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SOME AERIAL AND SOIL ALGAE FROM THE RYUKYU ISLANDS **

By

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Introduction

Though there are several works on the freshwater algal flora of the Ryukyu Islands,[15,16,31] very little is known about the algal flora especially of aerial and soil algae in this region.

The Ryukyu Islands are situated on the western subtropical region of the Pacific Ocean faced to the East China Sea (latitude ca. 27°50′−24°20′ S ; longitude ca. 124°20′ −128°20′), and, on phytogeographically, these isles belong to the Malayan territory of paleotropical region.

The agro-type of the Ryukyu Islands is generally characterized by calcareous soil found in limestone region in the southern part of the Okinawa Island and Ishigaki Island and by acidic soil originated from clay slate mostly found in the northern part of the Okinawa Island. Additionally, there are many mangrove areas where the soil chlorinity is high in concentration, and these areas form a peculiar soil ecosystem.

Recently, the present author investigated on the aerial and soil algal flora of this region, and herein he wishes to report on some ecological and taxonomic notes on these algae.

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Ecological Notes

1. Description of habitats.

As previously described, the soil of this region can be roughly classfied into three peculiar type *viz.* acidic soil, calcareous soil and mangrove forest soil. Certain chemical features of these soils were summerized in table 1.

The description of the investigated areas (sampling station 1−37) are as follows, and the location of these stations shown in text-figure 1.

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Table 1.

agro-type	acidic soil		calcareous soil		mangrove forest soil		
	pH	EC $\mu\mho$/cm	pH	EC	pH	EC	Cl mg/g
maximum	7.12	1850	7.60	1370	7.35	4200	0.76
minimum	4.05	90	6.60	125	5.10	200	0.01
mean	6.11	451	7.40	467	7.02	1243	0.17

station 1. Todoroki, Okinawa Isl.; forest soil pH=6.62, EC=122
2. Haneji, Okinawa Isl.; cultivated soil (cane) pH=6.75 EC=310.
3. Onna, Okinawa Isl.; cultivated soil (pineapple) pH=4.05 EC=270.
4. Iramina, Okinawa Isl.; waste land soil pH=7.60 EC=270.
5. Yomitan, Okinawa Isl.; cultivated soil (cane) pH=7.55 EC=340.
6, 7. Mabuni, Okinawa Isl.; forest soil (calcareous).
8, 37. Arakawa, Ishigaki Isl.; soil of footpath in rice-fields pH=7.55 EC=390.
9. Isobe, Ishigaki Isl.; waste land soil (calcareous) pH=7.55 EC=1370.
10. Nagura, Ishigaki Isl.; cultivated soil (calcareous) pH=7.30 EC=590.
11. Nagura, Ishigaki Isl.; sandy soil pH=7.45 EC=305.
12. Motonagura, Ishigaki Isl.; cultivated soil (pineapple)
13, 14. Arakawa, Ishigaki Isl.; cultivated soil (cane, sweet potato) pH=7.60, 7.43 EC =245, 490.
15. Kanna, Okinawa Isl.; cultivated soil (cane) pH=6.25 EC=145.
16. Kin, Okinawa Isl.; waste land soil pH=7.12 EC=350.
17, 19, 20, 24. Koza, Okinawa Isl.; waste land soil pH=7.41, 7.24 EC=105, 440.
18. Ishikawa Okinawa Isl.; waste land soil (calcareous) pH=7.40 EC=360.
21. Mt. Kochya, Okinawa Isl.; pH=7.10 EC=290.
22. Chibana, Okinawa Isl.; cultivated soil (cane) pH=7.55 EC=170.
25. Naha, Okinawa Isl.; uncultivated soil pH=6.60
26-28. Miyara, Ishigaki Isl.; mangrove forest soil pH= 7.0, 7.35, 7.6 EC=1000, 2100, 550 Cl=0.26, 0.05, 0.02.
29. Kandabashi, Ishigaki Isl.; river-beach soil near the estuary of Riv. Nagura pH= 7.3 EC=500 Cl=0.03.
30, 31. Ishikawa, Okinawa Isl.; mangrove forest soil pH=7.3 EC=500, 1400 Cl=0.03, 0.10.
32, 34, 36. Kanna, Okinawa Isl.; mangrove forest soil pH=6.8, 6.9, 5.1 EC=4200, 2000, 3000 Cl=0.76, 0.24, 0.4.
33, 35. Kochyakatabaru, Okinawa Isl.; mangrove forest soil pH=7.0, 7.35 EC=1800, 200 Cl=0.26, 0.01.

2. General feature of algal community

a) Calcareous soil algal community: The algal community found in calcareous soil area is characterized by its cyanophycean dominancy, namely in this area such algae as *Phormidium tenue* (MENEGH.) GOMONT, *Nostoc punctiforme* (KUETZ.) HARIOT, *Gloeothece rupestris* (LYNGB.) BORNET, *Westiellopsis prolifica* JANET, *Tolypothrix fragilis* (GARDN.) GEITLER and *Aphanothece stagnina* (SPRENG.) A. BR. are commonly recognized. On the contrary, such chlorophycean algae as *Hormidium flaccidum* (KUETZ.) A. BR. and *Stichococcus bacillaris* NAEG. found most commonly in Japanese acidic soil region are few

