SEMI-ANNUAL STATUS REPORT

TITLE: Biological Indicators For Monitoring Water Quality of MTF Canals System

(NASA-CR-143178) BIOLOGICAL INDICATORS FOR MONITORING WATER QUALITY OF MTF CANALS SYSTEM Semiannual Status Report, 26 Apr. 1974 - 25 Apr. 1975 (Mississippi Valley State Univ.) 16 p HC $3.25 CSCL 06B G3/51 N75-27717 Unclas 29803

NATIONAL AERONAUTICS SPACE ADMINISTRATION

Grant # NSG-8009

PERIOD COVERED:

April 26, 1974 to April 25, 1975

By

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ITTA BENA, MISS.

INTRODUCTION

It has been well established for many years that aquatic communities are affected by changes in the environment, including pollution, and that the degree of change in the community is related to the degree of change in the environment. There has, however, been considerable difficulty in finding generally applicable systems for measuring and demonstrating the relationship between changes in the environment and changes in the community.

The value of physical and chemical data is often over-emphasized by those concerned with stream pollution and its control. It is difficult if not impossible, to predict the biological effects of a complex continuously changing, industrial waste from chemical analyses alone. The biological monitor may not tell us the exact nature of toxic conditions, but it can indicate when the toxic conditions are developing.

The main purpose of the present research is to develop "biological models (diversity indexes) for predicting environmental effects on Mississippi Test Facilities (MTF) Canal Systems from National Aeronautics Space Administration (NASA) and tenant's chemical operations".

In order to predict the effects on local streams from NASA (MTF) and tenant's chemical operations, a physical model of an unpolluted stream has been established at MTF. This model is fed by artesian well water which is free of background levels of pollutants. Much of the stream was composed of riffles with depths between 20 and 36cm, and rubble sizes between 2 and 15 cm in greatest dimension. The remaining area of the stream was composed primarily of pools with extensive accumulation of sediments along the edges. These areas had low water depths usually ranged from 13 to 38 cm.

The species diversity and composition of the biota of unpolluted MTF stream is being determined and this will form a base-line data for future comparison. The biological modeling will be accomplished by adding controlled quantities or kinds of MTF chemical pollutants and evaluating the effects of these chemicals on the biological life of the stream.

MATERIALS & METHODS

Seven randomly selected stations were established on the MTF stream in May, 1974, Station A is upstream near the mouth whereas the remaining six (B, C, D, E, F & G) stations are downstream and are approximately 50 feet apart. These stations were sampled at approximately four weeks intervals. The water samples were held in aerated aquarium at Mississippi Valley State University for chemical and physical analysis and biota determination. Water and air temperature, dissolved oxygen, and PH (electrometric) were measured in the field (TABLE I). The tests included the following:

Total hardness--Hach Kit
Ortho Phosphate-Hach Kit
Biochemical oxygen Demand (B. O. D.)---
5 Day Incubation Technique.

Dissolved oxygen was measured with a Y. S. I. Oxygen meter, model 53. The results of this instrument were checked periodically against the Azide Modification of the Iodometric method (winkler) and the data showed the meter to be quite reliable.

The invertebrates were sampled by several methods. Plankton was collected by a standard 25-mesh net and by cruising with dip nets. Twenty liters were concentrated to 20 ml for counting. Population counts were determined after welch utilizing a sedgwich Rafter Cell Counting 30 fields. Identifications of protozoans (Appendix A) and diatoms, (Appendix B) were done with the help of various keys. The different genus of algae were also collected and identified (Appendix C).

Three samples of macro-invertebrates were taken from the soft substrates along the margins and in pools at each of the stations with Ekman dredge sampler (0.25 sq. ft.). Surber Sampler (1.0. sq. ft.) was also used to collect three samples from riffles of each station. The samples are being examine in the Mississippi Valley State University Laboratories. Identifications are being made by using the key by Edmondson (1959), Pennak (1953), and Usinger (1968).

