *Codiolum* stage in the life cycle, features that may be regarded to be additional means of adaptation to the extreme environment.

The biologically intriguing deep sublittoral and even elittoral occurrence of *Monostroma hariotii* and some other brown and red Antarctic seaweeds was already discussed in some of the senior authors's earlier papers (Zaneveld, 1965, 1966a, 1966b, 1966c, 1968, 1969). The present paper shows in detail where, when, and at what particular depth this green alga was collected. It also records the number of specimens gathered indicating clearly that *Monostroma hariotii* is an outspoken dominant green alga in the Antarctic sublittoral and elittoral habitats under consideration. All records, including the deepest ones between 177 and 348 meters around Possession Island and the Balleny Islands were read from the icebreaker's sonar depth recorder, and are therefore indisputable. Most of the algae collected were still attached to their substrate (a rock, a pebble, another alga or invertebrate). They were fresh, had their natural colours, and some were even fructificating. .

The occurrence of so many green algal specimens at the great depths mentioned is in contrast with the still widely accepted hypothesis of complementary chromatic adaptation by Engelmann (1883).

The main ecological factors affecting the (green) algal distribution under the extreme Antarctic conditions are – apart from limitations imposed by the various substrates, competition for suitable settling of spores or zygotes, and competition with other organisms – the variation in salinity, the low light intensity, the high hydro-

static pressure, and the constant low temperatures. The last three factors are known to reduce the rate of metabolism either directly or indirectly. Moreover, respiration in algae is affected principally by decreasing temperatures. Consequently, the ratio of assimilation to respiration increases and causes a high assimilation surplus. In addition, the metabolites accumulated by uninterrupted photosynthesis during the eight months of continuous sunlight in the Ross Sea, Antarctica may enhance the possibility of survival for certain algal species.

However, light is certainly not the only factor affecting depth zonation of seaweeds. Experiments with macro-algae in the field and culture techniques in the laboratory following Haxo & Blinks (1950) have shown that the accessory pigments of several algae are of much greater importance as light absorbers in photosynthesis than chlorophyll a. According to Saffo (1987) there are at least four mechanisms that algae may exploit for photosynthesis in dim, spectrally limited deep water, i.e. the production of more accessory pigments relative to chlorophyll a; the production of more photosynthetic pigment; accessory pigments as well as chlorophyll a, and possessing and developing particular morphological and physiological structures – such as the arrangement of chloroplasts or the thickness of thallus – that help in absorbing the maximum quantity of light at a certain depth.

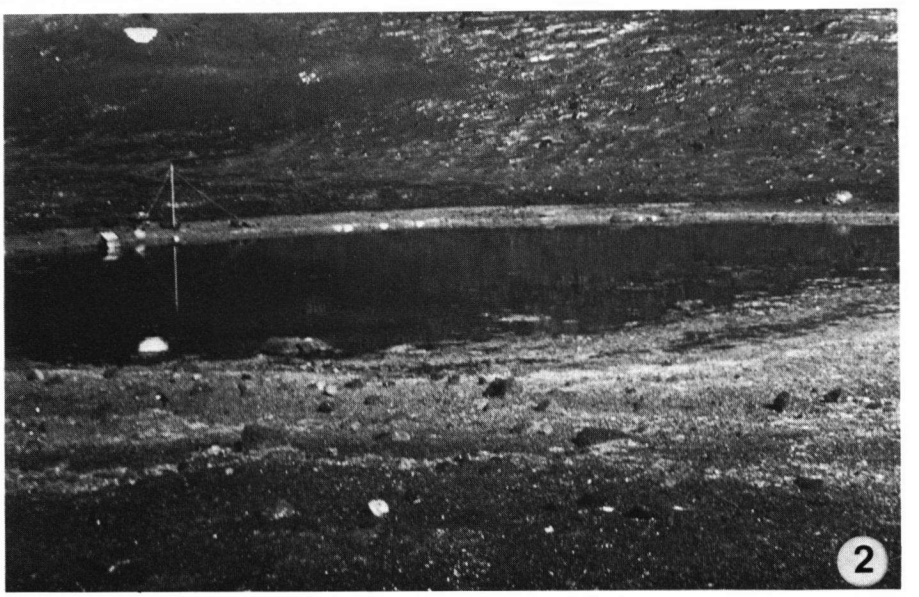
In addition, several other morphological and physiological characteristics play a role, such as adaptation to high light intensities, resistance to constant low temperatures, as well as biological interactions with other organisms, such as the presence of particular predators or herbivores.

In conclusion, in addition to the light factor a variety of other factors are effective to explain the deep depth occurrence of green seaweeds too. Explaining the possibility of autotrophic living in the Antarctic depths does not mean that heterotrophy or mixotrophy is excluded (Zaneveld, 1966). The collections made by our team in the first month after the dark winter period are indicative of such a possibility, i.e. juvenile and fructificating adult specimens are present in the month of September; a surplus of food reserves can be build up during the 24 hours of sunshine in the summer period; large numbers of sub-ice diatoms develop during the summer months providing great quantities of organic material in the winter period; algal metabolism proceeds at its lowest rate in the Antarctic deep water environment.

ABBREVIATIONS USED

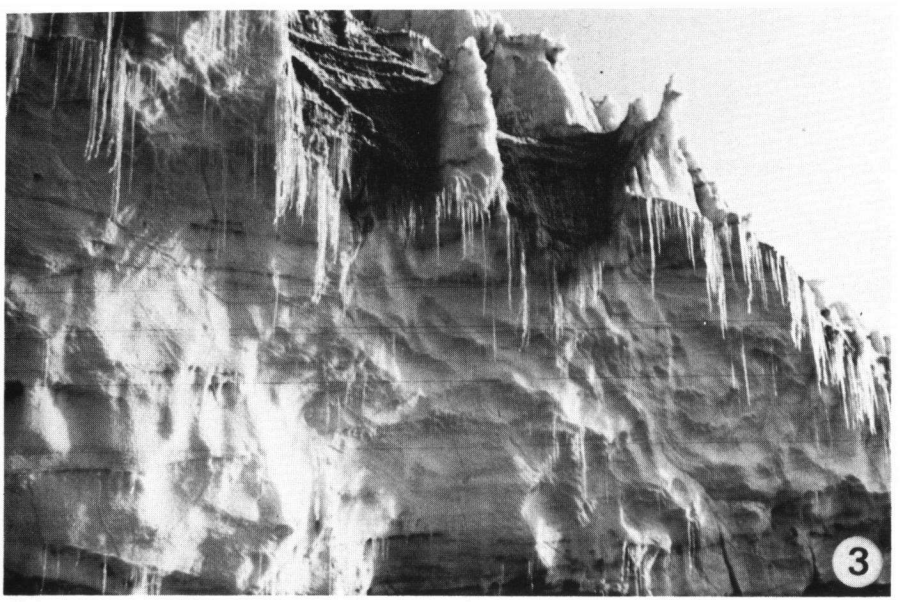
The abbreviation JSZ used in this paper stands for Herbarium of J.S. Zaneveld; L = Rijksherbarium, Leiden, The Netherlands.

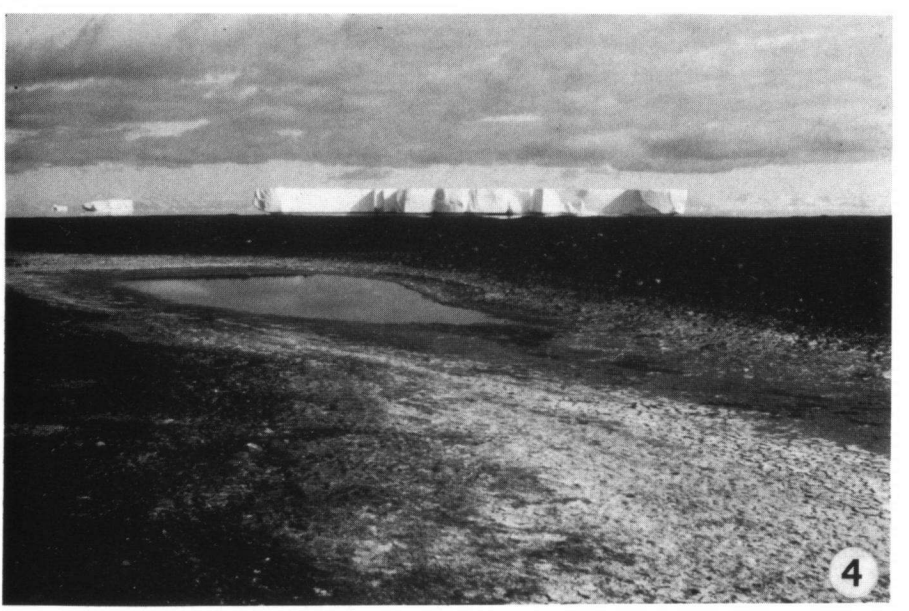
In the text the letters A, B, C, and D are used to indicate a group of four lakes, located near Cape Evans at Ross Island. Similarly, the letters P, Q, R, and S indicate a group of four lakes located near Cape Bird at Ross Island. Details about the location of these lakes, the composition of the lake water, and the algal flora are reported by Zaneveld (1969).



Photograph 1. The way meltwater lake R was formed in the beginning of the austral summer near Cape Bird, Ross Island is clearly visible by the remains of the frozen inlet stream. On the bottom of the lake grow green and blue-green algae (Photogr. J.S. Zaneveld, 30-XII-1964).

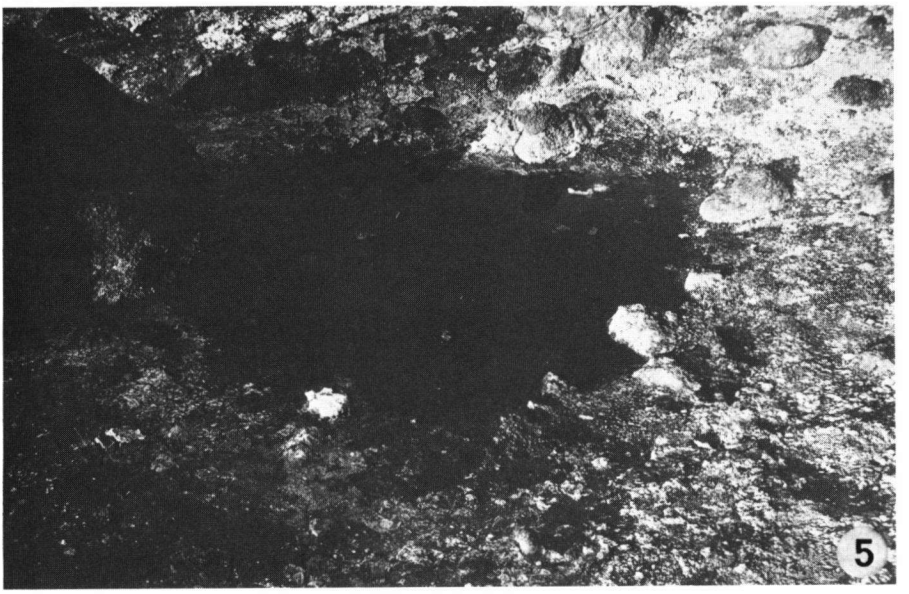
Photograph 2. Green and blue-green algae form mat-communities along the shores and on the bottom of meltwater lake B near Cape Evans at Ross Island (Photogr. J.S. Zaneveld, 12-XII-1964).

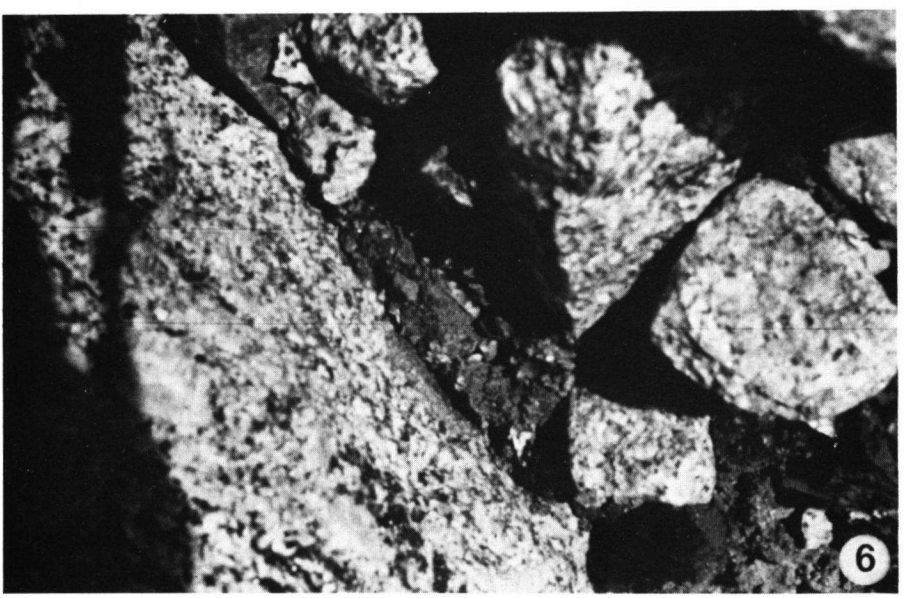




Photograph 3. The green coloured horizontal bands of *Prasiola crispa* (Lightfoot) Meneghini var. *antarctica* (Kützing) Knebel on steep sloping icebergs along the shore of Cape Bird, Ross Island (Photogr. J.S. Zaneveld, 27-I-1964).