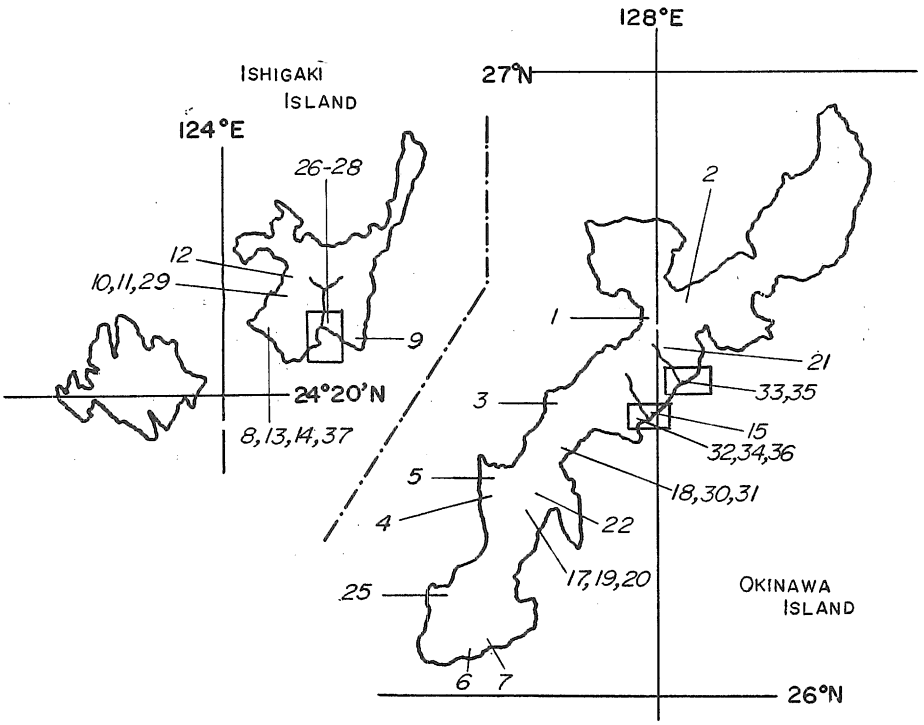


Fig. 1. Map of the Ryukyu Islands showing the sampling stations (1-37).
□ : Mangrove forest area.

or none in this region, and this floristic tendency is in agreement with the result of JOHN (1942). Additionally, the occurence of such algae as *Pithophora kewensii* WITTROCK, *Fritschiella tuberosa* IYENGAR, *Oedocladium operculatum* TIFFANY and *Leptosira terricola* (BRISTOL) PRINTZ in this region is of characteristic.

b) Acidic soil community : The algal components of acidic soil community of Okinawa especially in the northern part of the isle are essentially similar to those of the soil algal vegetation in Honshû, Japan, namely, the following algae are commonly recognized in this area ; *Chlorococcum echinozygotum* STARR, *Stichococcus bacillaris* NAEG., *Hormidium flaccidum* (KUETZ.) A. BR., *Chlamydomonas* spp , *Cylindrocystis brebissonii* MENEGH., *Monodus subterraneus* PETERSEN, *Phormidium tenue* (MENEGH) GOM , *Nostoc punctiforme* (KUETZ.) HARIOT and *et. al.*, however, such chlorophycean algae as *Ourococcus bicaudatus* GROBETY, *Bracteacoccus irregularis* (PETERSEN) STARR and the certain species of xanthophycean algae *e. g. Bumilleria exilis* KLEBS and *Botrydiopsis arhiza* BORZI are not recognized in this survey.

c) Mangrove forest soil algal community : Since the soil of mangrove soil has a peculiar brackish condition, the algal community of this area is composed of two of ecologically differentiated element. These algae, *Amphiprora alata* (EHRENB.) KUETZ. and *Rhizoclonium implexum* (DILW.) KUETZ., are common brackish water algae. And the certain species of freshwater and common soil algae *e. g. Chlorococcum echinozygotum* STARR, *Phormidium tenue* (MENEGH.) GOM., *Nostoc punctiforme* (KUETZ.) HARIOT,

Westiellopsis prolifica JANET, *Aphanothece stagnina* (SPRENG.) A. BR. and *Dichotomosiphon tuberosus* (A. BR.) ERNST are main components of the algal flora of this area. The occurence of *Dichotomosiphon tuberosus* (A. BR.) ERNST hos an ecological interest since the alga appears in such an unusual edaphic status on brackish soil.

d) Aerial algal community : The aerial algal vegetation of the Ryukyu Islands is relatively sparse, however, a bark of trees such as *Casuarina*, *Pandanus*, *Erythrina* and *Ficus retusa* growing in shaded area frequently harbours good growth of aerial epiphytic algae. The following algae are frequently recognized in this region ; *Trentepohlia aurea* (L.) MART. *Physolinum monilia* (DEWILD.) PRINTZ, *Phycopeltis arundinacea* (MONT.) DE TONI, *Cephaleuros virescens* KUNZE, *Monodus subterraneus* PETERSEN, *Chlorococcum* sp. and *Tolypothrix byssoidea* (BERK.) KIRCHNER.

Table 2 gives the agro-type and the algal components found in some examples of the soil algal communities in this region.

Table 2

agro-type / algae	acidic soil	calcareous soil	mangrove soil
Chlamydomonas snowiae	+		
Stichococcus bacillaris	+		
Microthamnion kuetzingianum	+		
Monodus subterraneus	+		
Stigonema ocellatum	+		
Chlorococcum echinozygotum	+	+	+
Scenedesmus bijuga & spp.	+	+	+
Hormidium flaccidum	+	+	
Zygogonium ericetorum	+	+	
Cylindrocystis brebissonii	+	+	
Phormidium tenue & spp.	+	+	+
Nostoc punctiforme & spp.	+	+	+
Oscillatoria tenuis & spp.	+	+	
Tolypothrix fragilis	+	+	
Gloeothece rupestris	+	+	+
Navicula sp.	+	+	+
Hantzschia amphioxys	+	+	+
Fritschiella tuberosa		+	
Leptosira terricola		+	
Oedocladium operculatum		+	
Westiellopsis prolifica		+	+
Calothrix elenkii		+	+
Aphanothece stagnina & sp.		+	+
Pithophora kewensii		+	
Scytonema varium		+	+
Dichotomosiphon tuberosis			+
Rhizoclonium implexum			+
Microcoleus chthonoplastes			+
Diploneis ovalis			+
Amphiprora alata			+

Taxonomic Notes

The following list includes twenty-four species of Chlorophyceae, eighteen species of Cyanophyceae, two species of Xanthophyceae and four species of Bacillariophyceae, and all totals fourty-two genera and fourty-eight species.

CLASS CHLOROPHYCEAE

Twenty-four species of Chlorophycean algae including one species of volvocalean alga, two species of ulotrichalean algae, seven species of chaetophoralean algae two species of cladophoralean algae, one species of oedogonialean alga, six species of chlorococcalean algae, two species of codialean algae and three species of zygnematalean algae are recognized.

Order Volvocales

Chlamydomonas snowiae PRINTZ

PASCHER, 1927, Süsswasserfl. H. 4 : 228, f. 175.

Cells ovoid to ellipsoid, 7−8 μbroad, 10−12 μ long ; chromatophore cup-shaped, with a single pyrenoid.

Loc. Station 1, 3, 12, 15.

Order Ulotrichales

Stichococcus bacillaris NAEG.

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

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

This alga is a one of the most common species in Japanese acidic soil, however it appeares very rare in this region.

