

**A MONOGRAPH ON THE DESMIDS
OF
PAKISTAN**

BY
FAZLI MALIK SARIM



DEPARTMENT OF BOTANY
University of Peshawar

1980

A MONOGRAPH ON THE DESMIDS OF PAKISTAN

BY

FAZLI MALIK SARIM (M.Sc.)

UNIVERSITY OF PESHAWAR

Thesis submitted to the Department of Botany,
University of Peshawar, in partial fulfilment of the requirements for the
degree of

DOCTOR OF PHILOSOPHY

IN

BOTANY

Advisor

(Prof. Dr. M.A.F. FARIDI)

April, 1980

Controller of Exams

Dt

The thesis of Mr. Fazli Malik Sarim
is approved.

S. Ahmed

H. S. Sarim

13.6.81

April, 1980

TABLE OF CONTENTS

	Page No.
ABSTRACT.....	I
INTRODUCTION.....	III
MATERIALS AND METHODS.....	IX
CLOSTERIOCURVIMETER.....	X
MAP OF PAKISTAN.....	XI
CHARACTERS OF THE FAMILIES.....	XII
KEY TO THE GENERA OF DESMIDS.....	XIV
CHARACTERS OF MICRASTERIAS.....	1
KEY TO THE TAXA.....	2
DESCRIPTION OF THE PLANTS.....	3
CHARACTERS OF EUASTRUM.....	24
KEY TO THE TAXA.....	24
DESCRIPTION OF THE PLANTS.....	25
CHARACTERS OF COSMARIUM.....	46
KEY TO THE TAXA.....	46
DESCRIPTION OF THE PLANTS.....	48
CHARACTERS OF CLOSTERIUM.....	80
KEY TO THE TAXA.....	81
DESCRIPTION OF THE PLANTS.....	82
CHARACTERS OF PLEUROTAENIUM.....	104
KEY TO THE TAXA.....	105
DESCRIPTION OF THE PLANTS.....	105
CHARACTERS OF STAUROSTRUM.....	112
KEY TO THE TAXA.....	113
DESCRIPTION OF THE PLANTS.....	113
CHARACTERS OF TRIPOCERAS.....	123
CHARACTERS OF DOCIDIUM.....	125
CHARACTERS OF XANTHIDIUM.....	126

KEY TO THE TAXA.....	127
DESCRIPTION OF THE PLANTS.....	127
CHARACTERS OF ARTHRODESMUS.....	135
KEY TO THE TAXA.....	136
DESCRIPTION OF THE PLANTS.....	136
CHARACTERS OF STAURODESMUS.....	140
KEY TO THE TAXA.....	140
DESCRIPTION OF THE PLANTS.....	140
CHARACTERS OF TETMEMORUS.....	143
KEY TO THE TAXA.....	143
DESCRIPTION OF THE PLANTS.....	143
CHARACTERS OF CYLINDROCYSTIS.....	145
KEY TO THE TAXA.....	145
DESCRIPTION OF THE PLANTS.....	145
CHARACTERS OF NETRIUM.....	147
KEY TO THE TAXA.....	147
DESCRIPTION OF THE PLANTS.....	147
CHARACTERS OF MESOTAENIUM.....	150
CHARACTERS OF BAMBUSINA.....	151
CHARACTERS OF DESMIDIUM.....	152
KEY TO THE TAXA.....	153
DESCRIPTION OF THE PLANTS.....	153
CHARACTERS OF PENIUM.....	156
KEY TO THE TAXA.....	156
DESCRIPTION OF THE PLANTS.....	157
CHARACTERS OF SPHAEROSOMA.....	158
KEY TO THE TAXA.....	159
DESCRIPTION OF THE PLANTS.....	159

	Page No.
CHARACTERS OF SPONDYLIOSIUM.....	160
KEY TO THE TAXA.....	161
DESCRIPTION OF THE PLANTS.....	161
CHARACTERS OF HYALOTHECA.....	162
KEY TO THE TAXA.....	163
DESCRIPTION OF THE PLANTS.....	163
CHARACTERS OF COSMOCLADIUM.....	165
CHARACTERS OF SPIROTAENIA.....	166
CHARACTERS OF OOCARDIUM.....	167
CHARACTERS OF GONATOZYGON.....	168
CHARACTERS OF ONYCHONEMA.....	170
CHARACTERS OF PHYMATODOCIS.....	171
CHARACTERS OF STREPTONEMA.....	171
ACKNOWLEDGEMENTS.....	173
LITERATURE CITED.....	175
CONTENTS-PLATES.....	203
PHOTOGRAPHS.....	225
GLOSSARY.....	242
INDEX.....	245

A B S T R A C T

One hundred and seventy four taxa belonging to 28 genera of desmids have been included in this work. Most of them are new records for Pakistan. Diagnostic characters of the families and the genera have been given. Keys are provided for all the taxa included in this study. Camera lucida drawings and photomicrographs of most of the taxa are given along with the diagnoses. The genera along with the number of taxa are Cosmarium (43), Closterium (24), Euastrum (22), Microasterias (19), Stauroastrum (13), Pleurotaenium (9), Xanthidium (7), Arthrodesmus (5), Staurodesmus (4), Desmidium (3), Tetmemorus (2), Cylindrocystis (2), Netrium (2), Penium (2), Hyalotheca (2), Sphaerosozoma (2), Spondylosium (2), Oocardium (1), Docidium (1), Triploceras (1), Spirotaenia (1), Mesotaenium (1), Bambusina (1), Phymatodocia (1), Gonatozygon (1), Streptonema (1), Cosmocladium (1), and Onychonema (1).

In all, 400 samples containing desmids were collected from all over the country. The more widely distributed taxa are Desmidium swartzii collected from 5 localities, Bambusina brebissonii from 4, Tetmemorus brebissonii from 4, Hyalotheca dissiliens from 3, Cosmarium botrytis from 3, Euastrum oblongum from 3, Penium margaritaceum from 3, and Netrium digitus from 3. The more common genera are Cosmarium and Closterium.

The nomenclature of all the taxa is according to the Rules of International Botanical Nomenclature. Riddles of nomenclature have also been solved whenever found

II

necessary. Some extremely rare des^mids have also been collected and included in this work.

This study is primarily based on field collections. Some taxa, however, had to be cultured in the laboratory to determine the exact identity. These taxa are mostly from basic waters.

INTRODUCTION

The present work was undertaken as a part of the programme to explore the algal flora of Pakistan. Prior to this study only two works (Sarim & Faridi, 1976 and Sabra Shah & Faridi, 1974) were done on the desmids in Pakistan. Their works covered a comparatively small area. This study includes the taxonomy of desmids from NWFP, Punjab, Sind and Baluchistan. Extensive tours were made to collect as many samples as possible. Specimens lying in other herbaria and with other botanists were also examined.

Pakistan has an area of 365,403 square miles. It is bounded on the North by the Himalayan mountains. A narrow arm of Afghanistan called Wakhan corridor separates it from the Russian Turkestan. The Chinese territories of Sinkiang and Tibet border Kashmir on the North and the North East. On the West, low dry hills and mountains separates Pakistan from Afghanistan and to the South, in Baluchistan, it has a common frontier with Iran for 500 miles. On the East side, Pakistan has a boundary with the Indian states of the Punjab and Rajestan. The Arabian Sea lies to the South of the country. Pakistan lies between 24°N and 37°N latitude and between 61°E and 75.5°E longitude. The climate of Pakistan, is of continental type and nowhere there is excessive rainfall. The principal rainy season lasts from July to September in the Punjab and Sind but winter months in N.W.F.P. The Summers are hot and Winters cold.

The soils of Pakistan belong to the dry group, Pedocals, which have a high content of calcium carbonate and a low content of organic matter.

Wallich (1860) was probably the first man to start investigating desmids of South Asia. He worked out some taxa from Bengal, India. Indian desmids were studied by several workers later on, particularly by Hobson (1963), Lagerheim (1888), Turner (1892), Schmidle (1895,1900), Borge (1899), West & West (1907), Carter (1929), Bruhl & Biswas (1926), lyengar & Bai (1941), Kamat (1962,1963) and Bharati (1965).

Islam (1970,1975), and Islam & Zaman (1975a) described many taxa from East Pakistan which is now called Bangladesh. His is the only work of importance from that country.

From Burma Zeller (1873), Joshua (1885,1886), West & West (1907) and Skuja (1949) reported many taxa and made important contribution towards the knowledge of this group.

The Indonesian and Singapore desmids were worked out by Grunow (1865), Gutwinkl (1902), Wildeman (1900) and Scott & Prescott (1961). The last named work includes as many as 526 taxa from Indonesia.

West & West (1902) and Schmidle (1895,1900) are probably the only workers of the desmids of Sri Lanka. Apart from his valuable contribution from Japan, Hirano has described desmids from Nepal (1952,1953) and Malaysia, Thailand and Phillippines (1967).

Sarim & Faridi (1976) worked out 47 taxa of Closterium from Peshawar valley of Pakistan. Prior to this group Sabra Shah & Faridi collected 37 taxa of Cosmarium from the same area (1974, unpublished). These are the only two works on desmids from a vast area of Pakistan, prior to this study.

The desmids are mostly unicellular plants of varied forms and symmetrical in three planes. Desmids belong to the order Zygnematales of the Class Chlorophyceae. There is a difference of opinion about the taxonomy of desmids.

The classification of desmids has undergone many changes ever since workers took interest in the group. Meneghini in 1837 used the term Desmideae as an order which was accepted by Ralfs in 1848 (Růžická, 1977). This was ultimately changed to Desmidiales by Pascher (1931) to bring it in conformity with the International Code of Botanical Nomenclature.

West & West (1904) divided the desmids into two groups, Saccoderm and Placoderm, while Oltmanns (1922) into Mesotaeniaceae and Desmidiaceae. He placed divergent genera Gonatozygon and Genticularia into Zygnemoideae. Thus according to his, Conjugales have three families. Krieger (1933) divided Conjugatae into two orders Zygnematales and Desmidiales. The Desmidiales were divided into Mesotaeniaceae, Gonatozygaceae and Zygnemaceae which was accepted by Fritsch (1964). Smith (1950) does not recognize Gonatozygaceae. Kosinskaja (1952) raised the status of the families of desmids, recognized by Krieger and Fritsch, to orders and named them as Desmidiales, Mesotaeniales and Gonatozygales.

Some more recent classifications are those of Prescott (1969) and Růžická (1977). Prescott recognizes two orders of the old Conjugatae following Krieger (1933), the Zygnematales and the Desmidiales. The Desmidiales include five families, the Mesotaeniaceae, the Gonatozygaceae,

the Closteriaceae, the Cosmariaceae, and the Hyalothecaceae. His classification is based on the mode of reproduction mostly. Ružička (1977) took into consideration the electron microscopic research of the cell wall done by Mix (1972). His classification is a combination of the old and new concepts. Like old workers he places Conjugatae as distinct from the green-algae and calls them as Conjugatophyceae. This class is divided into two orders Zygnematales and Desmidiiales. The Zygnematales include two families viz, Mesotaeniaceae and Zygnemataceae, while the Desmidiiales are further divided into two suborders Closteriineae and Desmidiineae. The later includes only one family Desmidiaceae while the former has three families, the Gonatozygaceae, Peniaceae and Closteriaceae.

It may be noted that some workers used the words Zygnemales and Zygnemaceae instead of their correct forms, the Zygnematales and the Zygnemataceae. The plural of Zygnems is Zygnemata. In the present work the classification of Ružička is followed and all the families and orders recognized by him have been accepted but his concept of the Class Conjugatophyceae has not been accepted. There are many taxa in other orders of green algae which show conjugation and amoeboid gametes, particularly the members of Volvocales. Similarly, the absence of flagellated swarmers is not confined to this group of green algae only.

About 400 samples were collected by the writer from all over Pakistan. Apart from these, specimens collected by other workers were also examined. The taxa which are more widely distributed are Desmidium swartzii

collected from five localities, Bambusina brebissonii from 4, Tetmemorus brebissonii from 4, Hyalotheca dissiliens from 3, Cosmarium botrytis from 3, Euastrum oblongum from 3, Penium margaritaceum from 3, and Netrium digitus from 3.

This study includes some rare plants like Oocardium stratum and Streptonema trilobatum. As a whole Cosmarium and Closterium are the commonest genera.

The basic soil of Pakistan is not very congenial to the growth of desmids, whenever, they are present, they are generally few in number. Careful examination of a tube may reveal even as few as one or two specimens. Each collection may have one or more species but generally the species are not very widely distributed.

In all 174 taxa of 28 genera have been included in this research. Since it is the first extensive study of desmids in this country, it is needless to say that most of them are new records. The description of taxa is accompanied by photomicrographs and camera lucida drawings. Suitable keys have been added to facilitate identification. The genera along with the number of taxa are Cosmarium (43), Closterium (24), Euastrum (22), Microasterias (19), Stauroastrum (13), Pleurotaenium (9), Xanthidium (7), Arthrodesmus (5), Staurodesmus (4), Desmidium (3), Tetmemorus (2), Cylindrocystis (2), Netrium (2), Penium (2), Hyalotheca (2), Sphaerozosma (2), Spondylosium (2), Oocardium (1), Docidium (1), Triploceras (1), Spirotaenia (1), Mesotaenium (1), Bambusina (1), Phymatodocis (1), Gonatozygon (1), Streptonema (1), Cosmocladium (1) and Onychonema (1).

VIII

The geographical distribution given in this work is mostly based on the papers consulted. A plant found in most countries of Europe, Asia and America and where desmids have been studied in details, has been shown as world wide in distribution.

IX

MATERIALS AND METHODS

Specimens were collected from ponds, drains, tanks, canal sides, marshy places, river margins, stagnant waters, rain pools, springs, streams and lakes.

Collections were made by plankton net, squeezing and scraping the aquatic vegetation, and dipping bottles in water. The specimens were examined in fresh conditions as far as was possible.

Immature specimens were cultured in petri-dishes. Soil extract was used as the culture medium as described by Faridi (1964, 1971). To clear the specimens 2% Potassium Hydroxide or 5% Acetic Acid solutions were used, whenever found necessary.

The soil extract was prepared by adding one gram of garden soil in 10 c.c. of river water. This solution was boiled for two to three hours to kill all organisms present in the soil. The mixture was filtered. Minerals and vitamins were added to enrich the soil extract by pouring a few drops of extract from crushed spinach leaves and fresh carrot juice. All cultures in petri-dishes were provided by artificial fluorescent light of 40 watts. The specimens were preserved in 3% Formalin.

Certain specimens could not be identified with certainty by direct examination. These were isolated in unialgal cultures and identified after more prolonged study. These were removed singly with the help of pipette and inoculated separately into petri-dishes containing soil extract. Closteriometer designed by Heimans (1946) for closteriometry has also been included.

X Closteriometry

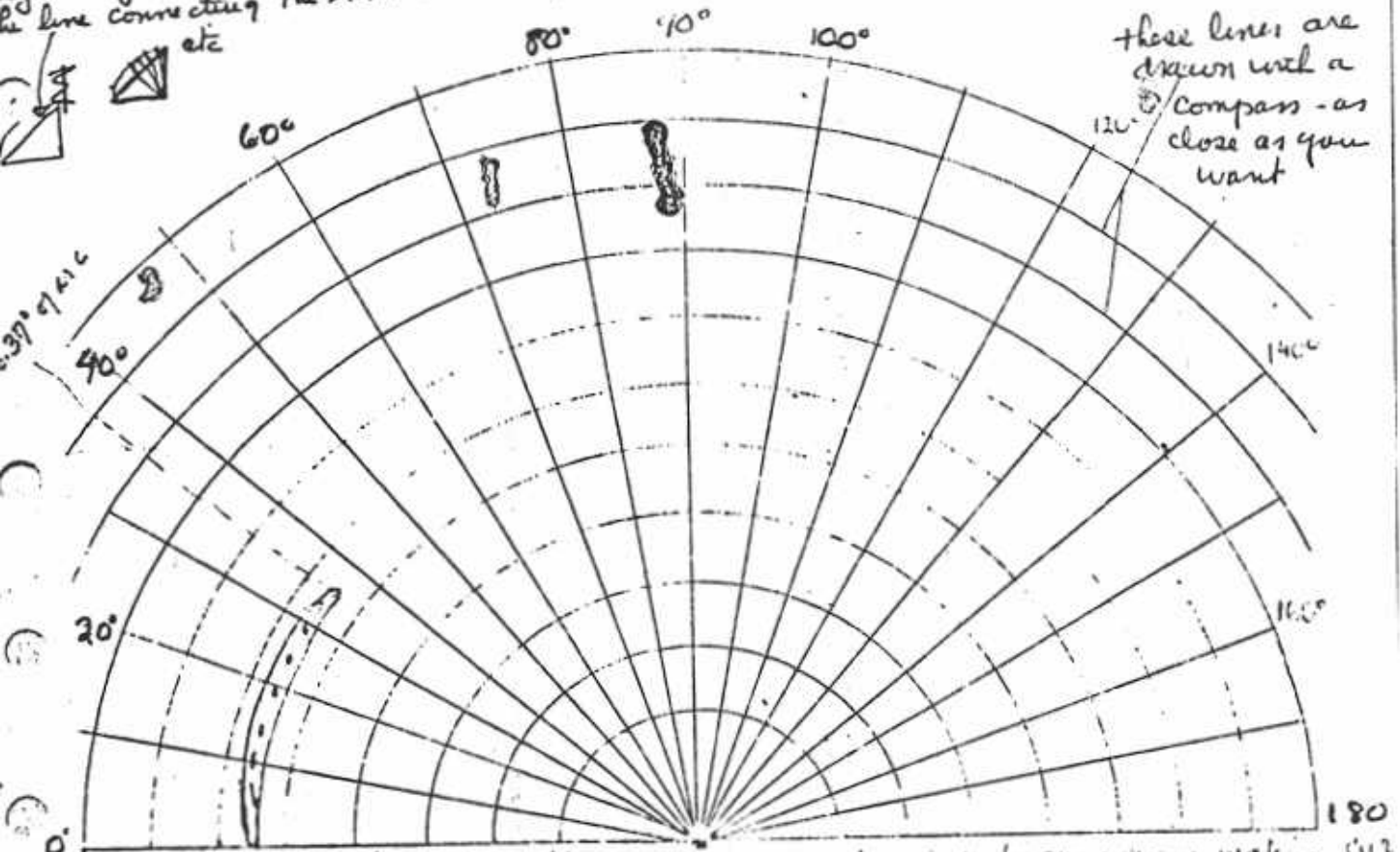
In attempting species determination of Closterium, two criteria in general use are often of little help. Length is generally accepted as the maximum straight distance between the apices, but this criterion changes with growth after each division. Breadth is the diameter of the greatest circular transverse section, and is more constant; better still is the ratio, length:breadth.

For the highly lunate or arcuate species, the measure of the grade of curvature is a more constant criterion. By using a set of drawn concentric arcs, a camera lucida drawing of a Closterium can be shifted under the semicircles until its curvature matches that of one of the arcs, which are then read in medians.

This is from a paper by one of my students. I draw a larger version, on tracing paper

These lines can be drawn by drawing the 90° line as a right angle, then subdividing the line connecting the extremities etc

"Closteriocyrcumeter"



these lines are drawn with a compass - as close as you want

put your pencil on the 90° line and draw a circle. Then put your pencil on the 120° line and draw a circle. Method devised by Heiman, J. 1946: 13th Biolog. Jaarboek. Dordrecht, 1946. pp 146-154

PAKISTAN

IX

AFGHANISTAN

IRAN

ARABIAN SEA



Scale: 1" = 100 Miles

CHARACTERS OF THE FAMILIES INCLUDED
IN THIS STUDY

Order 1. Zygnematales (Saccodermatae)

Cells without pores, conjugation tube common; cell wall a single piece.

Family 1. Zygnemataceae

Family 2. Mesotaeniaceae

Cells straight, mostly twice longer than broad; no pores; ornamentation often absent; cell wall a single continuous piece; chloroplasts 1-4, a band, an axile rod or a ribbon; conjugation tube common.

Genera: Mesotaenium, Netrium, Cylindrocystis, Spirotaenia.

Order 2. Desmidiaceae

Wall with pores mostly; conjugation tube present or absent; cell wall in two sections with an isthmus, cells unicellular, filamentous or rarely colonial.

Suborder 1. Closteriineae

Sculpturing on outer wall; pores in outer walls; omniradial; median girdle present.

Family 1. Gonatozygaceae.

Cells cylindrical or filamentous; wall mostly smooth rarely with granules or minute spines; pores not clear; median constriction absent.

Genus: Gonatozygon

Family 2: Peniaceae.

Cells straight with rounded angles; cell in two clear segments; constriction shallow or absent; pores in walls; crystals of end vacuoles rare; monotypic.

Genus: Penium

Family 3: Closteriaceae

Cells in two clear segments; cells greatly elongated, in most cases curved, rarely straight; ends narrow; pores in walls clear; end vacuoles with crystals; monotypic.

Genus: Closterium

Suborder 2. Desmidiineae

Sculpturing on secondary wall; pores in secondary walls; pores with a clear pore-apparatus; cells rarely omniradial; sinus very clear and often deep; median girdle absent.

Single family Desmidiaceae

Genera: Oocardium, Cosmocladium, Bambusina, Hyalotheca, Desmidium, Spondylosium, Sphaerzosma, Tetmemorus, Docidium, Pleurotaenium, Triploceras, Staurastrum, Diastrum, Micrasterias, Cosmarium, Xanthidium, Arthrodesmus, Onychonema, Staurodesmus, Streptonema, Phymatodocis.

There are about 42 genera of desmids out of which 28 genera have been included in this study. The following genera have not so far collected from the country.

Roya, Ancylonema, Genicularia, Groenbladia, Ichthyocercus, Actinotaenium, Triplastrum, Ichthyodontum, Allorgia, Amscottia, Dysphinctium, Biastridium, Teilingia and Bourrellyodesmus.

KEY TO THE GENERA OF DESMIDS

1. Cells solitary.....2
1. Cells in filaments.....20
1. Cells in colony.....27
 2. Median constriction present.....3
 2. Median constriction absent.....15
3. Chloroplast parietal.....4
3. Chloroplast axile.....5
 4. Cells several times longer than broad.....Pleurotaenium
 4. Cells not several times longer than broad.....Xanthidium
5. Cells with spines.....6
5. Cells without spines.....9
 6. Semicells monospinous.....7
 6. Semicells multispinous.....8
7. Cell wall smooth.....Staurodesmus
7. Cell wall not smooth.....Arthrodesmus
 8. Cells with whorls of protuberances.....Triploceras
 8. Cells otherwise.....Micrasterias
9. Angles continued in processes.....Staurostrum
9. Angles not continued in processes.....10
 10. Semicells apices incised.....11
 10. Semicells apices not incised.....12
11. Semicells with a central protuberance.....Euastrum
11. Semicells without a central protuberance.....Tetmemorus
 12. Semicell bases with vertical plications.....Docidium
 12. Semicell bases otherwise.....13
13. Chloroplast substellate.....Cylindrocystis
13. Chloroplast axile, plate like.....14
 14. Cells several times longer than broad.....Penium
 14. Cells not several times longer than broad....Cosmarium

15. Cells mostly curved, strongly attenuated at poles...Closterium
15. Cells not curved, not strongly attenuated at poles..16
 16. Chloroplast an axile plate.....Mesotaenium
 16. Chloroplast otherwise.....17
17. Chloroplast spirally twisted.....Spirotaenia
17. Chloroplast otherwise.....18
 18. Cell wall with minute spines.....Gonatozygon
 18. Cell wall without minute spines.....19
19. Cells about twice longer than broad.....Cylindrocystis
19. Cells at least three times longer than broad.....Netrium
19. Cells several times longer than broad.....Penium
 20. Cells united by apical processes.....21
 20. Cells not united by apical processes.....23
21. Cells slightly constricted.....Sphaerzosma
21. Cells deeply constricted.....22
 22. Sinus closed.....Onychonema
 22. Sinus open.....Streptonema
23. Cells more broad than long.....24
23. Cells otherwise.....25
 24. Median constriction marked.....Phymatodocis
 24. Median constriction otherwise.....Desmidium
25. Cells barrel-shaped.....Bambusina
25. Cells otherwise.....26
 26. Cells deeply constricted.....Spondylosium
 26. Cells slightly constricted.....Hyalotheca
27. Cells deeply constricted.....Cosmocladium
27. Cells slightly constricted.....Oocardium

CHARACTERS OF MICRASTERIAS

1. MICRASTERIAS Agardh ex Ralfs Brit. Desm. p.68. 1848.

Cells usually solitary, rarely in filaments, frequently of large size and with the length somewhat greater than the breadth, median constriction always well defined and usually linear to sublinear, isthmus never broad; mostly bilaterally symmetrical and greatly compressed; semicells semicircular to hexagonal, with two incisions from periphery to about half way to centre dividing the semicell into three lobes, the central or polar lobe and two lateral lobes; or with four incisions that divide the semicell into one polar and four lateral lobes; depth of incision variable and shape linear to cuneate; polar lobe generally with apex expanded and somewhat emarginate, at times with accessory asymmetrical processes; lateral lobes rarely entire, usually one, two, three or four times of secondary lobelets, the ultimate lobelets generally with emarginate apices or spines; cell wall usually smooth, at times with rows of spines near the incisions or marginal denticulations; entire body of cell rarely covered with spines; chloroplast a flattened massive axile plate having the same general contour as the semicell, with numerous small ridges at right angles to the chloroplast body, lobe of chloroplast in polar lobe of cell frequently deeply incised; pyrenoids numerous, from thirty to a hundred, and fairly evenly distributed throughout the chloroplast; vertical view usually narrowly fusiform-elliptic and lateral view of semicells narrowly pyramida[.].

KEY TO THE TAXA

1. Cell wall granulate.....M. mahabuleshwarensis
1. Cell wall punctate.....2
1. Cell wall smooth.....7
 2. Cells a little longer than broad.....3
 2. Cells otherwise.....4
3. Isthmus 18-20 μ m broad.....M. truncata
3. Isthmus 22-24 μ m broad.....M. papillifera
3. Isthmus 29 μ m broad.....M. rotata
 4. Sinus linear or narrowly linear.....5
 4. Sinus otherwise.....6
5. Cell 123-135 μ m broad.....M. oscitans
5. Cell 174 μ m broad.....M. radiosa
5. Cell 196 μ m broad.....M. laticeps
5. Cell 184-230 μ m broad.....M. denticulata var. angulosa
5. Cell 247 μ m broad.....M. doveri var. africana
5. Cell 450 μ m broad.....M. torreyi
 6. Cell 53-76 μ m long.....M. pinnatifida
 6. Cell 191-230 μ m long.....M. apiculata var. brachyptera
7. Semicells 3-lobed.....M. decemdentata
7. Semicells otherwise.....8
 8. Sinus linear or sublinear.....9
 8. Sinus otherwise.....10
9. Cell 78-90 μ m long.....M. foliacea
9. Cell 107-126 μ m long.....M. crux-melitensis
9. Cell 127-150 μ m long.....M. jenneri var. simplex
9. Cell 174-202 μ m long.....M. thomasi
 10. Cell $1\frac{1}{2}$ times longer than broad.....M. muricata
 10. Cell less than $1\frac{1}{2}$ times longer than broad.....M. radiata

DESCRIPTION OF THE PLANTS

1. Microsterias apiculata (Ehr.) Ralfs, var. brachyptera (Lund.)
West & West, Brit. Desm. vol.2, p.101, pl.46, fig.5. 1905.
- = M. brachyptera Lund. Desm. Succ. p. 12, pl. 1, fig.4. 1871.
(Basionym).
- = M. brachyptera forms bispinata Turn. New and rare Desm. p.
937, pl. 16, fig. 15. 1885.
- = M. apiculata (Ehr.) Menegh. Subsp. fimbriata y brachyptera
Nordst. Bornh. Desm. p. 190. 1888.
- = Helierella brachyptera Kuntze, Revis. gen. plant. p.898. 1891.
Taylor, 1955, p. 211, pl. 65, fig.6; Croasdale, 1956,
p.8, pl.2, fig.6; Eloranta, 1968, p.62, fig.1; Förster, 1968,
p.17, pl.7, fig.5; Kasprík, 1973, p.120, pl.2, fig.12; Lenzenweger,
1977, p.336, pl.1, fig.7.

191-230 μm long; 131-180 μm broad; isthmus 34-37 μm
broad; polar lobe 54-60 μm broad; thickness 72 μm .

Cells large, polar lobe projecting, relatively
larger and wider, with a distinct constriction below the
apex; apical margin widely reduced; lateral lobes shorter and
generally with fewer lobulations; sinus and incisions
between the lobes widely open, especially the incisions between
the polar lobe and the superior lateral lobes; generally
with a row of spines bordering each side of the polar lobe and
the sinus; cell wall punctate. (Pl.1, fig.3, photo.3).

Local distribution: Tangi, Distt. Peshawar, Sarim
No.28, Sept.20, 1976.

Geographical distribution: Europe, U.S.A., Pakistan.

2. M. crux-melitensis (Ehr.) Hass. ex Ralfs, Brit. Desm. p.73, pl.9, fig.3. 1848.
- = Euastrum crux-melitensis Ehr. Entwick. Lebends. d. Infus. p.82, 1832. (Basionym).
- = Cosmarium crux-melitensis Corda/ⁱⁿ Alm. de Carlsbad, p.243. 1839.
- = Microasterias melitensis Menegh. Synops. Desm. p.216. 1840.
- = M. crux-melitensis var. superflua Turn. Some new and rare Desm. p.936, pl.15, fig.11, 1885.
- = Helierella crux-melⁱtensis Kuntze, Revis. gen. plant. p.897. 1891.

West & West, vol.2, 1905, p.116, pl.53, figs. 1-3;
 Hirano, 1959a, p.271, pl.34, fig.15; Fritsch, 1961, fig.107;
 Wygasch, 1963, p.107, fig.3; Förster, 1965, p.132, pl.3, figs.
 1, 2; Lenzenweger, 1965, p.448, pl.1, fig.5; Lind, 1967, p.372,
 pl.3, fig.2; Zwart, 1969, p.172, fig.115, Förster, 1970, p.303,
 pl.12, figs. 1-6; Kasprik, 1973, p.120, pl.2, fig.13; Luknitskaya,
 1974, fig.2; Werner, 1977, p.51, pl.9, figs. 1-6; Tan & Ueda, 1978,
 p.61, figs. 1-21.

107-126 μ m long; 98-118 μ m broad; isthmus 16-19 μ m
 broad; polar lobe 35-43 μ m broad.

Cells of moderate size, a little longer than broad,
 very deeply constricted; sinus open with acute or linear apex;
 semicells 5-lobed, interlobular incisions widely open, those on
 each side of the polar lobe much deeper than those between the
 superior and inferior lateral lobes; polar lobe subquadrate in its
 lower half, upper half dilated, apex widely retuse, angles
 produced into short diverging processes with emarginate-biden-
 tate apices, lateral lobes divided into two short slightly diver-
 ging, elongate- quadrate lobules, emarginate- bidentate (some-
 times tridentate or quadridentate with a median notch at the

apex; vertical view subrhomboid-elliptical with slightly produced poles; cell wall smooth. (Pl.1, fig.4. photo.4).

Local distribution: Akbarpura, Distt. Peshawar.
Sarim No.30, Sept.25, 1976.

Geographical distribution: World wide.

3. M. decemdentata (Näg.)ⁱⁿ Arch./Pritch. Infus. p.726. 1861.

Hirano, 1959, p.269, pl.34, fig.17; pl.35, fig.5;
Grönblad, Scott & Croasdale, 1964, p.15, fig.219; Ochiai, 1966,
p.123, fig. D; Kanetsuna, 1967, p.80, pl.4. fig.4; Whitford &
Schumacher, 1973, p.70, pl.24, fig.4; Croasdale & Scott, 1976,
p.523, pl.7, fig.11; Claassen, 1977, p.239, figs.16, 17; Hinode,
1977, p.80.

68 μ m long; 62 μ m broad; isthmus 15 μ m broad; polar
lobe 49 μ m broad.

Cells small, elliptical, a little longer than broad,
deeply constricted; sinus linear and acute-angled; semicells
semicircular, 3-lobed; incisions between polar lobe and superior
lateral lobes deep, polar lobe wide cuneate, apex convex;
lateral lobes divided into two lobules, interlobular incisions
slightly deep and acute, lobules truncate and emarginate bear-
ing spines; vertical view fusiform; cell wall smooth.
(Pl.2, fig.4, photo.16).

Local distribution: Warsak, Distt. Peshawar, Sarim
No.202, Jan.5, 1978; Mardan, Sarim No.III, Dec. 12, 1976.

Geographical distribution: Japan, China, Europe,
Australia, Pakistan.

4. M. denticulata Bréb.^{ex Ralfs} var. angulosa (Hantzsch) West & West,
Alg. N. Inland p.30. 1902.

- = M. angulosa Hantzsch Rabenh. Alg. No.1407. 1862. (Basionym).
- = Didymidium (Micrasterias) angulosum (Hantzsch) Reinsch, Algenfl. Frank. p.147, pl.8, fig.2. 1867.
- = Helierella angulosa Kuntze, Revis. gen. plant. p.898. 1891.

West & West, vol.2, 1905, p.107, pl.50, figs.3, 4;
Grönblad, 1952, p.20; Croasdale, 1956, p.8, pl.2, fig.10; Hirano, 1959, p.275, pl.34, fig.7; Eloranta, 1968, p.62, fig.2; Mix, 1970, p.86, pl.5, fig.1; Kasprik, 1973, p.123, pl.1, fig.5; pl.2, fig.14; Whitford & Schumacher, 1973, p.70, pl.25, fig.4; Pickett-Heaps, 1974, p.16, figs.18, 20; Mix & Kasprik, 1977, p.66, fig.4; Werner, 1977, p.51, pl.8, fig.2; pl.25, fig.1.

210-282 μm long; 184-230 μm broad; isthmus 30-33 μm broad; thickness 54 μm .

Cells angular, often relatively broader near the poles; lateral lobes ^{only} divided by primary and secondary incisions, the four subdivisions being truncate with rounded angles, retuse, or retuse-emarginate; cell wall distinctly punctate and cell deeply constricted. (Pl.1, fig.10, photo.9).

Local distribution: Akbarpura, Distt: Peshawar, Sarim No.30, Sept. 25, 1976.

Geographical distribution: World wide.

5. M. doveri Biswas var. africana Bourrelly, Algues d'eau douce de la Republique de cote d'Ivoire. Bull de II. F.A.N.23 (2): 283-374. 1961.

Islam, 1970, p.919, pl.8, fig.4; pl.12, fig.3.

398 μm long; 247 μm broad; isthmus 28 μm broad.

Cells large, subcircular, deeply constricted, sinus narrowly linear; interlobular incisions linear; side view of semicell elliptic-oblong; cell wall punctate. (Pl.2, fig.1, photo.14).

Local distribution: Zoological Gardens Lahore,
Tank No.1, Sarim No.45, Oct.20, 1976.

Geographical distribution: Africa, Bangladesh, Pakistan.

6. M. foliacea Bail. ex Ralfs, Brit. Desm. P.210, pl.35, fig.3.
1848.

Smith, 1924, p.54, pl.65, figs.1, 2; Taylor, 1935,
p.213, pl.64, fig.3; Prescott, 1954, p.74, fig.110c; Hirano,
1959, p.279, pl.37, fig.2; Chung, Shin & Lee, 1965, p.59; Islam,
1970, p.919, pl.9, figs.5, 6; pl.12, figs.4, 5; Whitford & Schum-
acher, 1973, p.70, pl.23, fig.18.

78-90 μ m long; 82-85 μ m broad; isthmus 15-20 μ m broad;
polar lobe 45-58 μ m broad.

Cells of medium size, united in filaments by the
interlocking of the polar lobe, rectangular in outline, very
deeply constricted, sinus sublinear, isthmus very narrow; semicells
5-lobed; polar lobe exerted, basal fourth of the polar lobe
narrow, with erect parallel sides; lateral lobes asymmetrical,
cell wall smooth; vertical view narrowly fusiform, with apices
acuminate and median portion somewhat constricted; chloroplast
completely filling the cell, polar lobe entire, without
conspicuous ridges; pyrenoids 10-15. (Pl.1, fig.11, photo.10).

Local distribution: Naguman River Distt. Peshawar,
Sarim No.50, Oct.25, 1976; Bannu, Sarim No.108, Dec.10, 1976.

Geographical distribution; World wide.

7. M. Jenneri Ralfs var. simplex West, Alg. N. Wales, p.87,
pl.6, fig.34, 1890.
= M. jenneri forma brasiliensis Börg. Desm. Brasil. p.32,
pl.3, fig. 13, 1890.

West & West, vol.2, 1905, p.88, pl.43, fig.3; Taylor,

1935, p.213, pl.64, fig.2; pl.65, fig.4; Tomaszewicz, 1977, p.635, pl.1, figs.3,4.

127-150 μm long; 95-100 μm broad; isthmus 25-34 μm broad; polar lobe 53-56 μm broad.

Cells with the lateral lobes entire and slightly retuse, polar lobe narrow and more cuneate; sinus narrowly linear; cell wall smooth; cell deeply constricted, semicells 5-lobed, interlobular incisions narrow and linear, not very deep; side view of semicells oblong-elliptic; vertical view oblong-fusiform, with the sides in the middle subparallel, somewhat suddenly attenuated to the poles. (Pl.1, fig.7 photo. 7).

Local distribution: Katlang, Distt. Mardan, Sarim No.40, Oct.10, 1976.

Geographical distribution: Europe, Pakistan, Brazil.

8. M. laticeps Nordst. Vidensk. Medd. f. d. Naturhist. Foren. Kiöbenhavn. p.220, pl.2, fig.14. 1870.

Smith, 1924, p.41, pl.59, fig.3.

140 μm long: 196 μm broad at basal lobes: polar lobe 185 μm broad: isthmus 26 μm broad.

Cells large, quadrangular, breadth somewhat greater than the length, very deeply constricted, sinus with apical portion linear and outer portion acute-angled, isthmus narrow: semicells 3-lobed, polar lobe transversely fusiform with apex rounded and lateral angles very acute and slightly bent towards the base of the semicell; lateral lobes entire, horizontally disposed, lanceolate and with deeply bifid apices; cell wall minutely punctate; vertical view fusiform, with poles acuminate; chloroplast completely filling the semicell, polar lobe entire, with two conspicuous vertical ridges extending

from the nucleus to the apex of the cell, with other ridges following the outline of the cell; pyrenoids 12-15. (Pl.1, fig.14, photo.13).

Local distribution: Kalam Distt. Swat, Sarim No.170, Nov.3, 1978.

Geographical distribution: U.S.A., Pakistan, Europe.

9. M. mahabuleshwarensis Hobson in Quart. Journ. Micr. Sci. p.255. 1885.

= M. americana forma mahabuleshwarensis Mask. Note Micr. Amer. p.9, pl.1, fig.8. 1888.

= Helierella mahabuleshwarensis Kuntze, Revis. gen. plant. p.899. 1891.

West & West, vol.2, 1905, p.121; Hirano, 1959, p.281, pl.36, fig.12.

151-220 μ m long; 135-190 μ m broad; polar lobe 75-100 μ m broad; isthmus 19-20 μ m broad.

Cells moderately large, about $1\frac{1}{6}$ times longer than broad, very deeply constricted, sinus open with an acuminate apex; semicells 3-lobed, incision between lateral lobes and polar lobe very wide; polar lobe large and outstanding, lower half subquadrate, upper half dilated, with the angles produced into diverging sometimes almost horizontal, denticulate processes of considerable and variable length, with a pair of accessory denticulate processes disposed asymmetrically, one at the front and one at the back near the base of each lateral process, apical margin straight, slightly convex, or slightly concave, generally with several large granules or short, acute spines within the margin; lateral lobes deeply divided into two lobules by a wide acute-angled incision, each lobule in the form of an attenuated denticulate process; apices of all the processes tri- or

quadridenticulate; semicells in the middle above the isthmus with a small granulate or denticulate protuberance, with a row of denticulations within the lateral lobes sometimes with several scattered series and within the lateral margins of the polar lobe, these series generally extending to the basal protuberance; side view of semicell narrowly oblong-ovate, with a small basal inflation on each side, apex showing the asymmetrical disposition of the four processes; vertical view rhomboid-fusiform, poles attenuated and tridenticulate, at the middle on each side with a small granulate or denticulate protuberance, polar lobe showing very clearly the disposition of the four processes. (Pl.2, fig.3).

Local distribution; Khawashki Lake near Nowshera, Sarim No.200, Jan.2, 1978.

Geographical distribution: India, Burma, Java, Africa, Madagascar, U.S.A., Europe, Pakistan.

10. M. muricata (Bail.) Ralfs, Brit. Desm. p.210, 1848.

Smith, 1924, p.54, pl.64, figs.4-5.

160-198 μm long: 110-130 μm broad at the inferior lateral lobes, 88-106 μm broad at the superior lateral lobes, 86-96 μm broad at the apex of the polar lobes; isthmus 22-23 μm broad.

Cells large, length about one and a half times the breadth, fairly deeply constricted, sinus acute-angled at apex and then greatly dilated, outer portion with widely open parallel sides, isthmus relatively broad; semicells 5-lobed, polar and lateral incisions very broad and rectangular, with

upper portion greatly dilated and with the angles continued in long slightly tapering cylindrical processes that are upwardly curved and terminate in three or four minute blunt conical spines; polar apex convex, central portion with a conspicuous narrow emargination and the lateral margins with a second pair of asymmetrically disposed processes that are similar to those at the polar angles; superior lateral lobes divided by an incision to form two long horizontally disposed processes that lie above each other in a front view of the semicell, processes arising from a conical base; inferior lobes submamillate, with the apex continued in a long cylindrical horizontally disposed process, each process of inferior lateral lobe with two similar but shorter processes, the three lying in the same transverse plane at right angles to the long axis of the semicell, all processes of lateral lobes with truncate ends bearing three or four short blunt teeth; cell wall smooth; vertical view oblong, sides somewhat tumid and angles continued in long, slightly divergent processes, middle of each end with another similar process; chloroplast confined to the cell body but with fine laminate projections running into the processes, polar lobe entire, with two conspicuous longitudinal ridges extending from the polar apex to the nucleus and with curving ridges at the bases of the lateral lobes; pyrenoids 12-15, confined to the body of the cell. (Pl.2, fig.2, photo. 15).

Local distribution: Pabbi Distt. Peshawar, Sarim
No.48, Oct.22, 1976.

Geographical distribution: U.S.A., Pakistan, Europe.

11. M. oscitans Ralfs, Brit. Desm. p.76, pl.10, fig.2. 1848.
- = M. oscitans Ralfs in Jenners Flora Tunbridge Walls, p.198. 1845.
- = Holocystis oscitans, Hass. Brit. Freshw. Alg. p.387, pl.90, fig.4, 1845.
- = Diastrum (Micrasterias) oscitans Næg. Gatt. einz. Alg. p.123, 1849.
- = Tetrachastrum oscitans Dixon in Proc. Dubl. Nat. Hist. Soc. 1859.
- = Helierella oscitans Kuntze, Revis. gen. plant. p.899, 1891.
- = Micrasterias oscitans a typica Turn. Freshw. Alg. E. India, p.88, 1893.

West & West, vol.2, 1905, p.78, pl.41, figs.1-4;
Taylor, 1935, p.214, pl.64, fig.7; pl.68, fig.8; Prescott, 1966,
p.29, pl.8, fig.30; Whitford & Schumacher, 1973, p.71, pl.24,
fig.12.

125-140 μ m long; 123-135 μ m broad; polar lobe 91-95 μ m
broad; isthmus 25 μ m broad.

Cells of medium size, about as long as broad, deeply
constricted, inner half of sinus usually narrowly linear, outer
half open and acutely conical; semicells 3-lobed; polar lobe
wide, fusiform or subfusiform, with acuminate, rarely bifid
poles and a convex apex; incisions below the polar lobe deep
and somewhat widely open; lateral lobes horizontal, ovate-trian-
gular, with minutely bifid extremities; side view of semicell
elliptic-pyramidal, with a rounded apex; vertical view elliptic-
fusiform, with acuminate poles; cell wall punctate.

(Pl.1, fig.8, photo.8).

Local distribution: Katlang Distt. Mardan, Sarim
No.40, Oct.10, 1976.

Geographical distribution: Europe, U.S.A., Pakistan, India.

12. M. papillifera Bréb. ex Ralfs, Brit. Desm. p.72, pl.9, 1848.
 = Didymidium (Micrasterias) papilliferum Reinsch, Algenfl. Frank. p.146. 1867.
 = Helierella papillifera Kuntze, Revis. gen. plant. p.899. 1891.

West & West, vol. 2, 1905, p.91, pl.44, figs. 1,2, 7:
 Taylor, 1935, p.214, pl.66, fig.4; Hirano, 1959, p.273, pl.35, fig.10; pl.36, fig.8; pl.37, fig.41; Wygasch, 1963, p.108, figs.6, 7; Croasdale & Grönblad, 1964, p.172, pl.9, figs.2,3; Lenzenweger, 1965, p.450, pl.1, fig.10; Ochiai, 1966, p.123; Mattern, 1966, fig.11; Prescott, 1966, p.29, pl.8, fig.44; Lind, 1967, p.373, pl.5, fig.1; Zwart, 1969, fig.116; Förster, 1970, p.303, pl.16, figs.4,14; Kies, 1970, p.22, figs. 3-25; Kies, 1970a, p.139, figs.1, 7; Lenzenweger, 1970, p.4, pl.3, fig.7; Hinode, 1971, p.111, pl.6, fig.3; pl.5, fig.5; Kies, 1972, p.3, figs. 1-3; Whitford & Schumacher, 1973, p.71, pl.25, fig.9; Kasprisk, 1973, p.123, pl.3, figs.22-24; pl.5, figs.44, 45; Kies, 1973, p.139, pl.1; Coesel, 1974, p.365; Parra & Gonzales, 1977, p.21, fig.93; Werner, 1977, p.52, pl.8, figs.4,5; pl.26, figs.4,5.

118-145 μ m long; 108-145 μ m broad; polar lobe 35-44 μ m broad; isthmus 22-24 μ m broad.

Cells of moderate size, usually a little longer than broad, subelliptic or subcircular, deeply constricted, sinus very narrowly linear; semicells 5-lobed, with the lobes and lobules usually almost approximate, interlobular incisions linear; polar lobe cuneate with concave sides, apex concave with a slight median notch, each angle slightly produced and furcato-emarginate, with a pair of small teeth on each side of the median notch; lateral lobes cuneate, of almost equal breadth, each divided by a moderately deep incision into two lobules, lobules again divided, the four ultimate divisions of each lobe being emarginate or

rarely tridenticulate; side view of semicell elliptic-oblong, with a tricuspidate apex; vertical view narrowly oblong with subacute poles; cell wall generally punctate, with a row of acute granules or denticulations on each side of the sinus and the interlobular incisions; these granules or small teeth are marginal. (Pl.1, fig.2, photo.2).

Local distribution: Rawal Dam Canal, Rawalpindi, Sarim No.23, Sept.15,1976; Peshawar, Sarim No.58, Oct.28,1976.

Geographical distribution: World wide.

13. M. pinnatifida (Kg.) Ralfs, Brit. Desm. p.77, pl.10, fig.3.1848.
- = Diastrium pinnatifidum Kg. Phyc. germ. p.134.1845. (Basionym).
- = E. bifidum Focke, Phys. Stud. p.45, pl.1, fig.12. 1847.
- = E. didymacanthum Näg. Galt. einz. Alg. p.123, pl.6, fig.1.1849.
- = Tetrachastrum pinnatifidum Dixon in Quart. Jour. Micr. Sci. p.83.1859.
- = Didymidium (Micrasterias) pinnatifidum Reinsch, Algenfl. Frank. p.141.1867.
- = Micrasterias oscitans Ralfs var. pinnatifida Rabenh. Flor. Europ. Alg. p.189.1868.
- = Holocystis pinnatifida Bennet, Freshw. Alg. Eng. Lake Distr. p.8.1886.

West & West, vol.2, 1905, p.80, pl.41, figs.7, 11,12; Smith, 1924, p.41, pl.59, figs. 1, 2; Taylor,1935, p.214, pl.64, fig.5; Brunel,1938, p.3, fig. 1; Croasdale, 1956, p.10, pl.1, fig.7; Scott & Prescott,1958, p.41, fig.9; Hirano,1959, p.268, pl.34, fig.9; Lenzenweger,1965, p.452, pl.1, fig.11; Herrmann, 1966, p.35, fig.6; Ochiai, 1966. p.123; Herrmann,1968, p.363, fig.3; Forster,1969, p.40, pl.11, fig.2; Islam,1970, p.920, pl.10, figs. 3-7; Hinode, 1971, p.111, pl.6, fig.1; Whitford & Schumacher, 1973, p.71, pl.25, fig.1; Kasprisk,1973, p.123, pl.3, fig.25; Sormus & Bicudo, 1974, p.276, figs.1-28; Lenzenweger,1974, p.112, pl.2, fig.2; Islam & Zaman, 1975, p.51, pl.5, fig.68.

53-76 μm long; 57-80 μm broad; polar lobe 39-57 μm broad; isthmus 12-17 μm broad; thickness 15-18 μm .

Cells small, a little broader than long, deeply constricted; sinus open, triangular-acuminate with a narrowed apex; semicells 3-lobed, the interlobular incisions deep and broadly rounded; lateral lobes horizontally disposed, semifusiform, with attenuated and minutely bifid apices; polar lobe widely spreading, extremities narrower than those of the lateral lobes and minutely bifid, apex convex, straight, or sometimes very slightly retuse; side view of semicell narrowly ovate-pyramidal, with a rounded apex; vertical view narrowly rhomboid-lanceolate, with acuminate poles; cell wall minutely punctate. (Pl. 1, fig. 13, photo. 12).

Local distribution; Multan, Sarim No. 252, March 29, 1978.

Geographical distribution; World wide.

14. M. radiata Hass. West & West, Brit. Desm. vol. 2, p. 113, pl. 52, figs. 1-9, 1905.
- = M. melitensis Ralfs in Ann. Mag. Nat. Hist. p. 260, pl. 6, fig. 2. 1844.
- = M. radiata Hass. Brit. Freshw. Hass. p. 386, pl. 90, fig. 2. 1845.
- = M. furcata Ralfs, Brit. Desm. p. 73, pl. 9, fig. 2, 1848.
- = M. melitensis Menegh. var. gracilior Kg. Spec. Alg. p. 170. 1849.
- = Didymidium (Micrasterias) furcatum C furcatum Reinsch, Algenfl. Frank p. 144. 1867.
- = Micrasterias crux-melitensis (Ehr.) Hass. b. furcata Rabenh. Flor. Europ. Algar. 3, p. 190. 1868.
- = M. pseudofurcata Wille, Bull. Torr. Bot. Club, p. 1, pl. 6, fig. 3. 1881.
- = M. furcata Ralfs var. decurta Turn. New and rare Desm. p. 936, pl. 16, fig. 10. 1885.
- = M. furcata Ralfs var. simplex Wille, Bull. Torr. Bot. Club, p. 128, pl. 51, fig. 6. 1885.

- = Helierella furcata Kuntze, Revis. gen. plant. p.898. 1891.
 = Microsterias furcata Ralfs a typica Turn. Freshw. Alg. E. India, p.93, pl.5, fig.5 a. 1893.

Smith, 1924, p.50, pl.63, figs. 1-3; Taylor, 1935, p.214, pl.65, fig.1; Taft, 1945, p.191, pl.2, fig.20; Smith, 1950, fig.237 G; Croasdale, 1956, p.10, pl.2, fig.8; Hirano, 1959, p.272, pl.35, fig.9; Wygasch, 1963, p.108, figs.4, 5; Prescott, 1966, p.30, pl.10, fig.4; Förster, 1966, p.10, pl.3, fig.7; Grönblad, Scott & Croasdale, 1968, p.14, figs.63-65; Whitford & Schumacher, 1973, p.71, pl.24, fig.8; Pickett-Heaps, 1974, p.20, figs.28, 29; Stein, 1975, p.141, fig.106; Gaugh, Garvin & Woelkerling, 1976, fig.9.

123-195 μ m long; 113-186 μ m broad; isthmus 17-30 μ m broad; polar lobe 65-92 μ m broad; thickness 27-30 μ m.

Cells of medium size, usually a little longer than broad but sometimes broader than long, very deeply constricted; sinus widely open with an acute apex; semicells 5-lobed, incisions between the lobes wide and fairly deep; polar lobe with ^bsuparallel sides in the lower half, dilated upwards, with each angle produced into a long diverging process with a deeply furcate apex; lateral lobes commonly equal, but subject to great variation, normally divided into two long, narrow, diverging lobules, similar to the processes of the polar lobe with deeply furcate apices; sometimes one or both lateral lobes are simple and undivided; side view of semicell ovate-lanceolate; vertical view narrowly subrhomboid with produced and acuminate poles; cell wall smooth. (Pl.1, fig.12, photo.11).

Local distribution: Pond, C Block Satellite Town, Rawalpindi, Sarim No. 44, Oct.16, 1976.

Geographical distribution: World wide.

15. M. radiosa Ralfs, Brit. Desm. p.72, pl.8, fig.3. 1848.

Smith, 1924, p.45, fig.5.

172 μ m long; 174 μ m broad; isthmus 21 μ m broad.

Cells large, breadth^{about} equal to the length, circular in outline, very deeply constricted, sinus linear, with sides undulate and apex acute, isthmus very narrow; semicells 5-lobed, incisions between lobes linear and deep; polar lobe arising near the isthmus, with lateral margins subparallel and apical portion somewhat expanded, apical margin deeply emarginate and with lateral margins deeply bifid, emargination flanked on either side by a subapical mamillate projection that bears a single conspicuous erect spine; lateral margins deeply incised, with inner portion of incision more open and giving the lobelets an undulate appearance; superior lateral lobe usually somewhat larger than the inferior, superior of lateral lobes with three series of incisions the depth of each successive incision a third less than that of the preceding series, ultimate lobelets deeply emarginate and bifid, inferior lateral lobes sometimes with only two series of incisions; cell wall punctate; vartical view fusiform, with central portion slightly elevated and truncate; lateral view of semicells linear-oblong, with apex tridenticulate; chloroplast extending to ultimate lobelets, with apex of portion in polar lobe deeply incised, with two conspicuous vartical ridges extending from polar apex to the nucleus and secondary ridges bordering the major incisions; pyrenoids numerous, 50-65, in all parts of the chloroplast. (Pl.2, fig.5).

Local distribution: Pabbi, Distt. Peshawar, Sarim No.

48, Oct.22, 1976.

Geographical distribution: U.S.A., Pakistan, Europe.

16. M. rotata (Grev.) Ralfs, Brit. Desm. p.71, pl.8, fig.1. 1848.
 = M. furcata Agardh. in Flora, p.643, 1827.
 = Euastrum rota Ehr. Entw. d. Infus. p.82. 1832.
 = Echinella rotata Grev. in Hookers' Brit. Fl. p.398. 1833.
 = Cosmarium stellinum Corda in Alm. de Carlsbad, p.180. 1834.
 = Eutomia rotata Hary. Man. Brit. Alg. p.187. 1841.
 = Microsterias rotata (Grev.) Ralfs in Ann. Mag. Nat. Hist. p.259, pl.6, fig.1. 1844.
 = Didymidium (Microsterias) rotatum Reinsch, Algenfl. Frank. p.149. 1867.
 = Helierella rotata Kuntze, Revis. gen. plant. p.899. 1891.
 = Microsterias rotata var. acutidentata Benn. Freshw. Alg. S.W. Surrey, p.9, pl.2, fig.10. 1892.

West & West, vol.2, 1905, p.102, pl.48, figs. 1-6;
 Irene-Marie, 1951^b, p.192, pl.3, figs.2, 3; Tiffany & Britton, 1952, p.196, pl.51, fig.538; Croasdale, 1956, p.12, pl.2, fig.9;
 Waris, 1958, p.11, pl.4, figs.4-7; pl.5, figs.1-3; Hirano, 1959^a, p.277^L, pl.35, fig.1; Wygasch, 1963, p.108, figs.11, 12; Scott, Grönblad & Croasdale, 1965, p.40, fig.90; Lenzenweger, 1965, p.450, pl.1, fig.6; Ochiai, 1966, p.123; Lenzenweger, 1968^a, p.10, fig.1; Weber, 1969, p.462; Förster, 1970, p.304, pl.19, figs.4, 5; pl.20, figs. 1-4; pl.21, fig.1; Mix, 1970^a, p.86, pl.5, fig.10; Lenzenweger, 1970^a, p.6, pl.3, fig.6; Whitford & Schumacher, 1973, p.71, pl.25, fig.5; Kasprik, 1973, p.124, pl.1, fig.2; pl.3, fig.27; pl.4, fig.28; pl.5, figs.42, 43; Lenzenweger, 1973, pl.155, pl.1; Parra & Gonzales, 1977, p.21, fig.92; Werner, 1977, p.52, pl.8, fig.1; pl.25, fig.13.

208-366 μ m long; 165-305 μ m broad; isthmus 29 μ m broad; polar lobe 40-80 μ m broad.

Cells large, a little longer than broad, subcircular in outline, deeply constricted, sinus narrowly linear; semicells 5-lobed, interlobular incisions narrowly linear; polar lobe gradually widening upwards, with concave sides, apex retuse-emarginate, angles slightly produced and bidentate; lateral lobes unequal and broadly cuneate each divided into two lobules by a deep incision; superior lateral lobes larger than inferior lobes, each lobule subdivided into four equal emarginate or bidentate parts by three incisions, the median one being the deepest; lobules of interior lateral lobes divided into two, sometimes four bidentate, rarely tridentate parts; side view of semicell ovate-lanceolate, with a broadly truncate apex and an inflated base; vertical view narrowly elliptic-rhomboid, with acute poles and a small inflation in the middle of each side; cell wall punctate. (Pl.1, fig.9).

Local distribution: Akbarpura, Distt. Peshawar, Sarim No.30, Sept.25, 1976; Mardan, Sarim No. 36, Oct.4, 1976.

Geographical distribution: World wide.

17. M. thomasi Arch. Proc. Dubl. Nat. Hist. Soc. p.72, pl.2, figs. 1-5. 1862.
- = M. denticulata Bréb. forma thomasi Jacobs. Desm. Danem. p.187. 1875.
- = Helierella thomasi Kuntze, Revis. gen. plant. p.899. 1891.

West & West, vol.2, 1905, p.110, pl.51, figs. 3-6;
 Smith, 1924, p.48, pl.60, fig.5; Grönblad & Kallio, 1954, p.173, figs. 3,4; Kallio, 1959, p.16; Hirano, 1959, p.276, pl.35, fig.8;
 Selman, 1966, p.477; Ochiai, 1966, p.123; Förster, 1970, p.304, pl.17, figs. 1-18; Tassigny, 1971, fig.2; Selman, 1972, p.148, figs. 2, 3, 5, 6, 8-11; Pickett-Heaps, 1973, p.114, fig.6; Kasprik, 1973, p.126, pl.1, fig.3; pl.4, figs. 33-36; pl.6, figs.49-53; Pickett-Heaps & Tippit, 1973, p. 197, figs. 3-6; Pickett-Heaps, 1974, p.16,

figs.21-25; Lehtonen, 1977, p.165, pl.1, fig.C; pl.2, fig. B; Mix & Kasprík, 1977, p.65, pl.I, figs,1, 2.

174-202 μm long; 136-180 μm broad; isthmus 21-23 μm broad; thickness without projections 34-39 μm ; with projections 53-57 μm .

Cells large, suborbicular, very deeply constricted, sinus narrowly linear; semicells 5-lobed, incisions between the lobes very narrow and linear; polar lobe narrowly cuneate with concave sides not projecting, apical margin generally slightly retuse, with a fairly deep median notch, angles on each side of median notch, apiculate, outer angles commonly emarginate, sometimes only apiculate; lateral lobes fairly equal and broadly cuneate, with a deep and linear primary incision dividing each lobe into two equal lobules, each lobule with a secondary incision not very deep and generally with two tertiary incisions, four ultimate divisions of each lobule emarginate or bidentate, sometimes the tertiary divisions are absent so that each lobule is only subdivided into two parts, which are then tridentate or quadridentate; with three projections across the base of the semicells, the middle one conical and rounded or apiculate, the lateral ones attenuated and elongate, curved outwards, and emarginate or bidentate at their apices; with a conical tooth within the base of each lateral lobe, all these teeth being directed outwards; side view of semicell narrowly pyramidal, with a rounded basal inflation on each side; apex truncate, lateral margins each with two outwardly directed acute projections; vertical view fusiform, poles acute with three projections on each side towards the middle, the median projection conical and obtuse or apiculate, the

lateral projections very much curved towards the poles and generally bidentate, lateral margins towards the poles serrate; cell wall smooth. (Pl.1. fig.5, photo.5).

Local distribution: Nawankali, Distt. Mardan, Sarim No.34, Oct. 2, 1976.

Geographical distribution: World wide.

18. M. torreyi Bail. ex Ralfs, Brit. Desm. p.210, pl.35, fig.5. 1848.

Smith, 1924, p.49, pl.62, fig.2; Kallio, 1959, p.6, figs. 1-4; Kallio, 1960, p.2; Kallio & Heikkila, 1969, p.226, figs. 1-13; Förster, 1972, p.544, pl.13, fig.1; Lehtonen, 1977, p.165, figs. 1a, 2a, 3a, b.

410 μ m long; 450 μ m broad; polar lobe 74 μ m broad; isthmus 27 μ m broad.

Cells large, rectangular in outline, length and breadth about equal, deeply constricted, sinus linear and with outer portion somewhat open, isthmus very narrow; semicells 5-lobed, incisions deep, with apices sublinear and outer portion acute-angled; polar lobe arising near the isthmus, lateral margins of the polar lobe subparallel but widely divergent near the apex, apical margin with a conspicuous median emargination that gives it a concave appearance, median emargination flanked on either side by a simple mamillate swelling; cell wall punctate; polar angles fairly acute and simple, very rarely emarginate; lateral lobes of unequal size, the superior lateral lobe very deeply incised and one of the lobelets, usually the one adjacent to the polar lobe, in turn deeply incised, at times with both lobelets incised; inferior lateral lobes usually with but a single deep incision; all ultimate lobelets spatulate and with their apices acuminate, truncate, or deeply emarginate. (Pl.1, fig.6, photo.6).

Local distribution; Wah Stream No.2, Sarim No.37,
Oct. 6, 1976.

Geographical distribution: U.S.A, Europe, Pakistan.

19. M. truncata (Corda) Bréb. ex Ralfs, Brit. Desm. p.75, pl.8, fig.4. 1848.
- = Euastrum rota Ehr. Entwick. Lebends. d. Infus. p.82. 1832.
- = Cosmarium truncatum Corda in Alm. de Carlsbad, p.180, pl.2, fig.23, 1834 (Basionym).
- = C. quadragies-cuspidatum Corda in Alm. de Carlsbad, p.215, pl.6, fig.40. 1840.
- = Microsterias truncata var. quadrata Buln. in Hedwigia, p.21, pl.2, fig.2. 1859.
- = Didymidium (Microsterias) truncatum forma b. dentatum Reinsch, Algenfl. Frank. p.144.
- = Microsterias truncata var. euastroides De Toni, Syll. Alg. p.115. 1889.
- = M. truncata var. tridentata Bennett, Freshw. Alg. Hamps. and Devon. p.7, pl.1, fig.10. 1890.
- = Helierella truncata Kuntze, Revis. gen. plant. p.897. 1891.
- = Microsterias truncata forma punctata West, Alg. W. Ireland, p.135. 1892.

West & West, vol. 2, 1905, p.82, pl.42, figs.1-8; pl.45, figs.5, 6; Smith, 1924, p.43, pl.60, figs. 1-2; El-Nayal, 1935, p.49, fig.73; Taylor, 1935, p.216, pl.66, fig.5; Taft, 1945, p.191, pl.2, fig.21; Tiffany & Britton, 1952, p.195, pl.51, fig.539; Croasdale, 1956, p.12, pl.1, figs.9-11; Scott & Prescott, 1958, p.42, fig.10; Hirano, 1959, p.272, pl.36, figs.4, 5; Evans, 1962, p.66, fig.6; Wygasch, 1963, p.107, fig.1; Mattern, 1964, p.251, fig.15; Marcenko, 1965, p.542; Lenzenweger, 1965, p.448, pl.1, fig.3; Marcenko, 1966, p.157, figs.25-54; Ochiai, 1966, p.123; Mattern, 1966, fig.15; Eloranta, 1968, p.62, fig.3; Zwart, 1969, p.172, figs.111, 112; Tyler, 1970, p.220, fig.E; Förster, 1970, p.305, pl.14, figs. 1-22; pl.15, figs. 1-19;

Whitford & Schumacher, 1973, p.71, pl.24, fig.5; Tomaszewicz, 1973a, p.591, figs.1-3; Kusel-Fetzmann, 1973, p.51, pl.9, fig.2; Parra, 1975, p.35, fig.29; Werner, 1977, p.52, pl.8, fig.6; pl.25, fig.5.

87-138 μm long: 78-129 μm broad; polar lobe 65-97 μm broad; isthmus 18-20 μm broad; thickness 36-52 μm .

Cells small, generally a little longer than broad, elliptical with widely truncate poles, deeply constricted, sinus narrowly linear, often slightly open towards the outside; semicells scarcely 5-lobed, incisions below the polar lobe moderately deep and generally somewhat open, rarely narrowly linear, incisions between the two lateral lobes slightly open and not so deep; lateral lobes somewhat variable, typically bilobulate with each lobule emarginate; polar lobe very widely cuneate, sometimes almost fusiform, apex convex and usually flattened or slightly retuse in the middle, lateral angles acuminate or emarginate; side view of semicell broadly ovate; vertical view fusiform-elliptic, poles acute, cell wall punctate. (Pl.1, fig.1, photo.1).