Photograph 4. Benthic mats of green and blue-green algae along the shore of meltwater lake S in the Cape Bird, Ross Island area (Photogr. J.S. Zaneveld, 24-I-1964).





Photograph 5. The bright green coloured *Chlamydomonas* pool at the foot of Mt Erebus near Cape Evans, Ross Island (Photogr. J.S. Zaneveld, 19-I-1964).

Photograph 6. The black coloured stripes on the rocks of the Flat Iron near Granite Harbour, Victoria Land are the green leaf-like structures of *Prasiola crispa* (Lightfoot) Meneghini var. *antarctica* (Kützing) Knebel (Photogr. J.S. Zaneveld, 1-XII-1964).

SYSTEMATICS

Classis XANTHOPHYCEAE

Ordo **Tribonematales**

Familia HETERODENDRACEAE

Genus ***Heterococcus*** Chodat, 1908

Heterococcus moniliformis Vischer, 1937 — Fig. 1.

Heterococcus moniliformis: Flint & Stout, 1960: 767. Seaburg et al., 1979: 59, pl. 18, fig. 64 A–E.

Material examined. Marble Point, Victoria Land: on rocks on the bottom of a meltwater lake and along its shore, bright green when fresh, 9 Jan. 1964, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 64-01-0036.*

Description. Plants form cushionlike expanses that consist of intertwining, prostrate and erect, often branched filaments, up to 30 µm long; cells globose to ellipsoid and at the end of the filaments up to twice as long as broad; the parietal chloroplast does not encircle the whole cell lumen; pyrenoids lacking; zoospores with two unequal flagella; aplanospores not observed; plants bright green when fresh.

Remarks. At the locality sampled this species formed mats in and along the shore of his meltwater lake. Previously the species has only been recorded by Flint & Stout (1960) and Seaburg et al. (1979) and reported as *Heterococcus moniliformis*. The records of *Protoderma brownii* Fritsch and *P. viride* Kützing from other

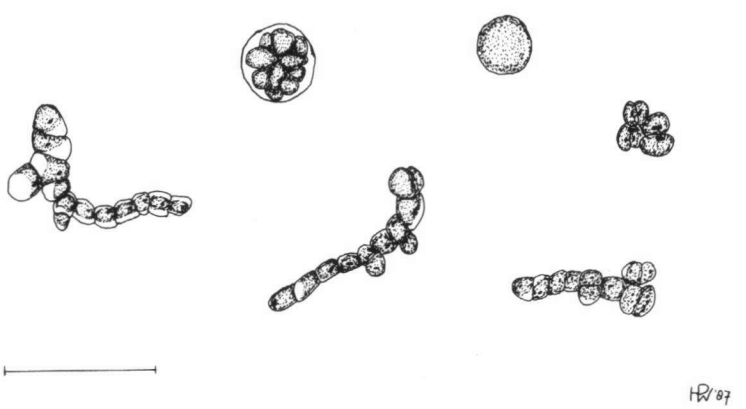


Fig. 1. *Heterococcus moniliformis* Vischer (*JSZ 64-01-0036*). Different stages of the plant; 30 µm indicated.

authors refer most probably to this species. Vischer's original (type) specimen was cultivated on earth collected in the Botanical Garden of Basel, Switzerland, 1937.

Originally the order was classified with the Chrysophyceae in the division Chromophyta (Bourelly, 1968) or Chrysophyta (Fott, 1971). The present authors place the order in the division Xanthophyta in accordance with conceptions stipulated by Chapman & Chapman (1973). With regard to its depth distribution *Heterococcus moniliformis* is a littoral benthic alga.

Geographical distribution. Antarctic records. The previous records are all from Victoria Land: Wright Valley (Flint & Stout, 1960); Lake Bonney, Lake Chad, Lake Fryxell, Lake Miers, and Lake Morning (all Seaburg et al., 1979).

Classis CHLOROPHYCEAE

Ordo Volvocales

Familia CHLAMYDOMONACEAE

Genus *Chlamydomonas* Ehrenberg, 1833

Chlamydomonas aff. ballenyana Kol in Kol & Flint, 1968 — Fig. 2; Photos 2 & 5.

Chlamydomonas ballenyana, Kol & Flint, 1968: 253, pl. 2, figs. 1–6; Kol, 1968: 122, fig. 51; Ettl, 1976: 681, pl. 163, fig. 1.
Chlamydomonas ballenyana var. *minor* Kol, 1971: 52, pl. 1, figs. 1–6.
Protococcus grevillei Kol, Zaneveld 1969a: 301 (non *Protococcus grevillei* (Agardh) Crouan).

Material examined. Cape Bird, Ross Island: green meltwater on a slope; 27 Jan. 1964, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 64-01-0110*.

Cape Royds, Ross Island: on the bottom of a frozen lake, called Blue Lake; plants when collected orange-green, associated with *Schizothrix rubella* and *Schizothrix calcicola*, 11 Nov. 1964, leg. J.S. Zaneveld, J.M. Curtis & J.K. Fletcher, *JSZ 64-11-0010B*.

Cape Evans, Ross Island: on rocks in a small pond behind the New Zealand hut, 24 Dec. 1963, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 63-12-0008;* ibidem, green coloured snow, 19 Feb.1964, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 64-02-0079*.

Cape Evans, Ross Island: Lake A, 15 Jan. 1964, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 64-01-0038*.

Cape Evans, Ross Island: attached to a bird bone in a small pond, 24 Dec. 1963, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 63-12-0007* (vegetative reproducing cells); ibidem, in a small pond associated with *Microcoleus vaginatus*, bright green when fresh, 19 Jan. 1964, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 64-01-0073*.

Description. Cells elliptic to almost circular; cells up to 30 µm in diameter; papillae on the outer surface absent; pyrenoid basal; a bell-shaped chloroplast encir-

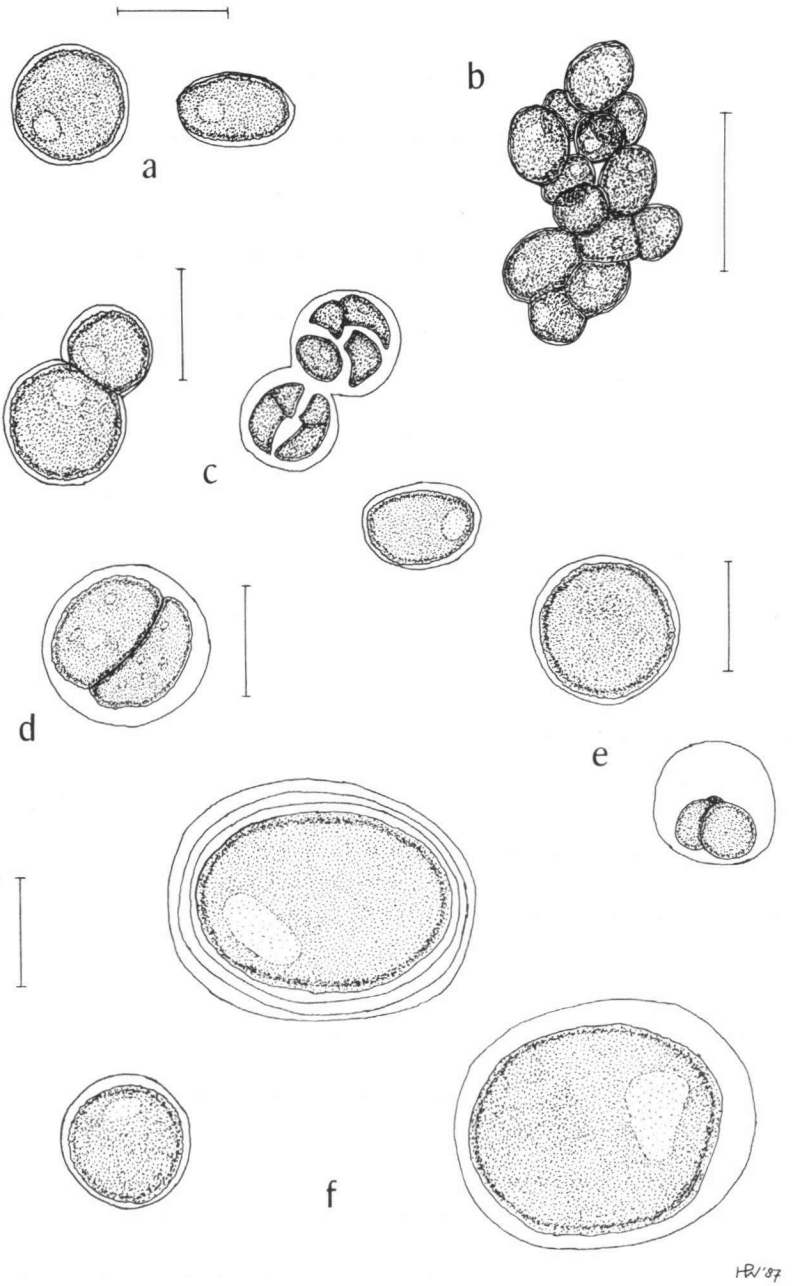


Fig. 2. *Chlamydomonas* aff. *ballenyana* Kol & Flint. Different stages of the plant. a (*JSZ 64-01-0073*); b. (*JSZ 64-01-0110*); c. (*JSZ 63-12-0008*); d. (*JSZ 64-01-0038*); e. (*JSZ 64-02-0079*); f. (*JSZ 64-11-0010B*). a., c–f. 10 μm indicated; b. 30 μm indicated.

cles almost the whole cell lumen; vacuole apical; the flagellae, when observed, are about the same length as the cell; colour greenish when fresh; vegetative reproduction by division of the protoplasts into two, 4 or 8 daughter cells.

Remarks. In the monograph on *Chlamydomonas* by Ettl (1976) nine major groups are distinguished. Only five of these groups are represented in Antarctica according to the literature. Seven previously reported species belong to the *Euchlamydomonas*-group (*C. intermedia* Chodat, 1894; *C. ehrenbergii* Goroschankin, 1891; *C. basimaculatus* Pascher & Jahoda, 1928; *C. gracilis* Snow, 1902; *C. snowiae* Printz, 1914; *C. caudata* Wille, 1903, *C. subcaudata* Wille, 1903), one to the *Chlamydella*-group (*C. elliptica* Korschikoff in Pascher, 1927), one to the *Chlorogoniella*-group (*C. acuta* Korschikoff in Pascher, 1927), one to the *Pseudagloë*-group (*C. agloëformis* Pascher, 1927), three to the *Sphaerella*-group (*C. ballenyana* Kol & Flint, 1968; *C. sanguinea* Lagerheim, 1892, *C. nivalis* (Bauer) Wille, 1903). The group of a remaining species (*Chlamydomonas antarctica* Wille in Gain, 1911) was not yet established by Ettl as this author (1976: 691) was of the opinion that this species was insufficiently described. Most likely it belongs to the *Sphaerella*-group. Another species, i.e.*Chlamydomonas alpina* (Wille) Playfair, proved to be a *Chloromonas* species (Ettl, 1976: 690). Of the 14 species reported so far, only six occur in Antarctica according to Ettl. These species are *C. intermedia, C. ehrenbergii, C. subcaudata, C. ballenyana, C. sanguinea*, and *C. antarctica.* Only in the *Sphaerella*-group it is difficult to determine the build-up of the chromatophore exactly. Concerning the species of this group Ettl (1976: 681) stated: "Schnee- oder eisbewohnende Arten, die oft weitgehende grüne oder rote Schneefärbung verursachen.