Hormidium flaccidum (KUETZ.) A. BR.

HEERING, 1914 : Süsswasserfl.

H. 6 : 46, f. 48. ; RAMANATHAN, 1962 : Ulotrichales : 81, pl. 21, f. A-F, pl. 22, f. A-E.

Filaments slender, composed of short cylindrical cells ; chromatophore parietal plate, with a single pyrenoid ; cells 8−12 μ in diameter, 8−12 μ long.

Loc. Station 1, 3, 5, 12, 15, 37.

Order Chaetophorales

Microthamnion kuetzingianum NAEG.

HAZEN, 1901 : *Mem. Torr. Bot. Cl.* 11 : 191, pl. 26, f. 1 ; HEERING, 1914 : Süsswasserfl. H. 6 : 118, f. 170 ; PRESCOTT, 1951 : Alg. West. Great Lak. 122, pl. 11, f. 4.

Thalli highly branched and densely tufted ; cells cylindrical, 3−4 μ in diameter, 10−20 μ long ; chromatophore a single parietal plate, without pyrenoids.

Loc. Station 3.

Leptosira terricola (BRISTOL) PRINTZ

PRINTZ, 1964 : *Hydrobiologia* XXIV : 264, f. LXXIV, 6−6.

(Syn. *Gongrosira terricola* BRISTOL, 1920)

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

Loc. Station 4, 17, 25, 37.

Fritschiella tuberosa IYENGAR

IYENGAR, 1932 : *New Phytol.* 31 : 335 : SINGH, 1941 : *New Phytol.* XL : 170 ; AKIYAMA and HIROSE, 1960 : *Bot. Mag. Tokyo*, 73 : 365.

Thalli consisting of branched filamentous erect, and prostrate, parenchymatous systems ; cells cylindrical in erect filament and globose to polygonal in prostrate system, each cell contains a single parietal plate chromatophore, with several pyrenoids.

Loc. Station 37.

Trentepohlia aurea (L.) MARTIUS

HEERING, 1914 : Süsswasserfl. H, 6 : 122, f. 173, 178. : PRINTZ, 1939 : *Nytt Mag. Naturv.* 80 : 153, T. VII, f. G-P.

Thalli irregularly branched filaments, forming cushion-like expansions ; cells cylindrical, 8−15 μ in diameter, 10−40 μ long ; each cell contains numerous, irregularly shaped discs of breaked chromatophores ; reproductive cells 20−30 μ in diameter.

Loc. Station 1, 8.

Physolinum monilia (DEWILD.) PRINTZ

PRINTZ, 1939 : *Nytt Mag. Naturv.* 90 : 190, t. 32, f. A-C. ; SKUJA, 1949 ; *Nova Acta Reg. Soc. Sci. Upsal. Ser.* IV, 14 :

Thalli irregularly branched filaments, composed of 10−30 cells ; cells spherical to ellipsoidal, each contains numerous discoidal or in sometimes irregularly incised parietal chromatophores ; asexual reproduction by means of budding and aplanospore formation ; cells 20−24 μ long, 15−19 μ in diameter ; aplanospores 6−8 μ in diameter.

Recently, this alga has been recognized from East Pakistan and South Japan by ISLAM (1960) and AKIYAMA (1967). The alga is recognized from a bark of *Casuarina* sp.

Phycopeltis arundinacea (MONT.) DE TONI

PRINTZ, 1939 : *Nytt Mag. Naturv.*, 80 : 171, t. 19, f. A-C. ISLAM, 1960 : *Trans. Amer. Microsc. Soc.* LXXIX : 418, pl. 2, f. 8.

Thalli regularly dichotomously branched filaments, forming circular expansions, up to 5 mm in diameter ; cells elongate quadrate to polygonal, 10−15 μ in diameter, 10−20 μ long.

Loc. Station 8.

Cephaleuros virescens KUNZE

PRINTZ, 1939 : *Nytt Mag. Naturv.*, 80 : 185, t. 29, f. C-H. ; ISLAM, 1960 : *Trans. Amer. Microsc. Soc.* LXXIX, 4 : 478, pl. 2, f. 9−14.

Thalli macroscopic, round or irregularly shaped disc, with sterile and fertile hairs, composed of mostly dichotomously branched filaments, arranged in pseudoparenchymatous tissue ; cells 10−20 μ in diameter, 20−40 μ long ; sporangia 20−25 μ in diameter.

Loc. Station 1.

Order Cladophorales

Rhizoclonium implexum (DILLW.) KUETZ.

KOSTER, 1955 : *Pubbl. Staz. Zool. Napoli* XXVII : 15.

Thalli unbranched filaments without rhizoid, composed of cylindrical cells ; cells 8–22 μ in diameter, 12–45 μ long, each contains a reticulate chromatophore, with many small pyrenoids.

This alga appeares only in brackish region.

Loc. Station 29, 30.

Pithophora kewensii WITTROCK

WITTROCK, 1877 : *Oefv. Kongl. Sv. Vet.* : 52, pl. II. f. 1–12.

Thalli irregularly branched filaments ; cells long and cylindrical, length as much as 10–20 times the breadth, 40–70 μ in diameter ; akinates ovoid to ellipsoid, intercalary or terminal, 75–85 μ in diameter, 120–250 μ long.

Loc. Station 25.

Order Oedogoniales

Oedocladium operculatum TIFFANY

TIFFANY, 1937 : *N. Amer. Flor.* 11 : 16, pl. 6, f. 58, 59.

Thalli monoecious ; oogonia solitary, ellipsoidal with superne operculatum, 25–28 μ in diameter, 30–35 μ long ; oospores subglobose or ellipsoid, 23–25 μ in diameter, 28–33 μ long ; spore walls scrobiculate ; antheridia solitary or in group of 3–4, hypogynous, 7–9 μ in diameter, 8–10 μ long ; vegetative cells 30–35 μ long, 8–15 μ in diameter.

Loc. Station 8, 25.

Order Chlorococcales

Chlorococcum echinozygotum STARR

STARR, 1955 : A Comparative Study of Chloro. Meneg. : 18, f. 22–57.

Cells solitary, spherical to ellipsoidal, 15–25 μ in diameter ; chromatophore a single cup-shaped, with a single pyrenoid ; zoospores ellipsoidal, with two flagella of equal length ; zygospores spherical, with spiny spore wall.

Loc. Station 3, 12, 19.

Scenedesmus bijuga (TURPIN) LAGERH.