Local distribution: Rawal Dam Canal, Rawalpindi, Sarim No.21, 1976.

Geographical distribution: World wide.

CHARACTERS OF EUASTRUM

2. EUASTRUM Ehr. ex Ralfs, Brit. Desm. p. 78. 1848.

Cells of variable size, solitary, longer than broad, compressed, deeply constricted in the middle, sinus generally linear rarely open; semicells commonly truncate-pyramidal, apex with a median incision of variable depth, sometimes scarcely evident or absent lateral margins entire, sinuate, or variously lobed, at or near the centre of the semicells with one or more somewhat hemispherical protuberances or tumours, variously disposed; vertical view more or less elliptical, with one or more protuberances on each side; one axile chloroplast in each semicell; often irregularly lobed and ridged, with a single pyrenoid in the small species, and a number of scattered ones in the large species.

KEY TO THE TAXA

- | | |
|--------------------------------------|---|
| 1. Cell wall punctate..... | 2 |
| 1. Cell wall smooth..... | 7 |
| 1. Cell wall granulate..... | 11 |
| 1. Cell wall scrobiculate..... | 16 |
| 2. Semicells 2-lobed..... | 3 |
| 2. Semicells otherwise..... | 4 |
| 3. Semicells subpyramidal..... | <u>E. bidentatum</u> |
| 3. Semicells elongate-pyramidal..... | <u>E. sinuosum</u> var. <u>gargense</u> |
| 4. Semicells 3-lobed..... | 5 |
| 4. Semicells 5-lobed..... | 6 |
| 5. Cell 33-35 μ m broad..... | <u>E. ansatum</u> var. <u>pyxidatum</u> |
| 5. Cell 36-42 μ m broad..... | <u>E. pectinatum</u> var. <u>inevolutum</u> |
| 5. Cell 44-47 μ m broad..... | <u>E. pectinatum</u> |
| 5. Cell 52-80 μ m broad..... | <u>E. ventricosum</u> |
| 6. Cell 55 μ m broad..... | <u>E. divergens</u> var. <u>ornatum</u> |
| 6. Cell 65-75 μ m broad..... | <u>E. humerosum</u> |
| 6. Cell 76-107 μ m broad..... | <u>E. oblongum</u> |

7. Cells $1\frac{1}{2}$ times longer than broad.....E. intermedium
7. Cells less than $1\frac{1}{2}$ times longer than broad.....8
8. Cells $1\frac{1}{2}$ times longer than broad.....9
8. Cells $1\frac{1}{3}$ times longer than broad.....10
9. Cell sides retuse.....E. insulare
9. Cell sides concave.....E. elegans
10. Semicells subpyramidal.....E. binale
10. Semicells truncate-pyramidal.....E. validum
11. Polar lobe cuneate.....E. verrucosum
11. Polar lobe otherwise.....12
12. Cells 81-109 μ m long.....E. ansatum var. dideltiforme
12. Cells less than 81 μ m long.....13
13. Cells about as long as broad.....E. spinulosum var. inermius
13. Cells $1\frac{1}{2}$ or more as long as broad.....14
14. Cells 39-50 μ m long.....E. turnerii
14. Cells less than 39 μ m long.....15
15. Semicells subquadrate.....E. denticulatum
15. Semicells truncate-pyramidal.....E. dubium
16. Sinus narrowly linear.....E. ampullaceum
16. Sinus widely open.....E. insigne

DESCRIPTION OF THE PLANTS

1. Diastrum ampullaceum Ralfs, Brit. Desm. p.83, pl.13, fig.4. 1848.
 = E. ampullaceum forma scrobiculata Nordst. Norges Desm. p.8. 1873.
 = Helierella ampullacea Kuntze, Revis. gen. plant. p.898. 1891.

West & West, vol. 2, 1905, p.19, pl.35, figs.8-10; Taylor, 1935, p.200, pl.52, figs.2, 3; Hirano, 1959a, p.248, pl.32, fig.8; Groasdale & Grönblad, 1964, p.162, pl.6, fig.6; Förster, 1966, p.52, pl.3, fig.10; Vuorisalo, 1969, p.106, fig.14; Whitford & Schumacher, 1973, p.68, pl.22, fig.9; Lenzenweger, 1976, p.66, pl.1, fig.4.

93-110 μ m long; 57-59 μ m broad; isthmus 14-17.5 μ m broad; thickness 34-36 μ m.

Cells of medium size, a little more than $1\frac{1}{2}$ times longer than broad, very deeply constricted, sinus narrowly linear and dilated at the extremity; semicells 3-lobed; polar lobe cuneate and dilated, with rounded angles, apex convex with a deep and narrow median incisions; lateral lobes much larger than the polar lobe, triangular with rounded basal angles, superior margin of the lobes with a mamillate projection, sometimes reduced to a rounded elevation; semicells with three protuberances across the base, the median one being emarginate, and with two across the centre, also with three conspicuous scrobiculations disposed between the five protuberances; side view of semicell elongate-pyramidal, basal angles rectangular and basal part of margins slightly retuse, upper part of margins somewhat concave, apex rounded; vertical view pointed-elliptic with four protuberances on each side and a fifth between and beneath the two central ones; mamillate projection of lateral lobes widely emarginate; polar lobe rectangular, with subacute angles and retuse sides, cell wall scrobiculate. (Pl.3, fig.4).

Local distribution: Katlang Distt. Mardan, Sarim

No.40, Oct.10,1976.

Geographical distribution: World wide.

2. E. ansatum Ralfs var. dideltiforme Ducell. in West & West, Brit. Desm. vol. 2, p.27. 1905.

Croasdale, 1955, p.530, pl.11, fig.6; Krieger & Scott, 1957, p.132, pl.1, fig.7; Grönblad, Prowse & Scott, 1958, p.12, figs. 35-37; Hirano, 1959a, p.245, pl.31, fig.8; Wygasch, 1963 p.107, fig.17; Croasdale & Grönblad. 1964, p.162, pl.6, fig.13; Lenzenweger, 1967, p.179, pl.7, fig.11; Eloranta, 1968, p.61; Grönblad, Scott & Croasdale, 1968, p.11, fig.35; Islam, 1970,

p.916, pl.16, fig.6; Hinode, 1971, p.107, pl.4, fig.17; pl.4 fig.15; Whitford & Schumacher, 1973, p.69, pl.22, fig.4; Hinode, 1977, p.78, fig.5a.

81-109 μm long; 42-53 μm broad; isthmus 11-15 μm broad.

Elongated form with no central scrobicula but with a marginal thickening at the upper lateral lobe; cell wall granulate; cells deeply constricted; sinus linear with a dilated extremity; semicells pyramidal. (Pl.2, fig.11).

Local distribution: Faisalabad, leg. Skindar Ali, Sarim No.140, Feb.15, 1977.

Geographical distribution: World wide.

3. E. ansatum Ralfs var. pyxidatum Delp. Desm. subalp. p.103, pl.6, fig.32. 1873.

West & West, vol.2, 1905, p.29, pl.36, figs.14, 15; Hirano, 1959, p.245, pl.31, fig.1; Cohn, 1967, p.231; Förster, 1970, p.299, pl.10, figs. 3-5; Hinode, 1971, p.108, pl.4, fig.8; Whitford & Schumacher, 1973, p.69, pl.22, fig.6; Werner, 1977, p.48, pl.6, fig.4; pl.21, figs. 1, 2, 6.

65-86 μm long; 33-35 μm broad; isthmus 12-14 μm broad; thickness 22-27 μm .

Semicells almost 3-lobed owing to the large development of the undulation above the basal angles, upper portion of lateral margins deeply sinuate; polar lobe subquadrate with rounded angles; sinus narrowly linear with a dilated extremity; cell deeply constricted; cell wall punctate. (Pl.3, fig.6, photo.23).

Local distribution: Akbarpura Distt. Peshawar, Sarim No.30, Sept.25, 1976.

Geographical distribution: World wide.

4. E. binale (Turp.) Ehr. ex Ralfs, Brit. Desm. p.90, pl.14.
fig. 8.1848.
- = Cosmarium binale (Turp.) Menegh. Synops. Desm. p.221.1840.
 - = Euastrum binale (Turp.) Ehr. Berlin. Monatsber. p.208.1840.
 - = Didymidium (Euastrum) binale Reinsch, Algenfl. Frank. p.138.1867.
 - = Euastrum binale a. typicum Kirchn. Alg. Schles. p.159.1878.
 - = Helierella binalis Kuntze, Revis. gen. plant. p.898.1891.
 - = Euastrum binale forma a. minuta Turn. Freshw. Alg. E.India, p.11, pl.10, fig.50, 1893.

West & West, vol.2, 1905, p.51, pl.38, figs.28, 29;
Taylor, 1935, p.200, pl.60, figs.1, 3. 18; Wasylik, 1961, p.19,
pl.1, figs.4, 4a, 8, 8a; Croasdale & Grönblad, 1964, p.164, pl.7,
fig.11; Whitford & Schumacher, 1973, p.69, pl.22, fig.21;
Tomaszewicz, 1973, p.395, pl.3, fig.5; Kusel-Fetzmann, 1977, p.109,
fig.551.

15-30 μm long; 12. 5-21 μm broad; isthmus 3-8.5 μm
broad; thickness 9-13 μm .

Cells minute, about $1\frac{1}{2}$ times longer than broad, deeply
constricted, sinus narrowly linear; semicells subpyramidal, basal
angles broadly rounded, entire, upper part of lateral margins
concave; apex broad and truncate, retuso-emarginate in the middle,
upper angles dilated to form a minute apiculus; side view of
semicell ovate, apex acutely rounded, with a slight protuberance
near the base on each side; vertical view elliptic, poles acute,
with a small rounded protuberance at the middle on each side; cell
wall smooth. (Pl.2, fig. 7, photo.18).

Local distribution; Kalri Lake, Sind, Sarim
No.277, April 9, 1978.

Geographical distribution: World wide.

5. E. bidentatum Näg. Gatt. einz. Alg. p.122, pl.7 D, fig.1a. 1849.
 = E. elegans (Bréb.) Kg. var. bidentatum (Näg.) Jacobs. Desm.
 Danem. p.191, 1875.
 = E. elegans (Bréb.) Kg. var. speciosum Boldt, Desm. Grönland,
 p.9, pl.1, fig. 10. 1888.

West & West, vol. 2, 1905, p.39, pl.37, figs. 16-19;
 Taylor, 1935, p.200, pl.39, fig. 10; pl. 60, fig.13; pl.61, fig.1;
 Prescott, 1936, p.142, pl.17, fig.13; Taft, 1945, p.190, pl.2,
 figs.11, 12; Croasdale, 1955, p.530, pl.12, figs.12, 13; Hirano,
 1959, p.265, pl.33, figs.1, 12; Kanetsuna, 1960, p.78, fig. 3;
 Croasdale & Grönblad, 1964, p.162, pl. 7, figs.1, 2; Förster,
 1965, p.128, pl.2, Croasdale, 1965, p.312, pl.2, figs. 4,5;
 Prescott, 1966, p.26, pl.3, fig.24; Lenzenweger, 1967, p.179, pl.7,
 fig.12; Eloranta, 1968, p.61, fig. 25; Vuorisalo, 1969, p.106,
 fig.22; Zwart, 1969, fig.105; Lenzenweger, 1970, p.11, pl.3
 fig.2; Förster, 1970, p.300, pl.10, figs. 25, 26; Croasdale, 1973,
 p.77, pl.11, figs. 24-26; Whitford & Schumacher, 1973, p.69, pl.23,
 fig.3; Parra, 1975, p.32, fig.56; Werner, 1977. p.48, pl.7,
 fig. 3; Hirano, 1977, p.219.

51-61 μm long; 32-39 μm broad; isthmus 6.3-11 μm
 broad; thickness 21-23 μm .

Cells small, about $1\frac{1}{2}$ times longer than broad, deeply
 constricted, sinus narrowly linear with a dilated extremity;
 semicells subpyramidal, with bilobulate sides; lower lobule
 subrectangular, sometimes emarginate, and with two or three sharp
 granules; upper lobule rounded or rounded-truncate, rarely
 emarginate, sometimes with one or two sharp granules; apex convex,
 sometimes slightly undulate, with a deep median notch, which
 may be somewhat open or closed, with a short, blunt spine at

each apical angle, and usually with a thickening at the angles on each side of the apical incision; semicells with a granulated protuberance in the centre above the isthmus, number and disposition of granules variable, with a large granule below and on each side of the apical incision sometimes absent, and with a few variously-disposed granules within the lateral lobules and the apex; side view of semicell ovate, with a protuberance usually emarginate on each side near the base, and a granule on each side higher up on the lateral margins; apex rounded and tridenticulate; vertical view elliptic, with a protuberance, emarginate or trigranulate at the middle on each side, poles with acute denticulations; cell wall punctate. (Pl.3, fig.11).

Local distribution: Waste water channel of Packages Ltd. Lahore, Sarim No.47, Oct. 12, 1976.

Geographical distribution: Europe, Russia, U.S.A., Pakistan, Japan, Chile.

6. E. denticulatum (Kirchn.) Gay. Note Conj. du midi de France, p.335. 1884.

= E. binale b. denticulatum Kirchn. Alg. Schles. p.159. 1878.

= E. amoenum Gay, Monogr. Loc. Conj. p.53, pl.1, fig.7. 1884.

= Helierella Kirchneri Kuntze, Revis. gen. plant. p.898. 1891.

West & West, vol. 2, 1905, p.56, pl.39, figs. 1-4;

Irénée-Marie, 1951^b, p.200, pl.4, fig.5; Croasdale, 1955, p.530, pl.13, figs.11, 12; Hirano, 1959^a, p.261, pl.35, fig.3; Croasdale & Grönblad, 1964, p.166, pl.7, fig.20; Prescott, 1966, p.26, pl.9, fig.17; Ochiai, 1966, p.122; Lind, 1967, p.371, pl.2, figs. 5,6; Lenzenweger, 1967, p.180, pl.7, fig.15; Eloranta, 1968, p.62, fig.28; Grönblad, Scott & Croasdale, 1968, p.12, fig.46; Förster, 1969, p.31, pl.8, figs.11, 12; Förster, 1970, p.300, pl.10, fig.21; Hinode, 1971, p.109, pl.5, fig.15; Whitford & Schumacher, 1973, p.69, pl.22, fig. 17.

13-26 μm long; 11.5-21 μm broad; isthmus 3.5-6.5 μm broad; thickness 7.5-14 μm .

Cells small but rather variable in size, about $1\frac{1}{2}$ times as long as broad, very deeply constricted, sinus narrowly linear with a dilated extremity; semicells subquadrate, almost trapezoid, basal angles rounded or subrectangular with a number of granules, upper part of lateral margins concave, apical part of semicell protracted, broadly rectangular, upper angles with an acute granule or short spine, apex truncate with a slight median notch, sometimes only emarginate-retuse; semicells with a granulated central protuberance and a number of granules or denticulations within the basal angles and the apex; side view of semicell ovate, with an acute apex, and an emarginate or granulated protuberance at each side near the base; vertical view elliptic, poles acute, with an emarginate or granulate protuberance at the middle on each side. (Pl.3, fig. 7).

Local distribution: Near Adamjee Paper Mills, Nowshera Distt. Peshawar, Sarim No.308, Jan. 30, 1979.

Geographical distribution: World wide.

7. E. divergens Josh. var. ornatum (Borge) Schmidle, Algen insbesondere solche des Plankton, aus dem Nyassa-See. Engler's Bot. Jahrb. 32: 56-88, 3 pl. 1902.

Grönblad & Croasdale, 1971, p.9, pl.3, fig.34.

64 μm long; 55 μm broad; isthmus 14 μm broad; polar lobe 21 μm broad.

Cells moderately large, a little longer than broad, deeply constricted; sinus narrowly linear with a dilated extremity; basal lobe developed; semicells 5-lobed; cell wall punctate. (Pl.2, fig. 12).

Local distribution: Near Adamjee Paper Mills Nowshera Distt. Peshawar. Sarim No.308, Jan. 30, 1979.

Geographical distribution: Europe, Africa, Pakistan.

8. E. dubium Näg. Gatt, einz. Alg. p.122, pl.7, fig.2. 1849.
- = E. binale Ralfs, Brit. Desm. Pl.14, fig. 7. 1848.
- = E. lobulatum Bréb. Liste Desm. P.124, pl.1, fig.4. 1856.
- = E. elegans (Bréb.) Kg. var. lobulatum (Bréb.) Jacobs. Desm. Danem. p.191. 1875.
- = E. binale (Turp.) Ehr. var. rotundata Istvanffi, Diag. praev. Alg. nov. Hungar. p.236. 1887.
- = E. erosum Lund. var. notabile West, Alg. Eng. Lake Distr. p.723, pl.9, fig.17. 1892.

West & West, vol.2, 1905, p.43, pl.38, figs. 5-8.

26.5-33 μ m long; 19-21 μ m broad; isthmus 4-6 μ m broad; thickness 10-12.5 μ m.

Cells very small, $1\frac{1}{2}$ times longer than broad, very deeply constricted, sinus narrowly linear with a slightly dilated extremity; semicells truncate-pyramidal, 5-lobed; polar lobe short, oblong-rectangular, apex truncate with a narrow median incision, apical angles with a small conical granule; upper lateral lobes rounded; lower lateral lobes very slightly larger than the upper ones, rounded, obliquely truncate, or sometimes slightly emarginate; semicells with two granules within the apex, one on each side of the notch, with two faint granules within each basal angle, often with a faint granule below the apical notch, and with a slight trace of a smooth central protuberance; side view of semicell ovate-oblong, apex acutely rounded, very slightly dilated on each side at the base; vertical view elliptic-oblong, poles acute, and with a very slight swelling sometimes absent at the middle on each side. (Pl.2, fig.14).

Local distribution: Sasnamana Ziarat, Baluchistan, leg. Khial Badshah, Sarim No.130, Jan. 15, 1977.

Geographical distribution: Europe, Pakistan.

9. E. elegans (Bréb.) Kg. ex Ralfs, Brit. Desm. p.89, 1848.
- = Hetrocarpella elegans Bréb. in Cheval. microscop. et usage, Paris, p.72. 1839.
- = Cosmarium elegans Bréb. in Menegh. Synops. Desm. p.222. 1840.
- = Euastrum elegans (Bréb) Kg. Phycol. germ. p.135. 1845.
- = E. elegans from declivis Reinsch, Spec. Gen. Alg. p.124, pl.20, fig.1. 1867.
- = Didymidium (Euastrum) elegans Reinsch, Algenfl. Frank. p.136. 1867.
- = Euastrum elegans a. typicum Kirchn. Alg. Schles. p.159. 1886.
- = E. declive Roy in Bates' Flora Leicestershire, p.35. 1886.
- = E. elegans var. lundellii Istvanffi, Diag. praev. Alg. nov. Hungar. p.236. 1887.
- = Helierella elegans Kuntze, Revis, gen. plant. p.898. 1891.

West & West, vol.2, 1905, p.48, pl.38, figs.16-21;

Taylor, 1935, p.202, pl.63, fig.4; Grönblad, 1952_a, p.26, pl.1, fig.4; Croasdale, 1955, p.531, pl.13, figs.5, 6; Scott & Prescott, 1958, p.34, fig.6; Hirano, 1959_a, p.259, pl.31, fig.10; Croasdale, 1962, p.21, pl.3, fig.36; Croasdale & Grönblad, 1964, p.166, pl.7, fig.9; Förster, 1965, p.130, pl.2, figs.14, 15; Lenzenweger, 1967, p.180, pl.7, fig.14; Eloranta, 1968, p.62, fig.27; Dubois-Tylski, 1969, p.320, pl.2, fig.14; Förster, 1970, p.301, pl.10, figs.27-29; Parra, 1975, p.33, fig.65; Werner, 1977, p.49, pl.7, fig.4; pl.22, fig.9.

29-36.5 μm long: 19-22 μm broad; isthmus 5.8-7 μm broad; thickness 10-14.5 μm .

Cells small, about $1\frac{1}{2}$ times longer than broad, deeply constricted, sinus narrowly linear; semicells ovate-pyramidal, basal angles subrectangular, retuse-emarginate, above with the sides concave, superior angles apiculate, apex strongly convex or broadly rounded with a deep and narrow median incision;

semicells with a granulate protuberance in the centre above the isthmus, the rest of the cell wall generally smooth; side view of semicell ovate with a truncately rounded apex and an emarginate protuberance on each side above the base, vertical view elliptic, with acute poles, and an emarginate protuberance in the middle on each side. (Pl.3, fig.10).

Local distribution: Lundkhwar, Distt: Mardan Sarim No.90, Dec.3, 1976; Near Adamjee Paper Mills, Nowshera, Distt: Peshawar, Sarim No.308, Jan.30, 1979.

Geographical distribution: World wide.

10. E. humerosum Ralfs, Brit. Desm. p.82, pl.13, fig.2. 1848.
 = E. humerosum a. genuinum Racib. Nonn. Desm. Polon. p.93. 1885.
 = Helierella humerosa Kuntze, Revis. gen. plant. p.898. 1891.

West & West, vol. 2, 1905, p.8, pl.34, figs.1, 2; Taylor, 1935, p.203, pl.61, fig.9; Hirano, 1959, p.257, pl.32, fig.12; Mattern, 1964, p.251. fig.11; Dubois-Tylski, 1969, p.320, pl.2, fig.12; Whitford & Schumacher, 1973, p.69, pl.22, fig.12; Lenzenweger, 1976, p.66, pl.1, fig.7.

110-123 μm long; 65-75 μm broad; isthmus 15.5-22 μm broad; thickness 40 μm .

Cells of moderate size, rather less than twice as long as broad, deeply constricted, sinus narrowly linear and dilated at the apex; semicells 5-lobed, incisions between the lobes widely open, upper incisions deeper and less widely open than lower incisions; polar lobe dilated, almost anvil-shaped with rounded angles, apex convex, straight or even slightly retuse with a fairly deep and narrow median incision, upper lateral lobe mamillate or narrowly mamillate, directed upwards and outwards; lower lateral lobes subquadrate, with retuse margins and rounded angles; semicells with

three protuberances across the base and two smaller ones across the middle, vertical view elliptic, with three prominent protuberances on each side; cell wall punctate. (Pl.3, fig.3, photo.22).

Local distribution: Near Associated Industries, Nowshera, Sarim No. 305, Jan. 28, 1979.

Geographical distribution: Europe, U.S.A. India, Japan, Pakistan.

11. E. insigne Hass. ex Ralfs, Brit. Desm. p.83, pl.13, fig.6. 1848.
- = E. insigne Hass. Brit. Freshw. Alg. p.21, pl.91, fig.2. 1845.
- = Didymidium (Euastrum) insigne Reinsch. Algenfl. Franken, p.130. 1867.
- = Euastrum mammillosum Wille in Bull. Torr. Bot. Club, p.18, pl.27, fig.21. 1883.
- = E. insigne b. typicum Racib. Nonn. Desm. Polon. p.92. 1885.
- = Helierella insigne Kuntze, Revis. gen. plant. p.898. 1891.
- = Euastrum insigne var. elegans Schmidle, Beitr. Alg. Schwarzwald. p.105, pl.6, fig.8. 1893.
- = E. insigne var. mammillosum (Wille) Turn. Freshw. Alg. E. India, P.79. 1893.

West & West, vol.2, 1905, p.31. pl.37, figs.2-5;
Taylor, 1935, p.204, pl.62, fig.5; Croasdale & Grönblad, 1964, p.166, pl.6, fig.15; Herrmann, 1969, p.153, pl.5, fig.1; pl.7, fig.2;
Hosiaislouma, 1975, p.12; Caljon, 1975, p.96, pl.1, fig.6.

108-135 μm long; 57-70 μm broad; isthmus 13-15.5 μm broad; thickness 32-36 μm .

Cells of medium size, about twice as long as broad, deeply constricted, sinus widely open, narrowed towards the extremity, semicells widely deltoid in the basal portion, then narrowed into a neck, which widens again into an obversely-deltoid apex, basal and apical angles rounded, frequently with an undulation on the margin

just above the basal angle, apex truncate with a narrow median incision; semicells with a large, submamillate, downwardly directed protuberance within each basal angles, which projects over the edge of the sinus, side view of the semicells elongate-pyramidal; angles at base submamillate, lower part of sides convex, upper part of sides concave, with a dilated apex, the angles of which bluntly mamillate and upwardly directed; vertical view oblong-rectangular, with a conical mamillate protuberance in the middle of each truncate pole; lateral margins retuse in the centre; polar lobe in the form of an oblique cross the four processes of which mamilliform; cell wall scrobiculate, scrobiculations larger at all the angles, the surfaces of which become rough sometimes almost papillate. (PL.3, fig.13. photo. 27).

Local distribution: Quetta, Baluchistan, leg. Jan Mohd, Sarim No. 273, April 4, 1978.

Geographical distribution: Europe, U.S.A., Pakistan.

12. E. insulare (Wittr.) Roy. in Scott. Desm. p.177. 1893.

= E. binale (Turp.) Ehr. var. insulare Wittr. Gotl. Ö1, söt. Alg. p.49, pl.4, fig.7. 1872.

= Cosmarium insulare (Wittr.) Schmidle, Chlorophy-F1. Torfstiche Virmheim, p.59. 1894.

West & West, vol.2, 1905, p.68, pl.40, figs.11-13.

17.5-30 μ m long; 11.5-22 μ m broad; isthmus 3.3-6 μ m broad; thickness 9.5-11.5 μ m.

Cells small, $1\frac{1}{2}$ times longer than broad, deeply constricted, sinus narrowly linear, with a dilated extremity; semicells 3-lobed, interlobular incisions subrectangular; polar lobe widely rectangular, angles rounded, apex truncate and retuse-emarginate in the middle; lateral lobes short, basal angles subrectangular, sides slightly retuse; side view of semicell ovate, with a slight protuberance on

each side; vertical view elliptic, with a very slight protuberance at the middle on each side; cell wall smooth. (Pl.2, fig.8).

Local distribution: Pabbi, Distt. Peshawar, Sarim No.48, Oct. 22, 1976.

Geographical distribution: Europe, U.S.A., Siam, Pakistan.

13. E. intermedium Cleve, Sverig. Desm. p.484, pl.4, fig.1, 1864.
 = E. insigne b. intermedium Rabenh. Flor. Europ. Algar. p.184. 1868.
 = Holocystis intermedia Benn. Freshw. Alg. Eng. Lake Distr. p.8. 1896.
 = Helierella intermedia Kuntze, Revis. gen. plant. p.898. 1891.

West & West, vol.2, 1905, p.33, pl.37, fig.6.

54-68 μ m long; 31-40 μ m broad; breadth of apex 20-26 μ m; isthmus 9-10 μ m broad; thickness 20-25 μ m.

Cells small, almost $1\frac{1}{2}$ times as long as broad, deeply constricted, sinus widely open but narrowed at the extremity; semicells 3-lobed, with a large open sinus between the polar and lateral lobes; lateral lobes obtusely conical; polar lobe somewhat anvil-shaped, angles acutely rounded, apex convexo-truncate with a narrow median incision; semicells with two protuberances across the middle of the basal half between the two lateral lobes, and with two very small protuberances on the polar lobe, one on each side of the median incision; side view of semicell elongate-pyramidal, with a protuberance on each side near the base, lateral margins concave, and with a slight swelling on each side of the apex, which is rounded or rounded-truncate; vertical view elliptical, poles acutely rounded, with two prominent protuberances on each side near the middle; polar lobe elliptical, with two slight swellings on each side near the middle; cell wall smooth. (Pl.3, fig.14, photo.28).

Local distribution: Bannu, Sarim No.231, Feb. 1, 1978.

Geographical distribution: Europe, U.S.A, Pakistan.

14. E. oblongum (Grev.) Ralfs, Brit. Desm. p.80, pl.12, figs.a-g. 1848.
- = E. pecten Ehr. Entwick. Lebends. d. Infus. p.82. 1832.
- = Echinella oblonga Grev. in Hook. Brit. Flor. p.398. 1833.
- = Cosmarium sinuosum Corda in Alm. de Carlsbad, p.121, pl.2, fig.21. 1835.
- = Microsterias sinuata Bréb. et God. Alg. Falaise, p.55, pl.7. 1835.
- = Heterocarpella sinuata Bréb. in Cheval microscop. et usage, Paris, p.272. 1839.
- = Cosmarium oblongum Bréb. in Menegh. Synops. Desm. p.221. 1840.
- = Eutomia oblonga Harv. Man. Brit. Alg. p.188. 1841.
- = Euastrum oblongum (Grev.) Ralfs in Ann. Mag. Nat. Hist. p.189, pl.6, fig.4. 1844.
- = E. oblongiforme Cramer in Hedwigia, p.64, pl.12, fig.3. 1863.
- = Didymidium (Euastrum) oblongum Reinsch, Algenfl. Frank. p.136. 1867.
- = Euastrum oblongum b. oblongiforme (Cram.) Rabenh. Flor. Europ. Algar. p.181. 1868.
- = E. oblongum var. trigibbum Schaarschm. Magyar. Desm. p.262. pl.1, fig.2. 1882.
- = E. oblongum formae genuinae Racib. Nonn. Desm. Polon. p.93. 1885.
- = Helierella pecten Kuntze, Revis. gen. plant. p.897. 1891.

West & West, vol.2, 1905, p.12, pl.34, figs.7-9; pl.35, fig.2; Smith, 1924, p.23, pl.56, fig.3; Taylor, 1935, p.205, pl.61, fig.7; Prescott, 1936, p.142, pl.16, fig.7; Irénée-Marie, 1951^b, p.204, pl.4, fig.6; Tiffany & Britton, 1952, p.181, pl.55, fig.617; Hirano, 1959^a, p.255, pl.31, fig.II; Wygasch, 1963, p.107, fig.16; Croasdale & Grönblad, 1964, p.168, pl.6, fig.1; Lenzenweger, 1967, p.179, pl.7, fig.9; Lenzenweger, 1968, fig.5; Herrmann, 1969, p.159, pl.8, fig.2; Zwart, 1969, p.171, fig.101; Mix, 1970^a, p.86, pl.5, fig.13; Förster, 1970, p.302, pl.11, figs.1-17; Hinde, 1971, p.109, pl.4, fig.21; Whitford & Schumacher, 1973, p.69, pl.22, fig.15;

Parra, 1975, p.34, figs.70,71; Werner, 1977, p.50, pl.6, figs.1, 2: pl.23, figs. 1, 2; Parra & Gonzales, 1977, p.21, fig.82; Scharf, 1979, p.35, pl.2, fig.9.

144-205 μm long; 76-107 μm broad; isthmus 20-31 μm broad; thickness 46-65 μm .

Cells large about twice as long as broad, in general outline oblong-elliptic, deeply constricted, sinus narrowly linear, and slightly dilated at the apex; semicells 5-lobed, incisions between the lobes fairly deep, and generally slightly open, upper ones occasionally closed; polar lobe widely cuneate, with rounded angles, apex convex with a deep and narrow median incision; upper and lower lateral lobes similar, upper ones slightly smaller than lower ones, subquadrate with retuse margins and rounded angles; semicells with a protuberance within each of the lateral lobes, with one at the base immediately above the isthmus, and with two smaller ones in the centre, often with a large scrobiculation between them; side view of semicell elongate-pyramidal, with rectangular basal angles and a dilated convex apex; lateral lobes rotundo-rhomboid, with somewhat retuse margins, upper angles of upper lateral lobes rarely emarginate; vertical view broadly elliptic, poles narrow and rounded, sides with four protuberances and a fifth one between and beneath the two central ones; polar lobe oblong-elliptical, with convex sides, emarginate poles, and rounded angles; cell wall punctate. (Pl.3, fig.2, photo.21).

Local distribution: Quetta, Baluchistan, leg. Jan Mohd, Sarim No. 272, April 4, 1978; Mardan, Sarim No.9 Aug. 10, 1976; Peshawar, Sarim No.42, Oct. 12, 1976.

Geographical distribution: World wide.

15. E. pectinatum Bréb. ex Ralfs, Brit. Desm. p.86, pl.14, fig.5. 1848.
 = Heterocarpella pectinata Bréb. in Cheval. Microscop. et usage, Paris, p.272. 1839.
 = Cosmarium pectinatum Bréb. in Menegh. Synops. Desm. p.222. 1840.
 = Didymidium (Euastrum) pectinatum Reinsch, Algenfl. Frank. p.123. 1867.
 = Euastrum pectinatum forma typica Boldt, Desmid. Grönland, p.6. 1888.
 = Helierella pectinata Kuntze, Revis. gen. plant. p.899. 1891.

West & West, vol.2, 1905, p.60, pl.39, figs. 10-12;

Cedercreutz, 1929, p.149; Hirano, 1959^a, p.235, pl.33, fig.21;

Mattern, 1962, p.244, fig.15; Wygasch, 1963, p.107, fig.18; Mattern, 1964, p.251; Lenzenweger, 1976, p.64, pl.1, fig.2; Lenzenweger, 1978, pl.2, fig.9.

69-73 μm long; 44-47 μm broad; polar lobe 32-35 μm broad; isthmus 11.5-12 μm broad; thickness 33-36 μm .

Cells of medium size, about $1\frac{1}{2}$ as long as broad, deeply constricted, sinus narrowly linear generally slightly open; semicells 3-lobed; polar lobe dilated, anvil-shaped, angles rounded, apex convexo-truncate and slightly retuse in the middle; lateral lobes subquadrate, deeply retuse at the outer margin, angles acutely rounded; semicells with three large protuberances across the broadest part, and with two protuberances within the polar lobes, one on each side; side view of semicell widely inflated below, then constricted and widening out into a dilated and subtruncate apex; angles of polar and lateral lobes bilobulate; vertical view elliptic-oblong, poles bimamillate with three large rounded conical protuberances on each side; polar lobe elliptic-oblong, poles bimamillate and with two rounded conical protuberances at each side; cell wall punctate. (Pl.3, fig.9, photo.25).

Local distribution: Mirpur Sokoro, Sind, Sarim No.257, April 3, 1978.

Geographical distribution: World wide.

16. E. pectinatum Bréb. ^{ex Ralfs} var. inevolutum West & West, Freshw.

Alg. Ork. and Shelt. p.15, pl.1, fig.13. 1905.

West & West, vol.2, 1905, p.61, pl.39, figs.13-15;

Taylor, 1935, p.206, pl.7, fig.15; Prescott, 1954, p.75, fig.111

b; Vuorisalo, 1969, p.107, fig.21.

51-63 μ m long; 36-42 μ m broad; polar lobe 24-28 μ m broad; isthmus 10-11.5 μ m broad; thickness 21-26 μ m.

Cells a little smaller than the species; lateral lobes generally more quadrate, outer margins only slightly retuse; cell deeply constricted; sinus narrowly linear or slightly open; semicells 3-lobed; neck of polar lobe broader and shorter, apex of polar lobe convex and strongly retuse in the middle, apical angles more ^{rounded} than the species; protuberances of lower part of semicell and particularly of polar lobe much reduced; cell wall punctate. (Pl.2, fig.13).

Local distribution: Quetta, Baluchistan, leg. Jan Mohd, Sarim No.270, April 5, 1978.

Geographical distribution: Europe, U.S.A., Pakistan.

17. E. sinuosum Lenorm. var. gangense (Turn.) Krieger in Krypt. Flor. p.502. 1937.

Hirano, 1959a, p.252, pl.32, fig.2; Scott, Grönblad & Croasdale, 1965, p.35, fig.48; Hinode, 1971, p.109, pl.5, figs.8, 9; pl.4, fig.16.

46-59 μ m long; 18-30 μ m broad; isthmus 6-11 μ m broad.

Cells small, sinus narrowly linear with a dilated extremity; deeply constricted; central mucous pores distinct; semicells elongate-pyramidal; polar lobe prominent, lateral lobes bilobulate, lobules rounded; side view of semicell pyramidal, vertical view elliptic; cell wall punctate. (Pl.3, fig.5).

Local distribution: Khairpur Sind, Sarim No.255, April 1, 1978.

Geographical distribution: Europe, Japan, Pakistan, Brazil.

18. *E. spinulosum* Delp. var. *inermius* Nordst. in Lund Univ.

Arsskr. p.16, fig.9. 1880.

Hirano, 1959a, p.240, pl.33, fig.16; Islam, 1970, p.918, pl.17, fig.4.

53-70 μm long; 47.6-59 μm broad; isthmus 11-17 μm broad.

Cells moderately large, a little longer than broad, deeply constricted, sinus linear; semicells semicircular, lateral lobes convex, polar lobe rectangular; cell apex retuse; cell wall granulate. (Pl.3, fig.12, photo.26).

Local distribution: Zoological Gardens Tank No.2, Lahore, Sarim No.46, Oct. 20, 1976.

Geographical distribution: Japan India, Burma, Africa, Australia, Bangladesh, Pakistan.

19. *E. turnerii* West, Alg. W. Ireland, p.141, pl.20, fig.18. 1892.

West & West, vol.2, 1905, p.37, pl.37, figs. 9, 10.

39-50 μm long; 28-33 μm broad; isthmus 7-9 μm broad; thickness 18-20 μm .

Cells small, about $1\frac{1}{2}$ times longer than broad, deeply constricted, sinus narrowly linear with a dilated extremity; semicells more or less 3-lobed; polar lobe short and very broad, oblong-rectangular, lateral margins retuse, apical angles with a short divergent spine, apex truncate, with four undulations and a narrow median incision; lateral lobes bilobulate, both upper and lower lobules truncato-emarginate; semicells with a small tumour in the centre ornamented with a ring of granules; cell wall with a number of granules within the polar and lateral lobes; side view of semicell ovate-pyramidal, apex acute, with a truncate granulate protuberance near the base on each side; vertical view elliptic, poles acutely rounded, with a truncate granulate protuberance at the middle on each side. (Pl.2, fig.10).

Local distribution: Pabbi Distt. Peshawar, Sarim No.48,
Oct. 22, 1976.

Geographical distribution: Europe, Australia, Pakistan.

20. E. validum West & West, Some N. Amer. Desm. p.245, pl.14,
fig.32. 1896.

West & West, vol.2, 1905, p.75, pl.40, figs.21, 22;
Taylor, 1935, p.209, pl.60, fig.7; Grönblad, 1947, p.24, pl.1,
figs. 2-3; Scott & Prescott, 1958, p.39, fig.6.

26.5-30 μ m long; 19-22 μ m broad; isthmus 4.4-4.5 μ m
broad; thickness 10-11 μ m.

Cells minute, $1\frac{1}{2}$ times longer than broad, very deeply
constricted, sinus narrowly linear with a dilated extremity, semicells
truncate-pyramidal; lateral margins retuse, inferior angles
inflated, superior angles rounded and sometimes slightly thickened;
apex broad, truncate-convex, emarginate and thickened in the middle;
semicells with a small papilla within each basal angle, a large
granule in the middle close to the isthmus, and a small scrobiculation
near the centre; side view of semicell ovate, with a granule near
the isthmus on each side; vertical view elliptic, with a small
papilla on either side of each pole; cell wall smooth.
(Pl.2, fig. 9, photo.19).

Local distribution: Pabbi, Distt. Peshawar, Sarim No.48,
Oct. 22, 1976.

Geographical distribution: Europe, Ceylon, U.S.A., Pakistan,
Australia.

21. E. ventricosum Lund. Desm. Suecp. pl.2, fig. 2. 1871.

= E. crassum (Bréb.) Kg. var. b Ralfs, Brit. Desm. pl.11, fig.3.
1848.

= Helierella ventricosa Kuntze, Revis. gen. plant. p.899. 1891.

West & West, vol.2, 1905, p.4, pl.33, figs. 1-3; Taylor,
1935, p.209, pl.62, fig.9; pl.63, fig.10.

80-136 μm long; 52-80 μm broad; isthmus 18-28 μm broad; thickness 33-48 μm .

Cells of medium size, $1\frac{1}{2}$ times longer than broad, deeply constricted, sinus narrowly linear; semicells in front view somewhat semielliptical, strongly dilated at the base, unequally 3-lobed, the intervening incisions narrow, polar lobes smaller than lateral lobes, strongly convex with a deep and narrow incision; from vertical view oblong-elliptic with deeply emarginate poles; lateral lobes bilobulate, with a broad median hollow, upper lobule obtuse and from the side view entire, lower lobule subtriangular with basal angles somewhat rounded, semicells with three tumours across the base and two across the middle; side view of semicell somewhat pyramidal, with a protuberance on each side below the middle, apex dilated, truncate, with rounded angles; vertical view angular-elliptic showing five undulations on each side; cell wall punctate. (Pl.3, fig.8, photo.24).

Local distribution: Mardan, Sarim No.61, Nov. 1, 1976; Feroz Sons Laboratories, Nowshera, Distt. Peshawar, Sarim No.307. Jan.30, 1979.

Geographical distribution: Europe, U.S.A., Pakistan.

- 22. E. verrucosum Ehr. ex Ralfs, Brit. Desm. p.79, pl.11, fig.2. 1848.
- = E. verrucosum a. typicum Racib. Nonn. Desm. Polon. p.94. 1885.
- = E. verrucosum a. typicum Boldt, Desm. Grönland, p.6. 1888.
- = Hellerella verrucosa Kuntze, Revis. gen. plant. p.899. 1891.

West & West, vol.2, 1905, p.64, pl.40, fig.1; Smith, 1924, p.27; Taylor, 1935, p.209, pl.63, fig.12; Thompson, 1938, p.41, pl.9, fig.22; Croasdale, 1955, p.532, pl.11, fig.11; Hirano, 1959, p.242, pl.33, fig.26; Wygasch, 1963, p.108, figs. 13-15; Mattern, 1964, fig.12; Prescott, 1966, p.28, pl.4, figs.35, 41; Schroevers, 1966, p.163; Lind, 1967, p.372, pl.3; Zwart, 1969, p.171, figs. 102-104;

Hinode, 1971, p.111, pl.5, fig.24; Whitford & Schumacher, 1973, p.69, pl.23, fig.9; Lenzenweger, 1977, p.336, pl.1, fig.5; Hirano, 1977, p.219.

93-114 μm long: 75-92 μm broad; isthmus 19-22 μm broad; thickness 53-55 μm .

Cells moderately large, subhexagonal, a little longer than broad, deeply constricted, sinus open for half its length and then narrowly linear; semicells 3-lobed, interlobular incisions deep but open; polar lobe widely cuneate, angles rounded and granulate, apex deeply retuse; lateral lobes wider than polar lobe, cuneate and bilobulate, lower lateral lobule subconical, rounded, granulate and horizontally directed, upper lateral lobule submamillate, granulate, upwardly and outwardly diverging; semicells with three large protuberances across the broadest part, the central one being the largest, each protuberance with large wart like granules arranged in concentric circles; cell wall granulate, granules most evident at the angles where they are often sharp and conical; side view of semicell widely inflated in the lower part owing to the verrucose central protuberance showing at each side, then narrowed to form a neck; apical portion dilated, angles rounded, apex retuse, vertical view elliptic, poles mamillate and granulate, with three large subverrucose protuberances on each side, upper and lower lateral lobules entire; polar lobe oblong-rectangular, with retuse sides and rounded angles.

(Pl.3, fig.1, photo.20).

Local distribution: Malakand, Sarim No.302, Jan. 2, 1979.

Geographical distribution: Europe, Russia, Africa, U.S.A., Japan, Pakistan.

CHARACTERS OF COSMARIUM

3. COSMARIUM Corda ex Ralfs, Brit. Desm. p.91. 1848.

Cells very variable in size, solitary, usually a little longer than broad, generally somewhat compressed, symmetrical in three planes at right angles to each other; constricted in the middle often deeply, but sometimes very slightly; semicells variable in outline, elliptical, circular, semicircular, subquadrate, or truncate-pyramidal; apex rounded truncate or subtruncate, without an apical incision; vertical view elliptic, subelliptic, or oblong rarely circular; chloroplast usually axile, usually one in each semicell, with four curved longitudinal plates, and a large central pyrenoid, or with two large pyrenoids transversely disposed; in a few species parietal, 4-8 in each semicell, with one or more pyrenoids in each chloroplast; cell wall smooth, punctate, scrobiculate, granulate, verrucose, papillate,

KEY TO THE TAXA

1. Cell wall granulate.....2
1. Cell wall punctate.....6
1. Cell wall smooth..... 16
1. Cell wall scrobiculate.....20
 2. Constriction shallow.....C. pseudamoenum
 2. Constriction deep.....3
3. Semicells elliptic.....4
3. Semicells otherwise.....5
 4. Cell 28 μ m broad.....C. portianum
 4. Cell 31-43 μ m broad.....C. commissurale var. crassum
5. Semicells subrectangular.....C. conspersum
5. Semicells pyramidal-truncate.....C. margaritifera
5. Semicells oblong-rectangular.....C. pseudobroomei
5. Semicells subcircular-obovate.....C. sphaeroideum
5. Semicells truncate-subsemicircular.....C. praemorsum

5. Semicells ovate-pyramidal,
cell 51-68 μ m broad.....C. botrytis
5. Semicells pyramidal-ovate,
cell 70-86 μ m broad.....C. tetraophthalmum
6. Constriction shallow.....C. debaryi
6. Constriction deep.....7
7. Semicells subelliptic.....8
7. Semicells otherwise.....9
8. Cell 25-31 μ m broad.....C. contractum
8. Cell 68-77 μ m broad.....C. cymatopleurum var. tyro
9. Semicells truncate-pyramidal.....10
9. Semicells otherwise.....11
10. Cell 19-30 μ m broad.....C. granatum
10. Cell 33-36.5 μ m broad.....C. nymannianum
11. Cells a little longer than broad.....12
11. Cells otherwise.....13
12. Semicells angular.....C. laeve var. octangularis
12. Semicells reniform.....C. phaseolus forma minor
12. Semicells subtrapeziform.....C. monodii
12. Semicells subrectangular.....C. subreinschii var. ocellat
12. Semicells depressed-semicircular....C. obsoletum
13. Cells about as long as broad.....14
13. Cells otherwise.....15
14. Semicells subsemicircular.....C. lundellii
14. Semicells subhexagonal-elliptic.....C. depressum var. achondrum
14. Semicells subhexagonal-reniform.....C. rectangulare var. hexag
15. Semicells semielliptic.....C. pachydermum
15. Semicells pyramidal-trapeziform.....C. scalaritum
15. Semicells semioblong-elliptic.....C. laeve
15. Semicells truncate-semielliptical.....C. pseudopyramidatum
15. Semicells truncate-subpyramidal.....C. dorsitruncatum
16. Constriction shallow.....C. raeticum
16. Constriction deep.....17

17. Sinus linear or narrowly linear.....18
17. Sinus otherwise.....19
18. Semicells semielliptic.....C. subcucumis
18. Semicells subsemicircular.....C. impressulum
18. Semicells subreniform.....C. bicardia
18. Semicells truncate-pyramidal.....C. hammeri
18. Semicells depressed-subsemicircular....C. tetrachondrum
19. Semicells subquadrate.....C. quadratum var. willei
19. Semicells elliptic.....C. contractum var. ellipsoideum
19. Semicells oblong.....C. bioculatum var. depressum
19. Semicells angular-obovate.....C. moniliforme var. subpyriforme
19. Semicells subpyramidal-semicircular..... C. ralfsii var. montana
20. Chloroplast axile..... 21
20. Chloroplast parietal.....22
21. Isthmus 17.5-20 μ m broad.....C. pyramidatum
21. Isthmus 40-45 μ m broad.....C. connatum
22. Semicells ovate.....C. ovale
22. Semicells ovate-truncate.....C. turgidum

DESCRIPTION OF THE PLANTS

1. Cosmarium bicardia Reinsch in Contr. Alg. Fung. p.83. 1875.

Hirano, 1956, p.104, pl.20, fig.16; Grönblad, Scott & Groasdale, 1964, p.16, pl.4, figs.80, 81.

28-29 μ m long; 25 μ m broad; isthmus 7 μ m broad.

Cells small, a little longer than broad, deeply constricted, sinus linear with a dilated extremity, semicells subreniform, basal angles obtuse and rounded; lateral view subcircular; vertical view oblong-elliptic; cell wall smooth. (Pl.5, fig.10).

Local distribution: Bahrain, Distt. Swat, Sarim No.188, Dec. 15, 1978.

Geographical distribution: Europe, Uganda, Burma, Japan, Pakistan

2. C. bioculatum Bréb. ^{ex Ralfs} var. depressum Schaarschm. in West & West, Brit. Desm. vol.2, p.166. 1905.

Grönblad, 1956, p.65, pl.1, fig.12; Hirano, 1957, p.101, fig.22; Croasdale, 1973, p.86, pl.14, figs.2, 3.

14-20 μ m long; 17-18 μ m broad; isthmus 4-5.5 μ m broad; thickness 5-8 μ m.

Cells subquadrate, with rounded angles; deeply constricted; sinus open; semicells transversely oblong with broadly flattened apices; vartical view oblong, sides parallel and poles rounded; cell wall smooth; chloroplast axile with one pyrenoid. (Pl.6, fig.8, photo.43).

Local distribution: Madain, Distt. Swat, Sarim No.190, Dec. 15, 1978.

Geographical distribution: Europe, U.S.A, Ellesmere Island, Japan, Pakistan.

3. C. botrytis Menegh. ex Ralfs, Brit. Desm. p.99, pl.16, fig.1. 1848.
 = C. botrytis Menegh. Synops. Desm. p.220. 1840.
 = Euastrum interstitiale Kg. Phycol. germ. p.136. 1845.
 = Cosmarium botrytis var. interstitiale Kg. Spec. Alg. p.175. 1849.
 = Euastrum (Cosmarium) botrytis Näg. Gatt. einz. Alg. p.119, pl.7a, fig.3. 1849.
 = Didymidium (Cosmarium) botrytis Reinsch, Algenfl. Frank. p.120. 1867.
 = Ursinella botrytis Kuntze, Revis. gen. plant. p.923. 1891.

West & West, vol.4, 1912, p.1, pl.96, figs.1,2, 5-15;
 Smith, 1924, p.33, pl.57, fig.22; Taylor, 1934, p.251, pl.52, fig.6;
 El-Nayal, 1935, p.54, fig.85; Prescott, 1936, p.136; Grönblad, 1944, p.10; Taft, 1945, p.192, pl.2, fig.32; Irénée-Marie, 1951, p.94, pl.1, fig.4; Tiffany & Britton, 1952, p.191, pl.53, fig.568;
 Croasdale, 1956, p.20, pl.17, fig.3; Hoshaw, 1961, p.493; Fritsch, 1961,

fig.109; Brandham & Godward, 1964, p.76, figs. 1-4; Mattern, 1964, p.250; Brandham, 1965, p.405, figs.11-22; Brandham, 1965a, p.451; Brandham & Godward, 1965b, p.428, pl.12, figs.2, 3; Brandham & Godward, 1965c, p.1382, figs. 1324; Brandham, 1965d, p.48, figs.2-4, 7-9; Brandham, 1965e, p.479, pl.1, figs.2, 3, 8; pl.2, fig.11; Brandham, 1967, p.312, fig.1; Brandham, 1967a, p.484, pl.1; Zwart, 1969, figs.88, 89; Förster, 1970, p.308, pl.23, fig.12; Lott, Harris & Turner, 1972, p.232, figs.1-3; pl.2, figs.4-9; Ueda, 1972, p.269; Pickett-Heaps, 1973, p.114, fig.5; Pickett-Heaps & Tippit, 1973, p.197; Whitford & Schumacher, 1973, p.72, pl.28, fig.14; Pickett-Heaps, 1974, p.10, figs.14-17; Shah, 1974, p.15, fig.20; Gayoso, 1976, p.87, fig.18; Parra & Gonzales, 1977, p.22, fig.130.

65-90 μm long; 51-68 μm broad; isthmus 17-24 μm broad; thickness 33-40 μm .

Cells above medium size, about $1\frac{1}{2}$ - $1\frac{1}{3}$ times as long as broad, deeply constricted, sinus narrowly linear with a dilated extremity; semicells ovate-pyramidal from a broad flat base, basal angles rounded, sides convex, apex rather narrowly truncate or subtruncate, apical angles rounded; side view of semicell broadly elliptic, vertical view elliptic, cell wall uniformly granulate, granules somewhat small and generally without any definite disposition, sometimes with a slight indication of a concentric arrangement or even a disposition in decussating oblique series, about 30-36 visible at the margin of the semicell; chloroplast axile, with two pyrenoids in each semicell. (Pl.4, fig.1, photo.29).

Local distribution: Shahdara, Lahore, Sarim No.49, Oct. 20, 1976; Abbottabad, Sarim No.74, Nov. 6, 1976; Peshawar University Campus, Sarim No.97, Dec. 7, 1976.

Geographical distribution: World wide.

4. C. commissurale Bréb. ^{ex Ralfs} var. crassum Nordst. Desm. Brasil, p.213, pl.3, fig.19, 1870.

West & West, vol.3, 1908, p.155, pl.77, figs.15, 16; Smith, 1924, p.35, pl.57, fig.26; Grönblad, 1945, p.16; Irénée-Marie, 1951, p.95; Wade, 1957, p.256; Prescott, 1966, p.13, pl.13, fig.3; Whitford & Schumacher, 1973, p.71, pl.27, fig.2.

28-37 μm long; 31-43 μm broad; isthmus 10-5-13 μm broad; thickness 22-26.5 μm .

Cells about $1\frac{1}{2}$ times as broad as long, deeply constricted; sinus not closed, but not nearly so much widened inwardly as in the species; semicells elliptic; lateral lobes of semicells much stouter; central granules variable, but often reduced in number, with three large central warts surrounded by one ring of 8 granules. (Pl.5, fig.1).

Local distribution: Islamabad, Sarim No.150, March 11, 1977.

Geographical distribution: Brazil, Europe, U.S.A. Canada, Pakistan.

5. C. connatum Bréb. ex Ralfs, Brit. Desm. p.108, pl.17, fig.10. 1848.
 = Dysphinctium meneghinianum Näg. Gatt. einz. Alg. p.112, pl.6, fig.2. 1849.
 = Dysphinctum connatum Reinsch, Algenfl. Frank. p.178. 1867.
 = Calocylinthus connatus Kirchn. Alg. Schles. p.143. 1878.
 = Calocylinthus connatus a. typicum Klebs, Desm. Ostpreuss. p.29. 1879.

West & West, vol.3, 1908, p.25, pl.27, figs.15, 16; Taylor, 1934, p.251, pl.69, fig.4; Taft, 1948, p.86; Croasdale, 1956, p.24, pl.9, fig.2; Hirano, 1956, p.88, pl.16, fig.17; pl.17, fig.8; Scott & Prescott, 1958, p.44, fig. 13; Grönblad, 1960, p.36, pl.2, figs.21, 22; Mattern, 1962, p.244, fig.8; Grönblad, Scott & Croasdale, 1964, p.16, figs. 51, 52; Ochiai, 1966, p.119, fig.B;

Lind, 1967, p.374, pl.4, fig.5; Kanetsuna, 1967, p.78, pl.4, fig.2; Grönblad & Croasdale, 1971, p.12, pl.6, fig.83; Hinode, 1971, p.114, pl.7, fig.9; pl.5, fig.7; Whitford & Schumacher, 1973, p.72, pl.30, fig.18; Parra, 1975, p.35, fig.121; Werner, 1977, p.54, pl.10, fig.3; Hirano, 1977, p.80, fig.6; Wasylik, 1961, p.22, pl.1, figs.17, 17a.

65-100 μm long; 46-74 μm broad; isthmus 40-50 μm broad; thickness 45-56 μm .

Cells large, almost $1\frac{1}{2}$ times longer than broad, moderately constricted, sinus widely open with an obtuse apex; semicells transversely subelliptic with a broad base, apex commonly very slightly flattened; vertical view subcircular, slightly compressed; cell wall often somewhat thick, finely scrobiculate, chloroplast axile, disposed in relation to two large pyrenoids in each semicell, with numerous, somewhat irregular, and often furcate lobes extending outwards until they become flattened against the inner surface of the cell wall. (Pl.6, fig.5).

Local distribution: Bannu, Sarim No.231, Feb,1, 1978.

Geographical distribution: World wide.

6. C. conspersum Ralfs, Brit. Desm. p.101, pl.16, fig.4. 1848.
 = C. anomalum Delp. Desm. subalp. p.29, pl.9, fig.15. 1877.
 = C. conspersum a. Ralfsii Racip.Nonn. Desm. Polon. p.75. 1885.
 = Ursinella conspersa Kuntze, Revis. gen. plant. p.924. 1891.

West & West, vol.4, 1912, p.13, pl.99, figs.1, 2;
 Cedercreutz, ^{1929,} p.150; Croasdale, 1965, p.317, pl.6, fig.7; Prescott, 1966, p.13, pl.13, fig.12; pl.9, fig.24; Zwart, 1969, p.167, fig.76; Werner, 1977, p.54, pl.10, fig.8.

82-110 μm long; 65-77 μm broad; isthmus 20-27 μm broad; thickness 40-46 μm .

14251

Cells large, about $1\frac{1}{2}$ times as long as broad, deeply constricted, sinus narrowly linear with a dilated extremity; semicells subrectangular, wider at the apex than at the base; angles slightly rounded, sides almost straight, apex convex, cell wall uniformly granulate, about 30 granules showing round the margin of a semicell, granules disposed in about 9 horizontal series and 13-15 vertical series, commonly with slight irregularities; side view of semicell almost circular; vertical view elliptic; chloroplast axile with two pyrenoids in each semicell. (Pl.4, fig.3).

Local distribution: Akbarpura, Distt. Peshawar, Sarim No.30, Sept. 25, 1976.

Geographical distribution: Europe, Russia, U.S.A., Pakistan.

7. C. contractum Kirchn. Alg. Schles. p.147. 1878.

= C. contractum a. silesiacum Racib. Nonn. Desm. Polon. p.84. 1885.

= Ursinella contracta Kuntze, Revis. gen. plant. p.924. 1891.

West & West, vol.2, 1905, p.170, pl.61, figs.23-25; Smith, 1924, p.30, pl.57, figs.9-11; Taylor, 1934, p.251, pl.50, fig.50; Hirano, 1956, p.98, pl.20, fig.2; Grönblad, 1960, p.36, pl.2, figs. 25-28; Croasdale & Grönblad, 1964, p.176, pl.11, fig.15; Eloranta, 1968, p.62, fig.32; Förster, 1969, p.47, pl.13, fig.7; Hinode, 1971, p.114, pl.7, fig.14; Thomasson, 1973, p.130, fig.2; Whitford & Schumacher, 1973, p.72, pl.30, fig.10; Parra, 1975, p.35, fig.83.

34.5-41 μ m long; 25-31 μ m broad; isthmus 7-8.7 μ m broad; thickness 18-19 μ m.

Cells rather small, about $1\frac{1}{2}$ times longer than broad, deeply constricted, sinus narrow towards the apex, rapidly widening outwards; semicells subelliptic, ventral margin always more convex than the dorsal margin; side view of semicell circular; vertical

view elliptic, cell wall colourless and finely punctate, chloroplast axile with one central pyrenoid. (Pl.6, fig.10, photo.44).

Local distribution: Madain, Distt. Swat, Sarim No.190, Dec. 15, 1978.

Geographical distribution: World wide.

8. C. contractum Kirchn. var. ellipsoideum (Elfv.) West & West, Alg. N. Ireland p.40.1902.

= C. ellipsoideum Elfv. Anteck. Finska Desm. p.13, pl.1, fig.10. 1883 (Basionym).

= Ursinella ellipsoidea Kuntze, Revis. gen. plant. p.924. 1891.

Taylor, 1934, p.252, pl.50, fig.1; Croasdale, 1956, p.24, pl.5, fig.19; Hirano, 1957, p.98, pl.20, figs.3, 4; Croasdale & Grönblad, 1964, p.176, pl.11, fig.16; Prescott, 1966, p.14, pl.5, fig.45.

31-51 μm long; 24-42 μm broad; isthmus 7-12 μm broad; thickness 14.5-27 μm .

Cells shorter, not more than $1\frac{1}{2}$ times as long as broad; *Sinus* open, deeply constricted; semicells elliptic, although the apex sometimes slightly flattened in the middle; cell wall usually smooth. (Pl.4, fig.12).

Local distribution: Peshawar University Campus, Sarim No.315, Feb. 2, 1979.

Geographical distribution: Europe, U.S.A, Japan, Pakistan.

9. C. cymatopleurum Nordst. var. tyrolicum Nordst. Desm. Ital. p.30, pl.12, fig.5. 1876.

= C. subochthodes Schmidle, Weit. Beitr. Algenfl. Rheineb. u. Schwarzwald. p.75, fig.26a. 1895.

West & West, vol.3, 1908, p.6, pl.65, figs.11,12.

80-108 μm long; 68-77 μm broad; isthmus 22-36 μm broad; thickness 47-50 μm .

Slightly larger than the species; deeply constricted; semicells subelliptic, the whole margin slightly undulate, basal angles less rounded; apex not truncate; cell wall more distinctly punctate. (Pl.6, fig.3).

Local distribution: Akbarpura, Peshawar, Sarim No.30, Sept. 25, 1976.

Geographical distribution: Europe, Pakistan.

10. C. debaryi Arch. in Pritch. Infus. p.735. 1861.
- = Pleurotaenium cosmarioides De Bary, Conj. p.75, pl.5, fig.32. 1858.
- = Cosmarium thwaitesii Ralfs b. majus Rabenh. Flor. Europ. Alg. p.175. 1868.
- = C. debaryi a. typicum Klebs, Desm. Ostpreuss. p.28, pl.3, fig.4b. 1879.
- = Calocylindrus debaryi Wolle, Freshw. Alg. U.S. p.27, pl.56, fig.12. 1887.
- = Cosmarium debaryi Hansg. Prodr. Algenfl. Böhm. p.246. 1888.
- = Pleurotaeniopsis debaryi De Toni, Syll. Alg. p.906. 1889.

West & West, vol. 3, 1908, p.61, pl.70, figs.14-16; Croasdale, 1956, p.28, pl.9, fig.13; Croasdale, 1965, p.318, pl.4, figs.6, 7; Herrmann, 1968, p.363, fig.4; Croasdale, 1973, p.88, pl.13, fig. 14.

100-112 μ m long: 46-54 μ m broad; isthmus 27.5-39 μ m broad; thickness 46-50 μ m.

Cells large, about twice as long as broad or rather more, moderately constricted, sinus open and acute; semicells subquadrate, sides subparallel, straight, slightly convex or even faintly retuse, basal angles rectangular but rounded, apical angles broadly rounded, apex truncate-convex or convex; vertical view almost circular, very slightly compressed; cell wall

minutely punctate; chloroplasts parietal and band like, about five in each semicell, each band with numerous small and rather irregular lobes pressed against the inner side of the cell wall, and with 2-4 pyrenoids; central part of each semicell occupied by a rather conspicuous hyaline vacuole. (Pl.6, fig.1).

Local distribution: Tehkal Payan, Peshawar, Sarim No.163, March 21, 1977.

Geographical distribution: Europe, U.S.A, Russia, Pakistan.

11. C. depressum (Näg.) Lund. var. achondrum (Boldt.) West & West, Contr. Freshw. Plankt. Scott. Lochs, p.484. 1905.
 = C. phaseolus Bréb. ^{ex Ralfs} var. achondum Boldt, Sibir. Chlorophy. p.103, pl.5, fig.7. 1885. (Basionym).

West & West, vol.2, 1905, p.177, pl.62, figs. 3, 4; Smith, 1924, p.30, pl.57, figs.5,6; Taft, 1945, p.192, pl.2, fig.33; Croasdale, 1956, p.28, pl.6, fig.5; Hirano, 1956, p.103, pl.19, fig.32; Scott & Prescott, 1958, p.45, fig.12; Grönblad, 1960, p.37, pl.3, figs.41, 42; Förster, 1965, p.137, pl.4, figs. 13, 14; Förster, 1969, p.49, pl.15, figs.3, 4; Förster, 1970, p.310, pl.20, fig.5.

37-51 μ m long; 40-51 μ m broad; isthmus 12-17 μ m broad; thickness 22-23 μ m.

Cells as long as broad or nearly so; deeply constricted; semicells subhexagonal-elliptic, apex broader and more truncate; cell wall punctate; chloroplast axile, each with one pyrenoid. (Pl.4, fig.15, photo.34).

Local distribution: Multan, Sarim No.252, March 29, 1978.

Geographical distribution: World wide.

12. C. dorsitruncatum (Nordst.) West in Contr. to our knowledge of the Freshw. Alg. of Madagascar, Trans. Linn. Soc. Bot.5 (2); 61, pl.7, fig.21. 1895.

Hirano, 1957, p.111, pl.19, fig.3; pl.21, fig.8.

29.4-35 μm long; 39-47.6 μm broad; isthmus 11-14 μm broad.

Cells of medium size, $1\frac{1}{2}$ times broader than long, deeply constricted; sinus linear with a dilated extremity; semicells depressed truncate-subpyramidal; basal angles rounded; vertical view oblong-rhomboid; cell wall punctate. (Pl.6, fig.6, photo.42).

Local distribution: Govt. College, Abbottabad, Sarim No.232, Feb. 8, 1978.

Geographical distribution: Madagascar, U.S.A, Japan, Pakistan.

13. C. galeritum Nordst. Desm. Brasil. p.209, pl.3, fig.26. 1870.

= Ursinella galerita Kuntze, Revis. gen. plant. p.924. 1891.

West & West, vol.2, 1905, p.194, pl.63, figs.24, 25.

51-56.5 μm long; 42-46 μm broad; isthmus 15.5-17 μm broad; thickness 23-24 μm .

Cells of moderate size, $1\frac{1}{5}$ times longer than broad, deeply constricted, sinus narrowly linear with a dilated extremity, slightly widening outwards; semicells pyramidal-trapeziform, basal angles well rounded, sides almost straight or slightly convex, upper angles rounded, apex narrowly truncate, and generally slightly convex; side view of semicell subcircular; vertical view elliptic, cell wall punctate; chloroplasts axile, each with two pyrenoids. (Pl.4, fig.8).