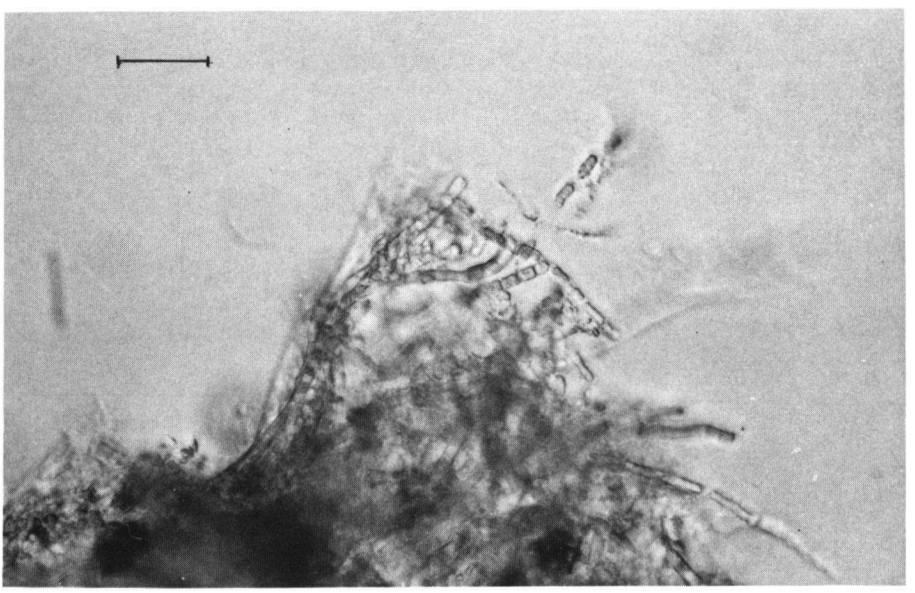


Fig. 3. *Stichococcus nivalis* Chodat (*JSZ 64-01-0113*); 50 µm indicated (Photogr. H.P. Wagner).

Sie befinden sich vorwiegend im unbeweglichen Zustand, in Form von Ruhezellen mit derber Hülle" and "In der Morphologie der Zellen ist manches unklar, vor allem bei jenen Arten, deren Zellinhalt durch den groszen Gehalt an Haematochrom vollkommen verdeckt ist." In our material the cell content is largely concealed by the chloroplast. We therefore assume, with some hesitation, our material to be *C. ballenyana.*

Our material is de-coloured due to its preservation in formaldehyde and therefore difficult to identify with certainty. It is for the first time that the species is collected in and recorded for Antarctica (Ross Island).

With regard to its depth distribution *Chlamydomonas* aff. *ballenyana* is littoral benthic and planktonic.

Geographical distribution. Antarctic record: Balleny Islands (Kol, 1968, 1972; Kol & Flint, 1968).

Ordo **Ulotrichales**

Familia ULOTRICHACEAE

Genus ***Stichococcus*** Nägeli, 1849

Stichococcus nivalis Chodat, 1917 — Fig. 3.

Stichococcus nivalis Chodat, 1917: 10; 1922: 79; Kol, 1968: 147, pl. 8, figs. 49–50, pl. 12, fig. 10; 1968a: 73, pl. 1, fig. 13; 1973: 59; Prescott, 1979: 67.

Stichococcus bacillaris Gain, 1912: 184, 189, 190, pl. 4, fig. 2; Wille, 1924: 401, pl. 27, figs. 78–83; DeWildeman, 1935: 18, fig. 6; Holm-Hansen, 1964: 47, 48, 50; Hirano, 1965: 186; Cameron, 1972: 248; Akiyama, 1977: 18; Prescott, 1979: 66; Seaburg et al., 1979: 55, pl. 16, fig. 57 (auct. non Nägeli, 1849).

Stichococcus bacillaris var. *minor* Nägeli, 1849; Gain, 1911: 481, 482; 1912: 184; Wille, 1924: 401; Hirano, 1965: 186; Prescott, 1979: 67 (as forma *minor*).

Stichococcus bacillaris var. *major* (Nägeli) Roth, 1806; Gain, 1911: 482; 1912: 184; Wille, 1924: 401; Hirano, 1965: 186; Prescott, 1979: 67 (as forma *major*).

Ulothrix subtilis Kützing, 1845; Fritsch, 1912: 318, 329, pl. 1, photos 1, 2, 6.

Ulothrix subtilis var. *tenerrima* (Kützing, 1833) Kirchner, 1878 forma *antarctica* Wille in Gain, 1912: 185, pl. 4, fig. 4.

Hormidium subtile Kützing, 1833; Fogg, 1967: 281; Prescott, 1979: 41 (non Kützing, 1843).

Hormiscia flaccida (Kützing, 1849) Lagerheim, 1888 var. *nivalis* DeWildeman, 1935: 17, fig. 4.

Material examined. Cape Bird, Ross Island: 'green snow' that has melted, 26 Jan. 1964, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 64-01-0113.*

Description. Plants filamentous, up to c. 20 cells long, filaments unbranched; crosswalls not constricted; cells quadrangular to somewhat cylindrical, 1.0–1.5 times as long as wide, 7.0–25 µm long, 7.0–11.5 µm in diameter; cell wall 0.5–1.0 µm thick; no pyrenoid; chloroplast almost encircles the whole cell lumen; plant bright green; zoospores and gametes not observed.

Remarks. According to Kol (1968, 1968a, 1973) this species seems to be restricted to snow and soil samples only. It can be distinguished from *Ulothrix sub-*

tilis Kützing by its less cylindrical cells, a chloroplast which does not encircle the cell lumen completely, and its much brighter green colour. As stated by Kol (l.c.) the two species do not occur in the same kind of habitat. Therefore, the taxa reported from snow samples such as *Hormidium subtile* or *Ulothrix subtilis* and varieties, are most probably *Stichococcus nivalis* Chodat. The latter species is one of the oldest known members of the snow flora.

Geographical distribution. Subantarctic records. South Orkney Islands: Scotia Bay, yellow snow (Fritsch, 1912); Coronation Island, Meier Point, green snow (Fogg, 1967).

Antarctic records. Antarctic Peninsula area: Gerlache Strait, green snow (DeWildeman, 1935); Wiencke Island, green snow, Booth Wandel Island, green snow, and Peterman Island, red snow (all Gain, 1911, 1912; Wille, 1924); west of Grahamsland (Chodat, 1917).

West of Queen Mary coast: Haswell Island (Kol, 1968a, 1973).

Victoria Land: Victoria Valley, Lake Vida shores (Cameron, 1972); Wright Dry Valley, Lake Vanda, Marble Point, and Ross Island (all Holm-Hansen, 1964).

Genus *Klebsormidium* Silva, Mattox & Blackwell, 1972

Note regarding the genus *Klebsormidium*. — When Silva, Mattox & Blackwell established *Klebsormidium* as a new generic name, because the names *Hormidium* and *Hormococcus* had been previously used, they assigned *Ulothrix flaccida* Kützing, 1849 as the type species. Kützing transferred *Lyngbya fragilis* Hooker & Harvey, 1845 into the genus *Ulothrix* (1849). Braun in Rabenhorst (1876) stated that *Ulothrix fragilis* (Hooker & Harvey) Kützing is identical with *Hormidium flaccidum* (Kützing) Braun, 1868. Subsequently, applying article 13.2 of the International Code of Botanical Nomenclature, *Ulothrix flaccida* Kützing becomes a more recent synonym of *Ulothrix fragilis* (Hooker & Harvey) Kützing (see Prescott, 1979: 71). Therefore, the valid name for *Ulothrix flaccida* is: *Klebsormidium fragilis* (Hooker & Harvey) Wagner & Zaneveld, comb. nov.

Klebsormidium drouetii Wagner & Zaneveld, *nov. spec.* — Fig. 4.

Material examined. Tent Island, McMurdo Sound: in littoral mats of a freshwater pond, 0.9 m deep, 14 Jan. 1964, leg. J.S. Zaneveld & W.I. Simmonds, JSZ 64-01-0019.

Cape Bird, Ross Island: washed ashore attached to *Bryozoa,* bright green when fresh, 25 Jan. 1964, leg. J.S. Zaneveld & W.I. Simmonds, JSZ 64-01-0094B (in part); ibidem, in meltwater pool on beach, bright green when fresh, 27 Jan. 1964, leg. J.S. Zaneveld & W.I. Simmonds, JSZ 64-01-0122 (holotype).

Cape Evans, Ross Island: Lake A, water bright green when collected, 17 Jan. 1964, leg. J.S. Zaneveld & W.I. Simmonds, JSZ 64-01-0061 (in part).

Cape Evans, Ross Island: in a meltwater lake partly benthic and partly floating, 14 Jan. 1964, leg. J.S. Zaneveld & W.I. Simmonds, JSZ 64-01-0028.

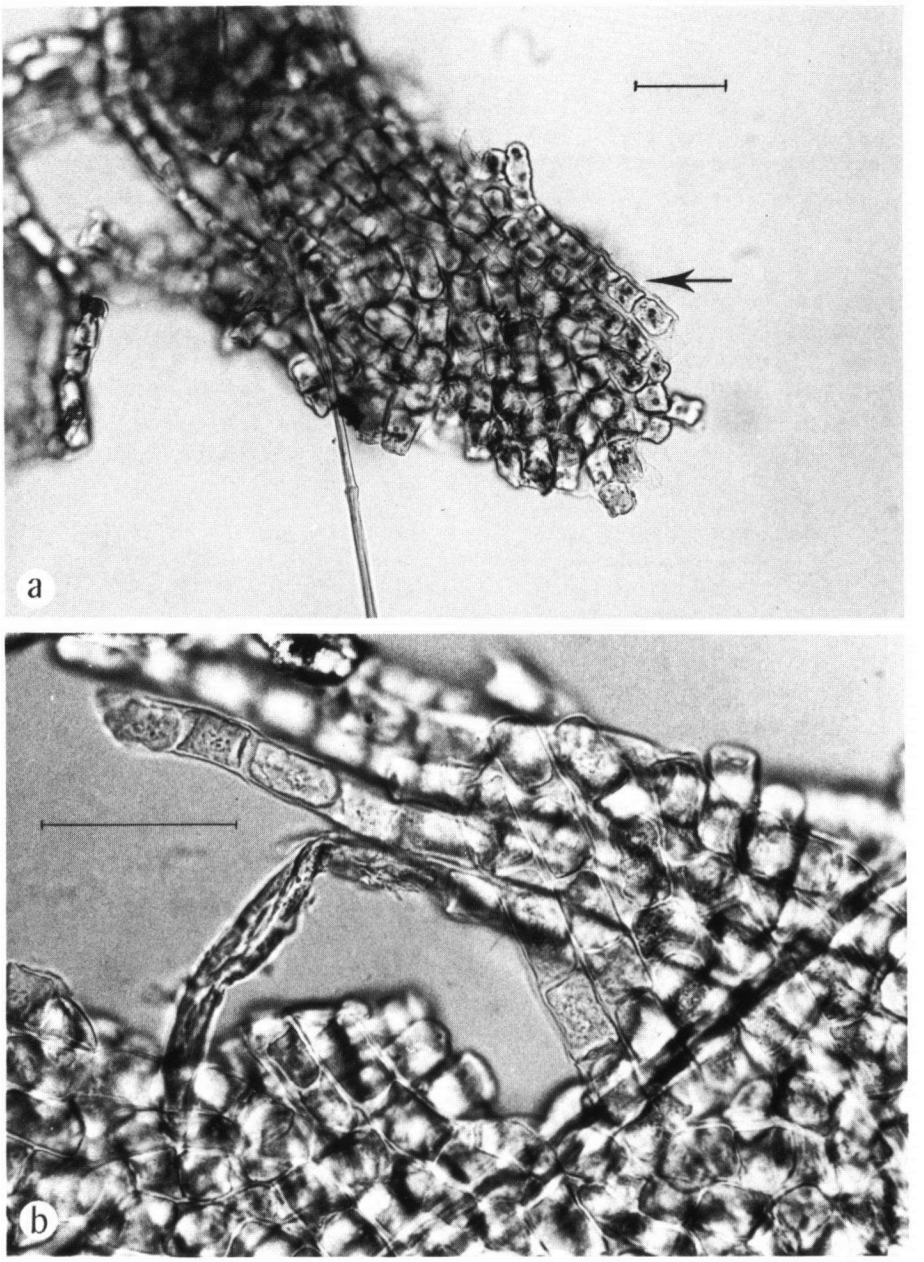


Fig. 4. *Klebsormidium drouetii* Wagner & Zaneveld (*JSZ 64-01-0122*). a. Detail of a 'mat' after colouring with JKJ in ethanol-50%-solution; holotype specimen indicated by an arrow; b. detail of an uncoloured 'mat'; 50 µm indicated (Photogr. H.P. Wagner).

