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SOME SOIL ALGAE FROM THE ARCTIC ALASKA, CANADA AND GREENLAND

By

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Introduction

Through the kindness of Dr. Yosio KOBAYASI of the National Science Museum of Tokyo, the author had an opportunity to study the soil algal materials of the Arctic Alaska, Canada and Greenland collected by the members of the Japanese Microbiological Expedition to the Arctic region in the summer of 1968.

The algae of the Arctic region were hitherto reported by many authors, chiefly R. BOLDT, O. BORGE, F. BÖRGESEN, A. CLEVE, F. HUSTEDT, E. KOL, G. KRASKE, O. NORDSTEDT, E. OSTRUP, J. B. PETERSEN and others (cited from HIRANO, 1965). Recently, G. W. PRESCOTT and W. C. VINYARD (1935) published an ecological study and detailed systematic list of algae especially on Cyanophyta, Chlorophyta, Euglenophyta, Chrysophyta and Pyrrhophyta. And also H. CROASDALE (1958, 1962, 1965) and H. CROASDALE and R. GRÖNBLAD (1964) reported especially on the desmids flora of this region. On the European Arctic algal flora, J. KRISTIANSEN (1964) described especially of some Flagellates from Finnish Lapland. In 1965 and also in 1968, the Japanese Microbiological Expedition to the Arctic region was carried out under the direction of Dr. Yosio KOBAYASI. Subsequently, in 1967, 1968, several reports concerning to the first Japanese Microbiological Expedition to the Alaskan Arctic in 1965 have been issued by following authors *viz.* M. CHIHARA (marine algae), T. YAMAGISHI (filamentous Chlorophyceae), Y. KOBAYASI (cryophytic algae and *Prasiola* species), K. MARUYAMA (Cyanophyceae), H. FUKUSHIMA and *et. al.* (diatoms) and M. HIRANO (desmids). Most of these reports are, however, chiefly contributed to the knowledge of the freshwater algae rather than the soil algae of this region.

Hereby, the author deals with some ecological notes and taxonomic list of the soil algae of the Arctic Alaska, Canada and Greenland.

Greatest thanks are due to Dr. Yosio KOBAYASI of National Science Museum of Tokyo who kindly afforded an opportunity for the studying on the materials.

Cordial thanks are also due to Professor Emertius Yukio YAMADA of Hokkaido University and Professor Hiroyuki HIROSE of Kobe University for their kind criticism and encouragement.

Ecological Notes

1. Collecting localities: The soil materials used in this study were collected by the

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members of the Japanese Microbiological Expedition to the Arctic Alaska, Canada and Greenland in July and August of 1968. For the most part of this area an agro-type is an arctic coastal plain tundra and heath district containing nummerous bogs, lakes and coastal lagoons (KOBAYASI, 1967, 1969). Majority of the soil materials are obtained from the surfaces of such tundra peat soil, heath soil and shores of lagoon. Other few materials (sample no. 6801-6805) were collected vertically with 30 cm intervals from the surface. In the Valley of Willow, Alaska, the permanent frost under the peat soil was observed in 120 cm depth. The collecting localities are described in Table 1 and Figure 1.

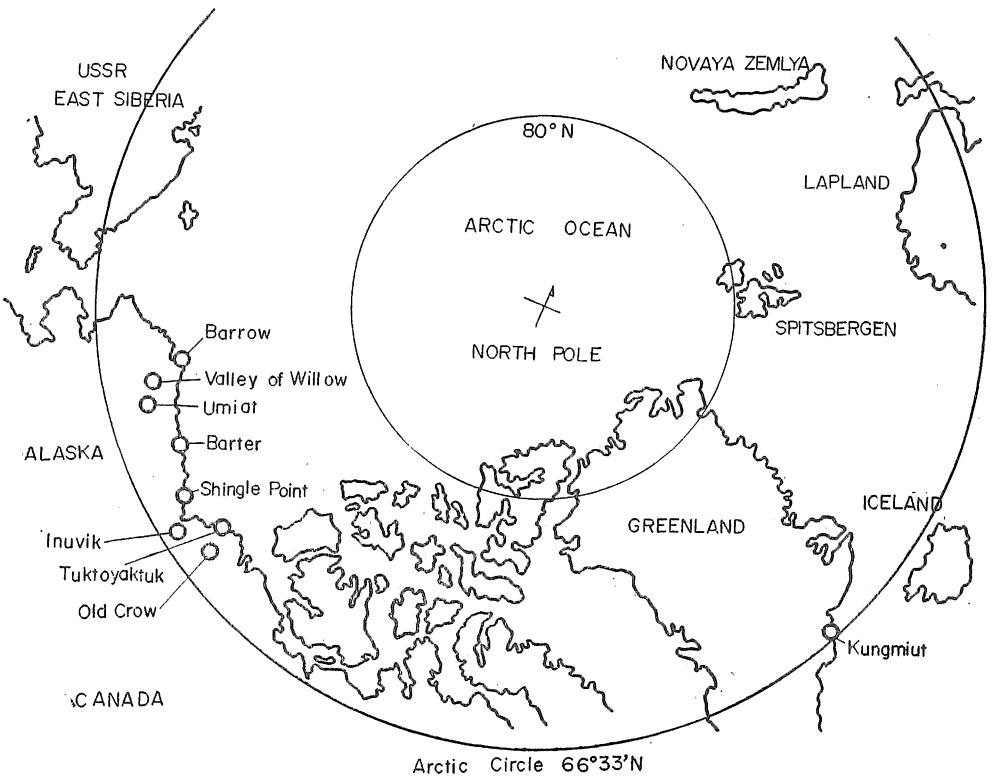

Fig. 1. A map showing collecting localities in the Arctic Alaska, Canada and Greenland.