Local distribution: Islamabad, Sarim No.150, March 11, 1977.

Geographical distribution: Europe, U.S.A, Africa, Pakistan, Brazil.

14. C. granatum Bréb. ex Ralfs, Brit. Desm. p.96, pl.32, fig.6. 1848.

= Didymidium (Cosmarium) granatum Reinsch, Algenfl. Frank, p.109. 1867.

= Cosmarium granatum Bréb. a. typicum Klebs, Desm. Ostpreuss, p.32 1879.

- = Duastrum (Cosmarium) granatum Gay. Monogr. Ioc. Conj. p.59. 1884.
- = Cosmarium granatum Bréb. var. concaum Lagerh. Contrib. alg. Ecuad. p.282. 1890.
- = Ursinella granata Kuntze, Revis. gen. plant. p.924. 1891.

West & West, vol.2, 1905, p.186, pl.63, figs.1-3; Smith, 1924, p.31, pl.57, fig.18; Taylor, 1934, p.253, pl.51, fig.1; Thompson, 1938, p.43, pl.10, fig.2; Croasdale, 1948, p.273; Tiffany & Britton, 1952, p.186, pl.53, fig.565; Grönblad, 1952_a, p.26, pl.1, fig.10; Grönblad, 1952, p.77; Hirano, 1955, p.39; Croasdale, 1956, p.34, pl.6, fig.11; Hirano, 1957, p.129, pl.20, fig.25; Grönblad & Růžická, 1959_a, fig.36; Grönblad, 1960, p.38, pl.3, fig.63; Messikommer, 1963, p.52, pl.1, fig.6; Mattern, 1964, p.250, fig.8; Croasdale & Grönblad, 1964, p.180, pl.11, fig.21; Croasdale, 1965, p.318, pl.2, figs.21-24; Prescott, 1966, p.15, pl.3, fig.30; pl.8, figs.46-48; Ochiai, 1966, p.120, fig.7; Eloranta, 1968, p.62, fig.41; Förster, 1969, p.51, pl.14, fig.8; Zwart, 1969, p.168, figs.23-28; Förster, 1970, p.310, pl.22, fig.15; Grönblad & Croasdale, 1971, p.14, pl.6, figs. 73, 74; Hinode, 1971, p.115, pl.7, fig.13; Croasdale, 1973, p.89, pl.12, figs.16-20; Whitford & Schumacher, 1973, p.72, pl.30, fig.1; Islam & Zaman, 1975_a, p.52, pl.5, figs.64, 65; Nygaard, 1976, p.86, pl.1, fig.c; Gough, Garvin & Woelkerling, 1976, figs. 1, 2; Hirano, 1977, p.213.

26-47 μm long; 19-30 μm broad; isthmus 6-9 μm broad; thickness 10.5-17.5 μm .

Cells small, about $1\frac{1}{2}$ times as long as broad, subrhomboid-elliptic, deeply constricted, sinus narrowly linear, slightly dilated at the apex; semicells truncate-pyramidal, basal angles rounded-subrectangular, sides at the base subparallel, then converging towards the apex, commonly straight or slightly convex, rarely

slightly concave upper angles obtuse, apex narrowly truncate and straight; side view of semicell elliptic-ovate; vertical view elliptic; cell wall finally punctate; chloroplast axile each with one pyrenoid. (Pl.4, fig.16, photo.35).

Local distribution: Peshawar, Sarim No.68, Nov.3, 1976; Sasnamana Ziarat, Baluchistan, leg. Khial Badshah, Sarim No.129, Jan. 15, 1977.

Geographical distribution: World wide.

15. C. hammeri Reinsch, Spec. Gen. Alg. p.115, pl.22, fig.1. 1867.
 = Didymidium (Cosmarium) hammeri a. majus Reinsch, Algenfl. Frank. p.111, pl.10, fig.1. 1867.
 = Euastrum hammeri Cohn, Desm. Bong. p.270. 1879.
 = Ursinella hammeri Kuntze, Revis. gen. plant. p.924. 1891.

West & West, vol.2, 1905, p.181, pl.62, figs.20, 21;
 Cedercreutz, 1941_a, p.110; Grönblad, 1948, p.9, fig.2; Hirano, 1957, p.126, pl.22, fig.19; Whitford & Schumacher, 1973, p.72, pl.29, fig.8; Islam & Zaman, 1975_a, p.52, pl.6, figs.71, 72; Lenzenweger, 1974, p.114, pl.2, fig.11;

40-50 μ m long; 27-35 μ m broad; isthmus 11-13 μ m broad;

Cells of moderate size, about $1\frac{1}{2}$ times longer than broad, subhexagonal, deeply constricted, sinus narrowly linear with a dilated apex, opening outwards; semicells truncate-pyramidal, basal angles well rounded, upper part of sides suddenly retuse, upper angles rounded, apex broadly truncate, straight or slightly retuse; side view of semicell elliptic-ovate; vertical view elliptic; cell wall smooth; chloroplasts axile with one pyrenoid. (Pl.6, fig.7).

Local distribution: Islamabad, Sarim No.150, March 11, 1977.

Geographical distribution: Europe, Japan, Ceylon, U.S.A, Pakistan.

16. C. impressulum Elfv. Anteck. Finska Desm. p.13, pl.I, fig.9. 1881.
 = C. meneghinii Bréb. forma Reinsch, Contrib. Alg. et Fung. pl.12, fig.12a. 1875.
 = C. meneghinii Bréb. b simplicissimum Wille, Norges Ferskv. Alg. p.30, pl.1, fig.11. 1880.
 = Duastrum (Cosmarium) impressulum Gay, Monogr. Ioc. Conj. p.61. 1884.
 = Cosmarium meneghinii Bréb. forma Reinschii Istvanffi, Diag. praev. Alg. nov. Hungar, p.237. 1887.
 = Ursinella impressula Kuntze, Revis. gen. plant. p.925. 1891.
 = Cosmarium crenulatum (Ehr.) Bréb. var. Reinschii Schmiddle, Beitr. Algenfl. Schwarzwald. u. Rheineb. p.96, pl.4, fig.10. 1893.
 = C. subortogonum Racib. forma minor Borge, Algolo. Notizen p.4, fig. 2. 1900.
 = C. meneghinii formae Hirn, Desm. Finland, pl.1, fig.6. 1903.

West & West, vol.3, 1908, p.86, pl.72, figs. 14-18;

Taylor, 1934, p.255, pl.68, fig. 12; pl.7, fig.11; Thompson, 1938, p.44, pl.10, fig.3; Croasdale, 1948, p.273; Irénée-Marie, 1951, p.102, pl.I, fig.12; Croasdale, 1956, p.39, pl.10, fig.11; Grönblad, 1956, p.27, fig.86; Hirano, 1957, p.163, pl.25, fig.24; Scott & Prescott, 1958, p.46, fig.6; Messikommer, 1963, pl.1, fig.9; Brandham, 1965, p.46, fig.1; Prescott, 1966, p.16, pl.4, fig.8; Zwart, 1969, p.168, figs.42, 43; Islam, 1970, p.924, pl.14, fig.1; Förster, 1970, p.311, pl.22, figs.20, 24; Hinode, 1971, p.115, pl.8, fig.8; Whitford & Schumacher, 1973, p.72, pl.29, fig.8; Shah, 1974, p.19, fig.30; Islam & Zaman, 1975, p.52, pl.7, figs.106, 107; Soding, Dorffing & Mix, 1976, p.153; Soding & Mix, 1977, p.16, pl.2, figs.4, 5; Werner, 1977, p.57, pl.12, fig.15; Hirano, 1977, p.213.

24-36 μm long; 19-26 μm broad; isthmus 5-9 μm broad; thickness 10-14 μm .

Cells rather small, about $1\frac{1}{2}$ times as long as broad, deeply constricted, sinus narrowly linear with a slightly dilated apex; semicells subsemicircular, margin regularly and markedly

8-undulate, sometimes almost crenate; crenations two at the apex and two on each side of the convex sides; side view of semicell broadly elliptic or elliptic-subcircular; vertical view elliptic; cell wall smooth; chloroplast axile with a central pyrenoid. (Pl.6, fig.4).

Local distribution: Near Adamjee Paper Mills, Nowshera, Distt. Peshawar, Sarim No. 308, Jan. 30, 1979.

Geographical distribution: World wide.

17. C. laeve Rabenh. Flor. Europ. Alg. p.161. 1868.

= C. meneghinii Bréb. var. simplicissimum Wille, Norges Ferskv. Alg. pl.1, fig.11a. 1880.

= Diastrum (Cosmarium) laeve Gay, Monogr. Ioc. Conj. p.59. 1884.

= Cosmarium meneghinii Bréb. var. subhexagonum Hansg. Prodr. Algenfl. Böhm. p.279. 1888.

= Ursinella laevis Kuntze, Revis. gen. plant. p.925. 1891.

West & West, vol.3, 1908, p.99, pl.73, figs.9-19; Taylor, 1934, p.255, pl.51, figs.8, 15; El-Nayal, 1935, p.49; Taft, 1945, p.195, pl.3, fig.2; Irénée-Marie, 1951, p.103, pl.1, fig.13; Hirano, 1957, p.164, pl.25, figs.40, 41, 46; Grönblad, 1960, p.39, pl.3, figs. 59-61; Messikommer, 1963, pl.1, fig.11; Prescott, 1966, p.16, pl.5, fig.46; Förster, 1970, p.312, pl.222, figs.11-14; Grönblad & Croasdale, 1971, p.15, pl.6, fig.90; Parra, 1975, p.38, fig.93; Parra & Gonzales, 1977, p. 23, fig. 104; Hirano, 1977, p.214.

15-34 μm long; 11.5-23 μm broad; isthmus 2.8-6.7 μm broad; thickness 9-13 μm .

Cells small, about $1\frac{1}{2}$ times as long as broad, very deeply constricted, sinus narrowly linear with a dilated apex; semicells semioblong-elliptic, with the basal angles slightly rounded or much rounded; apex narrowly truncate and retuse; side view of semicell ovate-elliptic; vertical view elliptic; cell wall punctate;

chloroplasts axile, one in each semicell, with a central pyrenoid. (Pl.5, fig.11, photo.41).

Local distribution: Naguman River, Distt. Peshawar, Sarim No.119, Jan. 1, 1977.

Geographical distribution: World wide.

18. C. laeve Rabenh. var. octangularis (Wille) West & West, Brit. Desm. vol.3, p.101, pl.73, fig.20. 1908.

= C. meneghinii Bréb. forma octangularis Wille, Ferakv. Alg. Nov. Semlj. p.43, pl.12, fig.35. 1879.

= C. laeve Rabenh. var. undulata Schmidle, Alg. Ceb. Oberrheins, p.548, pl.28, fig.5. 1893.

21-25 μm long; 17-19 μm broad; isthmus 6.5-7.5 μm broad.

Cells small, a little longer than broad, deeply constricted, semicells angular, irregularly 8-sided including the broad base; each lateral margin consisting of three short, straight or very slightly concave sides; apex retuse; cell wall punctate. (Pl.6, fig.14, photo.46).

Local distribution: University Town, Peshawar, Sarim No.242, Feb. 16, 1978.

Geographical distribution: Europe, U.S.A, Chile, Pakistan.

19. C. Lundellii Delp. Desm. Subalp. p.13, pl.7, fig.62. 1877.

= Ursinella lundellii Kuntze, Revis. gen. plant. p.925. 1891.

= Cosmarium subcirculare Turn. Freshw. Alg. E. India, p.52, pl.8. fig.3. 1893.

West & West, vol.2, 1905, p.138, pl.57, figs.1, 2; Croasdale, 1965, p.2, pl.1; Chardard, 1966, p.336; Prescott, 1966, p.17, pl.5, fig.43; Chardard, 1970, p.59, pl.1; Chardard & Heim, 1972, p.1367, pls.1-4; Chardard, 1973, p.59, pls.1-8; Chardard & Heim, 1974, p.609, pls.1-4; Chardard, 1977, p.241, figs.1-8.

79-82 μm long; 69-79 μm broad; isthmus 30-41 μm broad; thickness 42-45 μm .

Cells large, subcircular, about as long as broad, deeply constricted, sinus linear with a dilated apex; semicells sub-semicircular, basal angles broadly rounded; side view of semicell subcircular; vertical view elliptic; poles slightly drawn out; cell wall punctate generally thickened in the centre of the semicells; chloroplasts axile with prominent ridges, and with two large pyrenoids. (Pl.6, fig.9).

Local distribution: Zoological Gardens Lahore, Tank No.2, Sarim No.46, Oct. 20, 1976; Mardan, Sarim No.48, Nov.15, 1976.

Geographical distribution: Europe, U.S.A. India, Africa, Pakistan.

20. C. margaritiferum Menegh. ex Ralfs, p.100, pl.16, fig.2. 1848.

= Euastrum margaritiferum Ehr. Org. der Richt. des klein. Rau. Berlin, p.246. 1834.

= Microsterias margaritifera Bréb. in Mem. Soc. Acad. Sci. arts et bell. letter. de Falaise, p.55. 1835.

= Cosmarium margaritiferum Menegh. Synops Desm. p.219. 1840

= Didymidium (Cosmarium) margaritiferum Reinsch, Algenfl. Frank. p.118. 1867.

= Cosmarium margaritiferum a. genuinum Kirchn. Alg. Schles, p.151. 1878.

= C. confusum Cooke var. regularius Alg. W. Ireland p.156. 1892. 1892.

= C. malivernianum (Racib.) Schmidle var. badense Schmidle, Chlorophy. Tor. Virnh. p.58, pl.7, fig.21. 1894.

West & West, vol.3, 1908, p.199, pl.83, figs.4-11;

Wygasch, 1963, p.128, fig.19; Lind, 1967, p.375, pl.94, fig.1;

Eloranta, 1968, p.62, fig.42; Förster, 1970, p.312, pl.23, fig.9;

Lenzenweger, 1970, p.254, pl.11, fig.9; Werner, 1977, p.42, pl.3,

figs. 4-6; Parra & Gonzales, 1977, p.23, fig.129.

50-59 μm long; 42-56 μm broad; isthmus 13-16 μm broad; thickness 28-36 μm .

Cells of medium size, slightly longer than broad, deeply constricted, sinus narrowly linear with a dilated extremity; semicells pyramidal-truncate, basal and upper angles rounded, sides slightly convex, apex broad and straight or very slightly convex; cell wall granulate; side view of semicell circular; vertical view elliptic, chloroplast axile, with two pyrenoids. (Pl.6, fig.2).

Local distribution: Quetta Baluchistan, leg. Jan Mohammad, Sarim No.273, April 4, 1978.

Geographical distribution: U.S.A, Chile, Europe, Pakistan.

21. C. moniliforme (Turp.) Ralfs var. subpyriforme West & West, Brit. Desm. vol.3, p.23, pl.67, fig.5. 1908.

40 μm long; 20 μm broad; isthmus 7.7 μm broad.

Semicells somewhat angularly obovate, lateral margins in the lower part slightly flattened, cell wall smooth; vertical view circular; chloroplast axile, each with a central pyrenoid; cell sinus open, deeply constricted. (Pl.4, fig.14).

Local distribution: Khairpur Sind, Sarim No.255, April 1, 1978.

Geographical distribution: Europe, Pakistan.

22. C. monodii Bourrelly, Algues d'eau douce du Soudan Francais, Bull I. F.A.N. 19; 1071, pl.10, fig.88. 1957.

Grönblad & Croasdale, 1971, p.15, pl.5, fig.65.

114 μm long; 99 μm broad; isthmus 34 μm broad.

Cells large, a little longer than broad, deeply constricted, sinus open; semicells subtrapeziform, containing several strong spines on the sides and acrobiculations on the median constriction; cell wall finely punctate; each chloroplast with several pyrenoids. (Pl.4, fig.6).

Local distribution: Near Adamjee Paper Mills, Nowshera, Sarim No.308, Jan. 30, 1979.

Geographical distribution: Europe, Africa, Pakistan.

23. C. nymannianum Grun. Rabenh. Flor. Europ. Alg. p.166. 1868.

= Ursinella nymannianum Kuntze, Revis. gen. plant. p.925. 1891.

West & West, vol.2, 105, p.184, pl.62, figs.26, 27;

Taylor, 1934, p.259, pl.48, fig.13; Hirano, 1957, p.128, pl.20, fig.33;

Ochial, 1966, p.120.

44-48 μ m long; 33-36.5 μ m broad; isthmus 7.6-9.6 μ m broad.

Cells rather small, elongate-subhexagonal, about $1\frac{1}{2}$ times longer than broad, deeply constricted, sinus narrowly linear with a dilated extremity; semicells truncate-pyramidal, basal angles rounded, lower half of sides convex, upper half concave; upper angles rounded, apex retuse, in the centre with a large and conspicuous scrobiculation; side view of semicell subcircular; vertical view subrhomboid-elliptic, at the middle on each side thickened and showing the large scrobiculation; cell wall distinctly punctate; chloroplasts axile, each with one pyrenoid. (Pl.5, fig.6, photo.40).

Local distribution: Naguman River, Distt. Peshawar, Sarim No.119, Jan.1, 1977.

Geographical distribution: Europe, Ceylon, U.S.A, Japan. Pakistan.

24. C. obsoletum (Hantzsch) Reinsch, Spec. Gen. Alg. p.142. 1867.

= Arthrodesmus obsoletus Hantzsch in Rabenh. Alg. No.1407, 1862. (Basionym).

= Didymidium (Cosmarium) obsoletum Reinsch, Algenfl. Frank. p.110. pl.9, fig.5, 1867.

= Ursinella obsoleta Kuntze, Revis. gen. plant. p.925. 1891.

= Cosmarium palustre Turn. Freshw. Alg. E. India, p.60, pl.8, fig.65. 1893.

West & West, vol.2, 1905, p.133, pl.56, figs.1-3; Taft, 1939, p.83; Hirano, 1957, p.109, pl.21, fig.4; Scott & Prescott, 1958, p.47, fig.12; Kamiya, 1961, p.42, pl.2, figs.1-7; pl.4, figs. 1,2; pl.7, fig.1; Ochiai, 1966, p.119; Förster, 1969, p.53, pl.15, fig.6; Grönblad & Croasdale, 1971, p.15, pl.5, fig. 53; Hinode, 1971, p.115. pl.8, fig.9; Islam & Zaman, 1975, p.52, pl.7, fig.92; Coesel, 1976, p.66, pl.1, fig.11.

34-46 μm long; 42-54 μm broad; isthmus 15.5-20 μm broad; thickness 20-24 μm .

Cells of medium size, transversely elliptic, a little broader than long, deeply constricted, sinus narrowly linear with a dilated apex; semicells depressed-semicircular, basal angles submamillate and slightly thickened, apex generally slightly flattened; side view of semicell depressed-globose; vertical view elliptic, with obtusely conical poles, cell wall punctate sometimes slightly thickened in the centre of the semicells; chloroplasts axile, each with two pyrenoids. (Pl.5, fig.5, photo.39).

Local distribution: Zoological Gardens Lahore, Tank No.2, Sarim No.46, Oct 20, 1976.

Geographical distribution: Europe, U.S.A, Japan, Bangladesh, Africa, India, Ceylon, Pakistan.

25. C. ovale Ralfs, Brit. Desm. p.98, pl.15, fig.9. 1848.

= C. ovale Hansg. Prodr. Algenfl. Böhm. p.191, fig.113. 1888.

= Pleurotaeniopsis (Cosmaridium) ovalis (Ralfs) De Toni, Syll. Alg. p.912, 1889.

West & West, vol.3, 1908, p.267, pl.92, fig.1; pl.93, fig.1; pl.94, fig.1; Prescott, 1936, p.138, pl.15, figs. 16-17; Irénée-Marie, 1951, p.106; Grönblad, 1956, p.28, figs.61, 62; Fritsch, 1961, fig. 108; Whitford & Schumacher, 1973, p.73, pl.27, fig.3; Parra, 1975, p.40, fig.112.

178-222 μm long; 98-136 μm broad; isthmus 30-47 μm broad; thickness 74-96 μm .

Cells very large $1\frac{3}{5}$ - $1\frac{4}{5}$ times as long as broad, deeply constricted, sinus narrowly linear with a slightly dilated extremity; semicells ovate from a broad, flat base, the upper half considerably more attenuated than the lower half, basal angles rounded, lower half of sides convex, upper half almost straight, apex rounded but always with an indication of being subtruncate, lateral margins with 19-21 large conical granules, and with a somewhat irregular series within the margin, often with quite a number of these large granules within the basal angles, margin of the extreme apex usually smooth but with one or two series of conical granules within; side view of semicell ovate from a broadly rounded base apex rounded; granules forming a broad band extending up the middle from the isthmus to the apex; 4-5 visible at the apical margin, disposition of granules very irregular; vertical view elliptic, cell wall finely scrobiculate, and distinctly thickened in the centre of each semicell; chloroplasts parietal, forming 4-6 broad, irregular bands extending from base to apex of each semicell; Pyrenoids rather small and numerous, 9-11 in each chloroplast. (Pl.5, fig.2, photo.36).

Local distribution: Madain, Distt. Swat, Sarim No.190, Dec. 15, 1978.

Geographical distribution: World wide.

26. C. pachydermum Lund. Desm. Suec. p.39, pl.2, fig.15. 1871.
 = C. pachydermum a. typicum Klebs, Desm. Ostpreuss. p.34, pl.3, fig.36, 1879.
 = Ursinella pachyderma Kuntze, Revis, gen. plant. p.925. 1891.

West & West, vol.2, 1905, p.139, pl.57, fig.7; El-Nayal, 1935, p.51; Grönblad, 1943, p.14; Croasdale, 1956, p.44, pl.3, fig.3; Hirano, 1957, p.112, pl.22, fig.1; Scott & Prescott, 1958, p.48, fig.19; Mattern, 1964, p.25; Förster, 1965, p.144, pl.3, fig.16; Ochlaï, 1966, p.121; Lind, 1967, p.375, pl.6, fig.5; Zwart, 1969, p.169, fig.22, Mix, 1970, p.87, pl.5, fig.7; Förster, 1970, p.314, pl.21, fig. 2; Grönblad & Croasdale, 1971, p.16, pl.5, fig.58; Mix, 1973, p.183, pl.1; fig.1; Whitford & Schumacher, 1973, p.73, pl.30, fig.16; Coesel, 1974, p.364; Werner, 1977, p.58, pl.10, fig.1.

78-117 μm long; 60-87 μm broad; isthmus 30-40 μm broad; thickness 50-59 μm .

Cells large, broadly elliptic, about $1\frac{1}{2}$ times as long as broad, deeply constricted; sinus narrowly linear with a dilated apex; semicells widely semielliptic; apices broad; basal angles broadly rounded, lower part of sides somewhat straight; side view of semicell subcircular; vertical view elliptic; cell wall thick and densely punctate; chloroplasts axile, each with two pyrenoids. (Pl.4, fig.4).

Local distribution: Akbarpura, Distt. Peshawar, Sarim No.30, Sept 25, 1976; Abbottabad, Sarim No.43, Oct. 13, 1976.

Geographical distribution: World wide.

27. C. phaseolus Bréb. ^{ex Ralfs} forma minor Boldt, Siber, Chlorophy.
p.102. 1885.

West & West, vol.2, 1905, p.159, pl.60, fig.15; Irénée-Marie, 1951, p.107; Hirano, 1955, p.39, pl.1, fig.7; Croasdale, 1956, p.104. pl.19, fig.21; Whitford & Schumacher, 1973, p.73, pl.31, fig.17; Hirano, 1977, p.216.

20.4-21 μm long; 18 μm broad; isthmus 5.5-6 μm broad; thickness 11.5-14.4 μm .

Cells small, a little longer than broad, deeply constricted; chloroplast axile with one pyrenoid; semicells reniform and showing typical median protuberance at the middle on each side; cell wall punctate. (Pl.5, fig.12).

Local distribution: Madain, Distt. Swat, Sarim No.190, Dec. 15, 1978.

Geographical distribution: Europe, Siberia, Canada, U.S.A, Japan, Pakistan.

28. C. portianum Arch. in Quart. Jour. Micr. Sci. p.235, pl.11. 1860.
 = C. orbiculatum De Bary, Conj. p.41, pl.6, figs.49, 50. 1858.
 = C. pseudomargaritifera Reinsch, Contrib. Alg. et Fungi, p.84, pl.16, fig.12. 1875.
 = Ursinella portiana Kuntze, Revis. gen. plant. p.925. 1891.
 = Cosmarium portianum Arch. var. orthostichum Schmidle, Alg. Geb. Oberrheins, p.549, pl.28, fig.7. 1894.

Smith, 1924, p.33, pl.57, fig.24; Taft, 1945, p.198, pl.3, fig.22; Croasdale, 1956, p.20, pl.3, figs.1, 7; Croasdale & Grönblad, 1964, p.194, pl.14, fig.4; Ochiai, 1966, p.121, fig.26; Whitford & Schumacher, 1973, p.78, pl.28, fig.2; Parra, 1975, p.40, fig.108; Gough, Gaevin & Woelderling, 1976, fig.4; Werner, 1977, p.58, pl.13, figs. 13, 14; Kusel-Fetzmann, 1977, p.109, fig. 473; Parra & Gonzales, 1977, p.24, fig.131.

40 μ m long; 28 μ m broad; isthmus 10 μ m broad.

Cells small, $1\frac{1}{2}$ times longer than broad, deeply constricted, sinus a semicircular depression with a rounded apex, isthmus elongate; semicells elliptic and with poles quite blunt; semicell outline granulate; vertical view broadly elliptic; lateral view of semicells circular; cell wall granulate, with conspicuous granules arranged in vertical series, chloroplasts axile and

with one pyrenoid. (Pl.5, fig.9).

Local distribution: Multan, Sarim No.252, March 29, 1978.

Geographical distribution: U.S.A, Chile, Europe, Pakistan.

29. C. praemorsum Bréb. Liste Desm. p.128, pl.1, fig.8. 1856.

= C. praemorsum a. gallicum Racib. Desm. Nowe, p.89. 1889.

= Ursinella praemorsa Kuntze, Revis. gen. plant. p.925. 1891.

West & West, vol.3, 1908, p.196, pl.84, figs.1-5;

Croasdale & Grönblad, 1964, p.183, pl.14, fig.7; Förster, 1970, p.314, pl.23, figs.7, 8.

47-55 μm long; 43-51 μm broad; isthmus 14-16 μm broad; thickness 23-29 μm .

Cells of medium size, slightly longer than broad, deeply constricted; semicells widely truncate-subsemicircular, basal angles broadly rounded; sides convex, apex widely truncate or subtruncate, often very slightly convex; apical angles rounded; cell wall somewhat unevenly granulate, each lateral margin with about 8 granules, those nearest the apex being larger than those at the basal angles, apex smooth, with a number of irregularly scattered granules of somewhat variable size within both lateral margins and apex, in the centre of the semicells with a very variable number of large granules irregularly disposed, and sometimes intermingled with a few smaller granules, or occasionally with minute intergranular scrobiculations, generally with a fairly clear area on each side of the isthmus; side view of semicell subcircular or widely obovate-circular; vertical view elliptic, granules at the middle on each side rather more prominent than the others; chloroplasts axile, with two pyrenoids. (Pl.5, fig.8).

Local distribution: Madain, Distt. Swat, Sarim No.190, Dec 15, 1978.

Geographical distribution: Europe, Africa, U.S.A, Pakistan.

30. C. pseudamoenum Wille, Sydamerik. Algfl. p.18, pl.1, fig.37. 1884.
 = C. Inornatum Josh. Burmese Desm. p.648, pl.24, figs.26, 27. 1886.
 = Ursinella pseudamoena Kuntze, Revis. plant. p.925. 1891.
 = Dysphinctium pseudamoenum Schmidle, Beitr. Algenfl. Schwarzwald. u. Rheineb. p.92, pl.4, figs.4, 5. 1893.

West & West, vol.4, 1912, p.31, pl.120, figs.7-9; Cedercreutz, 1941, p.25; Hirano, 1956, p.93, pl.18, fig.5; Mattern, 1962, p.244, fig.10; Mattern, 1964, p.250; Dubois-Tylski, 1969, p.320, pl.1, fig.17; Werner, 1977, p.58, pl.6, fig.5.

44-59 μ m long; 18-29 μ m broad; isthmus 15-24 μ m broad; thickness 21-25 μ m.

Cells somewhat small, about twice as long as broad, almost cylindrical, only slightly constricted, sinus a small and open notch; semicells oblong with the sides straight or very slightly convex, apex broadly rounded or faintly truncate in the middle; cell wall uniformly granulate, granules small and rather variable in disposition and not infrequently in decussating oblique series; side view of semicell oblong with a rounded apex; vertical view subcircular-elliptic; chloroplasts axile, with one pyrenoid in each semicell. (Pl.4, fig.11, photo.33).

Local distribution: Akbarpura, Distt. Peshawar, Sarim No.30, Sept. 25, 1976.

Geographical distribution: Europe, Japan, Burma, Pakistan.

31. C. pseudobroomei Wille, Bull. Torr. Bot. Club, p.16, pl.44, fig.36. 1884.
 = C. broomei Ralfs, Brit. Desm. pl.33, fig.7. 1848.

West & West, vol.4, 1912, p.22, pl.100, figs.7, 8; pl.103, fig.7; Thompson, 1938, p.42, pl.9, fig.20; Scott & Prescott, 1958, p.50, pl.12, fig.23; Lind, 1967, p.376, pl.94, fig.3; Hinode, 1971, p.117, pl.9, fig.8; Grönblad & Croasdale, 1971, p.16, pl.8, fig.109;

Kusel-Fetzmann, 1977, p.109, fig.476.

33-38 μm long; 29-36 μm broad; isthmus 8-12 μm broad; thickness 16-17.5 μm .

Cells small, about as long as broad, deeply constricted, sinus narrowly linear with a dilated extremity; semicells oblong-rectangular with the angles slightly rounded; sides very slightly convex; side view of semicells subcircular; vertical view oblong, with subparallel sides, cell wall granulate; granules small and solid; chloroplast axile with two pyrenoids in each semicell. (Pl.5, fig.4, photo.38).

Local distribution: Haleji lake, Sind, Sarim No.275, April, 7, 1978.

Geographical distribution: World wide.

32. C. pseudopyramidatum Lund. Desm. Suec. p.41, pl.2, fig. 18. 1971.
 = C. pyramidatum Bréb. in Ralfs Brit. Desm. p.94, pl.15, fig.4. 1848.
 = C. pyramidatum Bréb. var. minus Reinsch in Rabenh. Alg. fig.6. 1868.
 = Enastrum (Cosmarium) pseudopyramidatum Gay, Monogr. loc. Conj. p.60. 1884.
 = Ursinella pseudopyramidata Kuntze, Revis. gen. plant. p.925. 1891.

West & West, vol.2, 1905, p.201, pl.64, figs. 9-12;
 Taylor, 1934, p.261, pl.51, fig.22; Grönblad, 1943, p.14, pl.1, fig.17; Croasdale, 1956, p.48, pl.7, fig.7; Hirano, 1957, p.134, pl.23, figs.5, 8; Fritsch, 1961, fig.108; Croasdale & Grönblad, 1964, p.184, pl.12, fig.5; Prescott, 1966, p.21, pl.4, fig.25; Ochiai, 1966, p.121; Lind, 1967, p.376, pl.6, fig.6; Eloranta, 1968, p.62, fig.31; Grönblad, Scott & Croasdale, 1968, p.19, fig.83; Dubois-Tylski, 1969, p.320, pl.1, fig.21; Forster, 1970, p.315, pl.21, fig.; Hinode, 1971, p.117, pl.8, figs. 1-3; Hosiaisloma, 1975, p.12; Parra, 1975, p.40, fig.119; Werner, 1977, p.59, pl.13,

figs. 10-12; Parra & Gonzales, 1977, p.24, fig.122; Prasad & Mehrotra, 1977, p.349, fig.23.

43-50 μm long; 25-33 μm broad; isthmus 7-10.5 μm broad; thickness 7-19.5 μm .

Cells of moderate size, about $1\frac{1}{2}$ times as long as broad, deeply constricted, sinus narrowly linear; semicells truncate-semielliptical, basal angles rounded, sides convex and converging to apex which is narrowly truncate, upper angles obtuse; side view of semicell broadly elliptic; vertical view elliptic; cell wall distinctly punctate; chloroplasts axile, each with one pyrenoid. (Pl.4, fig.9).

Local distribution: Nowāhera, Sarim No.20, Sept. 6, 1976; Gandi Garden, Karachi, Sarim No.251, March 28, 1978.

Geographical distribution: World wide.

33. G. pyramidatum Bréb. ex Ralfs, Brit. Desm. p.94, pl.15, fig.4. 1848.
 = Didymidium (Cosmarium) pyramidatum Reinsch, Algenfl. Frank. p.107. 1867.
 = Cosmarium pyramidatum b. typicum Klebs, Desm. Ostpreuss. p.31, pl.3, fig.18. 1879.
 = Ursinella pyramidata Kuntze, Revis. gen. plant. p.925. 1891.

West & West, vol.2, 1905, p.199, pl.64, figs. 5-7;
 Taylor, 1934, p.264, pl.68, fig.17; pl.50, figs.15, 16; Croasdale, 1956, p.48, pl.7, fig.6; Hirano, 1957, p.135, pl.23, figs. 10-12; Croasdale, 1965, p.64, fig.115; Prescott, 1966, p.21, pl.4, fig.37; Ochiai, 1966, p.121; Mattern, 1966, fig.9; Eloranta, 1968, p.63, fig.34; Dubois-Tylski, 1969, p.320, pl.1, fig.22; Hinode, 1971, p.117, pl.8, fig.5; Whitford & Schumacher, 1973, p.73, pl.30, fig.8; Werner, 1977, p.59, pl.13, figs. 1-9; Parra & Gonzales, 1977, p.24, fig.122.

58-100 μm long; 42-62 μm broad; isthmus 17.5-20 μm broad; thickness 26.5-36 μm .

Cells large, about $1\frac{1}{2}$ times as long as broad, truncate-elliptic in outline, deeply constricted, sinus very narrow and dilated towards the apex; semicells truncate-pyramidal, basal angles rounded, sides convex and in the upper part converging, upper angles obtuse, apex narrowly truncate; side view of semicell elliptic-oblong; cell wall minutely scrobiculate; chloroplasts axile, each with two pyrenoids. (Pl.4, fig.7, photo.32).

Local distribution: Akbarpura Distt. Peshawar, Sarim No.30, Sept. 25, 1976.

Geographical distribution: World wide.

34. C. quadratum Ralfs var. willei West & West, Brit. Desm. vol.3, p.59, pl.87, fig.21. 1908.

= C. quadratum Ralfs forma semicellulae Wille, Ferskv. Alg. Nov. Seml. p.37, pl.12, fig.21. 1879.

= Dysphinctium quadratum (Ralfs) Hansg. var. willei Schmidle, Beitr. Algenfl. Schwarzwald. u. Rheineb. p.91, pl.4, fig.1 1893.

Croasdale, 1956, p.49, pl.9, fig.12; Hirano, 1957, p.144, pl.24, fig.23; Forster, 1965, p.147, pl.4, fig.7; Förster, 1970, p.317, pl.21, figs. 7-11; Croasdale, 1973, p.101, pl.13, fig.13; Gayoso, 1976, p.91, fig.11; Werner, 1977, p.60, pl.12, figs.1-4; Parra & Gonzales, 1977, p.24, fig.116; Watanabe, 1978, p.116, pl.2, fig.9.

50-76 μm long; 30-46 μm broad; isthmus 16.8-27 μm broad; thickness 27-36 μm .

Sides of semicells straight or slightly convex; apex usually convex, sinus narrow at the apex but open towards the exterior; semicells subquadrate, cell deeply constricted; cell wall smooth; chloroplast axile. (Pl.4, fig.5, photo.31).

Local distribution: Gandi Garden Karachi, Sarim No.251, March 28, 1978.

Geographical distribution: World wide.

35. C. raeticum Messik. in Viertelj. Naturf. Ges. Zurich. p.80, fig.49.
1935.

Hirano, 1957, p.138, pl.23, fig.13.

16.8-25 μ m long; 14.8-21 μ m broad; isthmus 5-6 μ m broad.

Cells small, a little longer than broad, slightly constricted, sinus linear; semicells subpyramidal, margins undulate; apex truncate, vertical view elliptic, lateral view subcircular; cell wall smooth. (Pl.6, fig.11, photo.45).

Local distribution: Haleji Lake, Sind, Sarim No.275,
April 7, 1978.

Geographical distribution: Europe, Japan, Pakistan.

36. C. ralfsii Bréb. ^{ex Ralfs} / var. montana Racib. Nonn. Desm. Polon. p.70,
pl.10, fig. 4, 1885.

West & West, vol.2, 1905, p.142, pl.58, fig.3; Taylor, 1934,
p.264, pl.41, fig.1.

87-128 μ m long; 76-101 μ m broad; isthmus 20-23 μ m broad.

Cells large, subcircular, a little longer than broad, deeply constricted, sinus opening outwards, semicells subpyramidal—semicircular; basal angles of semicells less rounded and slightly produced; side view of semicell subcircular; vertical view rhomboid-elliptic, cell wall smooth, chloroplasts parietal, consisting of several irregular bands running from base to apex of each semicell, each band with several pyrenoids. (Pl.5, fig.3, photo.37).

Local distribution: Kalri Lake, Sind, Sarim No.278,
April 9, 1978.

Geographical distribution: Europe, Japan, Pakistan.

37. C. rectangulare Grun. var. hexagonum (Elfv.) West & West, Brit.
Desm. vol.3, p.56, pl.70, fig. 4. 1908.

- = C. hexagonum Elfv. Anteck, Finska Desm. p.12, pl.1, fig.8. 1881 (Basionym).
- = C. elfvingii Racib. Nonn. Desm. Polon. p.83. 1885.
- = Ursinella elfvingii Kuntze, Revis. gen. plant. p.924. 1891.

Taylor, 1934, p.265, pl.51, fig.17.

28-30 μm long; 24-27 μm broad; isthmus 7-8 μm broad; thickness 15 μm .

Cells small, about as long as broad, deeply constricted; semicells subhexagonal-reniform; cell wall punctate. (Pl.6, fig.13).

Local distribution: Multan, Sarim No.252, March 29, 1978.

Geographical distribution: Europe, U.S.A., Pakistan.

38. C. sphaeroideum West, Alg. W. Ireland, p.153, pl.21, fig.8. 1892.

West & West, vol.3, 1908, p.178, pl.82, figs. 2-4.

60-63 μm long; 38-40 μm broad; isthmus 15-20 μm broad; thickness 27-31 μm .

Cells of medium size, about $1\frac{1}{2}$ times as long as broad, deeply constricted; sinus narrow and short, but not completely closed; semicells subcircular-obovate, with the widest part about two-thirds the distance from the base, basal part truncately flattened, lower parts of sides slightly convex and diverging upwards, upper parts very broadly rounded, apex in the middle truncate. side view of semicell elliptic; vertical view broadly elliptic; cell wall granulate, granules large and flattened; chloroplasts axile, with two pyrenoids. (Pl.6, fig.12).

Local distribution: Wah stream No.2, Sarim No.37, Oct. 6, 1976.

Geographical distribution: Europe, Pakistan.

39. C. subcucumis Schmidle, Beitr. Algenfl. Schwarzwld. u. Rheineb. p.98, p.4, fig.20. 1893.

West & West, vol.2, 1905, p.155, pl.60, figs. 1-3;

Taylor, 1934, p.267, pl.50, fig.11; Taft, 1945, p.199, pl.4, fig.11; Taft, 1948, p.87; Irénée-Marie, 1951, p.118; Croasdale, 1956, p.53, pl.4, fig.1; Grönblad, 1956, p.28, fig.56; Hirano, 1957, p.119, pl.18, fig.13; pl.19, fig.28; Grönblad, 1960, p.41; Groasdale & Grönblad, 1964, p.187, pl.10, fig.14; Ochiai, 1966, p.122; Zwart, 1969, p.169, fig.10; Förster, 1970, p.321, pl.11, figs.4, 5; Whitford & Schumacher, 1973, p.74; fig.11; Werner, 1977, p.61, pl.10, fig.6; Hirano, 1977, p.219.

54-78 μm long; 36-45 μm broad; isthmus 15-19 μm broad; thickness 23-26 μm .

Cells large, broadly elliptic, about $1\frac{2}{5}$ to $1\frac{3}{4}$ times as long as broad, deeply constricted, sinus linear and dilated towards the extremity, semicells semielliptic, basal angles rounded, apex convex or somewhat flattened; side view of semicell broadly elliptic; vertical view elliptic; cell wall smooth; chloroplasts axile, each with two pyrenoids. (Pl.4, fig.10).

Local distribution: Akbarpura, Distt. Peshawar.

Sarim No. 30, Sept. 25, 1976.

Geographical distribution: World wide.

40. C. subreinschii Schmidle var. ocellatum West & West in Trans.

Linn. Soc. Bot. p.6, fig. 165. 1902.

Hirano, 1957, p.163, pl.25, fig.39.

21.5 μm long; 138 μm broad, isthmus 4.3 μm broad.

Cells small, a little longer than broad, deeply constricted, sinus narrow with a slightly dilated extremity; cells pyramidal-rectangular, semicells

subrectangular; apex truncate-convex; each semicell with one pyrenoid, cell wall punctate, (Pl.5, fig.13).

Local distribution: Khawashki Lake near Nowshera, Distt. Peshawar, Sarim No.200, Jan.2, 1979.

Geographical distribution: Japan, Ceylon, Pakistan.

41. C. tetrachondrum Lund. Desm. Suec. p.38, pl.3, fig.2. 1871.

= Ursinella tetrachondra Kuntze, Revis, gen. plant. p.925. 1891.

West & West, vol.2, 1905, p.175, pl.62, fig.1.

20.5 μm long; 23-26.3 μm broad; isthmus 6-7 μm broad; thickness 10.7 μm .

Cells small, about $1\frac{1}{3}$ times as broad as long, deeply constricted, sinus very narrow and linear; semicells very depressed-subsemicircular, basal angles rounded, apex truncate-convex, with a granule just above and near the extremity of each linear sinus; side view of semicell circular with a basal granule on each side; vertical view elliptic; cell wall smooth; chloroplasts axile with only one pyrenoid. (Pl.4, fig.13).

Local distribution: Malmandi Peshawar, Sarim No.316, Feb. 2, 1979.

Geographical distribution: Europe, Russia, Pakistan.

42. C. tetraophthalmum Bréb. ex Ralfs, Brit. Desm. p.98, pl.17, fig. 1. 1848

= Didymidium (Cosmarium) tetraophthalmum Reinsch, Algenfl. Frank. p.121. 1867.

= Cosmarium tetraophthalmum forma Lund. Desm Suec. p.27. 1871.

= C. tetraophthalmum Bréb. var. lundellii Wittr. Gotl. Öf. söt. Alg. p.56. 1872.

= Ursinella tetraophthalma Kuntze, Revis. gen. plant. p.925. 1891.

West & West, vol.3, 1908, p.270, pl.95, figs. 4-7;

Taylor, 1934, p.269, pl.52, fig.11; Prescott, 1936^{PM}; Irénée-Marie, 1949, p.275, pl.2, fig.20; Irénée-Marie, 1951, p.121; Grönblad, 1952, p.79;

Croasdale, 1956, p.57, pl.17, fig.1; Croasdale & Grönblad, 1964, p.188, pl.15, fig.4; Förster, 1965, p.151, pl.6, fig.16; Croasdale, 1965, p.326, pl.5, fig.21; Ochiai, 1966, p.120; Zwart, 1969, p.170, figs.86-87; Mix, 1970, p.87, pl.5, fig.12; Förster, 1970, p.322, pl.23, figs. 15, 16; Croasdale, 1973, p.108, pl.17, fig.1; Werner, 1977, p.62, pl.10, fig.2; Hirano, 1977, p.218.

90-120 μm long; 70-86 μm broad; isthmus 18-30 μm broad; thickness 42-51 μm .

Cells large, about $1\frac{1}{2}$ times as long as broad, deeply constricted, sinus narrowly linear with a dilated extremity; semicells pyramidal-ovate, basal angles very broadly rounded, sides slightly convex, extreme apex truncate and the apical angles rounded; cell wall granulate, with 12-14 large, rather flattened granules along each lateral margin; extreme apex smooth, granules within the margin large and more or less scattered with indications of both oblique and concentric arrangements, with a gradual reduction of granules towards the centre of the semicell, where they are quite small, and also with a considerable reduction of the granules within the smooth apex; side view of semicell almost circular; vertical view elliptic and within the poles strongly granulate, also granulate within the sides, at the middle of each side and in the centre destitute of granules; chloroplasts axile, each with two large pyrenoids. (Pl.5, fig.7).

Local distribution: Islamabad, Sarim No.150, March 11, 1977.

Geographical distribution: World wide.

43. C. turgidum Bréb. ex Ralfs, Brit. Desm. p.110, pl.32, fig.8. 1848.
 = Pleurotaenium turgidum De Bary, Conj. p.75, pl.5, fig. 31. 1858.
 = Dysphinctium turgidum Grun. in Verh. d. zool. bot. Ges. Wien. 1858.
 = Docidium turgidum Wittr. Skandinay. Desm. p.20. 1869.

- = Calocylindrus turgidus (Bréb.) Kirchn. Alg. Schles. p.142. 1878.
- = Cosmarium debaryi c. turgidum klebs, Desm. Ostpreuss. p.28. 1879.
- = Cosmaridium turgidum Hansg. Prodr. Algenfl. Böhm. p.245. 1888.
- = Pleurotaeniopsis turgidus (Bréb.) De Toni, Syll. Alg. p.907. 1889.

West & West, Vol.3, 1908, p.115, pl.75, figs.1-3; Hirano, 1956, p.87, pl.17, fig.15; Kamiya, 1961, p.42, pl.5, fig.3; Fritsch, 1961, fig.107; Kamiya, 1962, p.43, pl.1, figs.1-4; Mori, 1962, p.9, fig.8; Werner, 1977, p.62, pl.14, fig.1; pl.29, fig.1,

184-220 μ m long; 88-100 μ m broad; isthmus 70-84 μ m broad.

Cells very large, 2-2½ times as long as broad, slightly constricted, sinus a rounded notch; semicells ovate-truncate from a broad base, lower angles slightly rounded, sides convex and converging upwards, apex truncately rounded; vertical view circular; cell wall minutely scrobiculate; chloroplasts parietal, in the form of somewhat irregular longitudinal bands, 8 in each semicell, with several pyrenoids in each. (Pl.4, fig.2, photo.30).

Local distribution: Akbarpura, Distt. Peshawar, Sarim No.30, Sept. 25, 1976.

Geographical distribution; World wide.

CHARACTERS OF CLOSTERIUM

4. CLOSTERIUM Nitzsch ex Ralfs, Brit. Desm. p.159. 1848.

Cells greatly elongated and always, usually markedly, attenuated; ^{solitary} in most cases curved, rarely straight; without a median constriction; cell wall ^ucolorless or yellow to brown in colour; smooth or with longitudinal striae that are usually ridges but may be series of granules; commonly with one or more transverse lines at middle of cell or at different points along the cell; cells with a single chloroplast in each semicell that is either entire or with longitudinal ridges radiating from a comparatively slender central

axis; generally with a single axile row of pyrenoids, more rarely with pyrenoids scattered throughout chloroplast; cell apices hyaline in portion not occupied by chloroplasts and with a conspicuous vacuole that contains one or more granules that show a constant motion.

KEY TO THE TAXA

1. Cells straight.....2
1. Cells slightly curved.....3
1. Cells strongly curved.....6
 2. Cell 6-7 times longer than broad....Cl. lunula
 2. Cell 25-36 times longer than broad...Cl. setaceum
 2. Cell 37-40 times longer than broad...Cl. gracile
 2. Cell 85-95 times longer than broad...Cl. aciculare
3. Pyrenoids definite in number.....4
3. Pyrenoids variable in number.....5
 4. Pyrenoids 5 in number,
cell 12-15.5 μ m broad.....Cl. abruptum
 4. Pyrenoids 5 in number,
cell 17.5-22.5 μ m broad.....Cl. littorale
 4. Pyrenoids 6 in number
cell 16-31 μ m broad.....Cl. intermedium
 4. Pyrenoids 6 in number,
cell 33-50 μ m broad.....Cl. moniliferum
 4. Pyrenoids 7 in number,
cell 41.4-55 μ m broad.....Cl. moniliferum var. concauum
 4. Pyrenoids 8 in number,
cell 14-18.5 μ m broad.....Cl. striosum
 4. Pyrenoids 8 in number,
cell 35-45 μ m broad.....Cl. attenuatum
 4. Pyrenoids 16 in number,
cell 72-137 μ m broad.....Cl. ehrenbergii
5. Pyrenoids 1-3 in number,
cell wall colourless.....Cl. tumidum
5. Pyrenoids 4-5 in number,
cell wall straw coloured.....Cl. rostratum

- 5. Pyrenoids 5-7 in number,
cell wall brown..... Cl. baillyanum
- 5. Pyrenoids 5-7 in number,
cell wall yellowish-brown..... Cl. striolatum
- 5. Pyrenoids 6-7 in number,
cell wall reddish-brown..... Cl. costatum
- 5. Pyrenoids 7-11 in number,
cell wall colourless..... Cl. acerosum
- 5. Pyrenoids 8-11 in number, cell
wall yellowish-brown..... Cl. acerosum var. elongatum
- 5. Pyrenoids 9-11 in number,
cell wall reddish-brown..... Cl. lineatum
- 5. Pyrenoids 15-30 in number,
cell wall yellowish-brown..... Cl. turgidum var. giganteum
- 6. Cell 5-7 times longer than broad... Cl. incurvum
- 6. Cell 8-9 times longer than broad... Cl. venus
- 6. Cell 10 times longer than broad.... Cl. diana var. arcuatum

DESCRIPTION OF THE PLANTS

1. Closterium abruptum W. West, Alg. Eng. Lake Distr. p.719, pl.9,
fig.1. 1892.

West & West, vol.1, 1904, p.158, pl.20, figs.6-10; Taylor, 1934, p.242, pl.66, fig.9; Cedercreutz & Grönblad, 1936, p.1; Scott, Grönblad & Croasdale, 1965, p.27, fig.17; Webber, 1967, p.57; Lenzenweger, 1970, p.256, pl.12, fig.2; Whitford & Schumacher, 1973, p.65, pl.20, fig.4; Hosiaisloma, 1975, p.12; Růžická, 1975, p.197, figs.1,2; Sarim & Faridi, 1976, p.10, fig.19; Parra & Gonzales, 1977, p.16, fig.48; Růžická, 1977, p.222, pl.33, figs.20-24.

127-156 μ m long; 12-15.5 μ m broad; apices 6-7 μ m. broad.

Cells small, about 10 times longer than broad, slightly curved; outer margin about 55° of arc, median portion of cells almost straight, more curved towards the extremities, gradually but slightly attenuated towards the apices, which are broad and truncate; cell wall

smooth, colourless or straw coloured; chloroplasts with about six ridges and containing a central row of 5 pyrenoids; terminal vacuole with one large moving granule. (Pl.7, fig.8, photo.52).

Local distribution: Akbarpura, Distt. Peshawar, Sarim No.30, Sept. 25, 1976.

Geographical distribution: Europe, U.S.A., Pakistan, Chile.

2. Cl. acerosum (Schrank) Ehr. ex Ralfs, Brit. Desm. p.164, pl.27, fig.2. 1848.
- = Vibrio acerosus Schrank, p.47. 1803.
- = Cl. acerosum a. majus Reinsch. Algenfl. Frank. p.186. 1867.
- = Cl. acerosum a. typicum Klebs, Desm. Ostpreuss. p.7, pl.1, fig.6. 1879.
- = Cl. acerosum var. truncatum Gutw. Wahr. d. Priortat, p.66, 1890.
- = Arthrodia acerosa Kuntze, Revis. gen. plant. p.883. 1891.

West & West, vol.1, 1904, p.146, pl.18, figs.2-5; Smith, 1924, p.10, pl.53, fig.1; Taylor, 1934, p.242, pl.65, fig.20; Thompson, 1938, p.41, pl.9, fig.1; Taft, 1945, p.186, pl.1, fig.8, Smith, 1950, p.316, fig.226; Hughes, 1951, p.269, figs. 1a, 1b; Tiffany & Britton, 1952, p.169, pl.52, fig.550; Hirano, 1955, p.51, pl.8, fig.12; Croasdale, 1955, p.521, pl.7, fig.1; Scott & Prescott, 1958, p.22, fig.1; Fritsch, 1961, fig.109M; Croasdale, 1962, p.18, pl.1, fig.15; Kies, 1962, p.5; Croasdale & Grönblad, 1954, p.152, pl.3, fig.17; Förster, 1964, p.45, pl.1, fig.3, Chardard, 1965, p.2, pl.12; Croasdale, 1965, p.305, pl.1, fig.27; Chardard, 1966, p.336, pl.15, Prescott, 1966, p.4, pl.1, figs.1, 2; Lind, 1967, p.395, pl.1, figs.3, 3a, 4; Yeh & Gibor, 1970, p.47, fig.4; Islam, 1970, p.909, pl.6, figs. 1-3; Chardard & Heim, 1971, p.569, pl.1; Tassigny, 1971, p.408, fig.1; Rivera, Parra & Gonzales, 1973, p.56, pl.11, fig.5; Chardard, 1973, p.59, pl.7; Croasdale, 1973, p.74, pl.11, fig.9; Tassigny, 1973, p.283; Whitford & Schumacher, 1973, p.66, pl.19, fig.3; Watanabe,

1974, p.219, pl.3, fig.n; Islam & Zaman, 1975, p.50, pl.4, fig.32; Islam, 1975, p.32, pl.2, figs.15, 16; Růžicka, 1975, p.199; Parra, 1975, p.28, fig.17; Sarim & Faridi, 1976, p.10, fig.18; Chardard, 1977, p.241, figs.9, 10; Parra & Gonzales, 1977, p.16, fig.45; Růžicka, 1977, p.154, pl.18, figs.1-4; Prasad & Mehrotra, 1977, p.50, fig.4.

300-460 μ m long; 26-48 μ m broad.

Cells large, 8-16 times longer than broad, slightly curved, narrowly fusiform; outer margin slightly curved, about 10° - 20° of arc, inner margin almost straight or slightly convex; semicells gradually tapering to the apices, which are narrow and rounded-truncate, often slightly thickened; cell wall colourless and smooth, in older individuals becoming yellowish-brown and very delicately striolate; chloroplasts ridged, with a median series of 7-11 pyrenoids; terminal vacuoles with a number of moving granules. (Pl.8, fig.7, photo.59).

Local distribution: Azakhel Water lodged pool, Distt. Peshawar, Sarim No.156, March, 16, 1977.

Geographical distribution: World wide.

3. Cl. acerosum (Schrank) Ehr. ex Ralfs var. elongatum Bréb. Liste Desm. p.152. 1856.
- = Cl. acerosum B Ralfs, Brit. Desm. p.164, pl.27, fig.2. 1848.
- = Cl. acerosum var. acerosum Cooke, Brit. Desm. p.21, 1886.
- = Cl. acerosum (Schrank) Ehr. ex Ralfs forma elongatum (Bréb.) Kosinskaja, 1960. (vide, Růžicka, 1977).

West & West, vol.1, 1904, p.148, pl.18, fig.1; Taylor, 1934, p.242, pl.65, fig.23; Hughes, 1951, p.270, figs.2a, 2b; Tibor, 1959, p.513, figs.38, 39; Förster, 1970, p.279, pl.2, fig.19; Werner, 1977, p.39, pl.2, figs.13-15; Růžicka, 1977, p.158, pl.18, fig.10.

525-790 μm long; 29-50 μm broad;

Cells large, relatively a little longer, and with the striolations of the cell wall more distinct; cell wall of yellowish-brown colour; chloroplast ridged with a median series of about 8-11 pyrenoids. (Pl.7, fig.11).

Local distribution: Madain, Distt. Swat, Sarim No.190, Dec. 15, 1978.

Geographical distribution: Europe, U.S.A, Pakistan, *Russia*.

4. Cl. aciculare Tuffen West, Rem. Diat. Desm. p.153, pl.7, fig.16. 1860.

= Arthrodia acicularis Kuntze, Revis. gen. plant. p.883. 1891.

= Closterium gracile Bréb. forma gracillim West, Alg. W. Ireland, p.122, pl.19, fig.15. 1892.

= Cl. subpronum West & West, 1894. (vide, Růžicka, 1977).

West & West, vol.1, 1904, p.174, pl.21, figs.18, 19;
Smith, 1924, p.11; Scott & Prescott, 1958, p.22, pl.1, fig.1;
Förster, 1969, p.19, pl.2, fig.20; Förster, 1970, p.279, pl.2, fig.1; Watanabe, 1974, p.26, fig.3; Uherkovich, 1975, p.28; Compere, 1977, p.86, fig.316; Růžicka, 1977, p.108, pl.8 figs.21, 24; Kusel-Fetzmann, 1977, p.86, fig.316; Scharf, 1979, p.32, pl.2, figs.1-4.

440-590 μm long; 5-7 μm broad.

Cells very narrow and greatly elongated, 85-95 times longer than broad, almost straight for above half their length, very gradually attenuated from the middle to the apices, which are slightly incurved, acute or acutely rounded and very narrow; cell wall smooth and colourless; chloroplasts with from 6 to 8 pyrenoids; terminal vacuoles very long and containing one or two moving granules. (Pl.8, fig.5).

Local distribution: Islamabad, Sarim No.150, March 11, 1977.

Geographical distribution: Europe, Japan, U.S.A, Pakistan, Australia.

5. Cl. attenuatum Ehr. ex Ralfs, Brit. Desm. p.169, pl.29, fig.5. 1848.

= Cl. attenuatum Ehrenb. Infus. p.94, pl.6, fig.4. 1838.

= Cl. candianum Delp. Desm. subalp. p.104, pl.17, fig.7. 1877.

= Arthrodia attenuata Kuntze, Revis. gen. plant. p.883. 1891.

West & West, vol.1, 1904, p.169, pl.22, figs.1-3; Hirano, 1955a, p.40, pl.8, fig.1; Grönblad, Scott & Croasdale, 1968, p.9, fig.22; Dubois-Tylski, 1969, p.319, pl.2, fig.5; Lenzenweger, 1970, p.258, pl.12, fig.10; Förster, 1970, p.281, pl.5, fig.3; Růžická, 1975, p.200, fig.8; Werner, 1977, p.40, pl.3, fig.9; Růžická, 1977, p.193, pl.26, figs.1-8.

432-528 μ m long; 35-45 μ m broad.

Cells large, 11-14 times longer than broad, slightly curved, outer margin 45° of arc, inner margin not tumid, gradually attenuated towards each extremity, near the apices rather suddenly narrowed into an obtuse cone; cell wall striated, from 17-24 striae visible across the cell, brown or reddish-brown in colour; chloroplast ridged with 7 pyrenoids in a central series; terminal vacuoles with a large number of moving granules. (Pl.7, fig.6, photo.51).

Local distribution: Gandi Garden, Karachi, Sarim No.251, March 28, 1978.

Geographical distribution: World wide.

6. Cl. baillyanum (Bréb.) Bréb. Liste Desm. p.151. 1856.

Grönblad, 1919, p.10, pl.1, fig.19; Prescott, 1941, p.25, pl.1, figs.3-5; Grönblad, 1948, p.403, fig.2; Hughes, 1951, p.272, fig.9; Hirano, 1955a, p.39, pl.5, fig.5; Croasdale, 1955, p.522, pl.4, fig.9; Croasdale & Grönblad, 1964, p.154, pl.4, fig.18; Scott, Grönblad & Croasdale. 1965, p.27, fig.18; Eloranta, 1968, p.64,

fig.67; Hinode, 1971, p.103, pl.3, figs.3,4; Růžicka, 1975, p.201, figs.11, 13, 17; Hinode, 1977, p.75, figs.3, 8, 9; Růžicka, 1977, p.179, pl.23, figs.1-6.

432-736 μm long; 42-48 μm broad; apex 26 μm broad.

Cells large, 10 times longer than broad, slightly curved, gradually attenuated at poles; poles wide and truncate-rounded; cell wall brown and punctate, darker at each apex; each chloroplast with 5-7 pyrenoids, terminal vacuoles with several moving granules. (Pl.8, fig.1).

Local distribution: Madain, Distt. Swat, Sarim No.190, Dec.15, 1978.

Geographical distribution: Europe, Africa, India, U.S.A, Japan, Pakistan.

7. Cl. costatum Corda ex Ralfs, Brit. Desm. p.170, pl.29, fig.1. 1848.
- = Cl. costatum Corda, in Alm. de Carlsbad, p.185, pl.5, fig.61. 1834.
- = Cl. doliolatum Bréb. in Cheval microscop. et usage, Paris, p.272. 1839.
- = Cl. turgidulum Kg. Phycol. germ. p.132. 1845.
- = Cl. dilatatum Kg. Phycol. germ. p.132. 1845.
- = Cl. striolatum b. costatum Klebs, Desm. Ostpreuss. p.14, 1879.
- = Cl. costatum Corda ex Ralfs. var. subtumidum Racib. 1889. (vide, Růžicka, 1977).
- = Arthrodia costata Kuntze, Revis. gen. plant. p.883. 1891.
- = Cl. costatum Corda ex Ralfs var. multinucleatum Defland. 1924. (vide, Růžicka, 1977).
- = Cl. Costatum Corda ex Ralfs var. dilatatum (West & West) Krieger, 1935. (vide, Růžicka, 1977).

West & West, vol.1, 1904, p.120, pl.13, figs.1-3;
 Grönblad, 1945, p.55, pl.1, fig.1; Hughes, 1951, p.272; Hirano,
 1955, p.53, pl.8, fig.5; Croasdale, 1955, p.522, pl.4, fig.13;
 Mattern, 1962, fig.13; Mattern, 1964, p.249; Croasdale & Grönblad,
 1964, p.154, pl.4, figs.13, 13a; Dubois-Tylski, 1969, p.319, pl.2,
 fig.7; Mix, 1970, p.79, pl.3, fig.7; Lenzenweger, 1970, p.257,
 pl.12, fig.7; Förster, 1970, p.281, pl.8, figs. 1,2; Whitford &
 Schumacher, 1973, p.66, pl.18, fig.22; Růžicka, 1975, p.204,
 figs. 25-28; Parra & Gonzales, 1977, p.16, figs.66-69; Růžicka, 1977,
 p.195, pl.27, figs.1-6.

340-405 μ m long; 48-66 μ m broad.

Cells of medium size, 6-10 times longer than broad,
 slightly curved, outer margin from 90° to 98° of arc, gradually
 attenuated towards the apices which are rounded, truncately
 rounded or rounded conical; cell wall reddish-brown, costate, with
 6-8 costae visible across the cell; each chloroplast with 6-7
 pyrenoids in one axile series; terminal vacuoles with numerous
 moving granules. (Pl.7, fig.18, photo.57).

Local distribution: Tangi, Charssadda, Sarim No.28,
 Sept. 20, 1976.

Geographical distribution: World wide.

8. Cl. diana Ehr. ex Ralfs var. arcuatum (Bréb.) Rabenh.

Flor. Europ. Alg. p.133. 1868.

= Cl. arcuatum Bréb. ex Ralfs, Brit. Desm. p.219. 1848. (Basionym).

West & West, vol.1, 1904, p.131, pl.15, figs.21,22;
 Hughes, 1951, p.276, fig.56; Scott & Prescott, 1958, p.23, pl.1,
 fig.4; Croasdale & Grönblad, 1964, p.154, pl.3, figs.4,5;
 Croasdale, 1965, p.305, pl.1, fig.24; Förster, 1970, p.282,
 pl.3, fig.14; Yacubson, 1974, p.109, pl.5, fig.41; Whitford &
 Schumacher, 1973, p.66, pl.20, fig.15; Růžicka, 1977, p.134.
 pl.13, figs.19-21

129-290 μm long; 18-25 μm broad; apices 6-7 μm broad.

About 10 times longer than broad, slightly smaller and more strongly curved, than the species; outer margin 140° - 152° of arc; cell wall of a pale yellow colour. (Pl.8, fig.4, photo.58).

Local distribution: Pirbaba, Buner, Sarim No.199,
Dec. 30, 1978.

Geographical distribution: World wide.

9. Cl. ehrenbergii Menegh. ex Ralfs, Brit. Desm. p.166, pl.28, fig.2. 1848.
- = Cl. ehrenbergii Menegh. Synops. Desm. p.232. 1840.
- = Arthrodia ehrenbergii Kuntze, Revis. gen. plant. p.883. 1891.
- = Closterium ehrenbergii Menegh. ex Ralfs var. michailovskoense Elenkin. 1915. (vide, Růžicka, 1977).

West & West, vol.1, 1904, p.143, pl.17, figs.1-4;
Taft, 1945, p.186, Hughes, 1951, p.275, fig.17; Tiffany & Britton, 1952, p.172, pl.52, fig.558; Hirano, 1955, p.47, pl.3, fig.2;
Croasdale, 1955, p. 523, pl.6, fig.20; Fritsch, 1961. p.351, fig.109
E, H; Brandham & Godward, 1965, p.32, pl.12, figs.1-4; Prescott, 1966, p.5, pl.5, figs. 6,7; Lippert, 1967, p.182, figs.2, 24, 30;
Herrmann; 1967, p.363, fig.1; Förster, 1969, p.20, pl.3, fig.9;
Mix, 1970, p.81, pl.2, fig.11; Islam, 1970, p.910, pl.6, fig.14;
Förster, 1970, p.283, pl.4, fig.12; Mix, 1973, p.189, pl.4, fig.11;
Lippert, 1973, p.172, pl.1, figs. 1-4; Růžicka, 1973, p.291;
Whitford & Schumacher, 1973, p.66, pl.19, fig.1; Stein, 1975, p.137, fig.92; Parra, 1975, p.29, fig.18; Werner, 1977, p.41, pl.4, figs. 7-10; Růžicka, 1977, p.141, pl.15, figs. 1-3.