Description. Planta ex massa filamentorum, flexuosa, natans sive tegetiformis vel humilis; filamenta simplex; septa non constricta; cellula cylindrica, longitudo cellularum 1.0–3.5 × latudine, 3.0–25.5 µm longa, 2.3–11.5 µm lata; membrana 0.5–1.0 mm; chloroplasta magna recondit pyrenoide; pyrenoide simplex, infrequens duo; colore cinereo-viride vel vivio viride in vivo.

Plant filamentous, flexible, free-floating or forming mats on soil; filaments unbranched; crosswalls not constricted; cells cylindrical, 1.0–3.5 times as long as wide, 3.0–25.5 µm long, 2.3–11.5 µm in diameter; cell wall 0.5–1.0 µm thick; the plate-like chloroplast does not encircle the cell lumen completely and conceals the pyrenoid; one pyrenoid, rarely two; colour grayish green to bright green when fresh.

Remarks. The species which belongs to the genus *Klebsormidium* can be distinguished from a *Stichococcus* species by the presence of a pyrenoid. To make this pyrenoid visible for light microscopic study, however, the cells must be coloured with a JKJ solution in alcohol 50%.

Contrary to other species that belong to *Stichococcus* the new species forms mats. The filaments are more flexible than in *Stichococcus*, subsequently very long filaments of c. 69 cells long could be observed in the material at our disposal. The species occurs in the littoral zone.

As pointed out by Lokhorst & Vroman (1972: 458) *Ulothrix subtilissima* Rabenhorst, 1863 is a more recent synonym of *Ulothrix subtilis* Kützing, 1845. The new species was previously reported as *Stichococcus subtilis* (Kützing) Klerck (Zaneveld, 1969a) and as *Klebsormidium subtilissimum* (Rabenhorst) Silva, Mattox & Blackwell, 1972 (Seaburg et al., 1979).

The new name of this *Klebsormidium* species is given in honour of the well-known algal taxonomist, the late Dr. Francis Drouet, in recognition of his friendship during the years and for the assistance he gave the second author with respect to his Antarctic algae project.

Geographical distribution. Antarctic records. Victoria Land: Lake Boney, Lake Miers, Lake Brownworth, Lake Canopus, Lake Fryxell, Lake Hoare (all Gain, 1911; Hirano, 1965; Prescott, 1979; Seaburg et al., 1979).

Antarctic Peninsula (Gain, 1912a; Wille, 1924; Prescott, 1979).

Ross Island, Cape Evans: Lake A (Zaneveld, 1969a).

Genus *Ulothrix* Kützing, 1833

Note regarding the genus *Ulothrix*. — Thusfar nine different taxa of the genus *Ulothrix* have been reported from Antarctica. These taxa are *U. aequalis* Kützing, *U. flacca* (Dillwyn) Thuret, *U. flaccida* Kützing, *U. implexa* (Kützing) Kützing, *U. oscillarina* Kützing, *U. subtilis* Kützing, *U. subtilis* var. *variabilis* (Kützing) Kirchner, *U. tenerrima* Kützing var. *antarctica* West & West, and *U. australis* Gain. Type material of some of these species were studied by Lokhorst (1974), who stated that part of them are not *Ulothrix* species. Dr. Lokhorst identified *U. aequalis* Kützing as a *Microspora* species, *U. tenerrima* consists partly of a *Microspora* species and partly of a *Klebsormidium* species, *U. flaccida* Kützing as a *Klebsormidium* species (see

this paper, p. 155). *Ulothrix oscillarina* Kützing was indeterminable. These facts indicate the necessity to critically check all Ulotrichales from earlier expeditions.

Ulothrix implexa (Kützing, 1833) Kützing, 1849 — Fig. 5; Photos 1 & 4.

Ulothrix implexa Ardissone, 1888: 210; Hariot, 1892: 1429; West & West, 1911: 271; Gain, 1912: 117; Wille, 1924: 402; Skottsberg, 1941: 75; Papenfuss, 1964; 1; Prescott, 1979; 71.
Ulothrix imflexa (sic), Hirano, 1965: 186.

Material examined. Edisto Inlet, Red Castle Ridge, Victoria Land: light brown littoral benthic mats at end of frozen lake, alt. 213 m, 21 Nov. 1964, leg. J. Schoup, in herb. *JSZ 64-11-0060.*

Black Island, Ross Ice Shelf: plants form littoral benthic mats in all ponds of this ice-enclosed island, mats on top orange brown, underneath greenish brown, alt. 30 m, 24 Dec. 1964, leg. J.S. Zaneveld, J.M. Curtis & J.K. Fletcher, JSZ *64-12-0080B.*

Cape Bird, Ross Island: Lake P, the water of the lake very clear, the plants bright green when fresh, along the shore in soil enriched with bird fæces, 26/27 Jan. 1964, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 64-01-0125A.*

Cape Bird, Ross Island: Lake Q, plants form bright bluish green littoral benthic mats, often appearing rust-brown because of a thick cover of diatoms, 27 Jan. 1964, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 64-01-0126*; plants form green mats on the surface of the lake and along its borders, under water they are brownish white, 26/27 Jan. 1964, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 64-01-0126B;* ibidem, *JSZ 64-01-0126B2.*

Cape Evans, Ross Island: Lake A, the algae form bright green littoral benthic mats, 16 Jan. 1964, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 64-01-0060.*

Cape Royds, Ross Island: Coast Lake, with many bathing skuas, 27 Jan. 1963, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 63-12-0017.*

Description. Plant filamentous, flexible, up to 1.5 mm long; filaments uniseriate and unbranched; crosswalls not constricted; cells rectangular to more or less cylindrical, 1.0–1.5 times as long as wide, but twice as long as wide in the basal portion, 4.5–14.0 μm long, 4.0–14.0 μm in diameter; cell wall 0.5–4.0 μm thick; 1–2 pyrenoides; the single parietal reticulate chloroplast does not encircle the whole cell lumen; plants dull green, attached by single modified basal cells; zoospores and gametes not observed.

Remarks. This species has been found in water with a salinity varying between 0.1–0.6‰ (*JSZ 64-01-0061*) and 7.8–9.3‰ (*JSZ 64-01-0125B1/B2*). Hamel (1930) and some other authors are of the opinion that *U. implexa* is the freshwater to brackish water form of *U. subflaccida* Wille, 1901. Following Lokhorst & Vroman (1974: 567) the present authors consider both species to be distinct.

With regard to its depth distribution *U. implexa* is commonly present in littoral benthic mats, but it occurs also in enriched soil and in the plankton.

Geographical distribution. Subantarctic records. Falkland Islands, Berkeley Sound (Hooker, 1847), on wet rocks and in freshwater pools. Terre de Feu, Argentina (Ardissone, 1888; Hariot, 1892; Skottsberg, 1941).

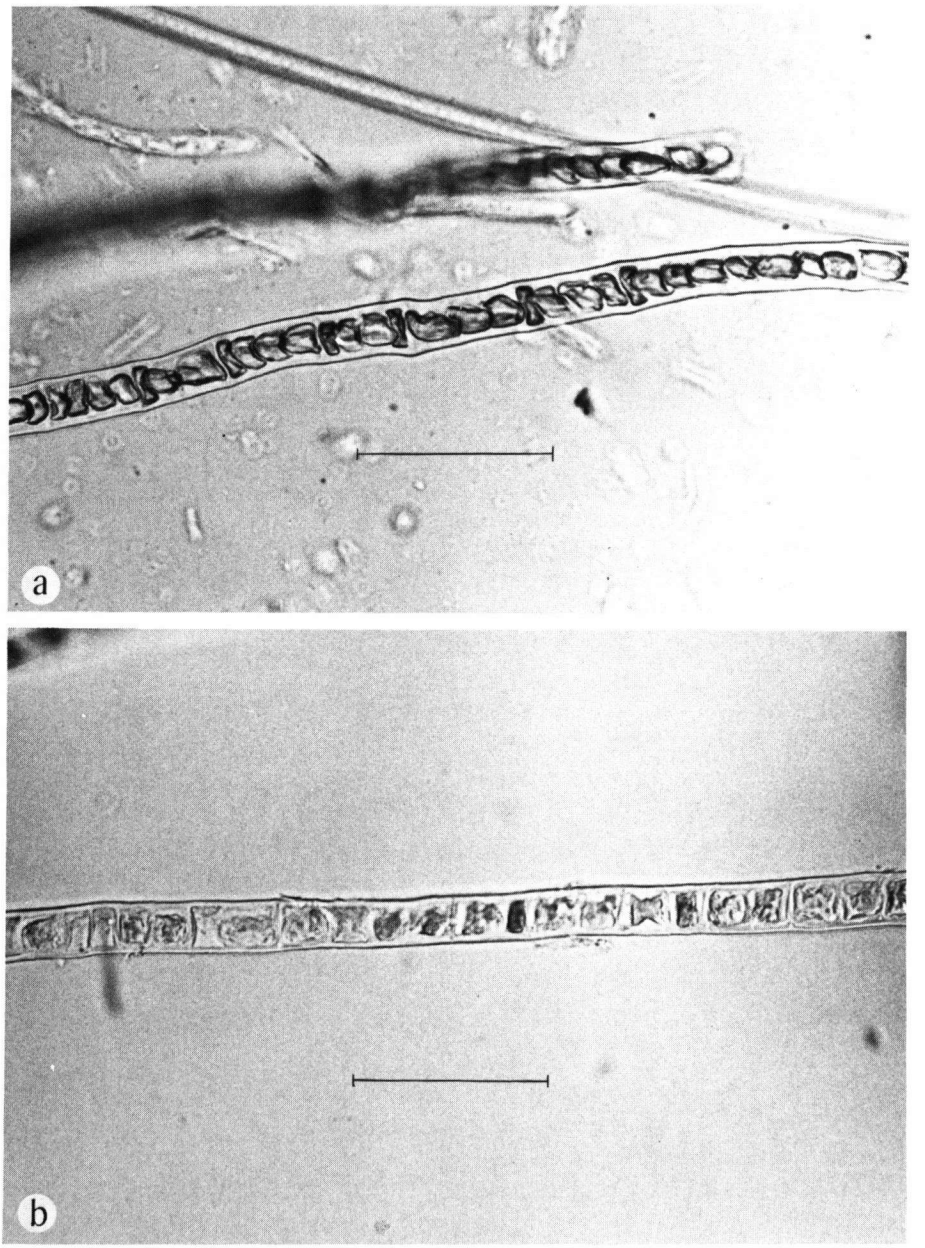


Fig. 5. *Ulothrix implexa* (Kützing) Kützing. a. (*JSZ 64-01-0126B1*); b. (*JSZ 64-01-0125A*); 50 µm indicated (Photogr. H.P. Wagner).

Antarctic records. Ross Island: Mt Erebus, on sloping, high moraines (West & West, 1911). West Antarctica (Skottsberg, 1941).

Cape Bird, Cape Evans, and Cape Royds at Ross Island are new range extensions for this species on this island.

Ulothrix australis Gain, 1911 — Fig. 6.

Ulothrix australis Gain, 1911b: 483; Gain, 1912: 15, figs. 1–6; Skottsberg, 1941: 75; 1953: 531; Delépine & Hureau, 1963: 112; Papenfuss, 1964: 1; Zaneveld, 1966a: 211; 1968: 11, pl. 13; 1969: pls. 1, 87, 88.
Ulothrix flacca (Dillwyn) Thuret in Jolis, 1863; Zaneveld, 1966b.

Material examined. Sandy Beach at the east coast of Macquarie Island, 24 Feb. 1965, leg. J.S. Zaneveld, J.M. Curtis & J.K. Fletcher, *JSZ 65-02-0281;* ibidem, on bird feathers, 24 Feb. 1965, leg. J.S. Zaneveld, J.M. Curtis & J.K. Fletcher, *JSZ 65-02-0288* (both samples preserved in an ethylalcohol formaldehyde mixture).