Diversity indexes based on classes, orders, and genera are being calculated for each of the seven stations by using the mathematical model put forth by (Patten, 1962) which is as following:

$$d = \Sigma \frac{Ni}{N} = \log_2 \frac{Ni}{N}$$

Where N = total number of individuals
Ni = individuals in the i-th species
i = 1,2,3 ------------s) which will be determined from the samples at each station.

Most of the fishes collected from MTF stream were Fathead minnow (Pinephales promelas) and mosquito fish (Gambusia affinis) and these were sampled once in two months from 10 feet long area at each of the stations. The fish were counted and recorded for future comparison.

The effects of various doses of Zinc bromide, potassium bromide and Sodium bromide on the survivial of microinvertebrates, macroinvertebrates and fish (Pimephales promelas and Gambusia affinis) are being investigated in the Mississippi Valley State University Laboratories.

References:

1. Edmondson, W. T., Fresh-water Biology, Wiley & Sons, Inc. New York, New York (1959).

2. Patten, B. C. Species Diversity in Net Phytoplankton of Raritan Bay. Jour. Mar. Res (Sears Foundation), 20:57h (1962.

3. Pennak, R. W., Fresh-water Invertebrates of the United States. Ronald Press, New York, New York (1953)

4. Usinger, R. L., Aquatic Insects of California, Univ. of California Press, Berkeley (1968).

TABLE I - PHYSICAL & CHEMICAL CHARACTERISTICS OF THE STUDY STATIONS ON MTF STREAM (Depth & Width =

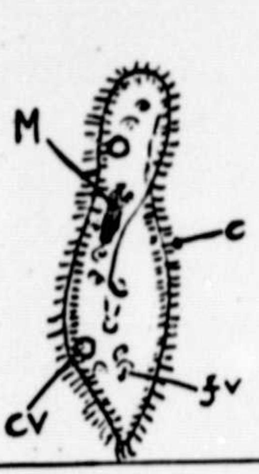
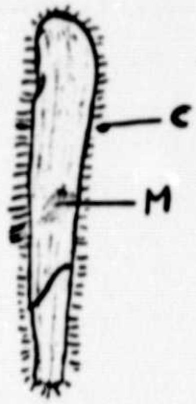
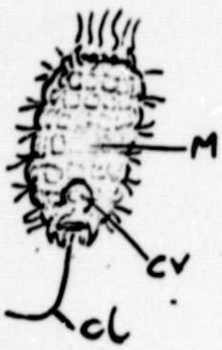
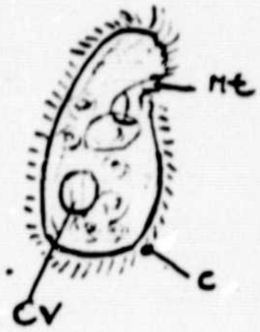
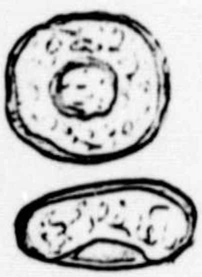
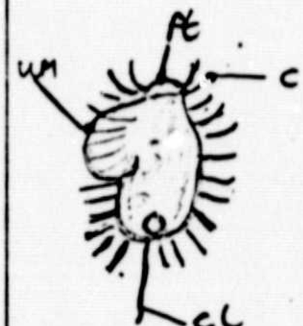
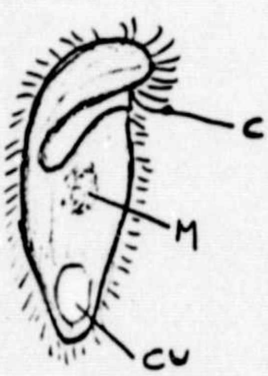
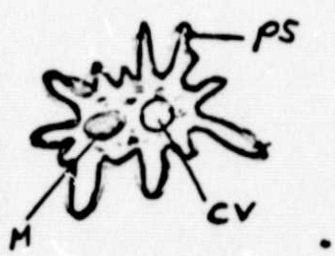
STATION #		TEMP cC	D.O.	PH	HARDNESS	ORTHO PHOSPHATE	B.O.D.
			mg/L				
A	1	30.0	7.5	7.0	17.1 gm per gal.	1.2 ppm	0.9 mg/L
	2	30.0	7.8	7.2	17.1 gm per gal.	1.4 ppm	1.1
	3	30.5	7.7	7.1	17.1 gm per gal.	1.2 ppm	1.0
B	1	32.5	7.5	7.4	17.1 gm per gal.	.1 ppm	1.2
	2	32.5	10.05	7.2	17.1 gm per gal.	1.1 ppm	0.8
	3	29.0	12.2	6.9	17.1 gm per gal.	1.2 ppm	0.6
C	1	29.5	7.1	7.7	17.1 gm per gal.	1.8 ppm	1.4
	2	29.5	9.8	7.3	17.1 gm per gal.	1.9 ppm	0.8
	3	31.5	13.8	7.4	17.1 gm per gal.	2.3 ppm	0.6
D	1	31.0	14.2	7.2	17.1 gm per gal.	.1 ppm	0.0
	2	25.1	14.0	7.4	17.1 gm per gal.	.3 ppm	0.0
After rain	3	27.5	12.3	7.3	17.1 gm per gal.	.1 ppm	0.6
E	1	28.0	8.9	7.2	17.1 gm per gal.	.6 ppm	0.7
	2	27.5	8.7	7.4	17.1 gm per gal.	.8 ppm	0.8
	3	27.5	8.5	7.3	17.1 gm. per gal.	.8 ppm	0.7
F	1	27.5	8.8	7.4	17.1 gm per gal.	.1 ppm	0.7
	2	27.0	8.6	7.5	17.1 gm per gal.	.3 ppm	0.8
	3	27.0	8.8	7.4	17.1 gm per gal.	.1 ppm	0.8
G	1	27.0	8.3	7.2	17.1 gm per gal.	.5 ppm	0.8
	2	26.8	8.2	7.3	17.1 gm per gal.	.6 ppm	0.8
	3	30.0	8.1	7.4	17.1 gm per gal.	.3 ppm	0.7

