A TAXONOMIC AND LIMNOLOGICAL STUDY OF THE ALGAE IN LAKE LANSING

Thesis for the Degree of M. S.

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Dennis Cobian Jackson

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ABSTRACT

A TAXONOMIC AND LIMNOLOGICAL STUDY OF THE ALGAE IN LAKE LANSING.

by Dennis C. Jackson

This study was designed to determine:

(1) the general algal floristic composition of the lake and to record the types of habitats where particular algal populations existed.

(2) the monthly and seasonal (winter, spring and early summer) successions in the phytoplankton on quantitative and qualitative basis.

(3) the monthly and seasonal successional (winter, spring, and early summer) changes, which may occur in the process of Aufwuchs colonization on artificial substrates.

Five permanent and eight incidental stations were established. At each of the five permanent stations plankton samples were collected and studied. All visible algae were collected from stones, rocks, etc., from the incidentally sampled stations. Collections for the quantitative aspects of the study were made with a Kemmerer Sampler, concentrated with a Foerst Electric Centrifuge, and counted with a Palmer Counting Slide in conjuction with a Whipple reticule plankton counting eyepiece.

The Major Findings

A total of 312 algal taxa are peported and all but 6 were collected in the course of this investigation. There are 13 new records of which seven are new to Michigan and six new to North America. Fourteen are not identified to species and possibly represent previously undescribed taxa.

The limnetic community is composed of organisms classified as

euplanktonic, but also intermingled with these are organisms displaced from the littoral and Aufwuchs communities. The total number of phytoplankton fluctuated throughout the year, exhibiting a small mid-winter pulse and a large spring maximum. These fluctuations are an expression of the total effect of the individual fluctuations of the organisms which compose the community. In the order of numerical abundance the algal divisions which contributed the largest quantity of organisms, to this phytoplankton were: the Chrysophyta, Cyanophyta, Chlorophyta and Pyrrhophyta.

The littoral region is the most heterogeneous environment in the lake and supports the largest number of taxa (237). These taxa belong to either the community of the plankton or to the Aufwuchs. Over 50% of the taxa occurring in the plankton are exclusively found in this region, and the major portion of these are Desmids and other Chlorophyta.

The Aufwuchs community can be classified according to the substrate upon which they develop, i.e., organic and inorganic. The community on stones is primarily composed of diatoms whereas the communities on the higher aquatic plants are usually dominated by filamentous green and blue-green algae. The Aufwuchs development and the complex succession of taxa on artificial substrates is related to a number of variables, such as space and the organisms present in the region. The rate of accumulation of this community is similar to that of the plankton community with a small mid-winter pulse and a spring maximum. The major constituents of the Aufwuchs community are the diatoms and along with these basic constituents are a number of planktonic forms which become caught and tangled with the attached forms. The vertical distribution of the Aufwuchs is different not only in community composition but in quantity as well. Whereas one might expect that the upper level would likely have a greater quantity of Aufwuchs due to light intensity, this usually is not the case.

The investigation revealed that the regions of a lake are normally inhabited by associations of species in recognizable communities. These communities, however, are not rigidly delimited, nor are their compositions static and fixed. They are entities which in response to their environment are dynamic in composition time and space.

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LAKE LANSING

By

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Dedicated To My

Mother and Father

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A TAXONOMIC AND LIMNOLOGICAL STUDY OF THE ALGAE IN LAKE LANSING

I. INTRODUCTION

A. History of the Investigation

Lake Lansing, although small, has played an important role as a recreational site for the surrounding communities. For over a hundred years its shores have been visited by bathers, fishermen, boat enthusiasts, and biological classes collecting algae, higher aquatic plants and zoological specimens. In spite of the fact that many university classes have frequently visited the lake it has never been investigated as a biological entity. Furthermore very little has been done on the lake with reference to its limnological characteristics. The first known study was a survey by R. C. Ball and party, in 1938, undertaken for the Institute of Fisheries Research, a division of the Michigan Department of Conservation. In addition there was a three-month study of the phytoplankton published by Tucker in 1957 and a recent report by Michigan Associates in 1960. The Ball survey included some chemical analyses and descriptions of some biological, and physical characteristics (nature of the bottom deposits etc.). The former, however, were mostly concerned with the higher aquatic vegetation and fish populations of the lake, hence the algae were but lightly treated. The Tucker publication, dealt with a number of Michigan lakes and was concerned with the relationship of phytoplankton periodicity to the nature of the physico-chemical environment.

The Michigan Associates' report concerns itself with the control of the nuisance weeds and makes no mention of algae. All of the reports have been of great value in supplying information toward an understanding of the existing conditions of the lake.

The present investigation was undertaken to contribute to our inadequate knowledge of Lake Lansing algae, and to analyze the various community compositions (euplankton, tychoplankton, aufwuchs). The study was done under the quidance of Dr. G. W. Prescott. The field investigation was carried out over a period of two years (September 1959 to June 1960, and September 1960 to June 1961), with the collections being made at weekly intervals, as regularly as possible.

B. Scope of the Study

Statement of the Problem

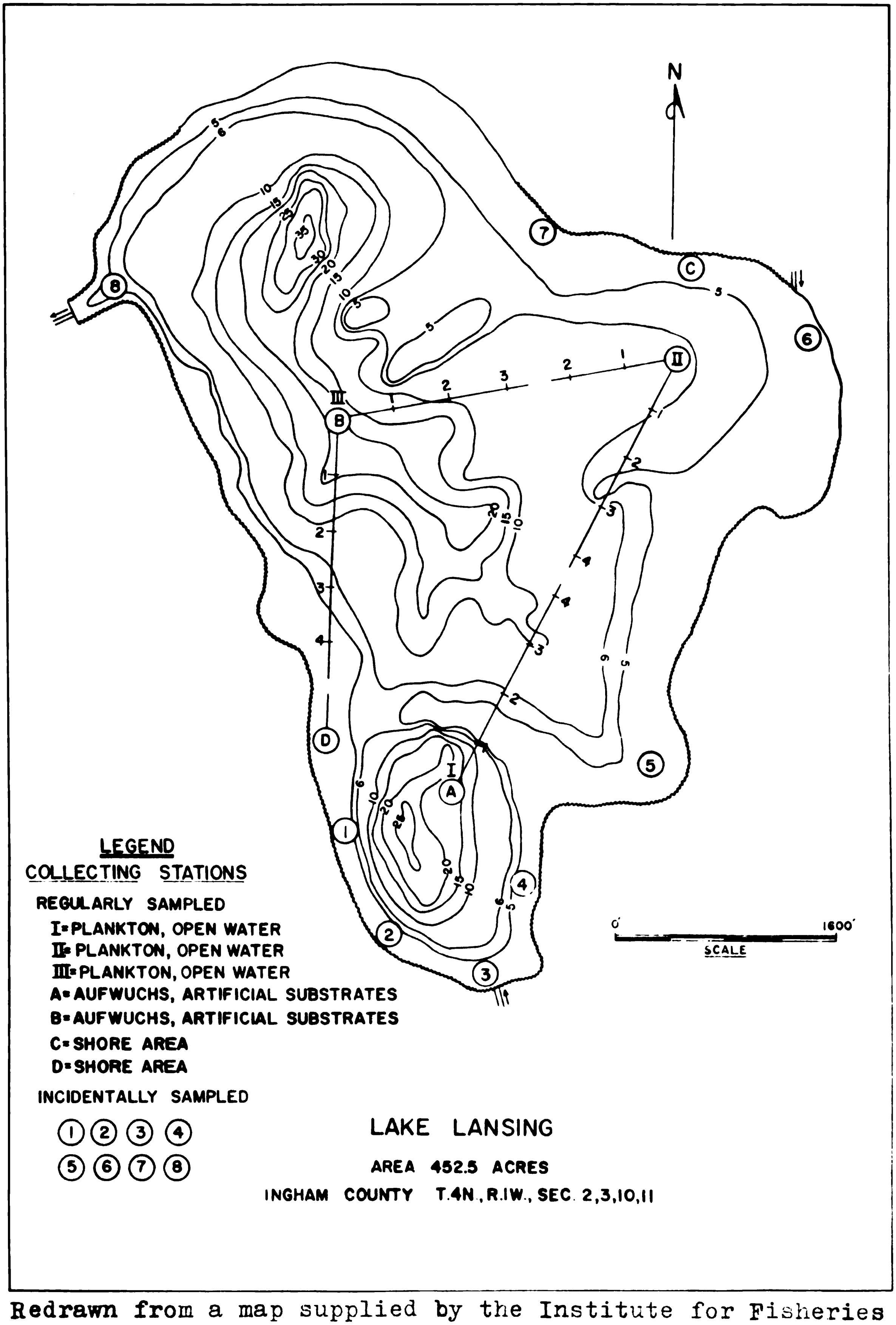
This investigation had the following three primary objectives:

1- To determine the general algal floristic composition of the lake, and to record the types of habitats where particular algal populations existed.

2- To determine the monthly and seasonal successions in phytoplankton on a quantitative and qualitative basis.*

3- To determine the monthly and seasonal successional changes which might occur in the process of Aufwuchs colonization on artificial substrates . *

* The investigation with reference to these two objectives was carried out from Oct. 28, 1960 to June 11, 1961.



Redrawn from a map supplied by the Institute for Fisheries Research Michigan Conservation Department.

II. THE LAKE

A. Location and Immediate Surroundings

Lake Lansing, formerly known as Pine Lake, is located approximately three and one-half miles northeast of the city of East Lansing and immediately north of the town of Haslett. It lies in Meridian township in the county of Ingham (T4N, R1W, Sects. 2,3,10 and 11). Because it is the largest body of water in that immediate area, the lake has played an important part in the recreational activities of the surrounding communities. Its shore area is one of extensive resort development, with the accompanying number of septic tanks which empty into the lake.

Rapidly aging, the lake contains a prolific abundance of floating, emergent, and submergent aquatic vegetation. Because of this the value of the lake as a recreational site has decreased and accordingly the residents of the area have undertaken a campaign to remove or control the nuisance vegetation. Both chemical and physical treatments have been applied; these it is certain will change the biotic composition of the lake.

B. General Physical Characteristics

The lake occupies an area of 452.5 acres, with the long axis of the lake running northwest-southeast for a distance of slightly more than one mile. The maximum width of the lake is about 5,000 feet, this being along an axis running east and west in the northern half. The depth of the lake, at the time of this investigation, gradually increased from its shallow margin to a maximum depth of 37 feet. However, with recent dredging in certain areas, this gradual slope has been changed to a sharp drop. There are two centers of relatively great depth. One occurs at the northwestern sector at 37 feet, the other is slightly west of the median line, at the southern tip, at a depth of approximately 27 feet. The average depth of the lake is 8.5 feet. (See map on page 3 for all locations.) The lake is a seepage one and apparently is spring-fed. There are no major streams which empty into it. There are two small inlets one at the southern tip the other at the north eastern sector, both of which are intermittent. The outlet is a small stream at the northwest; a dam is also located here. This dam raises the level of the lake three feet. A thermocline occurs between 18 and 28 feet (Ball 1938), and was present until late August according to Tucker (1957).

The bottom materials in general are composed of highly organic peat and marl. The shoal area is mostly fibrous peat while the deeper water is mostly pulpy peat. The depth of the peat and marl is variable but may be as much as ten feet or more (Michigan Associates 1960). Sand also occurs, mostly in scattered areas along the northern end of the lake.[1]

C. General Chemical Characteristics

It is well known that organisms differ in respect to their nutrient requirements. Hence variations in the chemical composition of water help to determine the composition of the aquatic biota. In this study it was necessary to obtain analyses of water in an effort to understand relationships between the algal flora and limnological features.

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[1]The information regarding the physical characteristics of the lake, were obtained from Ball (1938), Tucker (1957), and Michigan Associates (1960), also from calculations made from maps.

The lake is a hardwater, alkaline lake, having a pH which ranges from 7.0 to 8.4 . In general it could be said that the pH tends to be more nearly neutral (7.0) along the swampy margins, and to be more alkaline (8.4) toward the center of the lake. Total hardness ranges from 152 to 164 ppm; alkalinity from 152 to 174 ppm; iron from .04 to .05 ppm; phosphates were in amounts lower than could be recorded on the instrument available to this investigator but in recordable amounts when tested by other workers (Tucker and Michigan Associates); nitrites from 0.004 to 0.007 ppm and nitrates from 0.135 to 0.27 ppm.[2] (See table VII on page 73.) There is a high concentration of nutrients in the polluted areas where septic tanks empty into the lake. The differences between chemistry of the waters of these regions, in the marginal swampy regions, and in the open water of the lake, most assuredly are related to the dynamics of the community. Michigan Associates (1960), have made both chemical and biological analyses of the lake water, and the results are shown on table VI on page 72.

D. Position and Description of the Stations

Regularly Sampled Stations

The established or selected stations, I, II, III, A, B, C, and D, were visited regularly. They were marked either by permanent floats in the open water, or sited by land markers on the shore.

(See map on page 3 .)

Station I is in the open water of the southern half of the lake, marked by permanent floats, approximately 900 feet from the west shore and about 700 feet from the east shore. The water at this point is

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[2]The figures given above are solely in reference to the samples studied over the specific time indicated on table VII, page .

between 15 and 20 feet deep, with no visible aquatic vegetation growing in the immediate area. The bottom material is of sand and some fibrous organic peat.

Station II is also in the open water but in the northeastern portion of the lake. It is approximately 800 feet from the north shore and directly south of the County Park. The water in this area is shallow being a little over six feet in depth. The bottom material is sand and supports a sparse submerged vegetation composed mainly of species of *Potamogeton* and *Myriophyllum*.

Station III is another open water station, marked by permanent floats. It is about 900 feet east of the west shore, in the northwestern portion of the lake. The water in this area is between 20 and 25 feet deep, and there are no aquatic plants.

Station A is located at the exact site of station I. This station is the site of placement of artificial substrates used in the study of *Aufwuchs* colonization.

Station B is located at the exact site of station III. This station is the site of placement of a second series of artificial substrates used in the study of *Aufwuchs* colonization.

Station C is near the north shore, at the County Park. The water is shallow, the depth gradually increasing from 0 to 5 feet. The bottom material is sand, and on the beach there is practically no vegetation. East of station C is an area of aquatic vegetation, composed mainly of *Potamogeton crispus*, *P. pectinatus*, *P. Richardsonii*, *Alisma plantago-aquatica*, *Ceratophyllum demersum*, *Myriophyllum sp.*, *Scirpus validus* and *Chara* sp. In this sector of the shore there is an intermittent spring which empties into the lake. West of station C the aquatic vegetation is sparse, being mostly *Scirpus*.

Station D is located near the west shore, directly south of the amusement park. The lake bottom slopes gradually from 0 to 5 feet. Recently the lake has been dredged in this area altering this depth. The bottom material is marl and the aquatic vegetation consists mainly of Chara sp., several species of Potamogeton and Myriophyllum. Septic tanks directly empty into the lake at this station. This is a site where residents have attempted to eradicate the nuisance vegetation, as previously mentioned.

Incidentally Sampled Stations

Stations 1 through 8 are those which were not visited regularly throughout the year. As incidental collecting areas, they provided a variety of habitats located at points around the lake which differed from those of the open water.

Stations 1 and 2 are in swampy areas directly south of station D. The lake bottom slopes gradually in this area, from its bog-like margin. The bottom material is composed of fibrous peat. The higher aquatic vegetation is very dense, composed mostly of Typha latifolia, Nuphar advena, Potamogeton Richardsonii and Myriophyllum sp.

Station 3 is located at the inlet at the southern tip of the lake in a swampy area similar to that of stations 1 and 2, but the aquatic vegetation is more extensive. Typha latifolia, Nuphar advena, and Pontederia cordata are the most abundant species.

Station 4 is along the east shore at the southern portion of the lake. The aquatic vegetation in this area is not as great as that found at stations 1 through 3 but the region has a wide bog-like margin in which are found Iris sp. and Sarracenia purpurea. Nuphar advena is common along the shore. The bottom material is fibrous peat.

Station 5 is in a small cove along the eastern shore. The water is shallow gradually increasing in depth from 0 to 4 feet. The bottom material is of sand and peat, and the aquatic vegetation is mostly Potamogeton americana, Nuphar advena, Pontederia cordata, Myriophyllum sp., and Scirpus validus.

Station 6 is located at Sunset Cove, east of Station C. The water is very shallow, from 0 to 4 feet deep. The bottom material changes from silty sand, to peat, to marl southward along the shore. The aquatic vegetation is not great in quantity but that which is present is mostly Chara sp., Potamogeton pectinatus, P. Richardsonii, P. crispus, P. americana and Myriophyllum sp.

Station 7 is along the north shore to the west of station C. The bottom material is sand to the east, toward station C, and marl toward the west along the shore. There are a few septic tanks which empty into the lake near this station, and the lake shore is stony. The aquatic vegetation is sparse, mainly Scirpus validus.

Station 8 is located at the outlet of the lake in the north-west sector. The water is approximately 6 feet deep, dropping rather rapidly from the shore. The bottom material is fibrous peat and the vegetation is mostly submerged species of Potamogeton.

III. METHODS AND MATERIALS

The stations, just discussed and located on the map of Lake Lansing, met the requirements of the primary objectives of this investigation. They varied in condition or position from deep, open water to shallow open water, and from swampy areas with dense vegetation to clear areas with sparse vegetation. Collections were made at weekly intervals, depending upon the objectives related to the particular station. Weather conditions determined the regularity of the collections. The study was conducted over a period of two years, 1959 to 1960 and 1960 to 1961, excluding the summer months of July and August. The methods and materials used to obtain the biological, chemical, and physical data were determined after a preliminary survey of the lake, and or were adapted from those recommended by Welch in "Limnological Methods", and in Standard Methods of Water Analysis 1960.

A. Biological Techniques

Euplankton Qualitative

Euplankton qualitative samples were obtained from stations I, II, III, C and D, with incidental samples taken from the open water areas adjacent to stations 1 through 7. All samples were taken from the upper two feet of water. Two collecting methods were employed: (1) a No. 25 silk bolting cloth net, towed behind a boat, or cast out by hand; and (2) a Kemmerer Sampler (1200 cc capacity). (See quantitative euplankton techniques.) All samples were appropriately labeled, the labels indicating the area from which the sample was taken, with a code determined as follows:

If the plankton net had been towed from station I to station II, a distance approximately 3,200 feet, the label was written I - II. If the net had been towed from station D to station I, and then towed further in the direction of station II, for a distance of 1,600 feet, the label would read, D - I - I¼, the total distance covered. (See map on page 3 .) Over 100 euplankton qualitative samples were made from Lake Lansing during the entire period of the study. After examination the samples were numbered and preserved in either 6-3-1, a solution consisting of water, alcohol and formalin, or Lactofenol Cuprico de Amann, for later reexamination. Microscopic mounts were made from each collection until no additional species were found. Camera lucida drawings were made, and measurements recorded, for all algal taxa.

Euplankton Quantitative

The procedures used for the quantitative determination of phytoplankton, consisted of: (1) collecting the sample; (2) concentration and preservation of the sample; and (3) examination, enumeration and calculation of the number of organisms per liter.

The samples were collected from October, 1960 to June 1961 at the time intervals indicated on graphs 2, 3, 5, and 7. All the samples were taken at stations I and III, which are at opposite ends of the lake, from the upper two feet of water and before noon on the same day. Sampling was also undertaken at stations II, to see how this station differed from station III, which is at the same end of the lake but in deeper water. The sampling of this latter station for euplankton quantitative data was discontinued after a four-month study period.

Sampling during the period of open water was accomplished from a boat and, during the period of ice cover, through a hole chopped in the ice.

A Kemmerer Sampler was used for collections. This instrument is so designed, that samples may be taken from a desired depth, with a minimum amount of disturbance of the plankton. The operation of this instrument is discussed in Welch (1948) and is quite simple. A two-liter sample was obtained and this was placed in a specially prepared two-liter glass container (carefully cleaned with distilled water and appropriately marked for the particular station). Chloroform was immediately added to the sample, to slow down the activity of the organisms, until preservative could be added (Lactofenol Cuprico de Amann). The sample was then immediately transported to the laboratory for concentration.

A Foerst Electric Centrifuge was used to concentrate the two-liter sample. (See Welch, 1948, and Standard Methods of Water Analysis,1960.) The centrifuge was set up as recommended but with a slight modification. This consisted of introducing a glass tube into the sample container. Through the tube distilled water could be passed, to wash down the walls of the sample bottle. It was believed this would give, in the long run, more accurate results. Ordinarily the apparatus consists of: the centrifuge, a funnel with an attached pinch-cock, and a ring stand with iron rings, to support the sample bottle. The sample bottle is inverted over the funnel which acts as a feeder into the centrifuge. The pinch-cock controls the delivery of water which is collected for a second operation. With the centrifuge running at a maximum speed of 20,000 r.p.m. the sample was fed through at a rate of one liter per eight minutes. The plankton was carefully removed from the centrifuge bowl, the bowl rinsed with distilled water, and the sample volume increased to 20 ml. with preservative.

The Palmer Slide was used for phytoplankton counting. This slide has a volume of 0.1 ml. when filled and covered with a cover-glass, and is so designed that a 43X or 45X (high dry) objective can be used when viewing the slide. This allows for greater magnification and easier identification of organisms compared to the Sedgwick Rafter Cell (Palmer and Maloney 1954). Along with this slide, a Whipple reticule plankton-counting eyepiece, and a calibrated monocular compound microscope were used. The procedures for calibration and enumeration of nannoplankton were adapted from those suggested by Jackson and Williams (1962), while the use of the counting slide itself was adapted from Palmer and Maloney (1954). Before placing the representative sample of the concentrate on the slide, the concentrate was thoroughly mixed. A total of 20 fields per sample were counted and the identification and enumerations of organisms were recorded on sheets similar to the forms shown on pages 14,15.

A sample of the calculations made to determine the multiplier factor, and the subsequent determination of the number of phytoplankton organisms per liter is presented on page 16.

RECORDS OF EXAMINATION

MICROSCOPICAL EXAMINATION

Sample No..........................Source...............................

Date of Collection.................Date of Examination.................

Collected by.......................Examined by.........................

Concentration......................to...........Total Count...........

ORGANISMS	NUMBER OF ORGANISMS Total Count of fields										Total Count	Average No.
	1/2	3/4	5/6	7/8	9/10	11/12	13/14	15/16	17/18	19/20		

ALGAL PLANKTON RECORD

Locality_______________ Station No.______ Date___________ Hr.____

Type of analysis (Meso-, Micro-, Nanno-)

Organisms	Number per field										Total	Average
Diatoms												
Greens												
Blue-Greens												
Pigmented flagellates												
Total Algae												
Unpigmented forms												
Total organisms												
Pseudoplankton												
Grand Total												

INFORMATION BY COLLECTOR:

1. Collected by__________________
2. Depth__________________
3. Volume of sample__________________
4. Preservative__________________
5. Weather__________________
6. Visible algal growth__________________

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INFORMATION BY EXAMINER:

1. Analyzed by __________________
2. Date__________________
3. Method of concentration________
4. Amt. of water concentrated_____
5. Amt. of concentrate___________
6. Concentration__________________
7. Type of counting cell__________
8. Magnification used____________
9. Area of microscopic field_____
10. Factor for No. per ml.________

Sample Computation

Two-liter sample concentrated to 20 ml.

Calculation of Multiplier Factor

The total volume represented in the 20 fields examined consists of the total area of the Whipple fields multiplied by the depth.

Volume = (side of the Whipple field)^2 x depth x No. of fields counted

At a magnification of 440 x, it was observed that one side of the Whipple field measures 0.230 mm. The depth of the Palmer slide is 0.4mm. The volume of the fields examined will thus be:

$$V = 0.23 \times 0.23 \times 0.4 \times 20 = .4232 \text{ mm.}^3$$

$$\text{Multiplier Factor } F = \frac{1000 \text{ mm.}^3}{4232 \text{ mm.}^3} = 2363$$

2363 represents the number of times the volume studied would be contained in 1 ml. or 1000 mm.^{3}

Calculation of Number of Organisms per Liter.

$$\text{No. of organisms in sample studied} \times 2363 \times \frac{\text{ml. of concentrate}}{\text{ml. of original sample}} \times 1000 \text{ ml.}$$

Tychoplankton Qualitative

The tychoplankton samples were collected from stations C, D, 1, 2, 3, 4, 5, 6, and 7. Collections from one or two or more stations were made during almost all visits to the lake. Over 150 tychoplankton samples were collected, using a No. 25 silk bolting cloth net. Although the primary objective was to sample the free floating organisms, often the vegetation of the littoral region was squeezed, with the ensuing liquid collected into a vial. All samples were preserved and appropriately labeled. Camera lucida drawings were made and measurements for all algal taxa were recorded.

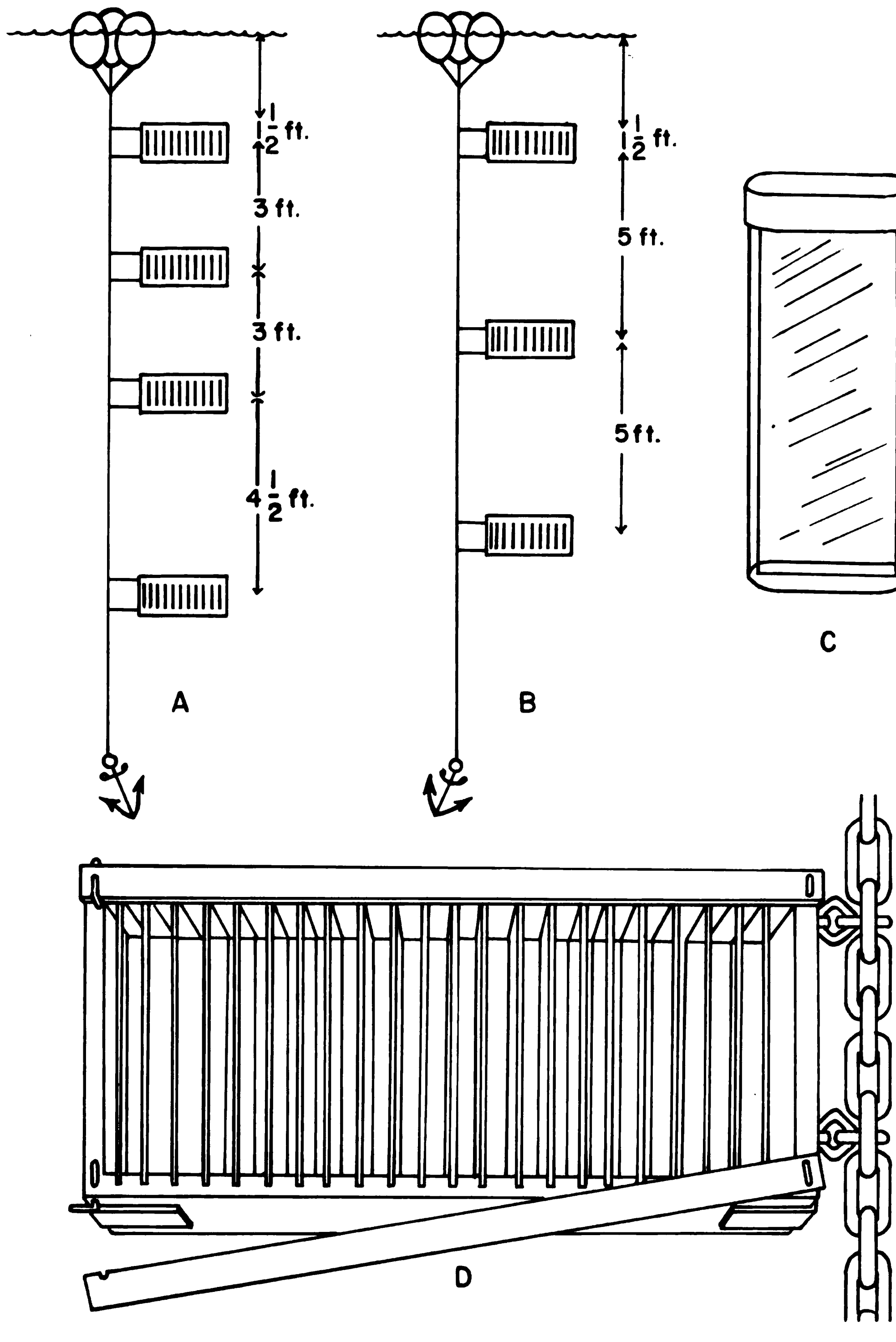
Aufwuchs Qualitative

The *Aufwuchs* community includes all the organisms that are attached to, or move upon submersed substrates but which do not penetrate into it Reid (1961). With this definition in mind, it can be stated then, that all stations except II, were sampled to obtain *Aufwuchs* evaluations. At stations 1 through 8, representative samples of the visible algae were collected from stones, rocks, etc.; these were examined, and for the majority of the algal taxa, measurements and camera lucida drawings were made. As mentioned previously, one of the primary objectives of this investigation was to record the monthly and seasonal successional changes which might occur in the process of *Aufwuchs* colonization of artificial substrates. For this purpose two stations, A and B, were equipped with appropriate equipment, which it was believed would yield such information. The equipment consisted of slide racks suspended at different levels in the open water of the lake. (See Welch 1948 and Cooke 1956 for discussion of the use of similar equipment in the study of attached organisms.) The racks were approximately seven inches long, three and one-quarter inches high, and one and one-half inches deep. They held 23 slides, which could be removed easily by sliding the upper and lower moveable arms out of the way. These arms could also be locked in place so that the slides did not fall out. (See figure one on page 20.) At station A , the racks, suspended so that the slides were in a vertical position, numbered 1 through 4 , with number one being closest to the surface of the lake($1\frac{1}{2}$ feet below the surface). Between rack No.1 and 2, and 2 and 3, the distance was three feet. Between rack No. 3 and rack No. 4, the distance was $4\frac{1}{2}$ feet. This would mean that rack No. 4 was 12 feet below the surface of the lake. At station B, the racks, were suspended from floats (as were the racks at station A), and numbered one through three, with rack 1 again being 1 $\frac{1}{2}$ feet below the surface of the lake, and the distance between rack No. 1 and 2 and between 2 and 3, being five feet.

The collections on slides were made throughout most of the winter and spring until the equipment was taken from the lake by some unknown party. After the slides were removed they were transported to the laboratory for examination. They were preserved as whole mount slides, each being labeled with the date they were removed. A record of the time during which the slides were suspended in the lake was also kept. The slides were used to give qualitative information on the Aufwuchs community and were not originally intended to give quantitative information. However, it was obvious to this investigator, that the quantity of Aufwuchs on the substrates differed depending upon the level at which the slides had been suspended and upon the time of the year the slides were introduced into the environment. An attempt was made to evaluate the difference in accumulation. This was done by placing the slides under the microscope, adding a Whipple ocular micrometer, and counting the number of organisms present in 20 separate fields the combined areas of which equaled 3 sq. mm. From the data obtained graph No. 8 was made.

Figure 1. Equipment used in the study of Aufwuchs colonization of artificial substrates. A, diagrammatic representation of slide racks at station A. B, slide racks at station B. C, plastic carrier used in transporting glass slides. D, illustration of Aufwuchs slide rack.

FIGURE - I



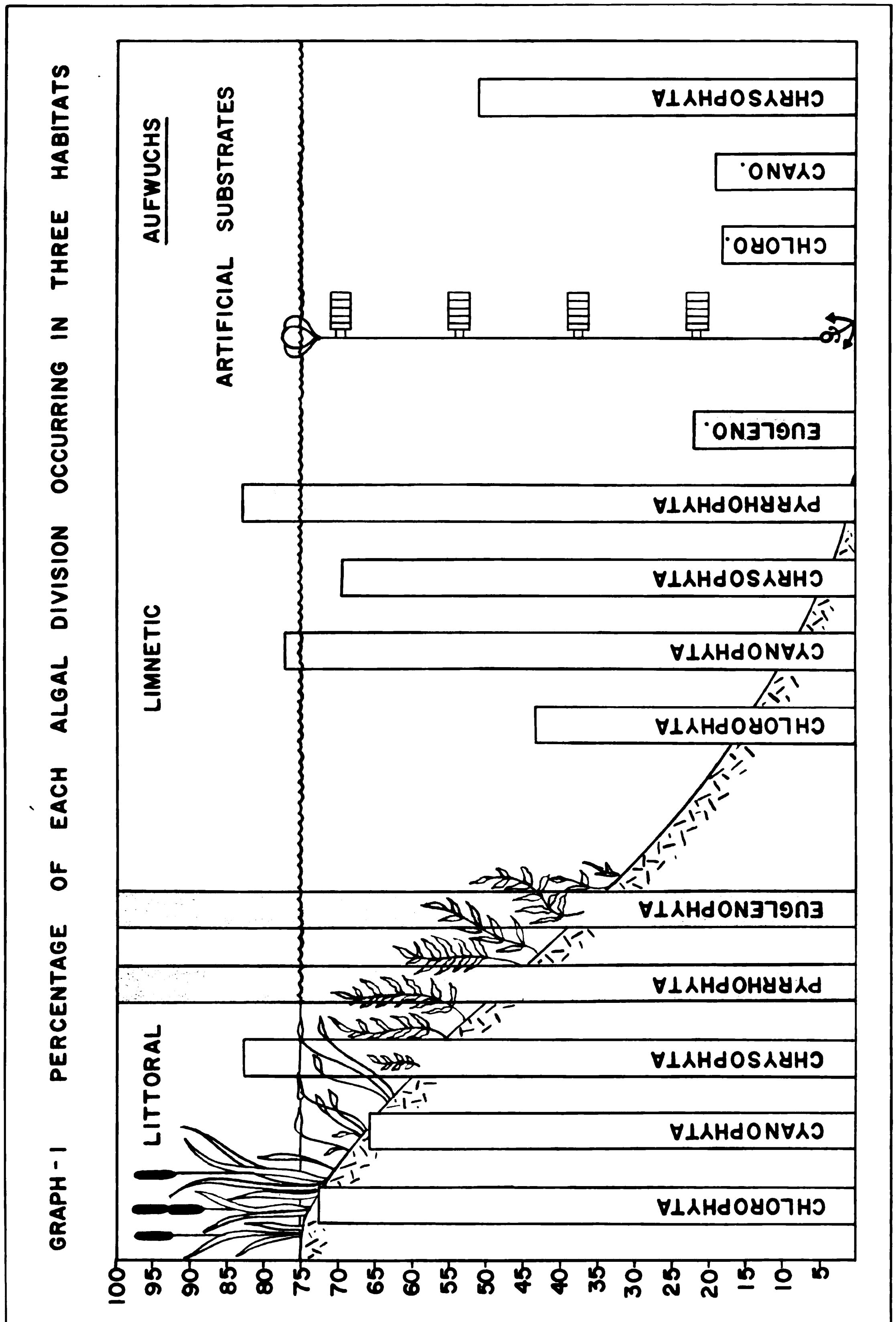
B. Physical and Chemical Techniques

The physical and chemical data cited in this thesis were obtained from reports by Ball (1938), Tucker (1957) and Michigan Associates (1960) and from analyses made by myself. Regular sampling points were established at stations I, II and III. Water was collected from the upper two feet at the surface, using a Kemmerer Sampler as previously described.