Description. Plant filamentous, flexible, up to 5.5 mm long; filaments uniseriate and unbranched, crosswalls not constricted; cells quadrangular to somewhat cylindrical, 0.5–1.5 times as long as wide, 5.0–18.0 μm long, 9.0–13.0 μm in diameter; cell wall 2.0–3.0 μm thick; up to 5 pyrenoids; the single parietal reticulate chloroplast covers the cell content; plant bright green, attached by single modi-

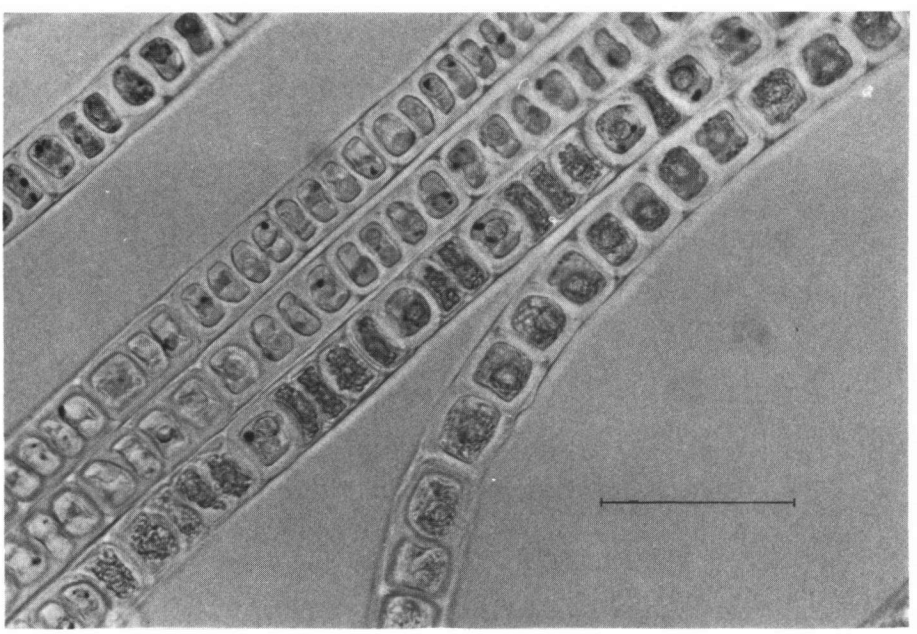


Fig. 6. *Ulothrix australis* Gain (*JSZ 65-02-0288*). Details of one long, folded filament; 50 μm indicated (Photogr. H.P. Wagner).

fied basal cells, each ending in a short rhizoid with a sharp tip; zoospores and gametes not observed.

Remarks. Due to its preservation in a mixture of ethylalcohol 70% and formaldehyde 4%, many filaments in our samples are de-coloured.

According to Delépine & Hureau (1963) this species is fertile during February. Most probably the alternation of the quadrangular cells with cylindrical cells is due to a beginning sporulation.

According to Dr. Lokhorst (pers. comm.) the number of pyrenoids and the shape of the cells makes this species conspecific with his *Ulothrix palusalsa*. If they indeed are one and the same species, then *U. palusalsa* Lokhorst is a later synonym of *U. australis* Gain.

With regard to its depth distribution *U. australis* is a littoral benthic species.

Geographical distribution. Antarctic records. Antarctic Peninsula: Deception Island (Gain, 1912); Goudier Island, Port Lockroy (Skottsberg, 1953); Wiencke Island (Skottsberg, 1953); Petermann Island (Gain, 1912); Grahamsland, west coast (Gain, 1911b); Louis Philippe Peninsula, Cape Roquemaurel (Skottsberg, 1941). Ross Sea: in the epilittoral zone around several islands (Zaneveld, 1966a, 1968). Adélie Coast: Pointe Géologie (Delépine & Hureau, 1963).

This is the first time that the species is recorded for Macquarie Island. Also, this is the first record of an Ulotrichalean alga for this island (compare Ricker, 1987).

Ordo **Acrosiphoniales**

Familia ACROSIPHONIACEAE

Genus *Urospora* Areschoug, 1866

Note regarding the genus *Urospora*. — There has always been much debate concerning the taxonomic position of *Urospora*. In the Antarctic literature the genus is generally treated as belonging to the Cladophorales. Parke & Dixon (1976) considered *Urospora* to belong to the Ulotrichales, while Lokhorst & Task (1981) in their revision of the western European *Urospora* assigned the genus to the order Acrosiphoniales. The latter named authors based their conclusion primarily on the kind of life cycle, containing an unicellular *Codiolum* sporophyte phase In accordance with them the present authors consider *Urospora* to belong to the Acrosiphoniales, as did Ricker (1987).

Urospora penicilliformis (Roth, 1806) Areschoug, 1874. — Fig. 7.

Conferva penicilliformes (Roth, 1806: 271).

Urospora penicilliformis, Reinbold, 1908: 186; Gain, 1912: 32, figs. 36–42; Hylmö, 1919: 11; Wille, 1924: 440; Papenfuss, 1964: 8; Hirano, 1965: 187; Zaneveld, 1969b: pls. 1, 87–89; Thérézien, 1976: 53; Lokhorst & Trask, 1981: 375, figs. 6, 7, pl. 5; Ricker, 1987: 52, fig. 23.

Urospora mirabilis, Levring, 1944: 4; Skottsberg, 1953: 533, 555.

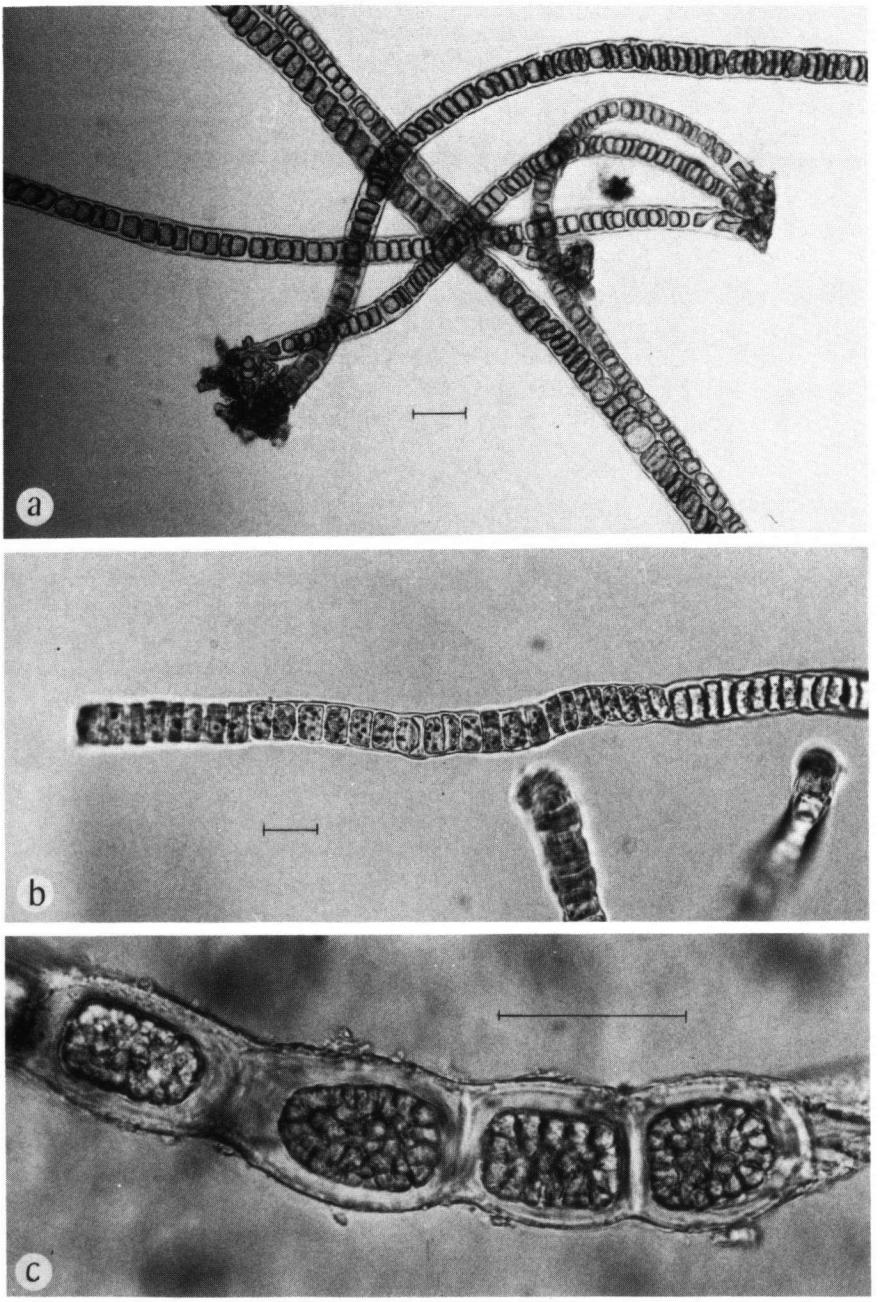


Fig. 7. *Urospora penicilliformis* (Roth) Areschoug. a. Thalli of plants (*JSZ 64-02-0104*); b. detail of a filament (*JSZ 63-12-0017*); c. sporangia (*JSZ 64-02-0102*); 50 µm indicated (Photogr. H.P. Wagner).

Material examined. Cape Hallett, Victoria Land: opposite Seabee Hook at the foot of the Manhaul Glacier, in a meltwater lake, 8 Feb. 1964, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 64-01-0101* (5 specimens); ibidem, *JSZ 64-02-0102* (5 specimens); ibidem, near Cape Hallett Station, washed ashore on a dead seaspider, 8 Feb. 1964, *JSZ 64-02-0103* (5 specimens).

Willett Cove, Victoria Land: littoral benthic along the northern corner of the cove, 8 Feb. 1964, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 64-02-0104* (4 specimens); ibidem, on pebbles with Cyanophyta 2 m offshore, 10 Feb. 1964, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 64-02-0104* (4 specimens).

Charcot Bay, near Cape Bruce, Victoria Land: 76° 08' S 162° 26' E.

Luther Peak, Victoria Land: plants bright green, between granite boulders where penguins rest, alt. 10 m, 1 Dec. 1964, leg. J.S. Zaneveld, J.M. Curtis & J.K. Fletcher, *JSZ 64-12-0107* (in part) (4 specimens).

Marble Point, Victoria Land: on rocks with Cyanophyta at low water, 14 Feb. 1964, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 64-01-0067* (2 specimens).

Cape Royds, Ross Island: in Coast Lake, a meltwater lake, NE of the Adélie penguin rockery, 27 Dec. 1963, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 63-12-0017* (2 specimens).

Description. Plant filamentous, forming mats; filaments uniseriate, unbranched, firm, up to 6 cm long; crosswalls not constricted (except between sporangia); multinucleate cells rectangular to barrel-shaped, 0.6–1.5 times as long as wide, 4.6–34.6 µm long, 4.6–39.2 µm in diameter; cell wall 1.2–16.2 µm thick, transparent; 5–20 pyrenoids; parietal reticulate chloroplast covers largely the cell content; plant dull to dark green attached by rhizoids derived from several modified lower basal cells of erect filaments; sporangia 1.5 times as long as wide, up to 60 µm long, up to 45 µm in diameter; zoospores 8–12 µm long, 5–8 µm broad, pyriform.

Remarks. Due to the large number of pyrenoids and the longer than wide sporangia this species clearly differs from those of *Ulothrix*. In young specimens the pyrenoids are inconspicuous and occur less frequently than in older specimens. The shape of the cells and the length of the filaments vary importantly. The rhizoids not developing from a single modified base of cell distinguishes *Urospora* from other uniseriate unbranched filamentous green algae such as *Ulothrix* and *Chaetomorpha*.

This species lives gregariously and forms firm thick green mats on the substrate of the littoral zone.

Geographical distribution. Subantarctic records. Crozet Islands (Levring, 1946); Kerguelen Islands (Reinbold, 1908); ibidem, Kerguelen Station in a freshwater pool (Wille, 1924; Hirano, 1965; Thérézien, 1976); Heard Island, Macquarie Island (Ricker, 1987).

Antarctic records. Antarctic Peninsula: Goudier Island, Port Lockroy (Skottsberg, 1953); Deception Island and Petermann Island (both Gain, 1912); Doumer Island, north side (Skottsberg, 1953); Grahams Land (Hylmö, 1919).