382-541 μm long; 72-137 μm broad; apices 12-18 μm broad.

Cells large, stout, $4-5\frac{1}{2}$ times longer than broad, slightly curved, outer margin 110° - 120° of arc, inner margin concave but inflated in the median part, gradually attenuated towards the apices, which are obtusely rounded; cell wall smooth and colourless; chloroplasts with eight to ten ridges, and containing about 16 pyrenoids; terminal vacuole with a cluster of small moving granules. (Pl.7, fig.3, photo.48).

Local distribution: Gandi Garden, Karachi, Sarim No.251, March 28, 1978.

Geographical distribution: World wide.

10. Cl. gracile Bréb. ex Ralfs, Brit. Desm. p.221. 1848.
- = Cl. gracile Bréb. in Cheval. des microscop. et usage Paris, p.272. 1839.
- = Cl. juncidum Ralfs, forma gracillima-ixvissima Rabenn. Flor. Europ. Algar. p.127. 1868.
- = Cl. gracile forma tenuissima Heimerl, Desm. Alp. p.591. 1891.
- = Arthrodia gracilis Kuntze, Revis. gen. plant. p.883. 1891.
- = Closterium limneticum Lemm. Phytoplank. sachs. Teiche, p.28, pl.2, figs.39-41. 1899.

West & West, vol.1, 1904, p.166, pl.21, figs. 8-12;
 Smith, 1924, p.10, fig.1; Taylor, 1934, p.244, pl.66, fig.7; Taft, 1945, p.180, pl.1, fig.13; Hughes, 1951, p.277, fig.39; Tiffany & Britton, 1952, p.174, pl.52, fig.556; Hirano, 1955, p.35, pl.6, figs. 8-10; Croasdale, 1955, p.523, pl.8, fig.4; Růžicka, 1962, p.183, figs.19, 20, 39; Evans, 1962, p.66; Croasdale & Grönblad, 1964, p.156, pl.3, fig.12; Croasdale, 1965, p.305, pl.1, fig.26; Buell, 1968, p.449, figs. 1-8; Eloranta, 1968, p.64, fig. 75; Förster, 1969, p.20, pl.2, figs. 18, 19; Zwart, 1969, fig. 13; Lenzenweger, 1970, p.253, pl.11, fig.4; Förster, 1970, p.283, pl.2, figs. 4-6; Grönblad & Croasdale, 1971, p.6, pl.1, fig.8; Poore & Marshall, 1972, p.75; Whitford & Schumacher, 1973, p.66, pl.18,

fig.12; Růžicka, 1975a, p.293, figs.88, 89; Parra, 1975, p.29, fig.43; Sarim & Faridi, 1976, p.18, fig.29; Hinode, 1977, p.75; Parra & Gonzales, 1977, p.17, figs. 46, 47; Růžicka, 1977, p.168, pl.21, figs.1-4.

130-190 μm long; 3.4-6 μm broad; apices 1.2-2.4 μm broad.

Cells small, slender and linear, about 37-40 times longer than broad, almost straight for more than half their length, margins parallel, gradually narrowed and gracefully curved towards the apices, which are obtuse; cell wall smooth and colourless; chloroplast sometimes sub-undulate, with five to seven pyrenoids, terminal vacuoles with one to several moving granules. (Pl.7, fig.15 and Pl.8, fig.2, photo.55).

Local distribution: New Bus Stand, Peshawar, Sarim No.154, March 13, 1977.

Geographical distribution: World wide.

11. Cl. incurvum Bréb. Liste Desm. p.150, pl.2, fig.47. 1856.
- = Cl. leibleinii Kg. b. minus Rabenh. Flor. Europ. Algar. p.132.1868.
- = Cl. diana e. incurvum Klebs, Desm. Ostpreuss. p.12, pl.1, fig.14. 1879.
- = Cl. venus Kg. ex Ralfs var. incurvum (Bréb.) Krieger, 1935. (vide, Růžicka, 1977).

West & West, vol.1, 1904, p.136, pl.15, figs.28-30; Grönblad, 1948, p.414; Grönblad, 1955, p.35, fig.3; Croasdale, 1955, p.523, pl.6, figs.5-8; Cook, 1963, p.9, figs.8, 18; Förster, 1970, p.283, pl.2, figs.24-29; Whitford & Schumacher, 1973, p.66, pl.20; fig.11; Růžicka, 1975a, p.293, fig.63; Sarim & Faridi, 1976, p.18, fig.41; Růžicka, 1977, p.118, pl.10, figs. 35-42.

52-64 μm long; 10.5-14 μm broad.

Cells very small, 5-7 times longer than broad, strongly curved, outer margin about 180° of arc, inner margin not tumid,

strongly attenuated towards the apices, which are acute; cell wall smooth and colourless; chloroplast with several small pyrenoids in one series; terminal vacuoles with several small moving granules. (Pl.7, fig.14).

Local distribution: Ali Masjid Bridge, Khyber Agency, Sarim No.135, Jan. 20, 1977.

Geographical distribution: Europe, Ceylon, U.S.A, Pakistan.

12. Cl. intermedium Ralfs, Brit. Desm. p.171, pl.29, fig.3. 1848.

= Cl. striolatum b. elongatum Rabenh. Flor. Europ. Algar. p.125. 1868.

= Cl. subdirectum West, Desm. Massachusetts, p.17, pl.3, fig.16. 1889.

= Arthrodia intermedia Kuntze, Revis. gen. plant. p.884. 1891.

West & West, vol.1, 1904, p.125, pl.14, figs.1-5; El-Nayal, 1935, p.47, fig.68; Hughes, 1951, p.277, figs.31, 32; Tiffany & Britton, 1952, p.172, pl.52, fig.559; Hirano, 1955, p.50, pl.6, fig.6; Croasdale, 1962, p.19, pl.1, fig.13; Croasdale & Grönblad, 1964, p.156, pl.4, fig.1; Ochiai, 1966, p.118, fig.11; Eloranta, 1968, p.64, fig.64; Herrmann, 1969, pl.1, fig.4; Mix, 1970, p.81, pl.3, fig.4; Lenzenweger, 1970, p.257, pl.12, fig.5; Förster, 1970, p.284, pl.6, figs.17-20; Hinode, 1971, p.103, pl.11, figs.13, 14; Whitford & Schumacher, 1973, p.66, pl.18, fig.19; Ružička, 1975, p.294; Sarim & Faridi, 1976, p.19, fig.30; Hinode, 1970, p.75, fig.2; Parra & Gonzales, 1977, p.17, fig.16; Ružička, 1977, p.215, pl.32, figs.1-5.

234-465 μ m long; 16-31 μ m broad; apices 10-11.5 μ m broad.

Cells of medium size, 12-15 times longer than broad, slightly curved, outer margin from 36° to 45° of arc, inner margin slightly concave, not tumid but sometimes straight in the median portion, gradually attenuated towards the apices, which are truncate with rounded angles; cell wall pale yellow or yellowish-brown in colour,

strongly striated, with 8-10 striae visible across the cell; each chloroplast with 6 pyrenoids; terminal vacuoles with one large moving granule or a few smaller ones. (Pl.7, fig.16, photo.56).

Local distribution: Bannu, Sarim No.231, Feb. 1, 1978.

Geographical distribution: World wide.

13. Cl. lineatum Ehr. ex Ralfs, Brit. Desm. p.1, 30, fig.1. 1848.
- = Cl. lineatum Ehr. Infus. p.296, pl.6, fig.8. 1838.
- = Arthrodia lineata Kuntze, Revis. gen. plant. p.883. 1891.
- = Closterium didymocarpum Schmidle, Alg. aus Nyassa-See, p.65, pl.1, fig. 15. 1903.

West & West, vol.1, 1904, p.181, pl.24, figs. 1-5;

El-Nayal, 1935, fig.69; Croasdale, 1955, p.524, pl.8,

fig.12; Fritsch, 1961, p.352, fig.111 C; Hirano, 1955a, p.40,

pl.60, figs.14, 15; Förster, 1970, p.285. pl.5, fig.; Lenzenweger,

1970, p.254, pl.11, fig. 9; Mix, 1970a, p.81, pl.3, fig.2;

Whitford & Schumacher, 1973, p.16, pl.18, fig.20; Parra, 1975,

p.30, fig.32; Werner, 1977, p.42, pl.3, fig.4; Ružicka, 1977,

p.184, pl.24, figs. 1-3; Kusel-Fetzmann, 1977, p.89, fig.346;

Prasad & Mehrotra, 1977a, p.50, fig.34;

415-760 μm long; 17-35 μm broad; apices 7-10 μm broad.

Cells large, long and narrow, 16-24 times longer

than broad, slightly curved, median portion. of the cell fairly straight and cylindrical, inner margin faintly and widely tumid, and gradually attenuated towards the apices, which are broad and truncately rounded, cell wall striated, striae rather variable, from 10 to 20 visible across the cell cell wall reddish-brown in colour; chloroplasts with about six ridges and a median row of nine to eleven pyranoids; terminal vacuoles with a close cluster of several moving granules. (Pl.7, fig.7).

Local distribution: Saidu Sharif Swat, Sarim No.164, March 23, 1977.

Geographical distribution: World wide.

14. Cl. littorale Gay. Monogr. Ioc. Conj. p.75, pl.2, fig.17. 1884.
= Arthrodia littoralis Kuntze, Revis. gen. plant. p.883. 1891.

West & West, vol. 1, 1904, p.155, pl.19, fig.14:

Tiffany & Britton, 1952, p.173, pl.51, fig.544; Hirano, 1955a, p.36, pl.5, figs.17, 18; Herrmann, 1968, p.358, fig.2; Whitford & Schumacher, 1973, p.66, pl.19, fig.5; Parra, 1975, p.30, fig.42; Růžicka, 1975a, p.298, figs. 90-94; Ichimura, & Watanabe, 1976, p.123; Werner, 1977, p.42, pl.2, fig.11; Růžicka, 1977, p.150, pl.17, figs. 1-9; Hirano, 1977, p.212; Ichimura & Watanabe, 1978, p.1; Ichimura & Watanabe, 1978a, p.11.

150-220 μ m long; 17.5-22.5 μ m broad.

Cells of medium size, about 10 times longer than broad; slightly curved, outer margin 35° - 40° of arc, inner margin a little concave, and slightly but widely tumid in the middle, gradually attenuated to the apices, which are obtusely rounded; cell wall smooth and colourless; chloroplast with 8 ridges and a central series of 5 pyrenoids; terminal vacuoles with a number of moving granules. (Pl.7, fig.2).

Local distribution: Govt. College Abbottabad, Sarim No.232, Feb. 8, 1978.

Geographical distribution: World wide.

15. Cl. lunula (Müll.) Nitzsch ex Ralfs, Brit. Desm. p.163, pl.27, fig. 1. 1848.
= Vibris lunula Müll. p.142. 1784.
= Cl. lunula a. typicum Klebs, Desm. Ostpreuss. p.6, pl.1, fig.1b. 1879.
= Arthrodia lunula Kuntze, Revis. gen. plant. p.883. 1891.
= Cl. lunula (Müll.) Nitzsch ex Ralfs forma minus West & West, 1904. (vide, Růžicka, 1977).

- = Cl. lunula (Müll.) Nitzsch ex Ralfs var. minus (West & West) Krieger 1935. (vide Růžicka, 1977).

West & West, vol.4, 1904, p.150, pl.18, figs.1-9; Hughes, 1951, p.282, fig.3; Tiffany & Britton, 1952, p.52, fig.561; Prescott, 1954, p.65, fig.90; Hirano, 1955, p.38, pl.9, figs.6, 7; Croasdale, 1955, p.525, pl.7, fig.4; Herrmann, 1966, p.32; figs.3, 4; Prescott, 1966, p.6, pl.2, figs.9,10; Mix, 1970, p.81, pl.3, fig.1; Lenzenweger, 1970, p.258, pl.13, fig.2; Förster, 1970, p.286, pl.5, fig.1; Croasdale, 1973, p.74, pl.11, fig.10; Whitford & Schumacher, 1973, p.66, pl.9, fig.13; Růžicka, 1975, p.299; Hinode, 1977, p.76, fig.3; Růžicka, 1977, p.145, pl.16, figs. 1-3.

478-680 μ m long; 76-116 μ m broad; apices 19-23 μ m broad.

Cells large, stout, 6-7 times longer than broad, almost straight, outer margin 40° - 45° of arc, inner margin generally straight, and very slightly tumid in the median part, gradually and gently narrowed to the apices which are slightly recurved and obtusely rounded; cell wall smooth and colourless; chloroplasts with about 10 to 12 ridges and numerous scattered pyrenoids; terminal vacuoles with a large cluster of moving granules.

(Pl.7, fig.1, photo.47).

Local distribution: Bannu, Sarim No.231, Feb. 1, 1978.

Geographical distribution: World wide.

16. Cl. moniliferum (Bory) Ehr. ex. Ralfs, Brit. Desm. p.166, pl.28, fig.3. 1848.
- = Cl. moniliferum (Bory) Ehr. Infus. p.91, pl.5, fig.14. 1838.
- = Cl. moniliferum a. genuinum Kirchn. Alg. Schles. p.141. 1878.
- = Cl. moniliferum a. typicum Klebs, Desm. Ostpreuss. p.9, pl.1, fig.8b. 1879.
- = Cl. leibleinii Kg. var. curtum West, Desm. Mass. p.17, pl.2, fig.8. 1889.
- = Arthrodia monilifera Kuntze, Revis. gen. plant. p.883. 1891.

- = Cl. malinvernianiforme Grönb.. 1920 (vide, Růžicka, 1977).
- = Cl. moniliferum (Bory) Ehr. ex Ralfs var. malinvernianiforme (Grönb.) Kosinskaja, 1960 (vide, Růžicka, 1977).

West & West, vol.1, 1904, p.142, pl.16, figs.15, 16;
 Smith, 1924, p.9, pl.52, fig.1; Taylor, 1934, p.244, pl.66, fig.15;
 El-Nayal, 1935, p.45, fig.63; Thompson, 1938, p.40, pl.9, fig.12;
 Tiffany, 1945, p.188, pl.1, fig.16; Smith, 1950 p.317; Hughes, 1951, p.282, fig.8; Tiffany & Britton, 1952, p.172, pl.52, fig.549; Mattern, 1954, p.250; Hirano, 1955, p.37; Hirano, 1955a, p.46, pl.3, fig.6;
 Croasdale, 1955, p.525, pl.6, fig.21; Tibor, 1959, p.513, fig.43;
 Fritsch, 1961, fig.107a; Messikommer, 1963, p.51, pl.1, fig.2; Cook, 1963, p.580; Croasdale & Grönblad, 1964, p.157, pl.3, fig.1; Brandham, 1965, p.483, pl.2, fig.12; Croasdale, 1965, p.305, pl.1, fig.22;
 Prescott, 1966, p.7, pl.2, figs.6, 7; Mattern, 1966, p.214, fig.7;
 Lippert, 1967, p.182, figs.1, 3-23; Zwart, 1969, p.167, figs.2-5;
 Mix, 1970a, p.83, pl.2, fig.9; Islam, 1970, p.910, pl.20, fig.3;
 Förster, 1970, p.286, pl.4, figs.3-6; Hinode, 1971, p.105, pl.2, fig.5;
 Dubois-Tylski, 1972, p.183, pl.1; Mix, 1973, p.185, pl.2, fig.5;
 Dubois-Tylski, 1973, p.91; Dubois-Tylski, Jacques & Lacoste, 1973, p.111; Dubois-Tylski, 1973c, p.41, pl.1; Lippert, 1973, p.172;
 Whitford & Schumacher, 1973, p.67, pl.20, fig.10; Dubois-Tylski & Abadie, 1974, p.181, pl.1; Watanabe, 1974, p.222, pl.3, fig.d; Howard & Cowie, 1975, p.33; Islam & Zaman, 1975a, p.50, pl.4, figs.36, 37, 39; Růžicka, 1975a, p.300; Parra, 1975, p.30, fig.21; Howard & Cowie, 1976, p.188; Howard & Cowie, 1976a, p.540; Sarim & Faridi, 1976, p.22, fig.43; Dubois-Tylski, 1977, p.27 d; Werner, 1977, p.43, pl.4, figs.11, 13; pl.17, fig.2; Parra & Gonzales, 1977, p.18, figs.25, 27; Růžicka, 1977, p.137, pl.14, figs.3-6; Hirano, 1977, p.212;
 Dubois-Tylski, 1978, p.211, pl.1.

222-370 μm long; 33-50 μm broad; apices 8-11 μm broad.

Cells of medium size, stout, 6-8 times longer than broad slightly curved, outer margin 100° - 110° of arc, inner margin with a distinct inflation in the middle, uniformly narrowed to the apices, which are obtusely rounded, cell wall smooth and colourless; chloroplasts with distinct ridges, about 6 in number and with a single series of 6 pyrenoids; terminal vacuoles with numerous moving granules. (Pl.7, fig.4, photo.49).

Local distribution: Gujrat, Punjab, Sarim No.285, Feb.1, 1978.

Geographical distribution: World wide.

17. Cl. moniliferum (Bory) Ehr. ex Ralfs var. concaum Klebs, in Krieger Krypt. Flor. p.13, pl.1, fig.201. 1935.

Hughes, 1951, p.283, fig.19; Hirano, 1955, p.47, pl.3, fig.7; Croasdale, 1955, p.525, pl.6, fig.22; Prescott, 1966, p.7, pl.2, figs.2, 3, Förster, 1969, p.22, pl.2, fig.30; Förster, 1970, p.287, pl.4, figs. 10, 11; Werner, 1977, p.43, pl.4, fig.12; pl.17, fig.3; Parra & Gonzales, 1977, p.18, fig.28; Růžicka, 1977, p.140, pl.14, figs.7-9.

200-245 μm long; 41.4-55 μm broad.

Cells of medium size, curved more than the species; cell wall colourless without a median girdle, smooth; terminal vacuoles conspicuous; Chloroplast with a median series of 7 pyrenoids. (Pl.7, fig.5, photo.50).

Local distribution: Gandi Garden Karachi, Sarim No.251, March 28, 1978.

Geographical distribution: World wide.

18. Cl. rostratum Ehr. ex Ralfs, Brit. Desm. p.175, pl.30, fig.3.1848.
 = Cl. rostratum Ehr. Entw. Lebends. d. Infus. p.67. 1832.
 = Cl. acus Nitzsch in Kg. Syn. Diat. p.595, pl.18, fig.81. 1834.
 = Cl. caudatum Corda in Alm. d. Carlsbad. p.190, pl.5, fig.66.1835.
 = Cl. rostratum a. typicum Klebs, Desm. Ostpreuss. p.18. 1879.
 = Arthrodia rostrata Kuntze, Revis. gen. plant. p.884. 1891.

West & West, vol.1, 1904, p.188, pl.26, figs.1-5; Hirano, 1955a, p.42, pl.6, figs.2, 3; Croasdale, 1955, p.526, pl.9, figs. 4, 5; Mattern, 1964, p.250; Croasdale & Grönblad, 1964, p.158, pl.4, fig.19; Croasdale, 1965, p.305, pl.1, fig.3; Ochiai, 1966, p.119; Croasdale, Scott & Grönblad, 1968, p.10, fig.21; Zwart, 1969, p.167, figs.9, 10; Lenzenweger, 1970, p.254, pl.11, fig.10; Förster, 1970, p.291, pl.6, figs.4-8; Dubois-Tylski, 1973, p.3, pl.1, figs.1-9; Croasdale, 1973, p.75, pl.11, fig.16; Whitford & Schumacher, 1973, p.67, pl.20, fig.3; Watanabe, 1974, p.222, pl.3, fig.m, Stein, 1975, p.137, fig.93; Ružička, 1977, p.209, pl.31, figs.1-6.

246-530 μ m long; 19-30 μ m broad; apices 3.4-5 μ m broad.

Cells of medium size, 12-18 times longer than broad, slightly curved, median part of cell fusiform-lanceolate, inner margin more convex than outer margin, extremities prolonged into long, colourless processes which are slightly incurved, apex obtuse and slightly dilated; cell wall straw coloured, finely striated, 25-27 striae visible across the cell; chloroplasts with four or five pyrenoids; terminal vacuoles large, situated within the base of the apical processes and containing from 12 to 15 moving granules. (Pl.8, fig.6).

Local distribution: Irum Cold Storage, Peshawar, Sarim No.154, March 13, 1977.

Geographical distribution: World wide.

19. Cl. setaceum Ehr. ex Ralfs, Brit. Desm. p.176, pl.30, fig.4.1848.
 = Cl. rostratum Ehr. c. setaceum Klebs, Desm. Ostpreuss. p.18.1879.
 = Arthrodia setacea Kuntze, Revis. gen. plant. p.884. 1891.

West & West, vol.1, 1904, p.190, pl.26, figs.9-13; Taylor, 1934, p.245, pl.66, fig.11; Hughes, 1951, p.285, fig.48; Hinode, 1955, p.40, pl.6, figs.1, 7; Croasdale, 1955, p.526, pl.9, fig.6; Ochiai, 1966, p.119; Lind, 1967, p.370, pl.1, fig.1; Grönblad, Scott & Croasdale, 1968, p.10, fig.19; Förster, 1969, p.24, pl.4, figs.13-15; Lenzenweger, 1970, p.256, pl.1, fig.12; Förster, 1970, p.292, pl.6, figs.11, 12; Hinode, 1971, p.105, pl.3, figs.11, 12; Whitford & Schumacher, 1973, p.67, pl.20, fig.21; Förster, 1974, p.151, pl.4, figs.2, 3; Růžicka, 1977, p.205, pl.30, figs.1-3.

227-450 μm long; 7.5-12.5 μm broad; apices 0.7-1.5 μm broad.

Cells small, very slender, almost straight, 25-36 times longer than broad, median portion of cell small, fusiform-lanceolate, both margins equally convex, extremities prolonged into slender, setaceous, colourless processes, which are slightly incurved and obtuse at the apices; each apical process is about three-eighths the length of the cell; cell wall colourless or pale straw-coloured, finely striated, about 13 fine striations visible across the cell; chloroplasts with two pyrenoids; terminal vacuoles within the base of the apical processes, with three or four moving granules. (Pl.7, fig.10, photo.53).

Local distribution: Rawal Dam Canal, Rawalpindi, Sarim No.23, Sept. 15, 1976.

Geographical distribution: Europe, Japan, U.S.A, Pakistan.

20. Cl. strigosum Bréb. Liste Desm. p.153, pl.2, fig.43. 1856.
 = Cl. strigosum a. typicum Klebs, Desm. Ostpreuss, p.8. 1879.
 = Cl. peracerosum Gay, 1884 (vide, Ruzicka, 1977).
 = Arthrodia strigosa Kuntze, Revis. gen. plant. p.884. 1891.

West & West, vol.1, 1904, p.165, pl.21, figs.6,7; El-Nayal, 1935, p.45, fig.64; Grönblād, 1943, p.13, pl.1, fig.2; Croasdale, 1948, p.273; Tiffany & Britton, 1952, p.174, pl.51, fig.545; Hirano, 1955, p.37, pl.4, fig.9; Růžicka, 1962, p.186, fig.36; Hirano, 1966, p.57; Ichimura, 1971, p.208, fig.1; Yacubson, 1974, p.109, pl.5, fig.43; Ichimura & Watanabe, 1976, p.123; Růžicka, 1976, p.8, figs. 141, 146; Růžicka, 1977, p.173, pl.21, figs.18-36; Ichimura & Watanabe, 1978, p.1.

254-358 μ m long; 14-18.5 μ m broad.

Cells of moderate size, 16-20 times longer than broad, slightly curved, median portion of cell straight, towards the extremities incurved, gradually attenuated to the apices which are somewhat incurved and subacute; cell wall smooth and colourless; chloroplasts with a central row of 8 pyrenoids; terminal vacuoles with several moving granules. (Pl.7, fig.17).

Local distribution: Cadet College Hasanabdal, Sarim No.227, Feb.2, 1978.

Geographical distribution: World wide.

21. Cl. striolatum Ehr. ex Ralfs, Brit. Desm. p.170, pl.29, fig.29.1848.
 = Cl. stroilatum Ehr. Entwick. Lebends. d. Infus. p.68. 1832.
 = Cl. striolatum var. tumidum Rabenh. Flor. Europ. Algar. p.126.1868.
 = Cl. striolatum a typicum Klebs, Desm. Ostpreuss. p.14, pl.2, fig.4a, 1879.
 = Cl. striolatum var. orthonotum Roy, Freshw. Alg. Enbridge Lake and Vicin. p.336. 1890.
 = Arthrodia striolata Kuntze, Revis. gen. plant. p.884. 1891.

West & West, vol.1, 1904, p.122, pl.13, figs.7-16; Prescott, 1941, p.26, pl.1, figs.16-18; Croasdale, 1948, p.273; Hughes, 1951, p.286, figs.35, 36; Tiffany & Britton, 1952, p.170, pl.51, fig.546; Hirano, 1955a, p.50, pl.7, figs.10-12; Croasdale, 1955, p.526, pl.4, fig.14; Wygasch, 1957, p.3; Fritsch, 1961, fig.109; Croasdale, 1962, p.19, pl.1, fig.9; Mattern, 1964, p.250; Croasdale & Grönblad, 1964, p.158, pl.4, figs.5, 6; Ochiai, 1966, p.119; Lind, 1967, p.273; Eloranta, 1968, p.250; Herrmann, 1969, p.148, pl.1, fig.2; pl.6, fig.5; pl.7, fig.6; pl.9, fig.1; Mix, 1970a, p.83, pl.3, fig.3; Förster, 1970, p.292, pl.6, fig.21; pl.7, figs.1-6; Hinode, 1971, p.107, pl.2, figs.10-12; Whitford & Schumacher, 1973, p.67, pl.18, fig.23; Watanabe, 1974, p.222, pl.3, fig.1; Růžicka, 1976, p.10; Sarim & Faridi, 1976, p.25, fig.23; Hinode, 1977, p.76, fig.2; Parra & Gonzales, 1977, p.19, fig.61; Růžicka, 1977, p.15, pl.32, figs.7-13.

235-478 μm long; 22-53 μm broad; apices 10-14 μm broad.

Cells of medium size, 8-12 times longer than broad, slightly curved, outer margin from 39° to 69° of arc, inner margin concave, never tumid, but sometimes straight in the middle, gradually attenuated to the apices, which are broad and truncate with rounded angles; cell wall yellowish-brown in colour, striated, with 14-21 striae visible across the cell; each chloroplast with about 6 ridges and an axile row of 5-7 pyrenoids; terminal vacuoles with many moving granules. (Pl.7, fig.9).

Local distribution: Waste water channel of Packages Ltd.

Lahore, Sarim No.14, Oct, 21, 1976.

Geographical distribution: World wide.

22. Cl. tumidum Johnson, Rare Desm. p.291, pl.239, pl.4, 1895.
 = Cl. cornu Ehr. var. ^B Ralfs, Brit. Desm. p.176, pl.30, fig.6. 1848.
 = Cl. cornu b. forma tumida Rabenh. Flor. Europ. Algar. p.137.1868.
 = Cl. cornu Wille, Ferskv. Alg. Nov. Semlj. p.59, pl.14, fig.80.1879.

West & West, vol.1, 1904, p.156, pl.19, fig.15.

59-139 μ m long; 7.7-18 μ m broad; apices 2.5-5.5 μ m broad.

Cells rather small, 8-9 times longer than broad, slightly curved; outer margin 28° - 58° of arc; inner margin of the cell broadly tumid in the middle, faintly convave towards the extremities, gradually attenuated towards the apices, which are truncately rounded and of somewhat variable width; cell wall smooth and colourless; chloroplast with four or six ridges; and 1-3 pyrenoids; terminal vacuoles with only one moving granule. (Pl.7, fig.12).

Local distribution: Sasnamana (Ziarat) Baluchistan, leg. Khial Badshah, Sarim No.130, Jan. 15, 1977.

Geographical distribution: Europe, Siam, U.S.A, Labrador, Pakistan.

23. Cl. turgidum Ehr. ex Ralfs var. giganteum (Nordst.) De Toni, Syll. Alg. p.828. 1889.

= Cl. turgidum Ehr. ex Ralfs subsp. giganteum Nordst. 1880.
 (vide, Růžicka, 1977).

= Cl. turgidum Ehr. ex Ralfs var. giganteum (Nordst.) De Toni
 forma bohemicum Rosa, 1935 (vide, Růžicka, 1977).

West & West, vol.1, 1904, p.171; Whitford & Schumacher, 1973, p.67, pl.19, fig.17; Růžicka, 1977, p.168, pl.19, fig.15.

600-900 μ m long; 55-100 μ m broad.

Cells large, slightly curved, outer margin about 40° of arc, gradually attenuated towards the extremities; cell wall yellowish-brown in colour; chloroplasts with about 15-30 pyrenoids; terminal vacuoles with many moving granules. (Pl.8, fig.3).

Local distribution: Pabbi, Distt. Peshawar, Sarim No.48, Oct.22, 1976; Nathiagali, Sarim No.203, March 20, 1977.

Geographical distribution: Brazil, Europe, U.S.A, Pakistan.

24. Cl. venus Kg. ex Ralfs, Brit. Desm. p.220, pl.36, fig.12. 1848.
 = Cl. venus Kg. Phyc. germ. p.130. 1845.
 = Cl. diana a. venus Klebs, Desm. Ostpreuss. p.12, pl.1, fig.14. 1879.
 = Arthrodia venus Kuntze, Revis, gen. plant. p.884. 1891.
 = Closterium trochiscosporum West & West, New and Int. Freshw. Alg. p.151, pl.3, fig.16. 1896.
 = Cl. venus Kg. ex Ralfs var. verrucosum (Roll) Krieger, 1935 (vide, Růžicka, 1977).

West & West, vol.1, 1904, p.137, pl.15, figs.15-20; Smith, 1924, p.9, pl.52, fig.9; Taylor, 1934, p.264, pl.66, fig.2; Prescott, 1941, p.26, fig.10; Taft, 1945, p.188, pl.2, fig.6; Hughes, 1951, p.287, fig.13; Grönblad, 1952, p.77; Tiffany & Britton, 1952, p.137, pl.58, fig.542; Croasdale, 1955, p.527; Cook, 1963, p.9, figs.7, 17; Croasdale & Grönblad, 1964, p.159, pl.2, figs.18-20; Prescott, 1966, p.8, pl.1, fig.13; Mix, 1970a, p.83, pl.3, fig.8; Lenzenweger, 1970, p.258, pl.13, fig.14; Hinode, 1971, p.107, pl.1, fig.33; Croasdale, 1973, p.75, pl.11, figs.3, 4; Whitford & Schumacher, 1973, p.67, pl.20, fig.18; Sarim & Faridi, 1976, p.27, fig.38; Růžicka, 1976, p.14; Werner, 1977, p.45, pl.2, fig.9; Hinode, 1977, p.76; Parra & Gonzales, 1977, p.19, fig.38; Růžicka, 1977, p.119, pl.11, figs.1-7; Hirano, 1977, p.212; Prasad & Mehrotra, 1977a, p.52, fig.20.

51-81 μ m long; 7-10.5 μ m broad.

Cells small, 8-9 times longer than broad, strongly curved, outer margin 150° - 160° of arc, inner margin not tumid, gradually attenuated to the apices, which are acute or acutely rounded; cell

wall smooth, colourless, or more rarely yellowish-brown; chloroplasts ridged, with two pyrenoids, rarely only one; terminal vacuoles large, with a number of moving granules. (Pl.7, fig.13, photo.54).

Local distribution: Kund Attock, Sarim No.131, Jan. 16, 1977.

Geographical distribution: World wide.

CHARACTERS OF PLEUROTAEINIUM

5. PLEUROTAEINIUM Näg. Gatt. einz. Alg. p.104. 1849.

Cells usually quite large, length several times the breadth, median constriction well defined but not deep, cells solitary, always straight; semicells never compressed, commonly cylindrical and somewhat attenuated towards the poles, very rarely ovate; poles always truncate, usually with angles more or less rounded and, except in rare cases, with a ring of mamillate to conical tubercles; bases of semicells inflated, at times with lateral margins above the inflations undulate; cell wall: rarely smooth, commonly punctate or minutely scrobiculate, sometimes granulose or papillate; never with vertical plications on swollen bases of semicells; walls at times of uneven thickness, the thinner portions producing a somewhat definite pattern; chloroplasts usually numerous and parietal, in the form of straight to undulate bands that extend the length of the semicell and contain numerous pyrenoids; rarely axile and with longitudinal plates and an axile row of pyrenoids; parietal chloroplasts at times fragmenting into small rhomboidal masses each containing a single pyrenoid.

KEY TO THE TAXA

1. Cell wall scrobiculate..... Pl. coronatum
1. Cell wall punctate..... 2
1. Cell wall smooth..... 5
 2. Cell with rings of nodules... Pl. nodosum
 2. Cells otherwise..... 3
3. Semicells tumid..... Pl. truncatum
3. Semicells otherwise..... 4
 4. Apices of cell truncate,
14.5-22 μ m broad..... Pl. ehrenbergii
 4. Apices of cell rounded-
truncate, 16-32 μ m broad..... Pl. trabeculatus
 4. Apices of cell truncate,
25-29 μ m broad..... Pl. subcoronulatum
5. Cell 80-115 μ m long..... Pl. minutum var. submultitaeniatum
5. Cell 145-179 μ m long..... Pl. minutum
5. Cell 211-320 μ m long..... Pl. tridentulum

DESCRIPTION OF THE PLANTS

1. Pleurotaenium coronatum (Bréb.) Rabenh. Flor. Europ. Algar.
p.143. 1868.
- = Docidium coronatum Bréb. in Ralfs Brit. Desm. p.217, pl.35, fig.6,
1848. (Basionym).
- = Pleurotaenium nodulosum var. coronatum (Bréb.) Boldt in Bih. till
Sv. Vet. Akad. Handl. Bd. 13, p.59. 1888.

West & West, vol.1, 1904, p.199, pl.27, figs.16-18; pl.28,
fig.4.

430-591 μ m long; breadth at base of semicells 38-70 μ m;
breadth at apex of semicells 37-53 μ m.

Cells large, 9-12 times longer than broad; semicells very
slightly and gradually attenuated from base to apex, with a prominent
basal inflation and several smaller undulations immediately above it,
upper half of lateral margins straight; apices truncate, with a

peripheral ring of 10-12 large, conical or flattened tubercles, 5-6 visible across the apex; cell wall scrobiculate. (Pl.8, fig.10).

Local distribution: Pabbi, Distt. Peshawar, Sarim No.48, Oct. 22, 1976.

Geographical distribution: Europe, Africa, U.S.A, Pakistan.

2. Pl. ehrenbergii (Bréb.) De Bary, Conj. p.75. 1858.

= Docidium ehrenbergii Bréb. in Dict. univ. hist. nat. p.93. 1844.

= D. ehrenbergii Bréb. ex Ralfs, Brit. Desm. p.157, pl.26, fig.4. 1848. (Basionym).

= Penium (Docidium) ehrenbergii Kg. Spec. Alg. 168. 1849.

= Docidium ehrenbergii var. tumidum Turn. Freshw. Alg. E. India, p.31, pl.4, fig.4. 1893.

= Pleurotaenium ehrenbergii (Bréb.) De Bary var. granulatum (Ralfs) West & West, 1904 (vide, Růžicka, 1977).

= Pl. ehrenbergii (Bréb.) De Bary var. constrictum (Playf.) Krieger 1937 (vide, Růžicka, 1977).

= Pl. ehrenbergii (Bréb.) De Bary forma granulatum (Ralfs) Kosinskaja 1960 (vide, Růžicka, 1977).

West & West, vol.1, 1904, p.205, pl.39, figs.9-11; pl.30, fig.1,

240-480 μ m long; breadth at base of semicells 18-35 μ m, at middle of semicells 16-26 μ m, at apices 14.5-22 μ m.

Cells of medium size, rather narrow and subcylindrical, 15-20 times longer than broad; semicells somewhat variable in form, not at all or sometimes slightly attenuated from base to apex, with a distinct though small basal inflation and one undulation sometimes two immediately above it; apices truncate, bordered by a ring of conical or rounded tubercles, 7-10 in number, 4 or 5 visible across the apex; cell wall punctate. (Pl.8, fig.15).

Local distribution: Akbarpura, Distt. Peshawar. Sarim No.30, Sept. 25, 1976.

Geographical distribution: Europe, China, India, U.S.A, Pakistan, Russia.

3. Pl. minutum (Ralfs) Delp. Gronb. Act. Soc. Faun. Flor. Fenn. pl.25, fig.4. 1924.
- = Docidium minutum Ralfs, Brit. Desm. p.158, pl.26, fig.5. 1848. (Basionym).
- = Penium minutum (Ralfs) Cleve 1864 (vide, Růžicka, 1977).
- = P. minutum (Ralfs) Cleve forma maius Lund. 1871. (vide, Růžicka, 1977).
- = P. minutum (Ralfs) Cleve forma minus Racib. 1885 (vide, Růžicka, 1977).
- = Pleurotaenium minutum (Ralfs) Delp. var. maius (Lund.) Gronb. 1924. (vide, Růžicka, 1977).
- = Pl. minutum (Ralfs) Delp. var. minus (Racib.) Krieger 1937 (vide, Růžicka, 1977).
- = Pl. minutum (Ralfs) Delp. forma maius (Lund.) Kosinskaja 1960 (vide, Růžicka, 1977).
- = Pl. minutum (Ralfs) Delp. forma minus (Racib.) Kosinskaja 1960 (vide Růžicka, 1977).

Taylor, 1934, p.246, pl.64, fig.11; Irene-Marie, 1952, p.13; Croasdale, 1955, p.528, pl.10, fig.10; Hirano, 1956, p.60, pl.10, figs.7, 9; Scott, Grönblad & Croasdale, 1965, p.30, fig.27; Förster, 1969, p.26, pl.5, fig.7; Islam, 1970, p.913, pl.4, figs.5, 6; Hinode, 1971, p.108, pl.3, fig.15; Whitford & Schumacher, 1973, p.68, pl.21, fig.7; Ratnasabapathy, & Kumano, 1974, p.24; Hosiaisloma, 1975, p.12; Růžicka, 1977, p.256, pl.36, figs.1-8.

145-179 μ m long; 14-15 μ m broad.

Cells small, cylindrical, about 8-12 times longer than broad, deeply constricted; gradually attenuated towards the apices which are truncate; cell wall smooth; chloroplasts axile with 3-7 pyrenoids and several irregular longitudinal ridges. (Pl.8, fig.14, photo.62).

Local distribution: Nawankali, Distt. Mardan, Sarim No.159, March 19, 1977.

Geographical distribution: Europe, Japan, U.S.A, Malaysia, Pakistan, Canada, Brazil, Bangladesh, ~~Russia~~.

4. Pl. minutum (Ralfs) Delp. var. submultitaeniatum Růžička, Die Desm. Mitteleuropas 1, p.260, pl.36, fig.14. 1977.

= Pl. minutum (Ralfs) Delp. var. submultitaeniatum Růžička, 1976 (vide, Růžička, 1977).

80-115 μ m long; 10-12.5 μ m broad; apices 5-7 μ m broad.

Cells small, subcylindrical, with bases inflated; semicells a little broader in the middle than at the bases; cell wall : smooth; chloroplast peripheral, band like. (Pl.8, fig.13, photo.61).

Local distribution: University Town Peshawar, Sarim No.242, Feb.16, 1978.

Geographical distribution: Europe, Pakistan.

5. Pl. nodosum (Bail.) Lund. Desm. Suec. p.90. 1871.

= Glosterium nodosum Bail., 1846 (vide, Růžička, 1977).

= Docidium nodosum Bail., in Ralfs Brit. Desm. p.218, pl.35, fig.8. 1848. (Basionym).

= D. nodosum var. hibernicum Cooke, Brit. Desm. p.13, 1886.

= Docidiopsis nodosa Racib, Desm. Nowe, p.107, pl.7, fig.22. 1889.

= D. nodosum a. typica Turn. Freshw. Alg. E.India, p.35. 1893.

West & West, vol.1, 1904, p.214, pl.31, figs.3-6; Smith, 1950, fig.229; Irénée-Marie, 1952, p.14; Prescott, 1954, p.71, fig. 102b; Hirano, 1956, p.70, pl.12, figs.8, 9; Gerrath, 1969, p.113, figs.1, 5-8; Hinode, 1971, p.108, pl.4, figs. 7-10; Whitford & Schumacher, 1973, p.68, pl.21, fig.19; Hinode, 1977, p.78, fig.4; Růžička, 1977, p.285, pl.44, figs. 1-5.

280-520 μ m long; 40-80 μ m broad; apices 24-50 μ m broad.

Cells large, 6½-8 times longer than broad; semicells with nodulose margins caused by four rings of prominent nodules, one basal ring, and three other equidistant rings, 6-8 nodules in each ring, gradually tapering from base to apex; apices dilated, convexo-truncate, with a peripheral ring of 6-8 conical teeth,

which do not project beyond the extreme apex; cell wall punctate. (Pl.8, fig.8, photo.60).

Local distribution: Stream Govt. College, Kohat, Sarim No.160, March 20, 1977.

Geographical distribution: Europe, India, Japan, U.S.A., Canada, Pakistan.

6. Pl. subcoronulatum (Turn.) West & West, in Trans. Linn. Soc. Bot. p.5, fig.44. 1895.

Smith, 1924, p.14; Hirano, 1956, p.68, pl.14, figs.1-3.

407-453 μm long; 29-37 μm broad at base of semicells, 25-29 μm broad at apices.

Cells fairly large, length about 12 times the breadth, united to form filaments, median constriction deep; semicells cylindrical, with bases inflated and lateral margins slightly undulate in the lower third of the semicell, lateral margins very slightly attenuated towards the apices; apices dilated, truncate, with rounded angles and a transverse ring of elliptic tubercles, about 10 visible in front view of cell; cell wall punctate. (Pl.8, fig.16).

Local distribution: Islamabad, Sarim No.150, March 11, 1977.

Geographical distribution: Japan, U.S.A., Pakistan.

7. Pl. trabecula (Ehr.) ex Næg. Gatt. einz. Alg. p.104, pl.6, fig.A. 1849.

= Closterium trabecula Ehr. Beitr. zur Kenntniss der Organismen der Infus. p.62, 1830.

= Docidium trabecula Reinsch, Algenfl. Frank. p.183. 1867.

West & West, vol.1, 1904, p.209, pl.30, figs.11-13.

390-664 μm long; breadth of apices 16-32 μm ; breadth at base of semicells 26-46 μm .

Cells large, subcylindrical, 11-15 times longer than broad; semicells with one basal inflation, rarely with a second slight undulation above it, almost cylindrical, gradually attenuated towards the apices, lateral margins almost straight, generally faintly convex; apices rounded-truncate, destitute of tubercles; cell wall punctate. (Pl.8, fig.11).

Local distribution: Khawashki Lake Near Nowshera, Distt. Peshawar, Sarim No.200, Jan. 2, 1978; Mardan, Sarim No.60, Nov. 1, 1976.

Geographical distribution: Europe, Japan, Russia, U.S.A., Siam, Pakistan.

8. Pl. tridentulum (Wolle) W. West, Alg. W. Ireland, p.120. 1892.
= Docidium tridentulum Wolle, in Bull. Torr. Bot. Club, p.14. 1882. (Basionym).
= D. sceptrum Roy in Scott. Naturalist, p.39, 1883.
= Penium tridentulum Eichl. & Racib., 1893. (vide, West & West, 1904).
= Pleurotaenium sceptrum West & West, Some N. American Desm. p.235, pl.13, fig.6. 1896.

West & West, vol.1, 1904, p.208, pl.30, figs.5,6.

211-320 μ m long; breadth at base of semicells 12.5-16 μ m; breadth at apex 6.5-8.3 μ m.

Cells rather small, narrow, about 20 times longer than broad; semicells gradually attenuated from base to apex, with a slight basal inflation, lateral margins straight; apices truncate, with four short spines or teeth; cell wall smooth. (Pl.8, fig.12).

Local distribution: Cherat, Distt. Peshawar, Sarim No.240, Feb. 15, 1978.

Geographical distribution: Europe, U.S.A., Pakistan.

9. Pl. truncatum (Bréb.) Näg. Gatt. einz. Alg. p.104. 1849.
 = Closterium truncatum Bréb. in Cheval. microscop. et usage, Paris, p.272. 1839.
 = Docidium truncatum Bréb. in Ralfs Brit. Desm. p.156, pl.26, fig.2, 1848. (Basionym).
 = Pleurotaenium truncatum (Bréb.) Näg. var. granulatum West & West 1894 (vide, Růžička, 1977).
 = Pl. truncatum (Bréb.) Näg. forma granulatum (West & West) Kosinskaja 1960 (vide, Růžička, 1977).

West & West, vol.1, 1904, p.203, pl.29, figs.3, 4;

Smith, 1924, p.16, pl.55, figs.1, 2; Smith, 1950, p.319, fig.229c; Irénée-Marie, 1952, p.15; Tiffany & Britton, 1952, p.180, pl.55, fig.605; Croasdale, 1955, p.529, pl.9, fig.8; Hirano, 1956, p.66, pl.12, figs.10, 11; Vuorisalo, 1957, p.133; Croasdale, 1965, p.312; Zwart, 1969, p.173, fig.131; Mix, 1970, p.85, pl.4, fig.3; Islam, 1970, p.914, pl.5, fig.14; Förster, 1970, p.298, pl.9, figs.7, 8; Parra, 1975, p.32, fig.53; Werner, 1977, p.47, pl.5, fig.9; pl.19, fig.5; Růžička, 1977, p.282, pl.43, figs.1-3.

380-560 μ m long; 54-75 μ m broad; apices 29-40 μ m broad;

Cells large, 6-8 times longer than broad, semicells tumid, generally a little broader in the middle than at the base, gradually and considerably attenuated from the middle to the apex, with a slight but distinct basal inflation; apices truncate or convexo-truncate, with a ring of 13-15 small, depressed, apical tubercles, 7-8 visible across the apex; cell wall punctate.

(Pl.8, fig.9).

Local distribution: Akbarpura, Distt. Peshawar, Sarim

No. 30, Sept.25, 1976.

Geographical distribution: World wide.

CHARACTERS OF STAUSTRUM

6. STAUSTRUM Meyen ex Ralfs, Brit. Desm. p. 119. 1848.

Cells variable in size, ^{Solitary,} with the length (without processes, spines or other appendages) generally somewhat greater than the breadth, median constriction usually deep though at times scarcely discernible, sinus generally acute-angled and isthmus narrow; semicells cylindrical, ellipsoidal, triangular, campanulate, cyathiform, hexagonal or variously shaped; with the cell wall smooth or punctate, without ornamentation or bearing granules, mucros, denticulations, simple to emarginate verrucae, spines, or combinations of these ornamentations; angles of a majority of the species continued in processes of variable length, though usually long, that in turn almost always have some sort of ornamentation and usually terminate in a truncate end with short divergent spines, at times with bifurcate ends that resemble spines; processes ordinarily arising in one whorl though sometimes in two transverse series of whorls; vertical view at times with a bilateral symmetry though commonly with a radial symmetry; radially symmetrical species with triangular forms predominating though the 4-8 angled or radiate species not uncommon and with the number of angles as high as eleven in one whorl; chloroplast generally with a simple axile mass containing one pyrenoid and with deeply incised lobes of variable size running to each angle of the cell, at times, especially in the larger species, with several pyrenoids in each lobe and with various irregularities; in very rare instances with parietal chloroplasts; cells, particularly the plankton species, at times enclosed in a spherical gelatinous envelope.

KEY TO THE TAXA

1. Cell constriction deep.....2
1. Cell constriction slight.....6
 2. Sinus open or acute-angled...3
 2. Sinus subrectangular.....St. connatum
3. Semicells subelliptical.....4
3. Semicells otherwise.....5
 4. Cell sides straight.....St. polytrichum
 4. Cell sides concave.....St. erasum
 4. Cell sides convex.....St. tumidum
5. Semicells cuneate.....St. duacense
5. Semicells elliptical.....St. setigerum
5. Semicells subrhomboid-elliptic..St. punctulatum
5. Semicells subpyramidal; ~~tr~~ truncate..... St. hirsutum
6. Vertical view of cell triangular..... 7
6. Vertical view otherwise..... 8
7. Semicells cup-shaped..... St. gracile
7. Semicells elongated-cyathiform. St. elongatum
7. Semicells subcuneate..... St. manfeldtii
8. Sinus open..... St. margaritaceum var. subcontortum
8. Sinus a semicircular depression..... St. leptocladum var. sinuatum

DESCRIPTION OF THE PLANTS

1. Staurostrum connatum (Lund.) Roy & Biss. Jap. Desm. p.237. 1886.
- = St. dejectum var. connatum Lund. Desm. Suec. p.60, pl.3, fig.28. 1871. (Basionym).
- = St. hexacanthum Gay, Monogr. Ioc. Conj. p.67, pl.2, fig.9. 1884.

West, West & Carter, vol.5, 1923, p.15, pl.130, figs.6-8,

21-29.5 μm long without spines; 20-22.5 μm broad; isthmus 6.6-9.2 μm broad; spines 8-13 μm long.

Cells small, about as long as broad, or up to $1\frac{1}{2}$ times longer than broad, excluding the spines; deeply constricted, sinus subrectangular, often acute at the apex opening broadly; semicells obversely subsemicircular, ventral margin very strongly convex, dorsal margin nearly straight, or even slightly concave, upper angles of semicells somewhat acutely rounded, with a long erect spine projecting from each; vertical view triangular, lateral margins slightly concave, angles broadly rounded, spines very small. (Pl.9, fig.11, photo.71).

Local distribution: Warsak canal, Sarim No.286, Dec.16, 1978.

Geographical distribution: Europe, China, Japan, U.S.A., Pakistan.

2. St. duacense West & West, Brit. Freshw. Phytoplankt. p.220. 1909.

= St. pseudosebaldi ssp. duacense West, Alg. W. Ireland, p.184, pl.24, fig.1, 1892.

= St. bicornis Borge, Sverig. Chlor.2, p.24, fig.15. 1895.

West, West & Carter, vol.5, 1923, p.116, pl.148, fig.1;
Grönblad, 1948, p.424; Hirano, 1959, p.367, pl.67, fig.15.

32-38 μm long; breadth, including processes, 55-67 μm ;
breadth of isthmus 9-11 μm ; thickness 18 μm .

Cells of medium size, nearly twice as broad as long, including the processes; deeply constricted, sinus acute; semicells cuneate, broadening towards the apex, not inflated at the base, but sometimes with a minute granule on each lateral margin near the sinus; apex broad and straight, with a row of emarginate verrucae; angles produced to form long, horizontal processes, bifid at their extremity;

dorsal margin of processes verrucose, verrucae reduced to simple denticulations towards the tips; ventral margin of processes similarly ornamented; vertical view oval, the poles produced to form long processes tipped with a spine, margins smooth, with a series of emarginate verrucae just within; chloroplast axile with a central pyrenoid and 5 or 6 ridges. (Pl.9, fig.3, photo.65).

Local distribution: Wah Mughal Gardens, Sarim No.204, Jan. 7, 1978.

Geographical distribution: Europe, Pakistan, Japan.

3. St. elongatum Barker, in Quart. Jour. Micr. Sci. vol.9, p.424.1869.

= St. terebrans Nordst. Norges Desm. p.34, pl.1, fig.16. 1873.

West, West & Carter, vol.5, 1923, p.156, pl.151, figs.2-5;

Heimans, 1969, fig.2; Hosiaisluma, 1975, p.11, figs.1-4.

60-77 μ m long; 42-48 μ m broad with processes; breadth at base of semicell 14-15 μ m; isthmus 9 μ m broad.

Cells large, about 6 times longer than broad, excluding the processes; slightly constricted, sinus acute and open; semicells elongated cyathiform considerably swollen at the base, where there are 3 or 4 close decussating rows of granules; apex convex, somewhat truncate in the middle, with two emarginate verrucae, and two others just beneath; sides concave; upper angles produced to form short processes, parallel or slightly divergent, tipped with 3 minute spines, and with two or three series of acute denticulations; vertical view triangular, sides concave with 2 median emarginate verrucae, and 2 others just within the margin; angles produced to form short processes. (Pl.9, fig.10, photo.70).

Local distribution: Fatehpur, Distt. Swat, Sarim No.287, Dec.17, 1978.

Geographical distribution: Europe, U.S.A, Pakistan.

4. St. erasum Bréb. Liste Desm. p.143, pl.1, fig.28. 1856.

= St. brebissonii var. ordinatum Schmidle, Lappmark Susswasseralgen, p.53, pl.3, fig.1. 1898.

West, West & Carter, vol.5, 1923, p.71, pl.137, figs.9-11; Grönblad, 1956, p.31, pl.11, figs. 134, 135; Hirano, 1959, p.325, pl.11, fig.10; Croasdale, 1962, p.38, pl.7, fig.131; Croasdale & Grönblad, 1964, p.202, pl.19, fig.5; Croasdale, 1965, p.330, pl.8, fig.7.

30-42 μ m long without spines; 30-42 μ m broad without spines; isthmus 10-11 μ m broad.

Cells small, about as long as broad, deeply constricted, sinus acute, widening rapidly outwards; semicells subelliptical, ventral margin much more convex than the dorsal, which is subtruncate, angles broadly rounded and slightly retuse; cell wall thickly covered with short spines arranged in concentric circles round the angles, where they are longest, and becoming very much reduced towards the centre of the faces; vertical view triangular, sides concave, centre of apex nearly or quite smooth. (Pl.9, fig.12).

Local distribution: Mangopir, Karachi, Sarim No.274, April 5, 1978.

Geographical distribution: Europe, U.S.A, Japan, Pakistan.

5. St. gracile Ralfs, Brit. Desm. p.136, pl.22, 1848.

= St. gracile Ralfs, in Ann. Mag. Nat. Hist. p.155, pl.11, fig.3.1845.

= Phycastrum gracile Kg. Spec. Alg. p.181, 1849.

= Didymidium (Staurastrum) gracile Reinsch, Algenfl. Frank. p.166. 1867.

West, West & Carter, vol.5, 1923, p.96, pl.144, figs.3-7; Smith, 1924, p.38, fig.9; Taylor, 1935, p.191, pl.39, fig.13; Irénée-Marie, 1951, p.319; Tiffany & Britton, 1952, p.199, pl.55, fig.613; Grönblad, 1952, p.79; Tibor, 1956, p.203, fig.23; Thomasson,

1957, p.256; Hirano, 1959, p.361, pl.64, fig.30; pl.65, fig.4; Lind, 1967, p.378, pl.7, figs.6, 6a; Zwart, 1969, p.173, figs.156, 157; Pickett-Heaps, 1973, p.114, fig.1; Hickel, 1973, p.840; Pickett-Heaps, 1974, p.4, figs.8, 9; Parra, 1975, p.46, fig.159; Parra & Gonzales, 1977, p.29, figs. 208-210; Uherkovich, 1978, p.17, pl.5, fig.17.

27-60 μm long; 44-110 μm broad with processes; isthmus 5.5-13 μm broad.

Cells variable, usually of small or medium size, 2-2½ times longer than broad, excluding the processes; slightly constricted, usually an acute notch; semicells variable in form, more or less cup-shaped; lower angles broadly rounded, lateral margins nearly vertical or slightly diverging, rarely slightly concave, semicells usually broadening slightly towards the apex, upper angles produced to form long slender processes of variable length, each tipped with three or four minute spines, and provided with several concentric series of denticulations; processes usually horizontal, sometimes slightly converging; vertical view usually triangular; sides straight or rarely slightly concave, angles produced to form long processes, lateral margins often with a series of minute granulations, sometimes paired, just within the margin; chloroplast axile, with a central pyrenoid in each semicell. (Pl.9, fig.15, photo. 72).

Local distribution: Waste water channel of Packages Ltd. Lahore, Sarim No.47, Oct. 21, 1976.

Geographical distribution: Europe, Canada, Africa, Ceylon, India, Japan, U.S.A., Pakistan, Chile.

6. St. hirsutum (Ehr.) Bréb. ex Ralfs, Brit. Desm. p.127, pl.22, fig.3, 1848.
- = Xanthidium hirsutum Ehr. Org. kl. Raum. p.318, 1834.
- = Euastrum hirsutum Kg. Phyc. Germ. p.137, 1845.
- = Staurastrum muricatum Ralfs, in Ann. Mag. Nat. Hist. pl.11. fig. 1a. 1845.
- = Phycastrum apiculolum Kg. Spec. Alg. p.182. 1849.
- = Staurastrum muricatum Nordst. Desm. Bornh. p.203, pl.6. fig. 19. 1888.
- = St. pilosum forma minor Witttr. & Nordst. Alg. exsic. No.1474 (vide, West & West, 1923).

West, West & Carter, 1923, vol.5, p.65, pl.138, figs.4-6.

34-44 μ m long without spines; 31-35 μ m broad without spines; isthmus 10-13 μ m broad; spines 1.5-2 μ m long.

Cells small, up to $1\frac{1}{2}$ times longer than broad, deeply constricted, sinus narrow nearly linear for some distance, then opening more widely; semicells subpyramidal-truncate, usually widest near the base, angles broadly rounded; cell wall covered with delicate hair-like spines arranged in concentric series round the angles; vertical view triangular, sides nearly straight, rarely very slightly convex or concave, angles obtusely rounded, centre of apex smooth; chloroplast axile, with a central pyrenoid in each semicell. (Pl.9, fig.4. photo.66).

Local distribution: Akbarpura Distt. Peshawar, Sarim No.30, Sept. 25, 1976.

Geographical distribution: Europe U.S.A., Pakistan.

7. St. leptocladum Nordst. var. sinuatum Woll. Bull. Torr. Bot. Club, p.10, fig.20. 1883.

Smith, 1924, p.104, pl.78, figs.12-14; Whitford & Schumacher, 1973, p.77, pl.33, fig.6.

65-68 μm long with processes; 25-29 μm long without processes; breadth with processes 80-93 μm ; without processes 12-15 μm ; isthmus 7-8 μm broad; thickness 10 μm .

Cells with the body much narrower and with the bases of the semicells not inflated, without ornamentation except for an apical notch; slightly constricted and sinus a semicircular depression; vertical view of semicell elliptic; processes arising at the same point and not lying in the same plane. (Pl.9, fig.6, photo. 68).

Local distribution: Naguman River Distt. Peshawar, Sarim No.50, Oct. 25, 1976.

Geographical distribution: U.S.A., Pakistan.

8. St. manfeldtii Delp. Sp. Desm. subalp. p.160, pl.13, figs.6-19.1877.

West, West & Carter, vol.5, 1923, p.114, pl.148, fig.2; Cedercreutz & Grönblad, 1936, p.6, fig.16; Irénée-Marie, 1951, p.324; Hirano, 1959, p.368, pl.68, fig.1; Grönblad, 1960, p.48, pl.12, figs. 238, 239; Fritsch, 1961, fig. 108; Zwart, 1969, p.173, figs.154, 155; Thomasson & Tyler, 1971, pl.5, figs. f, g, g; pl.6, fig. b; Grönblad & Croasdale, 1971, p.21, pl.9, fig.125; Pickett-Heaps, 1973, p.114, figs.3,4; Pickett-Heaps, 1974, p.4, figs. 11-13; Islam & Zaman, 1975, p.53, pl.7, fig.111; Gough, Garvin & Woelkerling. 1976. fig.7; Parra & Gonzales, 1977, p.29, figs. 216, 217.

42-57 μm long; 55-101 μm broad including processes; isthmus 9-13 μm broad.

Cells of medium size, about $1\frac{1}{2}$ times broader than long, including the processes; slightly constricted; semicells subcuneate, broadening towards the apex, which is slightly convex and provided with a row of emarginate or irregular verrucae; upper angles produced to form tapering processes tipped with three minute spines, and

covered with several series of denticulations which are sometimes continued over the body of the semicell itself, processes slightly converging or nearly horizontal; vertical view usually triangular, sides straight or very slightly convex, angles produced to form processes with slightly undulating margins, with a series of emarginate verrucae just within each lateral margin. (Pl.9, fig.13).

Local distribution: Cherat, Sarim No.240, Feb. 14, 1978.

Geographical distribution: Europe, India, China, Pakistan, Canada, Japan, Chile.

9. St. margaritaceum (Ehr.) Ralfs, var. subcontortum West & West, Alg. S. England, p.496, pl.17, fig.15. 1897.

West, West & Carter, vol.5, 1923, p.134, pl.150, fig.12.

26 μ m long; 25-27 μ m broad; isthmus 9 μ m broad.

Cells about as long as broad, cell slightly constricted; sinus open; semicells subspherical; processes truncate and all curved in one direction. (Pl.9, fig.8).

Local distribution: Sasnamana Ziarat, Baluchistan, leg. Khial Badshah, Sarim No.130, Jan. 15, 1977.

Geographical distribution: Europe, Pakistan.

10. St. polytrichum (Perty) Rabenh. Flor. Europ. Alg. p.214, 1868.
 = Phycastrium polytrichum Perty, Kleinst. Lebensf. p.210, pl.16, fig.24. 1852. (Basionym).
 = Staurostrum pringsheimii Reinsch, Spec. Gen. Alg. p.22, pl.5, fig.1. 1867.
 = St. pringsheimii var. duplo-major Turn. New Rare Desm. p.939, pl.16, fig.24. 1885.
 = St. teliferum var. convexum Benn. Alg. Engl. Lake Distr. p.11, pl.2, fig.21. 1886.

West, West & Carter, vol.5, 1923, p.53, pl.136, figs.8-10;
 Hirano, 1959, p.324, pl.61, fig.23; Croasdale, 1948, p.10; Croasdale, 1962, p.39, pl.7, fig.130; Lenzenweger, 1966, p.505, pl.3, fig.18;

Lenzenweger, 1976, p.69, pl.2, fig.6; Werner, 1977, p.65, pl.14, fig.5; pl.30, fig.1.

48-67 μm long without spines; 54-80 μm with spines; breadth without spines 41-48 μm ; with spines 50-70 μm ; isthmus 15-22 μm broad; spines 5-11 μm long.

Cells of medium size, about $1\frac{1}{2}$ times longer than broad, deeply constricted, sinus acute and sometimes fairly open; semicells subelliptical, cell wall covered with fairly long acute spines, arranged in obscure circles round the angles and sometimes visible as longitudinal rows on the faces; vertical view triangular, sides straight, angles somewhat obtusely rounded, spines becoming shorter towards the centre of the apex, which is quite smooth. (Pl.9, fig.5, photo.67).

Local distribution: Akbarpura, Distt. Peshawar, Sarim No. 30, Sept. 25, 1976.

Geographical distribution: Europe, Russia, U.S.A, Japan, Pakistan.

11. St. punctulatum Bréb. ex Ralfs, Brit. Desm. p.133, pl.22, fig.1. 1848

= Didymidium (Staurostrum) punctulatum Reinsch, Algenfl. Frank. p.159. 1867.

= Staurostrum punctulatum forma contorta Schmidle, Beitr. alp. Alg. p.62, 1896.

West & West, vol.4, 1912, p.179, pl.127, figs.8-11; 13, 14; Taylor, 1935, p.197, pl.35, fig.8; Irénée-Marie, 1951_a, p.329; Tiffany & Britton, 1952, p.198, pl.54, fig.603; Hirano, 1955, p.41; Hirano, 1959_a, p.299, pl.38, fig.13; Mattern, 1964, p.252; Lenzenweger, 1966, p.502, pl.3, fig.5; Lind, 1967, p.380, pl.7, fig.12; Förster, 1970, p.340, pl.26, fig.25; Whitford & Schumacher, 1973, p.78, pl.36, fig.17; Parra, 1975, p.48, fig.140; Werner, 1977, p.65, pl.15, fig.5;

Parra & Gonzales, 1977, p.30, fig.180; Hirano, 1977, p.220;
Watanabe, 1978, p.119, pl.4, fig.J.

26-40.5 μm long; 23-36.5 μm broad; isthmus 8-16 μm broad.

Cells small, a little longer than broad, deeply constricted, often twisted at the isthmus, sinus open and acute-angled, semicells subrhomboid-elliptic, dorsal and ventral margins about equally convex, angles somewhat actually rounded; vertical view triangular, side view slightly retuse in the middle; angles of one semicell often partly or entirely alternating with those of the other; cell wall uniformly granulate with flattened granules, which are in regular series around the angles. (Pl.9, fig.9, photo.69).

Local distribution: Malmandi, Peshawar, Sarim No.316,
Feb. 2, 1979.

Geographical distribution: World wide.

12. St. setigerum Cleve Sverig. Desm. p.490, pl.4. 1864.

= St. royanum Arch. in Quart. Jour. Micr. Sci. vol.17, p.103.1877.

West, West & Carter, vol.5, 1923, p.52, pl.136, figs.13,14.

50-56 μm long without spines; 42-45 μm broad without spines;
isthmus 14.5-17 μm broad; spines 15-20 μm long.

Cells of medium size, a little longer than broad, deeply constricted, sinus acute and open; semicells elliptical, ventral margin more convex than the dorsal, angles obtusely rounded and provided with 2-5 usually 3 long stout spines arranged in a vertical row, or sometimes in a circle; surface of cell provided with a number of long but more delicate spines than those at the angles, arranged in distant obscure circles round the angles; vertical view triangular, sides nearly straight, angles rather acutely rounded; chloroplast axile, with a central pyrenoid in each semicell.
(Pl.9, fig.7).

Local distribution: Quetta Baluchistan, leg. Jan Mohd, Sarim No.270, April 4, 1978.

Geographical distribution: Europe, U.S.A, Africa, Pakistan.

13. St. tumidum Bréb. ex Ralfs, Brit. Desm. p.126, pl.21, fig.6.1848.
 = Binatella tumida Bréb. Alg. Falaise, p.269. 1835.
 = Phycastrum tumidum Kg. Spec.Alg. p.179. 1849.
 = Pleurenterium tumidum (Bréb.) Wille in Engler & Prantl, Nat. Pflanzenfam. p.11. 1890.
 = Temperea tumida (Bréb.) Bougon in Le Microg. preparateur, p.68. 1897.