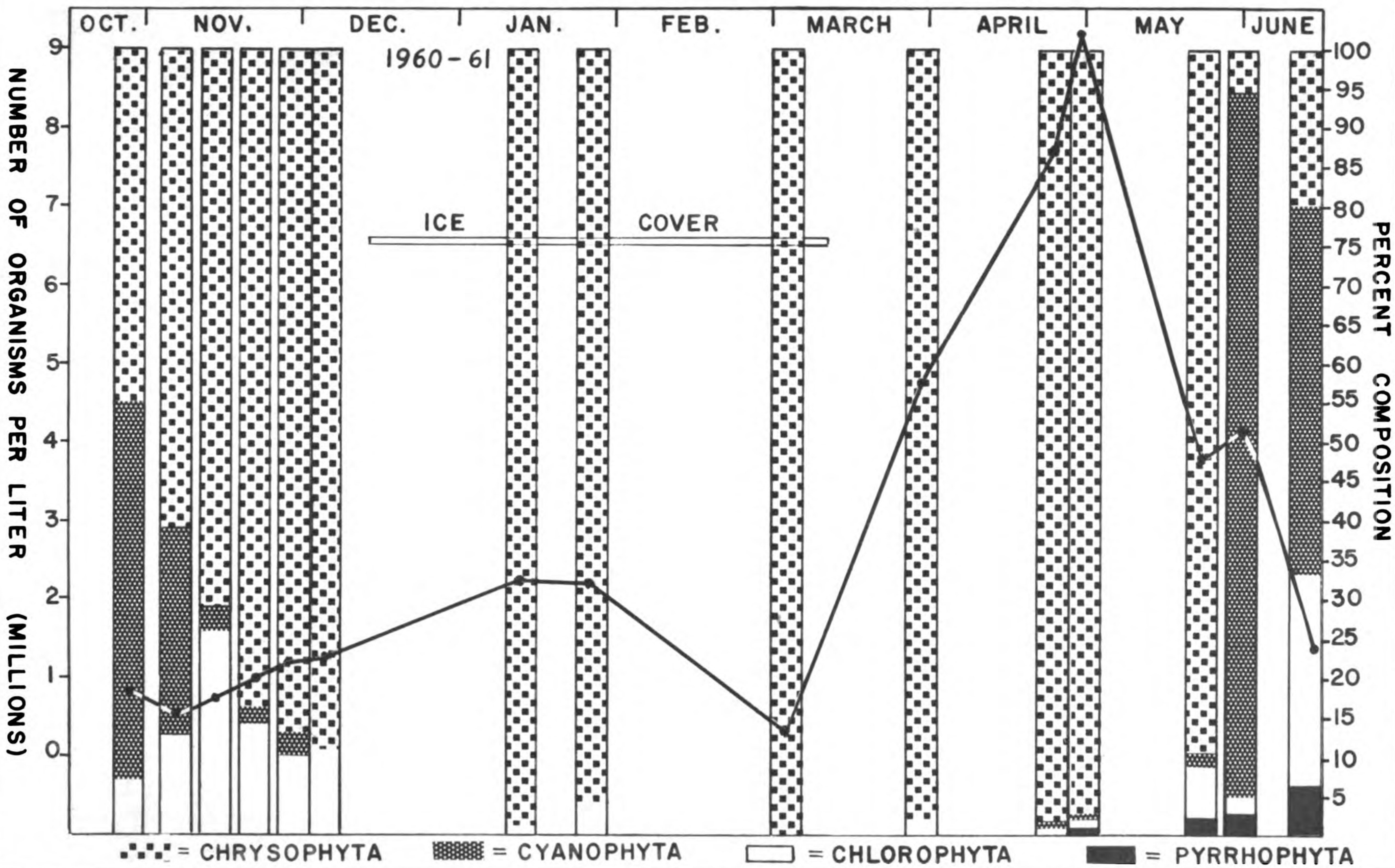
Surface water temperatures were obtained with a Centigrade thermometer graduated from -10 degrees to 110 degrees with an accuracy in reading of 0.5 degrees. Also recorded were the limit of visibility, the time of day, weather conditions (clear, cloudy etc.), and the water conditions (calm or rough). Total hardness, calcium hardness, and total alkalinity were obtained by using Hach titration methods, these being similar to methods suggested by Standard Methods of Water Annalysis (1960). The remainder of the chemical determinations, iron, nitrites, nitrates, phosphates, pH and turbidity as well were made by using a Hach DR. Colorimeter No. 585.*

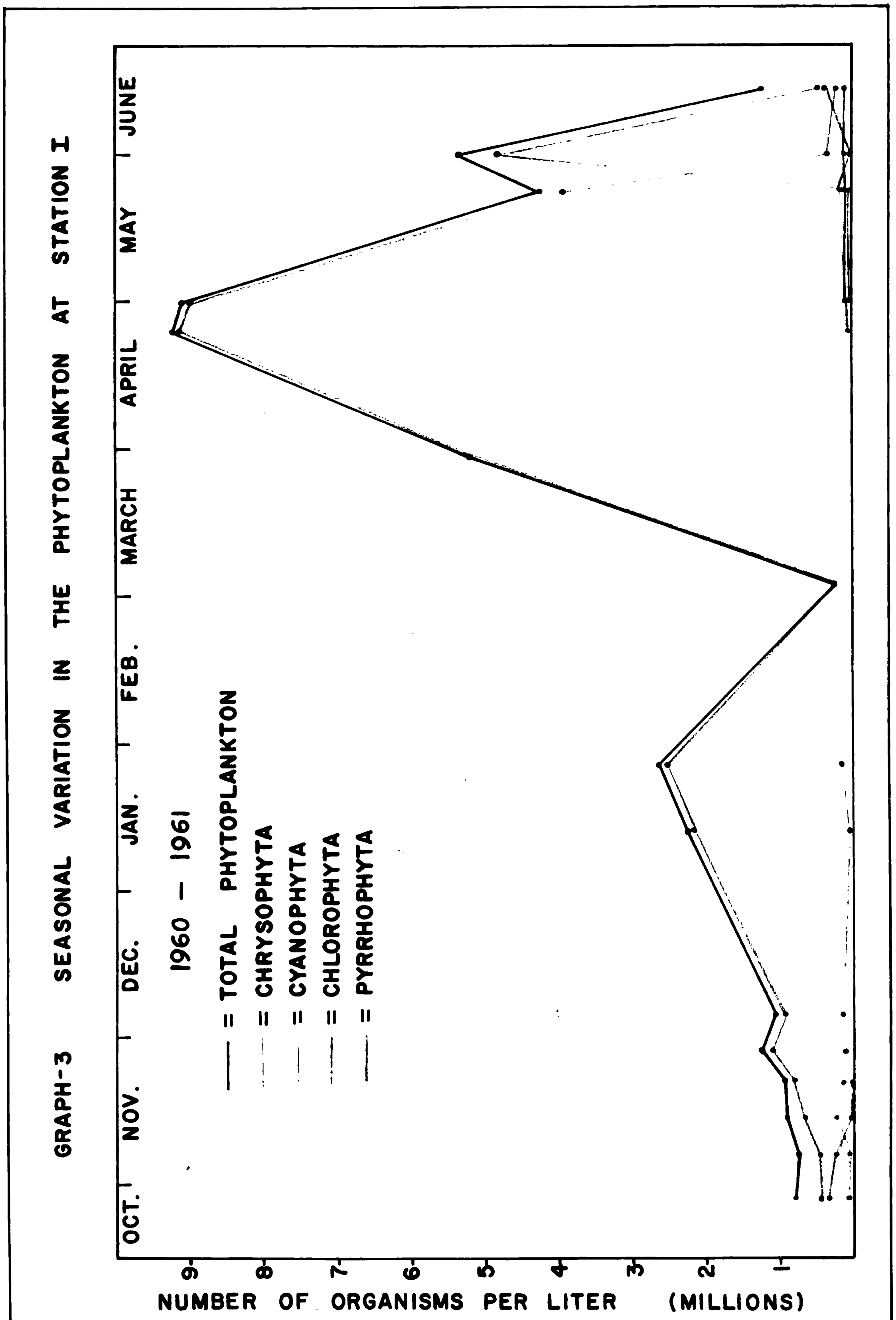
* Hach Chemical Company Ames Iowa.

IV. DATA AND MEASUREMENTS

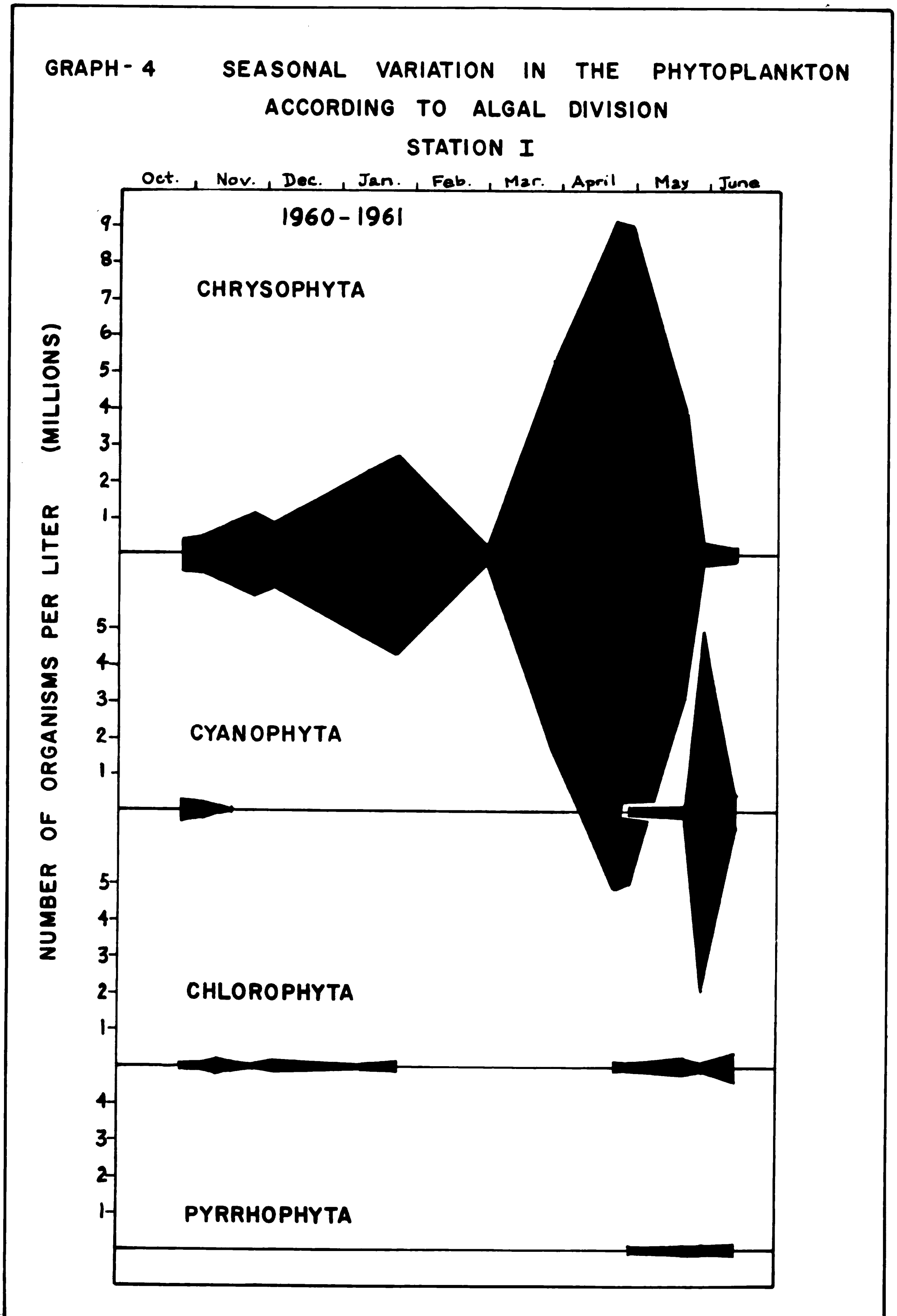

GRAPH - I PERCENTAGE OF EACH ALGAL DIVISION OCCURRING IN THREE HABITATS
LITTORAL
LIMNETIC
AUFWUCHS
ARTIFICIAL SUBSTRATES
CHLOROPHYTA
CYANOPHYTA
CHRYSOPHYTA
PYRRHOPHYTA
EUGLENOPHYTA
CHLOROPHYTA
CYANOPHYTA
CHRYSOPHYTA
PYRRHOPHYTA
EUGLENO.
CHLORO.
CYANO.
CHRYSOPHYTA
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5

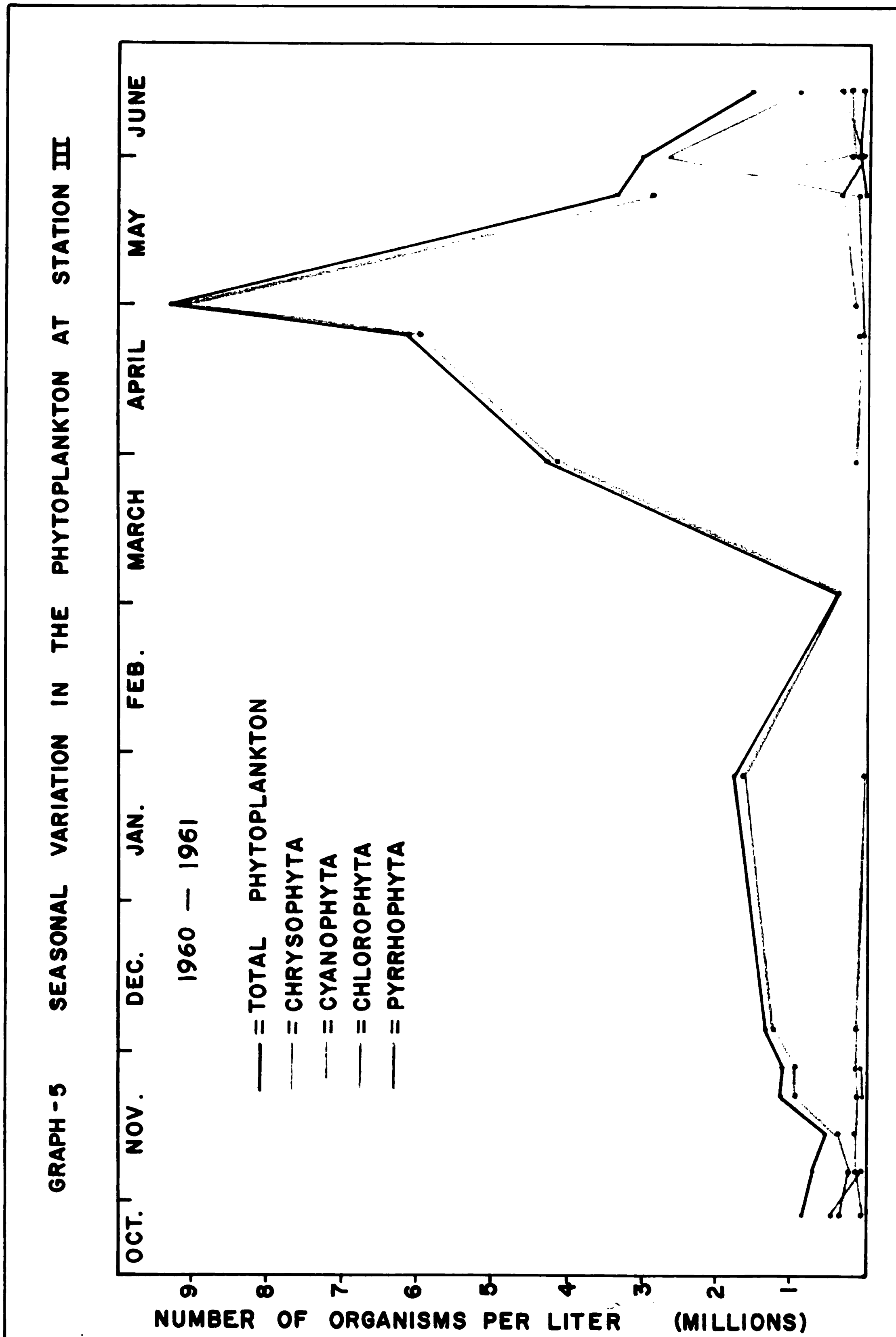
GRAPH-2 AVERAGE SEASONAL VARIATION OF THE TOTAL PHYTOPLANKTON





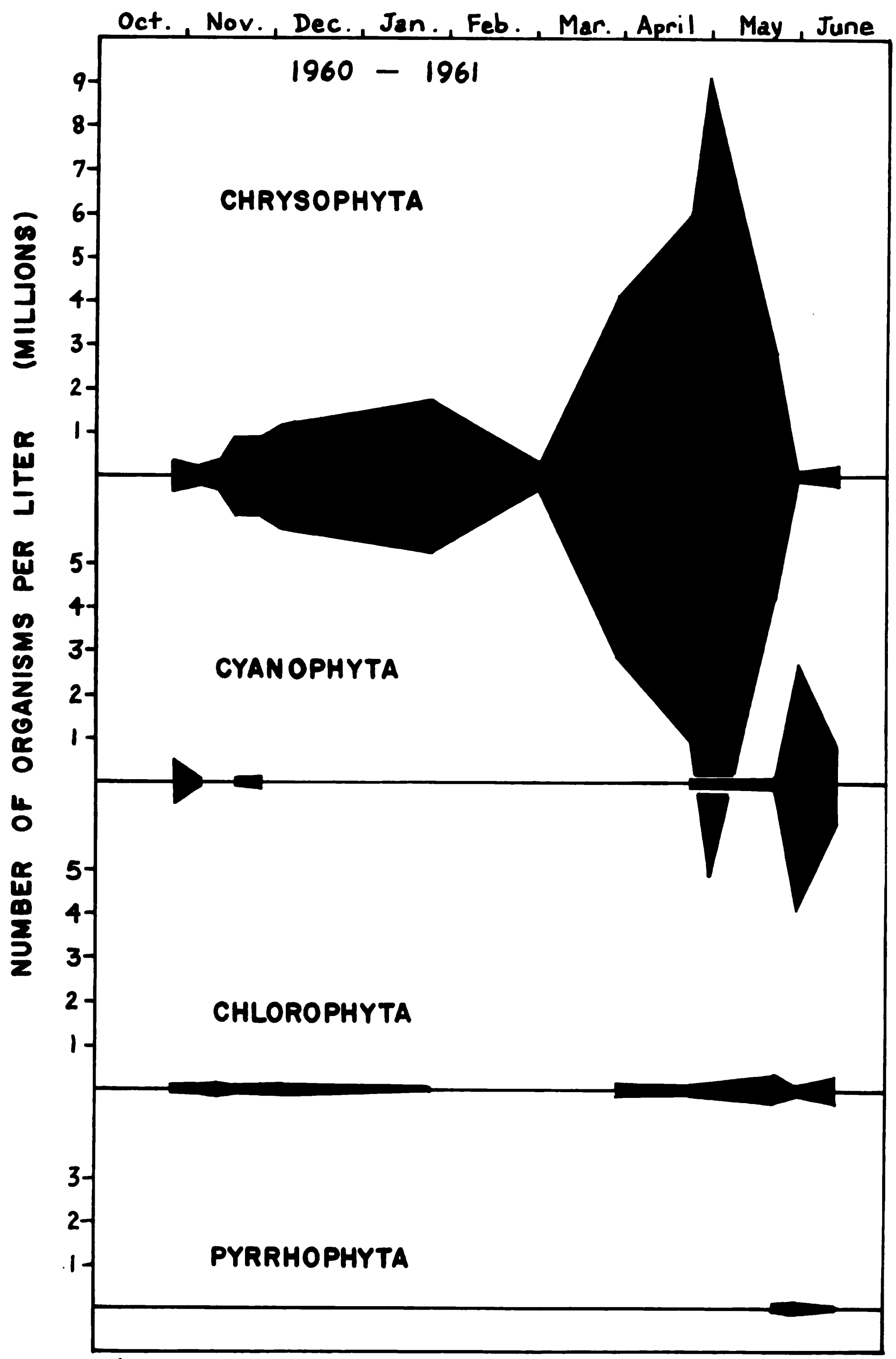
GRAPH-3 SEASONAL VARIATION IN THE PHYTOPLANKTON AT STATION I


GRAPH - 4 SEASONAL VARIATION IN THE PHYTOPLANKTON
ACCORDING TO ALGAL DIVISION
STATION I
Oct.
Nov.
Dec.
Jan.
Feb.
Mar.
April
May
June
1960 - 1961
CHRYSOPHYTA
CYANOPHYTA
CHLOROPHYTA
PYRRHOPHYTA
NUMBER OF ORGANISMS PER LITER (MILLIONS)
9
8
7
6
5
4
3
2
1



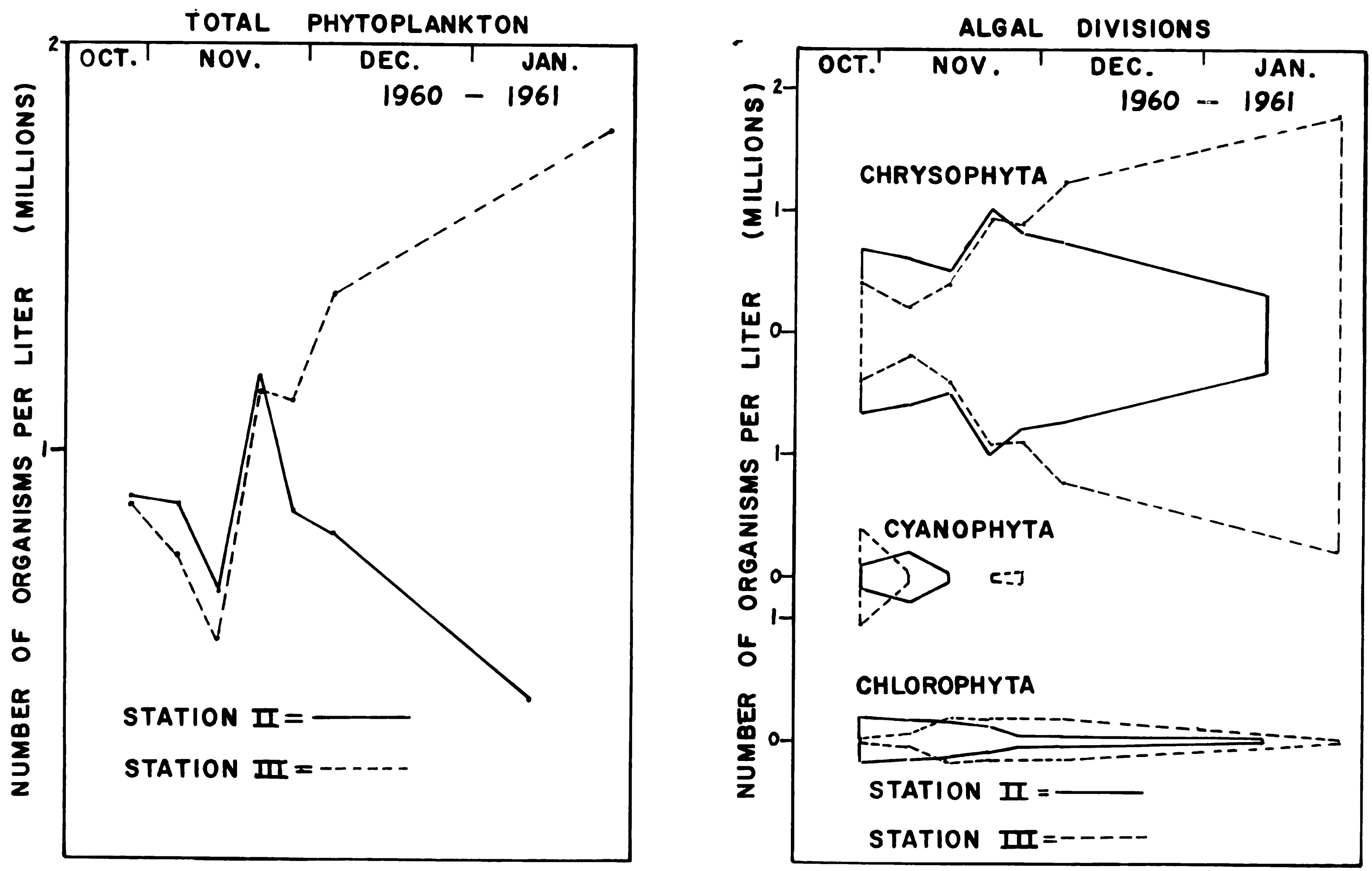
GRAPH-5 SEASONAL VARIATION IN THE PHYTOPLANKTON AT STATION III

GRAPH-6 SEASONAL VARIATION IN THE PHYTOPLANKTON ACCORDING TO ALGAL DIVISION STATION III

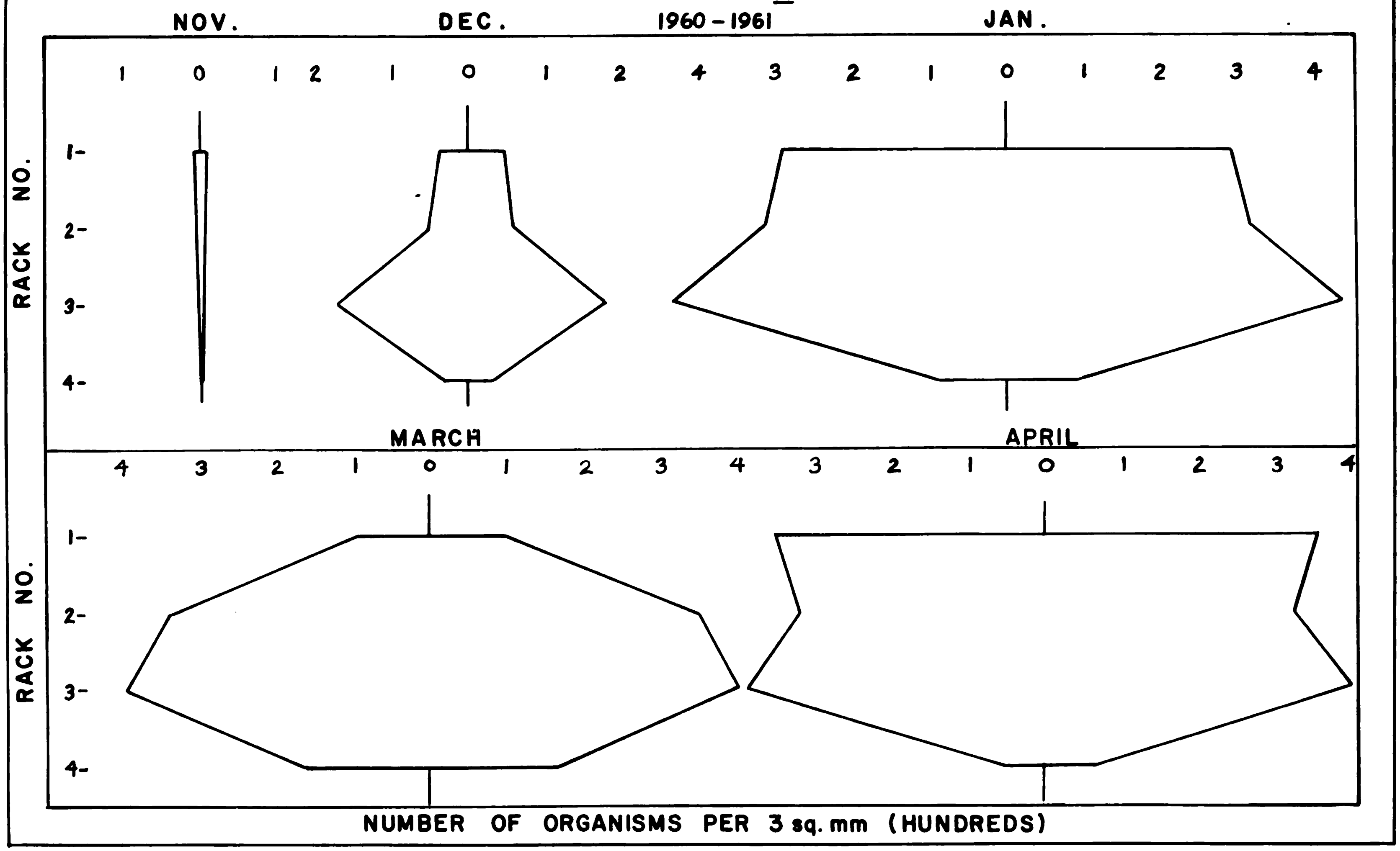


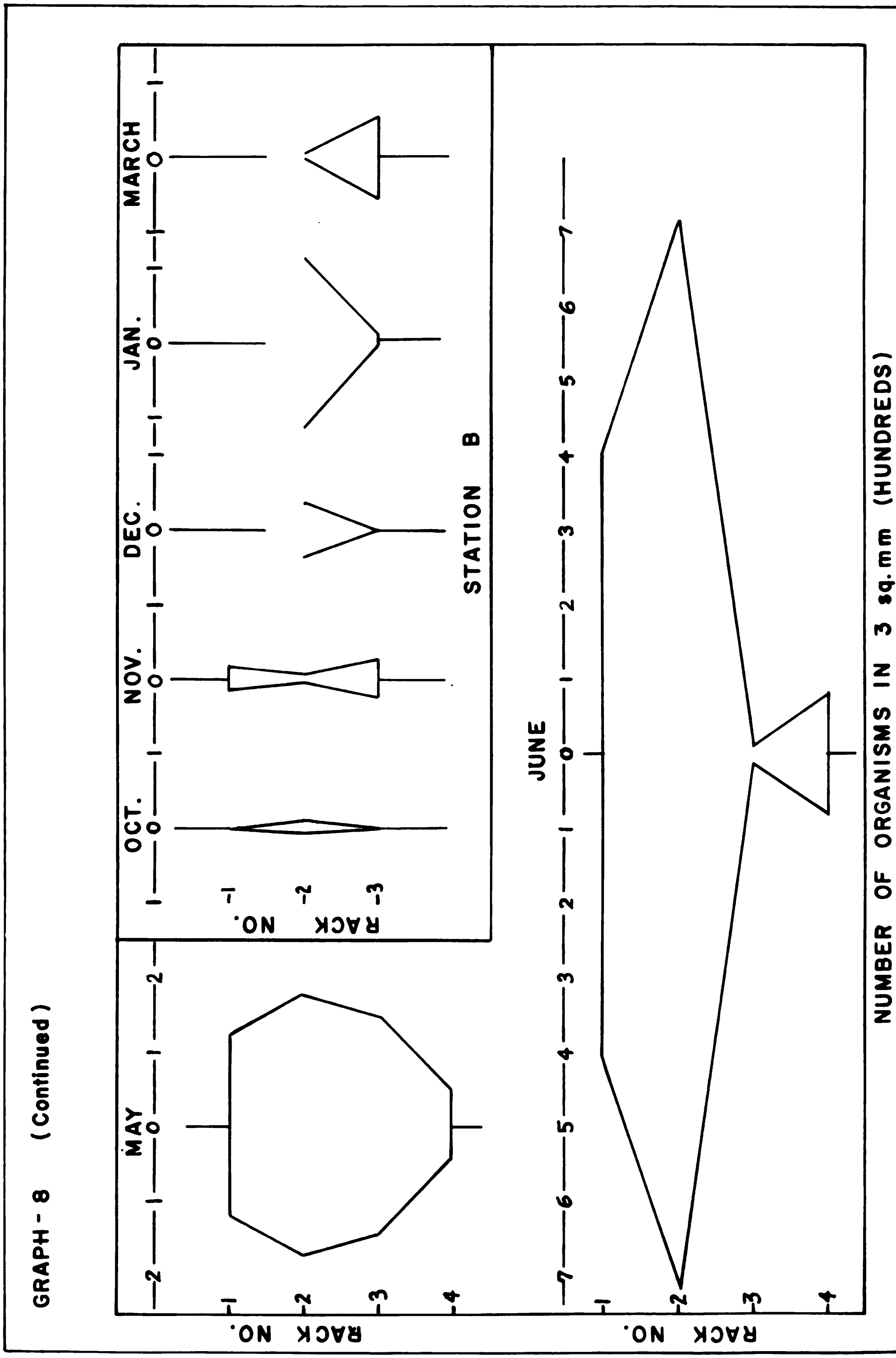
GRAPH-7

MONTHLY VARIATION OF PHYTOPLANKTON
COMPARISON BETWEEN STATION II & III



GRAPH - 8 AVERAGE QUANTITY OF <u>AUFWUCHS</u> DEVELOPED ON ARTIFICIAL SUBSTRATES
STATION <u>A</u>
1960 - 1961





GRAPH - 8 (Continued)

DATA

ALGAE: QUALITATIVE

TABLE I

* = Present

QUALITATIVE ANALYSIS
OF THE ALGAE IN
LAKE LANSING

	Sept.		Oct.		Nov.		Dec.		Jan.		Feb.		March		April		May		June	
YEAR	59	60	59	60	59	60	59	60	60	61	60	61	60	61	60	61	60	61	60	61
CYANOPHYTA																				
Anabaena sp.				*										*				*		*
A. catenula																		*		
A. circinalis			*											*		*				
A. macrospora var. robusta			*		*												*		*	
A. Schermetievi			*																	
A. subcylindrica			*		*										*					
Aphanizomenon																				
A. flos-aquae		*																		
Aphanocapsa elachista			*																*	
A. pulchra						*														
A. rivularis			*															*		*
Aphanothece Castagnei			*		*		*		*							*		*		
A. microscopica		*	*			*		*		*				*						
A. microspora			*																	
A. nidulans					*						*				*	*				
A. saxicola			*			*								*				*		
A. stagnina				*		*		*								*	*	*	*	*
Arthrospira Jenneri		*				*		*	*				*	*		*	*	*	*	*

TABLE I (continued)

* = Present

QUALITATIVE ANALYSIS
OF THE ALGAE IN
LAKE LANSING

	Sept.		Oct.		Nov.		Dec.		Jan.		Feb.		March		April		May		June	
YEAR	59	60	59	60	59	60	59	60	60	61	60	61	60	61	60	61	60	61	60	61
Calothrix Braunii			*																	
C. Castellii			*																	
C. fusca			*																	
C. parietina			*																	
C. scytonemicola																		*		
Chroococcus dispersus						*		*												
C. limneticus						*														
var. carneus						*														
var. distans																				*
var. subsalsus			*																	
C. minimus		*																	*	
C. minutus				*				*								*				
C. turgidus		*	*	*		*		*		*				*		*	*	*	*	*
var. maximus						*										*				
C. varius				*																
Coelosphaerium																				
C. Kuetzingianum		*	*																	*
C. Naegelianum		*	*	*	*	*	*	*	*				*	*	*	*	*	*	*	*
Gloeocapsa punctata			*	*			*													

TABLE I (continued)