2. General feature of algal community : The general feature of the soil algal communities of the Arctic Alaska, Canada and Greenland is characterized by the predominance of the chlorophytan algae (more than 50 percent of the taxa). Such algae as *Hormidium pseudostichococcus* HEERING, *H. subtile* (KUET.) HEERING, *Stichococcus bacillaris* NAEG., *Chlamydomonas* spp, *Chlorococcum* sp. and *Radiosphaera dissecta* (KORSCHIK.) STARR are commonly recognized. The certain chlorophytan algae known as a cryophyte, or snow algae, such as *Scotiella nivalis* (SCHUTT.) FRITSCH and *Koliella tatrae* (KOL) HINDÁK var. *tatrae* (KOL) HNDÁK are recognized in cultures of peat and sandy soils. Such an occurrence of these cryophytic algae in a soil terrestrial state has already

Table 1. Soil samples collected in arctic Alaska, Canada and Greenland.

sample no.	locality	date	note
6801-05	Valley of Willow, Alaska	Jul. 24	river side
6806	Lagoon near Barrow, Alaska	Jul. 23	lagoon
6815, 6816	Shingle point, Alaska	Jul. 14	peat soil
6821	Inuvik, East Valley, Canada	Jul. 15-18	heath soil
6823	Inuvik, East Valley, Canada	Jul. 17-18	peat soil
6831	Tuktoyaktuk, Canada	Jul. 17-18	peat soil
6832	〃	〃	dry black soil
6835	〃	〃	sandy soil
6836	〃	〃	heath soil
6839	Old crow, Canada	Jul. 19	forest soil
6840	〃	〃	peat soil among forest
6842	〃	〃	river side
6843	Barter Island, Alaska	Jul. 14, Jul. 21	sandy soil along coast line
6849	〃	〃	dry black soil
6851	〃	〃	soil in marshy places
6854-56	Umiat, Alaska	Jul. 24	
6871	Kungmiut, Greenland	Aug. 8	peat soil
6873	〃	〃	sandy soil
6878	〃	〃	sandy peat soil soil
6879	〃	〃	among moss
6881	〃	〃	soil among moss

Table 2. Comparison of the soil algal floras of the Arctic region and the Antarctica

	arctic region (mostly tundra and heath)				antarctic region (mostly sandy soil)		(peat)
	Alaska, Canada and Greenland[1]	USSR [2]	USSR [3]	USSR [4]	[5]	Ongul Isl. [6]	New Zealand[7]
CHLOROPHYCEAE	28	23	29	60	13	16	8
CYANOPHYCEAE	8	9	32	43	4	9	4
XANTHOPHYCEAE	12	14	9	20	2	4	−
BACILLARIOPHYCEAE	3	11	21	9	+	3	1
EUGLENOPHYCEAE & CHRYSOPHYCEAE	2	−	2	2	−	−	1
total	53	57	93	134	19(+)	32	15

1) AKIYAMA (in this study), 2) DROGOSTAISKAYA and NOVIKOVA-IVANOVA, 1967, 3), 4) HOLLERBACH and SHTINA, 1969, 5) HOLM-HANSEN, 1964, 6) AKIYAMA, 1967, 7) FLINT and FINERAN, 1959

been recognized in the Antarctican sandy soil and in some Japanese alpine soil (AKIYAMA, 1965, 1967).

Making a comparison between the soil algal community of the arctic region and that of the Antarctica (Table 2), it should be noticed that both floras of the Arctic region and the Antarctica are characterized by their chlorophycean dominancy. However, there is some differences in the ratio between Cyanophyta and Xanthophyta. Namely, in the Antarctica, the occurrence of cyanophytan members is remarkably common both in qualitatively and quantitatively compared with that of xanthophytan algae. In fact the natural algal growths found in this region were mostly composed of such algae as *Synechococcus aeruginosus* NAEG., *Aphanocapsa grevillei* (HASS.) RABENH., and *Nostoc punctiforme* (KUETZ.) HARTOT (AKIYAMA, 1967), on the contrary, in the Arctic region, relatively to xanthophytan algae the cyanophytan member are scarce. *Nostoc punctiforme* (KUETZ.) HARIOT, *Phormidium tenue* (MENEGH.) GOMONT and *Oscillatoria terebriformis* AG. are relatively common species found in this region. In marked contrast to cyano-

Table 3. Relationship of an agro-type and algal community

Algae		Agro-type	
Class	Species	Tundra peat soil	Heath soil
CHLOROPHYCEAE	*Chlamydomonas* spp.	+	+
	Stichococcus bacillaris	+	+
	Hormidium subtile	+	+
	Microthamnion kuetzingianum	+	+
	Leptosira terricola		+
	Scotiella nivalis	+	
	Bracteacoccus irregularis	+	
	Bracteacoccus minor	+	+
	Chlorococcum sp.	+	
	Radiosphaera dissecta	+	
	Selenastrum westii	+	
	Kentrosphaera bristolae	+	
	Trochiscia reticularis	+	
	Mesotaenium endlicherianum	+	
	Cosmarium tatricum v. *minor*	+	
	Oedogonium sp.	+	
XANTHOPHYCEAE	*Monodus subterraneus*	+	+
	Botrydiopsis arhiza	+	+
	Heterothrix exilis	+	
	Tribonema aequalis	+	
CYANOPHYCEAE	*Phormidium tenue*	+	
	Oscillatoria terebriformis	+	
	Nostoc punctiforme		+
EUGLENOPHYCEAE	*Euglena pascheri*		+
CHRYSOPHYCEAE	*Chrysosaccus sphaericus*	+	
BACILLARIOPHYCEAE	*Pinnularia borealis*	+	+
	Nitzschia obtusa v. *scalpelliformis*		+
	Hantzschia amphioxys	+	

phytan algae, xanthophytan members commonly appeared in this region. Such algae as *Monodus subterraneus* PETERSEN, *Heterothrix exilis* PASCHER and *Botrydium arhiza* BORZI are common species found in this region.

An interesting chrysophytan alga *Chrysosaccus sphaericus* BOURRELLY was recognized from the culture of peat soil collected in Inuvik, Canada.

The relationship between an agro-type and algal community is shown in Table 3. It will be seen from these data that the algal elements of the community found in peat soil (mostly tundra peat) of this region is relatively complicated compared with that of the heath soil algal community. According to PETERSEN (1932) and JOHN (1942), in the algal communities of subarctic Danish heath and English heath, the species concerned have usually belonged to the Chlorophyta such algae as *Chlamydomonas*, *Chlorococcum*, *Geminella*, *Hormidium* and *et. al.* and few species of xanthophytan algae. Moreover, the algal components of these districts are rather limited. In this respect the algal community of the Arctic Alaska, Canada and Greenland heath mostly resembled that of Danish and English heaths in temperate region. However, in the Arctic heath soil community, certain species of Cyanophyta were observed and the ocourrence of such cyanophytan algae has been reported from a subantarctican peaty soil of tussock grass-land heath in the Snares Island, New Zealand by FLINT and FINERAN (1969).