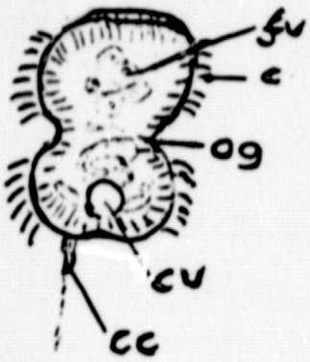
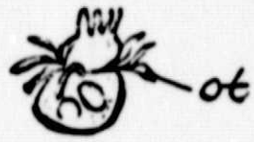
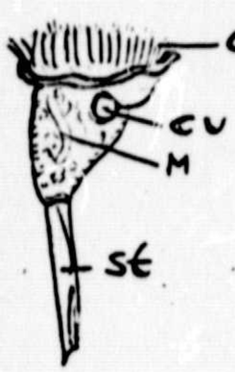
APPENDIX A

PROTOZOAN

1. Paramecium
2. Spirestomum
3. Coleps
4. Colpodium
5. Centropysix
6. Cyclidium
7. Metopus
8. Amoeba
9. Urocentrum
10. Mesodinium
11. Vorticella
12. Euplotes

PROTOZOANS

1 	PARAMECIUM-Two contractile vacuoles, 1 in front 1 in rear half of cell; 15 species.	2 	SPIROSTOMUM-Very elongated, wormlike, highly contractile ciliates; 7 species.
3 	COLEPS-1 genus in fresh water, 16 species.	4 	COLPODIUM-Body outline idented at mouth; left ciliary rows meet right ones at an angle along preoral sulture; right ciliary rows curve outward at oral groove; contractile vacuole near middle; 2 species.
5 	CENTROPYXIS-Membrane thin, chitinous with small siliceous plates. A perture circular, faintly in vaginated, about half the diameter of the shell in width.	6 	CYCLIDIUM-The preoral peristamal furrow ends posteriorly at mouth; 22 species.
7 	METOPUS-Body twisted; peristome narrow, running backward spirally; 49 species.	8 	AMEOBA-Very changeable in the shape of the body; usually with numerous pseudopods, shapely distinguished from the body.