* = Present

QUALITATIVE ANALYSIS
OF THE ALGAE IN
LAKE LANSING

	Sept.		Oct.		Nov.		Dec.		Jan.		Feb.		March		April		May		June	
YEAR	59	60	59	60	59	60	59	60	60	61	60	61	60	61	60	61	60	61	60	61
Gloeothece rupestris						*														*
Gomphosphaeria																				
G. aponina		*	*	*	*	*	*										*			
var. cordiformis						*														
var. multiplex		*	*	*		*											*	*	*	
Haplosiphon sp.				*																
Lyngbya																				
L. aerugineo-coerulea			*			*									*		*		*	
L. aestuarii		*	*	*	*	*	*						*	*	*	*	*	*	*	*
L. Birgei																				*
L. Digueti			*	*				*								*		*		
L. Hieronymusii		*	*	*	*	*	*	*	*		*			*	*		*	*	*	*
L. Lagerheimii			*																	
L. major		*	*	*		*	*	*										*		*
L. Martensiana		*	*	*		*		*						*	*	*	*	*	*	
L. Nordgaardii							*													
Marssoniella elegans		*												*						
Merismopedia convoluta		*	*		*	*											*	*		*
M. elegans			*													*	*	*	*	*

TABLE I (continued)

* = Present

QUALITATIVE ANALYSIS OF THE ALGAE IN LAKE LANSING

	Sept.		Oct.		Nov.		Dec.		Jan.		Feb.		March		April		May		June	
Year	59	60	59	60	59	60	59	60	60	61	60	61	60	61	60	61	60	61	60	61
Merismopedia glauca		*	*	*	*	*	*	*						*	*	*	*	*	*	*
M. punctata			*	*		*														
M. tenuissima		*	*	*		*		*						*	*	*	*	*	*	*
M. Trolleri				*										*						
Microcoleus lacustris			*													*				
Microcystis																				
M. aeruginosa		*	*	*	*	*	*	*	*		*			*	*	*	*	*	*	*
M. flos-aquae		*	*	*	*	*	*	*	*					*	*	*	*	*	*	*
M. incerta						*								*		*		*		
Nostoc paludosum			*															*		*
Oscillatoria amoena																	*			
O. princeps		*	*																	
O. sancta			*																	
O. subbrevis		*												*				*		
O. tenuis		*	*	*	*	*	*	*	*		*		*		*	*	*	*	*	*
Phormidium subfuscum																		*		*
P. tenue								*												
Plectonema nostocorum		*				*		*			*			*			*	*	*	*
P. notatum		*	*	*	*	*	*	*						*	*	*	*	*	*	*

TABLE I (continued)

* = Present

QUALITATIVE ANALYSIS OF THE ALGAE IN LAKE LANSING

	Sept.		Oct.		Nov.		Dec.		Jan.		Feb.		March		April		May		June	
YEAR	59	60	59	60	59	60	59	60	60	61	60	61	60	61	60	61	60	61	60	61
Rhabdoderma irregulare																*		*		
Scytonema crispum			*														*			*
Spirulina gigantea			*																	
S. princeps			*	*		*		*						*		*		*		*
S. subsalsa		*		*		*											*		*	*
Tolypothrix limbata			*																	
T. tenuis		*	*	*	*	*		*								*		*		*
CHRYSOPHYTA																				
Achnanthes				*		*		*	*	*	*	*	*	*	*	*		*		*
Amphora				*		*		*	*	*	*	*	*	*	*	*		*		*
Cocconies		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Cymatopleura														*		*	*	*	*	*
Cymbella				*		*	*	*	*	*	*			*	*	*	*	*	*	*
Diatoma				*	*	*	*	*	*	*										
Dinobryon cylindricum						*		*												
D. divergens															*		*	*		
D. sertularia		*		*	*	*	*	*	*	*	*		*		*	*	*			
D. sociale				*		*		*		*		*		*		*		*		*
Epithemia										*				*						

TABLE I (continued)

* = Present

QUALITATIVE ANALYSIS
OF THE ALGAE IN
LAKE LANSING

	Sept.		Oct.		Nov.		Dec.		Jan.		Feb.		March		April		May		June	
YEAR	59	60	59	60	59	60	59	60	60	61	60	61	60	61	60	61	60	61	60	61
Fragilaria		*		*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Gomphonema										*		*		*	*	*	*	*	*	
Navicula			*	*		*		*	*	*	*	*	*	*		*		*		*
Ophiocytium cochleare														*		*		*		
O. desertum																*		*		
O. gracilipes																*				
O. majus																*		*		
Pinnularia				*		*				*				*		*		*		*
Rhopalodia				*						*				*		*		*		
Synedra		*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		*
Synura uvella	*		*	*																
Tribonema bombycinum																*	*	*		
T. minus																*	*	*		
T. utriculosum																*	*	*		
T. viride																*	*	*		
Vaucheria geminata				*											*		*	*	*	*
Nitzschia														*		*		*		*
EUGLENOPHYTA																				
Anisonema sp.														*						

TABLE I (continued)

* = Present

QUALITATIVE ANALYSIS
OF THE ALGAE IN
LAKE LANSING

	Sept.		Oct.		Nov.		Dec.		Jan.		Feb.		March		April		May		June	
YEAR	59	60	59	60	59	60	59	60	60	61	60	61	60	61	60	61	60	61	60	61
Euglena spp.						*							*					*		
E. acus		*		*		*		*	*		*		*		*		*			
E. oxyuris var. minor						*														
Lepocinclis ovum																*				
Phacus acuminatus						*											*			
P. ankylonaton						*														
P. caudatus						*										*				
P. contortus																				
var. complicatus		*																		
P. gigas		*																		
P. lismorensis		*		*														*		
P. longicauda			*														*			
var. insecta			*																	
var. major						*											*			
P. orbicularis		*		*		*								*		*		*		
fa.		*																	*	
P. platalea																*				
P. pleuronectes		*	*																	
P. pseudoswirenkoi		*				*														

TABLE I (continued)

* = Present

QUALITATIVE ANALYSIS
OF THE ALGAE IN
LAKE LANSING

	Sept.		Oct.		Nov.		Dec.		Jan.		Feb.		March		April		May		June	
YEAR	59	60	59	60	59	60	59	60	60	61	60	61	60	61	60	61	60	61	60	61
Phacus rudicula		*	*													*				
P. setosus															*					
P. tortus																	*			
P. undulatus															*					
P. unguis																	*			
P. sp. A																			*	
P. sp. B		*																		
P. sp. C																*				
P. sp. D																	*			
P. sp. E		*																		
P. sp. F		*																		
P. sp. G			*																	
P. sp. H		*																		
P. sp. I		*																		
Trachelomonas																				
T. australica																				
var. rectangularis																*				
T. bulla														*						
T. cylindrica																*				

TABLE I (continued)

* = Present

QUALITATIVE ANALYSIS
OF THE ALGAE IN
LAKR LANSING

	Sept.		Oct.		Nov.		Dec.		Jan.		Feb.		March		April		May		June	
YEAR	59	60	59	60	59	60	59	60	60	61	60	61	60	61	60	61	60	61	60	61
Trachelomonas Dybowskii											*					*				
T. hispida									*					*		*				
var. duplex		*																		
T. obovata																				
var. Klebsiana																*				
T. planctonica																				
var. oblonga																*				
T. pulcherrima																*				
T. splendidissima			*																	
T. volvocina			*												*	*				
T. volvocinopsis																				
var. punctata																*				
PYRRHOPHYTA																				
Ceratium hirundinella		*	*	*	*	*											*		*	*
Peridinium bipes														*						
P. inconspicuum		*		*		*		*							*	*	*	*	*	*
P. umbonatum				*		*		*									*	*		
P. Volzii																		*		
P. Willei																	*	*		

TABLE I (continued)

* = Present

QUALITATIVE ANALYSIS
OF THE ALGAE IN
LAKE LANSING

	Sept.		Oct.		Nov.		Dec.		Jan.		Feb.		March		April		May		June	
YEAR	59	60	59	60	59	60	59	60	60	61	60	61	60	61	60	61	60	61	60	61
CHLOROPHYTA																				
Ankistrodesmus																				
A. falcatus		*	*	*		*	*			*				*		*	*	*	*	*
A. spiralis						*													*	*
Botryococcus Braunii				*	*	*		*						*		*	*	*	*	*
Bulbochaete sp.																		*		
Chara sp.	*	*	*	*	*	*	*						*	*	*	*	*	*	*	*
Chlamydomonas																				
C. pseudopertyi						*														
Cladophora fracta		*	*	*	*	*									*		*	*	*	
C. glomerata		*	*		*	*	*	*							*		*		*	*
C. insignis		*	*					*												
Closterium acerosum																*				
var. tumidum		*																		
Cl. incurvum																		*	*	
Cl. leibleinii																	*			
Cl. moniliferum															*	*	*	*	*	*
Cl. parvulum				*												*		*	*	
Cl. pseudolunula			*																*	

TABLE I (continued)

* = Present

QUALITATIVE ANALYSIS
OF THE ALGAE IN
LAKE LANSING

	Sept.		Oct.		Nov.		Dec.		Jan.		Feb.		March		April		May		June	
YEAR	59	60	59	60	59	60	59	60	60	61	60	61	60	61	60	61	60	61	60	61
Closterium strigosum																	*		*	
Cl. sublaterale															*	*				
Coleochaete																				
C. orbicularis																				*
Cosmarium angulare																				
var. canadense		*	*	*		*									*	*	*	*	*	*
C. angulosum																	*		*	*
C. Botrytis						*										*			*	*
var. mediolaeve																	*		*	
C. constrictum			*													*				
C. cucumis																	*	*		
C. cymatopleurum																				
var. tyrolicum			*																	
C. formosulum			*																	
C. Frantzetonii		*	*	*												*				
C. granatum		*	*	*	*	*	*	*		*				*	*	*	*	*	*	*
var. ocellatum						*								*		*			*	
var. subgranatum			*		*	*	*								*		*	*	*	
C. impressulum		*																*		*

TABLE I (continued)

* = Present

QUALITATIVE ANALYSIS
OF THE ALGAE IN
LAKE LANSING

	Sept.		Oct.		Nov.		Dec.		Jan.		Feb.		March		April		May		June	
YEAR	59	60	59	60	59	60	59	60	60	61	60	61	60	61	60	61	60	61	60	61
Cosmarium Kjellmanii																				
var. ornatum			*	*	*	*	*									*		*		
C. laeve var. depressum		*	*														*	*	*	
C. obtusatum			*														*		*	*
C. ochthodes																	*			
C. pachydermum																		*		
C. phaseolus		*		*		*		*										*		*
C. pseudonitidulum						*														*
C. pseudoornatum			*			*								*			*			
C. pseudopyramidatum																			*	
C. punctulatum				*		*														
C. regnesii																			*	
C. reniforme			*	*													*		*	
var. compressum		*	*	*													*		*	
var. elevatum			*	*											*		*	*		
C. subcostatum																			*	
C. subnudiceps						*											*			
C. subtumidum			*														*		*	
C. sulcatum var. sumatranum			*	*	*	*														

TABLE I (continued)

* = Present

QUALITATIVE ANALYSIS
OF THE ALGAE IN
LAKE LANSING

	Sept.		Oct.		Nov.		Dec.		Jan.		Feb.		March		April		May		June	
YEAR	59	60	59	60	59	60	59	60	60	61	60	61	60	61	60	61	60	61	60	61
Cosmarium tetraophthalmum		*																		
C. Turpinii		*		*		*										*		*	*	*
C. vexatum																	*			
var. rotundatum			*														*			
C. Wittrockii			*															*		
C. Ungerianum			*																	
C. sp. A		*	*		*		*													
C. sp. B			*											*			*			
C. sp. C													*	*		*	*	*	*	*
C. sp. D			*																	
C. sp. E		*															*		*	
Cylindrocapsa geminella																*	*	*		
Dictospaerium pulchellum			*	*	*	*	*			*				*		*		*		*
Dimorphococcus lunatus			*																	
Dispora crucigeniodes			*			*										*	*	*		*
Draparnaldia glomerata																*	*			
Elaktothrix viridis								*		*				*		*		*		*
Euastrum hypochondrum																				
fa. decoratum		*	*	*		*		*												

TABLE I (continued)

* = Present

QUALITATIVE ANALYSIS
OF THE ALGAE IN
LAKE LANSING

	Sept.		Oct.		Nov.		Dec.		Jan.		Feb.		March		April		May		June	
YEAR	59	60	59	60	59	60	59	60	60	61	60	61	60	61	60	61	60	61	60	61
Euastrum insulare		*	*	*		*		*		*						*	*		*	*
var. basichondrum			*	*		*								*						
E. Turneri				*						*										
fa.			*							*						*				
Eudorina elegans						*										*		*		
Golenkinia radiata		*			*								*				*			
Gloeocystis gigas								*								*		*		
Kirchneriella contorta										*										
K. lunaris										*										
K. obesa var. major										*										
Micrasterias sol																		*		
Microspora elegans					*															
M. tumidula																	*			
M. Williana														*						
Mougeotia spp.		*	*	*	*	*	*	*							*	*	*	*	*	*
Nephrocytium sp.						*										*				
N. Agardhianum				*												*				
N. obesum					*													*		
Oedogonium globosum					*													*		

TABLE I (continued)

* = Present

QUALITATIVE ANALYSIS
OF THE ALGAE IN
LAKE LANSING

	Sept.		Oct.		Nov.		Dec.		Jan.		Feb.		March		April		May		June	
YEAR	59	60	59	60	59	60	59	60	60	61	60	61	60	61	60	61	60	61	60	61
Oedogonium Pringsheimii						*														
O. spp.		*	*	*	*	*	*	*			*		*	*	*	*	*	*	*	*
Oocystis gigas		*																*		
O. lacustris		*		*		*		*		*				*		*		*		*
Pandorina morum			*															*		
Pediastrum biradiatum						*														
P. Boryanum	*	*	*	*	*	*	*	*		*	*		*	*	*	*	*	*	*	*
fa.						*										*				
var. longicorne		*	*	*	*	*	*							*	*	*	*	*	*	*
P. duplex			*	*		*		*						*	*	*	*	*	*	*
var. clathratum		*	*														*			
P. integrum						*		*		*				*		*		*		
var. perforatum fa.								*		*	*		*	*		*		*		*
P. simplex					*		*													
var. duodenarium			*																	
P. tetras		*	*	*		*				*				*	*	*	*	*	*	*
Penium margaritaceum			*																	
Pleurotaenium Ehrenbergii																		*		*
Pl. trabecula																	*	*	*	*

TABLE I (continued)

* = Present

QUALITATIVE ANALYSIS
OF THE ALGAE IN
LAKE LANSING

	Sept.		Oct.		Nov.		Dec.		Jan.		Feb.		March		April		May		June	
YEAR	59	60	59	60	59	60	59	60	60	61	60	61	60	61	60	61	60	61	60	61
Quadrigula Chodatii								*								*				
Rhizoclonium crassipelitum		*	*	*	*		*										*		*	
Scenedesmus abundans		*				*														
S. arcuatus																				
var. platydisca			*	*															*	
S. armatus			*																	
S. bijuga					*	*	*	*						*		*	*	*	*	*
S. dimorphus		*	*		*	*		*							*	*	*	*	*	
S. obliquus		*		*		*				*						*		*		*
S. quadricauda		*	*	*		*	*	*		*				*	*	*	*	*	*	*
var. parvus				*																
var. quadrispina														*						
Schizomeris Leibleinii		*		*	*	*									*	*	*	*	*	*
Sphaerocystis Schroeteri		*	*							*				*		*		*		*
Spirogyra spp.		*	*	*	*	*	*									*	*	*	*	*
S. porticalis															*		*	*	*	*
S. rivularis																			*	
S. singularis																	*	*		
Staurastrum bienneanum				*																

TABLE I (continued)

* = Present

QUALITATIVE ANALYSIS
OF THE ALGAE IN
LAKE LANSING

	Sept.		Oct.		Nov.		Dec.		Jan.		Feb.		March		April		May		June	
YEAR	59	60	59	60	59	60	59	60	60	61	60	61	60	61	60	61	60	61	60	61
Staurastrum bienneanum																				
var. ellipticum				*																
S. Brebissonii																		*		
S. chaetoceras				*														*		
S. disputatum																		*		
S. floriferum																	*			*
S. granulosum																		*		
S. Johnsonii																	*			
S. longiradiatum																				
var. elevatum		*	*	*	*												*	*	*	*
S. paradoxum			*			*	*							*						
S. planctonicum			*																	
S. polymorphum																	*	*		
S. punctulatum			*																*	
S. quebecense var. ornatum			*	*	*	*		*		*				*		*	*		*	*
S. Sebaldii var. ornatum			*														*			
S. striolatum		*	*														*			
Stigeoclonium fasciculare		*		*																
S. flagelliferum					*															

TABLE I (continued)

* = Present

QUALITATIVE ANALYSIS
OF THE ALGAE IN
LAKE LANSING

	Sept.		Oct.		Nov.		Dec.		Jan.		Feb.		March		April		May		June	
YEAR	59	60	59	60	59	60	59	60	60	61	60	61	60	61	60	61	60	61	60	61
Stigeoclonium lubricum		*	*	*	*	*		*								*	*	*	*	*
S. tenue			*	*	*	*									*	*	*			
Tetradesmus wisconsinense															*					
Tetraedron enorme fa.			*							*						*		*		
T. minimum		*	*	*	*	*		*		*						*		*		*
T. trigonum																*		*		*
var. gracile		*	*																	
T. timidulum																	*	*		*
Tetraspora gelatinosa			*												*	*		*		*
Ulothrix tenerrima			*												*					
Zygnema spp.																	*	*	*	*
Zygnema sterile																		*		

DATA

EUPLANKTON: QUANTITATIVE

Table II

Quantitative Analysis of
Phytoplankton
(Organisms per liter)

Station I 1960	Oct. 28	Nov. 5	Nov. 12	Nov. 19	Nov. 25	Dec. 3
CYANOPHYTA						
Microcystis aeruginosa	23,630					
Oscillatoria tenuis		23,630		23,630		
Plectonema notatum	330,820	236,300	23,630			
CHRYSOPHYTA						
Achnanthes spp.	47,260		23,630	47,260	94,520	118,150
Cocconies spp.		23,630				
Cymbella spp.						
Diatoms (miscellaneous)	189,040	23,630	23,630	141,780	236,300	70,890
Dinobryon sociale	47,260	23,630			47,260	23,630
Fragillaria spp.						
Gomphonema spp.						
Navicula spp.			23,630	70,890	23,630	23,630
Synedra spp.	118,150	401,710	614,380	543,490	732,530	732,530

Table II (continued)

Quantitative Analysis of
Phytoplankton
(Organisms per liter)

Station I 1960	Oct. 28	Nov. 5	Nov. 12	Nov. 19	Nov. 25	Dec. 3
CHLOROPHYTA						
Cosmarium impressulum	23,630					
Cosmarium granatum						23,630
Nephrocytium sp.				23,630		
Oocystis sp.		23,630	70,890	23,630	23,630	
Scenedesmus obliquus		23,630	23,630	23,630		
Scenedesmus quadricauda	47,260		141,780	70,890	94,520	118,150
Tetraedron minimum		23,630				
Tetraedron enorme fa.						
PYRRHOPHYTA						
Peridinium inconspicuum						
Peridinium umbonatum						
CYANOPHYTA	354,450	259,930	23,630			
CHRYSOPHYTA	401,710	472,600	685,270	803,420	1,134,240	968,830
CHLOROPHYTA	70,890	70,890	236,300	141,780	118,150	141,780
TOTAL COUNT	827,050	803,420	945,200	968,830	1,252,390	1,100,610

Table II (continued)

Quantitative Analysis of Phytoplankton (Organisms per liter)

Station I 1961	Jan. 10	Jan. 24	Feb.	March 1	March 29	
CYANOPHYTA						
Microcystis aeruginosa						
Oscillatoria tenuis						
Plectonema notatum						
CHRYSOPHYTA						
Achnanthes spp.	236,300	70,890			519,860	
Cocconies spp.	23,630					
Cymbella spp.					23,630	
Diatoms (miscellaneous)	259,930	401,710		23,630	354,450	
Dinobryon sociale	590,750	1,181,500		259,930	2,741,080	
Fragilaria spp.						
Gomphonema spp.					23,630	
Navicula spp.	23,630	94,520			236,300	
Synedra spp.	1,110,610	779,790			1,370,540	

Table II (continued)

Quantitative Analysis of
Phytoplankton
(Organisms per liter)

Station I 1961	Jan. 10	Jan. 24	Feb.	March 1	March 29	
CHLOROPHYTA						
Cosmarium impressulum						
Cosmarium granatum						
Nephrocytium sp.						
Oocystis sp.		47,260				
Scenedesmus obliquus						
Scenedesmus quadricauda	23,630	94,520				
Tetraedron minimum						
Tetraedron enorme fa.						
PYRRHOPHYTA						
Peridinium inconspicuum						
Peridinium umbonatum						
CYANOPHYTA						
CHRYSOPHYTA	2,244,850	2,528,410		283,560	5,269,490	
CHLOROPHYTA	23,630	141,780				
PYRRHOPHYTA						
TOTAL COUNT	2,268,480	2,670,190		283, 560	5,269,490	

Table II (continued)

Quantitative Analysis of
Phytoplankton
(Organisms per liter)

Station I 1961	April 22	April 30	May 19	May 30	June 11	
CYANOPHYTA						
Microcystis aeruginosa						
Oscillatoria tenuis						
Plectonema notatum		23,630	47,260	4,844,150	448,970	
CHRYSOPHYTA						
Achnanthes spp.	47,260	165.410	94,520	47,260		
Cocconies spp.						
Cymbella spp.						
Diatoms (miscellaneous)	141,780	47,260	94,520	94,520		
Dinobryon sociale	6,450,990	6,427,360	2,859,230	189,040	212,670	
Fragilaria spp.	401,710	118,150	330,820			
Gomphonema spp.						
Navicula spp.	23,630	47,260	212,670			
Synedra spp.	2,126,700	2,197,590	354,450	23,630	70,890	

Table II (continued) Quantitative Analysis of Phytoplankton (Organisms per liter)

Station I 1961	April 22	April 30	May 19	May 30	June 11	
CHLOROPHYTA						
Cosmarium impressulum						
Cosmarium granatum				23,630		
Nephrocytium sp.						
Oocystis sp.	23,630	23,630	94,520		212,670	
Scenedesmus obliquus						
Scenedesmus quadricauda	70,890	47,260	47,260	47,260	70,890	
Tetraedron minimum			23,630	23,630	141,780	
Tetraedron enorme fa.			23,630			
PYRRHOPHYTA						
Peridinium inconspicuum		70, 890	47,260	94,520	118,150	
Peridinium umbonatum			47,260			
CYANOPHYTA		23,630	47,260	4,844,150	448,970	
CHRYSOPHYTA	9,192,070	9,003,030	3,946,210	354,450	283,560	
CHLOROPHYTA	94,520	70,890	189,040	94,520	425,340	
PYRRHOPHYTA		70,890	94,520	94,520	118,150	
TOTAL COUNT	9,286,590	9,168,440	4,277,030	5,387,640	1,276,020	

Table III

Quantitative Analysis of Phytoplankton (Organisms per liter)

Station III 1960	Oct. 28	Nov. 5	Nov. 12	Nov. 19	Nov. 25	Dec. 3
CYANOPHYTA						
Chroococcus sp.						
Oscillatoria tenuis						
Plectonema notatum	448,970	47,260			47,260	
Spirulina subsalsa				23,630		
CHRYSOPHYTA						
Achnanthes spp.					94,520	236,300
Cocconies spp.		23,630		47,260		
Cymbella spp.			23,630			
Diatoms (miscellaneous)			70,890	70,890	94,520	189,040
Dinobryon divergens						
Dinobryon sociale	70,890	23,630		23,630	23,630	47,260
Fragilaria spp.						
Navicula spp.	47,260	23,630	23,630	23,630	70,890	165,410
Synedra spp.	259,930	141,780	259,930	827,050	661,640	614,380

Table III (continued)

Quantitative Analysis of Phytoplankton (Organisms per liter)

Station III 1960	Oct. 28	Nov. 5	Nov. 12	Nov. 19	Nov. 25	Dec. 3
CHLOROPHYTA						
Cosmarium sp.				23,630		23,630
Cosmarium granatum						
Nephrocytium sp.						
Oocystis sp.			23,630			23,630
Pediastrum Boryanum						
Pediastrum tetras					47,260	
Scenedesmus dimorphus						
Scenedesmus obliquus				23,630		
Scenedesmus quadricauda	47,260	70,890	94,520	94,520	94,520	94,520
Tetraedron minimum			47,260			
PYRRHOPHYTA						
Peridinium inconspicuum						
CYANOPHYTA	448,970	47,260		23,630	47,260	
CHRYSOPHYTA	378,080	212,670	378,080	992,460	945,200	1,252,390
CHLOROPHYTA	47,260	70,890	165,410	141,780	141,780	141,780
PYRRHOPHYTA						
TOTAL COUNT	874,310	756,160	543,490	1,157,870	1,134,240	1,394,170

Table III (continued)

Quantitative Analysis of Phytoplankton (Organisms per liter)

Station III 1961	Jan.*	Jan. 24	Feb.	March 1	March 29	
CYANOPHYTA						
Chroococcus sp.						
Oscillatoria tenuis						
Plectonema notatum						
Spirulina subsalsa						
CHRYSOPHYTA						
Achnanthes spp.		23,630			543,490	
Cocconies spp.					118,150	
Cymbella spp.					23,630	
Diatoms (miscellaneous)					259,930	
Dinobryon divergens						
Dinobryon sertularia		70,890				
Dinobryon sociale		1,016,090		212,670	1,914,030	
Fragilaria spp.		70,890				
Navicula spp.		23,630		23,630	189,040	
Synedrs spp.		567,120		118,150	1,110,610	
* = Sample lost.						

Table III (continued)

Quantitative Analysis of
Phytoplankton
(Organisms per liter)

Station III 1961	Jan. *	Jan. 24	Feb.	March 1	March29	
CHLOROPHYTA						
Cosmarium sp.						
Cosmarium granatum						
Nephrocytium sp.						
Oocystis sp.					23,630	
Pediastrum Boryanum						
Pediastrum tetras						
Scenedesmus dimorphus						
Scenedesmus obliquus		23,630				
Scenedesmus quadricauda					94,520	
Tetraedron minimum						
PYRRHOPHYTA						
Peridinium inconspicuum						
CYANOPHYTA						
CHRYSOPHYTA		1,772,250		354,450	4,158,880	
CHLOROPHYTA		23,630			118,150	
PYRRHOPHYTA						
TOTAL COUNT		1,795,880		354,450	4,277,030	

Table III (continued)

Quantitative Analysis of
Phytoplankton
(Organisms per liter)

Station III 1961	April 22	April 30	May 19	May 30	June 11	
CYANOPHYTA						
Chroococcus sp.			23,630		23,630	
Oscillatoria tenuis				23,630		
Plectonema notatum	47,260		47,260	2,760,190	897,940	
Spirulina subsalsa						
CHRYSOPHYTA						
Achnanthes spp.	47,260					
Cocconies spp.			23,630			
Cymbella spp.			23,630			
Diatoms (miscellaneous)	70,890	23,630	47,260	23,630		
Dinobryon divergens			118,150			
Dinobryon sertularia						
Dinobryon sociale	4,164,880	6,616,400	2,363,000	94,520	47,260	
Fragilaria spp.	47,260					
Navicula spp.	23,630	141,780	70,890			
Synedra spp.	1,654,100	2,386,630	236,300		212,670	

Table III (continued)

Quantitative Analysis of Phytoplankton (Organisms per liter)

Station III 1961	April 22	April 30	May 19	May 30	June 11	
CHLOROPHYTA						
Cosmarium sp.	23,630		23,630			
Cosmarium granatum					23,630	
Nephrocytium sp.		23,630				
Oocystis sp.	23,630		94,520		118,150	
Pediastrum Boryanum					23,630	
Pediastrum tetras			23,630		23,630	
Scenedesmus dimorphus			23,630			
Scenedesmus obliquus		23,630		23,630		
Scenedesmus quadricauda	23,630	47,260	141,780	47,260	23,630	
Tetraedron minimum		47,260	23,630		118,150	
PYRRHOPHYTA						
Peridinium inconspicuum			70,890	118,150	70,890	
CYANOPHYTA	47,260		70,890	2,693,820	921,570	
CHRYSOPHYTA	6,002,020	9,168,440	2,882,860	118,150	259,930	
CHLOROPHYTA	70,890	141,780	330,820	70,890	330,820	
PYRRHOPHYTA			70,890	118,150	70,890	
TOTAL COUNT	6,120,170	9,310,220	3,355,460	3,001,010	1,583,210	

Table IV

Quantitative Analysis of
Phytoplankton
(Organisms per liter)

Station II 1960	Oct. 28	Nov. 5	Nov. 12	Nov. 19	Nov. 25	
CYANOPHYTA						
Anabaena sp.		23,630				
Plectonema notatum	70,890	141,780	23,630			
CHRYSOPHYTA						
Achnanthes spp.	70,890	23,630	23,630	189,040	94,520	
Cocconies spp.	23,630		23,630	47,260	23,630	
Diatoms (miscellaneous)	141,780	47,260	47,260	47,260	47,260	
Dinobryon sociale	141,780	70,890	23,630	23,630	94,520	
Navicula spp.	47,260	70,890	47,260	165,410	70,890	
Synedra spp.	236,300	307,190	330,820	590,750	448,970	
CHLOROPHYTA						
Cosmarium granatum		23,630		23,630		
Oocystis sp.	23,630				23,630	
Scenedesmus dimorphus			23,630		23,630	
Scenedesmus obliquus		47,260				
Scenedesmus quadricauda	94,520	47,260	118,150	70,890	23,630	
Staurastrum chaetoceras	23,630					
Tetraedron minimum	23,630	23,630		23,630		

Table IV (continued) Quantitative Analysis of Phytoplankton (Organisms per liter)

Station II	Dec. 3	Jan.10,1961	Total number of organisms per liter according to Algal Division			
CYANOPHYTA						
Anabaena sp.				Oct. 28	Nov. 5	Nov. 12
Plectonema notatum			CYANOPHYTA	70,890	165,410	23,630
CHRYSOPHYTA			CHRYSOPHYTA	661,640	567,120	496,230
Achnanthes spp.	118,150		CHLOROPHYTA	165,410	141,780	141,780
Cocconies spp.	23,630		TOTAL COUNT	897,940	874,310	661,640
Diatoms (miscellaneous)	189,040	70,890		Nov. 19	Nov. 25	Dec. 3
Dinobryon sociale	23,630	94,520	CYANOPHYTA			
Navicula spp.	141,780	23,630	CHRYSOPHYTA	1,063,350	779,790	732,530
Synedra spp.	236,300	141,780	CHLOROPHYTA	118,150	70,890	70,890
			TOTAL COUNT	1,181,500	850,680	803,420
CHLOROPHYTA				Jan. 10		
Cosmarium granatum			CYANOPHYTA			
Oocystis sp.			CHRYSOPHYTA	354,450		
Scenedesmus dimorphus			CHLOROPHYTA	47,260		
Scenedesmus obliquus			TOTAL COUNT	401,710		
Scenedesmus quadricauda	70,890	47,260				
Staurastrum chaetoceras						
Tetraedron minimum						

DATA

AUFWUCHS :

QUALITATIVE & QUANTITATIVE

Table V

* = Present

Qualitative Analysis of

Aufwuchs on Artifical Substrates

	Oct.			Nov.							Dec.						Jan.1961						March						April				May				June			
STATION	B			A				B			A				B		A				B		A				B		A				A				A			
Rack No.	1	2	3	1	2	3	4	1	2	3	1	2	3	4	2	3	1	2	3	4	2	3	1	2	3	4	2	3	1	2	3	4	1	2	3	4	1	2	3	4
CHRYSOPHYTA																																								
Achnanthes spp.				*	*	*		*			*	*	*		*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		*	*	*	*	*	
Amphora spp.		*						*	*	*					*		*	*	*	*	*	*		*					*	*						*	*			
Cocconies spp.	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Cymatopleura spp.																											*			*	*				*					*
Diatoma spp.	*			*	*	*	*	*	*	*		*		*	*	*	*	*	*																					
Dinobryon sp.						*																						*	*	*										
Epithemia spp.																					*							*	*											
Fragilaria spp.	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Gomphonema spp.																		*	*	*	*				*	*		*		*	*	*			*					
Navicula spp.	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		*
Nitzschia spp.																											*			*						*				
Ophiocytium cochleare																															*									
Pinnularia spp.		*								*										*	*						*		*	*	*	*	*				*			
Rhopalodia spp.		*																		*							*			*	*									
Synedra spp.	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
Cymbella spp.		*	*	*	*	*		*			*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

Table V (continued)

* = Present

Qualitative Analysis of

Aufwuchs on Artifical Substrates

	Oct.			Nov.							Dec.						Jan. 1961						March						April				May				June			
STATION	B			A				B			A				B		A				B		A				B		A				A				A			
Rack No.	1	2	3	1	2	3	4	1	2	3	1	2	3	4	2	3	1	2	3	4	2	3	1	2	3	4	2	3	1	2	3	4	1	2	3	4	1	2	3	4
CYANOPHYTA																																								
Anabaena sp.	*	*																																*	*	*	*	*	*	*
A. circinalis																								*																
Arthrospira Jenneri																													*		*				*	*	*	*		*
Chroococcus sp.				*			*											*					*													*				
C. dispersus											*		*																											
C. turgidus									*				*					*												*	*		*		*	*		*		*
var. maximus																															*									
Lyngbya aestuarii																											*	*				*	*			*	*	*		*
L. Diguetii													*		*	*													*		*				*					
Merismopedia glauca																													*					*	*	*		*		*
M. tenuissima																																	*	*	*		*	*	*	*
Microcystis aeruginosa																																*								
Oscillatoria tenuis	*	*		*			*			*		*	*											*	*		*		*	*	*	*	*	*	*	*	*	*	*	*
Plectonema notatum														*										*	*				*	*					*		*	*		
Spirulina princeps																																*					*			*
S. subsalsa																																								*

Table V (continued) Qualitative Analysis of

* = Present <u>Aufwuchs</u> on Artifical Substrates

	Oct.			Nov.							Dec.						Jan. 1961						March						April				May				June			
STATION	B			A				B			A				B		A				B		A				B		A				A				A			
Rack No.	1	2	3	1	2	3	4	1	2	3	1	2	3	4	2	3	1	2	3	4	2	3	1	2	3	4	2	3	1	2	3	4	1	2	3	4	1	2	3	4
CHLOROPHYTA																																								
Botryococcus Braunii																																					*			
Chaetophoraceae (indet.)							*						*											*	*	*			*		*	*	*	*	*				*	*
Closterium moniliferum																															*		*		*		*	*		
Coleochaete orbicularis																																						*		
Cosmarium sp.																		*	*										*	*								*		
C. angulare var.canadense																													*									*		
C. granatum																		*			*			*					*	*										
C. pseudoornatum																								*																
Cylindrocapsa geminella																													*											
Dispora crucigeniodes																															*		*					*		
Elakatothrix viridis												*	*	*				*	*	*			*	*	*	*				*	*	*						*		
Euastrum insulare																		*	*													*								
E. Turneri fa.																			*											*										
Oedogonium spp.											*															*			*	*	*	*	*	*	*	*	*	*	*	
Oocystis sp.																		*																						
Pediastrum Boryanum				*					*		*	*	*				*	*	*	*	*		*	*	*	*			*	*	*	*	*	*	*	*	*	*	*	*

Table V (continued)

* = Present

Qualitative Analysis of

Aufwuchs on Artifical Substrates

	Oct.			Nov.							Dec.						Jan. 1961						March						April				May				June			
STATION	B			A				B			A				B		A				B		A				B		A				A				A			
Rack No.	1	2	3	1	2	3	4	1	2	3	1	2	3	4	2	3	1	2	3	4	2	3	1	2	3	4	2	3	1	2	3	4	1	2	3	4	1	2	3	4
Pediastrum duplex																								*					*	*	*			*			*	*		
P.integrum var.perforatum											*	*	*	*			*		*				*	*					*	*	*	*			*					
P. tetras																	*	*																						
Scenedesmus bijuga		*		*				*	*			*	*	*			*	*					*	*		*			*	*	*	*					*			
S. dimorphus				*																																		*		
S. quadricauda	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Sphaerocystis Schroeteri																								*	*					*	*		*							
Spirogyra sp.																																						*		
Staurastrum quebecense																																								
var. ornatum																		*																						
Stigeoclonoim sp.																													*	*	*		*							
Tetraedron enorme fa.																													*	*										
T. minimum																		*																						
T. trigonum																													*		*									
Tetraspora gelatinosa																																						*		

DATA

PHYSICAL & CHEMICAL

Table VI Bacteriological and Chemical analysis made by the Michigan Department of Health

DETERMINATION	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4
	ppm	ppm	ppm	ppm
Phosphates	2.0	35.0	.0	.0
Free Ammonia as Nitrogen	3.5	14.0	1.2	.5
Potassium	2.8	6.0	1.8	.8
Nitrates as Nitrogen	.2	.0	.0	.0
Detergent	.6	7.0	.0	.0
Calcium Carbonate	284	300	128	222
Hardness	305	275	140	250
pH	7.0	7.2	8.4	7.2
MPN	15,000*	1,400,000*	430	36
BOD	-	85	-	-

* Dangerous water for swimming is classified as having at least 2,400 coliform index.