Taxonomic List

The following list includes twenty-eight species of Chlorophyceae, twelve species of Xanthophyceae, one species of Euglenophyceae, one species of Chrysophyceae, three species of Bacillariophyceae and eight species of Cyanophyceae, all totals fifty-three species.

CHLOROPHYCEAE

Chlamydomonas agloeformis PASCHER

PASCHER, 1927 : Volvocales in PASCHER Süsswasserfl. H. 4 : 252, f. 206.

Cells oblong to elliptical in front view and semi-plane-lenticnlar in side view, with very small anterior papilla ; chromatophore a single H-shaped, with a single central pyrenoid ; eye spot anterior and lateral ; cells 13-18.5μ long, 6-7μ broad, 4-5μ in thickness.

St. 6855.

Chlamydomonas concinna GERLOFF

GERLOFF, 1940 ; *Arch. Protist.* 94 : 374, f. 34.

Cells elliptical to cylindrical, with small anterial papilla ; chromatophore a single cup-shaped, with a single pyrenoid located in the center of the chromatophore ; eye spot anterior and lateral ; cells 12-17 μ long, 7-9 μ broad.

St. 6831.

A number of *Chlamydomonas* sp. in the state of palmelloidal form were obtained from the following stations but the taxonomic details of the most of the species were not examined in this study. (St. 6816, 6821, 6823, 6832, 6836, 6839, 6851, 6856, 6873, 6878, 6881)

Stichococcus bacillaris NAEGELI

HAZEN, 1902 : *Mem. Torr. Bot. Cl.* 11 : 160, pl. 22, f. 1-3. ; HEERING, 1914 : Chlorophyceae in PASCHER Süsswasserfl. H. 6 : 52 ; RAMANATHAN, 1962 : Ulotrichales : 92, pl. 23, f. D.

Cells cylindrical, short, solitary or united to form a short filament ; chromatophore a parietal plate without pyrenoid ; cells 5-10 μ long, 2-4 μ broad.

St. 6806, 6816, 6821, 6835, 6836, 68396, 840, 6849, 6851, 6854, 6855, 6856, 6879.

Stichococcus exiguus GERN.

HEERING, 1914 : Chlorophyceae in PASCHER Süsswasserfl. H. 6 : 53 ; RAMANATHAN, 1962 : Ulotrichales : 92, pl. 23, f. e.

Cells cylindrical, straight or curved, with rounded ends ; chromatophore a parietal plate without pyrenoid ; cells 10-20 μ long, 1-1.5 μ broad.

St. 6843.

Hormidium subtile (KUETZ.) HEERING

HEERING, 1914 : Chlorophyceae in PASCHER Süsswasserfl. H.6 : 47, f. 54.

Cells cylindrical, united to form a filaments ; chromatophore a parietal plate with a single pyrenoid ; cells 4-10 μ long, 5-6 μ broad.

St. 6816, 6821, 6823, 6831, 6832, 6839, 6843, 6849, 6856, 6879.

Hormidium flaccidum (KUETZ.) A. BR.

HEERING, 1914 : Chlorophyceae in PASCHER Süsswasserfl. H. 6 : 46, f. 48 ; RAMANATHAN, 1962 : Ulotrichales : 81, pl. 21, f. A-f, pl. 22, f. A-E.

Cells cylindrical, united to form a filament ; chromatophore a parietal plate with a single pyrenoid ; cells 8-12 μ in diameter, 8-12 μ long.

St. 6823, 6840, 6851, 6865, 6873, 6878, 6879.

Hormidium pseudostichococcus HEERING

HEERING, 1914 : Chlorophyceae in PASCHER Süsswasserfl. H. 6 : 43, f. 52, 53. RAMANATHAN, 1962 : Ulotrichales : 86, pl. 21, f. G.

Cells solitary or united in short filament, composed of several cells ; cells oblong ovate to elliptical, each contains a single parietal laminate chromatophore with a single pyrenoid ; cells 4-5 μ in diameter, 5-10 μ long.

St. 6801, 6802, 6832, 6873.

Koliella tatrae (KOL) HINDÁK var. **tatrae** (KOL) HINDÁK

HINDÁK, 1963 : *Nova Hedwigia* 6 : 111, pl. 5, f. 3. (as *Raphidonema*, RAMANATHAN, 1962 : Ulotrichales : 101, pl. 2, f. A-C ; GARRIC, 1965 : *Amer. Journ. Bot.* 52 : 5, f. 25)

Cells short, lunate, spindle-shaped with long acute ends ; chromatophore a parietal laminate without pyrenoid ; cells 10-18 μ long, 1.5-2 μ in diameter. This alga is one of the most common cryophytic alga found in European and North American alpine region.

St. 6843,

Coccomyxa subglobosa PASCHER

PASCHER, 1915 : Chlorophyceae in PASCHER Süsswasserfl. H. 5 : 210, f. 3, 4.

Thalli amorphous masses, with copious, homogeneous emvelopes, containing numerous, subspherical cells arranged in irregularly ; each cells contains a parietal laminate

chromatophore without pyrenoid ; cells 4-10 μ long, 2.5-7 μ in diameter.

St. 6849, 6855.

Microthamnion kuetzingianum NAEG.

HAZEN, 1901 : *Mem. Torr. Bot. Cl.* 11 : 191, pl. 26, f. 1 : HEERING, 1914 : Chlorophyceae in PASCHER Süsswasserfl. H. 6 : 118, f. 170 : PRESCOTT, 1951 : Alg. West. Great Lak. Ar. : pl. 11, f. 4.

Thalli highly branched and densely tufted ; cells cylindrical, 3-4 μ in diameter, 10-20 μ long ; each cell contains a single parietal laminate chromatophore without pyrenoid.

St. 6821, 6823, 6839.

Leptosira terricola (BRISTOL) PRINTZ

PRINTZ, 1964 : *Hedwigia* 24 : 264, f. 74.

Thalli irregularly branched uniseriate filaments, composed of 10-30, spherical to ellipsoidal cells ; each cell contains a single parietal laminate chromatophore, with a single pyrenoid ; cells 10-20 μ in diameter, 10-30 μ long.