Wilkes Land: Cape Denison (Skottsberg, 1953); Mawson coast; Ingrid Christensen coast: Vestfold Hills (Ricker, 1987).

The species is recorded here for the first time from Victoria Land and Ross Island.

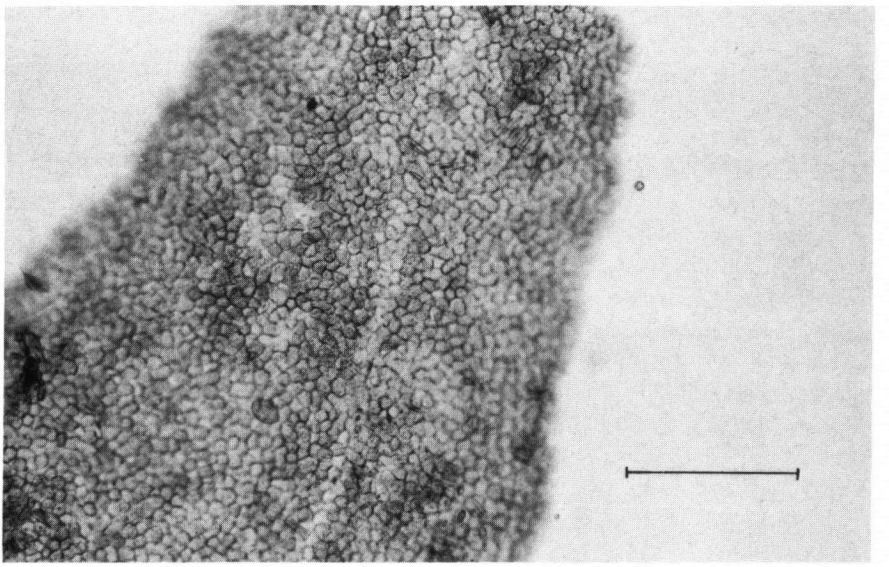


Fig. 8. *Monostroma hariotii* Gain (*JSZ 64-01-0067*). Surface view of thallus; 0.5 mm indicated (Photogr. H.P. Wagner).

Familia MONOSTROMATACEAE

Genus ***Monostroma*** Thuret, 1854

Monostroma hariotii Gain, 1911. – Fig. 8.

Monostroma hariotii Gain, 1911a: 726; 1912: 18, figs. 7a--11, pl. 1; Levring, 1944: 3, fig. 1a–b; Llaña, 1948: 21; Skottsberg, 1953: 531, 555; Delépine & Hureau, 1963: 112; Papenfuss, 1964: 2; Zaneveld, 1964: 68; 1966a: 211, 212; Delépine, MacKenzie Lamb & Zimmermann, 1966: 111, 115; Zaneveld, 1966b: 221 (fig. 1), 224–226 (table 1), 228; 1968: 11, pl. 13; 1969: 375, 378, fig. 7; 1969b: pls. 4–'6' (titles of plates 6 and 7 of this paper should be interchanged); Ricker, 1987: 32.

Monostroma harioti, Hylmö, 1919: 4, figs. 12–21; Delépine, MacKenzie Lamb & Zimmermann, 1970: 1975, figs. 4–9; Prescott, 1979: 44.

Material examined. Garden Cove, Bauer Bay, Macquarie Island: floating in tidepool, 25 Feb. 1965, leg. J.S. Zaneveld, J.M. Curtis & J.K. Fletcher, *JSZ 65-02-0514* (3 brownish green specimens).

Buckle Bay, Macquarie Island: at 46 m depth, 26 Feb. 1965, leg. J.S. Zaneveld, J.M. Curtis & J.K. Fletcher, *JSZ 65-02-0404* (2 specimens covered by diatoms and the red alga *Ballia callitricha* epiphytic on it).

Sandy Beach, Macquarie Island: just above the *Durvillea* zone, glistening when fresh, 24 Feb. 1965; leg. J.S. Zaneveld, J.M. Curtis & J.K. Fletcher, JSZ *65-02-0298* (45 dirty green, fragmented specimens).

Balleny Islands, Sturge Island: by trawling at depths between 177–182 m, 29 Jan. 1965, leg. J.S. Zaneveld, J.M. Curtis & J.K. Fletcher, *JSZ 65-01-0404* (2 specimens).

Off the west coast of Possession Island, Ross Sea: abundant at depths of 8–12 m, 21 Jan. 1965, leg. J.S. Zaneveld, J.M. Curtis & J.K. Fletcher, *JSZ 65-01-0232* (19 specimens, in association with *Phyllogigas grandifolius*).

14.4 km S of Possession Island, Ross Sea: plant green, collected by trawling between depths of 274–311 m, 20 Jan. 1965, leg. J.S. Zaneveld, J.M. Curtis & J.K. Fletcher, *JSZ 65-01-0216a* (1 specimen); ibidem, *JSZ 65-01-0216b* (3 specimens); ibidem, *JSZ 65-01-0216c* (2 specimens).

15 km S of Possession Island: plant green, collected by trawling at a depth of 348 m, 20 Jan. 1965, leg. J.S. Zaneveld, J.M. Curtis & J.K. Fletcher, *JSZ 65-01-0230* (2 specimens).

Ridley Beach, Victoria Land: washed ashore, 25 Jan. 1965, leg. J.S. Zaneveld, J.M. Curtis & J.K. Fletcher, *JSZ 65-01-0271* (18 specimens).

Robertson Bay, Victoria Land: plant green, collected by trawling at a depth of 91 m, 26 Jan. 1965, leg. J.S. Zaneveld, J.M. Curtis & J.K. Fletcher, *JSZ 65-01-0317a* (12 specimens); ibidem, plant dark green, collected by trawling at a depth of 97 m, 25 Jan. 1965, leg. J.S. Zaneveld, J.M. Curtis & J.K. Fletcher, *JSZ 65-01-0317b* (3 specimens); ibidem, plants green, collected by trawling at a depth of 183 m, 26 Jan. 1965, leg. J.S. Zaneveld, J.M. Curtis & J.K. Fletcher, *JSZ 65-01-390* (4 specimens); ibidem, at a depth of 68 m, *JSZ 65-01-0305*.

McMurdo Sound, Ross Sea: among the stomach contents of an Adélie penguin, 23 Dec. 1964, leg. H.J. Holloway, *JSZ 64-12-0077a* (several fragments); ibidem, *JSZ 64-12-0077b* (fragments).

3/4 mile off western side of Beaufort Island, Ross Sea: collected by Blake trawl at depths of 48–77 m, salinity 33‰, surface temperature sea water +1.2°C, 11 Jan. 1965, leg. J.S. Zaneveld, J.M. Curtis & J.K. Fletcher, *JSZ 65-01-0045* (67 specimens).

Tent Island (Delbridge Islands), Ross Sea: collected by dredging at a depth of 4 m, attached to pebbles, 30 Jan. 1964, leg. J.S. Zaneveld, J.M. Curtis & J.K. Fletcher, *JSZ 64-01-0152* (34 specimens).

Cape Bird, Ross Island: plants green, attached to rocks in furrows, 24 Jan. 1964, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 64-01-0079* (3 specimens); ibidem, by diving at 5 m along the western side of the peninsula, 25 Jan. 1964, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 64-01-0087* (6 specimens); ibidem, *JSZ 64-01-0089*; ibidem, collected by diving, 26 Jan. 1964, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 64-01-0097* (20 specimens); ibidem, collected by diving at 7 m depth, 26 Jan. 1964, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 64-01-0102* (6 specimens); ibidem, at a depth of 26 m, 26 Jan. 1964, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 64-01-0114* (3 specimens); ibidem, by diving at 7 m depth, 27 Jan. 1964, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 64-01-0115* (8 specimens); ibidem, collected by diving at a depth of 6 m, 30 Dec. 1964, leg. J.S. Zaneveld, J.M. Curtis & J.K. Fletcher, JSZ *64-12-0101* (19 specimens).

At the tip of Cape Bird, Ross Island: benthic at a depth of 3–5 m but also floating, 30 Dec. 1964, leg. J.S. Zaneveld, J.M. Curtis & J.K. Fletcher, *JSZ 64-12-0104* (5 specimens); ibidem, washed ashore on the farthest end of the peninsula, 27 Jan. 1964, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 64-01-0117* (21 specimens); ibidem, *JSZ 64-01-0120*.

Western side of Cape Bird, Ross Island: plants brownish on small pebbles at 5 m depth, 30 Dec. 1964, leg. J.S. Zaneveld, J.M. Curtis & J.K. Fletcher, *JSZ 64-12-0095* (16 specimens).

Cape Evans, Ross Island: plants attached to boulders and rocks in the sea in front of the beach at depths from 7 to 10 m, plants bright green when fresh, 17 Jan. 1964, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 64-01-0067* (11 specimens, some with sporangia).

Cape Crozier, Ross Island: off the shoreline on boulders at a depth of about 5 m along an extensive bed of *Iridaea obovata,* 14 Feb. 1964, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 64-02-0043* (11 specimens).

Ross Island: among the intestinal contents of an Adélie penguin, 24 Dec. 1964, leg. H.J. Holloway, *JSZ 64-12-0075* (several fragments).

Description. Plant cylindrical to subovate in shape, up to 51 cm long, up to 10 cm in diameter, consisting of only one layer of cells; basal cells 5–6 times as long as wide; apical cells 1.5–2.0 times as long as wide, 5.0–10.0 µm long, 7.5–15 µm in diameter; cells irregularly arranged; up to 5 pyrenoids; the lobed chloroplast does not cover the entire cell content; plant bright green to brownish green; zoospores 6–7 µm long, 4–5 µm in diameter, quadriflagellate; gametes not observed.

Remarks. This is the only known representative of the genus in Antarctica. The other two species recorded for Antarctica, *Monostroma endiviaefolium* A. & E.S. Gepp, and *M. applanatum* Gain, proved to be a rhodophycean alga of the genus *Porphyra* (Chamberlain, 1963) and a chrysophycean alga of the genus *Antarctosaccion* (Delépine et al., 1970), respectively.

Ricker (1987) in his treatise on Macquarie Island collected specimens of two *Monostroma* species on the island, a species 'a', possibly *M. latissimum* Wittrock sensu V.J. Chapman (1956: 379) and species 'b', closely allied to *M. parvum* V.J. Chapman (1956: 380).

As mentioned in this paper and reported already by Zaneveld (1966a: 212) *Monostroma hariotii* was collected by means of scuba-diving and trawling of an U.S.C.G. icebreaker down to a depth of 348 meters between Macquarie Island and Cape Crozier at the border of the Ross Ice shelf (77° 31' S and 169° 23' E). During cruises between the same two areas benthic brown and red seaweeds were also collected and some in even greater depths (Zaneveld, 1966a, 1966b, 1969). The depths were read from the icebreaker's depth recorder.

With regard to its vertical distribution *M. hariotii* is common in the region mentioned between the sea surface, in the littoral, sublittoral, and in the elittoral down to 348 meters. (For an explanation of this depth distribution, see the Introduction of this paper.)

Geographical distribution. Subantarctic records. Falkland Islands (Hylmö, 1919; Llaña, 1948); Magellaen Strait, Bahia de Margarita (Llaña, 1948). Macquarie Island (Ricker, 1987; Wagner & Zaneveld, 1988, present paper).

Antarctic records. Antarctic Peninsula: Casablanca Island near Wiencke Island (Gain, 1911a, 1912; Skottsberg, 1953); Petermann Island and Deception Island (both Gain, 1911a, 1912); Doumer Island (Skottsberg, 1953); Graham's Land (Hylmö, 1919; Llaña, 1948). Antarctic continent: Adélie Coast, Pointe Géologie (Delépine & Hureau, 1963); Wilkes Land, Cape Denison (Skottsberg, 1953).

In the present paper this species is reported for the first time from several localities in the western Ross Sea, off Sturge Island and from Macquarie Island.

Ordo **Prasiolales**

Familia PRASIOLACEAE

Genus ***Prasiola*** (C.Agardh, 1821) Meneghini, 1838

Prasiola crispa (Lightfoot) Meneghini, 1838 var. **antarctica** (Kützing) Kützing Knebel, 1935 forma **antarctica** (Kützing) Knebel, 1935 — Fig. 9; Photos 3 & 6.

Ulva crispa Lightfoot, 1777: 972; Hooker, 1847: 498; Fritsch, 1917: 4.