The surface water samples used above were obtained from the following points around the lake:

Sample 1- Near inlet drain at south end of lake. (Corresponds to station 3.)

Sample 2- Near shore at the end of the street near amusement park. (Corresponds to station D)

Sample 3- Approximately center of lake.

Sample 4- At the mouth of Clawson Drain on the north side of the lake. (In the area of station 6.)

Table VII Chemical analysis of surface waters of Lake Lansing. Water samples taken at weekly intervals over a period of two months (Oct. and Nov.). The figures indicate a range.

DETERMINATION	Station I	Station II	Station III
pH	7.3 - 7.9	7.3 - 8.2	7.3 - 7.5
Total Hardness	152 - 158 ppm	154 - 160 ppm	156 - 164 ppm
Alkalinity	154 - 174 ppm	152 - 170 ppm	152 - 162 ppm
Iron	.04 - .05 ppm	.04 - .05 ppm	.04 - .05 ppm
Nitrates	0.135 - 0.26 ppm	0.135 - 0.27 ppm	0.175 - 0.21 ppm
Nitrites	0.004 - 0.006ppm	0.004 - 0.006ppm	0.004 - 0.007ppm
Turbidity	1.0 - 2.0 ppm	1.0 - 3.0 ppm	2.0 - 6.3 ppm

V. DISCUSSION

Lake Lansing, as are many other natural habitats, is a tremendously complex entity of multiple communities which respond and interact individually and collectively to each other as well as to the environment. To identify these communities, in reference to the objectives of this investigation, we can classify them on an ecological basis, in the following two ways:

First according to occurrence.

A- Limnetic zone; that region of open water the horizontal extent of which is bounded peripherially by the zone of emergent vegetation.

B- Littoral zone; that region immediately adjacent to the shore, extending lakeward to the limit of occupancy of rooted vegetation.

C- Benthic zone; that zone consisting of the lake bottom. (In this investigation it includes the Aufwuchs community.)

Secondly, on the basis of the organism's life habitat.

A- Neuston; organisms resting or swimming on the surface, associated with the surface film.

B- Plankton; floating organisms unable to swim against currents, drifting.

1- Euplankton: true plankton; open water, drifting organisms.

2- Tychoplankton: floating or free-living organisms in shallow water of a lake intermingled with miscellaneous vegetation, usually near shore (Prescott 1962).

C- Nekton; organisms capable of swimming against water currents.

D- Benthos; organisms attached on the bottom of an aquatic habitat; often considered in a limited sense as deep-water life.

E- Aufwuchs; microorganisms forming a film and attached to, or moving upon submerged substrates (can be classified with Benthos).

A combination of the above classifications has been used by this investigator, and as such, the regions of the lake and the community or organisms which inhabit them, are now treated individually. The limits designating these ecological groupings are not applied strictly since the organisms are dynamic and can transcend, or be displaced from one region to the next.

Algal Communities

Limnetic

This open water community extending to the periphery of the zone of emergent vegetation and vertically to the depth of effective light penetration, is inhabited by organisms classified as euplanktonic. Intermingled with these, however, may be algae which usually inhabit the littoral and or benthic zones (including Aufwuchs). These are physically transported into the region by currents or by locomotion of the organisms. The composition of the community may become modified, therefore for reasons other than variations in limnological factors, and exclusive of time.

Qualitative Analysis

This series of analyses were undertaken to determine the degree of contribution made by the respective algal divisions to the limnetic community.

Qualitatively, of the 312 total algal taxa reported for Lake Lansing, almost half (164) were found occurring as members of the limnetic community, representing several divisions of algae (Cyanophyta, Chlorophyta, Chrysophyta, Pyrrhophyta, and Euglenophyta). Of this number only 58 were found to occur strictly as euplanktonic. The remainder were found to inhabit as well, the tychoplankton of the littoral region and or the Aufwuchs community of the benthic zone. The total euplanktonic flora is composed of Chlorophyta 53.3 percent, Cyanophyta 36.4 percent, and Chrysophyta 10.3 percent. Although the green algae contribute the greatest number of taxa this does not imply that this group dominates the community quantitatively. The relative importance of the various divisions can be determined by comparing the number of taxa in each division present in the community, with corresponding figures for the entire lake. Of the total number of reported Chlorophyta in the lake 44.3 percent occurred in the euplankton and only 20.8 percent of the total were exclusively euplanktonic. Of the total Cyanophyta, 77.2 percent occurred in the euplankton, and 26.58 percent appeared exclusively in this community. The Chrysophyta are more difficult to evaluate qualitatively, since the diatoms were not all identified to species. Nevertheless, the importance of this division is quite evident when one analyzes the quantitative data presented previously and treated further on in the discussion. The Chrysophyta are represented in the euplankton by 69.7 percent of the total taxa of golden-brown algae, and 18.2 percent were strictly euplanktonic. It becomes evident, from the above data, that the Cyanophyta play their greatest role as members of the limnetic community, and that 50 percent of the Chrysophyta also occur in this community. Whereas the Chlorophyta contributed the greatest number of taxa to the community, they are of secondary importance to the above divisions, and their major contribution is to the communities of the littoral and benthic zones. The Pyrrhophyta and Euglenophyta had no organisms which were strictly euplanktonic but of the six Dinoflagellate species, five occurred in the euplankton, whereas only eight members of the Euglenophyta, of a total of 45 taxa, were found occurring in this habitat. (See Graph No.1 for the above mentioned figures.)

Quantitative Analysis

Numerous publications on quantitative phytoplankton analyses exist in the literature, Birge and Juday (1922), Chandler (1940), Dailey (1938), Riley (1940) etc. Most workers agree that in medium to large sized, deep lakes of the temperate zone, phytoplankton communities exhibit an annual population curve, in respect to numbers of individuals, which is bimodal in character. Such a curve expresses a large spring pulse followed by a decrease in the population during the summer, with a second smaller pulse occurring in the autumn Odum (1959), Pennak (1946), and Welch (1952). Smaller, shallower lakes, however, exhibit population curves which can be highly variable, with no pulses or with one, two or three pulses, occurring at various intervals throughout the year as shown by Pennak (1946 and 1949). The data obtained from the present investigation, illustrated on Graphs 2 through 7, clearly indicate the weekly and monthly variations in the population. The spring maximum, mentioned previously as being typical of certain lakes in the temperate zone, is clearly revealed. No autumn maximum is indicated, however, as the investigation did not cover the time period when this autumn pulse might occur. Tucker (1957), in his quantitative phytoplankton study of

Lake Lansing from August to early November, did not indicate any autumn pulse. Fluctuations in the community composition, based on the algal divisions present are shown on Graphs 3, 4, 5, 6, and 7, while the percent composition, of the total phytoplankton present, represented by each division, is indicated on Graph 2. It is revealed from these data that, in the order of numerical abundance (unlike the qualitative analysis) the most important contributors to the limetic community are the Chrysophyta, Cyanophyta, Chlorophyta, and Pyrrhophyta.

In general, stations I and III, exhibited equal trends in the fluctuations of the phytoplankton population, and although the species compositions differred in the two areas, the species responsible for the major trends, including the spring maximum, were the same. The results of the investigation, beginning in late October at both stations, indicated a decreasing number of organisms until the middle of November. During this time the Cyanophyta were the most abundant organisms (48 percent) but the Chrysophyta were almost equal in numbers (45 percent). The remaining 7 percent represented the Chlorophyta. From about the middle of November until late January, the population showed a definite increase in numbers to what could be considered a small mid-winter pulse. This pulse was attributable to the Chrysophyta, and more specifically to the diatom Synedra sp. and to Dinobryon sociale. Synedra was most abundant during the early phases of this pulse but at its peak, Dinobryon sociale was dominant. The Cyanophyta were completely absent at the end of November, and the Chlorophyta, represented primarily by Scenedesmus quadricauda, persisted in small quantities until the end of January. The population reached its minimal point in early March, with the phytoplankton at this time, entirely composed of Chrysophyta.

Dinobryon sociale was the dominant species at station I, and Synedra, accompanied this species at station III. There was a decided increase in the phytoplankton population, culminating in the spring maximum in late April, following the melting of the ice cover in mid-March. The organisms responsible for this spring pulse, were the same as those which contributed to the mid-winter pulse. At the peak, or shortly thereafter, however, all the previously mentioned algal divisions were present (Chrysophyta, Cyanophyta, Chlorophyta, and Pyrrhophyta). The spring maximum was followed by a population decrease through May and June, and the Chrysophyta, which had previously composed the total or major portion of the total phytoplankton, were at a minimal condition. The Cyanophyta contributed the largest number of organisms in late May and June, exhibiting a pulse of its own during this time. From this time on the Chlorophyta and Pyrrhophyta showed gradual increases as the season progressed, while the blue-greens and golden-brown algae, were on the decrease. (See Graphs 2, 3, 5, and 7 for all the above mentioned fluctuations, and Tables II, III, and IV for the complete quantitative data on individual organisms.)

Station II, located in shallow water, as opposed to the other stations located in deep water, revealed a parallel fluctuation in the phytoplankton population until late November. As the season progressed, however, with colder temperatures and subsequent formation of an ice cover, the population exhibited a marked decrease. This was in direct contrast to what was occurring at the deep-water stations (development of mid-winter pulse). The species composition did not differ to any appreciable extent from that occurring at the other stations, and in actuality, the organisms composing the major portion of the phytoplankton were the same. According to the chemical and physical data taken, (Table VII), it appears that there were no differences which would account for the exhibited contrasting condition. However, not all the test performed were at a level which could indicate sensitive differences (phosphates), or concerned with other elements essential to the population such as oxygen and carbon dioxide. Under such conditions two things appear plausible and related.

First, the population decrease is obviously related to the biological condition of the community. That is, the mortality rate of the organisms exceeds the natality. This is an expression of the reaction between the organisms comprising the population the physical and chemical nature of the environment; the actions and interactions of and between the organisms as well as other inhabitants of the community; and upon the individual life histories of the population components. Of the first and last operatives, with reference to their influence from the available data, little more can be said. The second operative could in affect be responsible for the decrease in the population with various biological factors coming into play: antibiotic inhibition of a species to itself and other organisms, inter and intra species competition, and animal grazing to mention a few such biological factors. Of a speculative nature, self inhibition of the population caused by antagonistic substances arising from the metabolism of the phytoplankton, seems plausible. Fluctuations in the total phytoplankton number, caused by self inhibition, is known (Rice 1954).

Secondly, it appears that the above factors have a greater affect upon the community when operating under conditions in which the environment is in some way restricted. Under conditions of shallowness, where inhibitory substances are not diluted as much as they would be in greater water depth, these substances would be in greater concentration and as such would have a greater affect upon the community. Further, the effects of antagonistic substances upon the biota would be related to the restrictions imposed by ice cover. Water movement is inhibited and the concentration of solutes is increased when ice forms. The period of ice cover endures at a time of year when productivity is low and when other limitations are operating (low incidence of light e.g.).

The Chrysophyta contributed the greatest number of organsims throughout the four-month study period with the Chlorophyta contributing the second largest number. The Cyanophyta were represented in but small numbers and the Pyrrhophyta not at all in quantitative analyses. (See Graph No. 7 and Table No. IV, for comparison of total phytoplankton present, composition by algal division, and complete quantitative data for individual organisms.)

Water Blooms

Water blooms, a conspicuous and abundant growth of planktonic algae, sometimes appear suddenly, and often form a surface scum (Prescott 1962), in the lake. However, none were recorded at any of the stations where quantitative samples were collected. Often the blooms accumulate along the shore areas, as a result of wind and wave action. Four separate water blooms were observed during this investigation. The first, occurring in the fall of 1959, turned the surface waters of the shallow littoral region a pea soup color, and was composed primarily of Microcystis aeruginosa, M. flos-aquae, Coelosphaerium Naegelianum, and Anabaena sp. These same organisms then formed a similar bloom in the fall of 1962.

Ceratium hirundinella was the cause of a bloom in the spring of 1960 in the area along station C, coloring the water a redish-brown. Also observed at this time, was an abundance of dead fish. Whether the two events are related can be only conjectured. However, some of the Pyrrhophyta are known to be the causitive agents in fish-kill (Graham 1951). In this area and east and west of station C, in the fall of 1960, the fourth and largest bloom was observed. This was caused by Tolypothrix tenuis occurring in scattered patches which extended lakeward five to ten feet and for variable distances along the shore. In some areas this Tolypothrix bloom was from one to two feet in depth and the area appeared a deep bluish-brown. All these blooms, although perhaps originally members of the limnetic community, eventually became components of the littoral zone, and as such, influenced the algal community in this area both directly and indirectly.

Conclusions

1- The limnetic community is inhabited by organisms classified as euplanktonic. Intermingled with these, occur algae which usually inhabit the littoral and or the Aufwuchs community.

2- Almost half of the taxa reported for the entire lake can be found occurring as members of the limnetic community, and they represented all the major divisions of algae: Clorophyta, Cyanophyta, Chrysophyta, Pyrrhophyta and Euglenophyta.

3- The Chlorophyta contributed the greatest number of taxa to the limnetic community.

4- The Chrysophyta contributed the greatest quantity of organisms to the limnetic community. In order of numerical abundance the Chrysophyta are followed by the Cyanophyta, Chlorophyta, and Pyrrhophyta.

5- The Pyrrhophyta and Euglenophyta are the only divisions which have no taxa exclusively found as member of the limnetic community.

6- The limnetic community exhibited considerable weekly, monthly and seasonal variation both qualitatively and quantitatively.

7- Although the quantitative data available does not indicate an autumn pulse, a small mid-winter pulse in January, and a large spring pulse in April was clearly indicated for the phytoplankton community of this region. The population reached a minimal point in early March.

8- The exhibited fluctuation in the total phytoplankton is a reflection of the individual fluctuations of the organisms which form the community.

9- Principal organisms in the fall belong to the divisions, Cyanophyta and Chrysophyta; in January to the Chrysophyta and Chlorophyta; in March to the Chrysophyta; in April to the Chrysophyta, Chlorophyta and Cyanophyta; in late April to the Chrysophyta, Chlorophyta, Cyanophyta, and Pyrrhophyta; in May and June to the Cyanophyta and Chlorophyta with a minimal amount of Chrysophyta.

10- Parallel fluctuations in the phytoplankton exist between widely separated areas. A significant exception existed in a region of shallow water under ice cover.

11- _Synedra_ and _Dinobryon sociale_ are the principal taxa during the winter and spring pulses.

12- Water blooms, conspicuous and abundant growths of planktonic algae, occur in the lake. The organisms forming such blooms were _Microcystis aeruginosa_, _M. flos-aquae_, _Coelosphaerium Naegelianum_, _Anabaena sp._, _Ceratium hirundinella_ and _Tolypothrix tenuis_.

13- The investigation of the limnetic region, although indicating that there are fluctuations and differences in community composition, especially with reference to time, also indicates that there is much uniformity in composition with reference to space. The exhibited unity of character is a result of the degree of homogeneity of the environment, (or habitat), in this instance the open water.

Littoral

The littoral region is immediately adjacent to the shore, and extends lakeward to the limit of the rooted vegetation zone. In this investigation, however, only that portion up to the zone of floating leaf vegetation, has been investigated. In contrast with the more homogeneous environment of the limnetic, the littoral is highly heterogeneous. Various biological, chemical and physical forces combine to form a number of varying environmental conditions, resulting in the formation of particular habitats with recognizable communities. Responsible for this diversification in habitats and the delimiting of their communities are such factors as: the influence of the open water, non-homogeneous composition of the lake bottom, higher aquatic vegetation, wind and wave action, concentration of dissolved substances (i.e. nutrients) from decomposing organic matter, inorganic matter, indirect effect of effective light penetration, and fluctuations in the water level. Using the previously cited classification, the communities are those of the plankton (tychoplankton) and those of the *Aufwuchs*. Along with the tychoplanktonic organisms exclusively located in these waters are also included many forms occurring in the limnetic community as well as some displaced from the *Aufwuchs*. The *Aufwuchs* can be further classified according to the substrates. There are communities on inorganic substrates (stones, rocks, etc.) and there are those on organic substrates (living higher aquatic vegetation etc.). The community developing on the usually transient higher aquatic plant is composed of forms which are quick-growing with short developmental cycles. Whereas the inhabitants of the more permanent inorganic or, long-existing organic substrates (i.e. sunken logs), are those forms which are slow-growing with longer developmental cycles capable of forming persistent or permanent colonies.

The investigation revealed that the littoral region has the greatest variety of organisms and this is not surprising since it is the most heterogeneous environment in respect to critical factors. Of the 312 taxa reported for the lake, 237 or 75.9 percent can be found in this region, and these figures represent all the major divisions of algae. Whereas the Cyanophyta make their greatest contribution to the limnetic community, the Chlorophyta, Euglenophyta, Chrysophyta, and Pyrrhophyta are more abundant in the littoral zone. (See Graph No. 1.) The flora here was composed of Chlorophyta 45.6 percent; Cyanophyta, 21.5 percent; Euglenophyta, 19 percent; Chrysophyta, 11.3 percent and Pyrrhophyta, 2.6 percent. The major portion of the total number present, (93.7 percent), can be found in the plankton.

Plankton

The tychoplankton, especially rich in organisms which are found strictly in this habitat (over 50 percent) also includes organisms displaced from the Aufwuchs and limnetic communities.

The Euglenophyta and Pyrrhophyta, by their very nature, are mostly planktonic, and as such, are represented in the region by all species reported as occurring in the lake. It should be noted however, that whereas 80 percent of the Euglenophyta are restricted to the littoral region where waters are rich in organic nutrients, the Pyrrhophyta are not so restricted.

Although all members of the Pyrrhophyta occur in the littoral region, 83.3 percent of the taxa also occurs in the limnetic community. (See Graph No.1.) Only one species, Peridinium bipes, was found to be restricted to the littoral plankton.

Members of the Euglenophyta found to occur in the littoral plankton only are:

Euglena acus
E. oxyuris var. minor
Phacus ankylonaton
P. contortus var. complicatus
P. gigas
P. lismorensis
P. longicauda var. insecta
P. orbicularis fa.
P. platalea
Phacus pleuronectes
P. pseudoswirenkoi
P. rudicula
P. setosus
P. tortus
P. undulatus
P. unguis

Eight other Phacus were recorded as members of the plankton of the littoral region but they were not identified to species. The remaining Euglenophyta found exclusively in the zone were:

Lepocinclis ovum
Trachelomonas australica var. rectangularis
T. bulla
T. cylindrica
T. hispida var. duplex
T. obovata var. klebsiana
Anisonema sp.
Trachelomonas planctonica var. oblonga
T. pulcherrima
T. splendidissima
T. volvocina
T. volvocinopsis var. punctata

The Cyanophyta are represented primarily by true, free-floating organisms, or intermingled with other algae to form masses. Of the 51 blue-green taxa reported occurring in the littoral region 46 were found in the tychoplankton. However, of these 46 taxa, only six appear to be true plankters of this region: Chroococcus varius, Merismopedia punctata, Aphanothece stagnina, Oscillatoria amoena, Anabaena catenula, and Aphanizomenon flos-aquae. The remaining 40 taxa include seven which were found exclusively in the littoral community but occurred in intermingled algal masses: Oscillatoria sancta, Phormidium subfuscum, Lyngbya Lagerheimii, L. Nordgaardii, Scytonema crispus, Hapalosiphon sp. and Microcoleus lacustris; one species Plectonema nostocorum which inhabits the mucilage of Aphanothece stagnina, and the remainder are organisms which were common to the littoral, limnetic and or the Aufwuchs community.

The Chrysophyta are very well represented in the plankton. However, the majority of these organisms (diatoms) have been displaced from the Aufwuchs community, or can also be found in the limnetic. There are only six species which appear to be restricted to the region in the form of true plankters or as intermingled masses: Ophiocytium majus, Tribonema bombycinum, T. utriculosum, T. viride and Vaucheria geminata. This latter species often forms tangled mats almost on the shore. Besides the diatoms, Dinobryon cylindricum and D. sertularia are common to both the plankton of the littoral and of the limnetic regions.

The Chlorophyta represent 43.1 percent of the total algal taxa present in the littoral plankton, and 60 percent of these are found exclusively in this habitat. The major portion of these taxa are desmids, and they occur along the quiet margins of the lake.

Penium margaritaceum

Pleurotaenium trabecula

Micrasterias sol

Closterium acerosum

Cl. acerosum var. tumidum

Cl. incurvum

Cl. leibleinii

Cl. pseudolunula

Cl. strigosum

Cl. sublaterale

Staurastrum Brebissonii

St. disputatum

St. granulosum

St. Johnsonii

St. polymorphum

St. punctulatum

St. Sebaldii var. ornatum

St. striolatum

Cosmarium angulosum

C. Botrytis

C. Botrytis var. mediolaeve

C. constrictum

Cosmarium cucumis

C. cymatoplerum var. tyrolicum

C. formulosum

C. Franzstonii

C. impressulum

C. laeve var. depressum

C. obtusatum

C. ochthodes

C. pachydermum

C. pseudoornatum

C. pseudopyramidatum

C. regnesii

C. reniforme

C. subcostatum

C. subtumidum

C. sulcatum var. sumatranum

C. tetraophthalmum

C. Turpinii

C. vexatum

C. vexatum var. rotundatum

C. Wittrockii

C. Ungerianum

Five other desmids were collected but not identified to species.

Other green algae found occurring exclusively in the plankton of the littoral region are:

Chlamydomonas pseudopertyi
Pandorina morum
Chlorosarcina consociata
Pediastrum biradiatum
Schizomeris Leiblinii
Tetraedron trigonum var. *gracile*
Nephrocytium Agardhianum
N. obesum
Microspora tumidula
M. Willeana
Ulothrix tenerrima

Frequently tangled among the higher aquatic plants, dense mats of mixed algae occur in the littoral region. The mats are composed primarily of filamentous green algae, most frequently displaced from the *Aufwuchs* community. They vary in composition but the taxa usually composing the masses are: *Spirogyra porticalis*, *S. singularis*, *S.* spp. *Mougeotia* spp., *Oedogonium* spp., *Ulothrix* spp., *Cladophora insignis*, *C. fracta*, *C. glomerata*, *Rhizoclonium crassipellitum*, *Zygnema sterile*, and *Z.* spp. Sometimes *Cylindrocapsa geminella* may also occur. The mats often break apart allowing the component species to become more loosely associated with true plankton organisms.

Aufwuchs

The *Aufwuchs* is "That community of organisms that is attached to, or move upon, a submersed substrate, but which do not penetrate into it." Reid (1961). As pointed out previously, these *Aufwuchs* communities transcend into all the regions of the lake, although some authorities consider it part of the benthos Cooke (1956). Although Seligo, 1905, is credited with being the first to use the term *Aufwuchs* designating organisms attached to but not penetrating a substratum, as sited by Young (1945), and Cooke (1956), the term was not and is not the only one used. Hentshell 1915, used the term *Bewuchs*, and both these terms

were used together Willer (1929), Lenz (1928) and separately, Ruttner (1952), depending upon the investigator, in either narrower, broader, or in a completely different sense, than the original authors used them. The term periphyton was and is used by many investigators, Newcombe (1949), Young (1945), Cooke (1956), Roll (1939), Grzenda (1960). However, this term was originally used by Behning, 1924, to designate only organisms growing on artificial objects in water. Today the term has been expanded to mean:

"That assemblage of organisms growing upon free surfaces of submerged objects in water, and covering them with a slimy coat. It is that slippery brown or green layer usually found adhering to the surface of water plants, wood, stones or certain other objects immersed in water and may gradually develop from a few tiny gelatinous plants to culminate in a woolly felted coat that may be slippery or crusty with contained marl or sand." Young (1946), Welch (1948).

As one can see the terminology has been expanded until one can become confused as to what another investigator may mean when he refers to Aufwuchs, periphyton, etc. My study of this community could in part come under the original meaning of periphyton , as used by Behning, but I have not used the term for any portion of my investigation because its latter use has been expanded in meaning so that it is not readily distinguishable from Aufwuchs. Since the latter is the older term and really broader, I believe it is the more preferable one to use.

I would like to emphasize two points concerned with this investigation. First, the investigation if this community is cocerned solely with the algal composition, and secondly, primarily with growth that occurs on artificial substrates provided by the investigator, and upon persistent inorganic substrates (stones etc.) or the more resistant organic substrates (pilings etc.). The investigation of the Aufwuchs on living and non-living aquatic plants, was carried on by another investigator, Dr. Sebastian A. Guarrera of Universidad de La Plata, and will be reported on in a subsequent publication in the future.

For an exhaustive review of the literature on Aufwuchs see Cooke (1956) and Sladeckova (1962).

The Aufwuchs community of the littoral region is composed of species belonging to the Chrysophyta, Chlorophyta, and Cyanophyta, and of the 237 taxa reported for the littoral region, 17.8 percent can be found occurring as members of this community. These figures are,in a way, misleading, for the Aufwuchs is far richer in the number of taxa present. However, the diatoms, which are the greatest contributors to this community were not identified to species, which accounts for the low percentage indicated above.

One fact seems apparent as one views Aufwuchs communities growing on inorganic and organic substrates. The community on the inorganic substrate, stones, rocks, etc., is thick, firm, dark, and usually is slippery. On the other hand, the community on living substrates is usually light, fluffy, and flocculent. These appearances are due to the species composition of the communities on the different substrates. The communities on stones are primarily composed of diatoms, and lakeward the diatoms become more and more the dominant algal constituent. As one collects stones closer to the shore, more of the filamentous green algae become apparent. Stones closer to the shore, (besides the diatoms), were typically inhabited by: *Stigeoclonium lubricum*, *S. tenuis*, and various species of *Oedogonium*. These have the appearance of cottony masses or feathery tufts. Draparnaldia glomerata and species of Cladophora are other members of the Aufwuchs community on inorganic substrates and the latter genus often appears like flowing, long, green hair. Upon the submerged persistent organic substrates, Stigeoclonium flagelliferum occurs, and especially in the quiet waters of the swampy regions Tetraspora gelatinosa is often present.

Calothrix parietina, a blue-green, was collected as a member of the Aufwuchs community. However, the substrate was piling in the center of the lake and so not a component of the littoral region. It is mentioned here because it will not be considered with any of the remaining communities to be discussed.

This investigator collected a few samples of the visible algae growing on the higher aquatic plants. The flocculent material was at various times, mixtures of green, blue-green, and golden-brown algae, and included the following taxa: Oedogonium globosum, O. Pringsheimii, O. spp., Bulbochaete sp. Ophiocytium desertum, O. gracilipes, Calothrix scytonemicola, C. fusca, C. Castellii, C. Braunii, and Phormidium tenue.

Conclusions

The following statements can be made concerning the littoral region.

1- With its great heterogeneous environment created by various biological, chemical and physical factors (i.e. non homogeneous composition of the lake bottm, higher aquatic vegetation, wind and wave action, concentration of dissolved substances, etc.) the littoral region supports the largest variety of organisms present in the lake.

2- There are 312 taxa reported for the entire lake, and 237 occur in the littoral region with 95.8 of these being found in the plankton.

3- More of the Chrysophyta, Chlorophyta, Euglenophyta, and Pyrrhophyta can be found in the littoral region than in other zones in the lake.

4- The communities are those of the plankton and those of the Aufwuchs, the latter community can be further classified into those communities on inorganic substrates and those on organic substrates.

5- The plankton is not only rich in the number of organisms exclusively found in this region but also abundant in organisms displaced from the Aufwuchs and limnetic communities.

6- All taxa of the Euglenophyta and Pyrrhophyta are found occurring in the littoral plankton, with 80 percent of the Euglenophyta restricted to these waters, rich in organic nutrients.

7- The Cyanophyta primarily are present in the littoral region as members of the plankton.

8- The Chrysophyta are primarily part of the *Aufwuchs* community but most of the taxa can also be found in the plankton as a result of being displaced from its former community.

9- The Chlorophyta represent over 40 percent of the littoral plankton and the major portion of these are desmids located in the quiet, margin waters.

10- Mixtures of filamentous green algae frequently occur floating or tangled among the higher aquatic vegetation.

11- The Aufwuchs community on organic substrates differs in appearance from that on inorganic substrates. The community on stones, rocks, etc. is dark, thick, firm and usually slippery. That on the higher aquatic plant life is light, fluffy and floculent.

12- The diatoms are the dominant constituents of the community on stones etc., whereas the filamentous Chlorophyta and various Cyanophyta, compose the major portion of the floculent community on the higher aquatic vegetation.

Aufwuchs on Artificial Substrates

Investigation of the initiation and development of the Aufwuchs on artificial substrates (glass slides) revealed that the diatoms were not only the pioneer organisms but the persistent basic constituents of this community. Whereas it has been pointed out previously how the Aufwuchs greatly conributed to the plankton community of the limnetic region, it will now become apparent that the planktonic forms of the limnetic community contribute significantly to the Aufwuchs. It only need be mentioned that the initial population of the substrates originates from the plankton.

Qualitatively the Chrysophyta, Chlorophyta and Cyanophyta are responsible for the community composition. The percentages of these divisions present, as compared to those present in the entire lake are Chrysophyta 51 percent, Chlorophyta 18 percent, and Cyanophyta 19 percent. (See Graph No. 1 for the above mentioned percentages Graph No. 8 and Table No V, for all qualitative and quantitative data on this community.)

Examination of the Aufwuchs composition on the slides after only seven days exposure indicated that the following genera of diatoms were the first to become attached: *Diatoma*, *Amphora*, *Cocconies*, *Cymbella*, *Fragilaria*, *Acnanthes*, and *Synedra*. These same genera, although showing individual fluctuations, were usually in abundance throughout the study period and formed the basic diatom component of the community. Even with this basic diatom composition, the community still exhibited seasonal variation, and this was especially related to the plankton community. Planktonic organisms (eu- and tychoplankton), such as desmids were caught and held in the tangle of the attached forms, so that the Aufwuchs composition depended greatly upon what organisms were present in the plankton at the time the substrates were placed in the environment. Related to this, is the fact that there was also a difference in the vertical distribution of the organisms, so that the particular site where the racks were placed would also influence the community composition.

With the introduction of the glass slides in October, besides the above mentioned taxa were included in the Aufwuchs: Anabaena sp., Oscillatoria tenuis, Scenedesmus bijuga and S. quadricauda. As the community developed through November and December, the composition became more complex with the addition of the following taxa: Chroococcus sp., C. turgidus, C. dispersus, Lyngbya Diguettii, Plectonema notatum, Chaetophoraceae (indet.), Elakatothrix viridis, Oedogonium sp., Pediastrum Boryanum. P. intergrum var. perforatum fa., and Scenedesmus dimorphus. New slide substrates introduced in November and December did not contain the previously mentioned Anabaena sp. This genus was also absent during this time from the plankton community. During January there were no additions of blue-greens but two, Chroococcus dispersus and C. turgidus were absent. Since the blue-greens did not appear in the surface plankton of the limnetic community after November, it appears that certain of the planktonic blue-greens occur for a longer period of time, as members of the Aufwuchs community. The green algae, which were present in the plankton until late January and then reappeared in March, were still present in the Aufwuchs community. There was an increase in the number of Chlorophyta taxa, and there were only three taxa, two filamentous (Oedogonium and Chaetophoraceae) and one planktonic alga, (Scenedesmus dimorphus), which were no longer constituents of the community. The new taxa present were: Cosmarium sp., C. granatum, Euastrum insulare, E. Turneri fa., Oocystis sp., Pediastrum tetras, Staurastrum quebecense var. ornatum, and Tetraedron minimum.

Unfortunately the Aufwuchs samples for February were not obtained, because the slides were removed from the racks, by some unknown party.

The colonization and development of the Aufwuchs community through March and April is quite dramatic. All but four of the taxa (Pediastrum tetras, Staurastrum quebecense var. ornatum, Oocystis sp. and Tetraedron minimum), present in January, compose the community. In April the community reached its most heterogeneous composition. Many of the former blue-green and green algae, present during the early phases of this investigation, reappeared. So that along with those still present from January, were the following taxa:

Anabaena circinalis	Closterium moniliferum
Arthrospira Jenneri	Cosmarium angulare var. canadense
Chroococcus turgidus var. maximus	Cosmarium pseudoornatum
Lyngbya aestuarii	Cylindrocapsa geminella
Lyngbya Diguetii	Dispora crucigeniodes
Merismopedia glauca	Oedogonium sp.
Microcystis aeruginosa	Pediastrum duplex
Oscillatoria tenuis	Sphaerocystis Schroeteri
Plectonema notatum	Stigeoclonium sp.
Spirulina princeps	Tetraedron enorme fa.
Chaetophoraceae (indet.)	Tetraedron trigonum

In May and June, examination of the community indicated a decrease in the number of taxa present. No longer contributing to the composition were the following:

Anabaena circinalis

Chroococcus turgidus var. maximus

Microcystis aeruginosa

Cosmarium granatum

Cosmarium pseudoornatum

Cylindrocapsa geminella

Euastrum insulare

Tetraedron enorme fa.