9 	UROCENTRUM-Two encircling bands of cilia, with oral groove between; swim re-volving on a mucus thread spun from tuft of caudal cilia; 1 species.	10 	MESODINIUM-With equatorial groove and oral tentacles; body length less than 40
11 	UORTICELLA-Spasomneme well developed; stalk is thrown into a spiral coil when contracted; stalk unbranched; 86 species.	12 	EUPLOTES-Only 1 genus in fresh water; 8 species.

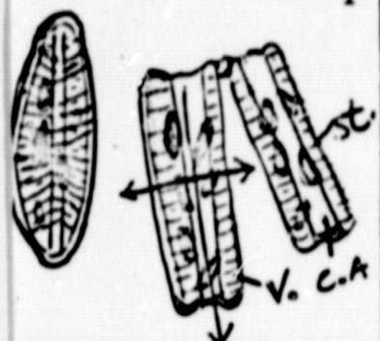
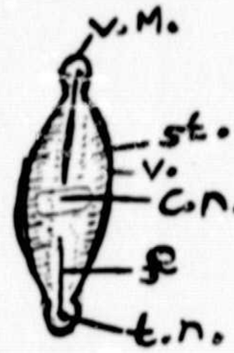
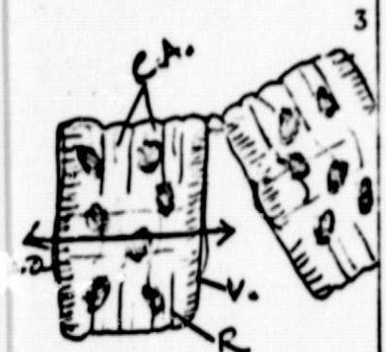
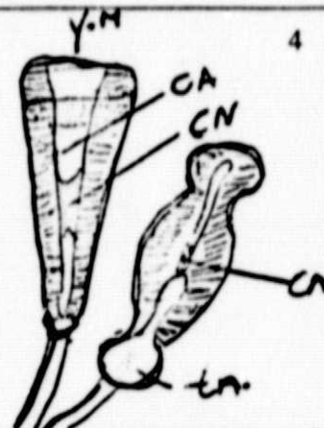
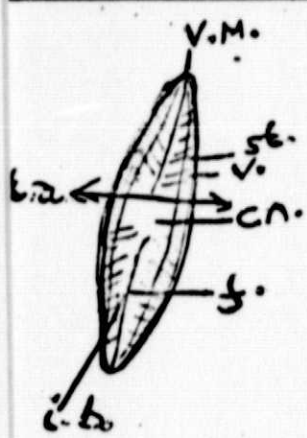
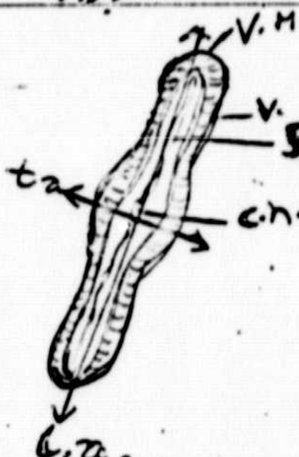
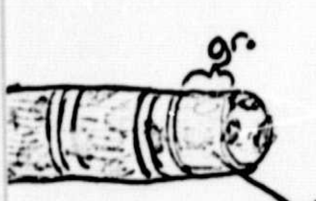
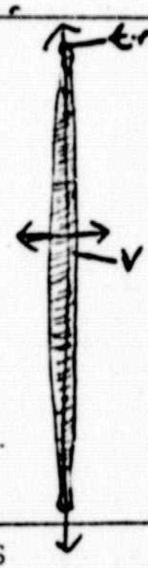
ABBREVIATIONS FOR PROTOZOANS

c-cilia	og-oral groove
cc-caudal cilia	ot-oral tentacles
cr-cirri	ps-pseudopods
cv-contractile vacuole	pt-peristome
fv-food vacuole	st-stalk
M-macro nucleus	um-undulating membrane
mt-mouth	