St. 6836, 6879.

Pseudo-pleurococcus printzii VISCHER

VLSCHER, 1933 : *Beich. Bot. Centr.* 51 : 29, Abb. 11, 12 ; PRINTZ, 1964 : *Hydrobiologia* 24 : 278, Tab. 86.

Thalli irregularly branched filaments or few-celled packets ; cells spherical or cylindrical containing a single parietal laminate chromatophore with a single pyrenoid ; cells 5-10 μ broad, 5-25 μ long.

The occurrence of this alga also recorded from the Ongul Islands, Antarctica by AKIYAMA (1967).

St. 6843.

Chlorella vulgaris BEIJERINCK

BRUNTHALER, 1915 : Chlorophyceae in PASCHER Süsswasserfl. H. 5 : 112, f. 71. PRESCOTT, 1951 : Alg. Wet. Great Lakes Ar. : 237, pl. 53, f. 13.

Cells spherical, 3.8-6.5 μ in diameter ; chromatophore a single parietal cup-shaped, with a single pyrenoid.

St. 6835, 6840, 6851, 6855, 6873.

Chlorella ellipsoidea GRENECK

BRUNTHALER, 1915 : Chlorophyceae in PASCHER Süsswasserfl. H. 5 : 113, f. 74.
PRESCOTT, 1951 : Alg. West. Great Lakes Ar. : 236, pl. 53, f. 11, 12.

Cells elliptical, 2-3 μ in diameter, 3-4 μ long ; chromatophore a single parietal laminate cup-shaped, with a single pyrenoid.

St. 6842.

Chlorococcum sp.

A number of *Chlorococcum* were obtained but the details of life-cycle of these algae were not examined in this study. (St. 6810, 6835, 6840, 6843, 6851, 6879).

Bracteacoccus irregularis (PETERSEN) STARR

STARR, 1955 : A Comp. Study *Chlorococcum* MENEGH. : 65.

Cells spherical to ovoid ; chromatophores 1-3, parietal laminate, without distinct

pyrenoid ; cells 25-35 μ in diameter, 25-40 μ long.

St. 6816, 6856.

Bracteacoccus minor (CHODAT) PTEROVA

STARR, 1955 : A Comp. Study *Chlorococcum* MENEGH. 63, f. 143-153.

Cells spherical, 6.3-9 μ in diameter ; chromatophore one to several separate, polygonal plates without pyrenoids, however give a weak starch reaction with iodine.

St. 6821, 6831, 6836.

Radiosphaera dissecta (KORSCHIK.) STARR

STARR, 1955 : A Comp, Study *Chlorococcum* MENEGH. : 50, f. 117-127.

Cells spherical, 15-35 μ in diameter ; chromatophore a single, asteroid, with a central pyrenoid.

St. 6816, 6832, 6851, 6855.

Planktosphaera gelatinosa G. M. SMITH

SMITH, 1920 : Phytopl. Inland Lakes Wisc. Part 1 : pl. 20, f. 3-6. ; PRESCOTT, 1951 : Alg. West. Great Lakes Ar. : 240, pl. 53, f. 23. : STARR, 1955 : A Comp. Study *Chlorococcum* MENEGH. : 93, f. 221-225.

Cells Spherical, solitary or in clusters ; each cell contains one to several, polygonal plate chromatophores contained a single pyrenoid ; cells 7.5-15 μ in diameter.

St. 6832, 6840, 6849, 6851, 6854.

Kentrosphaera bristolae G. M. SMITH

SMITH, 1950 : Freshwat. Alg. U. S. : 229, f. 142.

Cells irregular, spherical to ovate, with irregularly thickened cell walls ; chromatophore stellate with one to several central pyrenoids ; cells 70-90 μ long, 30-70 μ broad.

St. 6816, 6835, 6840, 6855, 6891, 6878.

This alga is also recorded from the Ongul Islands, Antarctica by AKIYAMA (1967).

Scotiella nivalis (SCHUTT.) FRITSCH

BRUNTHALER, 1915 : Chlorophyceae in PASCHER Süsswasserfl. H. 2 : 132, f. 119 ; FUKUSHIMA, 1963 : *Journ. Yokohama Munic. Univ.* 144 : 72, f. 21.

Cells solitary, elliptical with rotund ends, in top view stellate, cell walls thick and edged (mostly eight angles) ; cells 12-20 μ long, 8-12 μ in diameter.

St. 6816, 6835, 6840, 6855, 6871, 6878.

The occurence of this alga is also recorded from alpine soils in Japan by AKIYAMA (1965).

Trochiscia reticularis (REINSCH) HANSGIRG

SMITH, 1920 : Phytopl. Inland Lakes Wisc. : 109, pl. 22, f. 2. : PRESCOTT, 1955 : West. Great Lakes Ar. : 239, pl. 53, f. 19, 20.

Cells spherical ; walls thick, externally ridged to form a reticulum ; cells 10-25 μ in diameter.

St. 6855, 6871.

Selenastrum gracile REINSCH

SMITH, 1920 : Phytopl. Inland Lakes Wisc. 1 : 133, pl. 31, f. 5 ; PRESCOTT, 1951 : Alg. West. Great Lakes Ar. : 257, pl. 57, f. 11.

Cells lunate with sharply pointed apices ; chromatophore a single parietal laminate with a single pyrenoid ; cells 3-5 μ in diameter, 20-23 μ long.

St. 6821, 6840, 6851.

Scenedesmus bijuga (TURP.) LAGERH.

SMITH, 1920 : Phytopl. Inland Lakes Wisc. 1 : 152, pl. 37, f. 18-20 ; PRESCOTT, 1951 : Alg. West. Great Lakes Ar. : 276, pl. 63, f. 2, 7.

Coenobia composed of 2-4 cells arranged in a single flat series ; cells ovate or oblong, without spines, 8-16 μ long, 4-6 μ in diameter.

St. 6842.

Chlorosarcinopsis sp. ?

A species of *Chlorosarcinopsis* ? was obtained but the details of life-cycle of this alga was not examined in this study. (St. 6835)

Oedogonium sp.

A sterile, vegetative plant of this genus occurred in a peaty soil among a forest. (St. 6840).

Mesotaenium endlicherianum NAEG.