Tetraedron trigonum

Two taxa previously present, reappeared and there were five taxa not previously recorded, present in the community:

Botryococcus Braunii

Coleochaete orbicularis

Scenedesmus dimorphus

Spirogyra sp.

Tetraspora gelatinosa

Spirulina subsalsa

Merismopedia tenuissima

Anabaena sp.

Changes in composition brought about by members of the Chrysophyta throughout the investigation, have not as yet been mentioned. This is because the changes were not easily detected and for the most part were very gradual. There were some taxa which appeared rather suddenly or sporadically but the division, represented primarily by the diatoms, was well-distributed throughout the study period. Cymatopleura, appears only from April to June, and only on the substrates closest to the surface. Dinobryon sp., appeared twice, once in November at the lowest depths, and then again in April on the substrates closest to the surface. Epithemia was present only in January and April and Gomphonema became attached in January and persisted until May, appearing on all substrates except those closest to the surface. Nitzschia was recorded only during April and May occurring at the lower levels. Pinnularia and Rhopalodia, appeared sporadically throughout the investigation, and only in May and June, on the surface racks. Ophiocytium cochleare was present only in April.

It is seen from the above information, that as the season progressed the composition of the Aufwuchs community changed, becoming most complex during March and April. The rate of development of the community was also variable, not only with reference to time but also with reference to space. When comparison is made of the amount of accumulated Aufwuchs, on substrates introduced into the environment at various intervals but for equal lengths of exposure time, it is indicated that the community exhibited population pulses like those occurring in the plankton. For example, slides introduced at the end of December, developed an Aufwuchs in January, far greater in numbers, than slides introduced in October, November and early December, over an equal length of time. Substrates examined in late January had less than those in early January. Slides introduced in late March had accumulated Aufwuchs in April, greater than at any other time during the investigation, as shown by comparison with slides introduced at other times of the year, and exposed for the same length of time.

With reference to space, it was noticed that the amount of Aufwuchs differed in quantity, depending upon the level at which the substrates were located (the exposure time at each level being equal). Graph No.8 was made to show this variation, using the method previously described on page 18 .

This graph (station A) indicates that as the community begins its development, the greatest quantity of Aufwuchs occurs on the substrates nearest the surface. As the community progresses, however, the accumulation of Aufuchs is greatest at the second (4 ½ feet below the surface) and at the third level, (7 ½ feet below the surface), and usually mostly at the latter rack. In April the graph indicates that Rack No. 1

once again had an abundant Aufwuchs development. I believe this is a direct result of the influence of the plankton. Recall that during this same period, the surface waters were exhibiting the spring plankton maximum. In June the graph indicates that there was a sharp drop in the quantity of Aufwuchs at Rack No. 3. Examination of the slides at this level indicated that the substrates were covered with aquatic animals, which appears to indicate a condition of predation.

Before discussing the quantitative development of the community at station B, it should be mentioned that the racks here received a great deal of disturbance by fishermen, and were finally taken from the lake by some unknown party. In November the racks had been completely removed from the water and replaced because some of the slides were missing. Whether this would account for the sporadic amount of development at the various levels, can only be guessed. In December Rack No. 1 was taken from the lake.

The remaining substrates at the other two levels indicated that the greatest quantity of Aufwuchs occurred at level No. 2, (this level is almost equal in depth to level No. 3, at station A). In January the quantitative relationship between levels No. 2 and 3, is the same as that in December. The graph in March,indicates that there was a sharp drop in the quantity of Aufwuchs at level No. 2. At the time the slides were examined the substrates were covered with an aquatic fungus.

In general, Aufwuchs development was similar in composition at station A and B but station A had a greater quanity for an equal length of exposure time.

Conclusions

The following conclusions can be made from this study:

1- The use of vertically placed slides at various levels in a lake, is very useful for studying the development and composition of the Aufwuchs community.

2- Placing the substrates in a vertical, as opposed to a horizontal position, still allows for the attachment of living organisms, and lessens the chance of organic detritus settling upon the substrate.

3- Removal of the Aufwuchs from the substrate, while lifting the racks from the water, once the community is established, is not readily done.

4- The original population of the substrates originates from the immediately surrounding plankton.

5- The rate of development and the complex succession of taxa, involved in the formation of the Aufwuchs community, is related to a number of variables i.e. time (month, year), space (vertical etc.), and the orgaisms present in the region.

6- The Aufwuchs exhibits fluctuations in the rate of increase in the number of individuals similar to that exhibited by the plankton, i.e. with a small mid-winter pulse and a spring maximum.

7- The Aufwuchs community is different both in quality and quantity at different levels. Whereas one might expect that substrates in the upper level would have a greater quantity of Aufwuchs because of the light factor, this is usually not the case.

8- At any particular time the community is composed of a wide variety of algae, and along with these are animals and fungi, which can alter the quality and or the quantity of the community elements.

9- The major constituents of the community are the diatoms.

10- A significant number of planktonic taxa become incorporated into the *Aufwuchs* community.

VI. SUMMARY

Lake Lansing, formerly known as Pine Lake, is located approximately three and one-half miles north-east of the city of East Lansing, and bordering the northern limit of the town of Haslett. The present investigation was undertaken to contribute to the very inadequate knowledge of the algae in the lake, in respect to both species composition and community structure. The objectives therefore, were as follows:

1- To determine the floristic composition of the lake, and to record the types of habitats where particular algal populations existed.

2- To determine the nature of monthly and seasonal successions in phytoplankton on a quantitative and qualitative basis.

3- To determine the monthly and seasonal successional changes, which may occur in the process of *Aufwuchs* colonization on artificial substrates.

The lake occupies an area of 452.5 acres with the long axis running northwest-southeast for a distance of slightly more than one mile. Rapidly aging, the lake contains a prolific abundance of floating, emergent and submergent aquatic vegetation, which have greatly decreased the value of the lake as a recreational site. It is a hardwater, alkaline lake, having a pH tending to be more nearly neutral along the margin and to be more alkaline toward the center of the lake. There is a high concentration of nutrients in the polluted areas derived from the many septic tanks which empty into the lake, and from decomposition of abundant organic matter.

Five selected collecting stations were regularly visited and eight stations were incidentally sampled. These provided the variety of habitats needed for this investigation.

All but six of the 312 taxa reported here as occurring in the lake were collected and determined. Of these 306 taxa, 13 are new records for Michigan or for North America. Fourteen taxa are listed as previously undescribed in the literature, and four are listed as previously undescribed forms of known species.

The algal communities of the lake are in the limnetic, littoral and the benthic regions. It was found that these regions are normally inhabited by associations of species in recognizable communities. These communities, however, definitely are not rigidly delimited, nor are their compositions static and fixed. They are entities which in response to their environmental surroundings are dynamic in composition, and they vary according to time and space.

The limnetic community can be characterized by the following:

1- A community composed of euplanktonic organisms plus organisms displaced from the littoral and from the Aufwuchs community.

2- Almost half of the number of taxa found occurring in the entire lake, contributes to the composition of the community, which exhibits considerable weekly, monthly and seasonal variation both qualitatively and quantitatively. A mid-winter and spring maxima were indicated.

3- In order of numerical abundance, the following algal divisions contribute the greatest quanity of organisms to the phytoplankton: Chrysophyta, Cyanophyta, Chlorophyta and Pyrrhophyta.

The fluctuations in the total phytoplankton is an expression of the total affect of the individual fluctuations of the organisms composing the community. Although the limnetic community fluctuates and differs in composition, especially with reference to time, the community also exhibits unity in composition with reference to space. The exhibited unity of character is a result of the degree of homogeneity of the environment.

The littoral region is characterized by the following:

1- It contains the largest variety of organisms present in the lake. Of the 312 reported taxa, 237, can be found in the littoral region

2- The communities are composed of the plankton, in which 95.8 percent of the taxa of the region can be found, and the Aufwuchs. The Aufwuchs can be further divided into the communities on inorganic and organic substrates.

3- More of the taxa of the following algal divisions can be found occurring in the littoral region than in other zones of the lake: Chlorophyta, Chrysophyta, Euglenophyta and Pyrrhophyta.

4- The Euglenophyta and Pyrrhophyta are represented in the littoral plankton by all the taxa of these divisions which are reported to occur in the entire lake.

5- The plankton is not only rich in the number of taxa exclusively found in this region (more than 50 percent) but also abundant in organisms displaced from the limnetic and or the Aufwuchs communities.

6- The Aufwuchs communities on inorganic and organic substrates differ in appearance and composition, the former being composed primarily of diatoms, the latter of filamentous Chlorophyta.

The Aufwuchs community on artificial substrates, in this investigation, is considered part of the benthic community, and is characterized

by the following:

1- The initial population originates from the planktonic environment.

2- It contains mainly diatoms, with a considerable number of planktonic organisms becoming secondarily incorporated.

3- There were 62 taxa which composed the Aufwuchs community throughout the study period.

The rate of development, and the complex succession of taxa, involved in the formation of the community, is related to a number of variables of which should be mentioned: time, three dimentional locality and the biota available at the particular region. Taking into consideration the interplay of migration, natality, etc. the rate of accumulation of the community is similar to that of the plankton community, with a small mid-winter pulse and a spring maximum.

VII. SYSTEMATIC LIST OF THE ALGAE IN LAKE LANSING

The date which follows each taxon in this list is the date in which the taxon was first published in the combination here used.

Descriptions of these taxa may be found in the reference cited after each taxa.

Division Cyanophyta

Class Myxophyceae

Sub-class A. Chroococceae

Order Chroococcales

Family Chroococcaceae

Chroococcus Naegeli 1849

Chroococcus dispersus (Keissler) Lemmermann 1904

Pl. 1 fig. 4

Prescott 1962, page 447.

Diameter of cells 3 - 4.5μ.

Euplankton: Station D.

Aufwuchs: Artificial Substrates Station A.

Chroococcus limneticus Lemmermann 1898

Pl. 1 fig. 17

Prescott 1962, page 448.

Diameter of cells 6 - 7.0μ without sheath.

Euplankton: Station D.

Chroococcus limneticus var. carneus (Chodat) Lemmermann 1904

Prescott 1962, page 448.

Diameter of cells 8 - 9.0μ without sheath.

Euplankton: Stations III4 - D.

Chroococcus limneticus var. distans G.M. Smith 1916
Pl. 1 fig. 5

Smith 1920, page 30.

Diameter of cells 6.48 - 7.0μ without sheath.

Euplankton: Station D.

Chroococcus limneticus var. subsalsus Lemmermann 1901
Pl. 1 fig. 3

Prescott 1962, page 449.

Diameter of cells 3.24 - 4.86μ without sheath.

Euplankton: Station C.

Chroococcus minimus (Keissler) Lemmermann 1904

Prescott 1962, page 449.

Diameter of cells 2.5 -3.0μ without sheath..

Euplankton: Station C.

Chroococcus minutus (Kuetz.) Naegeli 1849

Prescott 1962, page 449.

Diameter of cells 4.86 - 6.5μ without sheath.

Euplankton: Stations D-I, II-C.

Tychoplankton: Station 1.

Chroococcus turgidus (Kuetz.) Naegeli 1849
Pl. 1 fig. 2

Prescott 1962, page 450.

Diameter of cells 14.0 - 22.0μ without sheath.

Euplankton: Stations C,D, II4 - II - III3, III - D - I, 5.

Tychoplankton: Stations C,D,1,5.

Aufwuchs: Artificial Substrates Station A.

Chroococcus turgidus var. maximus Nygaard 1926
Pl. 1 fig. 1

Huber-Pestalozzi 1938, page 147.

Diameter of cells 39.5 - 41.0μ without sheath.

Euplankton: Station D.

Aufwuchs: Artificial Substrates Station A.

Chroococcus turgidus ?

The cells are grouped in fours or eights, their diameter being from 9.72 - 12.0μ. The sheaths were wide and lamellated, colored a yellowish brown. The colonies of eight were from 38.0 - 45.0μ wide.

This plant was collected twice, in both the euplankton and the tychoplankton. It differred from the typical by having colored sheaths.

Station D.

Chroococcus varius A. Braun in Rabenhorst 1861 - 1878

Pl. 1 fig. 10

Prescott 1962, page 451.

Diameter of cells 5.0 - 6.0μ. This plant is larger than the typical species.

Tychoplankton: Station D.

Gloeocapsa Kuetzing 1843

Gloeocapsa puntata Naegeli 1849

Prescott 1962, page 452.

Diameter of cells 1.62 - 2.4μ.

Euplankton: Station C.

Tychoplankton: Stations C,D.

Aphanocapsa Naegeli 1849

Aphanocapsa elachista West & West 1895

Pl. 2 fig. 6

Prescott 1962, page 453.

Diameter of cells 1.62 - 2.0μ.

Euplankton: Station C.

Aphanocapsa pulchra (Kuetz.) Rabenhorst 1865

Prescott 1962, page 454.

Diameter of cells 4.0 - 4.5μ.

Euplankton: Stations II4 - II, III - D.

Aphanocapsa rivularis (Carm.) Rabenhorst 1865

Pl. 2 fig. 8

Prescott 1962, page 454.

Diameter of cells 6.0 - 6.5μ.

Euplankton: Stations C,D,5, I - II4.

Microcystis Kuetzing 1833

Microcystis aeruginosa Kuetzing emend Elenkin 1924

Pl. 2 fig. 2

Prescott 1962, page 456.

Diameter of cells 4.68 - 7.0μ.

Euplankton: Stations D - I, I - II - C, II - III, 1,3.

Tychoplankton: Stations C,D.

Aufwuchs: Artificial Substrates Station A.

Microsystis flos-aquae (Wittr.) Kirchner 1900

Pl. 2 fig. 3

Smith 1920, page 39.

Diameter of cells 3.5 - 5.25μ.

Euplankton: Stations C,D, D - I - II, II - III - D, 3,5.

Tychoplankton: Stations C,D.

Microcystis incerta Lemmermann 1903

Pl. 2 fig. 1

Prescott 1962, page 457.

Diameter of cells 1.62 - 3.12μ.

I followed Prescott, 1962, in assigning to M. incerta Lemm. forms listed by other authors under the name M. pulverea (Wood) Migula.

Euplankton: Stations I - II, D, 5.

Merismopedia Meyen 1839

Merismopedia convoluta de Brebisson in Kuetzing 1849

Pl. 1 fig. 12

Prescott 1962, page 458.

Diameter of cells 3.5 - 4.0μ.

Length of cells 5.25 - 7.0μ.

Euplankton: Stations C,D.

Tychoplankton: Stations C,D.

Merismopedia elegans A. Braun in Kuetzing 1849
Pl. 1 fig. 6

Prescott 1962, page 459.
Diameter of cells 4.68 - 5.02μ.
Length of cells 6.24 - 7.80μ.
Euplankton: Stations C,D.
Tychoplankton: Stations C,D.

Merismopedia glauca (Ehrenb.) Naegeli 1849
Pl. 1 fig. 7

Prescott 1962, page 459.
Diameter of cells 3.9 - 6.0μ.
Euplankton: Stations C,D, II - C - III, I.
Tychoplankton: Stations C,D, 1,2.
Aufwuchs: Artificial Substrates Station A.

Merismopedia punctata Meyen 1839
Pl. 1 fig. 8

Smith 1920, page 33.
Diameter of cells 2.75 - 3.5μ.
Tychoplankton: Stations C,D.

Merismopedia tenuissima Lemmermann 1898
Pl. 1 fig. 9

Smith 1920, page 33.
Diameter of cells 1.40 - 2.34μ.
Euplankton: Stations D - I, II4 - II, II - III.
Tychoplankton: Stations C,D,5.
Aufwuchs: Artificial Substrates Station A.

Merismopedia Troleri Bachmann 1920
Prescott 1962, page 460.
Diameter of cells 3.14 - 4.0μ.
Euplankton: Station D.
Tychoplankton: Station D.

Gloeothece Naegeli 1849

Gloeothece rupestris (Lynb.) Bornet 1880

Pl. 1 fig. 11

Prescott 1962, page 462.

Diameter of cells 4.05 - 6.48μ.

Length of cells 11.34 - 12.0μ.

Euplankton: Station D.

Tychoplankton: Station D.

Rhabdoderma Schmidle & Lauterborn 1900

Rhabdoderma irregulare (Naumann) Geitler 1925

Pl. 1 fig. 13

Prescott 1962, page 463.

Diameter of cells 1.4 - 2.0μ.

Length of cells 4.0 - 5.0μ.

Euplankton: Stations D,5.

Aphanothece Naegeli 1849

Aphanothece Castagnei (de Breb.) Rabenhorst 1865

Pl. 2 fig. 5

Prescott 1962, page 467.

Diameter of cells 3.24 - 3.5μ.

Length of cells 4.86 - 5.0μ.

Euplankton: Stations C,D.

Tychoplankton: Stations C,D,5.

Aphanothece microscopica Naegeli 1849

Prescott 1962, page 468.

Diameter of cells 3.5 - 4.0μ.

Length of cells 5.0 - 6.8μ.

Euplankton: Stations C,D, I - II4, II4 - II, II - III.

<u>Aphanothece</u> <u>microspora</u> (Menegh.)Rabenhorst 1863

Pl. <u>2</u> fig. <u>4</u>

Prescott 1962, page 468.

Diameter of cells 2.4 - 2.73μ.

Length of cells 5.67 - 6.0μ.

Euplankton: Station C.

<u>Aphanothece</u> <u>nidulans</u> P. Richter 1884

Prescott 1962, page 468.

Diameter of cells 1.5 - 1.63μ.

Length of cells 3.0 - 3.24μ.

Euplankton: Station D.

<u>Aphanothece</u> <u>saxicola</u> Naegeli 1849

Prescott 1962, page 468.

Diameter of cells 1.62 - 2.07μ.

Length of cells 4.86 - 5.0μ.

Euplankton: Station C.

<u>Aphanothece</u> <u>stagnina</u> (Spiengel) A. Braun in Rabenhorst 1864 - 69

Pl. <u>2</u> fig. <u>9</u>

Prescott 1962, page 469.

Diameter of cells 3.5 - 4.0μ.

Length of cells 5.0 - 7.0μ.

Free floating colonies: Stations C,D,2,4,5,6.

<u>Coelosphaerium</u> Naegeli 1849

<u>Coelosphaerium</u> <u>Kuetzingianum</u> Naegeli 1849

Pl. <u>1</u> fig. <u>16</u>

Prescott 1962, page 470.

Diameter of cells 3.0 - 4.68μ.

Diameter of colonies 62.0 - 71.76μ.

Euplankton: Station D.

Tychoplankton: Stations C,D.

<u>Coelospharium</u> <u>Naegelianum</u> Unger 1854

Pl. <u>1</u> fig. <u>15</u>

Prescott 1962, page 470.

Diameter of cells 3.0 - 3.5μ.

Length of cells 3.5 - 5.0μ.
Euplankton: Stations C,D, I - II, III - III4.
Tychoplankton: Stations C,D.

Marssoniella Lemmermann 1900

Marssoniella elegans Lemmermann 1900
Pl. 2 fig. 7
Prescott 1962, page 471.
Diameter of cells 2.5 - 3.12μ.
Length of cells 6.24 - 7.0μ.
Euplankton: Stations C,D, I - II4, II4 - II.

Gomphosphaeria Kuetzing 1836

Gomphosphaeria aponina Kuetzing 1836
Smith 1920, page 37.
Diameter of cells at greatest width, 4.5 - 5.5μ.
Length of cells 7.5 - 9.0μ.
Euplankton: Stations C, II.
Tychoplankton: Stations C,D.

Gomphosphaeria aponina var. cordiformis Wolle 1882
Smith 1920, page 37.
Diameter of cells at greatest width, 9.0 - 10.5μ.
Length of cells 14.0 - 15.25μ.
Diameter of colonies: 49.5 - 52.5μ.
Euplankton: Station D.

Gomphosphaeria aponina var. multiplex Nygaard 1926
Pl. 1 fig. 18
Huber-Pestalozzi 1938, page 152.
Diameter of cells at greatest width, 7.5 - 8.0μ.
Length of cells 14.0 - 15.5μ.
Diameter of colony 56.0 - 63.0μ.
Euplankton: Stations D - I, C, II, 5.
Tychoplankton: Stations C,D.

Subclass B. Hormogoneae

Order Hormogonales

Suborder Homocystineae

Family Oscillatoriaceae

Spirulina Turpin 1827

Spirulina gigantea Schmidle 1902

Pl. 3 fig. 6

Desikachary 1959, page 197.

Trichomes 3.24 - 4.0μ in diameter; spirals 11.0 - 12.48μ broad.

Euplankton: Stations C,D.

Tychoplankton: Stations C,D.

Spirulina princeps (West & West) G.S. West 1907

Pl. 3 fig. 11

Prescott 1962, page 480.

Trichomes 4.26 - 5.0μ in diameter; spirals 9.36 - 10.0μ wide; distance between spirals 14.0 - 15.0μ.

Euplankton: Stations D - I.

Tychoplankton: Stations C,D.

Aufwuchs: Artificial Substrates Station A.

Spirulina subsalsa Oersted 1842

Prescott 1962, page 480.

Trichomes closely spiralled, 1.63 - 2.0μ in diameter; spirals 3.24 - 3.5μ wide.

Euplankton: Stations D - I - II, III3 - III.

Tychoplankton: Stations C,D.

Aufwuchs: Artificial Substrates Station A.

Arthrospira Stizenberg 1892

Arthrospira Jenneri Stizenb. ex Gomont 1852

Pl. 3 fig. 7

Desikachary 1959, page 192.

Trichomes 4.0 - 5.0μ wide; cells 3.24 - 4.0μ long; regularly spirally coiled; spirals 9.0 - 9.5μ wide; distance between spirals 12.96 - 13.77μ.

Euplankton: Stations D - I, II4 - II - C - III, III - D, 3.
Tychoplankton: Stations C,D,3,5.
Aufwuchs: Artificial Substrates Station A.

Oscillatoria Vaucher 1803

Oscillatoria amoena (Kuetz.) Gomont 1892

Pl. 3 fig. 13

Prescott 1962, page 484.
Trichomes 4.68 - 5.46μ in diameter; cells 3.0 - 3.12μ long.
Tychoplankton: Station D.

Oscillatoria princeps Vaucher 1803

Pl. 3 fig. 8

Prescott 1962, page 489.
Trichomes 38.38 - 40.0μ in diameter; cells 4.86 - 5.0μ in length.
Euplankton: Station C.
Tychoplankton: Stations C,D.

Oscillatoria sancta (Kuetz.) Gomont 1892

Pl. 3 fig. 10

Prescott 1962, page 490.
Trichomes 15.72 - 17.16μ in diameter; cells 3.12 - 4.0μ in length.
Intermingled with other algae on submerged vegeatation.
Station D.

Oscillatoria subbrevis Schimdle 1901

Prescott 1962, page 491.
Trichomes 5.5 - 6.0μ in diameter; cells 1.26 - 2.0μ in length.
Euplankton: Stations II4 - II.
Tychoplankton: Stations C,5.

Oscillatoria tenuis C.A. Agardh 1813

Pl. 3 fig. 12

Prescott 1962, page 491.
Trichomes 4.86 - 7.02μ in diameter; cells 3.12 - 3.24μ in length.
Euplankton: Stations C,D, I - II - III.
Tychoplankton: Stations C,D,3.
Aufwuchs: Artificial Substrates Stations A,B.

Phormidium Kuetzing 1843

Phormidium subfuscum Kuetzing 1843

Prescott 1962, page 496.

Trichomes 6.5 - 7.0μ in diameter; cells 2.0 - 2.5μ in length.

Intermingled with other algae along shore.

Station D.

Phormidum tenue (Menegh.) Gomont 1892

Prescott 1962, page 496.

Trichomes 1.5 - 2.5μ in diameter; cells 2.76 - 3.0μ in length.

On submerged vegetation along shore.

Station D.

Lyngbya Agardh 1824

Lyngbya aerugineo-coerulea (Kuetz.) Gomont 1892

Pl. 4 fig. 2

Desikachary 1959, page 315.

Filaments 6.24 - 7.0μ in diameter; Trichomes 5.46 - 6.0μ in diameter; cells 2.0 - 2.34μ in length.

Intermingled with other algae in aquatic vegetation.

Stations C,D.

Euplankton: Station C.

Lyngbya aestuarii (Mert.) Liebmann 1841

Pl. 4 fig. 1

Desikachary 1959, page 305.

Filaments 12.48 - 13.0μ in diameter; Trichomes 10.14 - 11μ in diameter; cells 3.12 - 3.5μ in length.

Among aquatic vegetation: Stations C,D,5.

Euplankton: Stations C,D - I, 5.

Tychoplankton: Stations C,D.

Aufwuchs: Artificial Substrates Station A.

Lyngbya Birgei G.M. Smith 1916

Pl. 2 fig. 10

Desikachary 1959, page 296.

Filaments 19.44 - 20.0μ in diameter; trichomes 16.0 - 17.5μ in diameter; cells 2.34 - 2.5μ in length.

Euplankton: Station D.

Lyngbya Diguetii Gomont 1895

Pl. 2 fig. 11

Desikachary 1959, page 310.

Filaments 3.24 - 3.4μ in diameter; trichomes 2.02 - 2.43μ in diameter; cells 1.5 - 1.62μ in length.

Among other algae: Stations C,D,3,5.

Euplankton: Stations C,D.

Aufwuchs: Artificial Substrates Stations A,B.

Lyngbya Hieronymusii Lemmermann 1905

Pl. 2 fig. 12

Prescott 1962, page 501.

Filaments 12.96 - 13.5μ in diameter; trichomes 10.92 - 11.0μ in diameter; cells 2.43 - 3.0μ in length.

Euplankton: Stations C,D - I - II4, II2 - II, III - D, 3,5.

Tychoplankton: Stations C,D,1.

Lyngbya Lagerheimii (Moebius) Gomont 1890

Pl. 4 fig. 3

Prescott 1962, page 501.

Filaments 2.0 - 2.48μ in diameter; trichomes 2.2 - 2.30μ in diameter; cells 2.43μ in length.

Intermingled with other algae: Station D.

Lyngbya major Meneghini 1837

Pl. 2 fig. 13

Prescott 1962, page 502.

Filaments 16.38 - 21.64μ in diameter; trichomes 14.06 - 16.20μ in diameter; cells 2.34 - 3.24μ in length.

Euplankton: Stations C,D, D - I.

Tychoplankton: Stations C,D.

Intermingled with other algae: Stations C,D.

Lyngbya Martensiana Meneghini 1837

Pl. 4 fig. 4

Prescott 1962, page 502.

Filaments 8.10 - 10.92μ in diameter; trichomes 6.48 - 9.36μ in

diameter; cells 2.5 - 3.1μ in length.
Euplankton: Stations C,C - III, II4 - II, D - I.
Tychoplankton: Stations C,D.

Lyngbya Nordgaardii Wille 1918
Prescott 1962, page 503.
Filaments 1.62 - 2.0μ in diameter; trichomes 1.34 - 1.5μ in diameter; cells 1.2 - 1.3μ in length.
Among other algae along the shore: Station D.

Microcoleus Desmazieres 1823

Microcoleus lacustris (Rab.) Farlow 1877
Pl. 3 fig. 9
Prescott 1962, page 505.
Filaments 35.5 - 37.0μ wide; trichomes 3.12 - 4.0μ in diameter; cells 4.68 - 6.24μ in length.
Intermingled with other algae along the shore: Station D.

Suborder Heterocystineae
Family Nostocaceae
Anabaena Bory 1822

Anabaena catenula (Kuetz.) Bornet & Flahault 1888
Pl. 3 fig. 3
Huber-Pestalozzi 1938, page 215.
Cells 6.48 - 8.10μ in diameter; heterocysts 6.48 - 8.5μ in diameter; gonidia 8.10 - 9.72μ in diameter, 25.0 - 27.54μ in length.
Tychoplankton: Station 5.

Anabaena circinalis Rabenhorst 1852
Pl. 3 fig. 5
Huber-Pestalozzi 1938, page 214.
Cell diameter 7.29 - 8.0μ ; heterocysts 8.0 - 9.72μ in diameter; gonidia 14.5 - 15.60μ in diameter; 27.5 - 31.2μ in length.
Aufwuchs: Artificial Substrates Station A.

Anabaena flos-aquae (Lyngb.) de Breb. 1836
Reported by Tucher (1957).

Anabaena macrospora var. robusta Lemmermann 1898

Pl. 3 fig. 4

Huber-Pestalozzi 1938, page 209.

Cells 9.72 - 10.0μ in dimaeter; heterocysts 11.34 - 12.0μ in diameter; gonidia 17.84 - 18.0μ in diameter; 32.76 - 34.02μ in length.

Euplankton: Stations C,D.

Anabaena Schermetievi Elenkin 1909

Pl. 3 fig. 2

Huber-Pestalozzi 1938, page 207.

Cells 9.36 - 10μ in diameter; heterocysts 9.2 - 9.5μ in diameter; gonidia 12.48 - 18.72μ in diameter; 18.72 - 19.5μ in length.

This plant is very similar to var. incurvata fa. ovalispora Schkorbat.

Euplankton: Station D.

Anabaena subcylindrica Borge 1921

Pl. 3 fig. 1

Huber-Pestalozzi 1938, page 210.

Cells 3.24 - 4.0μ in diameter; 6.48 - 8.10μ in length; heterocysts 3.24 - 3.5μ in diameter; gonidia 6.48 - 7.0μ in diameter; 50.2 - 56.70μ in length.

The size of the vegetative cells of this plant, plus the fact that the gonidia can occur in a series, suggest that this plant is A. cylindrica Lemm., however the gonidia of A. cylindrica do not exceed 30μ, and this plant clearly shows the gonidia A. subcylindrica; for this reason it is placed here.

I suspect that these two species may be one, with two or more different morphological expressions.

Euplankton: Station C.

Anabaena sp.

Not determinable due to lack of spores.

Vegetative cells 3.0 - 3.4μ in diameter; cells 2.43 - 2.5μ in length; heterocysts 3.24 - 3.4μ in diameter; 6.48μ long.

Euplankton: Stations C,D, I.

Aufwuchs: Artificial Substrates Stations A,B.

Nostoc Vaucher 1903

Nostoc paludosum Kuetzing ?

Prescott 1962, page 524.

Cells 3.2 - 4.6μ in diameter; heterocysts ovate, 4.68μ in diameter;

This plant placed here on the basis of size and habit.

Euplankton: Stations C,D - I - II4.

Tychoplankton: Stations D,4,5.

Aphanizomenon Morren 1838

Aphanizomenon flos-aquae (L.) Ralfs 1850

Prescott 1962, page 528.

Cells 5.5 -6.0μ in diameter; 7.85 - 9.0μ in length.

Heterocysts 7.0μ in diameter; 12.5 - 13.0μ long.

Tychoplankton: Station D.

Family Scytonemataceae

Scytonema C.A. Aagardh 1824

Scytonema crispum (C.A.Ag.) Bornet 1889

Pl. 4 fig. 7

Prescott 1962, page 535.

Filaments 20.0 - 21.84μ in diameter; trichomes 14.04 - 15.0μ in diameter; cells 3.0 - 3.9μ in length; heterocysts 17.16 - 18.0μ in diameter; 17.16μ long.

Intermingled with other algae: Station D.

Tolypothrix Kuetzing 1843

Tolypothrix limbata Thuret in Bornet & Flahault 1887

Pl. 4 fig. 6

Prescott 1962, page 538.

Filaments 9.72 - 10.5μ in diameter; trichomes 5.67 - 6.48μ in diameter; cells 4.5 -5.0μ in length; heterocysts 7.0 - 9.72μ in diameter.

Entangled among aquatic vegetation: Stations C,D,4,5.

Free floating: Stations II - C.

Tolypothrix tenuis Kuetzing emend J. Schmidt 1899

Pl. 4 fig. 8

Prescott 1962, page 538.

Filaments 12.48 - 14.0μ in diameter; trichomes 4.68 - 7.08μ in diameter; cell length 3.12 - 6.24μ; heterocysts 6.24 - 7.08μ in diameter; 8.0 - 12.48μ long.

Iam following J. Schmidt (1899), who included T. Lanata in T. tenuis, when he redescribed the latter species.

Water blooms covering stations: C,6,7.

Free floating: Stations II - III, D - I - II4.

Tychoplankton: Stations C,D,1,6,7.

Plectonema Thuret 1875

Plectonema nostocorum Bornet 1880

Pl.4 fig. 10

Prescott 1962, page 539.

Filaments 1.5 - 2.0μ in diameter; cells 1.2 - 1.5μ in diameter; 1.42 - 2.0μ long.

Inhabiting the mucilage of Aphanothece stagnina.

Plectonema notatum Schmidle 1902

Prescott 1962, page 540.

Filaments 1.76 - 2.0μ in diameter; trichomes 1.2 - 1.7μ in diameter; cells 2.5 - 3.0μlong.

Among other algae.

Euplankton: Stations D - I, II - III - D, C, 5.

Tychoplankton: Stations C,D,1,2,3,4,5,6,7,8.

Aufwuchs: Artificial Substrates Station A.

Family Stigonemataceae

Hapalosiphon Naegeli 1849

Hapalosiphon sp.

Prescott 1962, page 543.

Filaments 6.48 - 7.0μ in diameter; cells ovate 4.86 - 5.0μ in diameter; Not enough material in the proper condition, seen, to identify the species.

Intermingled with other algae along the shore: Station D.

Family Rivulariaceae

Calothrix C.A.Agardh 1824

Calothrix Braunii Bornet & Flahault 1886

Pl. 4 figs. 12 & 13

Poljanski 1953, page 360.

Filaments 9.36 - 10.92μ in diameter at the base; trichomes 6.24 - 7.80μ in diameter; heterocysts 4.68 - 6.24μ in diameter.

This plant had its sheaths colored a yellowish brown at the base, which is not characteristic for this species according to the description. However, Poljanski, mentions that the sheaths can rarely be colored.

On submerged vegetation: Station C.

Calothrix Castellii (Massal.) Bornet & Flahault 1886

Pl. 4 fig. 14

Geitler 1932, page 611.

Filaments 10.92 - 12.0μ in diameter at the base; trichomes 8.58 - 9.0μ in diameter at the base, and 4.68 - 5.0μ at the mid-region. Heterocysts 8.21 - 8.5μ in diameter, 6.24 - 6.5μ long.

Attached to the mucilage of Tetraspora.

Calothrix fusca (Kuetz.) Bornet & Flahault 1886

Pl. 4 fig. 11

Geitler 1932, page 610.

Filaments 10.4 - 12.0μ in diameter at the base; trichomes 7.80 - 8.1μ in diameter at the base; cells 3.12 - 3.5μ long at the base; heterocysts 7.8 - 8.0μ in diameter.

Attached to the mucilage or in the mucilage of other algae.

Stations C,D,2,3.

Calothrix parietina (Naeg.) Thuret 1875

Pl. 4 fig. 9

Geitler 1932, page 605.