SMITH, 1920 : *Wisc. Geol. Nat. Hist. Sur.* 57, *Sci. ser.* 12 : 152, pl. 37, f. 18–20 ; PRESCOTT, 1951 : Alg. West. Great Lak. 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.

Loc. Station 2, 9.

Scenedesmus quadricauda (TURPIN) DE BRÉB.

SMITH, 1920 : *Wisc. Geol. Nat. Hist. Sur.* 57, *Sci. Ser.* 12 : 158, pl. 40, f. 9–11. ; PRESCOTT, Alg. West. Great Lak. Ar. ; 280, pl. 64, f. 2.

Coenobia flat, composed of 4–8 cells arranged in a single linear series ; cells cylindrical-ovoid, with rounded poles ; poles of terminal cells, with a single long spine ; cells 10–15 μ long, 3–5 μ in diameter.

Loc. Station 9.

Teraëdron minimum (A. BR.) HANSG.

PRESCOTT, 1951 : Alg. West. Great Lak. Ar. : 267, pl. 60, f. 12–15.

Cells tetragonal ; angles rounded, each with a minute granule ; cells 15–20 μ in diameter.

Loc. Station 9.

Pediastrum boryanum (TURPIN) MENEGH.

BRUNTHALER, 1915 : Süsswasserfl. H. 5 : 100, f. 61 a ; PRESCOTT, 1951 : Alg. West. Great Lak. Ar. : 222, pl. 47, f. 9.

Colonies entire, composed of 5- or 6-sided cells ; peripheral cells bilobed, each lobe ending in short spine ; walls granurate, cells 13–18 μ in diameter.

Loc. Station 9.

Pediastrum tetras (EHRENB.) RALFS

BRUNTHALER, 1915 : Süsswasserfl. H. 5 : 103, f. 64 a ; PRESCOTT, 1951 : Alg. West. Great Lak. Ar. : 227, pl. 50, f. 3, 6.

Colonies entire, composed of 4, quadrate cells with linear incisions ; cells 12–15 μ in diameter.

Loc. Station 9.

Order Codiales

Protosiphon botryoides (KUETZ.) KLEBS

BRUNTHALER, 1915 : Süsswasserfl. H. 5 : 86. f. 45.

Thalli multinucleate, coenocytic vesicles ; chromatophore a single parietal, perforate plate with several pyrenoids ; thalli up to 50 μ in diameter, as much as 200 μ long.

Dichotomosiphon tuberosus (A. BR.) ERNST

HEERING, 1921 : Süsswasserfl. H. 4 : 97, f. 93, 94. ; VENKATARAMAN, 1961 : Vaucheriaceae : 38, f. 18.

Thalli dichotomously branched coenocytic filaments, with constrictions at and between the dichotomies ; filaments 10–30 μ in diameter.

The alga appeared under the culture condition was slightly small.

Loc. Station 30, 34.

Order Zygnematales

Cosmarium granatum DEBRÉB.

SMITH, 1924 : *Wisc. Geol. Nat. Hist. Sur.* 57, *Sci. Ser.* Part 2 : 31, pl. 57, f. 18.

Cells small, deeply constricted, with linear sinus ; semicells pyramidate, with truncate apices ; walls smooth or finely punctate ; cells 25–35 μ long, 15–25 μ broad ; isthmus 6–8 μ broad.

Loc. Station 8.

Zygogonium ericetorum KUETZ.

TRANSEAU, 1952 : Zygnemataceae : 65, pl. X, f. 10–16 ; RANDHAWA, 1959 : Zygnemaceae : 265, f. 231.

Vegetative cells short cylindrical, 15–20 μ in diameter, 20–50 μ long ; chromatophores 2, stellate or ovoid, with a single central pyrenoid ; conjugation scalariform ; zygospores ovoid or ellipsoid, 15–25 μ in diameter, median spore walls smooth, colourless.

Loc. Station 8, 33.

CLASS CYANOPHYCEAE

Eighteen species of cyanophycean algae including three species of chroococcalean algae, twelve species of nostocalean algae and three species of stigonematalean algae are recognized.

Order Chroococcales

Aphanothece stagnina (SPRENG.) A. BR.

GEITLER, 1925 : Süsswasserfl. H. 12 : 70, f. 65 ; DESIKACHARY, 1959 : Cyanophyta : 137, pl. 21. f. 10.

Thalli gelatinous, spherical ; cells oblong or cylindrical, 5−7 μ long, 4−5 μ broad, without individual envelopes.

Loc. Station 8.

Aphanothece nidulans RICHTER

GEITLER, 1925 : Süsswasserfl. H. 12 : 71, f. 64. : DESIKACHARY, 1959 : Cyanophyta : 138, pl. 22. f. 1.

Thalli gelatinous, spherical ; cells cylindrical, 3−4 μ long, ca. 2 μ in diameter, without individual envelopes.

Loc. Station 9.

Gloeothece rupestris (LYNGB.) BORNET

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

Thalli gelatinous, composed of 2, 4 or more cells, with lamellated envelopes ; cells ellipsoidal or cylindrical, 8−12 μ long, 4−6 μ in diameter.

Loc. Common, Station 1, 4, 17, 18, 21, 25, 29, 35.

Order Nostocales

Phormidium tenue (MENEGH.) GOMONT

GEITLER, 1925 : 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 crosswalls, attenuated at the ends, with thin sheath ; cells 1−2 μ broad, 2−3 μ long ; end-cell acute-conical.

Loc. Common. Station 1, 2, 4, 5, 6, 8, 9, 10, 12, 13, 14, 15, 17, 18, 19, 20, 21, 22, 24, 25, 28, 29, 30, 32, 33, 34, 35, 36, 37.

Oscillatoria tenuis AG. ex GOM.

GEITLER, 1925 : Süsswasserfl. H. 12 : 362, f. 427 ; DESIKACHARY, 1959 : Cyanophyta : 222, pl. 42, f. 15.

Trichomes straight, slightly constricted at the cross-wall ; cells 4−6 μ long, 8−10 μ broad. Loc. Station 9, 12, 37.

Oscillatoria subbrevis SCHMIDLE

DESIKACHARY, 1959 : Cyanophyta : 207, pl. 37, f. 2, pl. 40, f. 1.

Trichomes straight, not constricted ; cells cylindrical, 7−8 μ in diameter, 2−3 μ long, not granulated at the cross-walls ; end-cell rounded, without calyptra.