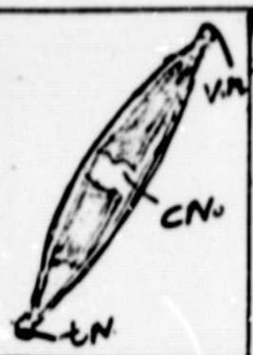
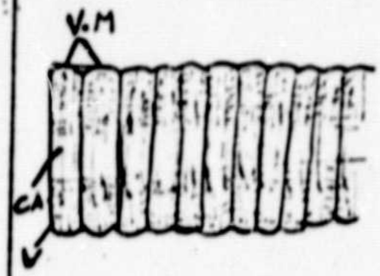
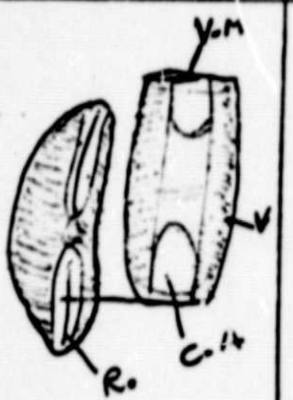
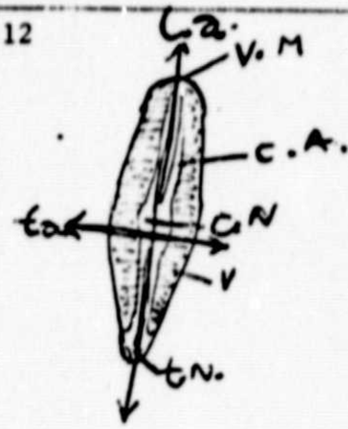
APPENDIX B

DIATOMS

1. Diatoma
2. Anomoeneis
3. Tabellaria
4. Gomphanema
5. Nauicula
6. Pinnularia
7. Melosira
8. Synedra
9. Nitzchia
10. Fragillaria
11. Cymbella
12. Gomphoneis

1 	DIATOMA-Valves symmetrical to transverse axis.	2 	ANOMOENEIS-Longitudinal lines scattered, central pores of raphe turned, if at all in the same direction.
3 	TABELLARIA-Septae usually straight; valves without costae.	4 	GOMPHONEMA-Striae composed of a single row of punctae.
5 	NAUICULA-Central area not a distinct stauras; striae distinctly or indistinctly punctate or cross lineate.	6 	PINNULARIA-Striae costate, crossed by a band that is more or less distinct.
7 	MELOSIRA-Frustules not so linked, girdle of frustule conspicuous, joined to valve mantle by groove.	8 	SYNEDRA-Frustules typically not forming filaments; often seen in valve view.

DIATOMS

9 	NITZCHIA-Keel more or less eccentric, cells not usually forming colonies.	10 	FRAGILLARIA-Frustules typically forming filaments, therefore, usually seen in girdle view; distinguished from filaments of Eunotia by not having terminal nodules.
11 	CYMBELLA-Raphe more or less eccentric sometimes approximate to ventral margin, ends of raphe at terminal nodules, distinct; girdle lacking intercalary bands.	12 	GOMPHONEIS-Straie composed of a double row of punctae.

GLOSSARY OF DIATOMS

1. Apical Axis. The axis of the valve connecting the two apices. The raphe or the pseudoraphe either lie in this axis or are eccentric to it.

2. Central Area. The clear area between the raphe and the ends of the straie.

3. Central Pores of Raphe. The points in the central nodule where the external branch of the raphe connects by a transverse canal with the internal branch of the raphe.

4. Costa. A rib or thickening of silica. The thickening may be internal or external to the valve surface.

5. Frustle. The diatom cell wall, which is composed of two valves joined by a connecting band known as the girdle. A portion of the girdle is joined to the valve mantle of each valve.