Filaments 9.36 - 10μ in diameter at the base; trichomes 7.8 - 8.0μ in diameter at the base; cells 2.5 - 3.12μ long at the base; heterocysts 6.24 - 6.5μ in diameter.

On pilings near Station I.

Calothrix scytonemicola Tilden 1910

Pl. 4 fig. 5

Tilden 1910, page 265.

Filaments 8.10 - 8.5μ in diameter at the base; trichomes at the base 7.5 - 8.0μ in diameter; heterocysts 8.10μ in diameter.

On submerged vegetation: Station 5.

Division Chrysophyta

Class Xanthophyceae

Order Heterococcales

Family chlorotheciaceae

Ohiocytium Naegeli 1849

Ophiocytium cochleare (Eichw.) A.Braun 1855

Pl. 5 fig. 4

Pascher in Rabenhorst's Kryptogamen Flora

Vol. XI Heterokonten 1939, page 887.

Cells 7.80 - 8.58μ in diameter.

Tychoplankton: Stations C,5.

Aufwuchs: Artificial Substrates Station A.

Ophiocytium desertum Printz 1914

Pl. 5 fig. 7

Pascher in Rabenhorst's Kryptogamen Flora

Vol. XI Heterokonten 1939, page 905.

Cells 10.92 - 12.0μ in diameter; 48.36 - 51.48μ long.

Attached to aquatic vegetation: Stations 4,5.

Ophiocytium gracilipes Rabenhorst 1868

Pl. 5 fig. 6

Pascher in Rabenhorst's Kryptogamen Flora.

Vol. XI Heterokonten 1939, page 901.

Cells 7.80 - 8.0μ in diameter; 45.24 - 47.0μ in length.

Attached, epiphytic upon other algae; Station 1-5.

Ophiocytium majus Naegeli 1849

Pl. 5 fig. 5

Prescott 1962, page 365.

Cells 15.60 - 18.72μ in diameter; 260.30 - 569.10μ in length.

Tychoplankton: Stations 3,4,5.

Order Heterotrichales

Family Tribonemataceae

Tribonema Derbes & Solier 1856

Tribonema bombycinum (C.A.Ag.) Derbes & Solier 1856

Pl. 5 fig. 3

Prescott 1962, page 367.

Filaments 6.48 - 8.10μ in diameter; cells 23.40 - 28.35μ long.

Intermingled with other algae and higher aquatic plants; Stations 3,4,5.

Tribonema minus (Wille) Hazen 1902

Pl. 5 fig. 1

Prescott 1962, page 368.

Filaments 5 - 6.24μ in diameter; cells 21.84 - 26.52μ in length.

In shallow water of the lake intermingled with aquatic vegetation: Stations: C, 1,2,3,4,5.

Tribonema utriculosum (Kuetz.) Hazen 1902

Pl. 5 figs. 2 & 12

Prescott 1962, page 368.

Filaments 15.60 - 16.0μ in diameter; cells 29.64 - 32.76μ in length.

In shallow water of the lake: Stations C,3,4,5.

Tribonema viride Pascher 1925

Pascher in Rabenhorst Kryptogamen Flora XI Heterokonten 1939, page 975.

Filaments 12.48 - 13.0μ in diameter; cells 28.08 - 34.32 - 57.72μ in length.

Intermingled with other algae and higher aquatic vegetation: Stations C,1,2,3,4,5.

Order Heterosiphonales

Family Vaucheriaceae

Vaucheria De Candolle 1805

Vaucheria geminata (Vauch.) De Candolle 1805

Pl. 5 fig. 8

Prescott 1962, page 292.

Filaments 81.0 - 85.80μ in diameter; oogonia 80.52μ in diameter; 81.12μ long.

Floating mats in shallow areas of the lake and intermingled with aquatic vegetation: Stations C,D,1,4,5.

Class Chrysophyceae

Order Chrysomonadales

Suborder Isochrysidineae

Family Synuraceae

Synura Ehrenberg 1838

Synura uvella Ehrenberg 1838

Prescott 1962, page 376.

Cells 12.84 - 14.04μ in diameter; 20.28 - 21.84μ in length.

Euplankton: Stations D,I,III4 - D, 1,2,3.

Suborder Ochromonodineae

Family Ochromonadaceae

Dinobryon Ehrenberg 1835

Dinobryon cylindricum Imhof 1883 ex Ahlstrom 1937

Pl. 5 fig. 9

Prescott 1962, page 378.

Loricas 8.58 - 10.5μ in diameter at the mouth 28.08 - 42.0μ long.

Euplankton: Stations C,D,D - I - II - III.

Tychoplankton: Stations C,D,1,5.

Dinobryon divergens Imhof 1887

Pl. 5 fig. 11

Prescott 1962, page 378.

Loricas 7.80 - 10.5μ in diameter at the mouth; widest point at mid-region 10.5μ in diameter; loricas 35.88 - 39.0μ long.

Euplankton: Stations C,D,D - I - II, II -III, III - D.

Dinobryon sertularia Ehrenberg 1835

Pl. 5 fig. 13

Prescott 1962, page 378.

Loricas 9.36 - 10.0μ in diameter at the mouth; 29.60 - 32.76μ in length.

Euplankton: Stations C,D,D - I, I - II, II -III, III - D,5.

Tychoplankton: Stations C,D.

Aufwuchs: Artificial Substrates Stations A,B.

Dinobryon sociale Ehrenberg 1835

Pl. 5 fig. 10

Prescott 1962, page 379.

Loricas 8.52 - 9.72μ in diameter at the mouth; 32.40 - 53.04μ in length.

Euplankton: Stations C,D,D - I - I4, I4 - II, II - III, III - D.

Class Bacillariophyceae

The Diatoms collected in the course of this study were identified to genus. They were found in all the variety of habitats in the lake: Euplankton, Tychoplankton, and Aufwuchs, throughout the year.

Order Centrales

Suborder Coscinodiscaceae

Family Coscinodiscaceae

Melosira varians Ag.

Reported by Tucker (1957).

Order Pennales

Suborder Fragilarineae

Family Tabellariaceae

Diatomella Greville 1855

Family Diatomaceae

Diatoma De Candolle 1805

Family Fragilariaceae

Asterionella formosa Hass.

Reported by Tucker (1957)

Fragilaria Lyngbye 1819; emend., Rabenhorst 1864

Fragilaria crotonesis Kitt.

Reported by Tucker (1957)

Synedra Ehrenberg 1830

Synedra pulchella var. longissima W. Smith

Reported by Tucker (1957)

Suborder Achnanthineae

Family Achnanthaceae

Achnanthes Bory 1822

Cocconeis Ehrenberg 1838

Suborder Naviculineae

Family Naviculaceae

Navicula Bory 1822

Pinnularia Ehrenberg 1840

Family Gomphonemataceae

Gomphonema Agardh 1824

Family Cymbellaceae

Amphora Ehrenberg 1840

Cymbella Agardh 1830

Epithemia De Brebisson 1838

Rhopalodia O. Muller 1895

Suborder Surirellineae

Family Nitzschiaceae

Nitzschia Hassall 1845

Family Surirellaceae

Cymatopleura W. Smith 1851

Division Pyrrhophyta

Class Dinophyceae

Order Peridiniales

Family Peridinaceae

Peridinium Ehrenberg 1832

Peridinium bipes Stein 1883

Pl. 6 fig. 5

Schiller in Rabenhorst's Kryptogamen Flora
Band X, 2. Teil, 1937, page 158.

Cells 65.52 - 67.08μ in diameter; 67.08 - 70.20μ in length.
Tychoplankton: Stations 4,5.
New record for Michigan.

Peridinium inconspicuum Lemmermann 1899

Pl. 6 fig. 4

Schiller in Rabenhorst's Kryptogamen Flora
Band X, 2. Teil, 1937, page 173.
Cells 24.96 - 28.08μ in length; 18.72 - 21.84μ in diameter.
Euplankton: Stations D - I - I4, II4 - II - C, II - III.
Tychoplankton: Stations C,D,1,2,4,5.

Peridinium umbonatum Stein 1883

Pl. 6. fig. 3

Schiller in Rabenhorst's Kryptogamen Flora
Band X, 2. Teil, 1937, page 171.
Cells 20.78 - 26.52μ in diameter; 23.40 - 29.62μ in length.
Euplankton: Stations I - II, II4 - II - C, II - III.
Tychoplankton: Stations C - D, 1,2,4,5.
New record for Michigan.

Peridinium Volzii Lemmermann 1905

Pl. 6 fig. 2

Schiller in Rabenhorst's Kryptogamen Flora
Band X, 2. Teil, 1937, page 171.
Cells 51.48 - 53.04μ in diameter; 53.46 - 54.60μ in length.
Euplankton: Station 5.
Tychoplankton: Station 5.
New record for Michigan.

Peridinium Willei Huitf. - Kaas. 1900

Pl. 6 fig. 1

Schiller in Rabenhorst's Kryptogamen Flora
Band X, 2. Teil, 1937, page 147.
Cells 48.60 - 54.60μ in diameter; 50.72 - 54.60μ in length.
Euplankton: Stations C,5.
Tychoplankton: Stations 4,5.

Family Ceratiaceae

Ceratium Schrank 1793

Ceratium hirundinella (O.F.Muell.) Dujardin 1841

Pl. 6 figs. 6 & 7

Prescott 1962, page 437.

Cells varying in size and morphological shape depending upon the environmental conditions; 202.75 - 226.05μ in length.

Euplankton: Stations C,D,D - I - II - III, III - D,6,7.

Tychoplankton: Stations C,D.

Water bloom proportions at stations C,6,7.

Associated with fish kill.

Division Euglenophyta

Class Euglenophyceae

Order Euglenales

Family Euglenaceae

Euglena Ehrenberg 1838

Euglena acus Ehrenberg 1838

Pl. 9 fig.4

Gojdics 1953, page 99.

Cells 6.75 - 9.72μ in diameter; 91.04 - 134.20μ in length.

Tychoplankton: Station D.

Euglena oxyuris Schmarda var. minor Prescott 1944

Pl. 9 fig.3

Presçott 1962, page 393.

Cells 15.60 - 17.16μ in diameter; 79.56 - 81.12μ in length.

In shallow water at station C.

Euglena spp.

There were at least four other species of Euglena present in the lake, but they were not identifiable due to lack of material showing the necessary taxonomic characters.

Shallow water: Station D,5.

Euplankton: Station D.

Phacus Dujardin 1841

Phacus acuminatus Stokes 1885

Pl. 8 fig. 3

Prescott 1962, page 396.

Cells 20.28 - 21.84μ in diameter; 25.25 - 28.08μ in length.

In shallow water, along the shore of station: D.

Euplankton: Station D.

Phacus ankylonaton Pochmann 1942

Pl. 8 fig. 13

Huber-Pestalozii 1955, page 196.

Cells 23.40 - 24.30μ in diameter; 43.68 - 45.36μ in length.

Slightly larger than the typical.

In shallow water of station 6.

New record for North America, previously reported from Poland, Czechoslovakia.

Phacus caudatus Huebner 1886

Pl. 8 fig. 5

Prescott 1962, page 398.

Cells 17.16 - 21.84μ in diameter; 35.0 - 43.68μ in length.

Euplankton: Stations C,D.

Tychoplankton: Stations C,D.

Phacus contortus var. complicata Bourrelly 1952

Pl. 7 fig. 1

Huber-Pestalozii 1955, page 205.

Cells 32.40 - 34.02μ in diameter; 43.74 - 46.98μ in length.

This is a new record for North America, the species, along with its two varieties, has only been reported twice; by Bourrelly in 1952, (Guadeloupe) and 1961 (Cote d'Ivoire.)

The alga resembles var. complicata as illustrated by Bourrelly in G.Huber-Pestalozzi 1955, but it is slightly larger in all measurements.

Tychoplankton: Station D.

<u>Phacus</u> <u>gigas</u> Da Cunha 1913

Pl. <u>7</u> fig. <u>3</u>

Huber-Pestalozzi 1955, page 210.

Cells 72.90 - 74.95μ in diameter; 116.45 - 123.12μ in length.

Slightly longer than measurements given for this species.

Tychoplankton: Station C.

<u>Phacus</u> <u>lismorensis</u> Playfair 1921

Pl. <u>7</u> fig. <u>4</u>

Huber-Pestalozzi 1955, page 219.

Cells 35.60 - 37.0μ in diameter; 114.07 - 123.30μ in length.

A new record for North America, previously reported from Australia, Europe, Russia and Java. The measurements larger than those in the original description, agree with those given by Skuja 1948.

Tychoplankton: Stations C,D,5.

<u>Phacus</u> <u>longicauda</u> (Ehrenb.) Dujardin 1841

Pl. <u>7</u> figs. <u>7</u> & <u>8</u>

Huber-Pestalozzi 1955, page 220.

Cells 45.24 -49.92μ in diameter; 78.00 - 79.56μ in length.

Euplankton: Station C.

Tychoplankton: Station C.

<u>Phacus</u> <u>longicauda</u> var. <u>insecta</u> Koczwara 1915

Pl. <u>7</u> figs. <u>5</u> & <u>6</u>

Huber-Pestalozzi 1955, page ?

Cells 41.31 - 45.24μ in diameter; 106.08 - 123.12μ in length.

New record for North America, previously found in Poland, South Africa and Java.

Tychoplankton: Stations D,4.

<u>Phacus</u> <u>longicauda</u> var. <u>major</u> Swirenko ?

Pl. <u>8</u> fig. <u>18</u>

Huber-Pestalozzi 1955, page ?

Cells 46.98 - 63.78μ in diameter; 147.62 - 150.70μ in length.

This plant was slightly smaller in length than the measurements given for the variety, however, it is so large, and fits well otherwise, that it is placed here.

New record for North America, previously reported in Russia, Australia and Venezuela.

Euplankton: Station II.

Tychoplankton: Station C.

<u>Phacus</u> <u>orbicularis</u> Huebner 1886

Pl. <u>8</u> fig. <u>1</u>

Prescott 1962, page 401.

Cells 34.83 - 35.64μ in diameter; 50.22 - 51.84μ in length.

Euplankton: Stations II4 - II, III - D.

Tychoplankton: Stations D,4,5.

<u>Phacus</u> <u>orbicularis</u> fa.

Pl. <u>8</u> fig. <u>2</u>

Cells 29.64 - 30.0μ in diameter; 45.24 - 46.0μ in length.

Tychoplankton: Station D.

<u>Phacus</u> <u>platalea</u> Drezepolski 1925

Pl. <u>8</u> fig. <u>7</u>

Huber-Pestalozzi 1955, page 210.

Cells 24.96 - 25.0μ in diameter; 35.88 - 36.0μ in length.

Entered here with a question mark because not enough material was seen.

Tychoplankton: Station D.

<u>Phacus</u> <u>pleuronectes</u> (O.F.M.) Dujardin 1841

Pl. <u>8</u> fig. <u>4</u>

Huber-Pestalozzi 1955, page 211.

Cells 42.12 - 61.56μ in length; 31.20 - 43.74μ in diameter.

Tychoplankton: Station D.

<u>Phacus</u> <u>pseudowirenkoi</u> Prescott 1944

Pl. <u>8</u> fig. <u>8</u>

Prescott 1962, page 402.

Cells 27.54 - 32.40μ in diameter; 42.12 - 43.68μ in length.

Tychoplankton: Stations C,II.

<u>Phacus</u> <u>rudicula</u> (Playf.) Pochm. 1942

Pl. <u>7</u> fig. <u>2</u>

Huber-Pestalozzi 1955, page 233.

Cells 15.60 - 16.0μ in diameter; 39.0 - 43.74μ in length.

New record for North America, previously reported in Central Europe and Australia.

Tychoplankton: Station D.

Phacus setosus France ?

Pl. 8 fig. 6

Huber-Pestalozzi 1955, page 191.

Cells 17.16 - 17.5μ in diameter; 26.52 - 32.76μ in length.

Tychoplankton: Station D.

Phacus tortus (Lemm.) Skvortzow 1928

Pl. 7 fig. 9

Prescott 1962, page 404.

Cells 51.84 - 52.0μ in diameter; 101.40 - 102.75μ in length.

Tychoplankton:Station D.

Phacus undulatus (Skv.) Poch. 1942

Pl. 8 fig. 12

Huber-Pestalozzi 1955, page 214.

Cells 37.44 - 38μ in diameter; 57.72 - 58μ in length.

Tychoplankton: Station D.

Phacus unguis Poch. 1942 ?

Pl. 8 fig. 11

Huber-Pestalozzi 1955, page 217.

Cells 20.28 - 21.84μ in diameter; 31.20 - 32.76μ in length.

New record for North America previously reported in Hungary and South America.

Tychoplankton: Station D.

Phacus sp. A. - Pl. 8 fig. 15

Cells 15.60 - 16.0μ in diameter; 34.32 - 35.0μ in length.

This is possibly a new variety of Ph. undulatus.

Tychoplankton: Station D.

Phacus sp B - Pl. 8 fig. 16

Cells 22.68 - 23.0μ in diameter; 38.07 - 38.5μ in length.

Possibly another variety of Ph. undulatus.

Tychoplankton: Station C.

Phacus sp.C - Pl. 8 fig. 19

Cells 23.49 - 24.0μ in diameter; 42.12 - 43.0μ in length.

Possibly another variety in the Ph. undulatus species complex.

Tychoplankton: Station 4.

Phacus sp. D - Pl. 8 fig. 10

Cells 23.40 - 24μ in diameter; 39.0 - 40.56μ in length.

A large paramylon plate in the center of the cell, several small paramylon rings.

A new variety of Ph. undulatus ?

Tychoplankton: Station C.

Phacus sp. E - Pl. 8 fig. 9

Cells 20.25 - 21.0μ in diameter; 30.78 - 31.0μ in length.

Periplast longitudinally striated; margin of the cells notched just above medium line; paramylon bodies 5 rings Sp. Nov.?

Tychoplankton: Station D.

Phacus sp. F - Pl. 8 fig. 14

Cells 28.08 - 29.16μ in diameter; 34.32 - 38.0μ in length.

Periplast longitudinally striated; margins notched; paramylon bodies, 2-3 rings.

Tychoplankton: Station D.

Phacus sp. G - Pl. 8 fig. 17

Cells 18.72 - 20.28μ in diameter; 34.32 - 39.0μ in length; 2-3 paramylon bodies.

This may ben an expression of Ph. ankylonoton.

Tychoplankton: Stations C,D.

Phacus sp. H - Pl. 9 fig. 18

Cells 21.06 - 22.0μ in diameter; 34.32 - 35.0μ in length.

Close to Ph. applanatus Poch.

Tychoplankton: Station D .

Phacus sp. I - Pl. 9 fig. 20

Cells 29.36 - 30μ in diameter; 87.37 - 90.0μ in length.

Appears similar to Ph. filicauda Poch., but not enough material seen.

Tychoplankton: Station D.

Lepocinclis Perty 1849

Lepocinclis ovum (Ehrenb.) Lemmermann 1901

Pl. 9 fig. 1

Prescott 1962, page 407.

Cells 12.96 - 13.0μ in diameter; 22.68 - 24.30μ in length.

Tychoplankton: Station 3.

Trachelomonas Ehrenberg 1835

Trachelomonas australica var. rectangularis Deflandre 1926

Pl. 9 fig. 10

Huber-Pestalozzi 1955, page 304.

Test 19.56 - 20.28μ in diameter; 32.76 - 33.0μ in length.

Tychoplankton: Stations D,1.

Trachelomonas bulla (Stein) Deflandre 1926

Pl. 9 fig. 11

Huber-Pestalozzi 1955, page 340.

Test 21.06 - 22μ in diameter; 32.40 - 33μ in length.

Tychoplankton: Station 5.

Trachelomonas cylindrica Ehrenberg ?

Pl. 9 fig. 9

Prescott 1962, page 412.

Test 11.0 - 11.34μ in diameter; 30.0 - 32.40μ in length.

This plant is longer than measurements given for the species.

Tychoplankton: Station 4.

Trachelomonas Dybowskii Drezepolsi 1922

Pl. 9 fig. 5

Prescott 1962, page 412.

Test 16.0 - 16.20μ in diameter; 19.02 - 19.44μ in length.

Euplankton: Station D.

Tychoplankton: Stations C,D.

Trachelomonas hispida (Perty) Stein 1883

Pl. 9 fig. 6

Prescott 1962, page 414.

Test 21.84 - 23.40μ in diameter; 23.40 - 27.30μ in length.

Euplankton: Station D.

Tychoplankton: Stations D,1,2.

Trachelomonas hispida var. duplex Deflandre 1926

Pl. 9 fig. 7

Huber-Pestalozzi 1955, page 295.

Test 19.50 - 20.0μ in diameter; 26.52 - 27.0μ in length.

Tychoplankton: Station D.

Trachelomonas obovata var. Klebsiana Deflandre 1926

Pl. 9 fig. 13

Huber-Pestalozzi 1955, page 316.

Test 16.20 - 16.5μ in diameter; 24.30 - 25.0μ in length.

Tychoplankton: Station C.

Trachelomonas planctonica var. oblonga Drezepolski 1921-22

Pl. 9 fig. 12

Huber-Pestalozzi 1955, page 328.

Test 19.44 - 20.28μ in diameter; 28.24 - 31.20μ in length.

Tychoplankton: Station D.

Trachelomonas pulcherrima Playfair 1916

Pl. 9 fig. 8

Huber-Pestalozzi 1955, page 289.

Test 17.5 - 18.72μ in diameter; 35.0 - 35.88μ in length.

Measurements larger than those given for the species but looks the same.

Tychoplankton: Station D.

Trachelomonas splendidissima Middelh. 1948

Pl. 9 fig. 15

Huber-Pestalozzi 1955, page 287.

Test 18.72 - 19.5μ in diameter; 29.62 - 32.76μ in length.

Tychoplankton: Station D.

Trachelomonas volvocina Ehrenberg 1933

Pl. 9 fig. 14

Prescott 1962, page 419.

Test 18.63 - 20.0μ in diameter.

Tychoplankton: Station D,4.

Trachelomonas volvocinopsis var. punctata (Skv.) Bourrelly 1952
Pl. 9 fig. 16

Huber-Pestalozzi 1955, page 254.
Test 20.5 - 22.68μ in diameter.
Tychoplankton: Station 4.

Family Peranemaceae

Anisonema Dujardin

Anisonema sp. - Pl. 9 fig. 17

Cells 17.16 - 17.5μ in diameter; 31.20 - 32.0μ in length.
Tychoplankton: Station D.

Division Chlorophyta

Class Chlorophyceae

Order Volvocales

Family Chlamydomonadaceae

Chlamydomonas Ehrenberg 1835

Chlamydomonas pseudopertyi Pascher 1927
Pl. 9 fig. 20

Prescott 1962, page 72.
Cells 20.28 - 21.06μ in diameter;
Tychoplankton: Station C.

Family Volvocaceae

Pandorina Bory 1824

Pandorina morum (Muell.) Bory 1824

Prescott 1962, page 75.
Cells 10.92 - 11.59μ in diameter; 13.24 - 14.04μ in length.
Tychoplankton: Station D.

Eudorina Ehrenberg 1832

Eudorina elegans Ehrenberg 1832
Pl. 9 fig. 21

Prescott 1962, page 76.
Cells 19.48 - 20.28μ in diameter.

Colonies up to 123.30μ in diameter.
Euplankton: Stations II - III, 5.

Order Tetrasporales
Family Palmellaceae
Sphaerocystis Chodat 1897

Sphaerocystis Schroeteri Chodat 1897
Pl. 18 fig. 5

Prescott 1962, page 83.
Cells 7.8 - 8.10μ in diameter.
Euplankton: Stations C,D.
Tychoplankton: Stations C, 1,4.
Aufwuchs: Artificial Substrates Station A.

Gloeocystis Naegeli 1849

Gloeocystis gigas (Kuetz.) Lagerheim 1883
Prescott 1962, page 84.
Cells 9.36 - 11.34μ in diameter.
Euplankton: Station 4.
Tychoplankton: Stations 4,5.

Family Tetrasporaceae
Tetraspora Link 1809

Tetraspora gelatinosa (Vauch.) Desvaux 1818
Prescott 1962, page 88.
Cells 3.12 - 4.68μ in diameter in young plants. Cells 10.92 - 12.48μ in diameter in older plants.
Attached to sunken logs, and aquatic vegetation: Stations D, 1,2,3,4.
Aufwuchs: Artificial Substrates Station A.

Family Coccomyxaceae
Chlorosarcina Gerneck 1907

Chlorosarcina consociata (Klebs.) G.M.Smith 1933
Smith 1930, page 135.
Cells 11.34 - 14.58μ in diameter.
Placed here with a question mark, not enough material seen,

nor enough literature on this species available.

Tychoplankton: Station D.

Elakatothrix Wille 1898

Elakatothrix viridis (Snow) Printz 1914

Prescott 1962, page 93.

Cells 4.68 - 6.24μ in diameter; 24.96 - 26.52μ in length.

Euplankton: Station I.

Aufwuchs: Artificial Substrates Station A.

Dispora Printz 1914

Dispora crucigenioides Printz 1914

Pl. 12 fig. 2

Prescott 1962, page 93.

Cells 3.24 - 3.5μ in diameter; 4.86 - 5.0μ in length.

Euplankton: Stations II - III.

Tychoplankton: Station D.

Aufwuchs: Artificial Substrates Station A.

Order Ulotrichales

Suborder Ulotrichineae

Family Ulotrichaceae

Ulothrix Kuetzing 1833

Ulothrix tenerrima Kuetzing 1843

Pl. 19 fig. 1

Prescott 1962, page 96.

Filaments 6.48 - 7.29μ in diameter; cells 9.72 - 10.92μ in length.

Intermingled with other algae along the shore: Station D.

Tychoplankton: Station D.

Suborder Schizomeridineae

Family Schizomeridaceae

Schizomeris Kuetzing 1843

Schizomeris Leibleinii Kuetzing 1843

Prescott 1962, page 105.

Filaments 20.28 - 24.96μ in diameter toward the base; 48.36 - 56.16μ in the multiseriate portion further up.

Cells 15.60 - 21.84μ in diameter.

Shallow water of lake shore: Stations C,D,4.

Order Microsporales

Family Microsporaceae

Microspora Thuret 1850

Microspora elegans Hansgirg 1891

Pl. 19 fig. 2

Prescott 1962, page 107.

Cells 14.58 - 15.0μ in diameter; 22.68 - 23.0μ in length.

Intermingled with other algae along the shore.

Euplankton: Station D.

Microspora tumidula Hazen 1902

Pascher 1914, Heft 6: Chlorophyceae III, page 151.

Cells 6.24 - 7.0μ in diameter; 10.92 - 11.0μ in length.

Shallow water along shore intermingled with other aquatic vegetation: Station C.

Microspora Willeana Lagerheim in De Toni 1889

Prescott 1962, page 108.

Cells 12.48 - 12.5μ in diameter; 14.04 - 15.60μ in length.

Intermingled with other algae in Plankton Sample: Station D.

Order Cylindrocapsales

Family Cylindrocapsaceae

Cylindrocapsa Reinsch. 1867

Cylindrocapsa geminella Wolle 1887

Pl. 19 fig. 3

Prescott 1962, page 110.

Cells 12.48 - 12.5μ in diameter; 20.28 - 20.5μ in length.

Entangled with other algae: Station 5.

Aufwuchs: Artificial Substrates Station A.

Order Chaetophorales

Family Chaetophoraceae

Stigeoclonium Kuetzing 1843

Stigeoclonium fascicular Kuetzing 1847

Islam 1960, page 214.

Reported by Islam in thesis titled "A Revision of Stigeoclonium and Critical Studies in Related Genera" Michigan State University.

Stigeoclonium flagelliferum Kuetzing 1895

Prescott 1962, page 115.

Cells 12.48 - 17.16μ in diameter; 49.92 - 88.92μ in length, in the main filament.

Attached to stones and wood along the shore: Station D.

Stigeoclonium lubricum (Dillw.) Kuetzing 1845

Prescott 1962, page 115.

Cells along the main axis 10.22 - 11.5μ in diameter; 25.92 - 26.52μ in length.

Attached to stones along the lake shore: Stations C,D,3,4,5.

Stigeoclonium tenue (C.A.Ag.) Kuetzing 1843

Pl. 18 fig. 1

Prescott 1962, page 115.

Cells of the main axis 7.80 - 9.36μ in diameter; 12.48 - 18.72 - 21.84μ in length.

Attached to stones and logs along the lake shrore: Stations C,D,1.

In plankton samples: Stations C,D.

Draparnaldia Bory 1808

Draparnaldia glomerata (Vauch.) C.A.Agardh 1812

Pl. 19 fig. 7

Prescott 1962, page 120.

Cells of the main filaments 54.60 - 55.0μ in diameter; 84.24 - 116.45μ in length.

Cells of the fascicles 7.80 - 9.36μ in diameter.

Lake shore: Stations 1,2,3.

In the shallow water along the lake shore, where an underground stream flows into the lake: Station C.

Family Coleochaetaceae

Coleochaete De Brebisson 1844

Coleochaete orbicularis Pringsheim 1860

Prescott 1962, page 129.

Cells 10.92 - 11.86μ in diameter; 12.48 - 13.5μ in length.

Colonies 49.92 - 53.04μ in diameter.

Attached to: Aufwuchs Artificial Substrates Station A.

Order Cladophorales

Family Cladophoraceae

Cladophora Kuetzing 1843

Cladophora fracta (Dillw.) Kuetzing 1843.

Prescott 1962, page 137.

Cells 82.68 - 109.60μ in diameter; 294.55 - 301.40μ in length.

Cells in secondary branches 39.0 - 40.56μ in diameter;

109.60 - 116.45μ in length.

Intermingled with other algae at: Station D.

Cladophora glomerata (L.) Kuetzing 1845

Prescott 1962, page 138.

Cells of the main filament 73.7 - 87.1μ in diameter; 402.0 - 448.0μ in length, and cells of the ultimate branches 20.2 - 26.8μ in diameter; 201.- 261.3μ in length.

Intermingled with other algae: Stations C,D,8.

Euplankton: Stations III - D.

Cladophora insignis (C.A.Ag.) Kuetzing 1845

Prescott 1962, page 139.

Cells of the main filaments 109.60 - 116.45μ in diameter; 341.50 - 685.0μ in length; cells of the branches 68.50 - 70.20μ in diameter up to 581.50μ in length.

Forming floating mats of mixed algae: Station D.

Rhizoclonium Kuetzing 1843

Rhizoclonium crassipellitum West & West 1897

Prescott 1962, page 141.

Cells of the filament 51.48 - 71.76μ in diameter;

109.60 - 123.30 - 150.70μ in length.

Entangled with other algae: Station D.

Order Oedogoniales

Family Oedogoniaceae

Bulbochaete C.A.Agardh 1817

Bulbochaete sp.

Cells 18.72 - 19.0μ in diameter; 39.00 - 40.56μ in length.

Not identified species because the plant was never found reproducing:

Station 5.

Oedogonium Link 1820

Oedogonium globosoum Nordstedt 1878

Pl. 19 fig. 5

Prescott 1962, page 178.

Cells 11.34 - 12.0μ in diameter; 51.84 - 63.78μ in length;

oogonia 40.50 - 42.12μ in diameter; oospores 32. - 38.88μ in diameter.

On submerged aquatic vegetation: Stations C,5.

Oedogonium Pringsheimii Cramer 1859

Pl. 19 fig. 4

Prescott 1962, page 187.

Cells 12.96 - 16.20μ in diameter; 42.12 - 46.98μ in length;

oogonia 39.88 - 42.12μ in diameter, 35.64 - 36.0μ in length;

oospore 34.32 - 35.0μ in diameter.

On stones: Station D.

Oedogonium sp.

There were at least 6 or 7 other species of Oedogonium in the lake. However, they were never found reproducing, and were not identified to species: collected at all stations.

Order Chlorococcales

Family Chlorococcaceae

Golenkinia Chodat 1894

Golenkinia radiata (Chod.) Wille 1911

Pl. 10 fig. 13

Prescott 1962, page 213.

Cells 9.72- 10.0μ in diameter.

Setae 25.92 - 26.52μ in length.

Euplankton: Stations C,D.

Family Hydrodictyaceae

Pediastrum Meyen 1829

Pediastrum biradiatum Meyen 1829 fa.

Prescott 1962, page 222.

Cells 15.60 - 18.72μ in diameter.

Colonies of 6 cells 36.0 - 37.44μ in diameter.

Tychoplankton: Station 5.

Pediastrum Boryanum (Turp.) Meneghini 1840

Pl. 11 figs. 3,7 & 8

Prescott 1962, page 222.

Cells 10.5 - 17.16μ in diameter; 14.0 - 21.84μ long;

16 celled colony 42.0 - 45.0μ in diameter.

Included under P. Boryanum are two other plants, which would correspond to other authors; P. glanduliforum and P. granulatum, but included here as formas, following Bigeard's (34) interpretation of this species.

Euplankton: Stations C,D,D - I - II, II - III, III - D, 1,2,3,4,5.

Tychoplankton: Stations C,D, 1,2,3,4,5.

Aufwuchs: Artificial Substrates Station A,B.

Pediastrum Boryanum var. longicorne Raciborski 1889

Pl. 11 fig. 4

Prescott 1962, page 222.

Cells 14.04 - 18.72μ in diameter, 21.84 - 22.0μ long.

Colonies of 16 cells 56.0 - 63.0μ in diameter.

Euplankton: Stations C,D,D - I - II, II - III - D.

Tychoplankton: Stations C,D,1,3,4,5.

Pediastrum duplex Meyen 1829

Pl. 11 fig. 1

Prescott 1962, page 223.

Cells 17.5 - 18.25μ in diameter.

Colonies of 32 cells 119.0 - 120.76μ in diameter.

Euplankton: Stations C,D,D - I - II, II - III, III - D, 1,3,4,5.

Tychoplankton: Stations C,D,4,5.

Aufwuchs: Artificial Substrates Station A.

Pediastrum duplex var. clathratum (A.Braun) Lagerheim 1882

Pl. 11 fig. 2

Prescott 1962, page 223.

Cells 13.7 - 16.20μ in diameter.

Colonies of 32 cells 92.37 - 94.0μ in diameter.

Euplankton: Stations C,D.

Pediastrum integrum Naegeli 1849

Prescott 1962, page 225.

Cells 17.16 - 21.80μ in diameter.

Colonies of 16 cells 68.64 - 79.56μ in diameter.

Euplankton: Stations C,D.

Pediastrum integrum var. perforatum Raciborski 1889 fa.

Pl. 11 fig. 10

Raciborski 1889, page 7.

Cells 29.64 - 31.20μ across, 23.40 - 24.96μ in length.

Colonies of 22 cells 137.0 - 150.70μ in diameter.

The plant resembles var. perforatum except the projections are bifurcate, may be just a fa.

Euplankton: Station D.

Aufwuchs: Artificial Substrates Station A.

Pediastrum simplex (Meyen) Lemmermann 1897

Prescott 1962, page 227.

Cells 19.0 - 19.4μ in diameter, 31.20 - 32.40μ in length.