West & West, vol.4, 1912, p.142, pl.122, figs.1-5.

112-134 μ m long; 90-127 μ m broad; isthmus 44-50 μ m broad.

Cells very large, a little longer than broad, deeply constricted, sinus open and acute-angled with a slightly rounded apex; semicells very broadly subelliptic, apex generally a little flattened and sometimes faintly concave in the middle, lateral angles with a small button-like thickening, which is sometimes replaced by a small, solid mamilla; vertical view triangular, rarely quadrangular, with strongly convex sides, and a small projecting mamilla at each angle; cell wall punctate; chloroplasts forming 4-6 parietal cushions in each semicell. (Pl.9, fig.14).

Local distribution: Sialkot, Sarim No.265, April 1, 1978.

Geographical distribution: Europe, U.S.A, Pakistan.

CHARACTERS OF TRIPIOCERAS

7. TRIPLOCERAS Bail. Microscop. Observ. p.37. 1851.

Cells large, ^{solitary,} length several times the breadth, median constriction well defined but shallow; semicells cylindrical, always straight, somewhat attenuated from bases to poles, never compressed, with lateral margins strongly undulate; undulations caused by transverse whorls of mamillate protuberances that

terminate in a single spine or broadly emarginate verrucae; poles flattened and with two long, upturned, divergent, obliquely disposed processes with truncate ends that bear 2-3 short sharp spines (front view of polar processes giving the cell apices a deeply incised appearance) ; apex with a protuberance midway between bases of processes that bears one or two erect spines; cell wall, except for verrucae smooth; chloroplasts axile, with longitudinal plates that extend from semicell base to apex; pyrenoids in an axile row.

1. Triploceras gracile Bail. Microscop. Observ. p.38, pl.1, fig.10. 1851.

= T. gracile Bail. forma kowdense Roll. 1923 (vide, Růžická, 1977).
Smith, 1924, p.19, pl.55, figs.5, 6; Taylor, 1935, p.248, pl.67, figs.3, 4; Smith, 1950, p.321, fig.231; Irénée-Marie, 1952, p.24; Prescott, 1954, p.70, fig.100; Grönblad, 1956, p.24, fig.19; Hirano, 1956, p.72, pl.15, figs.3, 4; Schumacher, 1960, p.63; Wasylik, 1961, p.18, pl.1, fig.3; Islam, 1970, p.915, pl.2, fig.3; pl.5, fig.9; Whitford & Schumacher, 1973, p.68, pl.17, fig.38; Gough, Garvin & Woelkerling, 1976, fig.11; Lenzenweger, 1977, p.336, pl.1, fig.2; Růžická, 1977, p.288, pl.44, figs.9-13; Lenzenweger, 1978, p.1, fig.1.

368-550 μm long; 27.5-31.5 μm broad at basal whorl with verrucae, 18-25 μm broad at apical whorl with verrucae, 10-12.5 μm broad just above apical whorl.

Cells large, length 12-20 times the breadth; median constriction fairly well defined; semicells cylindrical, somewhat attenuated at poles, without line of lateral margins strongly undulate, undulate outline caused by transverse whorls of mamillate protuberances that terminate in acute, horizontally disposed,

spinate verrucae in inferior portion of semicell and upwardly disposed spinate verrucae in superior portion, semicell apices flattened and with two fairly long, divergent, obliquely disposed, truncate processes terminating in two or three short spines; apex also with a single, rarely two mamillate protuberance arising midway between the bases of the polar processes and terminating in an acute erect spine; vertical view of pole elliptic, with poles terminating in spines and each lateral margin with a single, alternately disposed, truncate process; cell wall without pores; chloroplast axile with 6-8 straight delicate longitudinal ridges extending from semicell base to apex; pyrenoids fairly numerous and forming an axile row. (Pl.9, fig.1, photo.63).

Local distribution: Naguman River, Distt. Peshawar, Sarim No.50, Oct.25, 1976.

Geographical distribution: World wide.

CHARACTERS OF DOCIDIUM

8. DOCIDIUM Bréb. in Ralfs Brit. Desm. p.155. 1848.

Cells solitary, relatively small, straight, length several times the breadth, cylindrical; median constriction shallow, sinus always widely open, isthmus breadth practically the same as the breadth of the cell; semicells with straight or undulate sides and with truncate apices that are without ornamentation, inflated bases of semicells always with short vertical plications that frequently have a granule at the base of each plication; cell wall smooth, finely punctate, or with delicate vertical striae; chloroplasts axile and with irregular longitudinal ridges; with 6-8 pyrenoids arranged in an axile series.

1. Docidium undulatum Bail. Microscop. Observ. p.36, pl.1, fig.2.1851.
- = Pleurotaenium undulatum Rabenh. Flor. Europ. Alg. p.104. 1868.
- = Docidium dilatatum Lund. Desm. Suec. p.88, pl.5, fig.12. 1871.
- = D. dilatatum (Cleve) Lund. var. subundulatum W. West 1892.
(vide, Růžicka, 1977).
- = D. undulatum Bail. var. bisannicum Ducell. 1919 (vide, Růžicka, 1977).

West & West, vol.1, 1904, p.194, pl.27, figs.7-10; Smith, 1924, p.18, pl.55, fig.4; Prescott, 1954, p.71, fig.101; Hirano, 1956, p.58, pl.10, fig.14; Heimans, 1969, p.54; Förster, 1969, p.28, pl.6, fig.23; Whitford & Schumacher, 1973, p.67, pl.17, fig.39; Růžicka, 1977, p.248, pl.35, figs.8-19.

205 μ m long; 15 μ m broad at basal inflation, 12.5 μ m at apex.

Length about 15 times the breadth, cells very slightly constricted, sinus widely open; semicells with sides strongly undulate, (6-8 undulations between isthmus and apex) and apex narrowly obversely trapezoidal, angles of apex rounded and top flattened; basal plications ending in a small granule on the end towards the isthmus, about six visible in front view of semicell; cell wall smooth; chloroplast with an axile row of about eight pyrenoids. (Pl.9, fig.2, photo.64).

Local distribution: Zoological Gardens Lahore, Tank No.1, Sarim No.45, Oct. 20, 1976.

Geographical distribution: Europe, U.S.A, Japan, Pakistan.

CHARACTERS OF XANTHIDIUM

9. XANTHIDIUM Ehr. ex Ralfs, Brit. Desm. p.111. 1848.

Cells of variable, ^{solitary,} though generally of medium size; length frequently somewhat greater than the breadth, median constriction deep and sinus linear to acute-angled; semicells almost universally compressed, very rarely radially symmetrical, of variable shape, though usually polygonal and with apex flattened but not incised;

lateral margins with angles that bear simple, rarely furcate, spines; spines asymmetrically disposed with reference to the vertical plane; vertical view elliptic; lateral view of semicells circular to polygonal; cell wall smooth to punctate, with a thickened protuberant area in the middle of the cell face that frequently is scrobiculate; chloroplasts generally parietal; pyrenoids usually single in each chloroplast.

KEY TO THE TAXA

1. Cell with spines 116-185 μm long..... X. armatum
1. Cell with spines 27.5-38 μm long..... X. smithii
1. Cell 54-114 μm long..... 2
 2. Semicells subelliptic-hexagonal, cell with spines 54-114 μm long.... X. antilopaeum
 2. Semicells trapeziform-subsemicircular, cell with spines 60-77 μm long..... X. cristatum
 2. Semicells angular-reniform, cell with spines 65-74 μm long.... X. fasciculatum
 2. Semicells subcircular, cell with spines 65-74 μm long..... X. cristatum var. leiodermum
 2. Semicells subsemicircular, cell with spines 79-101 μm long..... X. brebissonii

DESCRIPTION OF THE PLANTS

1. Xanthidium antilopaeum (Bréb.) Kg. Spec. Alg. p.177 .1849.
 - = Heterocarpella antilopaea Bréb. in Cheval. Desm. microscop. et. usage, Paris, p.272. 1839.
 - = Xanthidium fasciculatum Ehr. a. Ralfs in Ann. Mag. Nat. Hist. p.466, pl.12, fig.3a. 1845.
 - = X. polygonum Hass. Brit. Freshw. Alg. p.360, pl.89, fig.4. 1845.
 - = X. antilopaeum var. hirsutum Gay, Monogr. Ioc. Conj. Montpellier, p.77. 1884.

- = X. spinulosum Benn. Freshw. Alg. Engl. Lake Distr. p.10, pl.2, fig.17. 1886.
 - = X. antilopaeum var. ornatum Anderss. Sverig. Chlor. p.13, pl.1, fig.6. 1890.
 - = X. fasciculatum var. ornatum Schmidle, Beitr. Algenfl. Schwarzwald. u. Rheineb. p.94, pl.4, fig.6. 1893.
 - = X. antilopaeum var. fasciculoides Lütken. Desm. Attersees, p.547. 1893.
 - = X. antilopaeum var. Schmidlei Borge in Nuova Notarisia, p.25.1895.
- West & West, vol.4, 1912, p.63, pl.108, figs.7-18; Smith, 1924, p.57, pl.65, figs.5, 6; Taylor, 1934, p.275, pl.57, fig.8; Prescott, 1934, p.139, pl.16, fig.6; Irénée-Marie, 1949, p.314, p.4, fig.46; Grönblad, 1952, p.26, pl.1, fig.21; Croasdale, 1957, p.120, pl.I, fig.1; Scott & Prescott, 1958, p.55; Grönblad & Ruzicka, 1959, p.222, fig.38; Fritsch, 1961, fig.110; Brandham, 1965, p.46, fig.6; Croasdale, 1965, p.328, pl.6, fig.12; Prescott, 1966, p.24, pl.II, fig.4; Lenzenweger, 1967, p.173, pl.6, fig.1; Zwart, 1969, fig.133; Islam, 1970, p.928, pl.7, fig.3; Förster, 1970, p.325, p.25, fig.9; Whitford & Schumacher, 1973, p.75, pl.32, fig.10; Lenzenweger, 1974, p.114, pl.2, fig.14; Parra, 1975, p.42, fig.122; Parra & Gonzales, 1977, p.25, fig.134; Hirano, 1977, p.219; Lenzenweger, 1978, p.3, pl.2, fig.7.

Length without spines 42-76 μm ; with spines 54-114 μm ; breadth without spines 42-72 μm ; with spines 57-108 μm ; breadth of isthmus 14.5-26 μm ; thickness 21-37 μm .

Cells of medium size, about as long as broad (without spines), deeply constricted, sinus somewhat variable in depth (according to form of basal half of semicell), shortly linear with a slightly dilated extremity, semicells subelliptic-hexagonal, all the angles very slightly rounded, sides and apex usually straight, each of the four exposed angles with a pair of simple, straight

or slightly curved, fairly long spines, central area of moderate size, generally round, more rarely elliptic, thickened and variously scrobiculated; side view of semicell circular or subcircular, with a slight thickening at each side, and a pair of diverging spines on the apical margin; vertical view elliptic with a slight thickening, often somewhat protuberant at the middle on each side, and a with a pair of slightly divergent spines on each polar margin; cell wall finely punctate; chloroplasts generally parietal, four in each semicell, each with one or more rarely with two, pyrenoids; sometimes irregular, and not infrequently wholly axile.
(Pl.10, fig.1, photo.73).

Local distribution: Lundkhwar, Distt. Mardan, Sarim
No.319, Feb.5, 1979.

Geographical distribution: World wide.

2. X. armatum (Bréb.) Rabenh. ex Ralfs, Brit. Desm. p.112, pl.18, figs. a-e; 1848.
- = Cosmarium armatum Bréb. in Menegh. Synops. Desm. p.218. 1840.
- = Euastrum armatum Kg. Phyc. germ. p.137.1845.
- = Xanthidium furcatum Ralfs in Ann. Mag. Nat. Hist. p.466, pl.12, fig.1. 1845.
- = Euastrum bigorrianum Perty in Mitt. d. nat. Ges. Bern. p.174. 1849.
- = Zygoxanthium bigorrianum Perty, Kleinst. Lebensf. p.200, pl.16, fig.23. 1852.
- = Didymidium (Xanthidium) armatum Reinsch, Algenfl. Frank. p.129. 1867.
- = Xanthidium bigorrianum (Perty) Rabenh. Flor. Europ. Alg. p.222. 1868.
- = X. armatum var. wolleanum Turn. New and Rare Desm. p.938, pl.15, fig.18. 1885.
- = Schizacanthum armatum (Bréb.) Wille in Engler & Prantl, Nat. Pflanzenfamil. p.11, fig.7E. 1890.
- = X. armatum var. supernumerarium Schmidle, Beitr. alp. Alg. p.348, pl.15, fig.8. 1895.

West & West, vol.4, 1912, p.51, pl.104, figs. 1-5;
 Smith, 1924, p.56, fig.6; Taylor, 1934, p.275, pl.57, fig.13;
 Grönblad, 1948, p.417; Fritsch, 1961, fig.107; Croasdale &
 Grönblad, 1964, p.189, pl.15, fig.13; Ochiai, 1966, p.125, fig.22;
 Lenzenweger, 1967, p.176, pl.7, fig.1; Eloranta, 1968, p.61, fig.5;
 Hinode, 1971, p.119, pl.9, fig.16; Hosiaisluma, 1973, p.12;
 Whitford & Schumacher, 1973, p.75, pl. 30, fig.9.

Length with spines 116-185 μm ; breadth with spines
 78-127 μm ; breadth of isthmus 30-43 μm ; thickness 63-88 μm .

Cells large, from $1\frac{1}{3}$ to $1\frac{1}{2}$ times as long as broad,
 deeply constricted, sinus open and acute-angled, somewhat acuminate
 at the extremity, semicells octangular, lower margins slightly
 concave but not infrequently straight, apex straight or slightly
 convex, with the two lateral angles and the apical angle on each
 side with short, stout, solid, water-like spines, which are 2-4,
 commonly 3, furcate at the apex with a similar stout furcate spine
 within each lateral angle and with a pair just within the apex,
 all of which are subject to variation, in the centre of the
 semicell with a ring of simple or emarginate teeth representing
 the serrated edge of a large central wart; side view of semicell
 ovate-rectangular, near the base on each side with a large truncate
 toothed wart, apical angle with 2-3 furcate spines, and with two
 similar furcate spines at the truncate apical margin; vertical
 view elliptic-oblong with subtruncate poles, with a large truncate
 toothed wart at the middle on each side, and with 2-3 furcate
 spines at equal intervals along each polar margin; cell wall
 punctate; chloroplasts sometimes distinctly parietal; ... semicell,
 each with several pyrenoids. (Pl.10, fig.5, photo.75).

Local distribution: Peshawar, Sarim No.63, Nov. 21, 1976;
Bannu, Sarim No.231, Feb.1, 1978:

Geographical distribution: Europe, Japan, U.S.A, India,
Pakistan.

3. X. brebissonii Ralfs, Brit. Desm. p.112, pl.19, fig.2. 1848.
= Binatella aculeata Breb. Alg. Falaise, p.58, pl.8. 1835.
= Holacanthum brebissonii Migula, Kryptog. in Flor. Deutschl.,
Österr u. Schweiz, Bd. 5, p.516, pl.28, fig.6. 1906.

West & West, vol.4, 1912, p.77, pl.11, figs.1,3, Fritsch,
1961. fig.108H.

Length without spines 61-80 μm ; with spines 79-101 μm ;
breadth without spines 62-76 μm ; with spines 80-104 μm ; breadth
of isthmus 18-27 μm ; thickness 36-50 μm .

Cells of medium size, about as long as broad (without
spines), deeply constricted, sinus almost closed at the apex but
opening outwards, semicells subsemicircular, base slightly convex
and apex a little flattened in the middle, with 8 or 10 pair of
stout marginal spines, central area strongly protuberant and
truncate, with a circle of 12-13 prominent granules; side view
of semicell subcircular with a truncate granulated protuberance at
the middle on each side and two or three spines at the apical margin;
vertical view elliptic, with 2 or 3 spines at each pole, and a
truncate granulated protuberance at the middle on each side.
(Pl.10, fig.3).

Local distribution: Sardheri, Distt. Peshawar, Sarim
No.31, Sept. 26, 1976.

Geographical distribution: Europe, Pakistan.

4. X. cristatum Bréb. ex Ralfs, Brit. Desm. p.115, pl.19, fig.3.1848.
 = Didymidium (Xanthidium) cristatum (Bréb.) Reinsch, Algenfl. Frank. p.127. 1867.
 = Xanthidium cristatum var. reniforme Cooke, Brit. Desm. p.133.1887.
 = Holocanthum cristatum (Bréb.) Wille in Engler & Prantl, Nat. Pflanzenfam. p.11, fig.7D. 1890.

West & West, vol.4, 1912, p.70, pl.111, figs.8,9; Smith, 1924, p.59, pl.66, figs.2,3; Taylor, 1934, p.275, pl.57, fig.2; Irénée-Marie, 1957, p.126; Grönblad, 1960, p.44, p.7, fig.144; Wygasch, 1963, p.107, fig.21; Lenzenweger, 1967, p.174, pl.6, fig.5; Lenzenweger, 1977, pl.1, fig.12.

Length without spines 44-55 μm ; with spines 60-77 μm ;
 breadth without spines 34.5-48 μm ; with spines 48-68 μm ; breadth
 of isthmus 13-15.5 μm ; thickness 25-32.5 μm .

Cells of medium size, a little longer than broad (without spines), deeply constricted, sinus rather variable, sometimes narrowly linear with a dilated extremity and sometimes slightly open; semi-cells trapeziform-subsemicircular, with a broad, subreniform, flat, or somewhat convex base, and with a basal lateral and apical angle on each side, apex truncate and generally straight and basal angles with a single slightly convergent spine, lateral and apical angles each with a pair of divergent spines, spines all simple and straight, central area differentiated into a small thickened protuberance, generally with a slight vertical elongation; side view of semicells circular, with a more or less flattened protuberance at the middle on each side, and with a pair of divergent spines at the apical margin; vertical view elliptic, with a small protuberance at the middle on each side, and three slightly divergent spines at each pole; cell wall punctate. (Pl.10, fig.2).

Local distribution: University Campus, Peshawar, Sarim No.55, Oct. 27, 1976.

Geographical distribution: Europe, India, Canada, U.S.A, Pakistan.

5. X. cristatum Bréb. ^{ex Ralfs} / var. leiodermum (Roy & Biss.) Turn. Freshw. Alg. E. India, p.99, pl.12, fig.33. 1893.
 = X. leiodermum Roy & Biss. Jap. Desm. p.240, pl.268, fig.11.1886. (Basionym).
 = X. glabrum Lagerh. Krit. Bemerk. Desm. p.539. 1887.

West & West, vol.4, 1912, p.72, pl.110, fig.11.

48-54 μm long without spines; with spines 65-74 μm ; 36-39 μm broad without spines, with spines 53-55 μm ; breadth of isthmus 11-13 μm ; thickness 25-30 μm .

Central area not protuberant, slightly thickened and sometimes of a yellow colour; semicells subcircular; cell wall smooth. (Pl.10, fig.4, photo.74).

Local distribution: Pabbi, Distt. Peshawar, Sarim No.48, Oct.22, 1976.

Geographical distribution: Europe, India, Japan, U.S.A, Pakistan.

6. X. fasciculatum Ehr. ex Ralfs, Brit. Desm. p.114, pl.19, fig.4. 1848.
 = X. fasciculatum Ehr. Infus. p.147, pl.10, fig.24b. 1838.
 = X. fasciculatum var. polygonum Ralfs in Ann. Mag. Nat. Hist. p.466, pl.12, fig.3e. 1845.
 = Euastrum fasciculatum Kg. Phyc. german. p.137. 1845.
 = Didymidium (Xanthidium) fasciculatum Reinsch, Algenfl. Frank. p.126. 1867.
 = Xanthidium fasciculatum var. ornatum Nordst. Desm. Grönland, p.12, pl.7, fig.10. 1885.
 = Holacanthum fasciculatum Franze in Oesterr. Bot. Zeitschr. p.384. 1893.

West & West, vol.4, 1912, p.75, pl.111, figs.6-8.

44-66 μm long without spines, with spines 65-74 μm ;
44-59 μm broad without spines, with spines 62-72 μm ; breadth of
isthmus 12-21 μm ; thickness 31-40 μm .

Cells of medium size, about as long as broad (without spines), deeply constricted, sinus linear, sometimes with a dilated extremity; semicells angular-reniform, margin with six equidistant pairs of simple and often rather short spines, apex subtruncate, central area rather small, and slightly protuberant, with a ring of 7-10 granules around a central group of 2 or 3 rarely smooth; side view of semicell subcircular, with a slight protuberance at the middle on each side, and a pair of divergent spines at the apical margin; vertical view elliptic, with a slight protuberance at the middle on each side, and a pair of divergent spines at each pole. (Pl.10, fig.6).

Local distribution: Multan, Sarim No.252, March 29, 1978.

Geographical distribution: Europe, India, Africa, U.S.A, Pakistan.

7. X. smithii Arch. Proc. Dubl. Nat. Hist. Soc. p.51, pl.1, fig.10.
1860.

= Arthrodesmus octocornis Ehr. var. major Roy & Biss. Scott Desm.
pl.2, fig.20. 1894.

West & West, vol.4, 1912, p.61, pl.108, figs.1-4; pl.111, fig.10; Vuorisalo, 1969, p.108, fig.24; Parra & Gonzales, 1977, p.25, fig.136; Lenzenweger, 1978, p.3, pl.2, fig.6.

Length without spines 21-30 μm ; with spines 27.5-38 μm long; without spines 19-28 μm ; broad; breadth of isthmus 8-11 μm ; thickness 12-16 μm .

Cells small, deeply constricted, sinus open and acute-angled with a rounded apex; semicells rectangular-trapeziform, basal and apical angles rounded, sides and apex very slightly concave or almost straight, each angle with a pair of simple straight and fairly long spines, with a small thickened area in the centre of the semicell; side view of semicell circular, with a small protuberance at the middle on each side, and with a pair of diverging, spines of the apex; vertical view elliptic-rhomboid, with a small rounded protuberance at the middle on each side, and with a pair of diverging spines at each pole. (Pl.10, fig.7, photo.76).

Local distribution: Akbarpura, Sarim No.30, Sept. 25, 1976.

Geographical distribution: Europe, Chile, Pakistan.

CHARACTERS OF ARTHRODESMUS

10. ARTHRODESMUS Ehr. ex Ralfs, Brit. Desm. p.117; 1848.

Cells solitary, generally small, with the length usually equal to the breadth, usually compressed and bilaterally symmetrical in front view, rarely triangular in vertical view and with a radial symmetry, median constriction pronounced and with sinus widely open to linear; semicells in front view generally triangular, rarely elliptic, subtrapeziform or subrectangular, with simple straight or curved spines at the angles, spines lying in the same plane; vertical view usually elliptic and with spines at the poles, rarely triangular; lateral view of semicells subcircular; cell wall of uniform thickness and without ornamentation on body of semicells; cells sometimes embedded in a wide gelatinous sheath with blunt radial strands of denser mucilage; chloroplasts axile, with one pyrenoid.

KEY TO THE TAXA

1. Semicells subrectangular..... A. bulnheimii
1. Semicells otherwise..... 2
 2. Apex concave..... 3
 2. Apex otherwise..... 4
3. Semicells elliptic - lunate..... A. bifidus
3. Semicells trapeziform - rectangular..... A. octocornis
 4. Semicells triangular..... A. triangularis
 4. Semicells subtriangular..... A. triangularis var. subtriangularis

DESCRIPTION OF THE PLANTS

1. Arthrodesmus bifidus Bréb. Liste Desm. p.135, pl.1, fig.19. 1856.

West & West, vol.4, 1912, p.113, pl.117, figs.11-13.

10-14 μm long including the minutely spinate angles;

11-15.5 μm broad; breadth of isthmus: 3-5.6 μm ; thickness 5-6.5 μm .

Cells minute, about as long as broad, deeply constricted, sinus open, subrectangular, with a minute acuminate extremity; semicells elliptic-lunate with the angles upwardly divergent, apex slightly concave, each lateral angle widely emarginate-bifid; vertical view narrowly elliptic, with a minute spine at each rounded pole; cell wall smooth; chloroplasts axile, one in each semicell, with a central pyrenoid. (Pl.10, fig.8).

Local distribution: Sasnamana Ziarat, Baluchistan, leg.

Khial Badshah, Sarim No.129, Jan. 15, 1977.

Geographical distribution: Europe, Japan, U.S.A., Pakistan.

2. A. bulnheimii Racib. Desm. Nowe, p.95, pl.16, fig.17. 1889.

= A. incus Bulnh. Hedwigia, p.51, pl.9, fig.3, 1861.

West & West, vol.4, 1912, p.105, pl.116, figs.1, 2;

Smith, 1924, p.127, pl.84, figs.7, 8; Irénée-Marie, 1952, p.17;

Vuorisalo, 1969, p.108, fig.23; Gough, Garvin & Woelkerling, 1976,

fig.10; Lenzenweger, 1977, pl.2, fig.1.

Length without spines 32-42 μm ; breadth without spines 30-40 μm ; length of spines 18-27 μm ; breadth of isthmus 7.5-9.6 μm ; thickness 16-20 μm .

Cells of medium size or sometimes less a little longer than broad, (without spines), deeply constricted, sinus narrowly linear with a slightly dilated apex; semicells transversely subrectangular, sometimes very slightly widened from base to apex, sides and apex slightly convex, angles slightly rounded, each apical angle with a long stout, divergent spine; cell wall smooth, punctate, or more rarely with a few irregular-scattered scrobiculations; vertical view elliptic with a stout spine at each pole. (Pl.10, fig.9, photo.77).

Local distribution: Mullazai, Distt. Peshawar, Sarim No.161, March 21, 1977.

Geographical distribution: Europe, Canada, U.S.A., Pakistan.

3. A. octocornis Ehr. ex Arch. in Pritch. Infus. p.736. 1861.
- = A. octocornis Ehr. Infus. p.152, 1838.
- = Micrasterias octocornis Menegh, Synops. Desm. p.216, 1840.
- = Staurostrum octocorne Ralfs in Ann. Mag. Nat. Hist. p.159, pl.12, fig.3, 1845.
- = Diastrum octocorne Kg. Phyc. germ. p.134. 1845.
- = Xanthidium octocorne (Ehr.) Ralfs, Brit. Desm. p.116, pl.20, fig. 2a, 1848.
- = Diastrum octacanthum Perty in Mitt. d. naturforsch. Ges. in Bern, p.174, 1849.
- = Didymidium (Xanthidium) octocorne Reinsch, Algenfl. Frank. p.127. 1867.
- = Xanthidium octocorne forma. minor Jacobs. Desm. Danem. p.211. 1876.
- = Artrodesmus lapczynskii Gutw. Nonn. Alg. Nov. p.57, pl.7, fig.68. 1896.

West & West, vol.4, 1912, p.117, pl.117, figs.6-10; Smith,

1924, p.134, pl.86, figs.8-12; Taylor, 1934, p.273, pl.56, fig.8; Smith, 1950, fig.240; Irénée-Marie, 1952, p.18; Croasdale, 1957, p.122, pl.1, figs.11,12; Croasdale & Grönblad, 1964, p.190, pl.16, fig.14; Lenzenweger, 1967, p.178, pl.7, fig.4; Eloranta, 1968, p.61, fig.18; Grönblad, Scott & Croasdale, 1968, p.22, fig.112; Parra, 1973, p.13, pl.13, fig.31; Whitford & Schumacher, 1973, p.75, pl.31, fig.32; Lenzenweger, 1974, p.106, pl.1, fig.3; Parra & Gonzales, 1977, p.28, fig.137; Uherkovich, 1978, p.16, pl.5, fig.2.

Length without spines 17-27 μm ; with spines 30-42 μm ; breadth without spines 14.3-19 μm ; with spines 28-35.5 μm ; breadth of isthmus 4.2-7.6 μm ; thickness 6.5-9 μm .

Cells small, about $1\frac{1}{2}$ times longer than broad (without spines), deeply constricted, sinus a wide, almost semicircular excavation; semicells transversely trapeziform-rectangular, sides and apex concave, angles slightly rounded and each with one fairly long straight ^{spine}; vertical view elliptic, with one straight spine showing at each rounded pole. (Pl.10, fig.11, photo.78).

Local distribution: Quetta Baluchistan, leg. Jan Mohd, Sarim No.273, April 4, 1978.

Geographical distribution: World wide.

4. A. triangularis Lagerh. Bidr. Amerik. Desm. Fl. p.244, pl.27, fig.22, 1885.

= A. incus forma rotundata Racib. Desm. Nowe, p.96, pl.6, fig.16. 1889.

= A. incus var. triangularis Lager, in Nuova Notarisia, p.182. 1893.

West & West, vol.4, 1912, p.97, pl.114, figs.11-13, 17; Smith, 1924, p.133, pl.86, fig.1; Mattern, 1962, fig.16; Mattern, 1964, p.249; Lenzenweger, 1967, p.178, pl.7, fig.5; Lenzenweger, 1970, p.264, pl.7, fig.7; Poore & Marshall, 1972, p.75.

Length without spines 23-30 μm ; breadth without spines 19-25 μm ; length of spines 12.5-25 μm ; breadth of isthmus 5-7 μm ; thickness 7.8-9 μm .

Cells rather small, a little longer than broad (without the spines), deeply constricted, sinus a wide (often almost semicircular) excavation, isthmus generally elongated and shortly cylindrical; semicells obversely triangular, apex elevated and convex, retuse in the median part, sides slightly convex, each lateral angle slightly rounded and with a long horizontally-placed spine; vertical view elliptic, each pole with a long spine; one axile chloroplast in each semicell containing a single pyrenoid. (Pl.10, fig.10).

Local distribution: Warsak Road Peshawar, Sarim No.151, March 12, 1977.

Geographical distribution: Europe, Burma, U.S.A, Pakistan.

5. A. triangularis Lagerh. var. subtriangularis (Borge) West & West, Freshw. Alg. Orkneys and Shetlands, p.24, pl.2, fig.36. 1905.
 = A. incus var. subtringularis Borge, Algologiska Notiser, p.212, pl.3, fig.4. 1897. (Basionym).
 = A. triangularis var. hebridarum West & West, Scott. Freshw. plankton, p.542. 1903.
 = A. granulatus Larsen, Ferskv. Vest-Gronb. p.324, pl.7, fig.7.1907.

West & West, vol.4, 1912, p.100, pl.115, figs.1-3; Smith, 1924, p.134, pl.86, figs.5-7; Taylor, 1934, p.274, pl.56, fig.1; Smith, 1950, p.328, fig.240.

30-42 μm long; 23-32 μm broad without spines, with spines 75-84.5 μm ; breadth of isthmus 8-8.5 μm .

Cell slightly larger, semicells subtriangular, lower margins of semicells indented just above the isthmus; apex much elevated, convex, but retuse in the middle; cell wall commonly possessing a number of irregularly scattered scrobiculations. (Pl.10, fig.12, photo.79).

Local distribution: Mansihra, leg. Qayum, Sarim No.139, Jan. 25, 1977.

Geographical distribution: Europe, U.S.A., Pakistan.

CHARACTERS OF STAURODESMUS

11. STAURODESMUS Teiling, in *Staurodesmus* genus novum, Bot. Not. 1948. (vide, Teiling, 1967).

Cells solitary, divided into two semicells by a median sinus, constriction generally deep, showing 2 or 3 apical or several prolonged angles, with one developed spine, sometimes reduced to a papilla, very rarely with a second spine above the first; cell wall smooth, always without verrucae; chloroplast axile, generally with a central pyrenoid, more rarely with 2 or several pyrenoids.

KEY TO THE TAXA

1. Length of the cell less than 20 μmStd. *extensus*
1. Length of the cell more than 20 μm2
 2. Length of the cell 25-30 μmStd. *dickiei*
 2. Length of the cell 36-40 μmStd. *convergens*
 2. Length of the cell 69-83 μmStd. *cornutus*

DESCRIPTION OF THE PLANTS

1. *Staurodesmus convergens* (Ehr.) Teiling, in *Staurodesmus* genus novum, Bot. Not. p.57. 1948.
- = *Arthrodesmus convergens* Ehr. pl.10, fig.11. 1838.
(vide, Teiling, 1967).

Grönblad, 1948a, p.417, figs.23-26; Irénée-Marie, 1952, p.17; Croasdale, 1957, p.124, pl.3, fig.44; Grönblad, Prowse & Scott, 1958, p.37; Wygasch, 1963, p.107, fig.20; Teiling, 1967, p.587, pl.24, fig.12; pl.25, fig.1; Lind, 1968, p.484; Hinode, 1971, p. 121, pl.9, fig.11; Gayoso, 1975, p.326, pl.1, fig.1; Parra, 1975, p.43, fig.123; Compere, 1977, p.142.

36-40 μm long; 34-40 μm broad; breadth of isthmus 12 μm ; thickness 24 μm .

Semicell fusiform with the ends elongated, often stout, slightly down-curved spine, the contour of the apex and the spines forming part of a circle arch, sinus acute. (Pl. 10, fig. 13, photo. 80).

Local distribution: Peshawar, Sarim No. 64, Nov. 2, 1976; Swabi, Distt. Mardan, Sarim No. 288, Feb. 3, 1978.

Geographical distribution: World wide.

2. Std. cornutus (Wolle) Teiling, Arkiv för Botanik Stockholm, p. 576, pl. 21, fig. 1. 1967.

= Staurostrum cornutum Wolle, pl. 57, fig. 3. 1887. (vide, Teiling 1967).

Förster, 1969, p. 66, pl. 31, figs. 11, 12.

69-83 μm long; 50-56 μm broad; isthmus 8-9 μm broad.

Semicell in front view broad elliptic, in end view triangular with rounded angles and straight or convex sides; the angles with a spine of moderate size, more or less curved downwards, sinus wide, acute. (Pl. 10, fig. 16).

Local distribution: Wah Stream No. 3 under Bridge, Sarim No. 274, April 10, 1978.

Geographical distribution: Europe, Pakistan.

3. Std. dickiei (Ralfs) Lillier. Ueber Folgen kult. Wasser. uber Makr. und Plank. in seichten Seen des sud. Olig. geb. Acta Limnologica, p. 264. 1950.

= Staurostrum dickiei Ralfs in Brit. Desm. pl. 21, fig. 3. 1848.

Teiling, 1967, p. 598, pl. 29, figs. 2, 3; pl. 30, figs. 12, 13; Hinode, 1971, p. 123, pl. 10, fig. 4; Gayoso 1975, p. 327, pl. 2, figs. 1-4; Parra, 1975, p. 43, figs. 126, 127; Parra & Gonzales, 1977, p. 26, figs. 161, 162.

25-30 μm long; breadth with spines 30-40 μm ; breadth of isthmus 10-12 μm .

Semicell in front view oval, often with slightly attenuated end (corners) bearing a spine of moderate size, curved downwards, in end view with rounded corners and slightly concave sides; sinus acute; chloroplast mono-or tricentric. (Pl.10, fig.15).

Local distribution: Tarujabba, Distt. Peshawar, Sarim No.280, April 11, 1978.

Geographical distribution: Europe, Chile, U.S.A, Japan, Pakistan.

4. Std. extensus (Borge) Teiling, in *Staurodesmus* genus novum, Bot. Not. p.67, fig.11. 1948.

= Arthrodesmus incus Ralfs, Brit. Desm. p.20, fig.4. 1848.

Croasdale & Grönblad, 1964, p.192, pl.17, fig.1; Teiling, 1967, p.514, pl.5, figs.17, 18; pl.31, fig.19; Dubois-Tylski, 1969, p.320, pl.2, fig.18; Förster, 1969, p.69, pl.29, fig.14; Förster, 1970, p.327, pl.25, figs. 23-27; Hinode, 1971, p.123, pl.9, fig.9; Coesel & Hoogendijk, 1975, p.125, pl.1, fig.c; Parra, 1975, p.43, fig.124; Parra & Gonzales, 1977, p.26, figs.140, 141.

17-19 μm long with spine; 17-19 μm broad with spine; breadth of isthmus 6-8 μm .

Semicell subrectangular with sharply contracted basal part, forming a long incurved isthmus with rounded sinus; apex slightly concave or straight, spines of moderate length, divergent. (Pl.10, fig.14, photo.81).

Local distribution: Sasnamana Ziarat Baluchistan, leg. Khial Badshah, Sarim No.129, Jan. 16, 1977.

Geographical distribution: Europe, U.S.A, Japan, Pakistan, Chile.

CHARACTERS OF TETMEMORUS

12. TETMEMORUS Ralfs, Brit. Desm. p.145. 1848.

Cells usually fairly large, length 2-8 times the breadth, with median constriction slight to fairly deep but always well defined, sinus always open; semicells straight, cylindrical to subfusiform, with poles somewhat compressed and having a very conspicuous vertical incision, generally linear and with a slightly inflated apex; cell wall smooth, punctate, or minutely scrobiculate; chloroplasts axile and with 8-10 vertical radiating plates that are simple or bifurcate at the point where they reach the cell wall; pyrenoids fairly numerous spherical to bacillar and arranged in a linear series along the central axis.

KEY TO THE TAXA

1. Cell wall scrobiculate.....T. brebissonii
 1. Cell wall punctate.....T. laevis

DESCRIPTION OF THE PLANTS

1. Tetmemorus brebissonii (Menegh.) Ralfs, Brit. Desm. p.145, pl.24, fig.1. 1848.
 = Glosterium brebissonii Menegh. Synops. Desm. p.236. 1840. (Basionym).
 = Tetmemorus brebissonii (Menegh.) Ralfs, in Ann. Mag. Nat. Hist. p.257, pl.8, fig.1. 1844.
 = Penium (Tetmemorus) brebissonii Kg. Sp. Alg. p.167. 1849.
 = Tetmemorus penioides Benn. Freshw. Alg. Eng. Lake Distr. p.13, pl.2, fig.26. 1886.

West & West, vol.1, 1904, p.216, pl.32, figs.1,2; Smith, 1924, p.20, pl.55, fig.10; Taylor, 1935, p.210, pl.53, figs.16, 17; Smith, 1950, p.321, fig.232; Irénée-Marie, 1952, p.24; Hirano, 1956, p.74, pl.13, fig.8; Scott & Prescott, 1958, p.28, fig.20; Croasdale & Grönblad, 1964, p.160, pl.5, fig.9; Förster, 1970,

p.298, pl.10, fig.1; Lenzenweger, 1967, p.180, pl.8, fig.6; Hinode, 1971, p.108, pl.4, fig.14; Ochiai, 1973, p.105; Whitford & Schumacher, 1973, p.68, pl.17, fig.33; Stein, 1975, p.142, fig.80.

155-220 μm long; 30-41 μm broad; breadth of isthmus 22-32 μm .

Cells subcylindrical, 4-6, commonly 5 times longer than broad, with a conspicuous median constriction; semicells slightly attenuated from base to apex; apex very broadly rounded with a deep median incision; cell wall scrobiculate; chloroplasts with a single median series of 4 or 5 pyrenoids; cells in side view fusiform; semicells attenuated. (Pl.11, fig.1, photo.82).

Local distribution: Bannu, Sarim No.15, Sept. 1, 1976; Swat, Sarim No.51, Oct. 26, 1976; Mardan Sarim No.88, Nov. 8, 1976; Bara, Distt. Peshawar, Sarim No.131, Jan. 16, 1977.

Geographical distribution: World wide.

2. Tar. laevis (Kg.) Ralfs, Brit. Desm. P.146, pl.24, fig.3, 1848.
= Closterium laeve Kg. Phyc. germ. p.132, 1845.
= Penium (Tetmemorus) laeve Gay, Monogr. Loc. Conj. p.71. 1884.

West & West, vol.1, 1904, p.222, pl.32, figs. 11-16;
Taylor, 1935, p.210, pl.39, fig.11; pl.63, fig.14; Scott, 1941, p.27, pl.2, figs.1,2; Grönblad, 1947, p.175, fig.2; Croasdale, 1955, p.529, pl.10, fig.13; Prescott, 1954, p.69, fig.99; Hirano, 1956, p.74, pl.14, fig.7; Croasdale & Grönblad, 1964, p.160, pl.5, fig.12; Grönblad & Croasdale, 1965, p.31, fig.39; Ochiai, 1966, p.125; Lenzenweger, 1967, p.181, pl.8, fig.5; Herrmann, 1969, p.151, pl.4, fig.2; Förster, 1969, p.29, pl.5, figs. 20-23; Mix, 1970, p.85, pl.4, fig.7; Förster, 1970, p.299, pl.9, figs.13-15; Hinode, 1971, p.108, pl.4, fig.16; Ratnasabapathy, 1972, p.104, pl.4; Whitford & Schumacher, 1973, p.68, pl.22, fig.2; Coesel, 1974, p.362, figs.1-3; Parra & Gonzales, 1977, p.20, fig.78.

67.5-123 μm long; 20-31.5 μm broad; breadth of isthmus 16-27 μm .

Cells small, $3\frac{1}{2}$ - $4\frac{1}{2}$, commonly 4 times longer than broad, with a slight median constriction; semicells very gradually attenuated to the apices; apex fairly broad and rounded, with a deep median incision; cell wall punctate; chloroplasts with a median series of 3 to 5 pyrenoids; semicells in side view more attenuated than in front view, specially near the apex.

(Pl. 11, fig. 2, photo. 83).

Local distribution: Akbarpura Distt. Peshawar, Sarim No. 30, Sept. 25, 1976.

Geographical distribution: World wide.

CHARACTERS OF CYLINDROCYSTIS

13. CYLINDROCYSTIS Menegh. ex Ralfs, Brit. Desm. p. 153. 1848.

Cells cylindrical, solitary, about twice longer than broad, often embedded in mucilage, unconstricted or with a slight median constriction, apices generally rounded; with one axile, substellate chloroplast in each semicell; pyrenoids large, one in the centre of each chloroplast.

KEY TO THE TAXA

1. Cells 15-18 μm broad..... C. brebissonii
1. Cells 20-40 μm broad..... C. americana

DESCRIPTION OF THE PLANTS

1. Cylindrocystis americana West & West, on some Desmids of the United States, p. 281, pl. 18, figs. 5, 6. 1898.

Whitford & Schumacher, 1973, p. 65, pl. 17, fig. 14.

20-50 μm long: 20-40 μm broad.

Cells moderately large, subcylindrical, slightly constricted in the middle, gradually dilated towards the apices; apex truncately rounded; cell wall thickened slightly at the apex, otherwise smooth; chloroplast stellate. (Pl.11, fig.3).

Local distribution: Nowshera Textile Mills, Sarim No.304, Jan. 26, 1979.

Geographical distribution: U.S.A, Pakistan.

2. C. brebissonii Menegh. in West & West, Brit. Desm. vol.1, p.85, pl.4, fig.23. 1904.
- = C. brebissonii Menegh. Monogr. Nostoch. p.89, pl.12, fig.13.1842.
- = Palmogloea brebissonii Kg. Tab. Phyc. p.19, pl.24, fig.4. 1847.
- = Penium brebissonii Ralfs, Brit. Desm. p.153, pl.26, fig.6. 1848.

Taylor, 1934, p.240, pl.65, figs.6, 7; Prescott, 1941, p.24, pl.2, fig.14; Smith, 1950, p.307, fig.214; Irénée-Marie, 1952, p.31; Prescott, 1954, p.71, fig.103; Hirano, 1955^a, p.17, pl.1, fig.10; Croasdale, 1955, p.519, pl.3, fig.10; Grönblad, 1959, p.58, figs.1-15; Fritsch, 1961, p.313, fig.96; Mattern, 1964, p.251, fig.4; Croasdale & Grönblad, 1964, p.148, pl.1, figs.8-11; Croasdale, 1965, p.305, p.1, fig.8; Scott, Grönblad & Croasdale, 1965, p.26, fig.1; Ochiai, 1966, p.122, fig.9; Eloranta, 1968, p.60, fig.17; Grönblad, Scott & Croasdale, 1968, p.8, figs.1,2; Förster, 1969, p.15, pl.1, figs.2, 3; Mix, 1970^a, p.77, pl.2, fig.5; pl.11, fig.15; Lenzenweger, 1970^a, p.5, pl.1, fig.5; Förster, 1970, p.275, pl.1, figs.10-15; Hinode, 1971, p.100, pl.1, figs.2,3; Mix, 1972, p.201, fig.1; Gerrath, 1973, p.103, pl.1, figs.1, 2; Croasdale, 1973, p.69, pl.10, figs.13, 15; Whitford & Schumacher, 1973, p.65, pl.17, fig.16; Stein, 1975, p.135, fig.81; Parra, 1975, p.26, fig.1; Werner, 1977, p.37, p.37, pl.1, figs.1-4; Hinode, 1977, p.74, figs.1, 5, 6; Parra & Gonzales, 1977, p.14, fig.1; Hirano, 1977, p.211.

43-55 μ m long; 15-18 μ m broad.

Cells cylindrical, unconstricted, about 2-3 times longer than broad, apex rounded; chloroplasts usually with few large radiating prolongations and often difficult of observation.

(Pl. 11, fig. 4, photo. 84).

Local distribution: Muzaffarabad, Azad Kashmir, leg. Manzoor, Sarim No. 233, Nov. 2, 1976.

Geographical distribution: World wide.

CHARACTERS OF NETRIUM

14. NETRIUM Näg. Gatt. einz. Alg. p. 107. 1849.

Cells generally large, length at least three times the breadth, neither constricted in the median portion nor compressed; solita cell shape cylindrical to naviculoid, with lateral margins gradually attenuated to truncate apices, or parallel and then sharply convergent in the apical region; cell wall always smooth and without pores; chloroplasts axile, usually one in each half-cell, with 6-12 longitudinal, radiating plates that have strongly notched edges; pyrenoids always axile, usually a single long rod, but at times with the rod fragmenting to form an axile row of spherical to irregularly shaped pyrenoids; cell division at no definite point.

KEY TO THE TAXA

1. Cells elliptic-oblong, chloroplasts with 6 longitudinal plates..... N. digitus
1. Cells cylindrical, chloroplast with 8 longitudinal plates..... N. interruptum

DESCRIPTION OF THE PLANTS

1. Netrium digitus (Ehr.) Itzigs. & Rothe. in Rabenh. Alg. No. 508. 1856.
= Closterium digitus Ehr. Entw. Lebends. d. Infus p. 68. 1832.
= Cl. lamellosum Bréb. Alg. Falaise, p. 59, pl. 8. 1835.

- = Penium digitus Bréb. in Ralfs Brit. Desm. p.150, pl.25, fig.3.1848.
- = P. lamellosum Kg. Sp. Alg. p.168. 1849.
- = P. digitus forma curta Anderss. Sverig. Chlor. p.19, pl.1, fig.14. 1890.
- = P. digitus forma recta Turn. Freshw. Alg, E.India. p.18, pl.1, fig.27. 1893.
- = P. navigium Turn. Freshw. Alg. E. India, p.17, pl.1, fig.9. 1893.
- = P. digitus var. montanum Lemm. Algenfl. Riesengeb. p.120, fig.15. 1896.

West & West, vol.1, 1904, p.64, pl.6, figs.14-16; Smith, 1924, p.6, pl.52, fig.5; Taylor, 1934, p.240, pl.65, figs. 3,4; Thompson, 1938, p.40, pl.9, fig.9; Smith, 1950, p.308, figs.215, 219; Irénée-Marie, 1952, p.30; Tiffany & Britton, 1952, p.166, pl.51, fig. 534; Prescott, 1954, p.73, fig.108; Hirano, 1955, p.18, pl.1, fig.7; Croasdale, 1955, p.519, pl.3, fig.17; Kamiya, 1961, p.41, pl.3, figs.1-3; Fritsch, 1961, p.313, fig.121; Kamiya, 1962, p.44, pl.5, figs. 1-3; Mori, 1962, p.8, fig.9; Mattern, 1962, p.244, fig.7; Biebel, 1964, p.697, figs.1, 2, 5-12; Mattern, 1964, p.251; Croasdale & Grönblad, 1964, p.148, pl.1, fig.20; Biebel & Reid, 1965, p.134; Croasdale & Grönblad, 1965, p.26, figs.2-4; Marcenko, 1966, p.157, figs.7-24; Prescott, 1966, p.2; Ochiai, 1966, p.123; Eloranta, 1968, p.61, fig.6; Herrmann, 1969, p.7, fig.1; Vuorisalo, 1969, p.104, fig.2; Zwart, 1969, p.172, figs.120, 121; Mix, 1970, p.77, pl.2, figs.1,2; Marcenko, 1970, p.33, figs. 1-4; Lenzenweger, 1970, p.5, pl.3, fig.1; Islam, 1970, p.908, pl.1, fig.9; pl.19, fig.2; Hinode, 1971, p.100, pl.1, fig.5; Mix, 1972, p.20, p.20, pl.201, figs.3, 5, 6; Ratnasabapathy, 1972, p.103, pl.3, fig.c; Mix, 1973, p.189, pl.4, fig.9; Whitford & Schumacher, 1973, p.65, pl.17, fig.23; Parra, 1975, p.26, fig.3; Hosiaisloma, 1976, p.107, figs.1-4; Kattner, Lorch & Weber, 1977, p.33; Werner, 1977, p.37, pl.1, figs.7-12; pl.17, fig.10; Hinode, 1977, p.74, figs. 1, 10; Parra & Gonzales, 1977, p.14, fig.3;

Nakano, 1977, p.46, pl.1, figs.1, 2.

130-387 μm long; 40-82 μm broad; breadth near apex 18-40 μm .

Cells of variable size, generally large, 3-4 times longer than broad, not constricted, elliptic-oblong, gradually attenuated, from the middle towards the apex which are rounded truncate, chloroplasts axile with about 6 longitudinal plates, deeply notched at the free margins, cell wall smooth. (Pl.11, fig.6, photo.86).

Local distribution: Swat, Sarim No.56 Oct. 27, 1976; Takhtbhai, Distt. Mardan, Sarim No.157, March 17, 1977; Baragali, Sarim No.370, Oct. 4, 1979.

Geographical distribution: World wide.

2. N. interruptum (Bréb.) Lütken. Zellmembr. Desm. p.407. 1902.
- = Penium interruptum Bréb. in Ralfs Brit. Desm. p.151, pl.25, fig.4. 1848.
- = Closterium (Netrium) interruptum Reinsch, Algenfl. Frank. p.185. 1867.

West & West, vol.1, 1904, p.68, pl.7, figs.1,2; Irénée-Marie, 1952, p.30; Hirano, 1955, p.21, pl.2, fig.1; Croasdale, 1962, p.16, pl.1, fig.3; Grönblad & Croasdale, 1965, p.27, fig.6; Eloranta, 1968, p.61, fig.16; Vuorisalo, 1969, p.104; Mix, 1970, pl.2, fig.7; Mix, 1973, p.185, pl.2, fig.3; Whitford & Schumacher, 1973, p.65, pl.17, fig.18; Parra, 1975, p.26, fig.5; Parra & Gonzales, 1977, p.14, fig.10.

220-320 μm long; 37-64 μm broad.

Cells large, 4-6 times longer than broad, not constricted, cylindrical, near each extremity becoming suddenly conical, apex obtusely rounded; chloroplasts 4, 2 in each semicell, median ones cylindrical, apical ones conical, each chloroplast with about 8 longitudinal plates, free margins of plates entire; apical vacuole conspicuous and containing a solitary moving granule.

(Pl.11, fig.9, photo.88).

Local distribution: Rajar, Charsadda, Distt. Peshawar, Sarim No.192, Dec. 17, 1978.

Geographical distribution: Europe, Russia, U.S.A, Japan, Pakistan, Canada, Chile.

CHARACTERS OF MESOTAENIUM

15. MESOTAENIUM Näg. Gatt. einz. Alg. p.108. 1849.

Cells cylindrical or subcylindrical, usually straight, solitary often slightly curved, not constricted, apices rounded or subtruncate; with a solitary chloroplast, more rarely with two chloroplasts, which is axile, flattened, and plate-like; pyrenoids one or several; nucleus frequently excentric.

1. Mesotaenium caldariorum (Lagerh.) Hansg. Prodr. Algenfl. Bohm. p.174. 1888.

= M. endlicherianum Näg. var. caldariorum Lagerh. Algol. Bidr. p.48, fig.4. 1886. (Basionym).

West & West, vol.1, 1904, p.53, pl.4, figs.15-17;

Chardard, 1964, p.77, figs. 1-9; Mix, 1972, p.203, fig.2; Ratnasabapathy, 1972, p.103; Scharf, 1977, p.31, figs. 9,10.

27-40 μ m long; 10.5-11.5 μ m broad.

Cells cylindrical or subcylindrical, $2\frac{1}{2}$ -4 times longer than broad, somewhat suddenly attenuated near the apices which are rounded; chloroplast axile, sometimes a little irregular and bent, often with one pyrenoid. (Pl.11, fig.7, photo.87).

Local distribution: Khat Pass Spring, Sarim No.158, March 18, 1977.

Geographical distribution: Europe, Malaysia, Pakistan.

CHARACTERS OF BAMBUSINA

16. BAMBUSINA (Kg.) Kg. Sp. Alg. p.188. 1849. Nom Cons.
 = Gymnozyga Ehr. Ber. K. Akad. Wiss. Berlin, p.212. 1840.
 = Gymnozyga Ehr. Ber. Monatsb. p.212. 1841.
 = Gymnozyga (Ehr.) Kg. Spec. Alg. p.188. 1849.

Cells united to form long filaments; filaments rarely twisted, frequently enclosed by a gelatinous sheath; cells barrel-shaped, not compressed, length about twice the breadth, median constriction slight, at times a small groove running around the cell; apices flattened and without protuberances; cell wall smooth or with vertical striae near the poles and at the isthmus; chloroplasts axile and with radiating vertical laminae; pyrenoids single and central.

1. Bambusina brebissonii (Kg.) Kg. Spec. Alg. p.188. 1849. Non cons.
 = Gymnozyga moniliformis Ehr. in Berlin Monatsb. p.212. 1841.
 = Desmidium borreri Ralfs in Ann. Mag. Nat. Hist. p.375, pl.8, fig.4. 1843.
 = Bambusina brebissonii Kg. Phyc. germ. p.140. 1845.
 = Didymoprium borreri Ralfs in Ann. Mag. Nat. Hist. p.10, pl.3, fig.5. 1845.
 = Bambusina borreri Delp. Sp. Desm. subalp. p.54, pl.2, fig.1877.
 = Gymnozyga brebissonii Wille in Engler. Nat. Pflanzenfam. p.15, pl.9j. 1890.

West, West & Carter, vol.5, 1923, p.255, pl.165, figs.8,9; Smith, 1924, p.46, pl.87, fig.11; Taylor, 1935, p.220, pl.34, fig.16; Whitford, 1943, p.153; Grönblad, 1945, p.35, figs. 343, 348; Smith, 1950, p.336, fig.247; Irénée-Marie, 1952, p.29; Prescott, 1954, p.90, fig.136; Croasdale, 1957, p.153, pl.10, fig.156; Scott & Prescott, 1958, p.69, Hirano, 1960, p.393, pl.54, fig.6; Kamiya, 1961, p.43, pl.5, figs.4, 5; Fritsch, 1961, fig.114 D; Croasdale & Grönblad, 1964, p.208, pl.21, figs.19, 20; Lenzenweger, 1965,

p.453, pl.2, fig.7; Förster, 1965, p.158, pl.9, figs.28, 29; Ochiai, 1966, p.123; Eloranta, 1968, p.61, fig.9; Förster, 1969, p.100, pl.53, figs.16-18; Dubois-Tylski, 1969, p.320. pl.1, fig.25; Islam, 1970, p.934, pl.3, figs.9, 10; Förster, 1970, p.344, pl.29, fig.21; Hinode, 1971, p.127, pl.10, fig.23; Gerrath, 1973, p.108, pl.3, fig.6; pl.4, figs.7-10; Whitford & Schumacher, 1973, p.79, pl.38, fig.I; Parra, 1975, p.50, fig.172; Stein, 1975, p.135, fig.99; Croasdale, & Scott, 1976, p.553, fig.9; Parra & Gonzales, 1977, p.31, fig.232; Scharf, 1979^a, p.45, figs.1-4.

25-30 μ m long; 17.5-22.5 μ m broad.

Filaments twisting, formed of rather barrel-shaped cells; semicells with a small basal inflation, and an extremely slight median constriction; lateral margins straight except for the broad rim at the base, apex broad and truncate; cell wall often showing very delicate longitudinal striations; vertical view circular, sometimes with two opposite mamillae; chloroplasts axile, one in each semicell, each having a central pyrenoid and about 6 radiating plates. (Pl.11, fig.10).

Local distribution: Peshawar, Sarim No.67, Nov. 3, 1976; Mardan, Sarim No.89, Nov. 8, 1976; Saidu Sharif, Distt. Swat, Sarim No.164, March 23, 1977; Malakand, Sarim No.399, Dec. 15, 1979.

Geographical distribution: World wide.

CHARACTERS OF DESMIDIUM

17. DESMIDIUM Agardh ex Ralfs, Brit. Desm. p.60. 1848.

Cells united to form long filaments; filaments usually spirally twisted and enclosed in a broad tough gelatinous envelop; median constriction generally shallow and poorly defined; cells not marked compressed, usually with a radial symmetry; breadth mostly about twice the length; semicells trapezoidal in front

view and with the apices plane or depressed in the median portion and forming an elliptic open space between adjacent cells; lateral view identical with the front view or subrectangular to octagonal; vertical view triangular, quadrangular or broadly elliptic; cell wall not ornamented; chloroplasts axile, with one or more pyrenoids.

KEY TO THE TAXA

1. Median constriction reduced to a faint undulation... D. baileyi
1. Median constriction otherwise..... 2
 2. Cells about $1\frac{1}{2}$ times broader than long..... D. coarctatum
 2. Cells about $2\frac{1}{2}$ times broader than long..... D. swartzii

DESCRIPTION OF THE PLANTS

1. Desmidium baileyi (Ralfs.) Nordst. Lund. Univ. Arsskr. p.16.1880.

Smith, 1924, p.145, pl.88, figs.5-7; Taylor, 1935, p.219, pl.29, fig.1; Smith, 1950, p.335, fig.246; Irénée-Marie, 1952, p.28; Prescott, 1954, p.90, fig.138b; Croasdale, 1957, p.153, pl.10, figs. 149, 150; Scott & Prescott, 1958, p.69; Hirano, 1960, p.397, pl.53, fig.4; Prescott, 1966, p.42, pl.11, fig.17; Lind, 1967, p.382, pl.11, figs.6, 6a; Islam, 1970, p.933, pl.1, figs.8, 8a; Poore & Marshall, 1972, p.75; Mix, 1973, p.187, pl.3, fig.8; Whitford & Schumacher, 1973, p.79, pl.37, fig.9; Islam & Zaman, 1975, p.54, pl.8, fig.120; Parra, 1975, p.51, fig.178.

20-26 μm long; 21-27.5 μm broad.

Cells united to form filaments that are straight (not spirally twisted) and devoid of a gelatinous sheath; cells fairly small, with the length and breadth about equal, median constriction reduced to a faint undulation; cell outline rectangular, with the lateral margins parallel and apices with a broad deep semielliptic depression that gives the appearance of short erect truncate projections at either lateral margin of the semicells apices;

adjacent cells of filaments almost completely separated by elliptical to subrectangular openings; vertical view triangular, with slightly convex sides and rounded angles; cell wall smooth.
(Pl.11, fig.18, photo.94).

Local distribution: Pabbi, Distt. Peshawar, Sarim No.48,
Oct. 22, 1976.

Geographical distribution: World wide.

2. D. coarctatum Nordst. Freshw. Alg. N. Zealand, p.25, pl.2, fig.3.
1888.

= Desmidium (Didymoprium) coarctatum Nordst. Bot. Notiser, p.155.1887.

West, West & Carter, vol.5, 1923, p.252, pl.165, figs.1,2;
Taylor, 1935, p.219; Grönblad, 1957, p.50, pl.36, figs.4, 5; Hirano,
1960, p. 395, pl.53, fig.60; Islam, 1970, p.934, pl.3, fig.8; Hinode,
1971, p.127, pl.10, fig.20; pl.5, fig.22; Lenzenweger, 1974, p.116,
pl.3, fig.9.

25-34 μm long; 34-38 μm broad; breadth of isthmus 33 μm ;
breadth of apex 12-14 μm ; thickness 24-26 μm .

Filaments flattened, twisted, cells in front view
elliptical, about $1\frac{1}{2}$ times broader than long, with a slight median
constriction, sinus linear, basal angles of semicell actually
rounded, lateral margins slightly undulate; apex of semicell about
 $\frac{1}{3}$ its diameter; lateral view of cells quadrangular, with the finest
indication of a median constriction; vertical view narrowly elliptical
with prominent rounded mamillae at the opposite poles; cell wall
with longitudinal rows of minute punctae; chloroplasts axile, one
in each semicell, each with a central pyrenoid. (Pl.11, fig.11,
photo.89).

Local distribution: Zoological Gardens Lahore, Sarim
No.45, Oct. 20, 1976.

Geographical distribution: World wide.

3. D. swartzii Agardh. ex Ralfs, Brit. Desm. p.61, pl.4, figs.a-e.1848.
= Diatoma swartzii Agardh, Disp. Alg. p.38. 1812.
= Desmidium swartzii Agardh, Syst. Alg. p.9. 1824.

West, West & Carter, vol.5, 1923, p.246, pl.163, figs. 5-8; Smith, 1924, p.144, pl.88, figs. 1,2; Taylor, 1935, p.220, pl.34, fig.12; Prescott, 1941, p.27, pl.2, fig.8; Taft, 1945, p.204, pl.5, fig.21; Irene-Marie, 1952, p.29, fig.5; Tiffany & Britton, 1952, p.205, pl.56, fig.628; Croasdale, 1957, p.153, pl.10, fig.152; Scott & Prescott, 1958, p.70, figs.21, 13; Hirano, 1960, p.396, pl.53, fig.5; Kamiya, 1961, p.43, pl.8, fig.4; Fritsch, 1961, fig.114 B; Mattern, 1964, fig.16; Lenzenweger, 1965, p.252, pl.2, fig.2; Mattern, 1966, p.215, fig.15; Kanetsuna, 1967, p.81, pl.4, figs.5, 9; Zwart, 1969, p.171, pl.110; Mix, 1970, p.89, pl.4, fig.6; Mix, 1973, p.189, pl.4, fig.14; Whitford & Schumacher, 1973, p.79, pl.37, fig.12; Stein, 1975, p.139, fig.79; Parra, 1975, p.52, fig.176; Werner, 1977, p.66, pl.16, fig.3; pl.30, fig.5; Watanabe, 1978, p.120, pl.4, fig.h.

12-20 μm long; 37-50 μm broad; breadth of isthmus 30-42.5 μm ; breadth of apices 30-41 μm .

Filaments triangular, twisted, usually destitute of a conspicuous gelatinous sheath; cells large, about $2\frac{1}{2}$ times broader than long; constriction moderately deep, sinus linear towards its apex, opening more widely; semicells narrowly oblong, lateral margins usually somewhat obliquely truncate, with the upper angle of the truncate margin conspicuously protruded towards the apex of the semicell, the lower angle more rounded; apex of semicell broadly

truncate, with a short connecting processes at each angle of the cell; middle of apex very slightly concave; spaces between the cells not visible, or recognised only with difficulty; vertical view triangular, angles actually rounded, sides slightly concave; chloroplasts axile, one in each semicell, with two massive lobes radiating from the centre into each angle of the semicell, and a large pyrenoid opposite each face. (Pl.11, fig.12, photo.90).

Local distribution: Nathiagali, Sarim No.73, Nov.5, 1976; Peshawar, Sarim No.77, Nov, 7, 1976; Bannu, Sarim No.95, Dec. 5, 1976; Abbottabad, Sarim No.104, Dec. 8, 1976; Church Memorial Tank Mardan, Sarim No.242, Feb. 17, 1978.

Geographical distribution: World wide.

CHARACTERS OF PENIUM

18. PENIUM Bréb. ex Ralfs, Brit. Desm. p.148. 1848.

Cells of variable length, length usually several times the breadth, ^{Solitary,} generally straight, with median portion somewhat constricted or without a median constriction; sinus, when present, only a slight depression; cells not compressed, shape generally cylindrical, at times fusiform to subelliptic, frequently somewhat attenuated at poles, apices usually truncate and with rounded angles; point of cell division definite; cell wall colourless to brownish, smooth to punctate or granulate, at times with the granules arranged in definite longitudinal series; chloroplasts axile, with longitudinal radiating plates that extend to the cell wall; pyrenoids generally in an axile row at centre of chloroplasts.

KEY TO THE TAXA

1. Chloroplast with about 10 longitudinal plates..... P. margaritaceum
1. Chloroplast with about 6 longitudinal plates..... P. cucurbitinum var. subpolymorphum

DESCRIPTION OF THE PLANTS

1. Penium cucurbitinum Biss, var. subpolymorphum Nordst. Freshw.

Alg. N.Zeal. p.71, pl.7, fig.20. 1888.

West & West, vol.1, 1904, pl.9, figs.19,20.

71-86 μm long; 32.5-38 μm , broad; isthmus 32-35 μm broad.

Cells of medium size, 2½ times longer than broad, more attenuated towards the apices than the species; apices subtruncately-rounded; cell wall densely and minutely punctate; chloroplasts with about 6 longitudinal ridges and one large pyrenoid. (Pl.11, fig.16).

Local distribution: Gandi Garden Karachi, Sarim No.251, March 28, 1978.

Geographical distribution: New Zealand, Europe, Pakistan.

2. P. margaritaceum (Ehr.) Bréb. ex Ralfs, Brit. Desm. p.149, pl.25, fig.1, 1848.

= Closterium margaritaceum Ehr. Infus. p.95, pl.6, fig.13. 1838.

= Cylindrocystis margaritacea Reinsch, Algenfl. Frank. p.198, 1867.