6. Girdle. Two bands of silica, one attached to each valve mantle. One of these bands overlaps the other. Thus, the diatom frustle has a boxlike formation. When the diatom divides these two bands of silica separate, and each daughter cell retains one valve and band inside of which a new valve and band is formed.

7. Intercalary Bands. Bands of silica that often occur between the valve mantle and the girdle of the diatom. They may be few or many in number and vary greatly in width. They sometimes extend into the valve to form a septum.

8. Keel. A projection of the valve surface, usually more or less eccentric to the apical axis. In it is enclosed the canal raphe which is characteristic of certain general of diatoms.

9. Punctae. Small holes or thin bits of valve wall with pores in them surrounded by a thickening of the wall. The thickening may be only very slight and may extend either inward or to the exterior.

10. Raphe. A slit in the valve forming an external and internal canal, often more or less - shaped, through which the protoplasm of the diatom may flow. By this means the diatom protoplasm is in intimate contact with the enviroment. The raphe is always found on the valve.

11. Stauros. A central nodule that extends almost, if not quite, to the margins of the valve.

12. Stria. A line of punctae. The close juxta position of the punctae may make the stria appear to be a solid line.

13. Terminal or Polar Nodule. An enlarged, usually thickened, area of the wall in which the Raphe terminates, forming an external and an internal fissure.

14. Transverve Axis. The axis of the valve that connects the two margins of the valve and is perpendicular to the apical axis.

15. Valve. The valve is composed of a more or less flattened surface and a mantle. Each diatom frustle is composed of two valves joined by a connecting band known as the girdle.

16. Valve Surface. The surface of a diatom that possesses most of the marking on which identification is based,

17. Valve mantle. The portion of the valve that is apparent in girdle view.

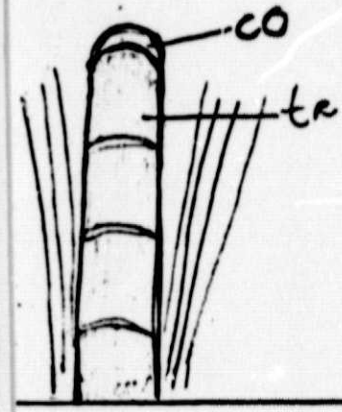
APPENDIX C

ALGAE

1. Oscillatoria
2. Euglena
3. Phacus
4. Cosmarium
5. Coelastrum
6. Scenedesmus
7. Closterium
8. Spirogyra
9. Spirulina
10. Lyngbya
11. Anacytsis
12. Microspora
13. Pithophora
14. Ulothix
15. Menoidium
16. Chilomonas

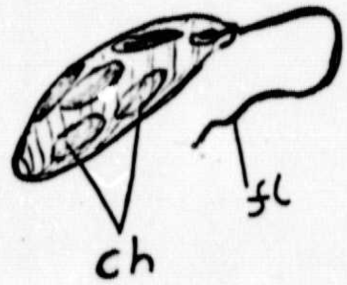
ALGAE

1



OSCILLATORIA-Trichomes straight or flexuaus, not permanently and rigidly spiraled.

2

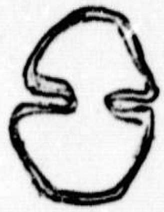


EUGLENA-Uniflagellate; cells pigmented; cells slightly to very plastic.

3

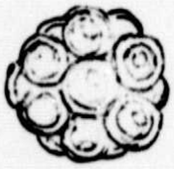
PHACUS-Cells with many small chloroplasts; cell strongly compressed.

4



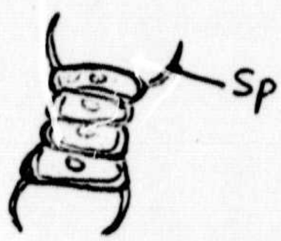
Cells smooth to variously embellished, at most with minute barbs.