Euplankton: Stations C,D.

Pediastrum simplex var. duodenarium (Bailey) Rabenhorst 1868

Pl. 11 fig. 9

Prescott 1962, page 227.

Cells 14.24 - 15.0μ in diameter, 22.68 - 23.40μ in length.

Colonies of 16 cells 76.64 - 78.0μ in diameter.

Euplankton: Stations C,D.

Pediastrum tetras (Ehrenberg) Ralfs 1844

Pl. 11 figs. 5 & 6

Prescott 1962, page 227.

Cells 7.80 - 8.10μ in diameter.

Colonies of 4 cells 14.04 - 15.60μ in diameter, colonies of 8 cells 22.64 - 28.08μ in diameter.

Euplankton: Stations C,D,D - I - II, II - III, 1,3,4,5.

Aufwuchs: Artificial Substrates Station A.

Family Botryococcaceae

Botryococcus Kuetzing 1849

Botryococcus braunii Kuetzing 1849

Pl. 10 fig. 21

Prescott 1962, page 232.

Cells 6.24 - 7.80μ in diameter, 10.92 - 11.0μ in length.

Euplankton: Stations C,D,D - I - II, II - III, III - D,4,5.

Aufwuchs: Artificial Substrates Station A.

Family Oocystaceae

Dictyosphaerium Naegeli 1849

Dictyosphaerium pulchellum Wood 1874

Pl. 10 fig. 14

Prescott 1962, page 238.

Cells 6.24 - 8.10μ in diameter.

Euplankton: Stations C,D,D - I, II - III.

Tychoplankton: Stations C,D,1.

Oocystis Naegeli 1855

Oocystis gigas Archer 1877

Pl. 10 fig. 19

Prescott 1962, page 244.

Cells 22.68 - 24.96μ in diameter, 35.64 - 42.12μ in length.

Slightly smaller in diameter than measurements given for the species.

Euplankton: Stations C,D,5.

Oocystis lacustris Chodat 1897

Prescott 1962, page 245.

Cells 11.68 - 12.0μ in diameter, 15.60 - 16.0μ long.

Euplankton: Stations I, II - III.

Nephrocytium Naegeli 1824

Nephrocytium Agardhianum Naegeli 1849

Pl. 10 fig. 18

Prescott 1962, page 248.

Cells 4.86 - 5.0μ in diameter, 11.34 - 12.0μ in length.

Tychoplankton: Stations D,4.

Nephrocytium obesum West & West 1894

Pl. 10 fig. 20

Prescott 1962, page 249.

Cells 15.60 - 16.0μ in diameter, 24.96 - 25.0μ in length.

Cells little shorter than measurements given for this species, but fits well otherwise.

Tychoplankton: Stations D,5.

Dimorphococcus A. Braun 1855

Dimorphococcus lunatus A. Braun 1855

Prescott 1962, page 252.

Cells 9.36 - 10.0μ in diameter, 11.34 - 17.0μ long.

Euplankton: Station D.

Ankistrodesmus Corda 1838

Ankistrodesmus falcatus (Corda) Ralfs 1848

Prescott 1962, page 253.

Cells 2.34 - 3.0μ in diameter, 24.04 - 25.75μ in length.

Euplankton: Stations C,D,D - I - II,4,5.

Ankistrodesmus spiralis (Turner) Lemmermann 1908

Prescott 1962, page 253.

Cells 1.56 - 2.0μ in diameter, 26.52 - 27.0μ in length.

Euplankton: Stations D,4.

Kirchneriella Schmidle 1893

Kirchneriella contorta (Schmidle) Bohlin 1897

Pl. 10 fig. 17

Prescott 1962, page 258.

Cells 1.42 - 2.0μ in diameter, 10.92 - 12.48μ in length.

Aufwuchs: Artificial Substrates Station A.

Kirchneriella lunaris (Kircher) Mobius 1894

Pl. 10 fig. 16

Prescott 1962, page 258.

Cells 6.24 - 7.80μ in diameter, 12.84 - 13.0μ in length.

Euplankton: Station I.

Kirchneriella obesa (West & West) Schmidle 1893

Pl. 10 fig. 15

Prescott 1962, page 259.

Cells 2.34 - 3.0μ in diameter, 7.80 - 9.36μ in length.

Euplankton: Station I.

Quadrigula Printz 1915

Quadrigula Chodatii (Tan.-Ful.) G.M.Smith 1920

Pl. 12 fig. 1

Prescott 1962, page 260.

Cells 6.48 - 7.0μ in diameter, 43.86 - 45.86μ in length.

Euplankton: Stations C,D.

Tetraedron Kuetzing 1845

Tetraedron enorme (Ralfs) Hansgirg 1888 fa.

Pl. 18 fig. 3

Prescott 1962, page 265.

Cells tetragonal; processes bifurcate; cells 21.84 - 23.40μ along the long axis viewed from the side, 32.40 - 33.0μ in diameter when viewed from the bottom. This plant does not look like the typical species, however, I believe it is a form.

Euplankton: Station D.

Aufwuchs: Artificial Substrates Station A.

Tetraedron minimum (A.Braun) Hansgirg 1888

Pl. 18 fig. 4

Prescott 1962, page 267.

Cells 6.48 - 14.0μ in diameter.

Euplankton: Stations C,D,D - I - II, II - III,5.

Aufwuchs: Artificial Substrates Station A.

Tetraedron trigonum (Naeg.) Hansgirg 1888

Pl. 18 fig. 8

Prescott 1962, page 270.

Cells 28.08 - 29.0μ in diameter.

Euplankton: Stations II - C.

Tychoplankton: Stations C,D,5.

Aufwuchs: Artificial Substrates Station A.

Tetraedron trigonum var. gracile (Reinsch) De Toni 1889

Pl. 18 fig. 6

Prescott 1962, page 270.

Cells 34.32 - 35.88μ in diameter, including the spines.

Tychoplankton: Station C.

Tetraedron tumidulum (Reinsch) Hansgirg 1889

Pl. 18 fig. 7

Prescott 1962, page 270.

Cells 37.44 - 45.24μ in diameter.

Tychoplankton: Station C.

Family Scenedesmaceae

Scenedesmus Meyen 1829

Scenedesmus abundans (Kuch.) Chodat 1913

Pl. 10 fig. 1

Prescott 1962, page 274.

Cells 3.12 - 3.5μ in diameter, 7.80 - 8.0μ in length.

Euplankton: Station D.

Scenedesmus arcuatus var. platydisca G.S.Smith 1916

Pl. 10 fig. 2

Prescott 1962, page 275.

Cells 6.7 - 7.0μ in diameter, 9.0 - 9.36μ in length.

Euplankton: Stations D,D - I - II.

Scenedesmus armatus (Chod.) G.S.Smith 1916

Pl. 10 fig. 7

Prescott 1962, page 276.

Cells 4.86 - 5.0μ in diameter, 15.60 - 16.20μ in length.

Euplankton: Station C.

Scenedesmus bijuga (Turp.) Lagerheim 1893

Pl. 10 fig. 3

Prescott 1962, page 276.

Cells 3.5 - 4.0μ wide, 18.5 - 12.25μ in length.

Tychoplankton: Stations C,D,1,4,5.

Aufwuchs: Artificial Substrates Station A.

Scenedesmus dimorphus (Turp.) Kuetzing 1833

Pl. 10 fig. 8

Prescott 1962, page 277.

Cells 4.86 - 5.0μ in diameter, 12.96 - 13.0μ in length.

Euplankton: Stations D - I - II4.

Tychoplankton: Station D.

Aufwuchs: Artificial Substrates Station A.

Scenedesmus obliquus (Turp.) Kuetzing 1833

Pl. 10 fig. 11

Prescott 1962, page 279.

Cells 4.86 - 6.24μ in diameter, 14.04 - 16.20μ in length.

Euplankton: Stations D,D - I - II4.

Tychoplankton: Stations C,D.

Scenedesmus quadricauda (Turp.) de Brebisson 1835

Pl. 10 fig. 5

Prescott 1962, page 280.

Cells 3.5 - 6.24μ in diameter, 10.5 - 16.20μ in length.

Euplankton: Stations C,D,D - I - I4 - II - C, II - III, D,5.

Tychoplankton: Stations C,D,1,2,3,4,5,6.

Aufwuchs: Artificial Substrates Stations A,B.

Scenedesmus quadricauda var. parvus G.M.Smith 1916

Pl. 10 fig. 10

Prescott 1962, page 280.

Cells 5.76 - 6.48μ in diameter, 9.72 - 10.92μ in length.

Euplankton: Stations D - I.

Scenedesmus quadricauda var. quadrispina (Chod.) G.M.Smith 1916

Pl. 10 fig. 6

Prescott 1962, page 280.

Cells 3.51 4.0μ in diameter, 10.92 - 12.48μ in length.

Spines 3.0 - 3.12μ long.

Euplankton: Station D.

Tetradesmus G.M.Smith 1913

Tetradesmus wisconsinense G.M.Smith 1939

Pl. 10 fig. 12

Prescott 1962, page 283.

Cells 6.24 - 6.5μ in diameter, 7.80 - 8.58μ in length.

Euplankton: Station D.

Order Zygnematales

Family Zygnemataceae

Mougeotia (C.A.Agardh) Wittrock 1872

Mougeotia sp.

There were at least three species of Mougheotia in Lake Lansing. However, they were never collected reproducing, hence could not be identified to species.

Intermingled with other algae along the shores:

Stations C,D,1,2,3,4,5,6,7.

Spirogyra Link 1820

Spirogyra porticalis (Muell.) Cleve 1868

Pl. 19 fig. 6

Prescott 1962, page 318.

Cells 35.88 - 42.12μ in diameter, 105 - 112.0μ long.

Zygospore, 38.5 - 40.25μ in diameter, 56.16 - 57.72μ in length.

Intermingled with other algae along the shore: Stations C,D,5.

Spirogyra rivularis (Hass.) Rabenhorst 1868

Prescott 1962, page 320.

Cells 39.0 - 41.10μ in diameter, 241.56 - 250.50μ in length.

Zygospore, 48.36 - 51.84μ in diameter, 87.60 - 97.20μ in length.

Intermingled with other algae: Station D.

Spirogyra singularis Nordstedt 1880

Prescott 1962, page 320.

Cells 29.64 - 31.20μ in diameter, 34.02 - 42.12μ in length.

Zygospore 24.96 - 29.16μ in diameter, 34.02 - 42.12μ in length.

Intermingled with other algae: Stations C,D,5.

Tychoplankton: Stations C,D,5.

Spirogyra sp.

There were at least eight or nine other species of Spirogyra present in the lake. They were never found reproducing, hence undeterminable.

Collected at all stations.

Zygnema C.A.Agardh 1828

Zygnema sterile Transeau 1934

Prescott 1962, page 323.

After Prescott.

Cells 44 - 54μ in diameter, 22 - 60μ in long, with a thick wall and inclosed by a firm pectic sheath.

Identified by vegetative characteristics.

Intermingled with other algae: Stations C,5.

Zygnema sp.

There were two possibly three other unidentifiable species of Zygnema. Entangled with other algae at all stations and euplanktonic and tychoplanktonic.

Family Desmidiaceae

Penium de Brebisson 1844

Penium margaritaceum (Ehrenberg) de Brebisson 1848

Pl. 12 fig. 8

Smith 1924, page 7.

Cells 23.40 - 24.96μ in diameter, 253.45 - 260.30μ in length; breadth at apices 18.72 - 20.28μ.

Tychoplankton: Station D.

Closterium Nitzsch 1817

Closterium acerosum (Shrank) Ehrenberg 1828

Pl. 15 fig. 17

Smith 1924, page 10.

Cells 500.0 - 527.45μ in length, 37.67 - 41.10μ broad at girdle.

Tychoplankton: Station 4.

Closterium acerosum var. tumidun Borge 1895

Pl. 16 fig. 3

Krieger 1937, page 319.

Cells 450.00 - 476.41μ in length, 33.78 - 34.0μ broad at girdle, 6.48 - 6.5μ broad at apex.

Tychoplankton: Station D.

Closterium incurvum de Breb. 1856

Pl. 15 fig. 14

Irenee-Marie 1938, page 69.

Cells 112.32 - 117.0μ in length, 17.16 - 17.5μ broad at the girdle, 4.68 - 5.0μ broad at the apex.

Tychoplankton: Stations C,5.

Closterium leibleinii Kuetzing 1834

Pl. 16 fig. 4

Irenee-Marie 1938, page 65.

Cells 184.95 - 187.88μ in length, 30.78 - 31.20μ broad at the girdle.

Tychoplankton: Station D.

Closterium moniliferum (Bory) Ehrenberg 1838

Pl. 16 fig. 5

Smith 1924, page 9.

Cells 167.75 - 171.25μ in length, breadth at girdle 37.26 - 39.0μ.

Euplankton: Station D.

Tychoplankton: Station D.

Aufwuchs: Artificial Substrates Station A.

Closterium parvulum Naeg. 1849

Pl. 15 figs. 12 & 13

Irenee-Marie 1938, page 68.

Cells 109.60 - 152.88μ in length, breadth at girdle 15.60 - 17.16μ.

Euplankton: Station III.

Tychoplankton: Stations D,1,5.

Closterium pseudolunula Borge 1909

Pl. 16 figs. 1 & 2

Krieger 1937, page 305.

Cells 442.73 - 448.56μ in length, diameter at girdle 62.40 - 63.78μ, 6.24 - 6.72μ broad at apex.

Tychoplankton: Station D.

Closterium strigosum de Breb. 1856

Pl. 16 figs. 1 & 2

Irenee-Marie 1938, page 82.

Cells 294.50 - 300.00μ in length, 18.72 - 18.90μ in diameter at the girdle.

Tychoplankton: Station D.

Closterium sublaterale Ruzicka 1957

Pl. 15 fig. 15

Ruzicka 1957, page 142.

Cells 315.10 - 321.95μ in length, 47.95 - 50.0μ broad at the girdle.

Tychoplankton: Station D.

Pleurotaenium Naegeli 1849

Pleurotaenium Ehrenbergii (de Breb.) De Bary 1858

Pl. 12 fig. 9

Smith 1924, page 15.

Cells 348.92 - 583.77μ in length, diameter of isthmus 26.84 - 46.97μ.

Euplankton: Station C.

Tychoplankton: Station C.

Pleurotaenium trabecula (Ehrenberg) Naegeli 1849

Pl. 12 figs. 10 & 11

Smith 1924, page 14.

Cells 465.80 - 617.32μ in length, 33.55 - 54.80μ broad at the base of the semicells.

Tychoplankton: Stations D,1,2,3,4,5.

Euastrum Ehrenberg 1832

Euastrum hypochondrum fa. decoratum Scott & Pres. 1952

Pl. 12 fig. 6

Scott and Prescott 1952, page 386.

Cells 63.0 - 64.80μ in length, 59.5 - 63.78μ in diameter, 35.0μ across, 14.0 - 14.58μ at the isthmus.

New record for Michigan, previously reported from Florida.

Euplankton: Stations C,D,D - I - II.

Tychoplankton: Stations C,D.

Euastrum insulare (Wittr.) Roy 1883

Pl. 12 fig. 5

Irenee-Marie 1938, page 140.

Cells 29.64 - 30.0μ in length, 18.72 - 19.0μ in diameter, 5.46 - 6.0μ at the isthmus.

Euplankton: Stations II3 - II.

Aufwuchs: Artificial Substrates Station A.

Euastrum insulare var. basichondrum Messik. 1938

Pl. 12 fig. 4

Messikommer 1938, page 162.

Cells 28.0 - 31.5μ in length, 18.25 - 21.0μ in diameter, 5.25 - 7.0μ in diameter at isthmus.

Euplankton: Stations II - C, D - I - II.

Euastrum turneri W.& W. 1893

Krieger 1937, page 589.

Cells 35.68 - 37.44μ in length, 25.92 - 26.52μ in diameter, isthmus 4.68 - 5.0μ in diameter.

Euplankton: Stations D - I.

Euastrum turneri W.&W. fa.

Pl. 12 fig. 7

Cells 21.84 - 23.0μ in length, 17.16 - 17.50μ in diameter, 4.0 - 4.68μ broad at the isthmus.

Smaller than typical.

Euplankton: Station D.

Tychoplankton: Station D.

Aufwuchs: Artificial Substrates Station A.

Micrasterias Agardh 1827

Micrasterias sol (Ehrenb.) Kuetzing 1849

Pl. 12 fig. 3

Krieger 1939, page 93.

Cells 123.30 - 130.15μ in diameter, 137.0 - 149.76μ in length, isthmus 24.96 - 25.0μ broad.

Tychoplankton: Station 5.

Staurastrum Meyen 1829

Staurastrum bienneanum var. ellipticum Wille 1879

Pl. 16 fig. 11

Croasdale 1957, page 142.

Cells 37.38 - 38.0μ in length, 35.64 - 36.0μ in diameter, isthmus 11.34 - 12μ broad.

Euplankton: Stations D - I.

Staurastrum Brebissonii Arch. 1861

Pl. 16 fig. 12

Croasdale 1957, page 142.

Cells 59.28 - 60.0μ in length without spines, with spines up to 65.52μ, cells in diameter 54.60 - 55.0μ without spines, up to 60.0μ isthmus 20.28 - 21.84μ broad.

Tychoplankton: Station C.

Staurastrum chaetoceras (Schroder) Smith 1924

Pl. 16 fig. 9

Smith 1924, page 99.

Cells 40.50 - 42.12μ in length with processes, breadth 55.08 - 58.32μ, breadth at isthmus 5.67 - 6.0μ.

Euplankton: Stations D - I.

Staurastrum disputatum W.& W. 1912

Pl. 17 fig. 5

West & West 1912, Vol. IV, page 176.

Cells 24.96 - 31.20μ in length, breadth 31.20 - 32.0μ, isthmus 7.80 - 9.36μ broad.

Smaller than the measurements given for the original, but smaller variety has been discribed.

Tychoplankton: Station 5.

Staurastrum floriferum W. & W. 1896

Pl. 16 fig. 8

Smith 1924, page 91.

Cells 27.92 - 28.0μ in length with processes, 71.28 - 72.0μ in .breadth with processes, isthmus 4.86 - 6.24μ.

Euplankton: Stations D, I - II4.

Staurastrum granulosum (Ehrenb.) Ralfs 1848

Pl. 16 fig. 10

Irenee-Marie 1938, page 287.

Cells 35.64 - 36.0μ in length, 38.88 - 39.0μ in breadth, isthmus 12.96 - 13.0μ in broad.

Tychoplankton: Station 5.

Staurastrum Johnsonii W. & W. 1896

Pl. 17 fig. 1

Smith 1924, page 104.

Cells 53.04 - 54.60μ in length with processes, breadth with processes 89.05 - 95.16μ, breadth of isthmus 12.48 - 14.04μ.

Tychoplankton: Station D.

Staurastrum longiradiatum var. elevatum Fritsch & Rich 1937

Pl. 17 fig. 4

Fritsch and Rich 1937, page 209.

Cells 64.80 - 79.77μ in length with processes, breadth with processes 73.32 - 81.0μ, breadth of the isthmus 4.68 - 6.48μ.

Euplankton: Stations C,D,I - II - C.

Staurastrum paradoxum Meyen 1829

Pl. 17 fig. 2

Smith 1924, page 85.

Cells 30.78 - 32.76μ in length with processes, 40.50 - 46.98μ in breadth with processes, isthmus 6.48 - 7.80μ in broad.

Euplankton: Stations C,D,I - II - C.

Staurastrum planctonicum Teiling 1946

Pl. 17 fig. 8

Teiling 1946, page 77.

Cells 51.84 - 64.80μ in length including the processes, 85.80 - 87.48μ in breadth including processes, isthmus 11.34 - 12.0μ broad.

Euplankton: Station D.

Staurastrum polymorphum de Breb. fa.

Pl. 16 fig. 6

Irenee-Marie 1938, page 306.

Cells 38.84 - 40.56μ in length, 40.56 - 46.98μ in breadth including processes, isthmus 10.92 - 12.96μ broad.

Tychoplankton: Stations C,5.

Staurastrum punctulatum de Breb. 1848

Pl. 16 fig. 7

Irenee-Marie 1938, page 284.

Cells 18.72 - 20.28μ in length, 26.52 - 28.08μ in breadth, isthmus 7.02 - 7.80μ in breadth.

Tychoplankton: Station D.

Staurastrum quebecense var. ornatum Wade 1957

Pl. 17 figs. 6 & 7

Wade 1957, page 269.

Cells 37.44 - 46.80μ in length, including processes, 48.60 - 57.72μ breadth including processes, isthmus 9.72 - 12.48μ in breadth.

Euplankton: Stations C,D,I - II,II - III.

Tychoplankton: Stations D,1.

Aufwuchs: Artificial Substrates Station A.

Staurastrum sebaldii var. ornatum Nordst. 1873

Pl. 17 fig. 9

Irenee-Marie 1938, page 309.

Cells 64.80 - 65.0μ in length including the processes, 114.07 - 115.0μ in breadth including the processes, isthmus 13.77 - 14.04μ in breadth.

Tychoplankton: Station D.

Staurastrum striolatum (Naeg.) Arch. 1861

Pl. 17 fig. 3

Croasdale 1957, page 149.

Cells 21.84 - 22.0μ in length, 24.96 - 25.0μ in breadth, isthmus 6.24 - 6.5μ broad.

Tychoplankton: Station D.

Cosmarium Corda 1834

Cosmarium angulare var. canadense Irenee-Marie 1938

Pl. 12 fig. 12

Irenee-Marie 1938, page 179.

Cells 26.52 - 29.64μ in diameter, 29.64 - 32.40μ in length, 6.24 - 8.10μ breadth at the isthmus.

New record for Michigan, previously reported from Canada.

Euplankton: Stations D - I.

Tychoplankton: Stations C,D.

Aufwuchs: Artificial Substrates Station A.

Cosmarium angulosum de Breb. 1856

Pl. 12 fig. 13

Irenee-Marie 1938, page 177.

Cells 19.44 - 20.0μ in length, 13.77 - 14.04μ in breadth, isthmus 4.86 - 5.0μ broad.

Tychoplankton: Station 4.

Cosmarium Botrytis (Bory) Meneghini 1840

Pl. 14 fig. 13

Smith 1924, page 33.

Cells 71.28 - 74.88μ in length, 55.08 - 57.72μ in breadth, isthmus 19.44 - 23.40μ in breadth.

Tychoplankton: Stations C,D,4.

Cosmarium Botrytis var. mediolaeve W. & W. 1892

Pl. 14 fig. 7

Taylor 1934, page 251.

Cells 49.92 - 51.48μ in length, 43.68 - 45.24μ in breadth, the breadth at the isthmus 12.48 - 14.04μ.

Tychoplankton: Stations C,D.

Cosmarium constrictum Delp. 1877

Pl. 13 fig. 14

Miller 1936, page 88.

Cells 45.24 - 46.80μ in length, 31.20 - 32.76μ broad, isthmus 10.92 - 11.03μ in breadth.

Tychoplankton: Stations C,D.

Cosmarium Cucumis (Corda) Ralfs 1844

Pl. 13 fig. 12

Irenee-Marie 1938, page 161.

Cells 38.88 - 39.0μ in breadth, 58.32 - 59.28μ in length, the breadth at the isthmus 19.80 - 21.06μ.

Tychoplankton: Station 5.

Cosmarium cymatoplerum var. tyrolicum Nordstedt 1876

Pl. 14 fig. 6

West and West 1908, page 6.

Cells 54.60 - 76.74μ in breadth, 76.74 - 78.0μ in length, the breadth of the isthmus 18.72 - 20.28μ.

Tychoplankton: Station C.

Cosmarium formosulum Hoffman 1888

Pl. 15 fig. 3

Taylor 1934, page 253.

Cells 43.68 - 45.36μ in length, breadth 29.16 - 31.20μ, isthmus 12.48 - 14.58μ in breadth.

Tychoplankton: Station D.

Cosmarium Franzstonii Taft 1945

Pl. 14 fig. 5

Taft 1945, page 194.

Cells 53.04 - 55.08μ broad, 65.52 - 68.64μ in length, isthmus 20.28 - 21.30μ breadth.

New record for Michigan, previously reported from Lake Erie by Taft.

Tychoplankton: Stations C,D,3.

Cosmarium granatum (de Breb.) Ralfs 1844

Pl. 12 fig. 14

Taylor 1934, page 253.

Cells 34.32 - 51.48μ in length, 24.96 - 35.64μ in breadth, isthmus 7.80 - 10.5μ broad.

Tychoplankton: Stations C,D.

Aufwuchs: Artificial Substrates Stations A,B.

<u>Cosmarium</u> <u>granatum</u> var. <u>ocellatum</u> W. & W. 1895

Pl. <u>12</u> fig. <u>15</u>

Croasdale 1956, page 36.

Cells 25.74 - 26.9μ in breadth, 34.32 - 39.76μ in length, isthmus 6.24 - 7.10μ in breadth.

Euplankton: Stations III - D.

Tychoplankton: Station D.

<u>Cosmarium</u> <u>granatum</u> var. <u>subgranatum</u> Nordstedt 1878

Pl. <u>13</u> fig. <u>1</u>

Croasdale 1956, page 36.

Cells 22.75 - 28.08μ in breadth, 29.64 - 31.5μ in length, isthmus 4.68 - 7.4μ broad.

Euplankton: Stations D - I.

Tychoplankton: Stations C,D.

<u>Cosmarium</u> <u>impressulum</u> Elfv. 1881

Pl. <u>13</u> fig. <u>2</u>

Croasdale 1956, page 39.

Cells 18.72 - 20.28μ in length, 14.04 - 15.60μ in breadth, isthmus 4.68 - 5.0μ in breadth.

Tychoplankton: Stations D,5.

<u>Cosmarium</u> <u>Kjellmanii</u> var. <u>ornatum</u> Wille 1879

Pl. <u>13</u> fig. <u>10</u>

Croasdale 1956, page 40.

Cells 29.64 - 30.78μ in breadth, 39.32 - 35.88μ in length, isthmus 8.5 - 9.36μ broad.

Euplankton: Stations C,D - I, II4 - II.

<u>Cosmarium</u> <u>laeve</u> var. <u>depressum</u> Croasdale 1956

Pl. <u>13</u> fig. <u>3</u>

Croasdale 1956, page 40.

Cells 14.04 - 17.16μ in breadth, 17.16 - 20.0μ in length, isthmus 3.12 - 4.68μ broad.

Tychoplankton: Stations D,5.

<u>Cosmarium</u> <u>obtusatum</u> Schmidle 1918

Pl. <u>15</u> fig. <u>2</u>

Croasdale 1956, page 42.

Cells 40.56 - 42.12μ in length, 35.64 - 38.5μ in length, isthmus 8.10 - 12.25μ in breadth.

Tychoplankton: Stations D,4.

<u>Cosmarium</u> <u>ochthodes</u> Nordstedt 1875

Pl. <u>14</u> fig. <u>12</u>

Taft 1945, page 198.

Cells 67.08 - 68.64μ in breadth, 93.60 - 95.90μ in length, isthmus 21.84 - 23.40μ broad.

Tychoplankton: Station D.

<u>Cosmarium</u> <u>pachydermum</u> Lundell 1871

Pl. <u>13</u> fig. <u>4</u>

Irenee-Marie 1938, page 160.

Cells 63.96 - 64.0μ in breadth, 68.64 - 81.12μ in length, isthmus 29.64 - 30.0μ in breadth.

Tychoplankton: Station 5.

<u>Cosmarium</u> <u>phaseolus</u> de Breb. 1840

Pl. <u>14</u> fig. <u>4</u>

Croasdale 1956, page 45.

Cells 30.78 - 31.20μ in breadth, 37.44 - 38.88μ in length, isthmus 8.0 - 9.72μ broad.

Euplankton: Stations III - D.

<u>Cosmarium</u> <u>pseudonitidulum</u> Nordstedt 1873

Pl. <u>14</u> fig. <u>10</u>

Croasdale 1956, page 47.

Cells 32.40 - 33.0μ in breadth, 43.74 - 45.24μ in length, isthmus 9.72 - 12.25μ in breadth.

Euplankton: Stations II - III, II - C.

Cosmarium pseudoornatum Eichl. et Gutw. 1894

Pl. 15 fig. 4

Ruzicka 1955, page 599.

Cells 30.78 - 34.32μ in breadth, 37.54 - 44.08μ in length, isthmus 7.80 - 9.36μ in breadth.

Tychoplankton: Stations C,D.

Aufwuchs: Artificial Substrates Station A.

Cosmarium pseudopyramidatum Lundell 1871

Pl. 15 fig. 5

Taylor 1934, page 261.

Cells 96.12 - 99.84μ in length, 74.88 - 76.5μ in breadth, isthmus 20.28 - 21.0μ broad.

This plant differed from the species by being almost twice as large.

Tychoplankton: Station D.

Cosmarium punctulatum de Breb. 1856

Pl. 15 fig. 8

Taylor 1934, page 264.

Cells 32.76 - 34.32μ in breadth, 37.44 - 38.88μ in length, isthmus 11.34 - 12.48μ in breadth.

Euplankton: Stations D - I.

Tychoplankton: Station C.

Cosmarium regnesii Reinsch 1867

Pl. 14 fig. 8

West and West 1908, page 36.

Cells 7.80 - 8.0μ in breadth, 7.8 - 9.36μ in length, breadth of isthmus 4.68 - 6.0μ.

Tychoplankton: Station D.

Cosmarium reniforme (Ralfs) Archer 1874

Pl. 13 fig. 7

Irenee-Marie 1938, page 194.

Cells 39.0 - 57.72μ in breadth, 43.68 - 59.28μ in length, isthmus 12.84 - 17.16μ in breadth.

Tychoplankton: Stations C,D.

<u>Cosmarium</u> <u>reniforme</u> var. <u>compressum</u> Nordstedt 1887

Pl. 13 fig. 13

West and West 1908, page 158.

Cells 47.0 - 48.36μ in breadth, 53.04 - 56.16μ in length, isthmus 14.04 - 18.72μ in breadth.

Euplankton: Stations D - I.

Tychoplankton: Stations C,D.

<u>Cosmarium</u> <u>reniforme</u> var. <u>elevatum</u> W. & W. 1898

Pl. 13 fig. 9

West and West 1908, page 159.

Cells 42.12 - 45.24μ in breadth, 56.36 - 59.28μ in length, breadth of the isthmus 15.60 - 16.0μ.

Euplankton: Stations D - I.

Tychoplankton: Station D.

<u>Cosmarium</u> <u>subcostatum</u> Nordstedt 1876

Pl. 14 fig. 9

West and West 1908, page 237.

Cells 24.96 - 25.0μ in length, 24.18 - 24.96μ broad, isthmus 7.80 - 8.58μ in breadth.

Tychoplankton: Station D.

<u>Cosmarium</u> <u>subnudiceps</u> W. & W. 1897

Pl. 13 fig. 8

Irenee-Marie 1948, page 167.

Cells 39.0 - 40.50μ in breadth, 49.92 - 56.86μ in length, isthmus 12.96 - 14.04μ broad.

New record for Michigan.

Euplankton: Stations II - C.

Tychoplankton: Stations C,D.

<u>Cosmarium</u> <u>subtumidum</u> Nordstedt 1878

Pl. 14 fig. 2

Irenee-Marie 1938, page 167.

Cells 43.68 - 46.80μ in length, 32.76 - 34.32μ in breadth, isthmus 9.36 - 10.92μ in breadth.

Tychoplankton: Stations C,D.

<u>Cosmarium</u> <u>sulcatum</u> var. <u>sumatranum</u> Schmidle 1901

Pl. <u>13</u> fig. <u>6</u>

Taft 1945, page 200.

Cells 31.20 - 37.0μ broad, 45.24 - 46.80μ in length, isthmus 9.36 - 10.92μ in breadth.

This plant is placed here with a question because it is larger than the measurements given for this species and not enough material was seen.

Tychoplankton: Station D.

<u>Cosmarium</u> <u>tetraophthalmum</u> de Breb. 1848

Pl. <u>15</u> fig. <u>4</u>

West and West 1908, page 270.

Cells 71.76 - 75.54μ in length, 61.52 - 62.40μ in breadth, isthmus 23.40 - 24.96μ broad.

Tychoplankton: Station D.

<u>Cosmarium</u> <u>Turpinii</u> de Breb. 1856

Pl. <u>14</u> fig. <u>1</u>

Irenee-Marie 1938, page 199.

Cells 68.64 - 69.0μ in length, 56.70 - 57.72μ broad, isthmus 16.20 - 17.16μ in breadth.

Tychoplankton: Stations D,1,2,3,5.

<u>Cosmarium</u> <u>vexatum</u> West 1892

Pl. <u>13</u> fig. <u>11</u>

West and West 1908, page 187.

Cells 43.68 - 44.0μ in length, 37.44 - 39.0μ broad, isthmus 10.92 - 11.0μ in breadth.

Tychoplankton: Station C.

<u>Cosmarium</u> <u>vexatum</u> var. <u>rotundatum</u> Messik. 1942

Pl. <u>14</u> fig. <u>3</u>

Messikommer 1942, page 159.

Cells 42.12 - 43.68μ in breadth, 46.80 - 56.16μ in length, isthmus 12.48 - 13.0μ broad.

Tychoplankton: Stations C,D.

Cosmarium Wittrockii Lundell 1871

Pl. 13 fig. 5

West and West 1908, page 179.

Cells 20.28 - 21.84μ in length, 20.28 - 21.84μ broad.

isthmus 16.38 - 17.0μ in breadth.

This plant resembles var. quasidepressum Skuja.

Tychoplankton: Stations D,5.

Cosmarium Ungerianum (Naeg.) De Bary 1849

Pl. 15 fig. 7

West and West 1908, page 195.

Cells 40.56 - 42.12μ in breadth, 53.04 - 54.60μ in length,

isthmus 14.04 - 15.60μ broad.

Cells slightly smaller than typical.

Tychoplankton: Station D.

Cosmarium sp. A

Pl. 15 fig. 10

Cells 32.76 - 43.74μ in breadth, 43.68 - 53.46μ in length,

isthmus 9.36 - 12.96μ broad.

This plant resembles C. cymatopleurum var. Tyrolicum Nordst.

Tychoplankton: Stations C,D.

Cosmarium sp. B

Pl. 15 fig. 11

Cells 28.08 - 29.64μ in breadth, 34.32 - 35.88μ in length,

isthmus 7.80 - 8.0μ broad.

Tychoplankton: Station D.

Cosmarium sp. C

Pl. 15 fig. 6

Cells 39.0 - 40.0μ in breadth, 40.56 - 42.12μ in length,

isthmus 14.04 - 15.60μ in breadth.

This plant resembles C. subreniforme Nordst.

Tychoplankton: Station C.

Cosmarium sp. D

Pl. 15 fig. 9

Cells 28.08 - 29.64μ in breadth, 28.08 - 29.64μ in length, isthmus 9.36 - 10.0μ broad.

Tychoplankton: Station D.

Cosmarium sp. E

Pl. 14 fig. 11

Cells 34.32 - 35.88μ in breadth, 40.56 - 42.12μ in length, isthmus 14.04 - 15.0μ in breadth.