Loc. Station 9.

Anabaena spp.

Loc. Station 11, 13, 25, 29, 34.

Nostoc punctiforme (KUETZ.) HARIOT

GEITLER, 1925 : Süsswasserfl. H. 12 : 295 ; PRESCOTT, 1951 : Alg. West. Great Lak. Ar. : 525, pl. 121, f. 4, 5 ; DESIKACHARY, 1959 : Cyanophyta : 374, pl. 59, f. 1 ; HIROSE, 1962 ; *Acta Phytotax. Geobot.* XX : 299.

Thalli microscopic, punctiform, gelatinous ; trichomes densely coiled ; cells globose or subglobose, 3−4 μ in diameter ; heterocyst broader than the vegetative cell, 4−5 μ in diameter.

Loc. Common. Station 1, 6, 13, 19, 25, 29.

Nostoc microscopicum CARM.

GEITLER, 1925 : Süsswasserfl. H. 12 : 302 ; PRESCOTT, 1951 : Alg. West. Great Lak. Ar. : 523, pl. 120, f. 3−5 ; DESIKACHARY, 1959 : Cyanophyta : 387 ; HIROSE, 1962 : *Acta Phytotax. Geobot.* XX : 301, f. 1 G, H, I.

Thalli gelatinous ; trichomes 5−6 μ broad ; cells subglobose, 5−7 μ in diameter ; heterocyst subglobose, 7−9 μ long, 5−7 μ broad.

Loc. Station 8, 13, 22, 25.

Cylindrospermum majus KUETZ. ex BORK. et FLAH.

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

Thalli filamentous composed of cylindrical cells, with a terminal heterocyst ; cells 3−5 μ in diameter ; heterocyst oblong, 3−5 μ in diameter, 5−6 μ long ; akinates ellipsoidal or subcylindrical, 8−10 μ in diameter, 10−20 μ long.

Loc. Station 1.

Microcoleus chthonoplastes THURET ex GOM.

GEITLER, 1925 : Süsswasserfl. H. 12 : 436 ; DESIKACHARY, 1959 : Cyanophyta : 343, pl. 60, f. 7−9.

Thalli gelatinous filaments, composed of several trichomes closely grouped ; trichomes constricted at the cross-walls ; cells cylindrical, 2−4 μ in diameter, 2−4 μ long.

Loc. Station 35.

Tolypothrix fragilis (GARDN.) GEITLER

DESIKACHARY, 1959 : Cyanophyta : 500, pl. 103, f. 1.

Filaments with false branches, usually arising from the vicinity of the heterocyst ; trichomes 4−5 μ bread, not constricted at the cross-wall ; cells as long as broad ; heterocysts spherical, 5−6 μ in diameter.

Loc. Station 17, 18, 21.

Tolypothrix byssoidae (BERK.) KIRCHN.

GEITLER, 1925 : Süsswasserfl. H. 12 : 258, f. 308 ; DESIKACHARY, 1959 : Cyanophyta : 502, pl. 103, f. 3, 4, 7.

Filaments with short false branches, arising from the vicinity of the heterocyst ; cells 7−10 μ broad, 6−8 μ long ; heterocysts basal, single or twos, 5−7 μ long, 6−8 μ broad.

The alga is recognized from a bark of *Casuarina* sp.

Loc. Station 8, 11.

Scytonema varium KUETZ. ex BORN. et FLAH.

GEITLER, 1925 : Süsswasserfl. H. 12 : 271 ; DESIKACHARY, 1959 : Cyanophyta : 474.

Filaments with false branches, arising from the vicinity of the heterocyst; cells subquadrate, granulated, 5−8 μ in diameter; sheath thin, gelatinous.

Loc. Station 35.

? **Calothrix elenkii** KOSSINSKAJA

DESIKACHARY. 1959: Cyanophyta: 531, pl, 114, f. 5, 6, 11.

Filaments 50−150 μ long, united in tufts, bent at the base, swollen at the base, 8−10 μ broad at the base, in the middle 4−6 μ broad; sheath thin, not lamellated; heterocysts basal, single, 6−8 μ in diameter.

Loc. Common. Station 4, 6, 13, 14, 18, 22, 29, 30, 33, 34, 35.

Order Stigonematales

Stigonema ocellatum (DILW.) THURET ex BORN. et FLAH.

GEITLER, 1925: Süsswasserfl. H. 12: 183, f. 228; DESIKACHARY, 1959: Cyanophyta: 607, pl. 138, f. 2.

Trichomes uni- or multi-seriate, mostly unilaterally branched; sheath firm, homogeneous or lamellose; cells spherical, ellipsoidal or quadrate, with or without conspicuous pit connections; heterocysts numerous, ovate or spherical, 15−25 μ in diameter.

Loc. Station 20.

Hapalosiphon welwitschii W. et G. S. WEST

GEITLER, 1925: Süsswasserfl. H. 12: 196; DESIKACHARY, 1959: Cyanophyta: 588, pl. 137, f. 5.

Filaments with short true lateral branches; cells spherical or ellipsoidal, 5−7 μ in diameter, 5−8 μ long; heterocysts rare, intercalary, quadrate, 8−10 μ long, 6−7 μ in diameter.

Loc.Station 17.

Westiellopsis prolifica JANET

DESIKACHARY, 1959: Cyanophyta: 596, pl. 131, f. 1−12.

Thalli branching filaments of two kinds, main filaments composed of spherical or subspherical cells, arranged in multiseriate like pseudohormocyst, lateral branches composed of cylindrical cells, not constricted at the cross-walls.

Loc. Common. Station 4, 5, 8, 13, 17, 18, 22, 24, 25, 29, 37.

CLASS XANTHOPHYCEAE

Two species of xanthophycean algae each belonging to Heterococcales and Heterosiphonales are recognized.

Order Heterococcales

Monodus subterraneus PETERSEN

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

Cells solitary, ovoid or oblong ovate, 10−15 μ long, 4−6 μ broad; chromatophore a single parietal plate, without pyrenoid.

This alga is one of the most common member of the acidic soil community in Japan and the alga is recognized from the same acidic soils in the middle and northern parts of the Ryukyu Island.

Order Heterosiphonales

Botrydium granulatum (L.) GREV.

PASCHER, 1925 : Süsswasserfl. H. 11 : 117, f. 94–96 ; PRESCOTT, 1951 : Alg. West Great Lak. Ar. : 369, pl. 96, f. 17, 18.