5



COELASTRUM-With 2 to 69 cells joined laterally to form a hollow sphere.

6

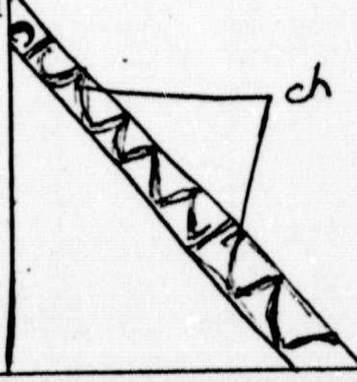


SCENEDESMUS-Cells ellipsoid; colony linear.

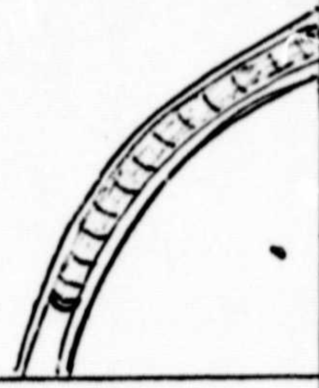
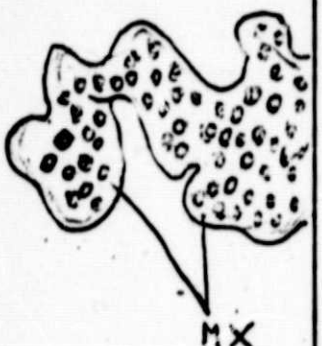
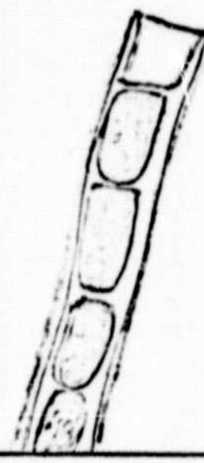
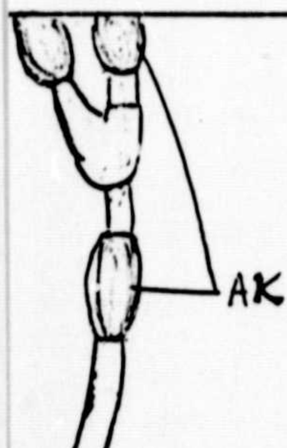
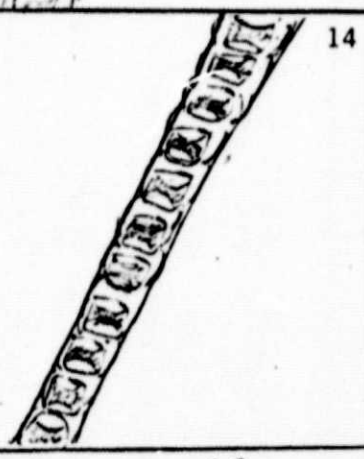
7

CLOSTERIUM-Poles of cell not bearing spines.

8



SPIROGYRA-With 1 or more spiral, bandlike chloroplasts; usually spiraled more than once; distinct conjugation tube.

9 	SPIRULINA-Spiral shaped	10 	LYNGBYA-Plants aquatic.
11 	ANACYTSIS-Cells before division spherical, irregularly distributed through the gelatinous matrix or in a series of rows in 3 planes perpendicular to each other; cell division proceeding successively in 3 planes perpendicular to each other.	12 	MICROSPORA-Cells 2 or 3 times as long as wide; walls of H-shaped pieces in optical section.
13 	PITHOPHORA-Branches few, from the base or rhizoidal in form; with numerous dark akinetes	14 	ULOTHIX-Cells not in pairs; cells shorter than wide, or dimensions equal.
15 	MENOIDIUM-Without pharyngeal rods; lunate triangular in section.	16 	CHILOMONAS-Cells slightly flattened; anterior end oblique.

ABBREVIATIONS FOR ALGAE:

ak-akinetes; fl-flagellum; ch-chloroplast; mx-matrix; co-concave cell; pl-pole; sp-spines
df-di-flagellate