Prasiola crispa: Wille, 1902: 207, pls. 3 & 4; Holmes, 1905: 197; Hariot, 1908: 3; West & West, 1911: 267, 268, 272, pl. 24, figs. 8, 9, 12–18; Gain, 1912: 157, 178, 193, 197; Holmes, 1912: 87; Fritsch, 1912: 329, fig. A; 1912a: 16, text-figs A–D; Carlson, 1913: 52, 73; Fritsch, 1917: 4; Lucas, 1919: 5; Wille, 1924: 403; Drouet, 1961: 10; Rudolph, 1963: 585; Hirano, 1965: 128, 133, 135–137, 152, 195; Rudolph, 1966: 114; Ugolini & Moul, 1966: 129; Baker, 1967: 461, fig. 3b; Longton, 1967: 221, 232; Tilbrook, 1967: 334, 337, 340, 342, 346; Fukushima, 1969: 60; Rudolph, 1970: 813, fig. 1B; Gimingham & Smith, 1970: 771; Tilbrook, 1970: 887; Greene & Longton, 1970: 792; Parker et al., 1972: 78; Schofield & Ahmadjian, 1972: 99; Kol, 1973: 59; Prescott, 1979: 54; Seaburg et al., 1979: 56, pl. 17, fig. 60a–c.

Prasiola crispa subsp. *antarctica* (Kützing) Knebel, 1935: 20; Ricker, 1987: 46, fig. 23.

Prasiola crispa subsp. *antarctica* forma *antarctica* (Kützing) Knebel, 1935: 21, fig. 10e–g; Papenfuss, 1964: 4; Zaneveld, 1966a: 211; Kobayashi, 1967: 213; Zaneveld, 1968: 11; 1969b: 35–41; Ahmadjian, 1970: 805.

Prasiola crispa var. *antarctica* (Kützing) Knebel, Fukushima, 1959: 5.

Prasiola crispa var. *aspera* West & West, 1911: 273, pl. 24, figs. 8 & 9.

Prasiola crispa var. *inflata* Fritsch, 1917: 9, pl. 1, fig. 14.

Prasiola crispa forma α Fritsch, 1917: 9, pl. 1, fig. 15.

Prasiola crispa forma ß Fritsch, 1917: 9, pl. 1, figs. 1–3, 6–10.

Prasiola crispa forma γ Fritsch, 1917: 9, pl. 1, figs. 4 & 5.

Prasiola antarctica Kützing, 1849: 473; 1855: t. 40, fig. 4; Borge, 1901: 9; West & West, 1911: 269, 273, pl. 24, figs. 10 & 11; Fritsch, 1912a: 17, text-figs. E & F; Carlson, 1913: 72; Wille, 1924: 403; Hirano, 1965: 135, 152, 187; Prescott, 1979: 53.

Prasiola fluviatilis (Sommerfelt, 1827) Areschoug, 1866: 6 forma *antarctica* Wille, 1924: 403; Hirano, 1965: 187; Parker et al., 1972: 72.

Prasiola georgica Reinsch, 1890: 355, pl. 4, figs. 8 & 9; Gain, 1912: 196; Kobayashi, 1967: 216.

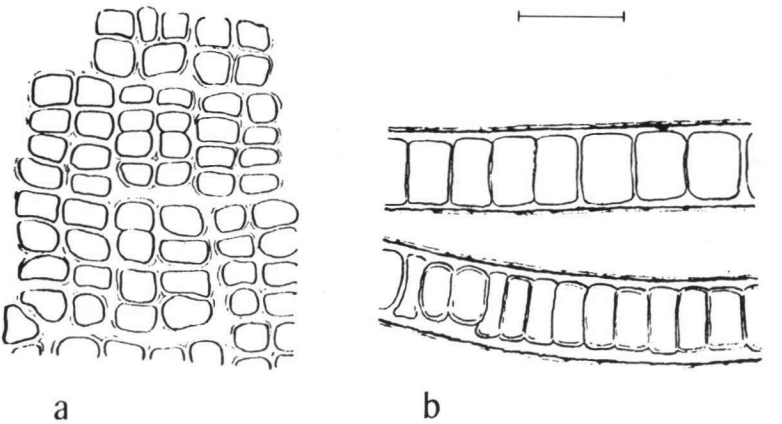


Fig. 9. *Prasiola crispa* (Lightfoot) Menethini var. *antarctica* (Kützing) Knebel. a. Surface view of thallus; b. *Hormidium*-stage; 20 μm indicated (after Kobayashi, 1967).

Material examined. Cockburn Island off Antarctic Peninsula at 64° 13' S, 57° 00' W: Botany of the British Antarctic Voyage, leg. J.D. Hooker, 6 Jan. 1843, in Herb. JSZ (syntype).

Melchior Archipelago, small island NE of Lysted Island off the Antarctic Peninsula: U.S. Antarctic Expedition, 1940–1941, leg. E.A. Siple, 6 March 1941, in Herb. JSZ.

Cape Hallett, Victoria Land: in a shallow meltwater lake at the foot of the Manhaul Glacier opposite Seabee Hook, 8 Feb. 1964, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 64-02-0107*.

Charcot Bay, near Cape Bruce, 76° 08' S 162° 26' E, Victoria Land: plant bright green, between granite boulders where penguins had rested, alt. 10 m, 1 Dec. 1964, leg. J.S. Zaneveld, J.M. Curtis & J.K. Fletcher, *JSZ 64-12-0107* (in part).

Depot Island, Ross Sea: on granite rocks, alt. c. 60 m, 18 Nov. 1964, leg. J.S. Zaneveld, J.M. Curtis & J.K. Fletcher, JSZ *64-11-0023*.

The Flat Iron, Granite Harbour, Victoria Land: in a cavity on tape of a granite boulder, alt. c. 11 m, 24 Feb. 1964, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 64-02-0084;* ibidem, on rocks, alt. 12 m, 25 Feb. 1964, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 64-02-0088;* ibidem, *JSZ 64-02-0090;* ibidem, very abundant on granite boulders where Adélie penguins had rested, plants bright green, alt. 250 m, 1 Dec. 1964, leg. J.S. Zaneveld, J.M. Curtis & J.K. Fletcher, *JSZ 64-12-0001;* ibidem, in a crevasse between granite boulders, plant bright green when fresh, alt. c. 180–250 m, 2 Nov. 1964, leg. J.S. Zaneveld, J.M. Curtis & J.K. Fletcher, *JSZ 64-11-0002*.

Beaufort Island, Ross Sea: in a shallow meltwater lake enriched by penguin fæces and on soil, 11 Jan. 1965, leg. J.S. Zaneveld, J.M. Curtis & J.K. Fletcher, *JSZ 65-01-0066*.

Cape Bird, Ross Island: between rocks on a slope, alt. 12 m, 3 Nov. 1964, leg. J.S. Zaneveld, J.M. Curtis & J.K. Fletcher, *JSZ 64-11-0003;* ibidem, at the foot of Mount Bird on rocks wetted by meltwater, plants bright green when fresh, 26 Jan. 1964, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 64-01-0112.*

Cape Royds, Ross Island: on volcanic rocks, alt. 4.5 m, 26 Dec. 1963, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 63-12-0009;* ibidem, on the top of a hill in a 30 cm deep pond, 27 Dec. 1963, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 63-12-0018.*

Cape Evans, Ross Island: on a slope of basaltic lava where skuas breed, plants dark green when fresh, 14 Jan. 1964, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 64-01-0031A.*

Cape Crozier, Ross Island: in the lower part of a penguin rookery on its eastern sloping side, 20 Jan. 1964, leg. Ed. Schofield, *JSZ 64-02-0039;* ibidem, in snow on a slope of lava ash, plants bright green when fresh, alt. 40 m, 1 Nov. 1964, leg. leg. J.S. Zaneveld, J.M. Curtis & J.K. Fletcher, *JSZ 64-11-0001.*

Possession Island, Ross Sea: on the edge of an 80 m high cliff near an abandoned penguin rookery among volcanic rocks, 1 Dec. 1964, leg. J.L. Gressitt & J. Schoup, *JSZ 64-12-0057;* ibidem, *JSZ 64-12-0059.*

Description. In the complicated life cycle of this species the following three stages – already reported by Fritsch (1917) – can be observed:

a. *Hormidium*-stage: plants filamentous, uniseriate, unbranched; cells 0.25–1.0 times as long as wide, 40–70 µm long, 4.5–9.0 µm in diameter; cell wall 0.25–3.0 µm thick; one pyrenoid; chloroplast does not encircle the whole cell lumen; plants light to dark green coloured.
b. *Schizogonium*-stage: plants filamentous as in the *Hormidium*-stage, but at several places an active division of cells into quartets can be observed.
c. *Prasiola*-stage: plants foliaceous, small, up to 100 mm long (*JSZ 64-11-0023*), with an average length of 30–40 mm; the one cell thick blade narrows towards its base and forms a short stipe; cells quadrangular to somewhat cylindrical, 1.0–1.5 times as long as wide, 4.5–9.0 µm long, 4.5–9.0 µm in diameter; cells regularly ordered in quartets; cells with a centrally located star-shaped chloroplast with one pyrenoid; plant dirty, dark green; aplanospores and gametes not observed.

Remarks. This is a very common variety on the Antarctic continent, where it can be found high above the mean sea level on rocks and isebergs exposed to the air and spraying sea water. In addition, it may abound at places where Adélie penguins have rested and deposited their excrements. The variety is also found along the moisty borders of meltwater lakes. It is an aerial alga that does not grow submerged. The taxon is characteristic for the epilittoral zone.

Geographical distribution. Subantarctic records. Southern Patagonia (Borge, 1901); Falkland Islands (Hooker, 1847; Gain, 1912; Carlson, 1913; Kobayashi, 1967); Kerguelen Islands (Reinbold, 1908; Carlson, 1913); South Shetland Islands, Nelson Island (Carlson, 1913); South Orkney Islands (Holmes, 1905, 1912; Fritsch, 1912; Tilbrook, 1967; Smith, 1972); Cockburn Island (Hooker, 1847; Holmes, 1905, 1912; Gain, 1912); South Georgia Island (Carlson, 1913);

Bouvet Islands, South Sandwich Islands (Tilbrook, 1967); Macquarie Island (Ricker, 1987; Wagner & Zaneveld, 1988).

Antarctic records. Victoria Land (Wille, 1902, 1924; Fritsch, 1912a; Rudolph, 1963; Ugolini & Moul, 1966; Baker, 1967; Kobayashi, 1967; Seaburg et al., 1979); Wilkes Land and Adélie Coast (both Lucas, 1919); Queen Mary Land, Mirny (Kol, 1968), Ingrid Christensen Coast, Vestfold Hills (Ricker, 1987); Prince Olav Coast, Ongul Islands; Haswell Island (Kol, 1973)

Ross Sea (Drouet, 1961; Zaneveld, 1966a, 1968); Possession Island; Beaufort Island (Zaneveld, 1988); Ross Island (Wille, 1902, 1924; West & West, 1911; Fukushima, 1964; Zaneveld, 1964, 1966a; Cameron, 1966; Schofield & Ahmadjian, 1972); Antarctica (Carlson, 1913; Fukushima, 1969).

This paper presents the first records of this taxon of Possession Island, Beaufort Island, several locations on Wilkes Land, and the Ross Sea.

Ordo **Cladophorales**

Familia CLADOPHORACEAE

Genus ***Chaetomorpha*** Kützing, 1845

Chaetomorpha mawsonii Lucas, 1919. — Fig. 10.

Chaetomorpha mawsonii Lucas, 1919: 6, pl. 4, figs. 1–3; Papenfuss, 1964: 5; Ricker, 1987: 54.

Material examined. Off Possession Island, Ross Sea (71° 56' S, 171° 10' E), abundantly present at depths of 8–14 m off the western coast of the island in front of an Adélie penguin rookery in association with *Monostroma hariotii, Desmarestia willii,* and *Ballia callitricha,* 21 Jan. 1965, leg. J.S. Zaneveld, J.M. Curtis & J.K. Fletcher, *JSZ 65-01-0232* (73 specimens).

Balleny Islands: Borradaile Island: washed ashore, 10 Feb. 1965, leg. J. S. Zaneveld, J.M. Curtis & J.K. Fletcher, *JSZ 65-02-0086B* (6 specimens); ibidem, 14 Feb. 1965, *JSZ 65-02-0239.*

Cape Evans, Ross Island: by diving at 1.9 m depth, 15 Jan. 1964, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 64-01-0040;* ibidem, *JSZ 64-01-0232* (3 specimens).