KRIGER, 1933 : Desmidiaceen in RABENHORST Kryptogamenfl. : 193, T. 3, F. 5.

Cells straight or slightly curved, with rotund apices ; chromatophore a single plate containing 2-4 pyrenoids ; cells 6-7 μ broad, 25-30 μ long.

St. 6840.

Cosmarium tatricum RACIB. f. **minor** MESIK. ?

HIRANO, 1968 : Alaskan Desmids : 35, pl. 2, f. 2.

Cells 18 μ long, 12 μ broad and isthmus 8 μ broad ; semi-cells trapezoidal with concaved sides and an apex ; sinus closed and moderately deep.

This alga is also collected from the Alaskan Arctic region by HIRANO (1968).

St. 6840.

XANTHOPHYCEAE

Pleurochloris magna BOYE-PETERSEN

PASCHER, 1939 : Heterokonten in RABENHORST Kryptogamenfl. : 343, f. 217.

Cells spherical, 5-10 μ in diameter ; cells contain a single parietal laminate chromatophore and several oil droplets.

St. 6801, 6802, 6879.

Pleurochloris anomala JAMES

PASCHER, 1939 : Heterokonten in RABENHORST Kryptogamenfl. 348, f. 221.

Cells spherical, 5-15 μ in diameter ; cells contain 2 (some times 3), parietal laminate chromatophores and several oil droplets.

St. 6806, 6851, 6856.

Monodus subterraneus PETERSEN

PETERSEN, 1932 : *Arch. Protist.* 76 : 406, f. 13. ; PASCHER, 1938 : Heterokonten in RABENHORST Kryptogamenfl. : 445, f. 308.

Cells ovoid or oblong ovate, 10-15 μ long, 4-6 μ broad ; chromatophore a single parietal laminate.

This alga is one of the most cosmopolitic member of soil algae, and the alga is also recorded in Antarctica.

St. 6801, 6802, 6815, 6816, 6821, 6823, 6831, 6835, 6836, 6839, 6842, 6843, 6849, 6851, 6854, 6871, 6873, 6878, 6879, 6881.

Monodus dactylococcoides PASCHER

PASCHER, 1939 : Heterokonten in RABENHORST Kryptogamenfl. : 451, f. 315.

Cells slightly curved ellipsoid or spindle-shaped, 2-3 μ in diameter, 8-10 μ long ; chromatophore a single parietal laminate.

St. 6831, 6856.

Chlorocloster terrestris PASCHER

PASCHER, 1925 : Heterokontae in PASCHER Süsswasserfl. H. 11 : 53, PASCHER, 1939 : Heterokonten in RABENHORST Kryptogamenfl. : 456, f. 139, 318.

Cells spindle-shaped, containing 2 to several laminate chromatophores ; cells 3-7 μ in diameter, 20-30 μ long.

St. 6851.

Monallantos brevicylindrus PASCHER

PASCHER, 1939 : Heterokonten in RABENHORST Kryptogamenfl. : 422, f. 289, 290.

Cells depressed ellipsoid with rotund poles, 3-6 μ in diameter, 5-10 μ long ; chromatophores 2-4, parietal laminate ; cells contain several oil droplets.

St. 6881.

Ellipsoidion anulatum PASCHER

PASCHER, 1939 : Heterokonten in RABENHORST Kryptogamenfl : 415, f. 281.

Cells ovoid to oblong ovoid, containing mostly 2 laminate chromatophores ; cells 6-9 μ broad, 10-15 μ long.

St. 6801.

Botrydiopsis arhiza BORZI

PASCHER, 1925 : Heterokontae in PASCHER Süsswasserfl. H. 11 : 44, f. 25 ; PASCHER, 1937 : Heterokonten in RABENHORST Kryptogamenfl. : 387, f. 244.

Cells spherical, containing many discoidal chromatophores ; cells 6-20 μ in diameter.

St. 6802, 6806, 6816, 6821, 6835, 6840, 6843, 6849, 6855, 6856, 6871, 6873.

Heterothrix exilis PASCHER

PASCHER, 1939 : Heterokonten in RABENHORST Kryptogamenfl, (syn. *Bumilleria exilis* KLEBS in PASCHER, 1925 : Heterokontae in PASCHER Süsswasserfl. H. 11 : 111, f. 90)

Cells cylindrical, united to form short, unbranched filaments ; each cell contains mostly 2 parietal laminate chromatophores ; cells 5-10 μ long, 3-6 μ in diameter.

St. 6823, 6835, 6842, 6843, 6851, 6855.

Tribonema aequale PASCHER

PASCHER, 1925 : Heterokontae in PASCHER Süsswasserfl. H. 11 : 103, f. 84. : PASCHER, 1939 : Heterokonten in RABENHORST Kryptogamenfl. : 967, f. 817, 818.

Cells cylindrical united to form long filaments ; each cell contains 2-4, parietal laminate chromatophores ; cells 6-8 μ in diameter, 10-20 μ long.

St. 6823, 6839, 6843, 6851.

Heterococcus caespitosus VISCHER

PASCHER, 1939 : Heterokonten in RABENHORST Kryptogamenfl. 1002, f. 51, 138, 139. ; FRITSCH and JOHN, 1942 : *Ann. Bot.* N. S. 4 : 340, f. 7. B. (syn. *Monocilia*)

Cells spherical to elliptical or cylindrical, united to form a irregularly branched filament ; each cell contains 2 to several laminate chromatophores ; cells 3-8 μ broad,

8-12 μ long.

St. 6843, 6851.

Vaucheria sp.

A sterile, vegetative plant of *Vaucheria* sp. occurred in a soil of marshy district. (St. 6851).

EUGLENOPHYCEAE

Euglena pascheri SUIR.

HUBER-PESTALOZZI, 1955 : Das Phytopl. Süsswasser 4 : 96, Abb. 74. B.

Cells soft and pliable (metabolic), cylindrical to fusiform, 5-10 μ broad, 40-55 μ long ; chromatophores many, small plates without pyrenoids ; paramylon bodies many, small rods.

St. 6821.

CHRYSOPHYCEAE

Chrysosaccus sphaericus BOURRELLY

BOURRELLY, 1957 : Recherc. Chrysophycees : 294, pl. X, f. 28.