= Penium pandurans De Not. Desm. Ital. p.70, pl.8, fig.80, 1867.

= P. margaritaceum (Ehr.) ex Bréb. var. irregularies West & West 1905b. (vide, Růžička, 1977).

West & West, vol.1, 1904, p.83, pl.8, figs.32-35;

Smith, 1924, p.7, pl.52, fig.6; Smith, 1950, p.318, fig.228; Irénée-Marie, 1952, p.22; Tiffany & Britton, 1952, p.176, pl.1, fig.540; Prescott, 1954, p.72, fig.104; Hirano, 1955a, p.26, pl.2, fig.5; Croasdale, 1962, p.18, pl.1, fig.4; Croasdale, 1964, p.77, figs.10-20; Croasdale, 1965, p.305, pl.1, fig.13; Prescott, 1966, p.4, pl.4, fig.10; Lind, 1967, p.365, pl.1, figs.1,2; Grönblad, Scott & Croasdale, 1968, p.9, fig.7; Gerrath, 1969, p.113, figs.2, 12, 14; Lenzenweger, 1970, p.262, pl.12, fig.17; pl.29, fig.14; Islam, 1970, p.909, pl.19, figs.3-9; Hinode, 1971, p.101, pl.1, fig.15; Croasdale, 1973, p.70, pl.10, fig.26; Whitford & Schumacher, 1973, p.65, pl.17, fig.28; Werner, 1977, p.39, pl.2, fig.2; Parra & Gonzales, 1977,

p.15, fig.18; Růžicka, 1977, p.61, pl.4, figs.1-5.

73-170 μm long; 12.5-26 μm broad; breadth of apex 7.5-18 μm .

Cells large, 6-12 times longer than broad, cylindrical or subfusiform, with a distinct median constriction, apices truncately rounded; cell wall reddish-brown in colour and with longitudinal rows of granules; chloroplast with about 10 longitudinal plates (or ridges) and often showing a slight median interruption. (Pl.11, fig.15, photo.92).

Local distribution: Matta, Distt. Swat, Sarim No.100, Dec. 7, 1976; Mardan, Sarim No.105, Dec. 8, 1976; Nathiagali, Sarim No.146, March 7, 1977.

Geographical distribution: World wide.

CHARACTERS OF SPHAEROSMA

19. SPHAEROSMA Corda ex Ralfs, Brit. Desm. p.65. 1848.

Cells usually small and with the breadth generally somewhat greater than the length; united to form permanent filaments by short apical processes that lie on opposite sides of the apices of the semicells and interlock with corresponding processes from adjacent cells; processes frequently simple granules, never overlapping the adjacent cells; cells compressed, generally moderately constricted and with an open sinus; semicells elliptic to oblong, lateral margins smooth or granulate, never with spines; vertical view usually elliptic and lateral view of semicells subspherical; cell wall smooth, punctate, or with granules arranged in a definite pattern; chloroplasts axile and with one pyrenoid.

KEY TO THE TAXA

1. Semicells oblong or subreniform.....Sph. vertebratum
2. Semicells oval.....Sph. excavatum

DESCRIPTION OF THE PLANTS

1. Sphaerosoma excavatum Ralfs, Brit. Desm. p.67, pl.6, fig.2. 1848.
= Sph. excavatum Ralfs. in Ann. Mag. Nat. His. vol.16, p.15, pl.3, fig.8. 1845.
= Isthmosira excavata Kg. Sp. Alg. p.189. 1849.

West, West & Carter, vol.5, 1923, p.211, pl.160, figs.1-3;
Smith, 1924, p.138, pl.86, figs.17, 18; Smith, 1950, p.331, fig.242;
Prescott, 1954, p.89, fig.134; Croasdale, 1957, p.151, pl.10, fig.133;
Hirano, 1960, p.398, pl.53, fig.22; Ochiai, 1966, p.124, fig.E4;
Grönblad, Scott & Croasdale, 1968, p.26, fig.152; Kirk, Postek &
Cox, 1976, p.6.

7.5-12 μm long; 7-14 μm broad; breadth of isthmus 3.5-6.5 μm ; thickness 5-7 μm .

Cells very small, usually only slightly longer than broad, but sometimes as much as twice as long as broad, constriction moderately deep, sinus widely excavated, obtuse; semicells broadly oval, isthmus slightly elongated, lateral view of cell oblong-elliptic, sides slightly concave; vertical view oblong with rounded ends and four minute attaching processes on the long margins; cell wall usually smooth, sometimes with horizontal rows of minute granules; chloroplast axile, one in each semicell with a central pyrenoid. (Pl.11, fig.20, photo.95).

Local distribution: Multan, Sarim No.252, March 29, 1978.

Geographical distribution: Europe, Japan, Africa, U.S.A, India, Pakistan.

2. Sph. vertebratum (Bréb.) Ralfs, Brit. Desm. p.65, pl.6, fig.1.1848.
 = Desmidium vertebratum Bréb. Alg. Falaise, p.269, pl.2. 1835.
 = Isthmia vertebrata Menegh. Synops. Desm. p.205. 1840.
 = Desmidium compressum Ralfs in Ann. Mag. Nat. Hist. vol.9, p.253, 1842.
 = Isthmosira vertebrata Kg. Phyc. germ. p.141. 1845.
 = Sphaerzosma unidentata Ralfs in Ann. Mag. Nat. Hist. vol.16, p.14. 1846.

West, West & Carter, vol.5, 1923, p.209, pl.159, figs.9, 10; Fritsch, 1961, p.358, fig.114; Compere, 1970, p.128, fig.622.

19 μ m long; 21-24 μ m broad; breadth of isthmus 9-10 μ m; thickness 12 μ m.

Cells small, about as long as broad, or sometimes a little broader, constriction fairly deep, sinus narrow, linear, obtuse at the apex; semicells nearly oblong or subreniform, slightly narrower at the apex; lower margin nearly straight, upper angles very rounded, apex flattened; lateral view of cell oblong, slightly constricted in the middle, semicells short and oval; apical processes median; cell wall smooth; chloroplasts axile, with a central pyrenoid in each semicell. (Pl.11, fig.19).

Local distribution: Katlang, Distt. Mardan, Sarim No.40, Oct, 10, 1976.

Geographical distribution: Europe, U.S.A, Pakistan.

CHARACTERS OF SPONDYLIOSIUM

20. SPONDYLIOSIUM Bréb. in Kg. Sp. Alg. p.189. 1849.

Cells usually of moderate size, ratio between length and breadth variable; united to form permanent filaments; cells moderately to deeply constricted, sinus linear to somewhat open, with an acute to rounded apex; semicells usually compressed, rarely radially symmetrical, elliptic to oblong or triangular, apices

flattened, at times with a truncate elevation or with a slight concavity, never with apical processes; cell wall smooth or punctate, very rarely with granules arranged in a definite pattern; chloroplasts axile and usually with but a single pyrenoid; filaments with or without a gelatinous envelope.

KEY TO THE TAXA

1. Sinus open and obtuse, semicells subelliptical.....Sp. *secedens*
1. Sinus linear, semicells truncate-pyramidal.....Sp. *pulchellum*

DESCRIPTION OF THE PLANTS

1. *Spondylosium pulchellum* Arch. in Pritch. Infus. p.724, pl.3, fig.10, 1861.
 - = *Sphaerozosma pulchellum* Arch. Suppl. Cat. Desm. p.253, pl.21, fig.7. 1858.
 - = *Sph. secedens* var. *pulchellum* Hansg. Prodr. Alg. Bohm. p.170.1888.
- West, West & Carter, vol.5, 1923, p.227, pl.161, figs.1-3;
 Cedercreutz, 1941, p.28; Hirano, 1960, p.389, pl.53, fig.25;
 Lenzenweger, 1965, p.453, pl.2, fig.6; Tomaszewicz, 1973, p.298, pl.5, fig.15; Tomaszewicz, 1974, p.406, pl.5, fig.19.

12-15 μm long; 10-11 μm broad; breadth of apex 5 μm ;
 breadth of isthmus 4.5-6 μm .

Cells very small, about as long as broad, sometimes longer than broad, constriction fairly deep, sinus linear; semicells truncate-pyramidal, inflated at the base, apex broad and flat, upper angles sharp, almost rectangular; lower angles broadly rounded; sides concave; semicells in side view subcircular; in end view elliptical; filaments often long, not twisted, frequently found attached by a short thick gelatinous stalk to other aquatic plants (Pl.11, fig.21, photo.96).

Local distribution: Warsak Canal, Peshawar, Sarim No.286, Dec. 16, 1978.

Geographical distribution: Europe, U.S.A, Japan, Pakistan.

2. Sp. secedens (De Bary) Arch. in Pritch. Infus. p.719. 1861.
 = Sphaerozosma secedens De Bary, Conj. p.76, pl.4, figs.35-37.1858. (Basionym).
 = Sph. excavatum var. secedens Rabenh. Krypt.-fl. Sachs. p.178.1863.
 = Sph. pygmaeum Hauptfl. Zellm. u. Hüllgallerte Desm. pl.2, fig.24. 1888.

West, West & Carter, vol.5, 1923, p.225, pl.161, figs.8-11; Irénée-Marie, 1952, p.27; Leher, 1958, p.80.

8.5-12 μ m long; 7.5-10 μ m broad; thickness 5-6 μ m; breadth of isthmus 3.5-6 μ m.

Cells small, about as long as broad, but sometimes slightly longer or shorter, constriction moderately deep, sinus open and obtuse; semicells subelliptical; lateral angles rounded, ventral margin slightly convex, dorsal margin primarily strongly convex but with a conspicuous deep concavity in the middle; cells attached together by the projecting parts of the apices to form fragile filaments, which readily break; filaments destitute of a mucous sheath; cell wall smooth. (Pl.11, fig.22, photo.97).

Local distribution: Fatehpur, Distt, Swat, Sarim No.287, Dec.17, 1978.

Geographical distribution: Europe, Canada, Pakistan.

CHARACTERS OF HYALOTHECA

21. HYALOTHECA Ehr. ex Ralfs, Brit. Desm. p.51. 1848.

Cells united to form long filaments; filaments not twisted, generally enclosed by a copious gelatinous envelope that at times is radially fibrillar; cells usually somewhat longer than broad, cylindrical to discoidal, median constriction very slight;

ends of cells plane and without projections, polar angles usually rounded; vertical view circular; cell wall without ornamentation aside from transverse ridges or in rare cases transverse rows of granules just beneath the apices of the semicells; chloroplasts axile and with several vertical lobes that extend to the cell walls; pyrenoids single and central; cells without a girdle-like thickening at the point of division.

KEY TO THE TAXA

- 1a Cells broader than long..... H. dissiliens
 1. Cells about as long as broad..... H. mucosa

DESCRIPTION OF THE PLANTS

1. Hyalotheca dissiliens (Smith) Bréb. ex Ralfs, Brit. Desm.
 p.51, pl.1, fig.1, 1848.

= Conferva dissiliens Smith, Engl. Bot. Vol.35, pl.2464. 1812.

= Desmidium mucosum Bréb. Alg. Falaise, p.65, pl.2. 1935.

= Gloeoprium dissiliens Hass. Brit. Freshw. Alg. p.346, pl.83,
 fig. 34. 1845.

= Hyalotheca mucosa Kg. Sp. Alg. p.187. 1849.

West, West & Carter, vol.5, 1923, p.229, pl.161, figs.16-
 Smith, 1924, p. 142, pl.87, figs.8, 9; Taylor, 1935, p.221;
 Prescott, 1941, p.27, pl.2, figs.5-7; Smith, 1950, p.333, fig.244;
 Irénée-Marie, 1952, p.27; Prescott, 1954, p.90, fig.137;
 Croasdale, 1957, p.152, pl.10, fig.146; Hirano, 1960, p.391, pl.53,
 figs.12, 13; Grönblad, 1960, p.51, pl.9, figs. 185, 186; Kamiya,
 1961, p.43, pl.4, figs.1, 2; Fritsch, 1961, fig.107 D; Taft, 1964,
 p.46, fig.9; Mattern, 1964, p.251, fig.17; Croasdale & Grönblad,
 1964, p.207, pl.21, figs.12, 13; Lenzenweger, 1965, p.453, pl.2,
 fig.8; Förster, 1965, p.158, pl.9, figs.24, 25, 27; Ochiai, 1966,
 p.132; Eloranta, 1968, p.61, fig.11; Prescott, 1969, p.117,
 fig.120; Förster, 1969, p.99, pl.51, figs. 3-5; Mix, 1970, p.98,
 pl.4, fig.5; Parra & Gonzales, 1970, p.31, fig.231; Förster, 1970,

p.344, pl.29, figs.13-16; Hinode, 1971, p.127, pl.10, fig.21; Ratnasabapathy, 1972, p.105, pl.4 D; Croasdale, 1973, p.117, pl.18, fig.12; Whitford & Schumacher, 1973, p.79, pl.38, fig.7; Stein, 1975, p.139, fig.100; Parra, 1975, p.50, fig.169; Werner, 1977, p.66, pl.16, fig.2; Hinode, 1977, p.89; Watanabe, 1978, p.119, pl.4, fig.1.

10-33 μ m long; 10-39 μ m broad.

Cells of medium size, about $1\frac{1}{2}$ times broader than long, slightly constricted,, consisting of a very slight concavity in the middle of the lateral margins; cells united by their apices to form long slimy filaments, constricted at the joints; apex of semicells broadly truncate, about as broad as the isthmus, lateral margins slightly convex; vertical view circular sometimes with two opposite papillae, or three, equidistant; chloroplasts axile, one in each semicell, with a central pyrenoid and a number of radiating ridges, star-like in the vertical view; filaments usually enveloped in a conspicuous gelatinous sheath often as broad as the filaments itself. (Pl.11, fig.23, photo.98).

Local distribution: Shahlimar Bagh, Lahore, Sarim No.49, Oct. 22, 1976; Mardan, Sarim No.88, Nov. 8, 1976; Peshawar, Sarim No.91, Dec. 4, 1976.

Geographical distribution: World wide.

2. H. mucosa (Mert.) Ehr. ex Ralfs, Brit. Desm. p.53, pl.1, fig.2. 1848.
- = Conferva mucosa Mert. in Dillwyn Brit. Confervaepp.46, pl.B. 1809.
- = Actinocyclus variabilis Corda in Alm. de Carlsbad, p.198, pl.2, fig.11. 1840.
- = Hyalotheca mucosa (Mert.) Ehr. in Berlin Monatsb. p.212. 1840.
- = Gloeoprium mucosum Ralfs in Ann. Mag. Nat.Hist. vol.16, p.11, pl.3, fig.6. 1845.
- = Hyalotheca ralfsii Kg. Sp. Alg. p.187. 1849.
- = Mixotaenium armillare Delp. Sp. Desm. subalp. p.50, pl.1, figs.13. 1873.

West, West & Carter, vol.5, 1923, p.235, pl.162, figs.1-4; Smith, 1924, p.142, pl.87, fig.10; Prescott, 1941, p.28, pl.2, fig.4; Taft, 1945, p.204, pl.5 fig.20; Smith, 1950, p.333, fig.244A; Irénée-Marie, 1952, p.28; Tiffany & Britton, 1952, p.204, pl.56, fig.630; Croasdale, 1957, p.152, pl.10, fig.142; Scott & Prescott, 1958, p.69; Hirano, 1960, p.391, pl.53, figs. 18, 19; Fritsch, 1961, fig.109D; Croasdale & Grönblad, 1964, p.207, pl.21, fig.16; Förster, 1969, p.99, pl.51, figs.11-15; Lenzenweger, 1970a, p.4, pl.1, fig.4; Whitford & Schumacher, 1973, p.79, pl.38, fig.11.

16-22 μm long; 16-22 μm broad.

Cells of medium size, quadrangular, about as long as broad, cylindrical, usually without the faintest indication of a constriction in the normal resting cell, very slightly or not conspicuously constricted at the joints, each semicell with two parallel rings of tiny granules just beneath its apex; vertical view circular, chloroplasts axile one in each semicell, each with a central pyrenoid and several radiating ridges; filaments enclosed in a very massive gelatinous sheath, usually of greater thickness. (Pl.11, fig.24, photo.99).

Local distribution: Warsak Road, Peshawar, Sarim No.41, Oct, 11, 1976.

Geographical distribution: World wide.

CHARACTERS OF COSMOCLADIUM

22. COSMOCLADIUM Bréb. Liste Desm. p.133. 1856.

Cells united by bands of gelatinous material to form spherical to ellipsoidal, sessile or free-floating colonies; colonies enclosed by hyaline, homogeneous gelatinous envelopes; cells small, length somewhat greater than the breadth, median constriction usually deep and sinus linear; semicells usually

compressed and front view elliptic; vertical view elliptic and lateral view of semicells subcircular; cell wall smooth, without ornamentation aside from pores; chloroplasts axile, with one pyrenoid.

1. Cosmocladium constrictum Arch. in Quart. Jour. Micr. Sci. p.415. 1875.

= Dictyosphaerium sp. Arch. in Quart. Jour. Micr. Sci. p.127.1865.

West, West & Carter, vol.5, 1923, p.198, pl.158, figs.1-3; Hirano, 1960, p.387, pl.53, fig.9; Gerrath, 1970, p.213; Whitford & Schumacher, 1973, p.75, pl.36, fig.20.

16-20 μm long; 10-12 μm broad; breadth of isthmus 8.5-9 μm .

Cells very small, rather more than $1\frac{1}{2}$ times longer than broad, subcylindrical, constriction extremely slight, semicells subpyramidal, narrowing slightly towards the apex, with gently rounded outlines; end view circular; chloroplast axile, only one in each cell, with a central pyrenoid (occasionally 2 are present) and four radiating parietal lobes; cells united by means of gelatinous filaments to form branched colonies of an irregular shape; cell not only at the ends of the strands but arranged distantly at intervals along them. (Pl.11, fig.25, photo.100).

Local distribution: New Bus Stand Peshawar, Sarim No.323, Feb. 10, 1979.

Geographical distribution: Europe, U.S.A, Japan, Pakistan, Canada.

CHARACTERS OF SPIROTAENIA

23. SPIROTAENIA Bréb. ex Ralfs, Brit. Desm. p.178. 1848.

Cells of variable size, straight, length at least five times the breadth, neither constricted nor compressed; cells solitary, usually cylindrical and with parallel sides, more rarely with sides attenuated or fusiform; poles commonly broadly rounded, infrequently

subacute; cell wall smooth and without pores; chloroplast a fairly broad, parietal, spirally twisted ribbon extending from pole to pole; or axile and with longitudinal blades that are spirally twisted; in either case with several pyrenoids; cell wall with no fixed point at which division takes place.

1. Spirotaenia obscura Ralfs, Brit. Decm. p.179, pl.34, fig.2. 1848.

West & West, vol.1, 1904, p.44, pl.3, figs.7-12;

Croasdale, 1955, p.519, pl.3, fig.9; Hirano, 1955, p.14, pl.2, fig.3; Grönblad & Růžicka, 1959, p.209, figs.32-34; Fritsch, 1961, p.311, fig.96; Whitford & Schumacher, 1973, p.64, pl.17, fig.9; Stein, 1975, p.135, fig.91.

50-210 μ m long; 15-30 μ m broad.

Cells of medium size, $3\frac{1}{2}$ -8 times longer than broad, cylindrical or fusiform, attenuated towards each pole, apices rounded; chloroplast, axile, not quite reaching the poles, with 3-8 ridges spirally twisted to the left, rarely almost straight ridges thickened at the free margin; pyrenoids several. (Pl.11, fig.7).

Local distribution: Baragali, Sarim No.148, March 9, 1977.

Geographical distribution: Europe, U.S.A., Canada, Japan, Pakistan.

CHARACTERS OF OOCARDIUM

24. OOCARDIUM Näg. Gatt. einz. Alg. p.74, 1849.

Cells small, depressed, considerably broader than long, very slightly constricted, unequally flattened on the two sides, so that the cells are only symmetrical in 2 planes at right angles; cell wall smooth; chloroplasts axile with a central pyrenoid in each semicell; cells embedded in the ultimate ends of a radiating and branched system of gelatinous strands, the latter being encrusted with lime, aggregated in colonies.

1. Coccardium stratum Näg. Gatt. einz. Alg. p.75, pl.3. 1849.

West, West & Carter, vol.5, 1923, p.204, pl.159, figs. 1-8;
 Smith, 1950, p.325, fig.236; Prescott, 1954, p.99, fig.155;
 Golubic & Marcenko, 1958, p.177, fig.1; Fritsch, 1961, fig.114;
 Rieth, 1970, p.51, fig.3; Pfiester, 1976, p.134, figs.1, 2.

13-20 μm long; 18-24 μm broad; thickness 17 μm .

Colonies small, hemispherical or longer column-like structures, gregarious, bright, green; cells small, about $1\frac{1}{2}$ times broader than long, in the front view, depressed, very slightly constricted, unequally depressed on the two sides so that the cell is longer on the one side than the other; lateral view oblong-elliptic, slightly longer than broad with the faintest indication of a constriction; vertical view oblong-elliptic, chloroplasts axile, one in each semicell, coccntrated in the front view towards the broader side of the cell, with a central pyrenoid in each chloroplast; cells embedded in the ultimate ends of branched gelatinous strings, each strand of which is sorrounded by a hollow cylinder of lime, from the apex of which the cell just protrudes; cell inserted in the tube so that the broader end of the cell, containing the greater part of the chloroplast is directed towards the periphery, and the narrow end within the tube, with the constriction in a vertical direction. (Pl.2, fig.6, photo.17).

Local distribution: Mangopir Karachi, Sarim No.27, April 8, 1978.

Geographical distribution: Europe, U.S.A., Pakistan.

CHARACTERS OF GONATOTYCON

25. GONATOTYCON De Bary, in Hedwigia p.105, 1856.

Cells cylindrical, ^{solitary,} length many times the breadth, without a trace of a median constriction; sides of cells parallel, except near apices where they may be either slightly dilated or convergent;

apices truncate, with angles only slightly rounded, at times subcapitate; cell wall smooth, finely granulate, or clothed with minute spicules or spines; chloroplasts axile ribbon-like strands extending from pole to pole or from each pole to middle of cell; pyrenoids fairly numerous and at regular intervals along the chloroplast; cell division at any point in the cell wall, the cells frequently remaining attached at apices and forming temporary colonics of variable length; colonies readily separating into component cells on being disturbed and always separating prior to conjugation.

1. Gonatozygon aculeatum Hastings, Am. Mo. Micr. Jour. p.13. 1892.

Smith, 1924, p.5, pl.52, fig.3; Taylor, 1934, p.240, pl.47, fig.14; Grönblad, 1945, p.1, pl.1, fig.1; Smith, 1950, p.307, fig.217A; Prescott, 1954, p.73, fig.107; Hirano, 1955, p.23, pl.1, fig.4; Scott & Prescott, 1958, p.22, pl.3, fig.13; Förster, 1969, p.16, pl.1, figs. 30-32; Růžička, 1970, p.205, pl.11, fig.2; Mix, 1972, p.207, figs.13-15; Whitford & Schumacher, 1973, p.43, pl.7, fig.9; Parra, 1975, p.27, fig. 7; Kusel-Fetzmann, 1977, p.79, fig.288; Parra & Gonzales, 1977, p.15, figs.15-17.

211-212 μm long; 12.5 μm broad; apices 15-22 μm broad; spines 5-9.5 μm long.

Cells fairly long, cylindrical, length 15-20 times the breadth (without spines); apices somewhat dilated and truncate, apical angles very slightly rounded; cell wall densely clothed with small, sharp, erect spines; truncate ends without spines; chloroplasts with 6-9 pyrenoids. (Pl.11, fig.14, photo.91).

Local distribution: Bara Peshawar, Sarim No.131, Jan. 16, 1977.

Geographical distribution: World wide.

CHARACTERS OF ONYCHONEMA

26. ONYCHONEMA Wall. in Desmidiaceae of lower Bengal Ann. Mag. Nat. Hist. Ser. 3,5, p.194. 1860.

Cells generally small, breadth usually somewhat greater than the length; united to form permanent filaments by two apical processes that lie on opposite sides of the apex and overlap adjacent cells of the filament; cells compressed, deeply constricted and generally with a closed sinus; semicells elliptic, with a smooth or serrate outline, lateral angles smooth or with a single long convergent spine; cell wall smooth or with transverse rows or granules or pores, at times finely punctate; vertical view fusiform-elliptic, with the apical processes of the front view alternately arranged and the poles rounded or bearing a single straight spine; lateral view of semicells usually circular; chloroplasts axile and with one pyrenoid; colonies generally enclosed in a fairly broad gelatinous sheath.

1. Onychonema laeve Nordst. Desm. Brasil p.206, pl.3, fig.34. 1870.
= Xanthidiastrum paradoxum Delp. Sp. Desm. subalp. p.80, pl.3, fig.27. 1877.

West, West & Carter, vol.5, 1923, p.218, pl.160, fig.15, 16; Smith, 1924, p.136; Hirano, 1960, p.402, pl.54, fig.8; Lind, 1967, p.382, pl.99, fig.7; Kirk, Postek & Cox, 1976, p.5, fig.1.

16-17 μm long; breadth without spines 20.5-25 μm ; including spines 25-46 μm ; breadth of isthmus 6 μm .

Cells larger, slightly broader than long, deeply constricted, sinus narrow for part of its length, dilated at the apex and opening widely; semicells oblong or subreniform, attenuated towards the lateral angles and ending in a long stout converging spine; apical processes rather shorter than the spines; vertical view elliptic, filaments usually embedded in a mucous investment. (Pl.11, fig.5, photo.85).

Local distribution: Nowshera Textile Mills, Sarim
No.304, Jan. 26, 1979.

Geographical distribution: Europe, Japan, India, U.S.A,
Pakistan, Brazil.

CHARACTERS OF PHYMATODOCIS

27. PHYMATODOCIS Nordst. in Alg. Brasil, 1977 (vide, West & West, 1904).

Cells in filaments, more broader than long, united directly, without processes; median constriction marked; cells angular or with radiate arms in vertical view; semicells asymmetrical.

1. Phymatodocis nordstedtiana Wille forma minor Borgessen, in E. Warming, Sym. Fl. Brasiliae. Vid. Medd. nathist. Foren. p.930. 1890.

Scott & Grönblad, 1957, p.52, pl.37, fig.13; Whitford & Schumacher, 1973, p.79, pl.37, fig.17.

20-50 μm long; 55-65 μm broad; isthmus 25-35 μm broad.

Cells quadrangular in front view and adhering in filaments, which may be very slightly twisted; cells broader than long, with flattened apex and open sinus. (Pl.11, fig.13).

Local distribution: Takhtbhai, Mardan, Sarim No.157,
March 17, 1977.

Geographical distribution: U.S.A, Europe, Pakistan, Brazil.

CHARACTERS OF STREPTONEMA

28. STREPTONEMA Wall. in Desmidiaceae of lower Bengal Ann. Mag. Nat. Hist. Ser. 3, 5. 1860 (vide, Scott & Prescott, 1958).

Cells small, or of medium size, often deeply constricted, with an open sinus, cells united ^{by apical processes} to form long filaments, sometimes twisted.

1. Streptonema trilobatum Wall. in Desmidiaceae of lower Bengal
Ann. Mag. Nat. Hist. Ser. 3, 5, p.196, pl.9, figs.1-6.1860.

Scott & Prescott, 1958, p.70, fig.21; Hirose, Sugiyama
& Kumano, 1960, p.106, figs.G-1; Islam, 1970, p.932, pl.3, figs.
1-5; pl.21, fig.2; Pl.22, fig.2.

Length without polar projection $28\ \mu\text{m}$; $55\ \mu\text{m}$ broad;
isthmus $20\ \mu\text{m}$ broad.

Cells small, more broader than long, deeply constricted,
sinus open; semicells elliptic, lateral view of semicells
subspherical, with apex truncate and flattened; chloroplast axile.
(Pl.11, fig.17, photo.93).

Local distribution: Pabbi, Distt. Peshawar, Sarim
No.48, Oct. 22, 1976.

Geographical distribution: Japan, U.S.A, Australia,
Bangladesh, Pakistan, India.

ACKNOWLEDGEMENTS

The writer is extremely indebted to his major Professor Dr. M.A.F. Faridi for guidance, invaluable literature and stimulating discussions on every aspect of the problem during the course of this investigation. Thanks are also extended for his critical review of the manuscript.

Particular gratitude is acknowledged to Dr. Hannah T. Croasdale, without her help this study would not have been as it is today. She helped in literature and identifications. Dr. G.W. Prescott also took special interest in the study and was always helpful. Drs. W. Scharf, A. Vuorisalo, T. Minode and L.A. Whitford were kind enough to send gifts of books and grateful thanks are due to them.

Many other workers of desmids fully cooperated in the study and provided valuable literature particularly Drs. R.H. Thompson, R. Chardard, M. Hirano, R. Lenzenweger, M. Mix, J. Růžicka, K. Thomasson, T.B. Tylski, K. Ueda, R.L. Frock, B. Smith, C.E.M. Bicudo, P.F.M. Coesel, K. Förster, T. Ichimura, L. Kies and A.K.M. Nurul Islam. Apart from them, the writer received reprints from hundreds of workers from all over the world and their references are given in the literature cited. All of them deserve thanks.

Phycologists of Pakistan particularly Dr. M. Nizamuddin, Dr. S.N. Arbani, Dr. M. Shameel, Dr. Phool B. Zahid, Dr. Sultan Ahmad and Miss. Ghazala Anjum provided me with their collections. Messrs Prof. Rashid Ali, M. Pervaiz, Qaisar Ali, Farrukh Hussain, Prof. Imtiazul Haq, Mrs. Zahida Malik, Jan Mohammad and Khial Badshah also helped in collections.

Dr. Islam Mahmood Khan, Dr. M. Said, Dr. Ihsan Illahi^{Dr.}/S.R. Chughtai and Dr. Habib-ur-Rehman helped in photomicrographs, guidance and encouragement. Thanks are offered to all of them.

Department of Genetics, Faculty of Agriculture, Peshawar, Pakistan Council of Scientific and Industrial Research, Peshawar and Pakistan Forest Institute, Peshawar provided laboratory facilities whenever needed.

My own alma mater, the Department of Botany, University of Peshawar gave full laboratory facilities and a liberal grant of scholarship.

Finally I am very thankful to Messrs. Faiz ullah and Abadullah for typing the manuscript.

L I T E R A T U R E C I T E D

- Bharati, S.G. 1965. *Micrasterias euastriellopsis* sp. nov. An interesting new species of the genus *Micrasterias*. Rev. Alg. 43-45.
- Bicudo, C.E.M. & L. Sormus. 1972. Polymorphism in the Desmid *Micrasterias laticeps* and its taxonomical implications. J. Phycol. 8 (3): 237-242.
- _____ 1975. Use of measurements for differentiation of infraspecific taxa in *Micrasterias laticeps*. Br. Phycol. J. 10: 43-47.
- _____ & P. Compere. 1978. A taxonomic study of the desmid genus *Bourrellyodesmus* (Zygnemaphyceae). Bull. Jard. Bot. Nat. Belg. Bull. Nat. Plantentuin Belg. 48 (3/4): 409-426.
- Biebel, P. 1964. The sexual cycle of *Netrium digitus*. Amer. J. Bot. 51 (7): 697-704.
- _____ & R. Reid. 1965. Inheritance of mating types and zygospore morphology in *Netrium digitus* var. *lamellosum*. Proceedings of the Pennsylv. Acad. Sc. 39: 134-137.
- Borge, O. 1899. Ueber tropische und subtropische Susswasser-Chlorophyceen. Bih. T.K.Sv.Vet. Akad. Handl., Afd.3. No.12.
- Brandham, P.E. & M.B.E. Godward. 1964. The production and inheritance of the haploid triradiate form in *Cosmarium botrytis*. Phycologia, 4 (2): 75-83.
- _____ 1965. Polyploidy in Desmids. Can. J. Bot. 43: 405-417.
- _____ 1965a. Some new chromosome counts in the Desmids. Br. Phycol. Bull. 2 (6): 451-455.

- Brandham, P.E. & M.B.E. Godward. 1965b. The inheritance of mating type in Desmids. *The new Phytologist*, 64: 428-435.
- _____ & M.B.E. Godward. 1965c. Meiosis in *Cosmarium botrytis*. *Canad. J. Bot.* 43: 1379-1386.
- _____ 1965d. Formation, division and conjugation of multinucleate cells of Desmids. *Phycologia*, 5 (1): 45-52.
- _____ 1965e. The occurrence of parthenospores and other haploid resistant spores in Desmids. *Trans. Amer. Micros. Soc.* 84 (4): 478-484.
- _____ 1967. Time-lapse studies of conjugation in *Cosmarium botrytis*. 1: Gamete fusion and spore formation. *Rev. Algol.* 8 (4): 312-316.
- _____ 1967a. Time-lapse studies of conjugation in *Cosmarium botrytis*. II. Pseudoconjugation and an Anisogamous mating behavior involving chemotaxis. *Can. J. Bot.* 45: 483-493.
- Bruhl, P. & K. Biswas. 1926. Algae of Loktak Lake. *Mem. Asiatic Soc. Bengal*, 8: 257-316.
- Brunel, J. 1938. Sur deux formes nouvelles de *Miristerias*. *Contr. Inst. Bot. Univ. Montreal*, 32: 3-6.
- Buell, H.F. 1968. *Closterium gracile* Bréb. (Desmidiaceae) -- a new interpretation. *Bul. Torr. Bot. Club*, 95 (5): 449-454.
- Caljon, A. 1975. Algologisch onderzoek van de vennen van Turnhout (Antw.) *Biol. Jb. Dodonea*, 43: 90-115.
- Carter, N. 1929. Freshwater algae from India. *Records of the Bot. Survey of India*. pp. 263-266.
- Cederdrenitz, C. 1929. Susswasseralgen aus Petsamo. *Mem. Soc. pro Fauna et Flora Fenn.* 5: 140-158.
- _____ 1932. Susswasseralgen aus Petsamo II. *Mem. Soc. Pro Faun. et Flora Fenn.* 7: 237-248.
- _____ & R. Grönblad. 1936. Bemerkungen über einige Desmidiaceen von Aland. *Soc. Scient. Fenn. Comm. Biol.* 7 (2): 1-10.

- Cedercreutz, C. 1941. Beitrag zur kenntnis der Susswasseralgen auf den Azoren. Soc. Scient. Fenn. Comm. Biol. 8: 1-36.
- _____ 1941a. Beitrag zur kenntnis der felsenalgen in Finnland, 17: 105-121.
- _____ 1944. Fresh-water algae from Labrador. Mem. Soc. Fau. et Flora Fenn. 19: 217-222.
- Chardard, R. 1964. Etude de l' ultrastructure de deux Algues Zygothryx: Mesotaenium caldariorum et Penium margaritaceum. Rev. Cyt. and Biol. Veg. 27: 77-93.
- _____ 1965. Nouvelles observations sur l' infrastructure de deux algues Desmidiacees: Cosmarium lundellii et Closterium acerosum. Rev. Cyt. and Biol. Veg. 28: 2-30.
- _____ 1966. Aspects infrastructure aux de l' autoantagonisme chez deux Desmidiacees (Algues Zygothryx). Rev. Cyto. and Biol. Veg. 29: 335-356.
- _____ 1970. Action des solutions hypertoniques sur l' ultrastructure d' une Algue verte: Cosmarium lundellii Delp. Soc. Bot. Fr. Memoires, pp. 59-82.
- _____ & R.M. Heim. 1971. Ultrastructure des plastes d' une Desmidiacee (Closterium acerosum Ehr.) cultivee attenuée. C.R. Acad. Sc. Paris, 273: 569-571.
- _____ & R.M. Heim. 1971a. Ultrastructure du pyrenoide d' une Desmidiacee (Closterium acerosum Ehr.). cultivee en lumiere attenuée. C.R. Acad. Sc. Paris, 273: 1190-1192.
- _____ 1973. Action de la lumiere et de l'obscurite sur la structure des plastes de Cosmarium lundellii et de Closterium acerosum (Desmidiaceae). Beih. Nova Hedwigia, 42: 59-81.
- _____ 1977. La secretion de mucilage chez quelques Desmidiacees. 1. Les pores. Protistologica, 13 (2): 214-251.

- Chung, Y.H., J.H. Shim & M.J. Lee. 1965. A study on the microflora of the Han River. 1. The phytoplanktons and the effect of the marine water in the lower course of the Han River. *Kor. Jour. Bot.* 8 (4): 7-29.
- Claassen, M.I. 1977. Freshwater algae of Southern Africa. 4. Some *Micrasterias* from Rhodesia, including a new species. *Bothalia*, 12 (2): 239-245.
- Coesel, P.F.M. 1974. Notes on sexual reproduction in desmids. 1. 1. Zygospor formation in nature (with special reference to some unusual records of zygotes). *Acta. Bot. Neerl.* 23 (4): 361-368.
- _____ & E.M.G. Hoogendijk. 1975. Bijfragen tot de kennis der Nederlandse Desmidiaceeenflora 2. Desmidiaceeen uit het Mosterdveen. *Overdruk uit Gorteria*, 7 (8): 123-128.
- _____ 1976. Bijfragen tot de kennis der Nederlandse Desmidiaceeenflora, 4. De leemputten bij staverden. *over. vit Gorteria*, 8 (4): 61-68.
- Cohu, R.L. 1967. Contribution a l'etude hydrobiologique de la region de Paimont: l'etang du Chatenay. *Bull. Soc. Scient. Bretagne*, 32: 225-234.
- Compere, P. 1977. Algues de la Region du lac Tchad. *Cah. O.R.S.T.O.M., ser Hydrobiol.* 11 (2): 77-177.
- Cook, P.W. 1963. Variation in vegetative and sexual morphology among the small curved species of *Closterium*. *Phycologia*, 3 (1): 1-18.
- _____ 1963a. Host range studies of certain phycomycetes parasitic on Desmids. *Amer. J. Bot.* 50 (5): 580-588.
- Croasdale, H. 1948. Fresh and brackish water algae of Penikese Island 2. *Rhodora*, 50: 269-279.

Croasdale, H. 1955. Freshwater algae of Alaska 1. Some Desmids from the Interior. *Farlowia*, 4 (4): 513-565.

_____ 1956. Freshwater algae of Alaska 1. Some Desmids from the Interior Part 2: *Actinotaenium*, *Microsterias* and *Cosmarium*. *Trans. Amer. Micros. Soc.* 75 (1): 1-70.

_____ 1957. Freshwater algae of Alaska. 1. Some Desmids from the Interior. Part 3: *Cosmaria* concluded. *Trans. Amer. Micros. Soc.* 76 (2): 116-158.

_____ 1962. Freshwater algae of Alaska 3. Desmids from the Cape Thompson Area. *Trans. Amer. Micros. Soc.* 81 (1): 12-42.

_____ & R. Grönblad, 1964. Desmids of Labrador 1. Desmids of the Southeastern Coastal Area. *Trans. Amer. Micros. Soc.* 83 (2): 142-212.

_____ 1965. Desmids of Devon Island, N.W.T., Canada, *Trans. Amer. Micros. Soc.* 84 (3): 301-335.

_____ 1973. Freshwater algae of Ellesmere Island, N.W.T., Nation. Mus. Canada. 3: 5-131.

_____ & A.M. Scott. 1976. New or otherwise interesting Desmids from Northern Australia. *Nova Hedwigia*, 27 (3+4): 501-596.

Dubois-Tylski, Th. 1969. Florule algologique d'un marais d'Ardenne, *Rev. Algolo.* 4: 316-325.

_____ 1972. Le cycle de *Closterium moniliferum* in vitro. *Soc. Bot. Fr., Memoires*, pp. 183-200.

_____ 1973. Aspects ultrastructuraux de l'induction sexuelle chez *Closterium moniliferum* (Bory) Ehr. (Desmidiaceae). *Beih. Nova. Hedwigia*, 42: 91-101.

_____, R.M. Jacques & L. Lacoste. 1973a. Action des radiations monochromatiques sur la multiplication vegetative et la sexualisation du *Closterium moniliferum* (Bory) Ehr. *C.R. Acad. Sc. Paris*, 276: 1165-1168.

- Dubois-Tylski, Th. 1973b. La conjugaison en culture in vitro chez *Closterium rostratum* Ehr. Bull. Soc. Bot. Fr. 120: 33-42.
- _____ 1973c. Etude ultrastructurale de la conjugaison et de la Jeune zygospore chez *Closterium moniliferum* (Bory) Ehr. Ann. Sci. Natur. Bot. Paris, 14 (12): 41-52.
- _____ & M. Abadie. 1974. Etude ultrastructurale de la zygospore mure de l'algue Desmidiée *Closterium moniliferum* (Bory) Ehr. Ann. Sci. Naturelles, Bot. 15 (12): 181-194.
- _____ 1977. Influence de la teneur en nitrate du milieu sur la sexualisation du *Closterium moniliferum* (Bory) Ehr. (Chlorophycees, Zygothryx). Soc. Phycol. De France, Bull. 22: 27-31.
- _____ 1978. Evolution ultrastructurale de la Zygospore du *Closterium moniliferum* (Bory) Ehr. Rev. Algol. N.S. 3: 211-224.
- El-Nayal, A.A. 1935. Egyptian freshwater algae. Bull. Fac. Sci. 4: 1-106.
- Eloranta, P. 1968. Havaintoja Maskun Karevansuon Desmidiäles-ryhman Levista. Eripainos Turun Ylioppilas 14: 58-74.
- Evans, J.H. 1962. Some new records and forms of algae in central East Africa. Hydrobiol. 20 (1): 60-86.
- Faridi, M.A.F. 1964. Some simple techniques for the production of zoospores in freshwater algae. Turtox News, 42 (1): 58-9.
- _____ 1971. The genera of fresh-water algae of Pakistan and Kashmir. Biologia, 17 (2): 123-142.
- Förster, K. 1964. Beiträge zur Desmidiaceen-flora des Ost-Allgaus. Ber. d. Bayer. Botan. Ges. 37: 41-52.
- _____ 1965. Beitrag zur Desmidiäen-Flora der Torne-Lappmark in Schwedisch-Lappland, Arkiv for Botanik, 6 (3): 109-161.

- Förster, K. 1965a. Beiträge zur Kenntnis der Desmidiaceen-flora von Nepal, Erg. Forsch. Uniter. Nepal Himal. 2: 25-58.
- _____ 1966. Beiträge zur Desmidiaceen-flora des Ost-Allgaus. Ber. d. Bayer. Botan. Ges. 39: 47-55.
- _____ 1966a. Zweiter Beiträge zur Desmidiaceen-flora des Ost-Allgaus. Das Wasenmoos bei Pfronten. Ber. d. Naturf. Ges. Augsburg. 18: 3-21.
- _____ 1966b. Ein Vorschlag zur einheitlichen zeichnerischen Darstellung von Desmidiaceen. Hedwigia, 10 (3/4): 463-479.
- _____ 1968. Beiträge zur Desmidiaceen-flora des Ost-Allgaus. Ber. d. Bayer. Bot. Ges. 40: 17-30.
- _____ 1969. Amazonische Desmidieen. Amazoniana, 11 ($\frac{1}{2}$): 5-116.
- _____ 1970. Beitrag zur Desmidieenflora von Sud-Holstein und der Hansestadt Hamburg. Nova Hedwigia, 20: 253-411.
- _____ 1972. Desmidieen aus dem Südosten der Vereinigten Staaten von Amerika. Hedwigia, 23: 515-644.
- _____ 1974. Amazonische Desmidieen. Amazoniana, 5 (2): 135-242.
- Fritsch, F.E. 1964. The structure and reproduction of the algae. vol.1, Cambridge. pp. 791. 245 figs.
- Gayoso, A.M. 1975. Contribucion al Conocimiento de las Desmidiaceas del Parque Nacional Los Alerces (Chubut). Bol. Soc. Argent. Bot. 16 (4): 325-338.
- _____ 1976. Contribution al conocimiento de las Desmidiaceas del Parque Nacional Los Alerces (Chubut). Bol. Soc. Argent. Bot. 17 (1-2): 83-94.
- Gerrath, J.F. 1969. *Penium spinulosum* (Wolle) comb. Nov. (Desmidiaceae): a taxonomic correction based on cell wall ultrastructure. Phycologia, 8 (2): 109-118.

- Gerrath, J.F. 1970. Ultrastructure of the Connecting strands in *Cosmoecium sexonicum* De Bary (Desmidiaceae) and a discussion of the taxonomy of the genus. *Phycologia*, 9 (3/4): 209-215.
- _____ 1973. Notes on Desmid ultrastructure. 1. cell wall and zygote wall of *Cylindrocapsa brebissonii* Menegh. 2. The replicate division septum of *Bambusina brebissonii* Kg. *Beih. Nova Hedwigia*, 42: 103-113.
- Golubic, S. & E. Marcenko. 1958. Zur morphologie und taxonomie der Desmidiaceen gattung *Oocardium*. *Schweiz. Z. Hydrologie*, 20: 177-185.
- Gough, S.B., T.W. Garvin. & W.J. Woelkerling. 1976. On processing field and culture samples of Desmids (Desmidiaceae, Chlorophyta) for scanning electron microscopy. *Br. Phycol. J.* 11: 245-250.
- Grönblad, R. 1919. Observations criticae quas ad Cognoscenda *Closterium didymotocum* Corda et *Closterium baillyanum* Bréb. *Acta Soc. Pro Fau. et Flora Fenn.* 46 (5): 4-20.
- _____ 1943. Beitrag zur kenntnis der süsswasseralgen Gotlands und Olands. *Soc. Scient. Fenn., Comm. Biol.* 9 (2): 1-18.
- _____ 1944. Ein beitrag zur kenntnis der Desmidiaceen des Gebietes Südlich Vom oberenswird. *Acta Soc. pro Fauna et Flora Fenn.* 63 (5): 1-15.
- _____ 1945. De Algis Brasiliensibus. *Acta Soc. Scient. Fenn.* 11 (6): 3-43.
- _____ 1945a. A further report of Freshwater algae recorded from the neighbourhood of the Zoological Station at Tvärminne. *Mem. Soc. Pro Fau. et Flora Fenn.* 21: 49-58.

- Grönblad, R. 1947. Desmidiaceen aus Salmi. Acta Soc. Fau. et Flor. Fenn. 66(1): 1-31.
- _____ 1947a. Desmids from the island of Hogland (Suursaari) in the gulf of Finland. Me. Soc. pro Fau. et Flora Fenn. 23: 170-181.
- _____ 1948. A list of desmids and plankton-organisms from the surroundings of Velikaja Guba (Suurlahti) in East Carelia (Onega). Soc. Scient. Fenn. Comm. Biol. 10(5): 1-11.
- _____ 1948a. Freshwater algae from Tacktom trask. Botan. Notiser, 4:413-424.
- _____ 1952. Some Desmids from Gotland and Oland. Botan. Notiser, 1:72-80.
- _____ 1952a. Desmids from West Greenland. Medd. om Gronl. 147 (8): 4-26.
- _____ & P. Kallio. 1954. A new genus and a new species among the Desmids. Botan. Notiser, 2:167-178.
- _____ 1955. On the Desmids collected by Professor Mauna J. Kotilainen in Tervola, North Finland. Arch. Soc. Vanamo, 9: 40-44.
- _____ 1955a. A contribution to the knowledge of the algae of brackish water in some ponds in the Woods Hole Region, U.S.A. Mem. Soc. Fau. et Flor. Fenn. 31:63-69.
- _____ 1956. Desmids from the United States, collected in 1947-1949 by Dr Hannah Croasdale and Dr. Edwin T. Moul. Soc. Scient. Fenn. Comm. Biol. 15(12): 4-38.
- _____, G.A. Prowse & A.M. Scott. 1958. Sudanese Desmids. Acta Bot. Fenn. 58:3-82.

- Grönblad, R. 1959. Studies on the zygosporos in the genus *Cylindrocystis*. *Botan. Notiser*, 112 (1): 85-89.
- _____ & J. Ruzicka, 1959a. Zur systematik der Desmidiaceen. *Botan. Notiser*, 112 (2): 205-226.
- _____ 1960. Contribution to the knowledge of the freshwater algae of Italy. *Soc. Scient. Fenn. Comm. Biol.* 22 (4): 5-85.
- _____, A.M. Scott & H. Croasdale. 1964. Desmids from Uganda and Lake Victoria. *Acta Bot. Fenn.* 66: 3-57.
- _____, A.M. Scott & H. Croasdale. 1968. Desmids from Sierra Leone, Tropical West Africa. *Acta Bot. Fenn.* 78: 3-41.
- _____ & H. Croasdale. 1971. Desmids from Namibia (SW Africa) *Acta. Bot. Fenn.* 93: 3-40.
- Grunow, A. 1965. Susswasser und Desmidiaceen von der Insel Banka. In *Rebenhorst's Beitr. zur Kenntnis und Verbreitung der Algen*, Heft 2.
- Gutwinski, R. 1902. De Algis a Dre. M. Raciborski anno 1899 in insula Java Collectis. *Bull. Acad. Sc. Cracovie, Cl. Sc. math. and nat.*, pp. 573-617.
- Heimans, J. 1946. 13th Biology Jaarboek. *Dodonea*, pp. 146-154.
- _____ 1969. Ecological, phytogeographical and taxonomic problems with Desmids, *Vegetatio*, 17 (1-6): 50-82.
- Herrmann, R. 1966. Zur frage des plasmalemmas bei Desmidialen. *Protoplasma*, 61 (1-2): 12-59.
- _____ 1968. Die plastiden pigmente einiger Desmidiaceen. *Protoplasma*, 66: 357-368.
- _____ 1969. Zur Resistenz der Desmidialen. 1. Einfluss cytologischer und soziologisch-Ökologischer Faktoren auf die wirkung Ca-entziehender Reagenzien. *Smn.* 177 (15): 141-175.
- Hickel, B. 1973. Phytoplankton in two ponds in Kathmandu valley (Nepal). *Int. Rev. ges. Hydrobiol.* 58 (6): 835-842.

- Hinode, T. 1971. A study on the Desmids of Kurozo, a Sphagnum-moor in Shikoku. *Hikobia*, 6 (1-2): 95-130.
- _____ 1977. Desmids collected from Miyajima island Hiroshima Prefecture. *Hikobia*, 8 (1-2): 71-90.
- Hirano, M. 1952-53. Freshwater Algae. Fauna and Flora of Nepal Himalaya. Scientific results of the Japanese Expeditions to Nepal Himalaya. 1: 6-42.
- _____ 1955. Freshwater algae from Northeastern part of Afghanistan Res. Kyoto Univ. Sci. Exp. 8: 15-54.
- _____ 1955a. Flora Desmidiarum Japonicarum. Contr. Biol. Lab. Kyoto Univ. 1: 1-56.
- _____ 1956. Flora Desmidiarum Japonicarum. Contr. Biol. Lab. Kyoto Univ. 2: 57-106.
- _____ 1957. Flora Desmidiarum Japonicarum Contr. Biol. Lab. Kyoto Univ. 4: 107-165.
- _____ 1959. Flora Desmidiarum Japonicarum. Contr. Biol. Lab. Kyoto Univ. Jap. 9: 302-386.
- _____ 1959a. Flora Desmidiarum Japonicarum. Contr. Biol. Lab. Kyoto Univ. 7: 226-301.
- _____ 1960. Flora Desmidiarum Japonicarum. Contr. Biol. Lab. Kyoto Univ. Japan. 11: 387-474.
- _____ 1966. Freshwater algae of Karakoram and Swat-Himalaya. Res. Kyo. Univ. Sci. Exp. 8: 55-66.
- _____ 1967. Freshwater Algae collected by the joint Thai-Japanese biological expedition to Southeast Asia 1961-62. Nat. and life in S-E Asia, 5, Fauna and Flora, Res. Soc. Kyoto.
- _____ 1977. Freshwater algae of Afghanistan in plants of West Pakistan and Afghanistan e. Siro Kitamura pp. 1-283. Indus publications, Karachi.
- Hirose, H., H. Sugiyama & S. Kumano, 1960. On some phytoplankton new to Japan. *J. Rikusuigaku*, 21 (2): 104-108.

- Hobson, J. 1863. Notes on Indian Desmidiaceae. Quarterly Jour. Micr. Sci. 3: 168-170.
- Hoshaw, R.W. 1961. Sexual cycles of three green algae for laboratory study. Amer. Biol. Teach. 23 (8): 489-499.
- Hosiaisluma, V. 1975. *Staurastrum elongatum* (Desmidiaceae) in Finland. Memoranda Soc. Fauna Flora Fenn. 51: 11-13.
- _____ 1976. Effect of Hcl and Nacl on the growth of *Netrium digitus* (Desmidiaceae). Ann. Bot. Fennici, 13: 107-113.
- Howard, A. & F.G. Cowie. 1975. Survival curve characteristics in a Desmid. 6th L H Gray Conf. 3-12.
- _____ 1976. Over-Repair in *Closterium*. Increased radioresistance caused by an earlier exposure to radiation. Radiat. Cell. Cont. Process Springer-Verlag. pp. 188-195.
- _____ 1976a. Induced resistance in a desmid *Closterium moniliferum*. Radiat. Res. 65:540-549.
- Hughes, E. 1951. *Closterium* in Central Canada. Canad. Jour. Bot. 30: 266-289.
- Ichimura, T. 1971. Sexual cell division and conjugation-papilla formation in sexual reproduction of *Closterium strigosum*. - Sapporo, Japan, Univ. of Tokyo Press, pp. 208-214.
- _____ & M.M. Watanabe, 1976. Biosystematic of the *Closterium peracerosum-strigosum* - littorale complex. 1. Morphological variation among the inbreeding populations and an experimental demonstration for source of the cell size variation. Bot. Mag. Tokyo pp. 140.
- _____ 1978. Biosystematic studies of the *Closterium peracerosum* - *strigosum* - littorale complex. II. Reproductive isolation and morphological variation among several populations from the Northern Kanto Area in Japan. Bot. Mag. Tokyo, 91: 1-10.

- Ichimura, T. & M.M. Watanabe, 1978a. Biosystematic studies of the *Closterium peracerosum* - *strigosum* - *littorale* complex. III. Degrees of sexual isolation among the three populations groups from the Northern Kanto area. Bot. Mag. Tokyo, 91:11-24.
- Irénée-Marie, F. 1949. Quelques Desmidiées du lac Mistassini. Natur. Canad. 76 (8-10): 242-316.
- _____ 1951. Desmidiées de la Région de Québec. Nature. Canad. 78:88-127.
- _____ 1951a. Desmidiées de la région de Québec. Natur. Canad. 78(10):301-339.
- _____ 1951b. Desmidiées de la Région de Québec. 2. Les *Microsterias*, les *Euastrum* et les *Closterium*. Natur. Canad. 78(7-8): 177-221.
- _____ 1952. Desmidiées de la Région de Québec. 4. Natur. Canad. 79 (1):11-45.
- Islam, A.K.M. 1970. Contributions to the knowledge of Desmids of East Pakistan, Part I, Nova Hedwigia, 20:903-983.
- _____ 1975. Contribution to the knowledge of Desmidis of Bangladesh. Part 2. Dacca Univ. studies, 23 (2):31-37.
- _____ & K.M. Zaman. 1975a. Limnological studies of the River Buriganga III. Biological aspect. J. Asiatic Soc. Bangladesh (Sc.), 1 (1):45-65.
- Iyengar, M.O.P. & B. Bai:1941. Desmids of Kodal Kanal. South India. Jour. Indian Bot. Soc. 20 (1 and 2): 73-103.
- Joshua, W. 1885. On some new and rare Desmidiées. No. 3. Jour. Bot. 23:33-35.
- _____ 1886. Burmese Desmidiées, with descriptions of new species occurring in the neighbourhood of Rangoon. Jour. Linn. Soc. London, Bot. 21: 634-654.

- Kallio, P. 1959. The relationship between nuclear quantity and cytoplasmic units in *Micrasterias*. *Ann. Acad. Sci. Fenn.* 4(44): 1-44.
- _____ 1960. Morphogenetics of *Micrasterias americana* in clone culture. *Nature*. 187 (4732): 164-166.
- _____ & H. Heikkila. 1969. UV-induced facies change in *Micrasterias torreyi*. *Osterr. Bot. Z.* 116: 226-243.
- Kamat, N.D. 1962. Chlorophyceae of Ahmedabad India, *Hydrobiologia*, 20 (3): 248-279.
- _____ 1963. The Algae of Mahabaleshwar. *Jour. Univ. Bombay*, 31 (3 and 5): 28-41.
- Kamiya, T. 1961. Electron microscope observations on the cells of Conjugatae. *Bull. Aichi Gakugei Univ.* 10:39-54.
- _____ 1962. Electron microscopic observations on the cells of conjugatae (supplementary report). *Bull. Aichi Gakugei Univ.* 11: 43-59.
- Kanetsuna, Y. 1960. Studies on the diatom and desmid-flora of the reclaimed paddy fields by drainage in the city of Toyohashi, Aichi Prefecture. *J. Rikusuigaku*, 21 (2):73-86.
- _____ 1967. Studies on the diatom and desmid-flora of the paddy-fields in the two valleys, Kiso-dani and Ina-dani, Nagano Prefecture. *J. Rikusuigaku*, 28 (2):68-91.
- _____ 1972. On the relation between the occurrence of Desmids and the salinity in the Hokuriku district of Japan. *Bull. Jap. Soc. Phycol.* 20 (3): 101-110.
- Kasprik, W. 1973. Beitrage zur karyologie der Desmidiaceen - Gattung *Micrasterias* AG.- *Beih. Nova Hedwigia*, 42:115-137

- Kattner, E., D. Lorch & A. Weber. 1977. The components of the cell wall and slime of a strain of *Netrium digitus* (Ehr.) Itzigs. & Rothe. Mitt. Inst. Allg. Bot. Hamburg, 15:33-39.
- Kiermayer, O. & U. Menge. 1977. Beobachtungen zur struktur der dictyosomen Von *Micrasterias denticulata* Breb. Mikroskopie (Wien), 33: 168-176.
- Kies, L. 1962. Über die experimentelle Auslösung Von fortpflanzung-svorgangen bei Desmidiaceen. Vortrag. Gesamtg. Botan., Herausgeg. Deutsch. Bot. Gesellsch. Neue Folge, 1:65-70.
- _____ 1970. Elektronenmikroskopische untersuchungen über bildung und struktur der zygotenwand bei *Micrasterias papillifera* (Desmidiaceae). 1. Das exospor. Protoplasma, 70:21-47.
- _____ 1970a. Elektronenmikroskopische untersuchungen über bildung und struktur der zygotenwand bei *Micrasterias papillifera* (Desmidiaceae). II. Die struktur von Mesospor und endospor. Protoplasma, 71:139-146.
- _____ 1972. Geschlechtliche fortpflanzung von *Micrasterias papillifera* (Conjugatophyceae). Inst. Wissen. Film. 1064:3-12.
- _____ 1973. Elektronenmikroskopische untersuchungen über die konjugation bei *Micrasterias papillifera* (Desmidiaceae). Beih. Nova Hedwigia, 42: 139-154.
- Kirk, L.W., M.T. Postek & E.R. Cox. 1976. The Desmid genera *Sphaerozosma*, *Onychonema* and *Teilingia*: An historical appraisal. J. Phycol. 12(1):5-9.
- Kosinskaja, E.K. 1952. Flora plantarum Cryptogamarum URSS. 2. Conjugatae (1): Mesotaeniales et Gonatozygales. Acad. Sci. URSS Inst. Bot. 2: 1-162.

- Krieger, W. 1933. Die Desmidiaceen. In L. Rabenhorst, Kryptogamen-Flora von Deutschland, Österreich und der Schweiz. 13, Abt.1: 1-223. 33 figs. 8 pl.
- _____ & A.M. Scott. 1957. Einige Desmidiaceen aus Peru. *Hydrobiologia*, 9(2-3):126-144.
- Kubicek, Fr. & P. Marvan. 1953. Plankton of sedimentary reservoirs belonging to the waterworks in Brno. *Acta Acad. Scient. Natur. Morano-Silesiaca*, 25(7):217-256.
- Kusel-Fetzmann, E. 1969. Einige Algen aus Nepal. Khumbu Himal, 6(1):37-56.
- _____ 1973. Beiträge zur Kenntnis der Algen flora der Hochgebirge zentralamerikas und der Nordlichen Anden. *Hochgebirgsfors. Univ. Wien*, 3:29-68.
- _____ 1974. Beiträge zur Kenntnis der Algenflora des Neusiedler Sees I. Sitzung. *Osterr. Akad. Wissen. Mathem. naturw.* 183(3):5-28.
- Legerheim, G. 1888. Ueber Desmidiaceen aus Bengalen. *Bihang T.K. Svenska Vet. Akad. Handl.* 13,3(9): 1-12.
- Leher, K. 1958. Vergleichende Ökologische Untersuchungen einiger Desmidiaceen gesellschaften in den Hochmooren der Osterseen. *Berich. Bayerisch. Botan. Gesellsch.* 32:48-83.
- Lehtonen, J. 1977. Morphogenesis in *Micrasterias torreyi* Bail. and *M. thomasi* Arch. studied with UV microbeam Irradiation and chemicals. *Ann. Bot. Fenn.* 14:165-190.
- Lenzenweger, R. 1965. Beiträge zur Desmidiaceen flora des Ibmer Moores. *Jb. Öö. Mus.* 110:445-454.
- _____ 1966. Beiträge zur Desmidiaceen flora des Ibmer Moores I. Die gattung *Stauroastrum*, Meyen. *Jb. Öö. Mus.* 111:501-512.

- Lenzenweger, R. 1967. Beiträge zur Desmidiaceen flora des Ibmer Moores. Jb. Öö. Mus. 112:173-184.
- _____ 1968. Beobachtungen zu einer besonderen form Von missbildungen bei Desmidiaceenzellen. Arch. Protistenk, 110:305-312.
- _____ 1968a. Zygotenbildung bei der zieralge *Micrasterias*. Mikrokosmos, 1:10-13.
- _____ 1970. Beiträge zur Desmidiaceen flora des Ibmer Moores. Jb. Öö. Mus. 115:251-266.
- _____ 1970a. Beiträge zur Desmidiaceen flora von Oberösterreich. Mitt. Bot. Linz. 2:2-14.
- _____ 1973. Über konjugation und zygotenkeimung bei *Micrasterias rotata* Grev. Ralfs. (Desmidiaceae). Beih. Nova Hedwigia, 42: 155-161.
- _____ 1974. Beiträge zur Desmidiaceen flora von West - Borneo. I. Algen probe aus einem lenitischen Wassergraben bei Sungipinjuh. Mitt. Bot. 6/2:103-128.
- _____ 1976. Einige Desmidiaceen aus Mooren Nordkareliens Nebst Beobachtungen an Deppeizygoten. Linzer Biol. Beitr. 8:63-78.
- _____ 1977. Zieralgen aus Leppland. Mikrokosmos, 11:334-337.
- _____ 1978. Einige Desmidiaceen aus Mittel-Finnland und Finnisch - Lappland aus Aufsammlungen. Natur. Neimat. Ried, 1:1-11.
- Lind, E.M. 1967. Some East African Desmids. Nova Hedwigia, 13:361-387.
- _____ 1968. Notes on the distribution of phytoplankton in some Kenya waters. Br. Phycol. Bull. 3(3):481-493.
- Lippert, B.E. 1967. Sexual reproduction in *Glosterium moniliferum* and *Glosterium ehrenbergii*. J. Phycol. 3(4):182-198.

- Lippert, B.E. 1973. Some factors affecting conjugation in *Closterium* (Desmidiaceae). *Beih. Nova Hedwigia*, 42:171-177.
- Lott, J.N.A, G.P. Harris & C.D. Turner. 1972. The cell wall of *Cosmarium botrytis*. *J. Phycol.* 8(3):232-236.
- Luknitskaya, A.F. 1975. A simple method of quick determination of cell sizes and shapes in Desmid Algae. *Aka. Hayk. CCP*, 60:1-2.
- Marcenko, E. 1965. Restoration of irradiated Algae after a period of darkness. pp.542-543.
- _____ 1966. Über die wirkungen der gammastrahlen auf algen (Desmidiaceae). *Protoplasma*, 62 (2-3):157-183.
- _____ 1970. Changes in the chloroplast - ultrastructure of *Netrium digitus* (Desmidiaceae) after a period of darkness. *Acta Bot. Croat.* 29:33-38.
- Marshall, H.G. 1976. The phytoplankton of Lake Drummond, Dismal Swamp, Virginia. *Castanea*, 41:1-9.
- Mattern, H. 1962. Die algenflora stehender Gewässer der Umgebung von Crailsheim. Teil 1. Gewässer des Gipskeupers. *Jahrbuch ver. Vaterl. Naturkde. Württemberg*. 117:227-283.
- _____ 1964. Die algenflora stehender gewässer der Umgebung von Crailsheim, Teil II. Gewässer im Stubensandsteingebiet. *jh. ver. Vaterl. Naturkde. Württemberg*. 118:211-286.
- _____ 1966. Beobachtungen über die Algenflora der Spitzberg-tümpel. Spitzberg bei Tübingen, 3:197-222.
- Messikommer, E. 1963. Beitrag zur Kenntnis der Algen-verbreitung in der Westschweiz. *viert. Natur. Gesell. Zurich*, 108:37-69.
- Mix, M. 1970. Gürtelbänder bei *Closterium gracile* Bréb. (Desmidiaceae). *Mitt. Staatsinst. Allg. Bot. Hamburg*, 13:93-96.
- _____ 1970a. Die Desmidiaceen des Zeller Lochs bei Fulda. *Mitt. Staatsinst. Allg. Bot. Hamburg*, 13:71-92.