Thalli macroscopic, coenocytic vesicules, composed of spherical epiterranean portion and subterranean rhizoidal branches ; chromatophores numerous discs ; thalli ca. 1 mm in diameter.

CLASS BACILLARIOPHYCEAE

Four species of pennate diatoms are recognized.

Order Pennales

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

Loc. Station 1, 2, 3, 22, 29, 34, 35, 37.

Hantzschia amphioxys (EHRENB.) GRUNOW

Loc. Station 4, 6, 10, 12, 13, 15, 18, 19, 21, 22, 24, 35.

Diploneis ovalis (HILSE.) CLEVE

Loc. Station 27, 34.

Amphiprora alata (EHRENB.) KUETZ.

Loc. Station 27, 34.

Résumé

A floristic study of the aerial and soil algae of the Ryukyu Islands by means of crude cultures has taken.

1) Fourty-one genera and fourty-seven species including twenty-three species of Chlorophyceae, eighteen species of Cyanophyceae, two species of Xanthophyceae and four species of Bacillariophyceae are recognized.

2) The following algae are abundantly found in the Ryukyu Islands ; *viz. Gloeothece rupestris* (LYNGB.) BORNET, *Phormidium tenue* (MENEGH.) GOMONT, *Calothrix elenkii* KOSSINSKAJA, *Westiellopsis prolifica* JANET, *Nitzschia obtusa* W. SMITH var. *scalpelliformis* GRUNOW and *Hantzschia amphioxys* (EHRENB.) GRUNOW.

3) The soil algal community of calcareous soil region is dominated mostly by cyanophycean algae, however, the certain chlorophycean and xanthophycean species *e. g. Stichococcus bacillaris* NAEG. and *Monodus subterraneus* PETERSEN which are common algae in the acidic soil region of Honshû, Japan are restricted their distribution within the northern part of the Okinawa Island.

Reference

1) AKIYAMA, M. and H. HIROSE (**1960**) : A newly found terrestr. alga from Jap., *Fritschiella tuberosa* IYENG. *Bot. Mag. Tokyo* **73** : 365-368.

2) ..... (**1965**) : Some soil alg. from Jap. *Bull. Shimane Univ.* **15** : 96-117.

3) .....and H. HIROSE (**1967**) : *Physolinum monilia* (DEWILD.) PRINTZ, a newly found subaer. alga from Jap. *Bull. Jap. Soc. Phycol.* **15** : 127-131.

4) BRUNTHALER, J. (**1915**) : Chlorophyceae in Süsswasserfl. H. **5** Jena
5) DESIKACHARY, T. V. (**1959**) : Cyanophyta *Ind. Counc. Agr. Res.* New Dehli
6) GEITLER u. A. PASCHER (**1925**) : Cyanophyceen in Süsswasserfl. H. **12** Jena
7) HAZEN, T. E. (**1901**) : The Ulotricaceae and Chaetophoraceae of the U. S. *Mem. Torr. Bot. Cl.* **11** : 135-250.
8) HEERING, W. (**1914, 1921**) : Chlorophyceae in Süsswasserfl. H. **6, 7**. Jena
9) HIROSE, H. (**1962**) : On the genus *Nostoc* VAUCHER of Jap. *Acta Phytotax. Geobot.* **XX**·· 296-307.
10) ISLAM, N. (**1960**) : Some subaerial green alg. from E. Pakistan *Trans. Amer. Microse. Soc.* **LXXIX** : 471-479.
11) IYENGAR, M. O. P. (**1932**) : *Fritschiella.* a new terrestr. memb. of the Chaet. *Now Phytol.* **31** : 329-336.
12) JOHN, R. P. (**1942**) : An ecolog. and taxon. st. of the alg. of Brit. soils I. *Ann. Bot. New Ser.* **VI** : 323-349.
13) KOSTER, T. TH. (**1955**) : The genus *Rhizocl.* KUETZ. in the Nethrl. *Pubbl. Zool. Napoli* **XXVII** : 335-357.
14) KRIEGR, W. (**1933-1937**) : Die Desmidiaceen in Kryptogamenfl.
15) OKADA, Yosh. (**1936, 1939**) : Report on some Jap. freshw. alg. (1), (4). *Jap. Journ. Bot.* **12** : 272-278, *ibid.* **15** : 164-166.
16) .....(**1939**) : Report on the flora of the "Suga" or the salt river in Okinawa Island, Ryukyu. *ibid.* **15** : 48-53.
17) PASCHER, A. (**1925, 1927**) : Chlorophyceae and Heterokontae in Süsswasserfl. H. **4, 11**. Jena
18) PRESCOTT, G. W. (**1951**) : Algae of the western great lakes area. *Cranbrook Inst. Sci. Bull.* **31**. Michigan
19) PRINTZ, H. (**1939**) : Vorarbeiten zu einer Monographie der Trentepohliaceen. *Nytt Mag. for Naturv. Ap.* **80** : 137-199.
20) .....(**1964**) : Die Chaetophoralen der Binnengev. *Hydrobiol.* **24** : 1-420.
21) RAMANATHAN, K. R. (**1962**) : Ulotrichales *Ind. Counc. Agr. Res.*, New Delhi
22) RANDHAWA, M. S. (**1959**) : Zygnemaceae *Ind. Counc. Agr. Res.*, New Delhi
23) SINGH, R. N. (**1941**) : On some phases in the life history of the terrestr. alga, *Frits. tuberosa* IYENG., and its autecol. *New Phytol.* **XL** : 170-182.
24) SKUJA, H. (**1949**) : Zur Süsswasseralgen Fl. Burmas. *Nova Acta Reg. Soc. Upsal. Ser.* **IV** : 1-188.
25) SMITH, G. M. (**1920, 1924**) : Phytopl. of the inland lakes of Wisc. *Bull. Univ. Wisc. Geol. Nat. Hist. Sur.* 57, *Sci. Ser.* **12** : Part I and II.
26) STARR, R. C. (**1955**) : A comparative study of *Chlorococcum* MENEGH. *Indiana Univ. Press*
27) TIFFANY, L. H. (**1937**) : Oedogoniales *North Amer. Fl.* **11** : 1-102.
28) TRANSEAU, E. N. (**1951**) : The Zygnemataceae *Ohio Univ. Press*
29) VENKATARAMAN, G. S. (**1961**) : Vaucheriaceae *Ind. Counc. Agr. Res.* New Delhi
30) WITTROCK, V. B. (**1877**) : On the develop. and systematic. arrengement of the *Pithophoraceae Oefv. Kongl. Sv. Vet.*
31) YAMAGISHI, T. (**1969**) : Notes on the freshwater algae in Japan 1. The freshwater algae of Okinawa *Bull. Jap. Soc. Phycol.* **17** : 11-12.