Thalli gelatinous composed of numerous spherical cells mostly arranged in four groups ; cells contain 4-6, polygonal laminate chromatophores coloured in golden brown and many leucosin granules ; cells 5-10 μ in diameter.

St. 6823.

BACILLARIOPHYCEAE

Pinnularia borealis EHR.

HUSTEDT, 1930 : Bacillariophyceae in PASCHER Süsswasserfl. H. 10 : 326, f. 597.

Valves linear-elliptic, with slightly concave or straight sides ; raphe filiform ; transverse striations parallel, 4-6 in 10 μ ; cells 30-40 μ long, 10-15 μ broad.

St. 6816, 6821, 6842, 6879

Hantzschia amphioxys (EHR.) GRUN.

HUSTEDT, 1930 : Bacillariophyceae in PASCHER Süsswasserfl. H. 10 : 394, f. 747.

Valves concave on one side and convex on the other, with rotund poles ; transverse striations 15-20 in 10 μ ; cells 35-40 μ long, 5-8 μ broad.

St. 6840, 6855.

Nitzschia obtusa W. SMITH var. **scalpelliformis** GRUN.

HUSTEDT, 1930 : Bacillariophyceae in PASCHER Süsswasserfl. H : 10 : 422, f. 817, d.

Valves straight with semi-cuneate poles ; transverse striations 5-9 in 10 μ ; cells 60-100 μ long, 8-10 μ broad.

St. 6835.

CYANOPHYCEAE

Synechococcus aeruginosum NAEG.

GEITLER, 1925 : Cyanophyceae in PASCHER Süsswasserfl. H. 12 : 111, f. 132 ; DESIKACHARY, 1959 : Cyanophyta : 143, pl. 25. f. 6, 12.

Cells cylindrical to oblong, 10-18 μ broad, 20-40 μ long.

This alga is also known from Antarctica.

St. 6873.

Gloeothece rupestris (LYNGB.) BORNET

GEITLER, 1925 : Cyanophyceae in PASCHER Süsswasserfl. H. 12 : 97, f. 103 ; DESIKACHARY, 1959 : Cyanophyta : 127, pl. 25, f. 4.

Thalli gelatinous, composed of many cells ; cells elliptical or cylindrical, 8-12 μ long, 4-6 μ in diameter.

St. 6835, 6842.

Phormidium tenue (MENEGH.) GOMONT

GEITLER, 1925 : Cyanophyceae in PASCHER Süsswasserfl. H. 12 : 381, f. 478 ; DESIKACHARY, 1959 : Cyanophyta : 259, pl. 43. f. 13-15. pl. 44. f. 7-9.

Trichomes bent, densely entangled, slightly constricted at the cross walls, attenuated at the ends, with thin sheath ; cells 1-2 μ broad, 2-3 μ long ; end cells acute-conical.

St. 6835, 6840, 6842, 6851, 6855.

Oscillatoria terebriformis AG. ex GOM.

GEITLER, 1925 : Cyanophyceae in PASCHER Süsswasserfl. H. 12 : 367, f. 444 ; DESIKACHARY, 1959 : Cyanophyta : 217, pl. 38, f. 16.

Trichomes ending in bow-shaped, slightly attenuated, without calyptra ; cells 4-6 μ broad, 2.5-4 μ long.

St. 6840.

Cylindrospermum majus KUETZ. ex BORN. et FLAH.

GEITLER, 1925 : Cyanophyceae in PASCHER Süsswasserfl. H. 12 : 333, f. 397 ; DESIKACHARY, 1959 : Cyanophyta : 362, pl. 80, f. 1.

Trichome composed of cylindrical cells, with a terminal heterocyst ; cells 3-5 μ in diameter ; heterocyst oblong ovate, 5-6 μ long, 3-5 μ in diameter ; akinates elliptical or subcylindrical, 10-20 μ long, 8-10 μ in diameter.

St. 6842.

Noduralia spumigena MERT. ex BORN. et FL.

GEITLER, 1925 : Cyanophyceae in PASCHER Süsswasserfl. H. 12 : 285 ; DESIKACHARY, 1959 : Cyanophyta : 423, pl. 80, f. 13, 14.

Trichomes composed of depressed elliptical cells, with a delicate mucilaginous sheath ; cells 5-7 μ broad, 1.5-2.5 μ long.

St. 6835, 6843.

Anabaena fertilissima RAO G. B.

DESIKACHARY, 1959 : Cyanophyta : 398, pl. 74, f. 1.

Trichomes composed of barrel-shaped cells ; cells 4-5 μ broad, 4-6 μ long ; heterocyst almost spherical, 5-6 μ in diameter ; spores spherical, formed in series.

St. 6843.

Nostoc punctiforme (KUETZ.) HARIOT

GEITLER, 1925 : Cyanophyceae in PASCHER Süsswasserfl. H. 12 : 295 ; DESIKACHARY, 1959 : Cyanophyta : 374, pl. 59, f. 1.

Thalli microscopic, punctiform ; trichomes densely coiled ; cells short barrel-shaped or subglobose, 3-4 μ in diameter ; heterocyst broader than the vegetative cell, 4-5 μ in diameter.

St. 6821, 6835, 6842, 6843.

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Plates with Explanations

Fig. 1 *Hormidium flaccidum* (KUETZ.) A. BR.

Fig. 2 *Hormidium subtile* (KUETZ) HEERING

Fig. 3 *Hormidium Pseudostichococcus* HEERING

Fig. 4 *Koliella tatrae* var. *tatrae* (KOL) HINDÁK

Fig. 5 *Microthamnion kuetzingianum* NAEG.