Description. Plant uniseriate, unbranched, filamentous, up to 170 mm long, attached to the substrate by long furcating rhizoids which derive from modified basal cells, each rhizoid ends in a conical disk for attachment; filaments rigid and firm; most cells cylindrical, 3–4 times as long as wide, up to 1100 μm long and up to 480 μm in diameter, becoming more and more inflated towards the apex of a filament; cylindrical cells interspersed at times by oval spherical cells, up to 2000 μm long; cell wall 60–80 μm thick, evidently three layered with slightly pronounced constrictions at the joints; up to 27 nuclei per cell; the single chloroplast parietal reticulate, cruciform in oval spherical cells; pyrenoids numerous; the rhizoids form a kind of lozenge-shaped holdfast, 4000 μm long and up to 1750 μm wide at the base; plants glistening bright green; zoospores and gametes not observed.

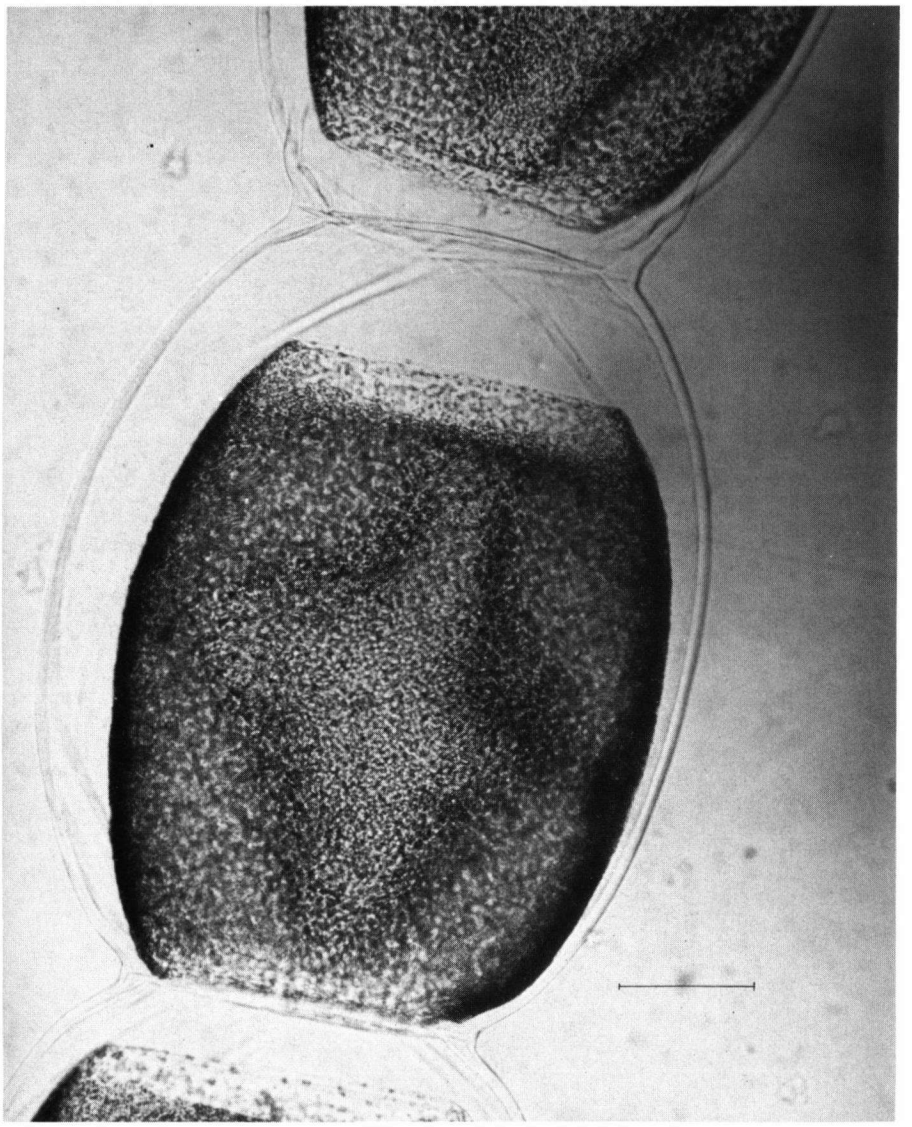


Fig. 10. *Chaetomorpha mawsonii* Lucas (*JSZ 65-02-0233*). Detail of a spherical cell; 100 μm indicated (Photogr. T.N. Sanderlin).

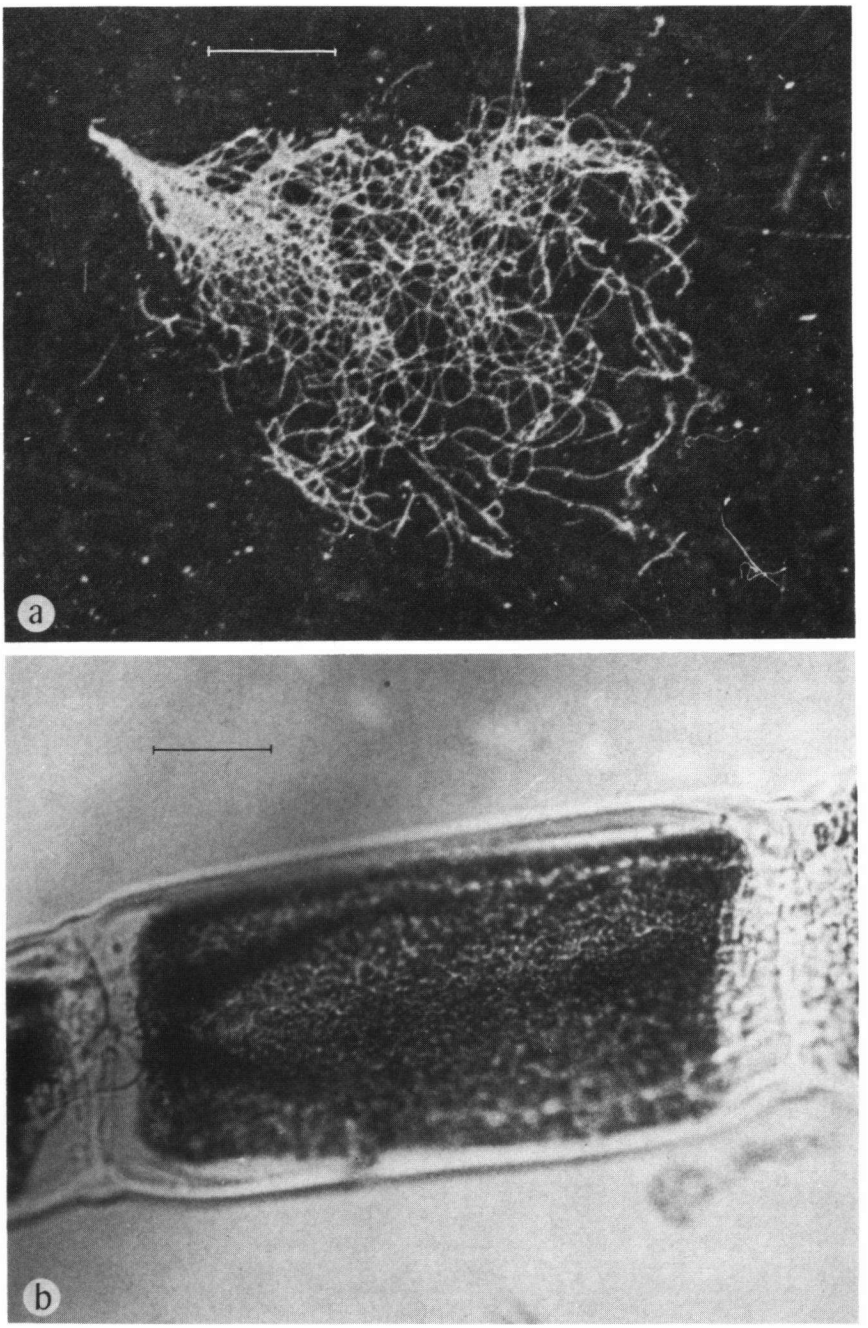


Fig. 11. *Lola irregularis* Zaneveld (*JSZ 64-01-0094B*). a. Thallus of the holotype; 1 mm indicated; b. detail of a; 10 μm indicated (Photogr. T.N. Sanderlin).

Remarks. The material at our disposal fit very well with Lucas' (1919) description, except that his plants were a little taller (26 vs 17 cm) and the diameter of the holdfasts were somewhat larger (1750 vs 293 µm). A characteristic of our plants is that they adhere very well to paper. With regard to its depth distribution *Chaetomorpha mawsonii* is a sublittoral benthic species.

Geographical distribution. Antarctic records. Balleny Islands (Kol, 1968, 1971; Kol & Flint, 1968).

The present records are the first for the Ross Sea (off Possession Island), Antarctica.

Genus *Lola* A. et G. Hamel, 1929

Lola irregularis Zaneveld, 1966. — Fig. 11.

Lola irregularis Zaneveld, 1966: 47, figs. 1–3; 1969b: pl. 71.

Material examined. Depot Island, Ross Sea: plants attached to rocks at a depth of 31 m, collected by scuba-diving, 18 Nov. 1964, leg. J.S. Zaneveld, J.M. Curtis & J.K. Fletcher, *JSZ 64-11-0026a.*

Cape Bird, Ross Island: washed ashore attached to *Bryozoa,* plants bright green when fresh, 25 Jan. 1964, leg. J.S. Zaneveld & W.I. Simmonds, *JSZ 64-01-0094B* (in part) (holotype); ibidem, plants light green, in a meltwater stream, 30 Dec. 1964, leg. J.S. Zaneveld, J.M. Curtis & J.K. Fletcher, *JSZ 64-12-0094.*

Description. Plant consists of an entangled mass of free floating light green filaments, 10–15 mm long or attached by a triangular shaped, compact, closely interwoven stratum of rhizoids; filaments rather flexible, curved in different directions, cylindrical throughout; cells irregular in shape, 1.0–1.5 times as long as wide, 6.9–16.2 µm long, 5.4–9.2 µm in diameter; cell wall 1.0–2.3 µm thick, transparent; 5–20 parietal nuclei per cell, and 1–3 pyrenoids; chloroplasts reticulate; rhizoidal protuberances few, usually absent; plant light green; zoospores and gametes not observed.

Remarks. Besides the fact that this is the only species belonging to this genus known from the Antarctic region, this species can be easily separated from all other *Lola* species by the irregular size of the cells, the small diameter of the filaments (not exceeding 10 µm), and the thickness of the cell walls (Zaneveld, 1966).

Lola can be distinguished from *Ulothrix* by the number of parietal nuclei and the irregular shape of the cells. With regard to its depth distribution *Lola irregularis* is a sublittoral benthic species.

Geographical distribution. Antarctic records. Cape Bird, Ross Island: (Zaneveld, 1966, type locality; 1969b).

ACKNOWLEDGEMENTS

In carrying out this study and preparing the present paper we wish to thank Professor C. Kalkman, Director of the Rijksherbarium, Leiden, for his constant interest and for providing the oppor-

tunity to carry out the work in his institute. We also want to recognize the valuable assistance of Drs. G.M. Lokhorst and W.F. Prud'homme van Reine, phycologists at the Rijksherbarium, for discussing taxonomic problems, and of Dr. P.W. Leenhouts, tropical phanerogamist at the same institution, for reading the manuscript.

The senior author is particularly indebted to the late Dr. Francis Drouet, phycologist at the Philadelphia Museum of Natural Sciences, U.S.A. for the constant interest and encouragement in these Antarctic algae studies.

In collecting and preparing the material the senior author wants to recognize the outstanding assistance of the then Old Dominion University students, W.I. Simmonds (1963–1964), J.M. Curtis and J.K. Fletcher (1964–1965), and L.L. Nero and D.M. Bresnahan (1967) at Norfolk, Virginia, U.S.A., and in particular for overcoming cheerfully with me the hardships of camping on the ice and diving in the inhospitable subzero Antarctic waters. My thanks are also due to the then O.D.U. student T.N. Sanderlin, Norfolk, VA, for figures 10 and 11.

The senior author is grateful to acknowledge the assistance of the Office of Polar Programs, National Science Foundation, Washington, D.C. for support of grants GA-50, GA-150, and GA-877 and to the U.S. Navy Task Force 43, Antarctica for the most valuable logistic support.

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