Plates with Explanations

Explanation of Plate 1.

Fig. A. *Fritschiella tuberosa* IYENGAR (a cultured form)

Fig. B, C. *Leptosira terricola* (BRISTOL) PRINTZ

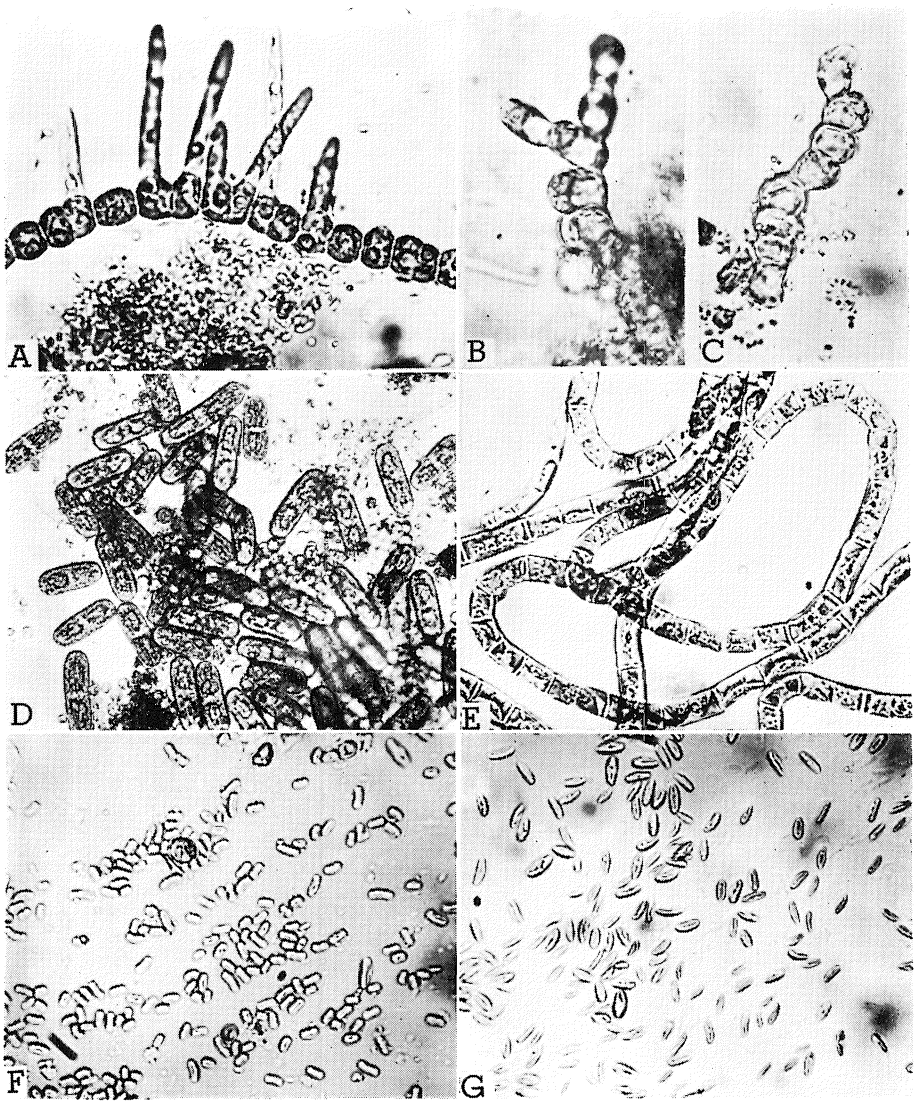
Fig. D. *Cylindrocystis brebissonii* MENEGH.

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

Fig. F. *Stichococcus bacillaris* NAEG.

Fig. G. *Monodus subterraneus* PETERSEN

Plate 1.



Explanation of Plate 2.

Fig. A, B. *Dichotomosiphon tuberosus* (A. BR.) ERNST

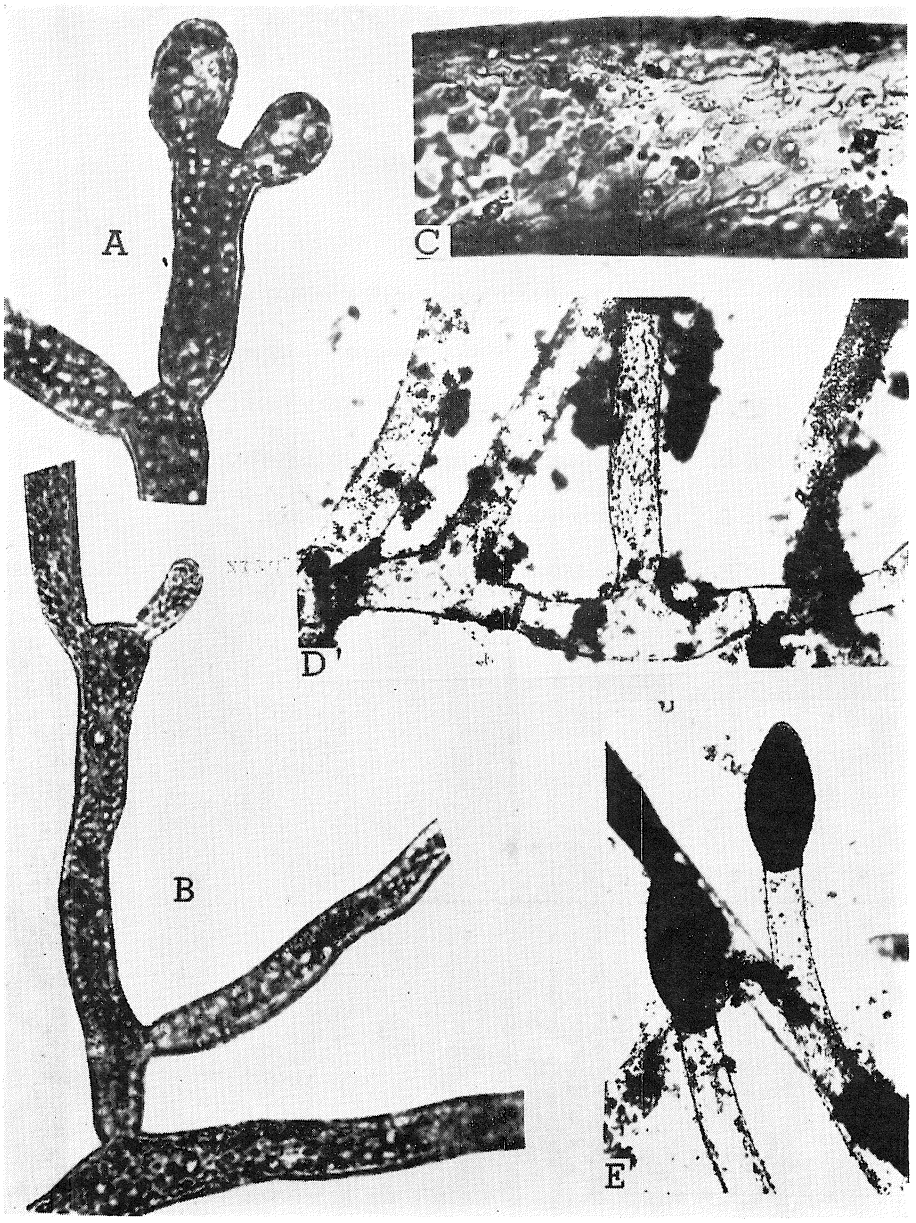
A : A portion of young fertile branch.