Fig. 6 *Leptosira terricola* (BRISTOL) PRINTZ

Plate 1

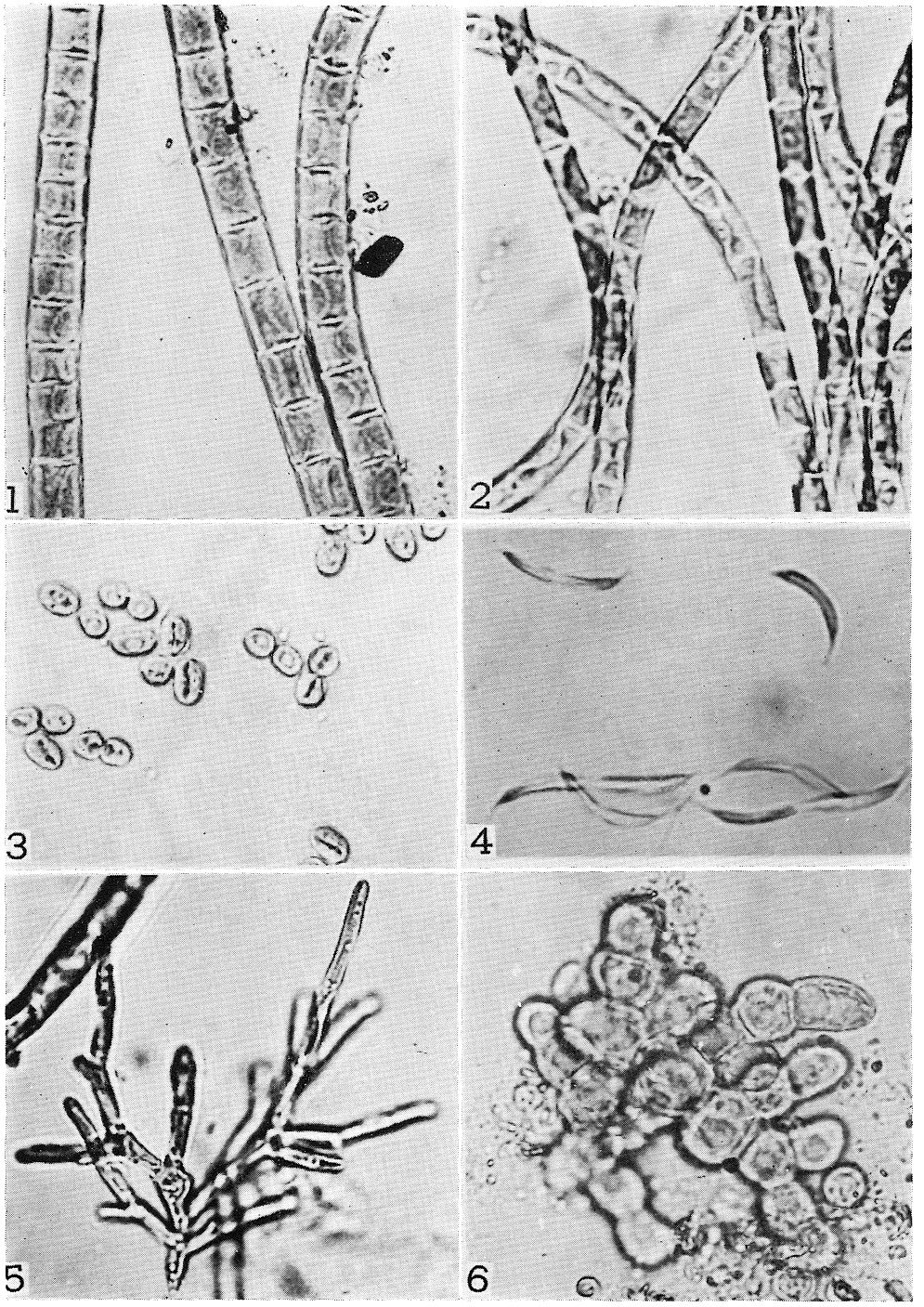

Fig. 1 *Scotiella nivalis* (SCHUTT.) FRITSCH

Fig. 2 *Kentrosphaera bristolae* G. M. SMITH

Fig. 3 *Radiosphaera dissecta* (KORSCHIK.) STARR

Fig. 4 *Trochiscia reticularis* (REINSCH) HANSGIRG

Fig. 5 *Chlorosarcinopsis* sp. ?

Fig. 6 *Cosmarium tatricum* RACIB. f. *minor* MESIK. ?

Fig. 7 *Mesotaenium endlicherianum* NAEG.