- Mix, M. 1972. Die Feinstruktur der Zellwände bei Mesotaeniaceae und Gonatozygaceae mit einer vergleichenden Betrachtung der verschiedenen wandtypen der conjugatophyceae und über deren systematischen Wert. - Arch. Mikrobiol. 81: 197-220.
- _____ 1973. Die Feinstruktur der Zellwände der conjugaten und ihre systematische Bedeutung. Beih. Nova Hedwigia, 42: 179-194.
- _____ & W.Kasprik. 1977. Zur morphologie, Karyologie und taxonomie der Desmidiaceen - Gattung Micrasterias AG. der formenkreis der "Denticulata-Gruppe". Mitt. Inst. Allg. Bot. Hamburg, 15:53-68.
- Mori, M. 1962. Some tetratological examples of Desmids. Bull. Jap. Soc. Phycol. 10(1):8-11.
- Munawar, M. 1974. Limnological studies on freshwater ponds of Hyderabad, India. 4-the biocenose. Periodicity and species composition and unicellular and colonial phytoplankton in polluted and unpolluted environments. Hydrobiologia, 45(1):1-32.
- Nakano, T. 1977. Some Desmids from Orogatawa Moor, Okayama Prefecture. Bull. Hiruz. Research Inst. 3:45-51.
- Nygaard, G. 1976. Desmids from an arctic salt lake. Bot. Tidsskrift bd. 71(1-2):84-86.
- Ochiai, T. 1966. Desmid flora of Iyari Moor, Naga prefecture. Bull. Jap. Soc. Phycol. 14(3): 116-126.
- _____ 1973. Desmid flora of Kirigamine Moor. Bull. Jap. Soc. Phycol. 21(3):103-107.
- Oltmanns, F. 1922. Morphologie und Biologie der Algen 2d ed. vol.1. Jena 459 pp, 287 figs.
- Parra, O. 1973. Estudio cuolitativo Del Fitoplancton De La Laguna verde concepcion (Chile) Excl. Diatomeas.- Gayana Bot. 24:1-26.
- _____ 1975. Desmidiaceas de Chile. 1. Desmidiaceas de la region de concepcion y Alrededores. Gayana Bot. 30:3-90.

- Parra, O. & M. Gonzales. 1977. Desmidiaceas de Chile 3. Desmidiaceas de la Isla de Chiloe. Gayana Bot. 34:3-103.
- Pascher, A. 1931. Systematische Übersicht über die mit Flagellaten in Zusammenhang stehenden Algenreihen und Versuch einen Einreihung dieser Algenstämme in die Stämme des Pflanzenreiches. Beih. Bot. Centralb. 48:317-332.
- Pflester, L.A. 1976. Oocardium stratum a rare Desmid (Chlorophyceae) Jour. Phycol. 12(1):134.
- Pickett-Heaps, J.D. & L.C. Fowke. 1971. Conjugation in the Desmid Closterium littorale. J. Phycol. 7(1):37-50.
- _____ 1973. Stereo-Scanning electron microscopy of Desmids. Jour. Microsc. 99(1):109-116.
- _____ & D.H. Tippit. 1973a. Desmid morphogenesis. Brook. Symp. Biol. 25:191-205.
- _____ 1974. Scanning electron Microscopy of some cultured Desmids. Trans. Amer. Micros. Soc. 93(1):1-23.
- Poore, W.H. & H.G. Marshall. 1972. Lake Drummond of the dismal Swamp: 1. Phytoplankton composition. Virginia. J. Sci. 23(2): 72-76.
- Prasad, B.N. & R.K. Mehrotra. 1977. Some Desmids new to Indian Flora. J. Ind. Bot. Soc. 56: 343-350.
- _____ 1977a. Desmid Flora of North Indian Paddy Fields. New. Botanist. 4(1-4):49-74.
- Prescott, G.W. 1936. Notes on alpine and subalpine Desmids from Western United States. Papers Michi. Acad. Sci., Arts and letters, 21: 135-146.
- _____ 1941. A concluding list of Desmids from Isle Royale, Michigan. Pap. Michig. Acad. Sci., Arts, and letters, 26: 23-29.

- Prescott, G.W. 1954. How to know the fresh-water Algae. W.M.C. Brown Company, Publishers Dubuque, Iowa.
- _____ 1966. Algae of the Panama Canal and its tributaries-
2. Conjugales. Phycos, 5(1-2): 1-49.
- _____ 1969. The algae, a review. Nelson and sons Ltd.
London. pp. 1-434.
- Ralfs, J. 1848. The British Desmidiaceae. Reeve, Benham, and
Reeve, King William street, Strand.
- Ratnasabapathy, M. 1972. Algae from Gungong Jerai (Kedah Peak),
Malaysia. Gard. Bull. Singapore, 26: 95-110.
- _____ & S. Kumano. 1974. Desmids from Tasek Bera,
West Malaysia. Bull. Jap. Soc. Phycol. 22(1): 22-28.
- Rieth, A. 1970. Susswasser-algenarten in Einzeldarstellung, II.
Oocardium stratum nach material aus Kuba. Die Kulturpflanze,
Akad. Verlag, Berlin, 18: 51-71.
- Rivera, P., O. Parra & S. Gonzales. 1973. Fitoplancton Del
Estero Lenga, Chile - Gayana Bot. 23: 1-93.
- Růžická, J. 1962. Closterium limneticum Lemm., 1899 - Preslia,
34: 176-189.
- _____ 1970. Zur taxonomie und variabilitat der Familie
Gonatozygaceae. 3. Taxonomie der Arten Gonatozygon pilosum
Wolle, G. aculeatum Hastings und G. monotaenium De Bary. Preslia
(Praha), 42: 201-214.
- _____ 1975. Erwagungen uber die Taxonomie der gattung
Closterium I. Preslia (Praha), 47: 193-210.
- _____ 1975a. Erwagungen uber die Taxonomic der gattung
Closterium 2. Preslia (Praha), 47: 289-304.
- _____ 1976. Erwagungen uber Taxonomie der gattung
Closterium 3. Preslia (Praha), 48: 1-16.

- Růžicka, J. 1977. Die Desmidiaceen Mitteleuropas, Band. 1. E. Schweizerbart'sche verlagzbuchhandlung Stuttgart.
- Sarim, F.M. & M.A.F. Faridi. 1976. Closterium in Peshawar Valley. Pak. J. Bot. 8(2): 221-239.
- Scharf, W. 1974. Die kultur Zieralgen. Mikrokosmos, Franck. Verlag. Stuttgart, 5: 141-143.
- _____ 1977. Beitrage zur Desmidiaceenflora des Niederrheingebietes und des Laacher Sees (Eifel). Decheniana (Bonn), 130: 29-41.
- _____ 1979. Zieralgen (Desmidiales, Mesotaeniaceae) aus Eifelmaaren. Decheniana (Bonn), 132: 29-42.
- _____ 1979a. Zellteilung bei der Zieralge Bambusina brebissonii. Mikrokosmos, 2: 45-46.
- Schmidle, W. 1895. Einige Algen aus Sumatra. Hedwigia, 34: 291-307.
- _____ 1900. Ueber von Prof. Hansgirg in Ostindien gesammelte Susswasseralgen. Hedwigia, 39: 160-190.
- Schroever, P.J. 1966. Some observations on micro-coenoses in a bog region influenced by man. Wentia, 15: 163-190.
- Schumacher, G.J. 1960. Further notes on the occurrence of Desmids in Utricularia Bladders. Castanea, 25: 62-65.
- Scott, A.M. & R. Gronblad. 1957. New and interesting Desmids from the Southeastern United States. Acta Soc. Scient. Fenn. 11(8): 3-62.
- _____ & G.W. Prescott. 1958. Some freshwater algae from Arnhem Land in the Northern Territory of Australia. Rec. Amer. Austral. Scien. Exped. 3: 9-132.
- _____ 1961. Indonesian Desmids. Hydrobiologia, 17 (1-2): 1-132.

- Scott, A.M., R. Grönblad & H. Croasdale. 1965. Desmids from the Amazon Basin, Brazil collected by Dr. H. Sioli. Acta Bot. Fenn. 69: 3-94.
- Selman, G.G. 1966. Experimental evidence for the nuclear control of differentiation in *Micrasterias*. J. Embryol. exp. Morph. 16 (3): 469-485.
- _____ 1972. Anucleate Development in *Micrasterias* induced using an ultraviolet microbeam. Biol. Radiobiol. Anucl. sys. Acad. Pres. Inc., N. York, pp. 145-164.
- Shah, S. & M.A.F. Faridi. 1974. *Cosmarium* in Peshawar Valley. Thesis Botany Department, Peshawar University.
- Skuja, H. 1949. Zur Susswasseralgenflora Burmas. Nova Acta Reg. Soc. Sci. Upsaliensis, 14 (5): 1-188.
- Smith, G.M. 1924. Phytoplankton of the inland lakes of Wisconsin. Part 2. Desmidiaceae. Wisc. Geol. and Natur. Hist. Survey 57. Madison.
- _____ 1950. The fresh-water Algae of the United States McGraw - Hill Book Company, Inc. New York.
- Soding, H., Dorffling & M. Mix. 1976. Über die Bildung von Bakterienhemmstoffen durch *Cosmarium impressulum* - Arch. Microbic. 108: 153-157.
- _____ & M. Mix. 1977. Observations on the mutual influence of Algae (Conjugatophyceae) and Bacteria in common Agar culture. Mitt. Inst. Allg. Bot. Hamburg, 15: 15-26.
- Sormus, L. & C.E.M. Bicudo. 1974. Polymorphism in the Desmid *Micrasterias pinnatifida* and its taxonomical implications. J. Phycol. 10 (3): 274-279.
- Starr, R.C. 1959. Sexual reproduction in certain species of *Cosmarium*. Archiv für Protistenk, 104 (1): 155-164.

- Stein, J.R. 1975. Freshwater algae of British Columbia: the Lower Fraser Valley. *Syesis*, 8: 119-184.
- Taft, C.E. 1939. Additions to the algae of Michigan. *Bull. Torr. Bot. Club*. 66: 77-85.
- _____ 1945. The Desmids of the West end of Lake Erie. Ohio J. Sci. 65 (5): 180-205.
- _____ 1948. Some algae from the black hills of South Dakota and the Turtle Mountain Region of North Dakota. Ohio. J. Sci. 38 (2): 84-88.
- _____ 1964. New records of algae from the West end of Lake Erie. Ohio, J. Sc. 64 (1): 43-50.
- Tan, K. & K. Ueda. 1978. Rapid degeneration of the protoplasm in artificially induced small cells of *Micrasterias crux-melittensis*. *Protoplasma*, 97: 61-70.
- Tassigny, M. 1971. La sexualite des Desmidiées. *Ann. Biol.* 10 (7-8): 403-429.
- _____ 1973. Observations des variations qualitatives des populations de Desmidiées dans quelques étangs mesotrophes et dystrophes. *Beih. Nova Hedwigia*, 42: 283-316.
- Taylor, R. 1934. The fresh-water algae of Newfoundland. 1. pap. *Amer. Acad. Sci., Arts, Letters*, 19: 217-278.
- _____ 1935. The fresh-water algae of Newfoundland Part 2. *Pap. Michi. Acad. Sci., Arts, Letters*, 20: 185-230.
- Teiling, E. 1967. The Desmid genus *Staurodesmus*. *Arkiv For Botanik*, 6(11): 467-630.
- Thomasson, K. 1957. Contributions to the knowledge of the plankton in Scandinavian Mountain Lakes. 4. *Botaniska Notiser*, 110 (2): 251-264.
- _____ 1960. Some planketic *Staurostra* from New Zealand *Botan. Notiser*, 113 (3): 225-245.

- Thomasson, K. & P.A. Tyler. 1971. Taxonomy of Australian freshwater algae 2. Some planktic *Staurostra* from Tasmania. *Nova Hedwigia*, 21: 287-319.
- _____ 1972. Some planktic *Staurostra* from New Zealand 2. *Svensk Bot. Tidskr.* 66: 257-274.
- _____ 1973. *Actinotaenium*, *Cosmarium* and *Staurodesmus* in the plankton of Rotorua Lakes. *Svensk Bot. Tidskr.* 67: 127-141.
- _____ 1974. Some planktic *Staurostra* from New Zealand. 3. *Svensk Bot. Tidskr.* 68: 35-50.
- _____ 1977. Two conspicuous *Desmids* from Amazonas. *Bot. Notiser*, 130: 41-51.
- Thompson, R. 1938. A preliminary survey of the freshwater algae of Eastern Kansas. *Univ. Kansas Sci. Bull.* 25 (1) : 5-83.
- Tibor, H. 1956. *Algenteratologien im seston des Balaton und ihre entwicklungsgeschichtlichen Beziehungen.* *Acta Biol. Acad. Sci. Hung.* 6(3-4): 203-213.
- _____ 1959. *Nyari phytoseston-es teratologiai vizsgalatok Balatonboglaron.* *Acta Acad. Paed. Agriensis*, pp. 507-530.
- Tiffany, L.H. & M.E. Britton. 1952. *The Algae of Illinois.* The University of Chicago Press. Chicago.
- Tomaszewicz, G.H. 1973. *Desmids of transitional peats in Konik Stary near Warsaw.* *Acta Soc. Bot. Polon.* 62 (3): 391-408.
- _____ 1973a. The typical variety and developmental stages of *Mirasterias truncata* (Corda) Breb. *Acta. Soc. Bot. Polon.* 62(4):591-598.
- _____ 1974. *Desmids of a dune-surrounded lake in Zieleniec near Warsaw.* *Acta Soc. Bot. Polon.* 63(3): 399-419.
- _____ 1977. *Micrasterias Jenneri* Ralfs var. *simplex* W. West and developmental stage of *M. Jenneri* Ralfs var. *Jenneri.* *Acta Soc. Bot.* 66 (4): 635-640.

- Turner, W. B. 1892. Freshwater Algae of East India. Kg. Sv. vet. Acad. Handl., 25 (5): 1-187.
- Tyler, P.A. 1970. Taxonomy of Australian freshwater Algae. 1. The genus *Micrasterias* in South-Eastern Australia. Br. Phycol. J. 5 (2): 211-234.
- Ueda, K. 1972. Electron microscopical observations on nuclear Division in *Micrasterias americana*. Bot. Mag. Tokyo, 85: 263-271.
- Uherkovich, G. 1975. Taxonomisch-Ökologische übersich der Chlorophyten-, Rhodophyten-, Schizomycophyten - und Mycophyten - organismen der Teiss (Tisza) und ihrer Nebengewasser. Tiscia (Szeged), 10: 15-37.
- _____ 1978. A Tiva - To Es A Nagyberek (Barcsi Osborokas) Algairol. Dunantulidolg. Term. Tud. Sor. 1: 9-35.
- Vuorisalo, A. 1957. Eraiden Desmidiaceae levien Ja Volvox aureuksen esiintymisesta Ja ekologiasta Suomen pikkuvesissa. Arch. Soc. Vanamo, 4: 112-136.
- _____ 1969. Conjugatophyceae of Utsjoki, Finnish Lapland. Ann. Univ. Turku, 11 (40): 98-111.
- Wade, W.E. 1957. Additions to our knowledge of the Desmid flora of Michigan. Revue Algolog. 4: 249-273.
- Wallich, G.C. 1860. Descriptions of Desmidiaceae of Lower Bengal. Ann. and Mag. Nat. Hist. 3: 184-197.
- Waris, H. 1958. Splitting of the Nucleus by centrifuging in *Micrasterias*. Ann. Acad. Scient. Fenn. 4 (4): 3-20.
- Wasylik, K. 1961. Desmidiaceen der Moore in der Umgebung von Korvanen in Sodankyla, Finnisch-Lappland. Soc. Scient. Fenn. Comm. Biol. 23 (10): 3-46.
- Watanabe, M. 1974. Freshwater algae from Lake Akan, Hokkaido, (2). J. Jap. Bot. 49 (7): 215-224.

- Watanabe, M. 1978. Freshwater algae from Lake Akan, Hokkaido, (3) J. Jap. Bot. 53 (4): 112-121.
- Webber, E.E. 1967. Flagellates and Desmids new to Massachusetts. Rhodora, 69 (777): 55-58.
- Weber, A. 1969. Über die Chloroplastenfarbstoffe einiger conjugation Flora, Abt. A, 160:457-473.
- Werner, E. 1977. Ein beitrage zur kenntnis der Desmidiaceen im Hudelmoos. Mitt. Thurg. Natur. Gesell. Frauen. 42: 9-98.
- West, W. & G.S. West. 1902. A contribution to freshwater algae of Geylon. Trans. Linn. Soc. Bot. London 6: 123-215.
- _____ 1907. Freshwater algae from Burma, including a few from Bengal and Madras. Ann. Roy. Bot. Garden, Calcutta 6 (2): 175-179.
- _____ 1904-1912. A Monograph of the British Desmidiaceae 1-4. Ray Society, London.
- _____ & N. Carter, 1923. A Monograph of the British Desmidiaceae 5. Ray Society, London.
- Whitford, L.A. 1943. The freshwater algae of North Carolina. Papers from the Department of Botany, the Ohio State University, 445: 131-170.
- _____ 1958. Phytoplankton in North Carolina Lakes and Ponds. J. Elisha Mitchell Scient. Soc. 74 (2): 143-157.
- _____ & G.J. Schumacher, 1973. A manual of freshwater algae. Sparks Press Raleigh, N.C.
- Wildeman, E. de. 1900. Les Algues de la Flore de Buitenzorg. (Essai d'une Flore Algologique de Java) Leide.
- Wygash, J. 1957. Fruhjahrs - algen eines Torfmoores im Eggegebirge. Natur. Heimat. 17 (3): 1-4.
- _____ 1963. Zieralgen Vom Erdfallsee. Natur. Heimat. 23 (4): 106-112.

- Yacubson, S. 1974. El fitoplancton de la Laguna de San Javier del Valle. (Estado Merida), Venezuela, Rev. Algolog, 11 (1-2): 91-131.
- Yeh, P.Z. & A. Gibor. 1970. Growth patterns and Motility of *Spirogyra* sp. and *Closterium acerosum*. J. Phycol. 6 (1): 44-48.
- Zeller, G. 1873. Algae collected by Mr. S. Kurz in British Burma. Jour. Asiatic Soc. Bengal 42 (3): 175.
- Zwart, K.W.R. 1969. Het Voorkomen van Desmidiaceae in de Molenpolder, in De Zuidelijke Vechtplassen Flora en Fauna. pp.205. Rivon-Verhandeling, Uitgave, Netherland.

CONTENTS - PLATE NO. 1.

Text Page	Fig. No.
22	1. <u>Microsterias truncata</u> x195
13	2. <u>M. papillifera</u> x195
3	3. <u>M. apiculata</u> var. <u>brachyptera</u> x150
4	4. <u>M. crux-melitensis</u> x 250
19	5. <u>M. thomasiana</u> x195
21	6. <u>M. torreyi</u> x100
7	7. <u>M. jenneri</u> var. <u>simplex</u> x 300
12	8. <u>M. oscitans</u> x 250
18	9. <u>M. rotata</u> x195
5	10. <u>M. denticulata</u> var. <u>angulosa</u> x150
7	11. <u>M. foliacea</u> x 300
15	12. <u>M. radiata</u> x150
14	13. <u>M. pinnatifida</u> x 250
8	14. <u>M. laticeps</u> x 150

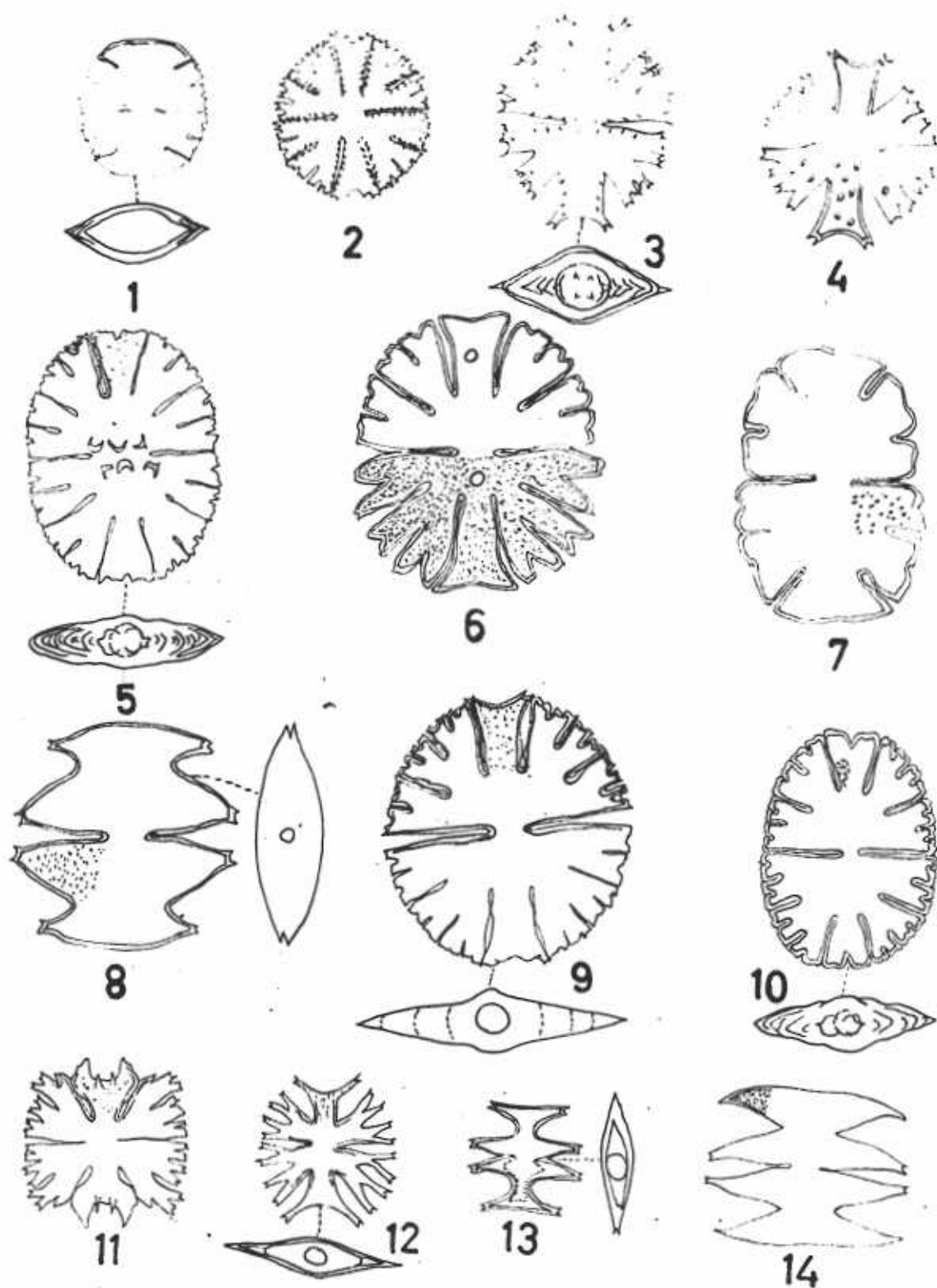
PLATE - No. I.

PLATE 1

CONTENTS - PLATE NO. 2.

Text Page	Fig. No.
6	1. <u>Microsterias doveri</u> var. <u>africana</u> x125
10	2. <u>M. muricata</u> x 150
9	3. <u>M. mahabuleshwariensis</u> x250
5	4. <u>M. decemdentata</u> x 525
17	5. <u>M. radiosa</u> x 200
168	6. <u>Oocardium stratum</u> x 600
28	7. <u>Euastrum binale</u> x 550
36	8. <u>E. insulare</u> x625
43	9. <u>E. validum</u> x 350
42	10. <u>E. turnerii</u> x 525
26	11. <u>E. ansatum</u> var. <u>dideltiforme</u> x450
31	12. <u>E. divergens</u> var. <u>ornatum</u> x 425
41	13. <u>E. pectinatum</u> var. <u>inevolutum</u> x 375
32	14. <u>E. dubium</u> x1000

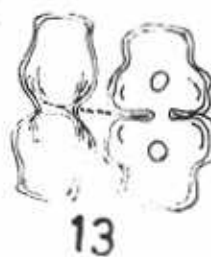
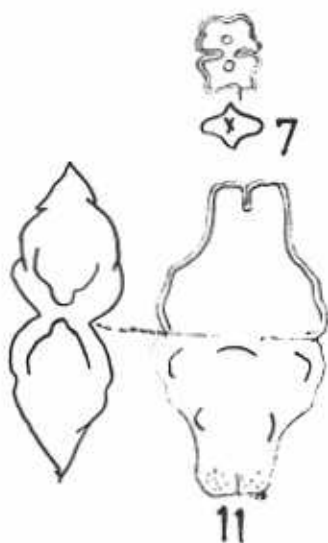
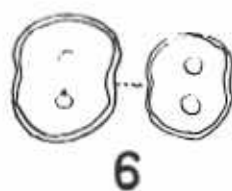
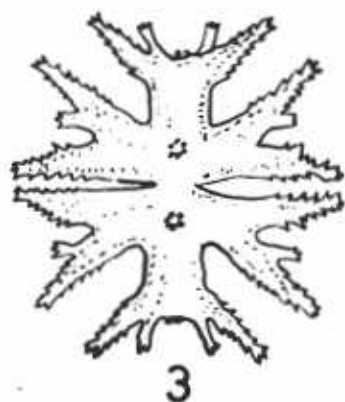
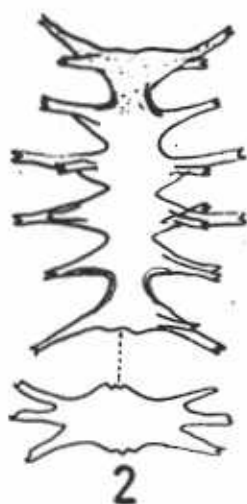
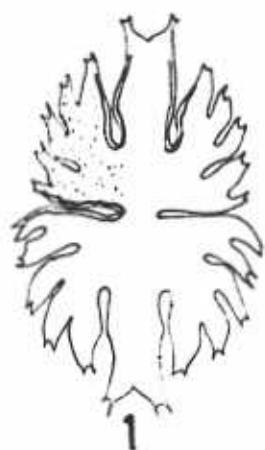


PLATE 2

CONTENTS - PLATE NO. 3.

Text Page	Fig. No.	
44	1.	<u>Euastrum verrucosum</u> x 550
38	2.	<u>E. oblongum</u> x 275
34	3.	<u>E. humerosum</u> x 375
25	4.	<u>E. ampullaceum</u> x 350
41	5.	<u>E. sinuosum</u> var. <u>gangense</u> x 375
27	6.	<u>E. ansatum</u> var. <u>pyxidatum</u> x 525
30	7.	<u>E. denticulatum</u> x 1425
43	8.	<u>E. ventricosum</u> x 300
40	9.	<u>E. pectinatum</u> x 350
33	10.	<u>E. elegans</u> x 700
29	11.	<u>E. bidentatum</u> x 575
42	12.	<u>E. spinulosum</u> var. <u>inermius</u> x 425
45	13.	<u>E. insigne</u> x 425
37	14.	<u>E. intermedium</u> x 500

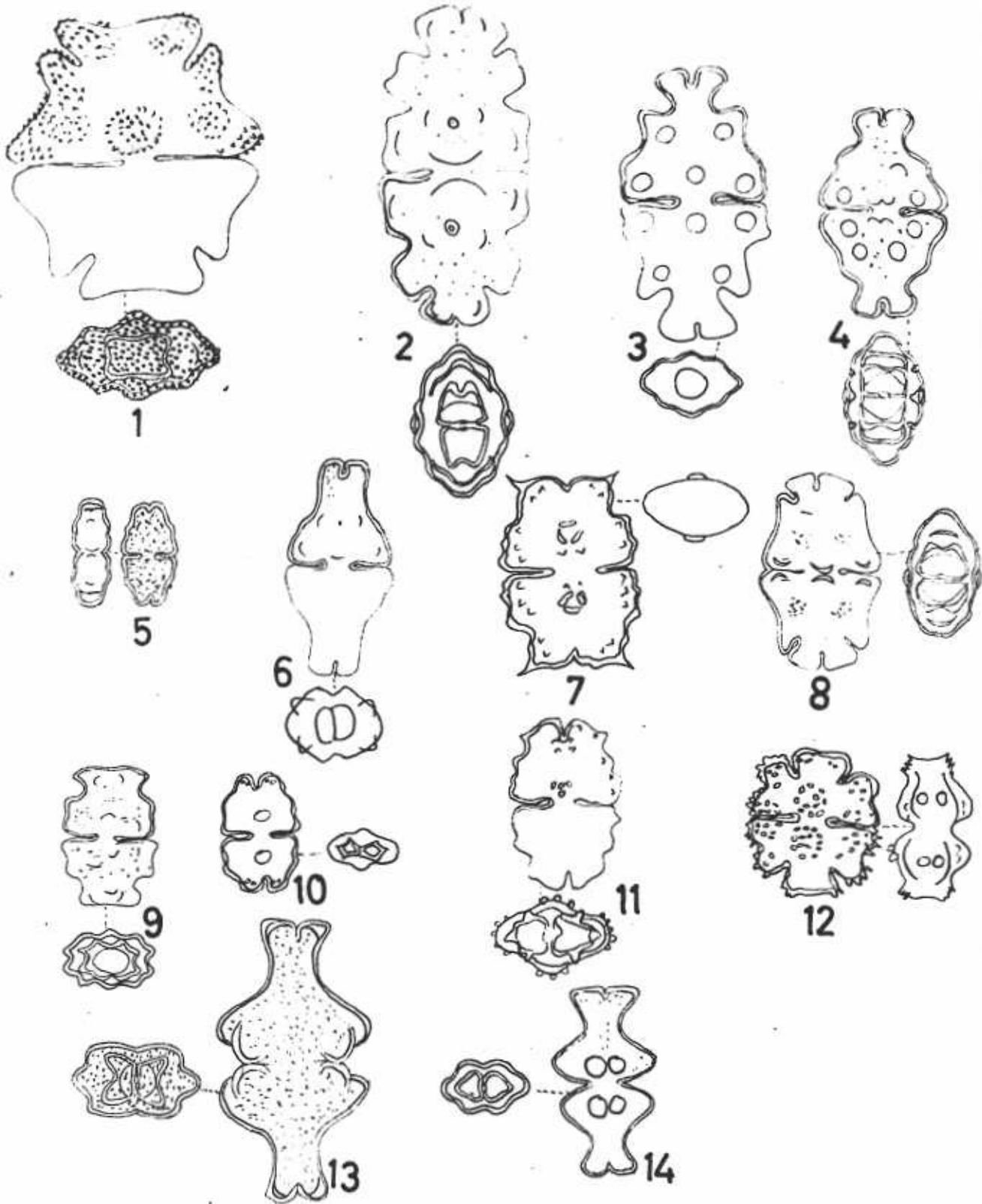


PLATE 3

CONTENTS - PLATE NO. 4.

Text Page	Fig. No.	
49	1.	<u>Cosmarium botrytis</u> x 450
79	2.	<u>C. turgidum</u> x 275
52	3.	<u>C. conspersum</u> x 300
67	4.	<u>C. pachydermum</u> x 400
74	5.	<u>C. quadratum</u> var. <u>willei</u> x 250
64	6.	<u>C. monodii</u> x 300
73	7.	<u>C. pyramidatum</u> x 350
57	8.	<u>C. galeritum</u> x 500
72	9.	<u>C. pseudopyramidatum</u> x 375
77	10.	<u>C. subcucumis</u> x 350
71	11.	<u>C. pseudamoenum</u> x 350
54	12.	<u>C. contractum</u> var. <u>ellipsoideum</u> x 600
78	13.	<u>C. tetrachondrum</u> x 150
64	14.	<u>C. moniliforme</u> var. <u>subpyriforme</u> x 550
56	15.	<u>C. depressum</u> var. <u>achondrum</u> x 900
57	16.	<u>C. granatum</u> x 650

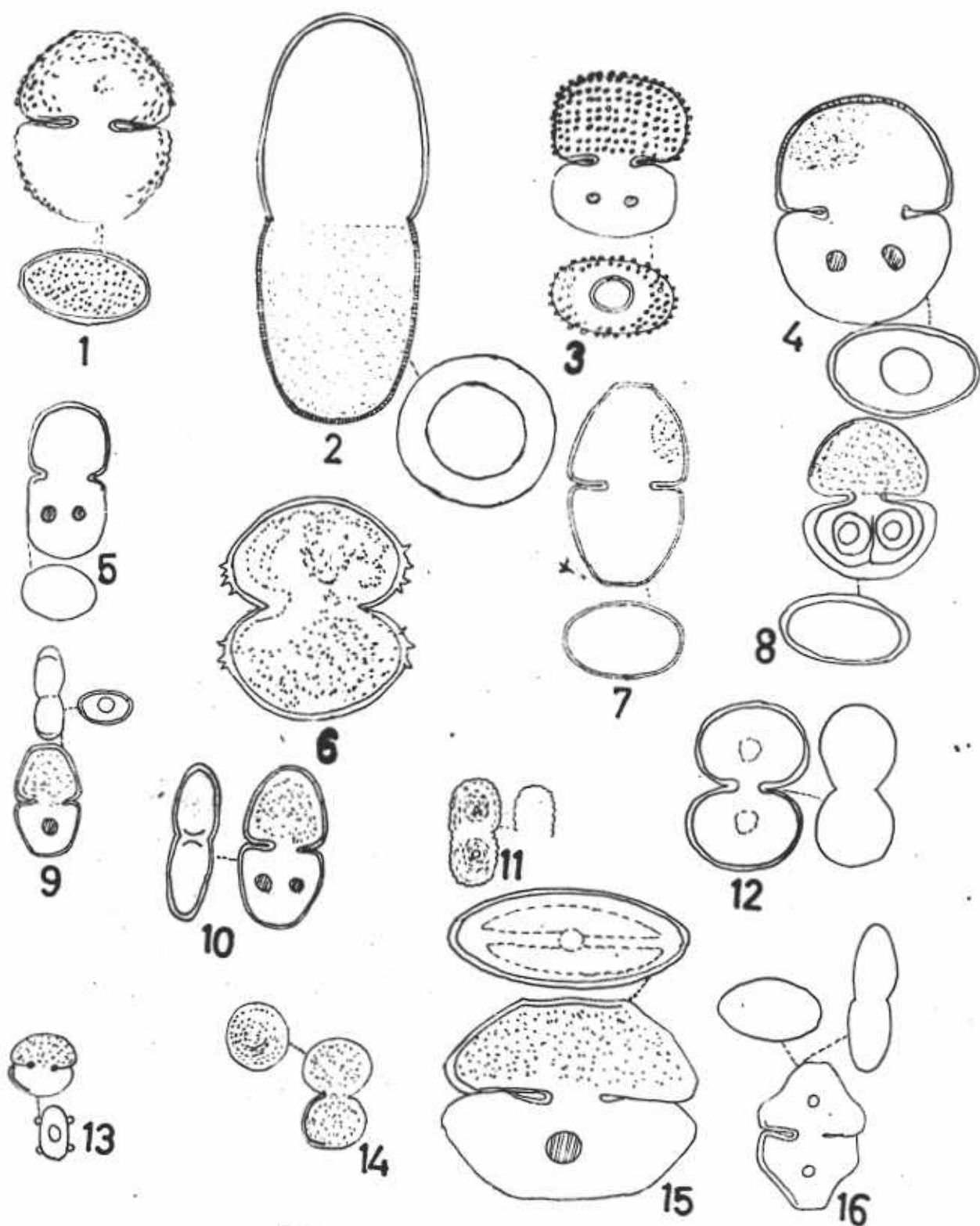


PLATE 4

CONTENTS - PLATE NO. 5.

Text Page	Fig. No.
51	1. <u>Cosmarium commissurale</u> var. <u>crassum</u> x 650
66	2. <u>C. ovale</u> x 350
75	3. <u>C. ralfsii</u> var. <u>montana</u> x 425
71	4. <u>C. pseudobroomei</u> x 550
65	5. <u>C. obsoletum</u> x 625
65	6. <u>C. nymannianum</u> x 400
78	7. <u>C. tetraophthalmum</u> x 400
70	8. <u>C. praemorsum</u> x 300
69	9. <u>C. portianum</u> x 350
48	10. <u>C. bicardia</u> x 325
61	11. <u>C. laeve</u> x 750
68	12. <u>C. phaseolus</u> forma <u>minor</u> x 1225
77	13. <u>C. subreinschii</u> var. <u>ocellatum</u> x 100

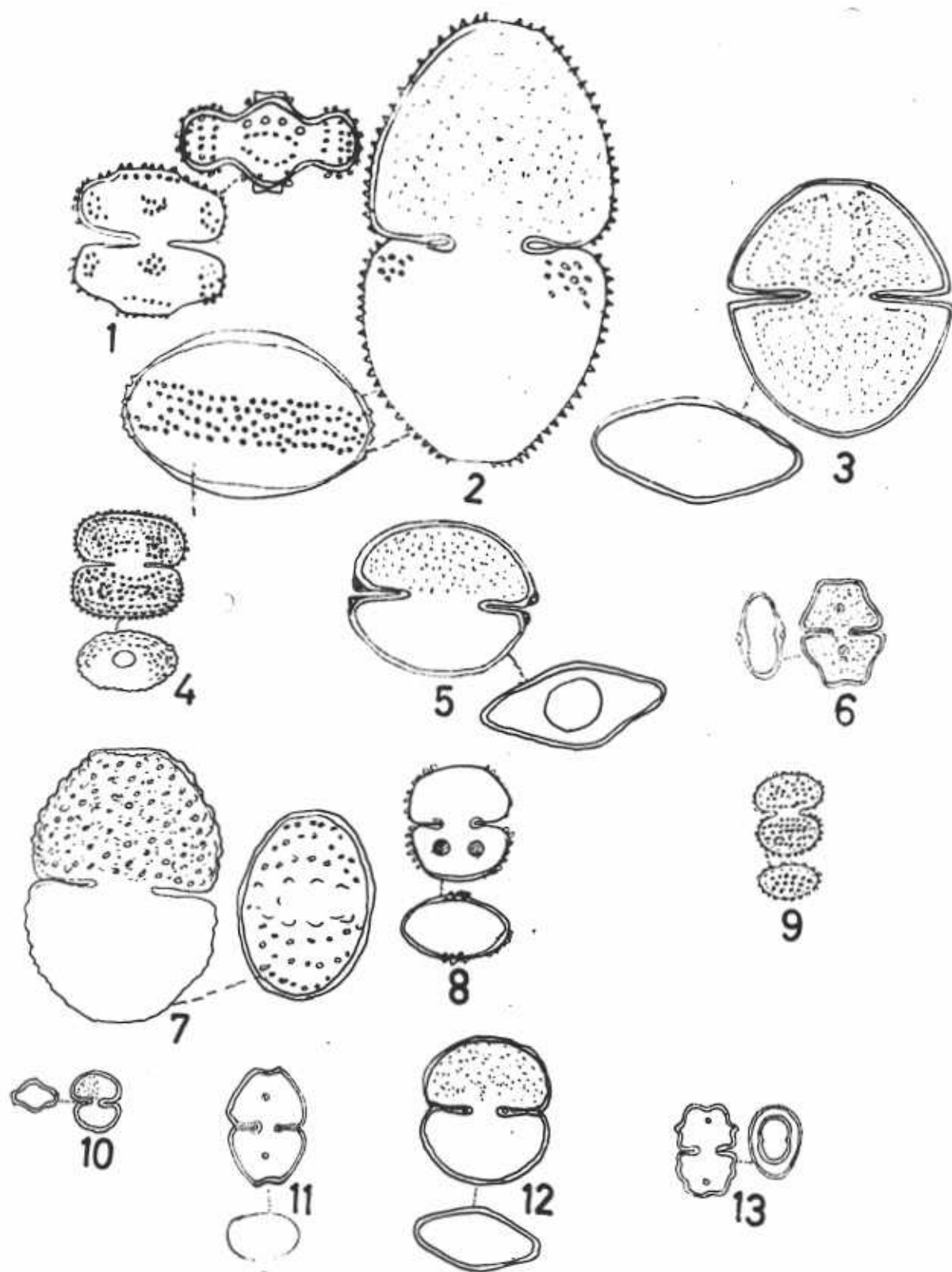


PLATE 5

CONTENTS - PLATE NO. 6.

ext Page	Fig. No.	
55	1.	<u>Cosmarium debaryi</u> x 425
63	2.	<u>C. margaritifera</u> x 650
54	3.	<u>C. cymatopleurum</u> var. <u>tyrolicum</u> x 350
60	4.	<u>C. impressulum</u> x 500
51	5.	<u>C. connatum</u> x 425
56	6.	<u>C. dorsitruncatum</u> x 375
59	7.	<u>C. hammeri</u> x 650
49	8.	<u>C. bioculatum</u> var. <u>depressum</u> x 550
62	9.	<u>C. lundellii</u> x 500
53	10.	<u>C. contractum</u> x 600
75	11.	<u>C. raeticum</u> x 750
76	12.	<u>C. sphaeroideum</u> x 425
75	13.	<u>C. rectangulare</u> var. <u>hexagonum</u> x 525
62	14.	<u>C. laeve</u> var. <u>octangularis</u> x825

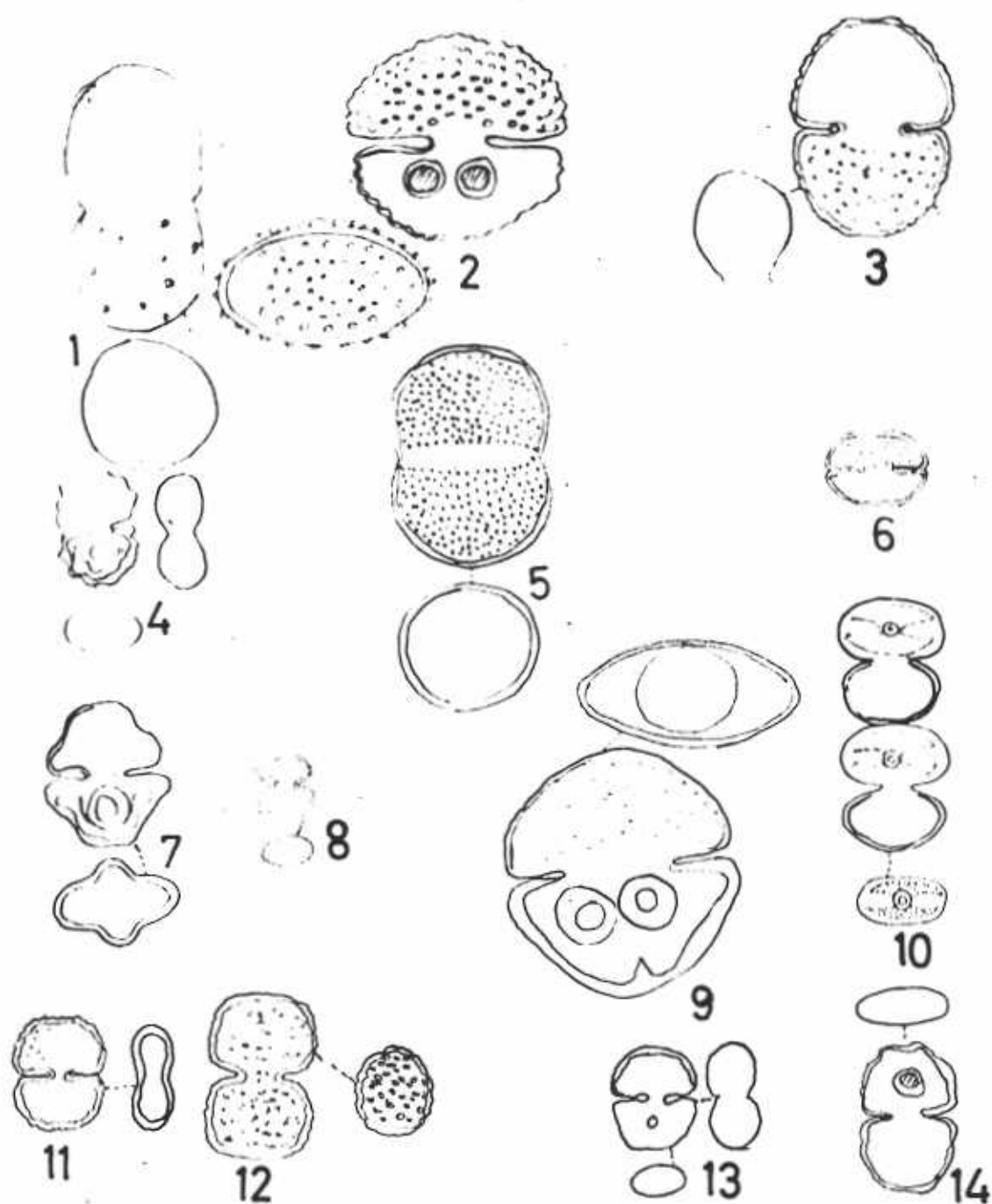


PLATE 6

CONTENTS - PLATE NO. 7.

Text Page	Fig. No.	
94	1.	<u>Closterium lunula</u> x 100
94	2.	<u>Cl. littorale</u> x 250
89	3.	<u>Cl. ehrenbergii</u> x 100
95	4.	<u>Cl. moniliferum</u> x 150
97	5.	<u>Cl. moniliferum</u> var. <u>concauum</u> x 150
86	6.	<u>Cl. attenuatum</u> x 1000
93	7.	<u>Cl. lineatum</u> x 100
82	8.	<u>Cl. abruptum</u> x 300
100	9.	<u>Cl. striolatum</u> x 150
99	10.	<u>Cl. setaceum</u> x 325
84	11.	<u>Cl. acerosum</u> var. <u>elongatum</u> x 150
102	12.	<u>Cl. tumidum</u> x350
103	13.	<u>Cl. venus</u> x 375
91	14.	<u>Cl. incurvum</u> x 150
90	15.	<u>Cl. gracile</u> x 500
92	16.	<u>Cl. intermedium</u> x 175
100	17.	<u>Cl. strigosum</u> x 250
87	18.	<u>Cl. costatum</u> x 100

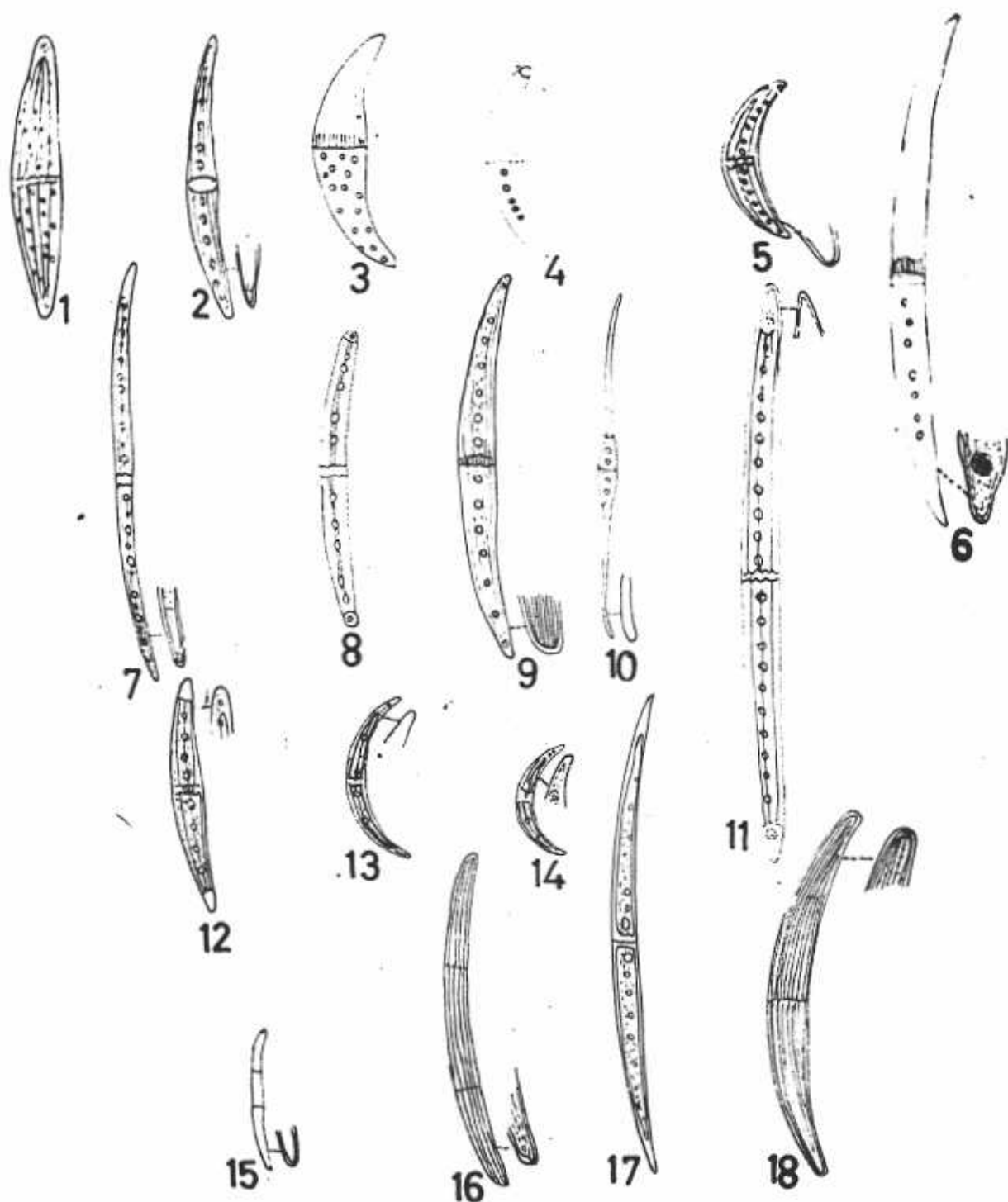


PLATE 7

CONTENTS - PLATE NO. 8.

Text Page	Fig. No.	
86	1.	<u>Closterium baillyanum</u> x 150
90	2.	<u>Cl. gracile</u> x 750
102	3.	<u>Cl. turgidum</u> var. <u>giganteum</u> x 150
88	4.	<u>Cl. dienae</u> var. <u>arcuatum</u> x 195
85	5.	<u>Cl. aciculare</u> x 325
98	6.	<u>Cl. rostratum</u> x 1025
83	7.	<u>Cl. acerosum</u> x 125
108	8.	<u>Pleurotaenium nodosum</u> x 150
111	9.	<u>Pl. truncatum</u> x 175
105	10.	<u>Pl. coronatum</u> x 150
109	11.	<u>Pl. trabecula</u> x 225
110	12.	<u>Pl. tridentulum</u> x 275
108	13.	<u>Pl. minutum</u> var. <u>submultitaeniatum</u> x 550
107	14.	<u>Pl. minutum</u> x350
106	15.	<u>Pl. ehrenbergii</u> x 100
109	16.	<u>Pl. subcoronulatum</u> x 450

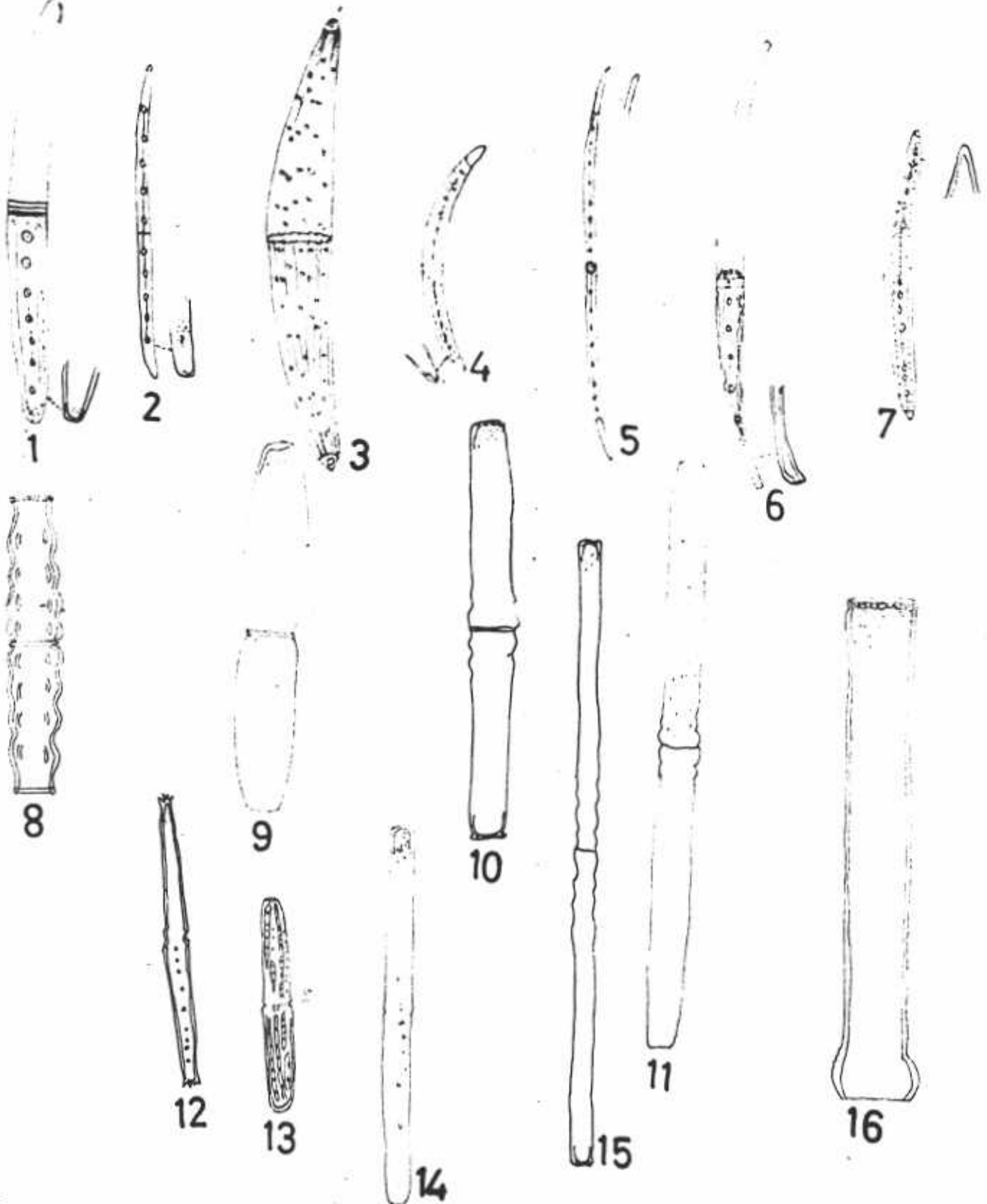


PLATE 8

CONTENTS - PLATE NO. 9.

Text Page	Fig. No.	
124	1.	<u>Triploceras gracile</u> x 150
126	2.	<u>Docidium undulatum</u> x 200
114	3.	<u>Stauroastrum duacense</u> x 500
118	4.	<u>St. hirsutum</u> x 500
120	5.	<u>St. polytrichum</u> x 450
118	6.	<u>St. leptocladum</u> var. <u>sinuatum</u> x 225
122	7.	<u>St. setigerum</u> x 450
120	8.	<u>St. margaritaceum</u> var. <u>subcontortum</u> x 225
121	9.	<u>St. punctulatum</u> x 575
115	10.	<u>St. elongatum</u> x 425
113	11.	<u>St. connatum</u> x 525
116	12.	<u>St. erasum</u> x 475
119	13.	<u>St. manfeldtii</u> x 300
123	14.	<u>St. tumidum</u> x 250
116	15.	<u>St. gracile</u> x 225

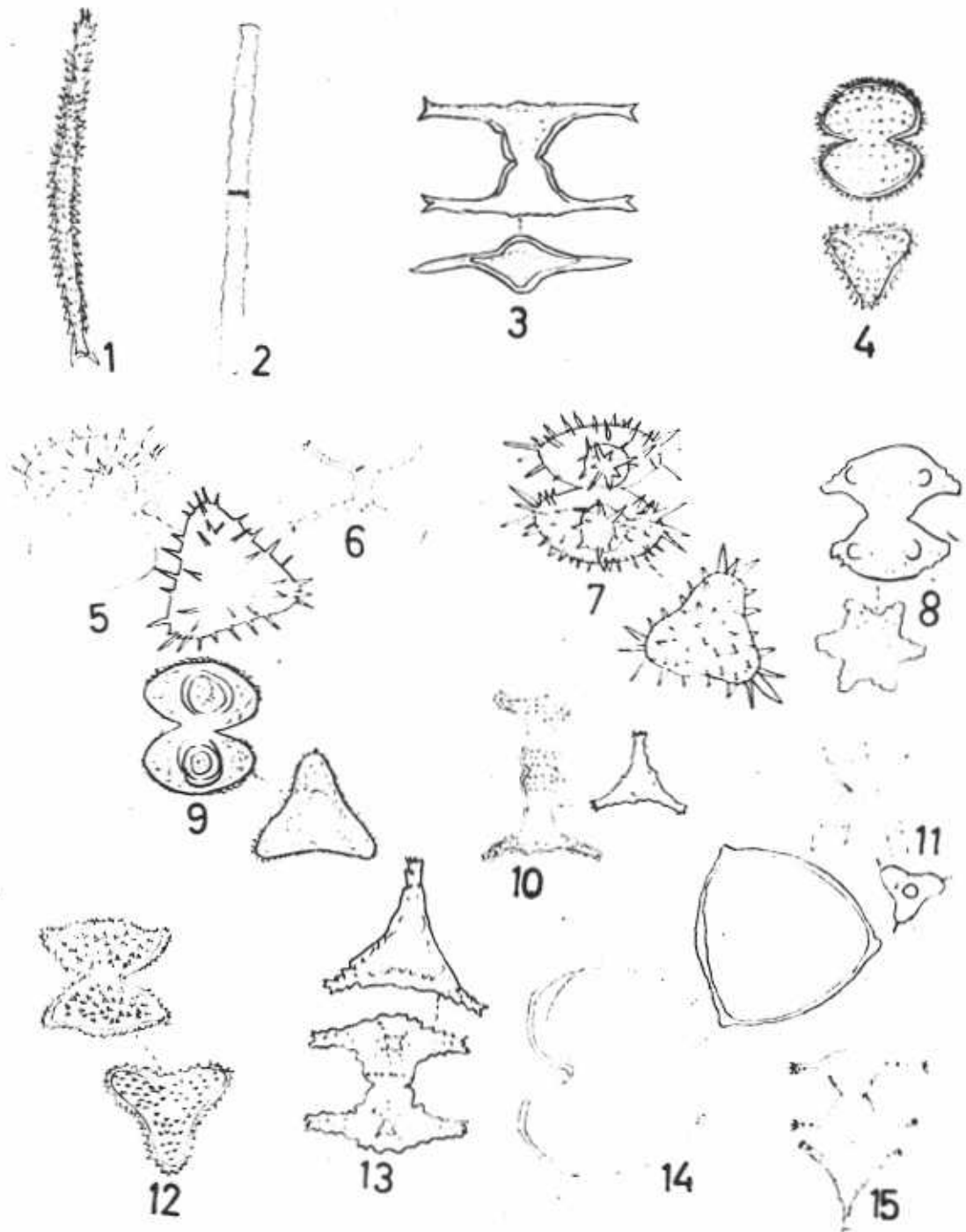
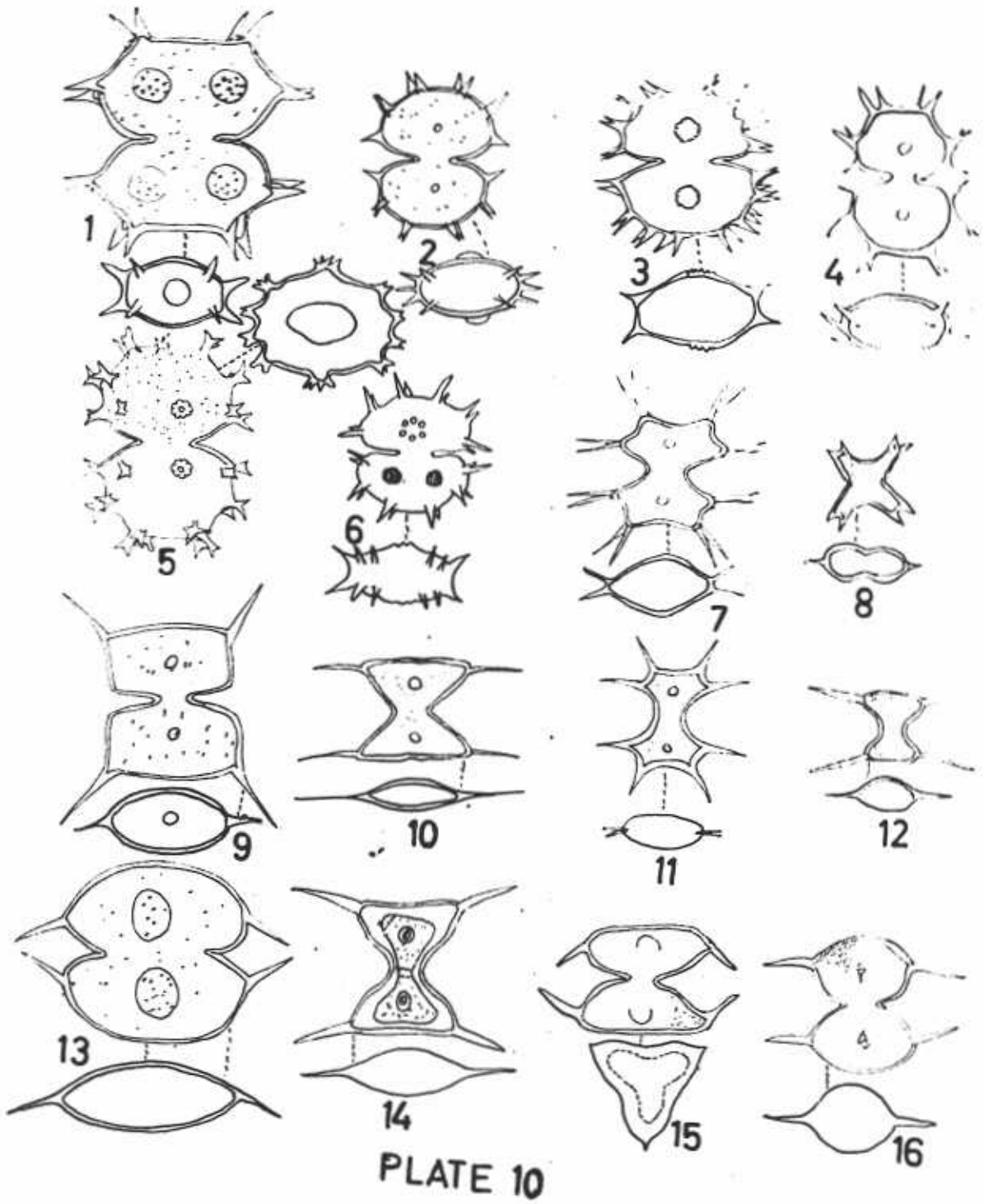


PLATE 9

CONTENTS - PLATE NO. 10.

Text Page	Fig. No.	
127	1.	<u>Xanthidium antilopaeum</u> x 525
132	2.	<u>X. cristatum</u> x 450
131	3.	<u>X. brebissonii</u> x 350
133	4.	<u>X. cristatum</u> var. <u>leioderium</u> x 500
129	5.	<u>X. armatum</u> x 275
133	6.	<u>X. fasciculatum</u> x 400
134	7.	<u>X. smithii</u> x 800
136	8.	<u>Arthrodesmus bifidus</u> x 525
136	9.	<u>A. bulnheimii</u> x 650
138	10.	<u>A. triangularis</u> x 725
137	11.	<u>A. octocornis</u> x 875
139	12.	<u>A. triangularis</u> var. <u>subtriangularis</u> x 400
140	13.	<u>Staurodesmus convergens</u> x 900
142	14.	<u>Std. extensus</u> x 2000
141	15.	<u>Std. dickei</u> x 1000
141	16.	<u>Std. cornutus</u> x 650



CONTENTS - PLATE NO. 11.