B : A portion of dichotomous branches with constrictions.

Fig. C, D, E. *Pithophora kewensii* WITTROCK

C : Coenocytic filament showing numerous chromatophores containing pyrenoids.

Plate 2.



Explanation of Plate 3.

Fig. A, B. *Oedocladium operculatum* TIFFANY

A : A vegetative filament with a conical cap.

B : An oogonium with a hypogynous antheridium.

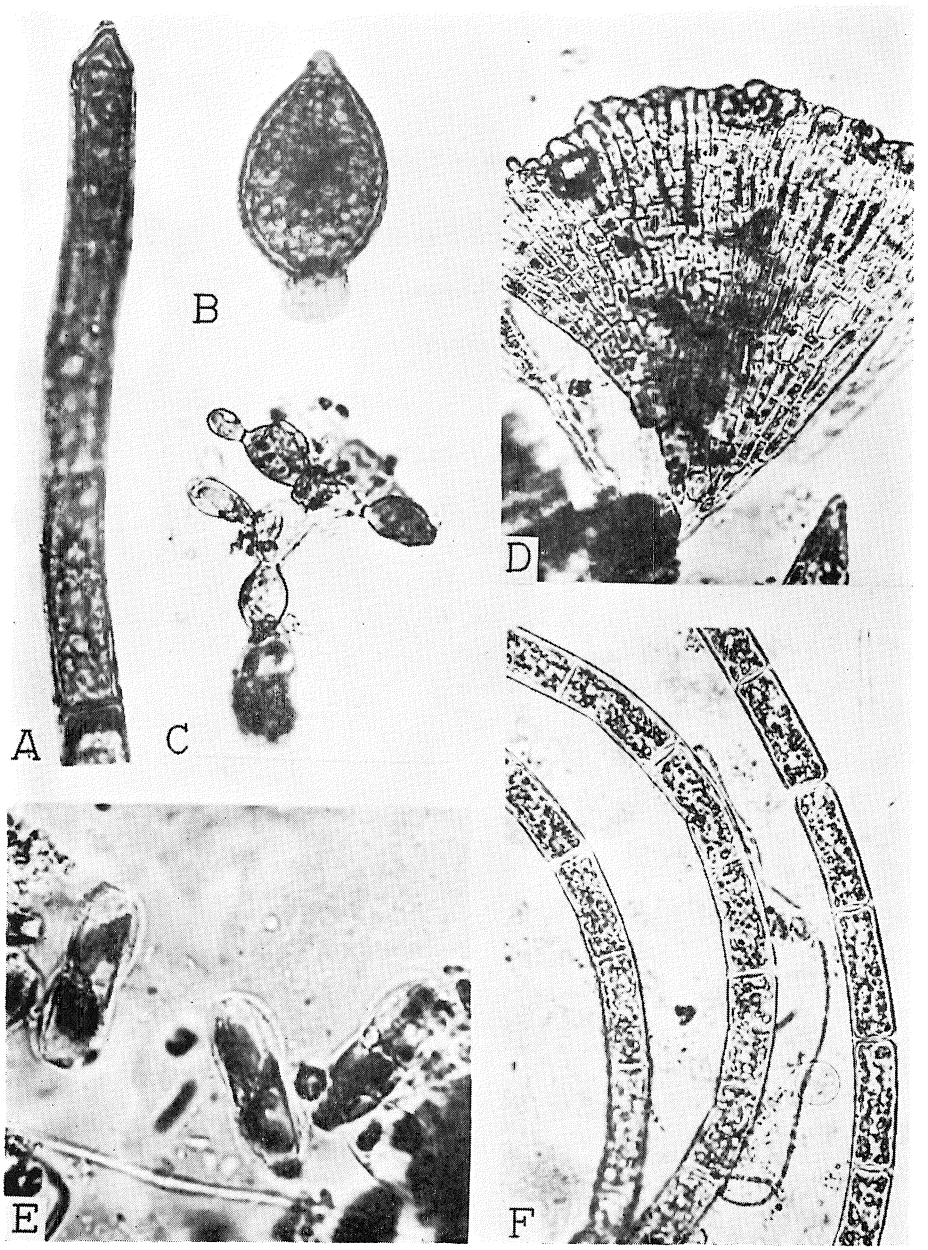
Fig. C. *Physolinum monilia* (DE WILDM.) PRINTZ

Fig. D. *Phycopeltis arundinacea* (MONT.)DE TONI

Fig. E. *Amphiprora alata* (EHRENB.) KUETZ.

Fig. F. *Rhizoclonium implexum* (DILLW.) KUETZ.

Plate 3.



Explanation of Plate 4.

Fig. A. *Scytonema varium* KUETZ ex BORN. et FLAH.

Fig. B. *Tolypothrix fragilis* (GARDN.) GEITLER

Fig. C. *Westiellopsis prolifica* JANET

Fig. D. *Anabaena* sp.

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

Fig. F. *Nostoc microscopicum* CARM. ex BORN. et FLAH.

Plate 4.