Plate 2

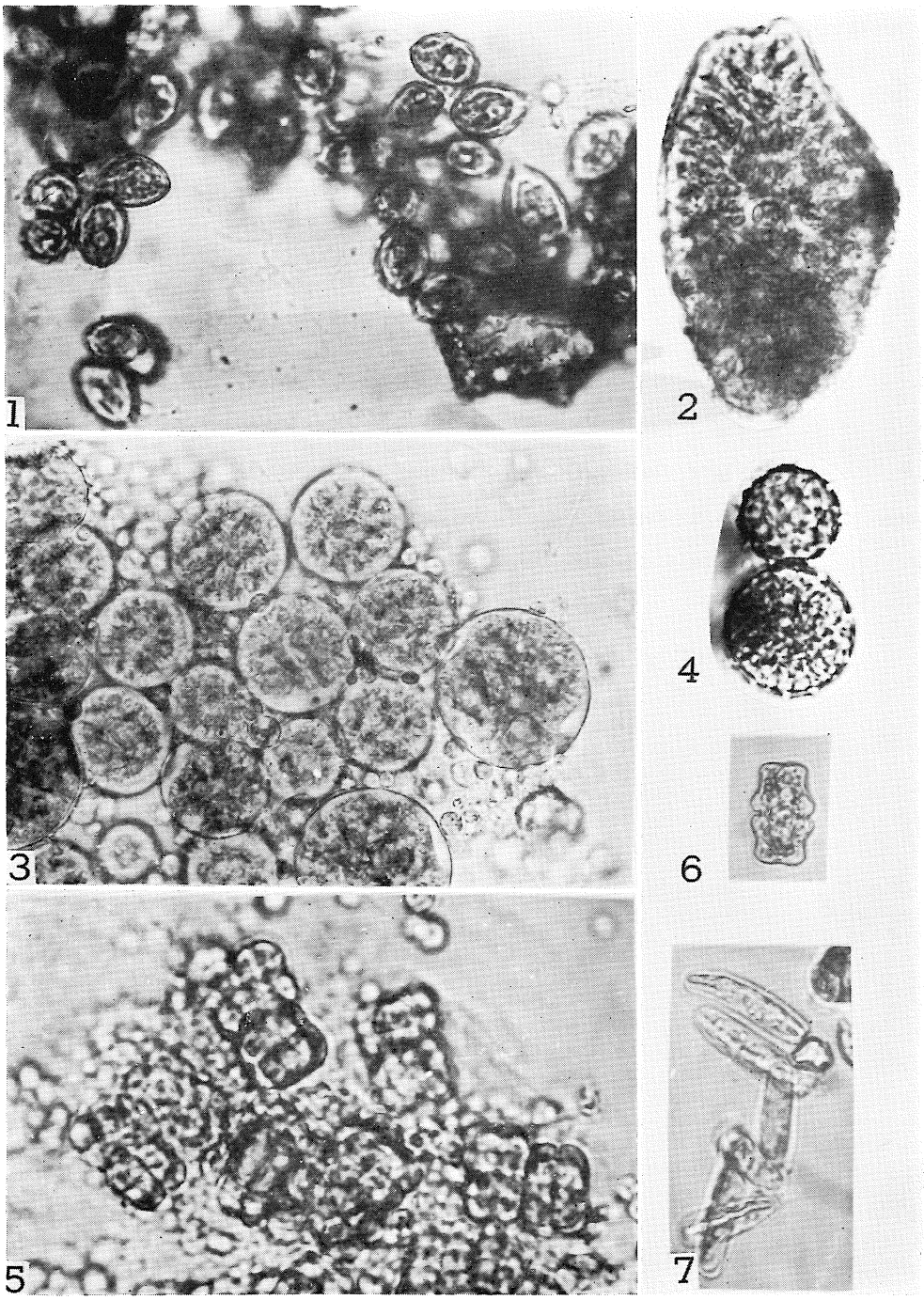

Fig. 1 *Monallantos brevicylindrus* PASCHER

Fig. 2 *Ellipsoidion anulatum* PASCHER

Fig. 3 *Monodus subterraneus* PETERSEN (old culture form)

Fig. 4 *Heterothrix exilis* PASCHER

Fig. 5 *Tribonema aequale* PASCHER

Fig. 6, 7 *Heterococcus caespitosus* VISCHER

Plate 3

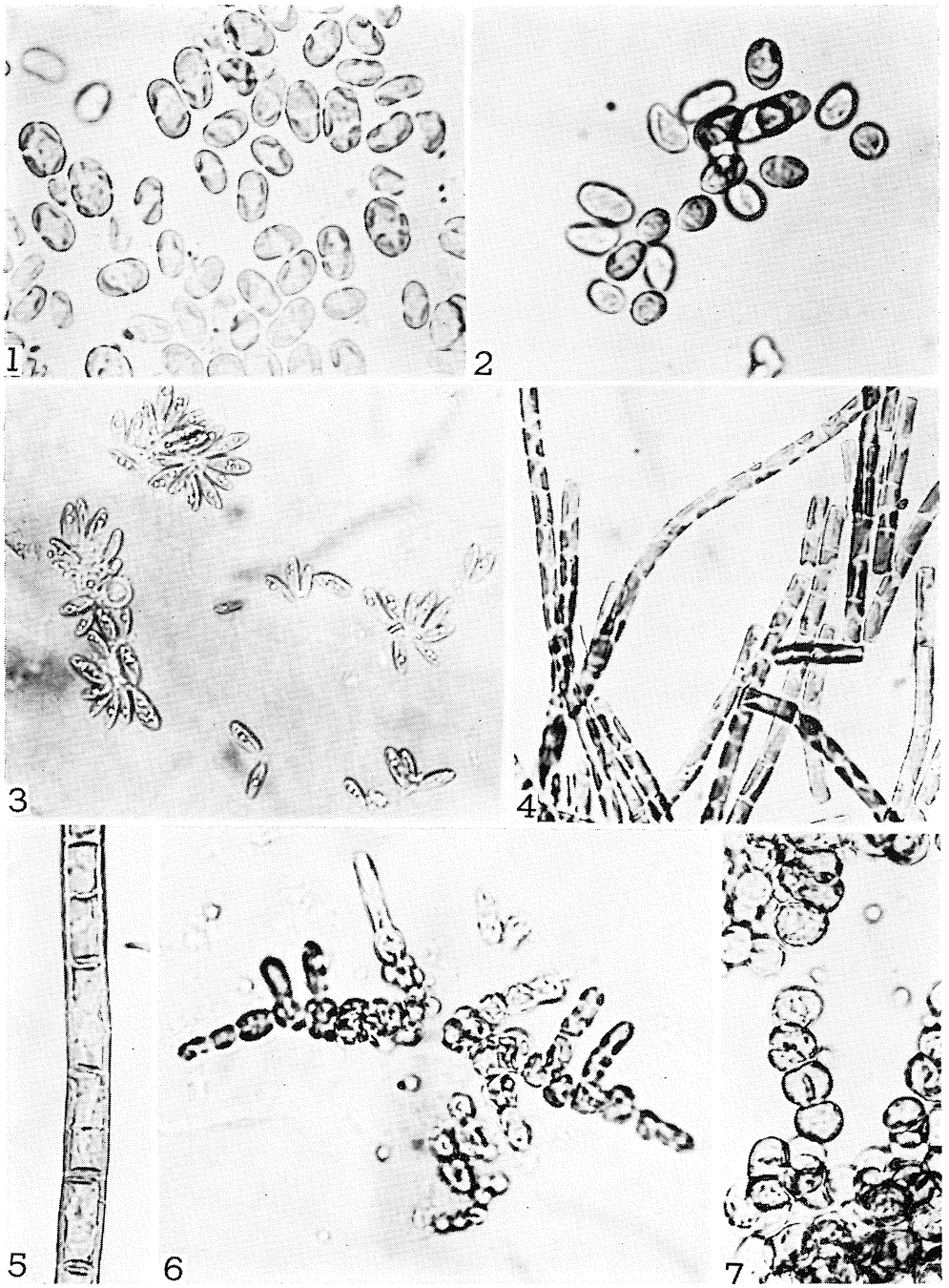

Fig. 1 *Synechococcus aeruginosus* NAEG.

Fig. 2 *Gloeothece rupestris* (LYNGB.) BORNET

Fig. 3 *Nostoc punctiforme* (KUETZ.) HARIOT

Fig. 4 *Cylindrospermum majus* KUETZ. ex BORN. et FLAH.

Fig. 5 *Oscillatoria terebriformis* AG. ex GOM.

Fig. 6 *Chrysosaccus sphaericus* BOURRELLY

Plate 4