Text Page	Fig. No.	
143	1.	<u>Tetmemorus brebissonii</u> x 250
144	2.	<u>T. laevis</u> x 400
145	3.	<u>Cylindrocystis americana</u> x 350
146	4.	<u>C. brebissonii</u> x 700
170	5.	<u>Onychonema laeve</u> x 400
147	6.	<u>Netrium digitus</u> x 195
167	7.	<u>Spirotaenia obscura</u> x 225
150	8.	<u>Mesotaenium caldariorum</u> x500
149	9.	<u>Netrium interruptum</u> x 250
151	10.	<u>Bambusina brebissonii</u> x 550
154	11.	<u>Desmidium coarctatum</u> x 475
155	12.	<u>D. swartzii</u> x 350
171	13.	<u>Phymatodocis nordstedtiana</u> forma <u>minor</u> x 200
169	14.	<u>Gonatozygon aculeatum</u> x 250
157	15.	<u>Penium margaritaceum</u> x 375
157	16.	<u>P. cucurbitinum</u> var. <u>subpolymorphum</u> x 275
172	17.	<u>Streptonema trilobatum</u> x 275
153	18.	<u>Desmidium baileyi</u> x 250
160	19.	<u>Sphaerozosma vertebratum</u> x 400
159	20.	<u>Sph. excavatum</u> x 900
161	21.	<u>Spondylosium pulchellum</u> x 1000
162	22.	<u>Sp. secedens</u> x 875
163	23.	<u>Hyalotheca dissiliens</u> x 625
164	24.	<u>H. mucosa</u> x 575
166	25.	<u>Cosmocladium constrictum</u> x 725

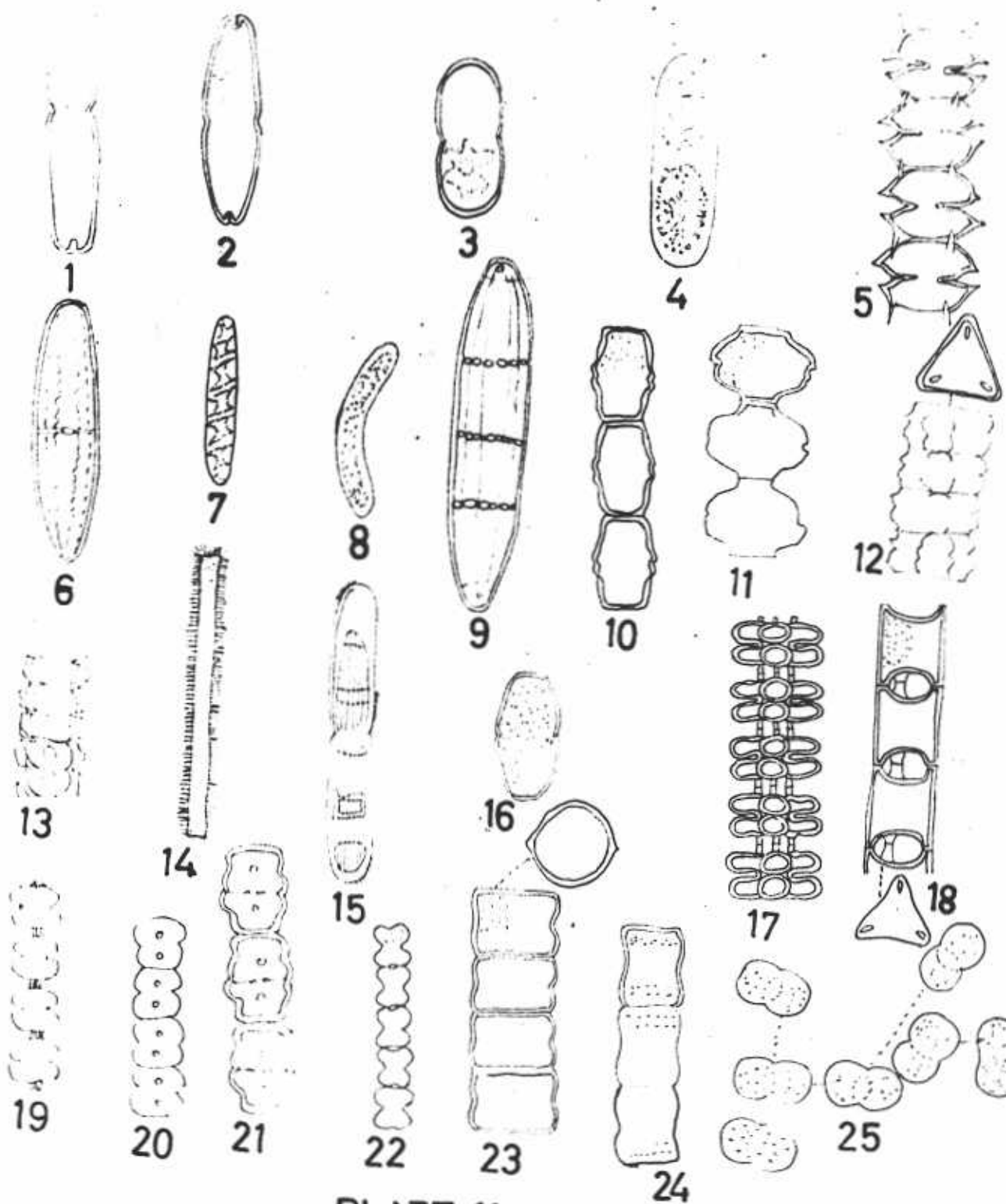


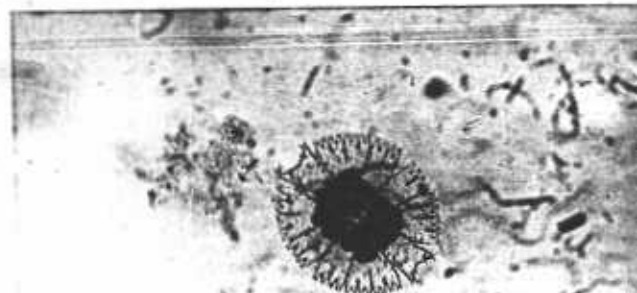
PLATE 11

Photo. No.

1. Microsterias truncata x 45°
2. M. papillifera x 50°
3. M. apiculata var. brachyptera x 50°
4. M. crux-melitensis x 50°
5. M. thomasi x 50°
6. M. torreyi x 45°



1



2



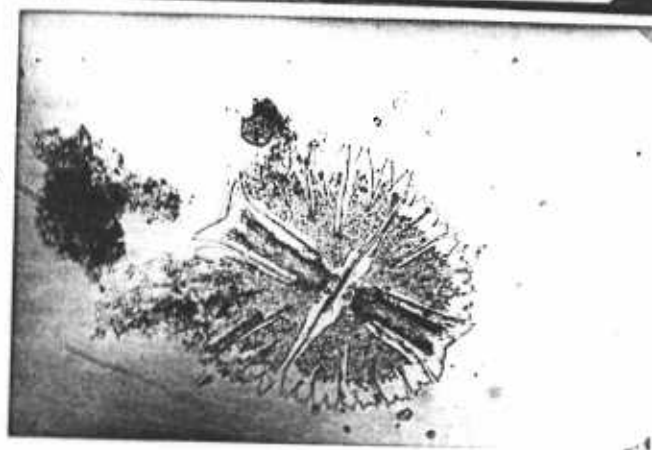
3



4



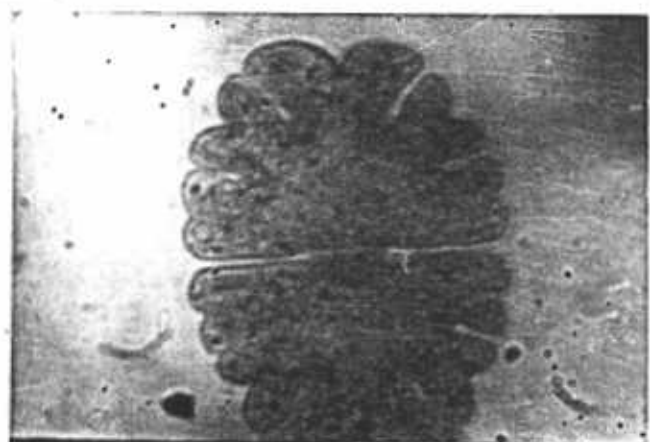
5



6

Photo. No.

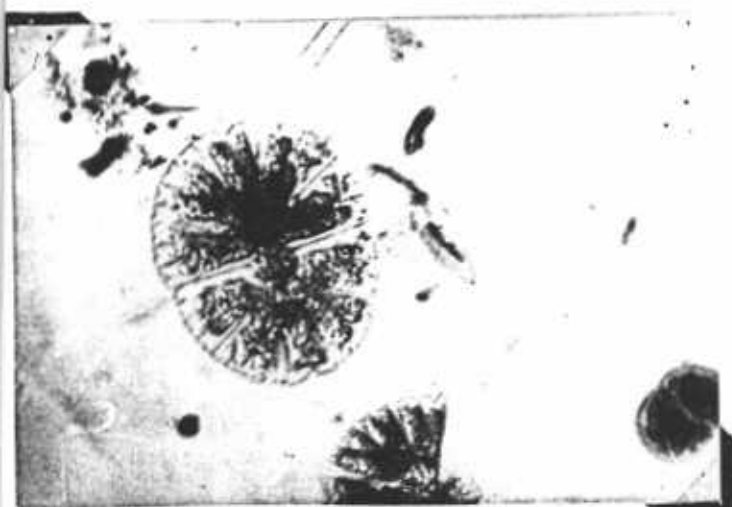
7. Microsterias jenneri var. simplex x 45°
8. M. oscitans x 50°
9. M. denticulata var. angulosa x 50°
10. M. foliacea x 45°
11. M. radiata x 50°
12. M. pinnatifida x 45°



7



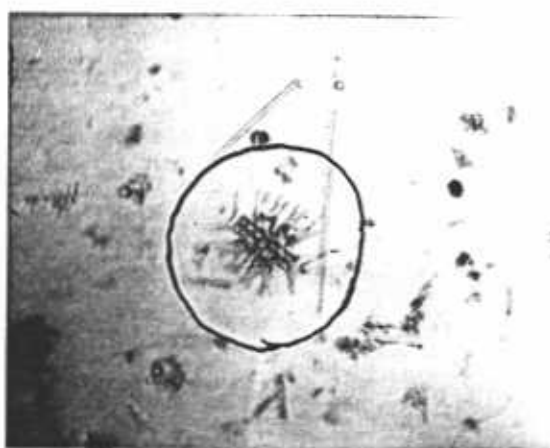
8



9



10



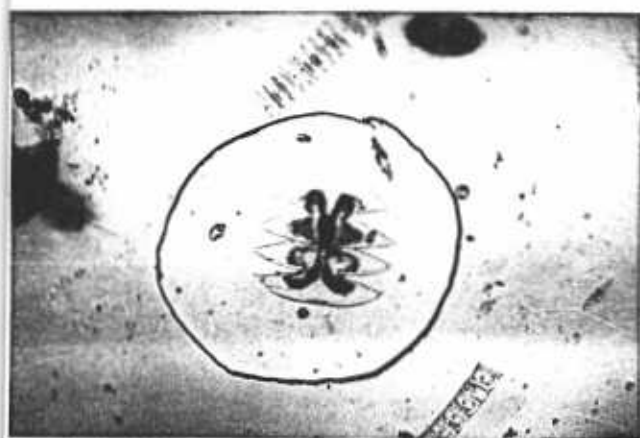
11



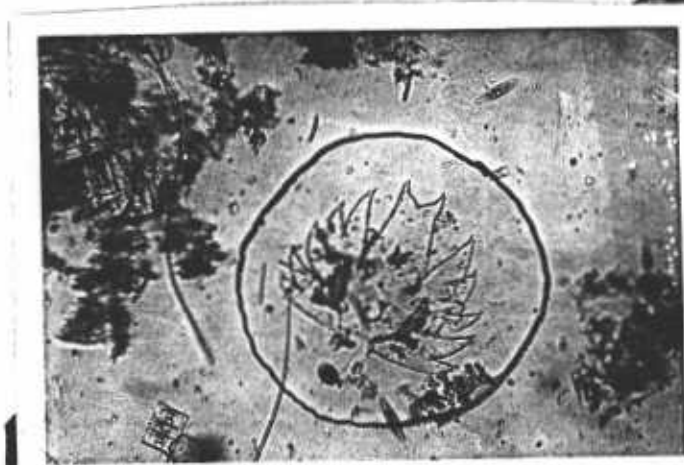
12

Photo. No.

13. Microsterias laticeps x 50
14. M. doveri var. africana x 50
15. M. muricata x 50
16. M. decemdentata x 50
17. Oocardium stratum x 450
18. Euastrum binale x 50



13



14



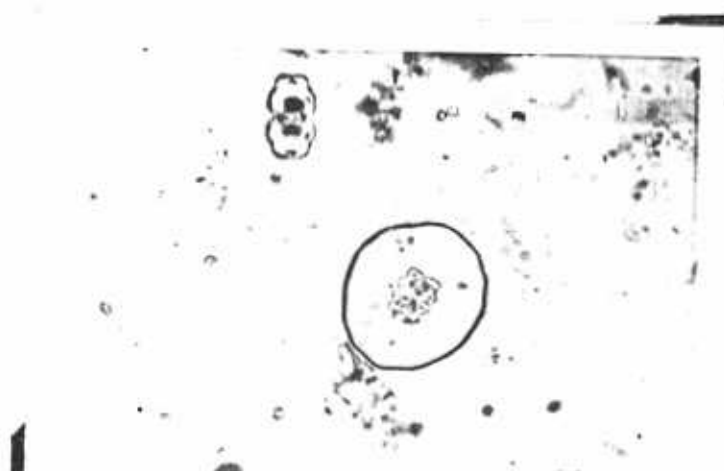
15



16



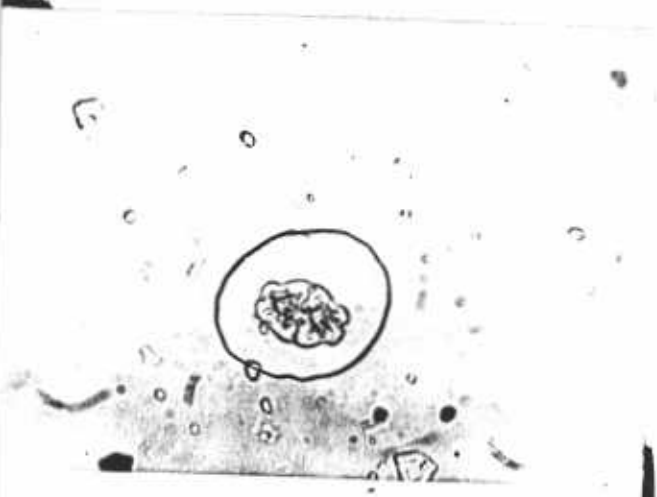
17



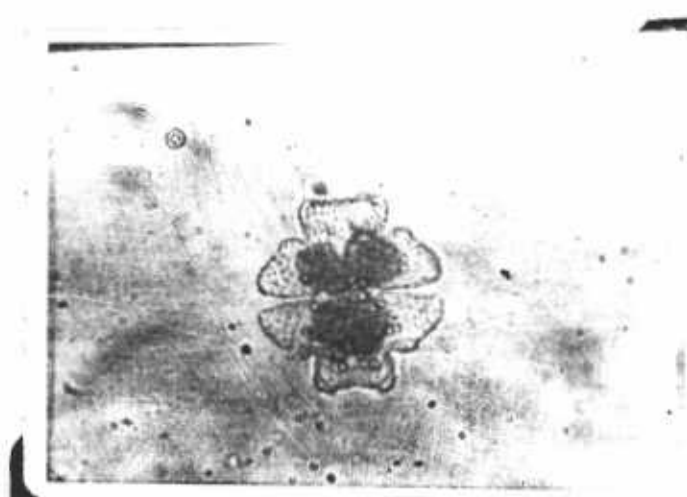
18

Photo. No.

19. Euastrum validum $\times 50$
20. E. verrucosum $\times 50$
21. E. oblongum $\times 45$
22. E. humerosum $\times 45$
23. E. ansatum var. pyxidatum $\times 45$
24. E. ventricosum $\times 50$



19



20



21



22



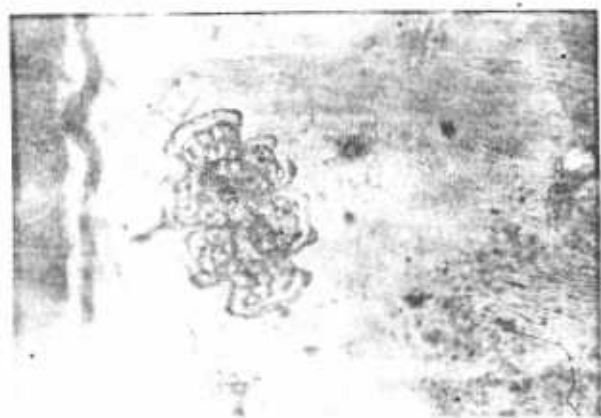
23



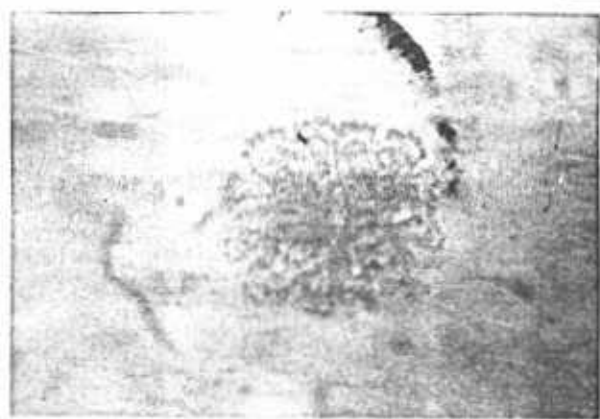
24

Photo. No.

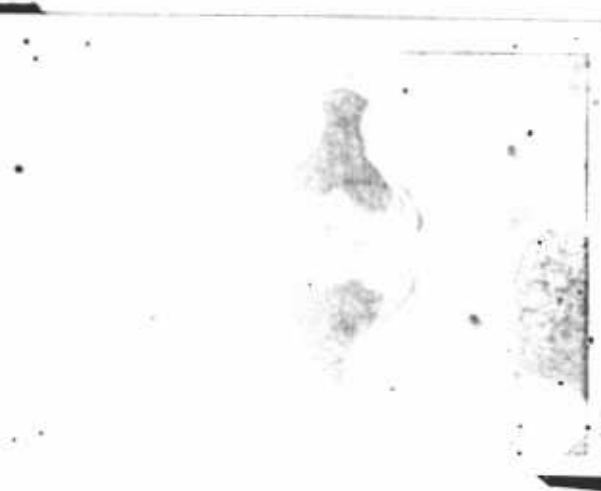
25. Mastrum pectinatum x 50
26. E. spinulosum var. inermius x 50
27. E. insigne x 450
28. E. intermedium x 450
29. Cosmarium botrytis x 50
30. C. turgidum x 450



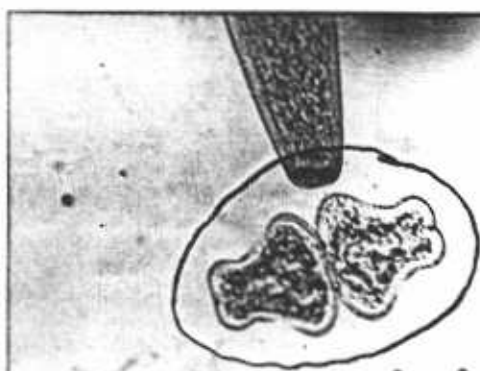
25



26



27



28



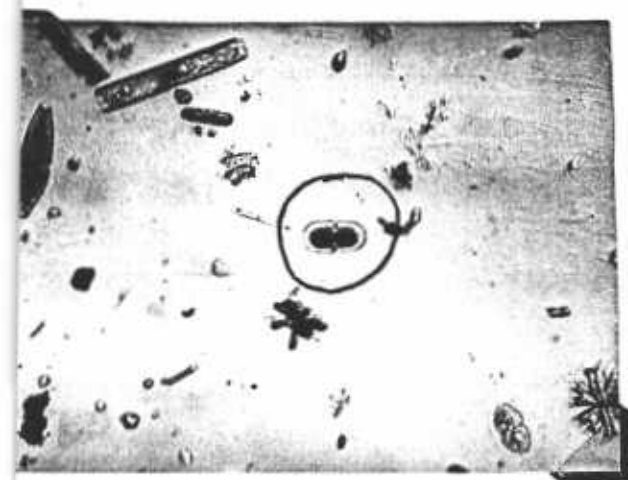
29



30

Photo. No.

31. Cosmarium quadratum var. willei x 50
32. C. pyramidatum x 450
33. C. pseudamoenum x 50
34. C. depressum var. achondrum x 50
35. C. granatum x 50
36. C. ovale x 450



31



32



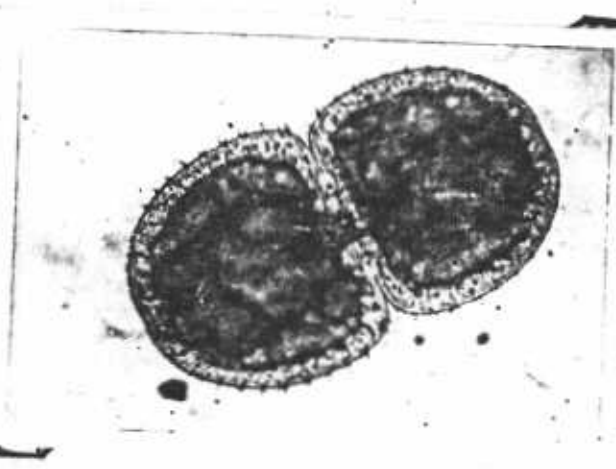
33



34



35



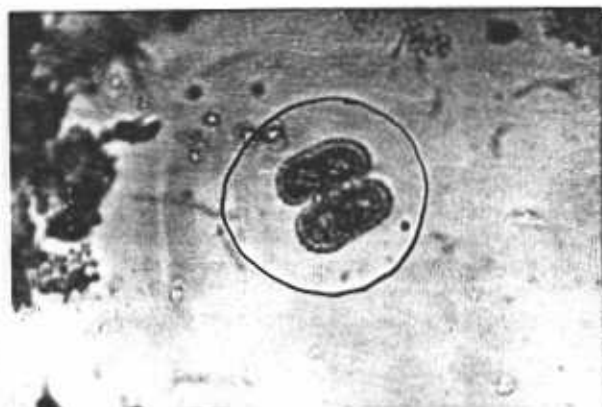
36

Photo. No.

- 37. Cosmarium ralfsii var. montana x 45.
- 38. C. pseudobroomei x 5.
- 39. C. obsoletum x 5.
- 40. C. nymannianum x 5.
- 41. C. laeve x 5.
- 42. C. dorsitruncatum x 5.



37



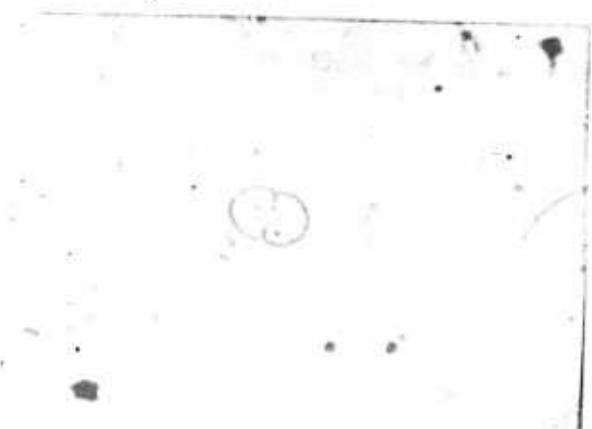
38



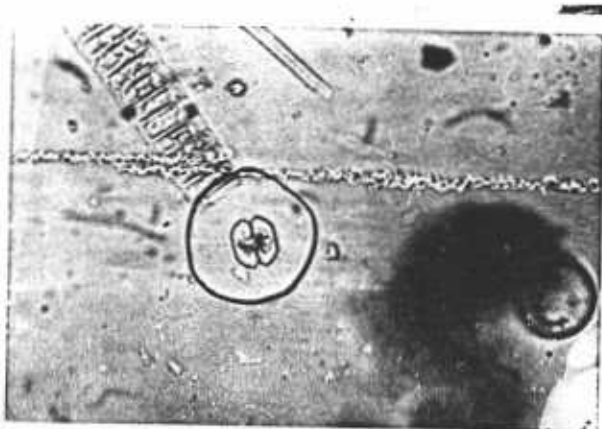
39



40



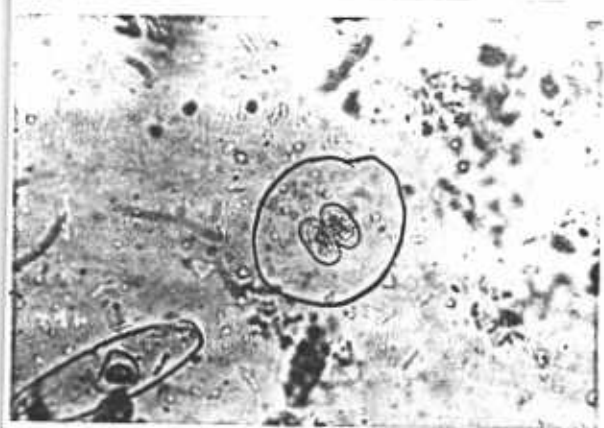
41



42

Photo. No.

43. Cosmarium bioculatum var. depressum x 50
44. C. contractum x 50
45. C. raeticum x 50
46. C. laeve var. octangularis x 50
47. Closterium lunula x 450
48. Cl. ehrenbergii x 50



43



44



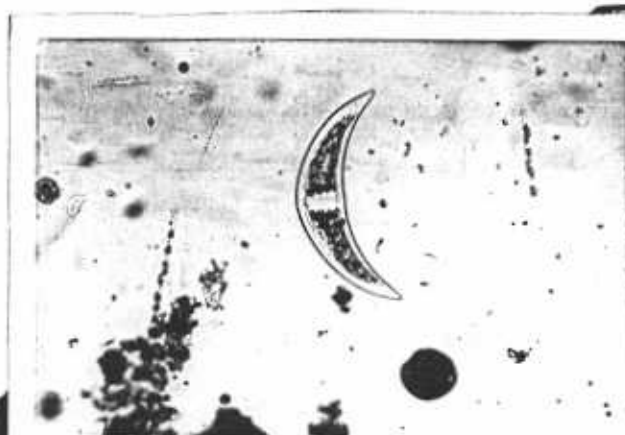
45



46



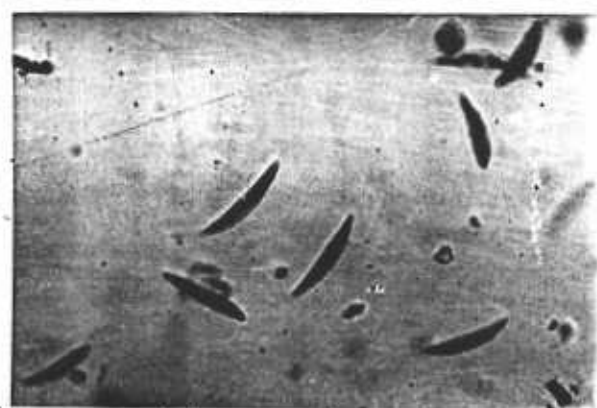
47



48

Photo. No.

- 49. Closterium moniliferum $\times 50$
- 50. Cl. moniliferum var. concaum $\times 50$
- 51. Cl. attenuatum $\times 50$
- 52. Cl. abruptum $\times 50$
- 53. Cl. setaceum $\times 50$
- 54. Cl. venus $\times 450$



49



50



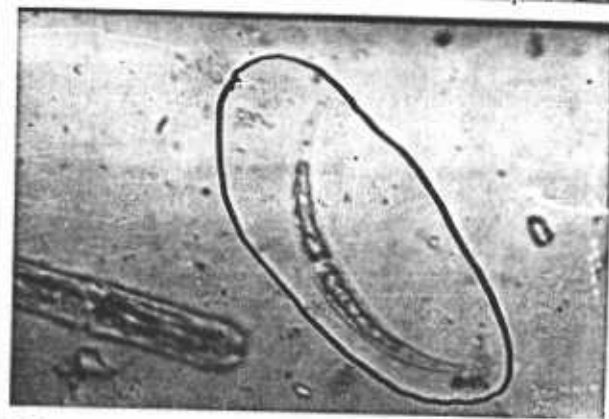
51



52



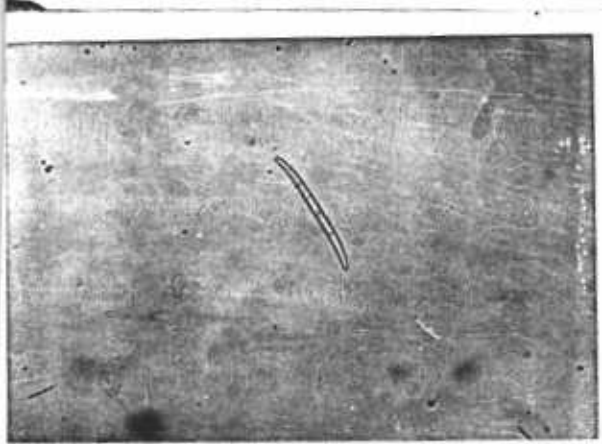
53



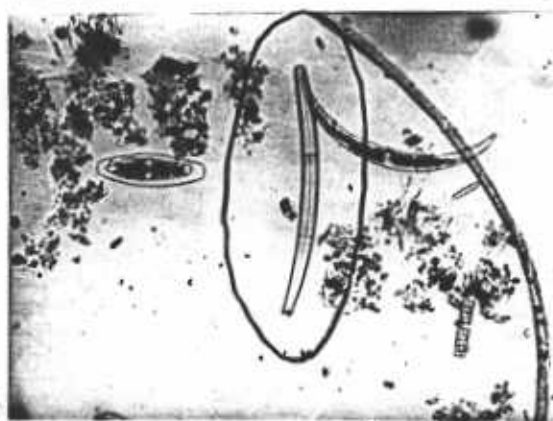
54

Photo. No.

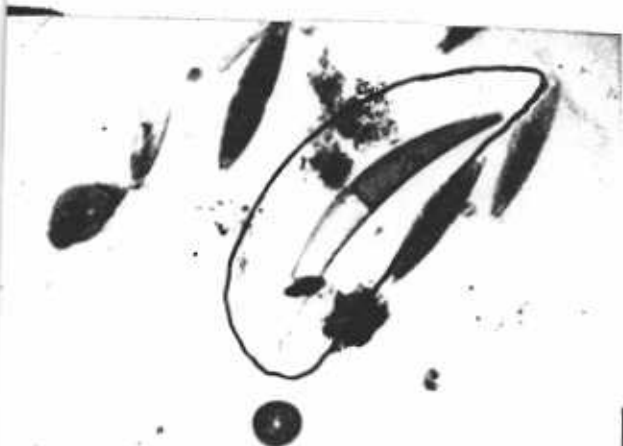
- 55. Closterium gracile x 50
- 56. Cl. intermedium x 50
- 57. Cl. costatum x 50
- 58. Cl. diana var. arcuatum x 50
- 59. Cl. acerosum x 50
- 60. Pleurotaenium nodosum x 50



55



56



57



58



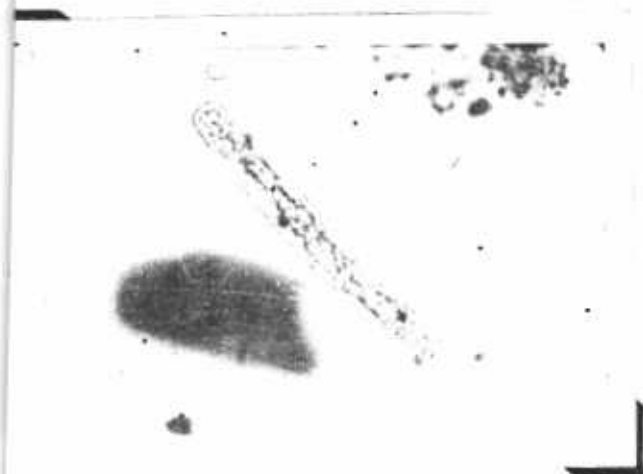
59



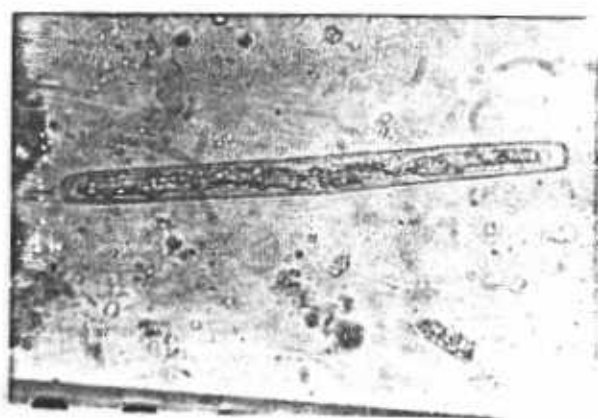
60

Photo. No.

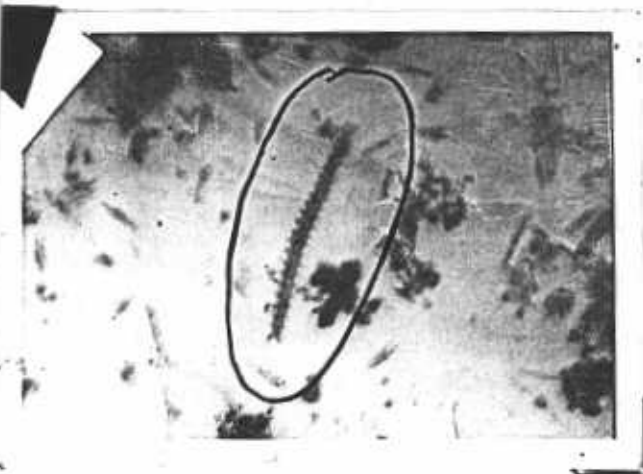
61. Pleurotaenium minutum var. submultitaeniatum $\times 45\times$
62. Pl. minutum $\times 45\times$
63. Triploceras gracile $\times 50\times$
64. Docidium undulatum $\times 50\times$
65. Staurastrum duacense $\times 50\times$
66. St. hirsutum $\times 50\times$



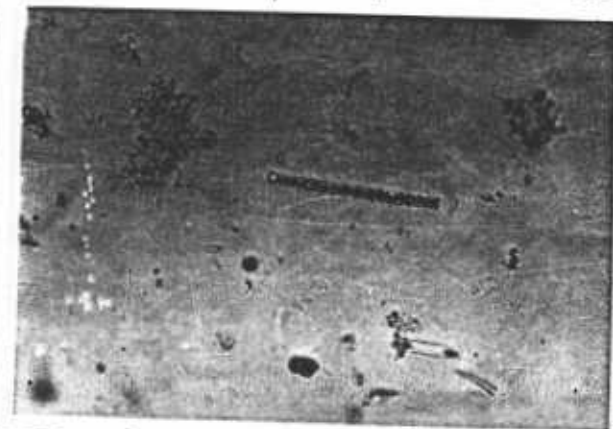
61



62



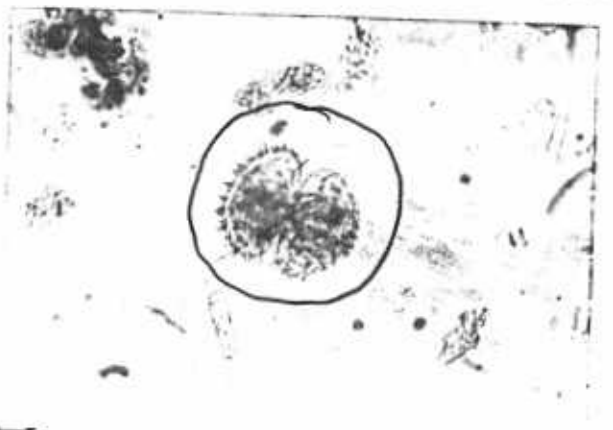
63



64



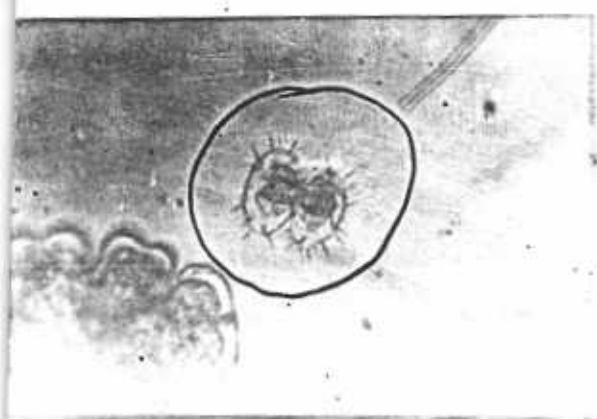
65



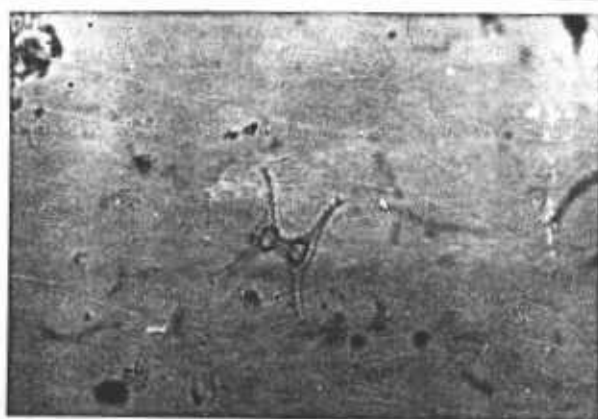
66

Photo. No.

- 67. Stauroastrum polytrichum x 50
- 68. St. leptocladum var. sinuatum x 50
- 69. St. punctulatum x 50
- 70. St. elongatum x 50
- 71. St. connatum x 50
- 72. St. gracile x 50



67



68



69



70



71



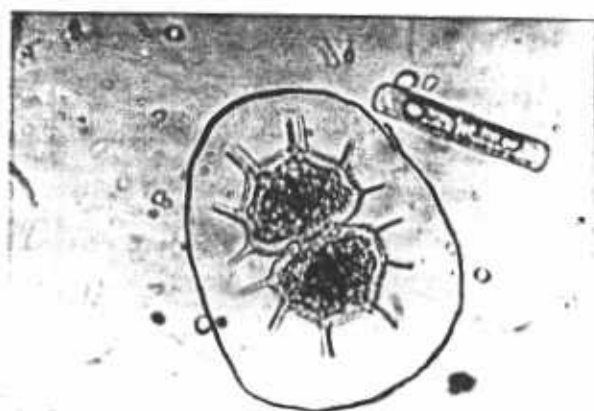
72

Photo. No.

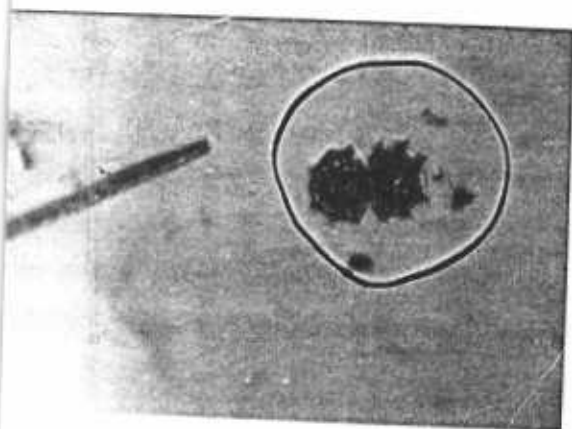
- 73. Xanthidium antilopaeum x 45°
- 74. X. cristatum var. leiodermum x 45°
- 75. X. armatum x 5°
- 76. X. smithii x 5°
- 77. Arthrodesmus hulnheimii x 5°
- 78. A. octocornis x 5°



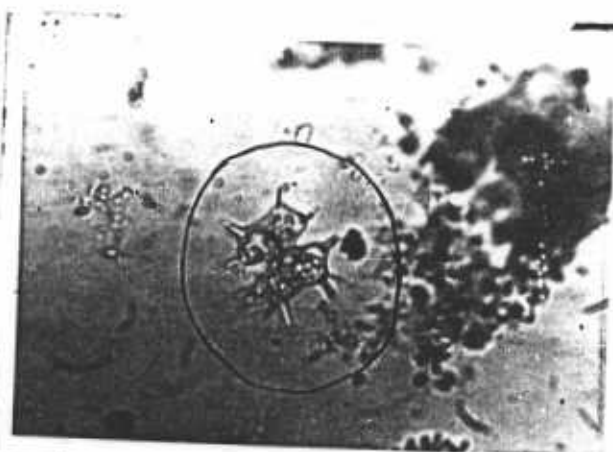
73



74



75



76

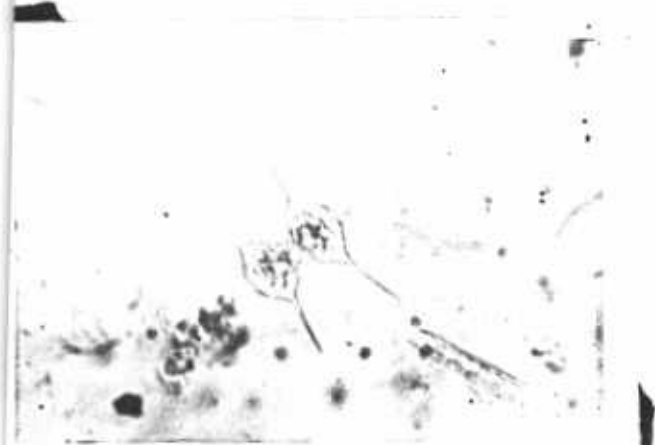
77



78

Photo. No.

79. Arthrodesmus triangularis var. subtriangularis $\times 50$
80. Staurodesmus convergens $\times 450$
81. Std. extensus $\times 50$
82. Tetmemorus brebissonii $\times 450$
83. T. laevis $\times 450$
84. Cylindrocystis brebissonii $\times 450$



79



80



81



82



83



84

Photo. No.

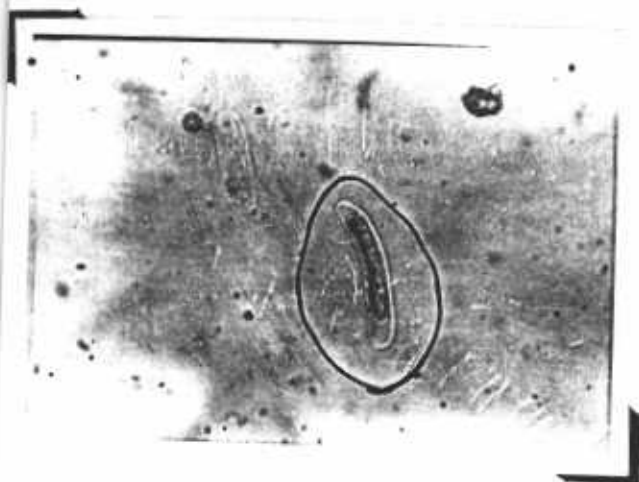
- 85. Onychonema laeve x 450
- 86. Netrium digitus x 50
- 87. Mesotaenium caldariorum x 450
- 88. Netrium interruptum x 50
- 89. Desmidium coarctatum x 450
- 90. D. swartzii x 450



85



86



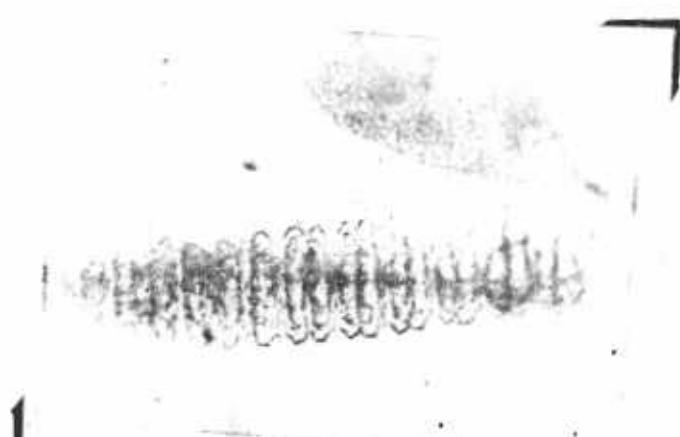
87



88



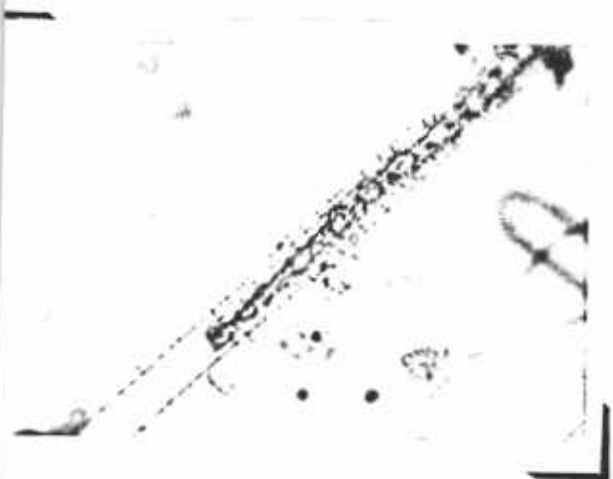
89



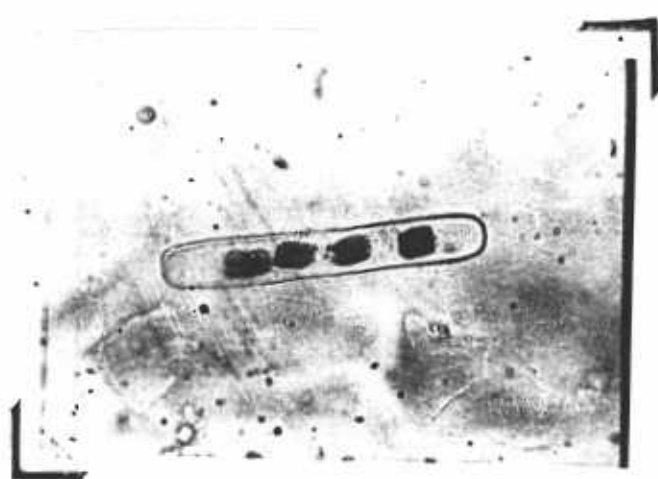
90

Photo. No.

91. Gonatozygon aculeatum x 450
92. Penium margaritaceum x 450
93. Streptonema trilobatum x 50
94. Desmidium baileyi x 450 .
95. Sphaerosoma excavatum x 450
96. Spondylosium pulchellum x 450



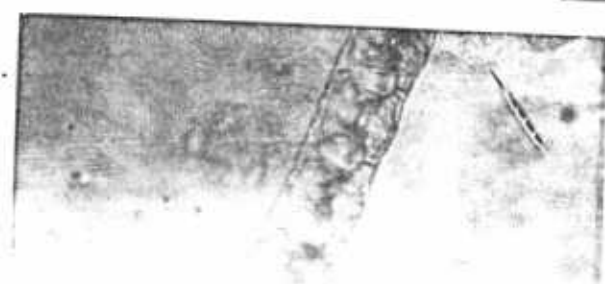
91



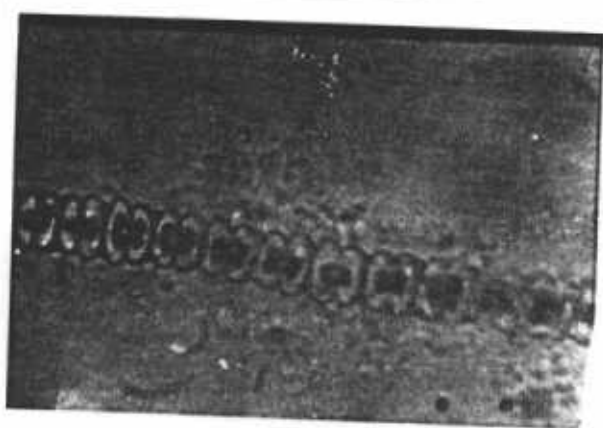
92



93



94



95



96

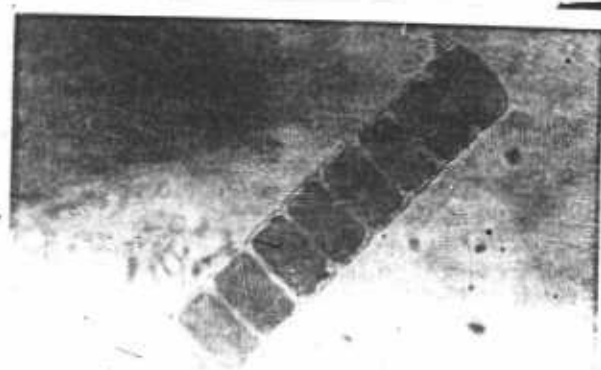


Photo. No.

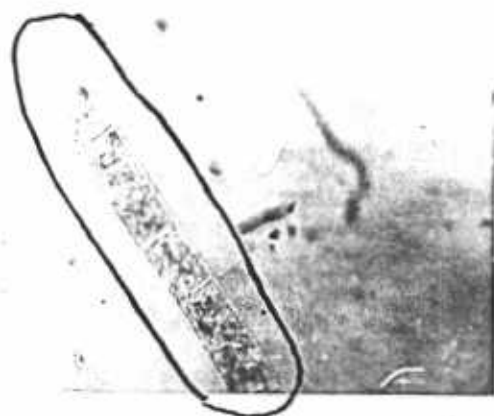
- 97. Spondylosium secedens x 450
- 98. Hyalotheca dissiliens x 450
- 99. H. mucosa x 50
- 100. Cosmocladium constrictum x 450



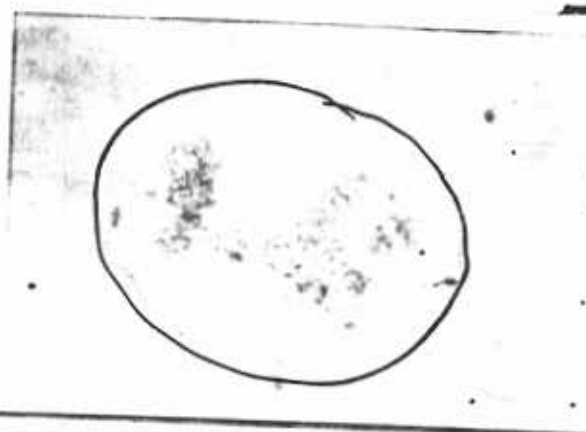
97



98



99



100

GLOSSARY

Acuminate: Narrowing to a point.

Apiculate: Ending in a short, sharp point.

Apiculus: A short point at the end of a spore.

Asymmetrical: Said of an organ or organism which has the two sides of a central plane unlike.

Attenuate: Narrowed.

Axile chloroplast: A chloroplast lying along the axis of the cell.

Bacillar: Rod-shaped.

Bifid: Forked; having a fissure near the centre.

Bilateral symmetry: Can be halved in only one plane, so that the halves are mirror images of each other.

Campanulate: Bell-shaped.

Concave: Hollowed out, like a saucer.

Constricted: Narrowed suddenly.

Convex: Rounded.

Costate: Ribbed.

Crenate: Edged with rounded teeth that point forward.

Cuneate: Wedge-shaped.

Cuspidate: Having a rigid point.

Cyathiform: Like a conical, narrow cup. It is sometimes stalked.

Deltoid: Triangular.

Decussate: Said of leaves, when they are opposite, but each pair is at right angle to the ones above and below it.

Dilated: Expanded and flattened.

Discoid: Said of an algal thallus which is one cell thick and closely applied to the substratum.

Elliptical: Narrow, and tapering at each end.

Furcate: Divided into two branches which diverge; forked.

Fusiform: Elongated, and tapering towards each end.

Girdle: A transverse groove.

Globose: Nearly spherical.

Gregarious: Growing close together, but not matted.

Isthmus: The narrow connecting zone between the semicells of the Desmidiaceae.

Lanceolate: Flattened, two or three times as long as broad, widest in the middle and tapering to a pointed apex.

Linear: Having parallel edges, and at least 4-5 times as long as broad.

Lunate: Quarter-moon-shaped, with one side concave.

Mamillate: Having a rounded outgrowth, ending in a papilla, or point.

Mucro: A short sharp point formed by the continuation of the midrib.

Navicular: Shaped like a boat.

Nodulose: Bearing local thickenings, especially of an elongated plant member.

Oblong: Elliptical, blunt at each end, having nearly parallel sides, and two to four times as long as broad.

Obtuse: Rounded or blunt, or being greater than a right angle.

Orbicular: Flat, with a circular, or almost circular outline.

Oval: Flat, rounded at each end, with curved sides, and about twice as long as broad, being widest in the middle.

Papilla: A minute blunt hair or a small rounded process.

Parietal: Lying along or close to the wall.

Plicate: Folded like a fan.

Punctate: Dotted, or marked with small hollows.

Radial symmetry: If an organ or organism can be split down any radius longitudinally to give two identical halves, it is radially symmetrical.

Reniform: Kidney-shaped, either solid or flat.

Retuse: Having a bluntly rounded apex with a central notch.

Rhomboid: Having sides of equal length, but not a square, and being attached by one of the acute angles.

Rotund: Approximately circular.

Scrobiculate: Having the surface dotted all over with small, rounded depressions.

Serrate: Said of a toothed margin, when the teeth are pointed, and project forwards.

Setaceous: Shaped like a bristle.

Sinuate: Having the margin divided into wide irregular teeth or lobes, which are separated by shallow notches.

Sinus: A depression or notch in a margin between two lobes.

Striate: Marked with parallel, longitudinal lines, furrows, ridges, or streaks of colour.

Trapeziform: Of unsymmetrical four-sided shape.

Truncate: Blunt-ended, as if cut off abruptly.

Tubercle: A rounded protuberance.

Tumid: Swollen; inflated.

Undulate: Wavy.

Verruca: A granular or wart-like outgrowth on a thallus.

Verrucose: Said of a surface covered with wart-like upgrowths.

Wart: A small blunt-tipped rounded upgrowth.

- Arthrodesmus i, vii, xii, xiv, 135
bifidus 136, f. 6, pl. 10
vulnheimii 136, 137, f. 9, pl. 10, ph. 77
octocornis 136, 137, 138, f. 11, pl. 10, ph. 78
triangularis 136, 138, 139, f. 10, pl. 10
subtriangularis 136, 139, 140, f. 12, pl. 10, ph. 79
Rambusina i, vii, xii, xv, 151
brebissonii i, vii, 151, 152, f. 10, pl. 11
Glosterium f, iv, vii, xii, xv, 80, 81
abruptum 81, 82, 83, f. 8, pl. 7, ph. 52
acerosum 82, 83, 84, f. 7, pl. 8, ph. 59
aciculare 81, 85, 86, f. 5, pl. 8
attenuatum 81, 86, f. 6, pl. 7, ph. 51
baillyanum 82, 86, 87, f. 1, pl. 8
costatum 82, 87, 88, f. 18, pl. 7
dianae var. arcuatum 82, 88, 89, f. 4, pl. 8, ph. 58
ehrenbergii 81, 89, 90, f. 3, pl. 7, ph. 48
gracile 81, 90, 91, f. 15, pl. 7; f. 2, pl. 8, ph. 55
incurvum 82, 91, 92, f. 14, pl. 7
intermedium 81, 92, 93, f. 16, pl. 7, ph. 56
lineatum 82, 93, 94, f. 7, pl. 7
littorale 81, 94, f. 2, pl. 7
lunula 81, 94, 95, f. 1, pl. 7
moniliferum 81, 95, 96, 97, f. 4, pl. 7, ph. 49
concavum 81, 97, f. 5, pl. 7, ph. 50
rostratum 81, 98, f. 6, pl. 8
setaceum 81, 99, f. 10, pl. 7, ph. 53
strigosum 81, 100, f. 17, pl. 7
stiolatum 82, 100, 101, f. 9, pl. 7
tumidum 81, 102, f. 12, pl. 7
turgidum var. giganteum 82, 102, 103, f. 3, pl. 8
venus 82, 103, 104, f. 13, pl. 7, ph. 54
Cosmarium i, iv, vii, xii, xiv, 46
bicardia 48, f. 10, pl. 5
bioculatum var. depressum 4 f. 8, pl. 6, ph. 43
botrytis i, vii, 47, 49, 50, f. 1, pl. 4, ph. 29
commissurale var. crassum 46, connatum 48, 51, 52, f. 5, pl. 7
consersum 46, 52, 53, f. 3, pl. 4
contractum 47, 53, 54, f. 10, pl. 6, ph. 44
ellipsoideum 48, 54, f. 12, pl. 4
cymatopleurum var. tyrolicum 47, 54, 55, f. 3, pl. 6
debarvi 47, 55, 56, f. 1, pl. 6
depressum var. achondrum 47, 56, f. 15, pl. 4, ph. 34
dorsitruncatum 47, 56, 57, f. 6, pl. 6, ph. 42
galeritum 47, 57, f. 8, pl. 4
granatum 47, 57, 58, 59, f. 16, pl. 4, ph. 34
hammeri 48, 60, f. 4, pl. 6
impressulum 48, 60, 61, f. 4, pl. 6
laeve 47, 61, 62, f. 11, pl. 5, ph. 41
octangularis 47, 62, f. 14, pl. 6, ph. 46
lundellii 47, 62, 63, f. 9, pl. 6
margaritifera 46, 63, 64, f. 14, pl. 4
moniliiforme var. subpyriforme 48, 64, f. 14, pl. 4
monodii 47, 64, 65, f. 6, pl. 4
nymannianum 47, 65, f. 6, pl. 5, ph. 40
obsoletum 47, 65, 66, f. 5, pl. 5, ph. 39
ovale 48, 66, 67, f. 2, pl. 5, ph. 36
pachydermum 47, 67, 68, f. 4, pl. 4
phaseolus f. minor 47, 68, 69, f. 12, pl. 5
portianum 46, 69, 70, f. 9, pl. 5
praemorsum 46, 70, f. 8, pl. 5
pseudoamoenum 46, 71, f. 11, pl. 4, ph. 33
pseudobroomei 46, 71, 72, f. 4, pl. 5, ph. 38
pseudopyramidatum 47, 72, 73, f. 9, pl. 4
pyramidatum 48, 73, 74, f. 7, pl. 4, ph. 32
quadratum var. willei 48, 74, f. 5, pl. 4, ph. 31
raeticum 47, 75, f. 11, pl. 6, ph. 45
ralfsii var. montana 48, 75, f. 3, pl. 5, ph. 37
rectangulare var. hexagonum 47, 75, 76, f. 13, pl. 6
sphaeroideum 46, 76, f. 12, pl. 6
subcucumis 48, 77, f. 10, pl. 4

- subreinschii var. ocellatum 47, 77, 78, f. 13, pl. 5
tetrachondrum 48, 78, f. 13, pl. 4,
tetraophthalmum 48, 78, f. 7, pl. 5
turgidum 48, 79, 80, f. 2, pl. 4, ph. 30
Cosmocladium i, vii, xii, xv, 165, 166
constrictum 166, f. 25, pl. 11, ph. 100
Cylindrocystis i, vii, xii, xiv, 145
americana 145, 146, f. 3, pl. 11
brebissonii 146, 147, f. 4, pl. 11, ph. 84
Desmidium i, vii, xii, xv, 152, 153, 154, f. 18, pl. 11, ph. 94
coarctatum 153, 154, f. 11, pl. 11, ph. 89
swartzii i, vi, 153, 155, 156, f. 12, pl. 11, ph. 90
Docidium i, vii, xii, xiv, 125
undulatum 126, f. 2, pl. 9, ph. 64
Euastrum i, vii, xii, xv, 24
ampullaceum 25, 26, f. 4, pl. 3
ansatum var. dideltiforme 25, 26, 27, f. 11, pl. 2
pyxidatum 24, 27, f. 6, pl. 3, ph. 23
bidentatum 24, 29, 30, f. 11, pl. 3
denticulatum 25, 30, 31, f. 7, pl. 3
divergens var. ornatum 24, 31, f. 12, pl. 2
dubium 25, 32, f. 14, pl. 2
elegans 25, 33, 34, f. 10, pl. 3
humerosum 24, 34, 35, f. 3, pl. 3, ph. 22
insigne 25, 35, 36, f. 13, pl. 3, ph. 27
insulare 25, 36, 37, f. 8, pl. 2
intermedium 25, 37, f. 14, pl. 3, ph. 28
oblongum i, vii, 24, 38, 39, f. 2, pl. 3, ph. 21
pectinatum 24, 40, f. 9, pl. 3, ph. 25
inevolutum 24, 41, f. 13, pl. 2
sinuosum var. gandense 24, 41, f. 5, pl. 3
spinulosum var. inermius 25, 42, f. 12, pl. 3, ph. 26
turnerii 25, 42, 43, f. 10, pl. 2
validum 25, 43, f. 9, pl. 2, ph. 19
ventricosum 24, 43, 44, f. 8, pl. 3, ph. 24
verrucosum 25, 44, 45, f. 1, pl. 3, ph. 20
Gonatozygon i, vii, xii, xv, 168, 169
aculeatum 169, f. 14, pl. 11, ph. 91
Hyalotheca i, vii, xii, xv, 162, 163
dissiliens i, vii, 163, 164, f. 23, pl. 11, ph. 98
mucosa 163, 164, 165, f. 24, pl. 11, ph. 99
Mesetaenium i, vii, xii, xv, 150
Mesetaenium i, vii, xii, xv, 150
caldariorum 150, f. 7, pl. 11, ph. 87
Microsterias i, l, vii, xii, xiv, 150
apiculata var. brachyptera 3, f. 3, pl. 1
crux-melitensis 4, 5, f. 4, pl. 1, ph. 4
decemdentata 5, f. 4, pl. 2, ph. 16
denticulata var. angulosa 5, 6, f. 10, pl. 1, ph. 9
doveri var. africana 6, 7, f. 1, pl. 2, ph. 14
foliacea 7, f. 11, pl. 1, ph. 10
jenneri var. simplex 7, 8, f. 7, pl. 1, ph. 7
laticeps 2, 8, 9, f. 14, pl. 1, ph. 13
mahabuleshwariensis 2, 9, 10, f. 3, pl. 2
muricata 2, 10, 11, f. 2, pl. 2, ph. 15
oscitans 2, 12, f. 8, pl. 1, ph. 8
papillifera 2, 13, 14, f. 2, pl. 1, ph. 2
pinnatifida 2, 14, 15, f. 13, pl. 1, ph. 12
radiata 2, 15, 16, f. 14, pl. 1, ph. 11
radiosa 2, 17, 18, f. 5, pl. 2
rotata 2, 18, 19, f. 9, pl. 1
thomasi 2, 19, 20, 21, f. 5, pl. 1, ph. 5
torrevi 2, 21, 22, f. 6, pl. 1, ph. 6
truncata 2, 22, 23, f. 1, pl. 1, ph. 1
Netrium i, vii, xii, xv, 147
digitus i, vii, 147, 148, 149, f. 6, pl. 11, ph. 86
interruptum 147, 149, 150, f. 9, pl. 11, ph. 88
Onychonema i, vii, xii, xv, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000
laeve 170, 180, f. 5, pl. 11, ph. 85
Oocardium i, vii, xii, xv, 167
stratum vii, 168, f. 6, pl. 2, ph. 17
Penium i, vii, xii, xv, 156
cucurbitinum var. subpolymorphum 156, 157, f. 16, pl. 11
margaritaceum i, vii, 156, 157, 158, f. 15, pl. 11, ph. 92
Phymatodocis i, vii, xii, xv, 171
nordstedtiana f. minor 171, f. 13, pl. 11
Pleurotaenium i, vii, xii, xiv, 104
coronatum 105, 106, f. 10, pl. 8
ehrenbergii 105, 106, f. 15, pl. 8
minutum var. submultitaeniatum 105, 108, f. 13, pl. 3, ph. 61

- nodosum 105, 108, 109, f. 8,
 pl. 8, ph. 60
subcontortum 105, 109, f. 16, pl. 8
trabecula 105, 109, 110, f. 11, pl. 8
tridentulum 105, 110, f. 12, pl. 8
truncata 105, 111, f. 9, pl. 8
Sphaerozosma i, vii, xii, xv, 158
excavatum 159, f. 20, pl. 11, ph. 95
vertebratum 159, 160, f. 19, pl. 11
Spirotaenia i, vii, xii, xv, 166, 167
obscura 167, f. 7, pl. 11
Spondylosium i, vii, xii, xv, 160, 161
pulchellum 161, 162, f. 21, pl. 11, ph. 96
secedens 161, 162, f. 22, pl. 11, ph. 97
Stauroastrum i, vii, xii, xiv, 112
connatum 113, 114, f. 11, pl. 9, ph. 71
duacense 113, 114, 115, f. 3, pl. 9, ph. 65
elongatum 113, 115, f. 10, pl. 9, ph. 70
erasum 113, 116, f. 12, pl. 9
gracile 113, 116, 117, f. 15, pl. 9, ph. 72
hirsutum 113, 118, f. 4, pl. 9, ph. 66
leptocladum var. sinuatum 113, 118,
 119, f. 6, pl. 9, ph. 68
manfeldtii 113, 119, 120, f. 13, pl. 9
margaritaceum var. subcontortum 113,
 120, f. 8, pl. 9
polytrichum 113, 120, 121, f. 5, pl. 9,
 ph. 67
punctulatum 113, 121, 122, f. 9, pl. 9,
 ph. 69
setigerum 113, 122, 123, f. 7, pl. 9
tumidum 113, 123, f. 14, pl. 9
Staurodesmus i, vii, xii, viv, 140
convergens 140, 141, f. 13, pl. 10,
 ph. 80
cornutus 140, 141, f. 16, pl. 10
dickiei 140, 142, f. 15, pl. 10
extensus 140, 142, f. 14, pl. 10, ph. 81
Streptonema i, vii, xii, xv, 171
trilobatum vii, 172, f. 17, pl. 11, ph. 93
Tetmemorus i, vii, xii, xiv, 143
brebissonii i, vii, 143, 144, f. 1, pl. 11,
 ph. 82
laevis 143, 144, 145, f. 2, pl. 11, ph. 83
Triploceras i, vii, xii, xiv, 123, 124
gracile 124, 125, f. 1, pl. 9, ph. 63
Canthidium i, vii, xii, viv, 126, 127
antilopeum 127, 128, 129, f. 1, pl. 10, ph. 73
armatum 127, 129, 130, 131, f. 5, pl. 10, ph. 75
brebissonii 127, 131, f. 3, pl. 10
cristatum 127, 132, 133, f. 2, pl. 10
fasciculatum 127, 133, 134, f. 6, pl. 10
smithii 127, 143, 135, f. 7, pl. 10, ph. 76

- Committee for Economic development , 1997.
- N.W.F.P. "Development Statistics" . Bureau of Statistics, 1994.
- Nafziger,E.W. "Education and Entrepreneurship". Journal of Development Administration, April , 1970.
- Nahm, A., Vonderembse, M. and Koufteros, X. 'The impact of organizational structure on time-based manufacturing and plant performance' , *Journal of Operations Management*, 21(3): 281-306, 2003
- National Management Consultants, "Credit Strategy For Financing Small Scale Enterprises in NWFP". The Bank of Khyber, Feb. 01, 1995.
- Nicolescu, O. Intrapreneurship-a major category of entrepreneurship
- Norman M. Scarborough and Thomas W. Zimmerer "Effective small Business Management ".(2nd Edition),Merrill Publishing Company, 1984.
- PAK"Pakistan Economic Survey" . Islamabad Economic Adviser's wing , Finance Division. 1996-97.
- Pakistan Country Assistance Strategy, World Bank Report,Annex ii,page 3
- Paul Foley and Howard Green."Small Business Success". Paul chapman publishing, 1989.
- Peel, M. and Bridge J. 'How planning and capital budgeting improve SME performance' , *Long range Planning* , 31(6): 848-56, 1998
- Peres, W. and Stumpo, G. 'Small and Medium-Sized Manufacturing Enterprises in Latin America and the Caribbean' Under the New Economic Model' , *World Development*, 28(9): 1643-55, 2000