Tychoplankton: Stations C,D.

VIII. PLATES

PLATE 1

PLATE-1

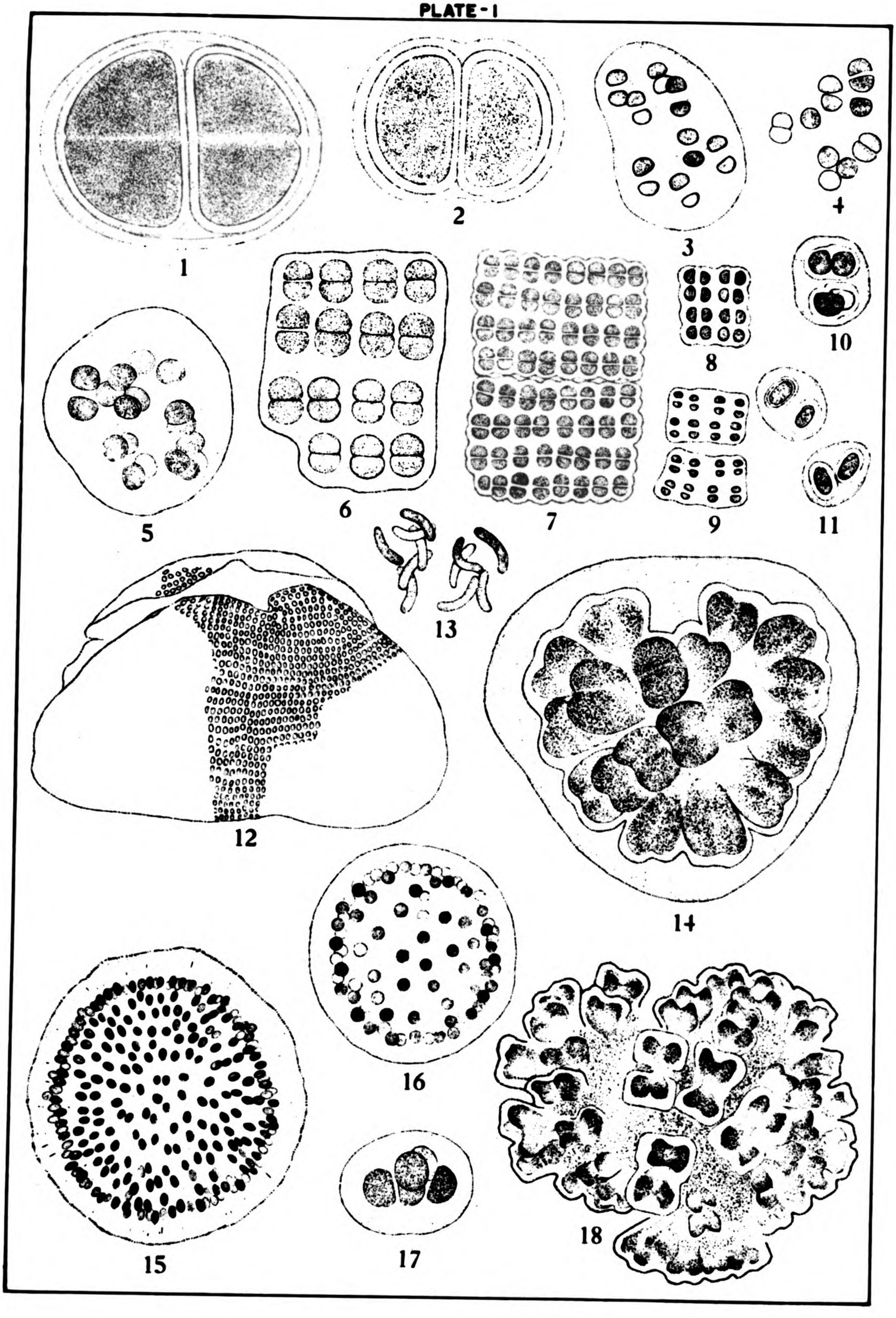


PLATE 2

PLATE-2

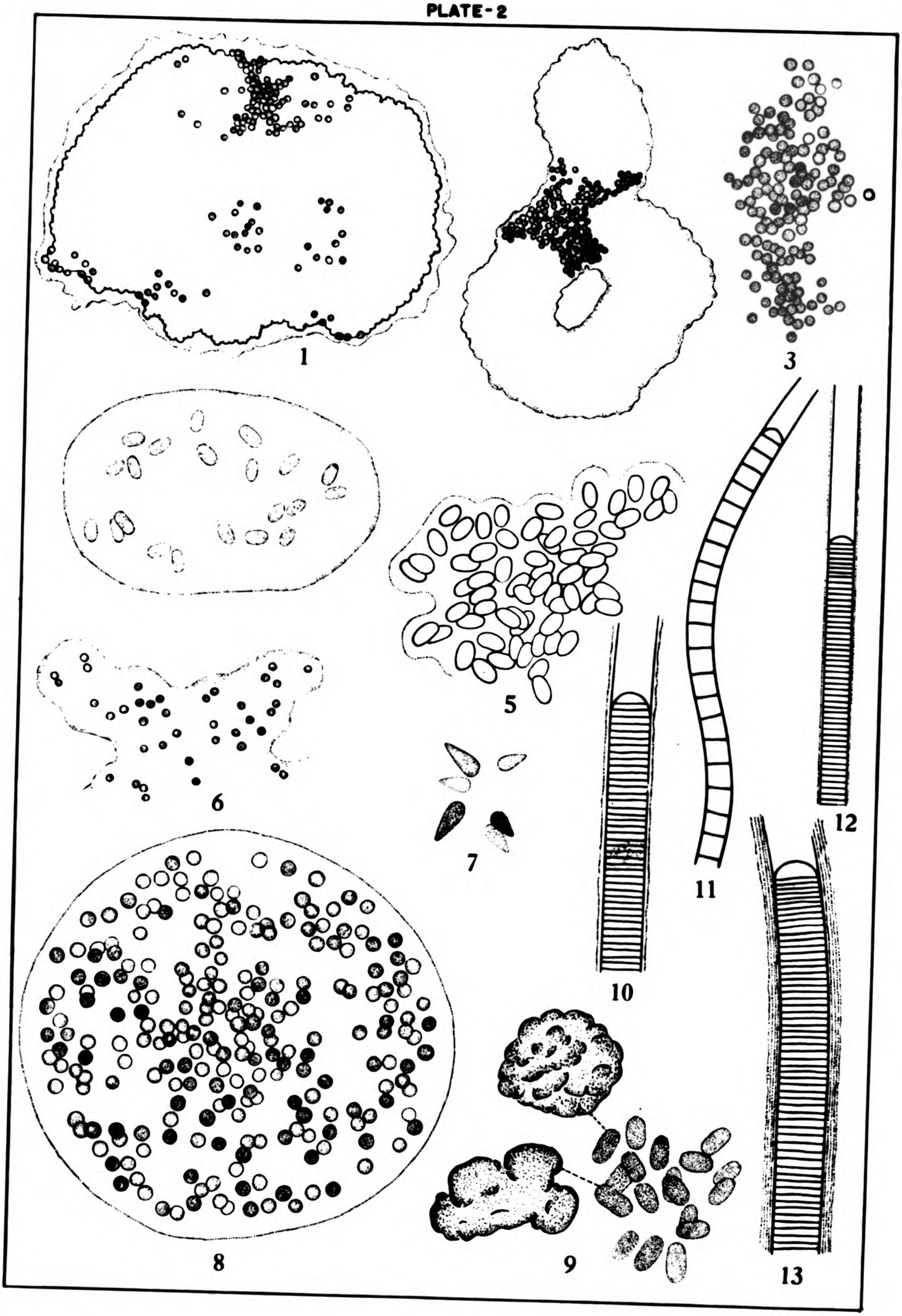


PLATE 3

PLATE-3

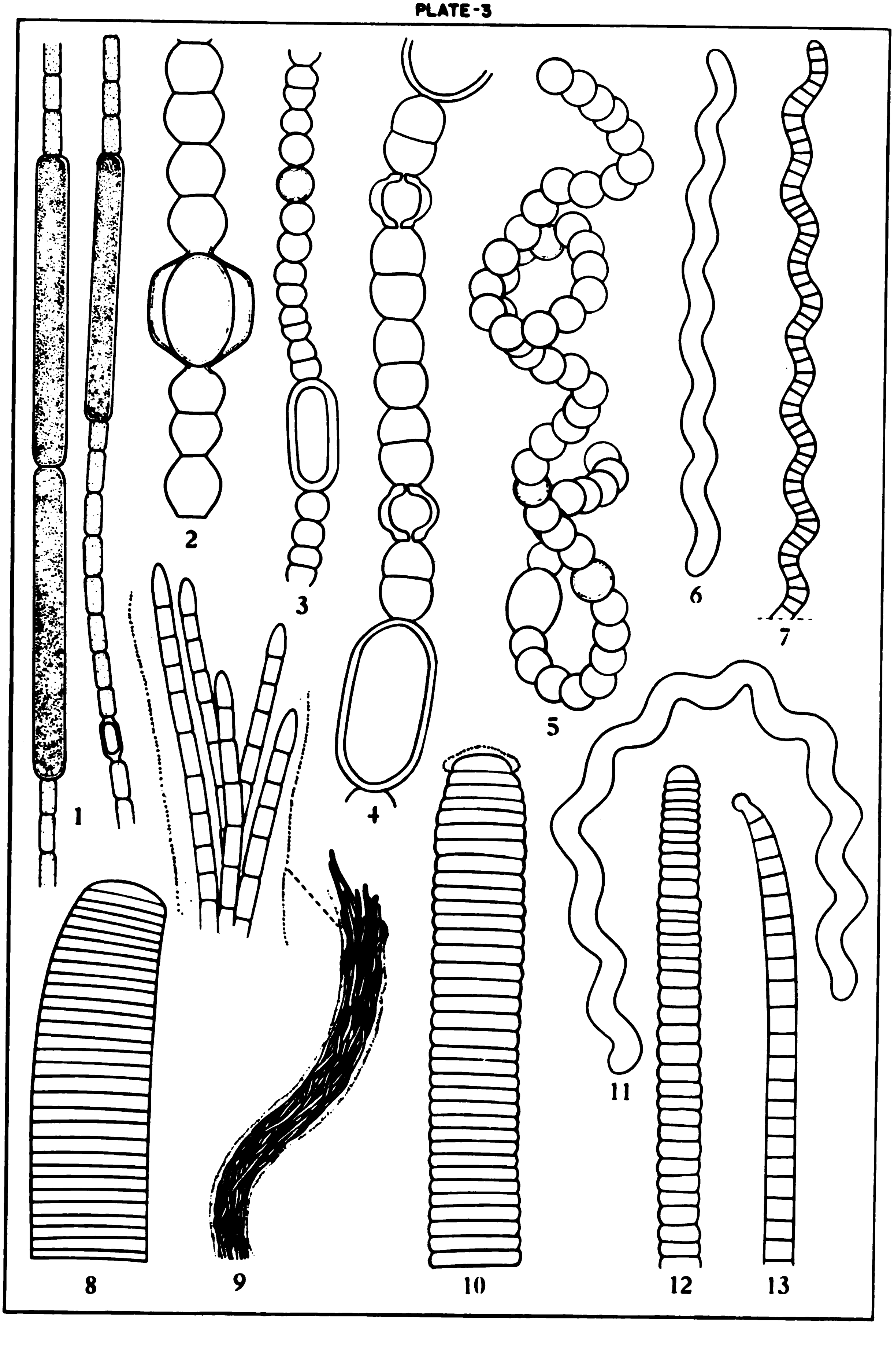


PLATE 4

PLATE- 4

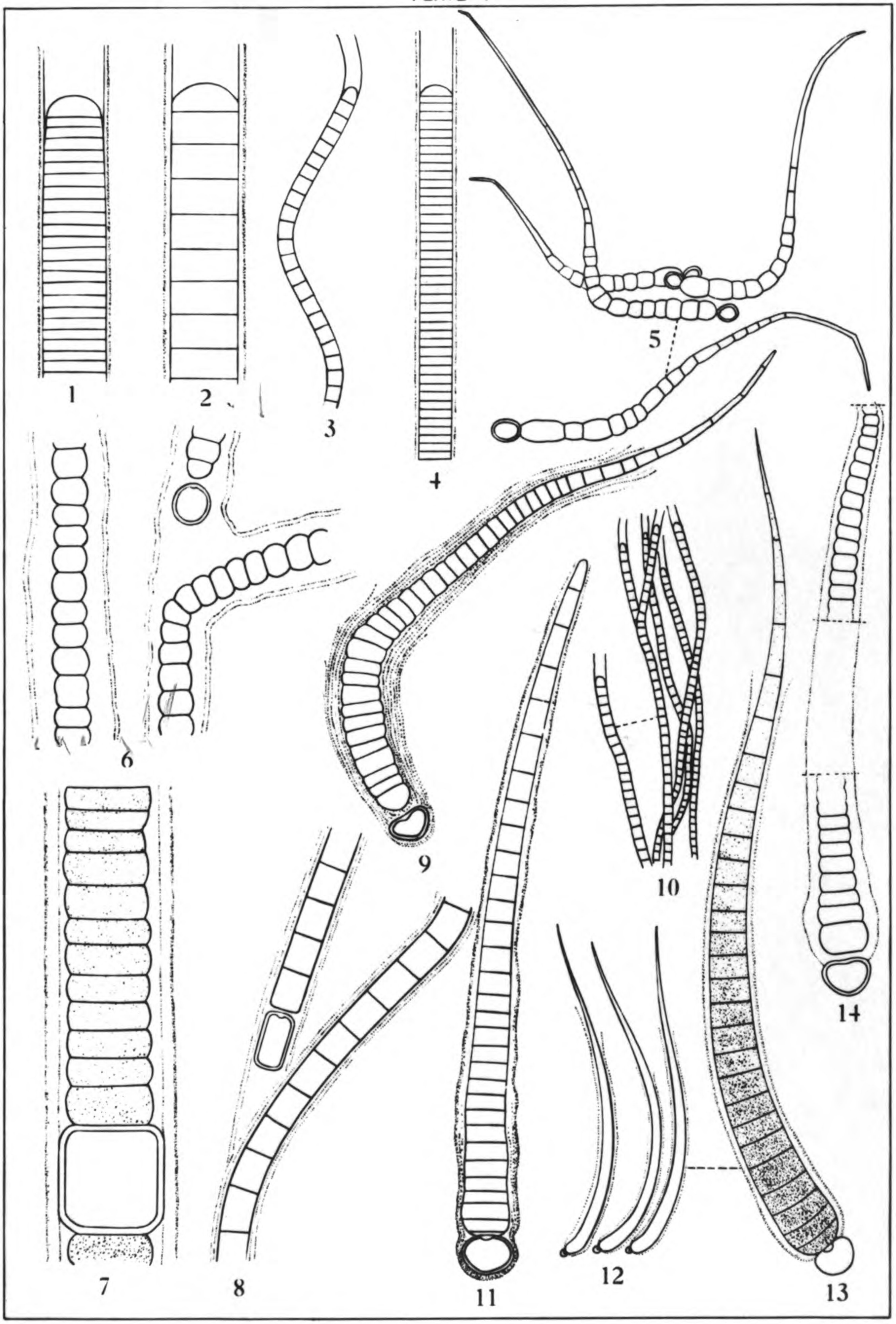


PLATE 5

PLATE-5

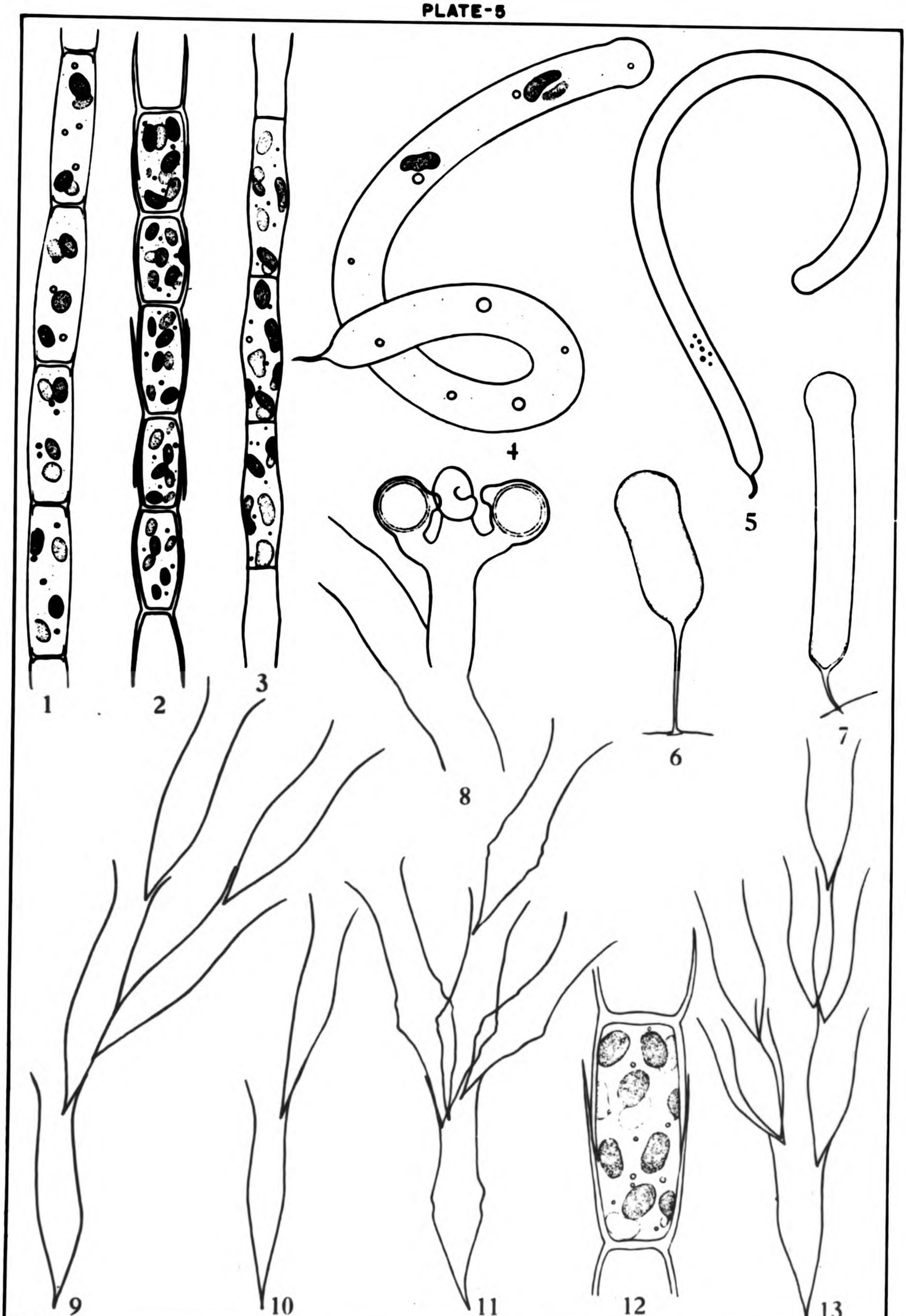


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PLATE-6

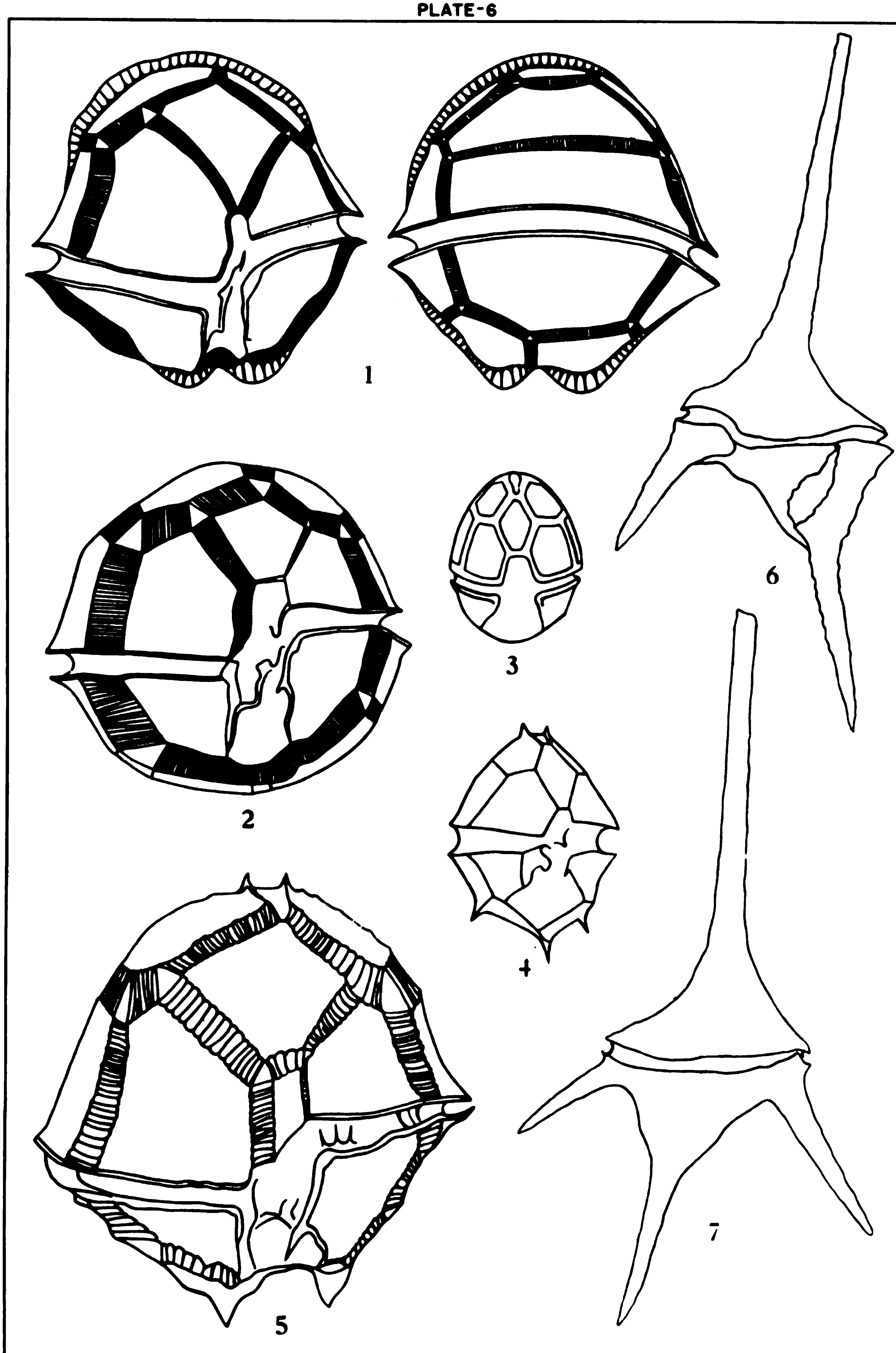

PLATE 7

PLATE-7

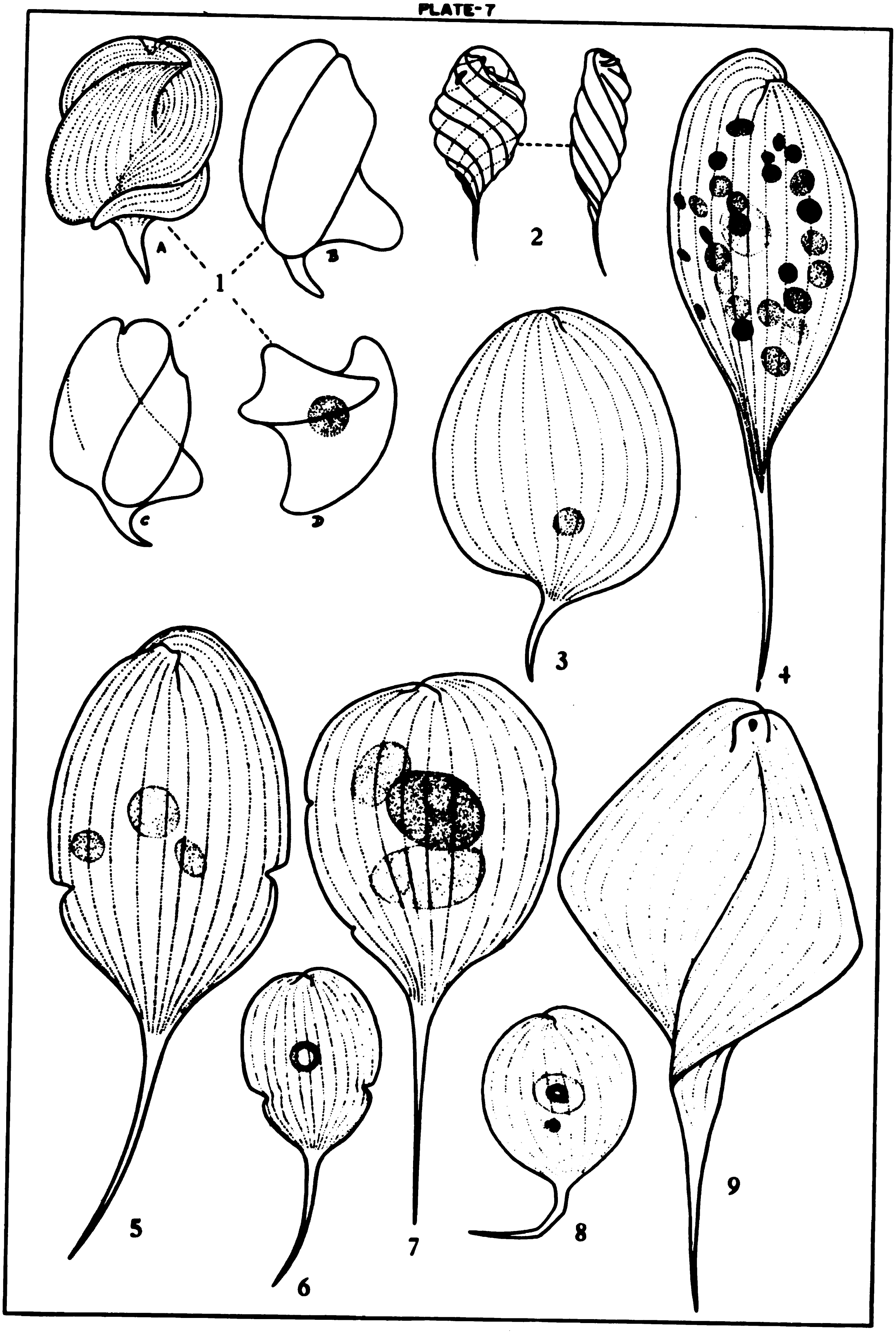

PLATE 8

PLATE-8

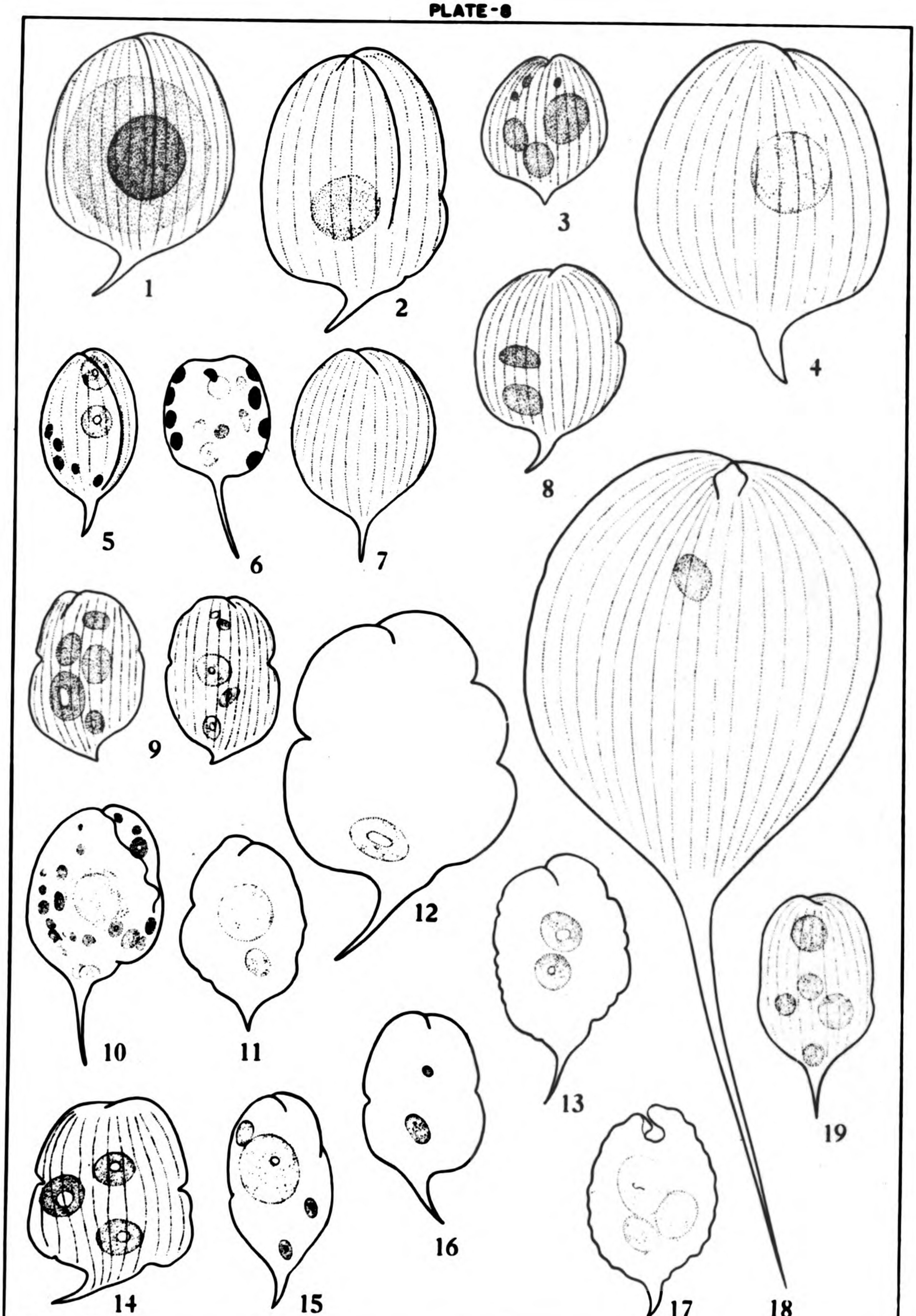

PLATE 9

PLATE-9

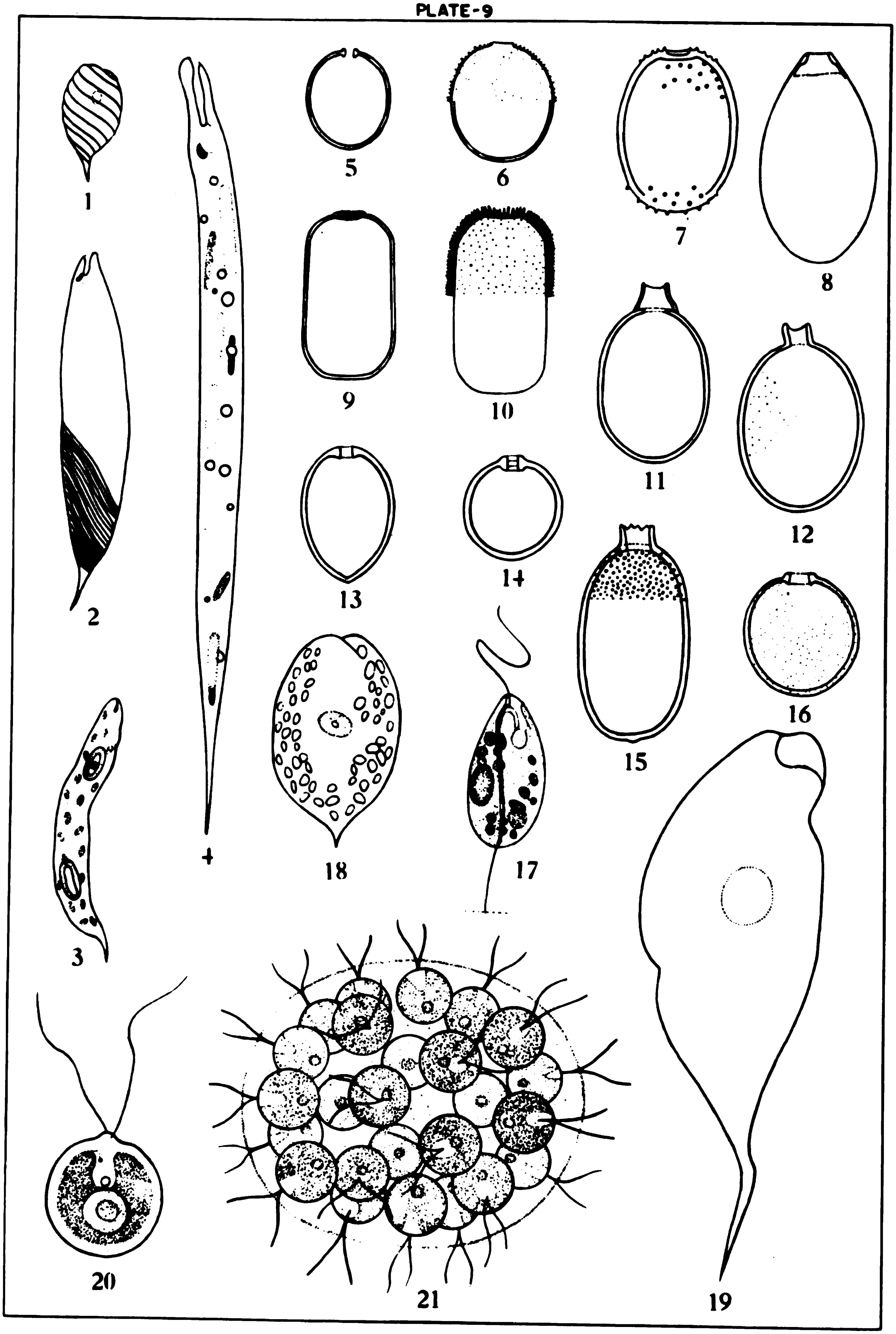

PLATE 10

	Fig.
Scenedesmus abundans	1
Scenedesmus arcuatus var. *platydisca*	2
Scenedesmus bijuga	3 & 4
Scenedesmus quadricauda	5
Scenedesmus quadricauda var. *quadrispina*	6
Scenedesmus armatus	7
Scenedesmus dimorphus	8
Scenedesmus obliguus	9
Scenedesmus quadricauda var. *parvus*	10
Scenedesmus obliguus	11
Tetradesmus wisconsinense	12
Golenkinia radiata	13
Dictyosphaerium pulchellum	14
Kirchneriella obesa	15
Kirchneriella lunaris	16
Kirchneriella contorta	17
Nephrocytium Agardhianum	18
Oocystis gigas	19
Nephrocytium obesum	20
Botryococcus Braunii	21

PLATE-10

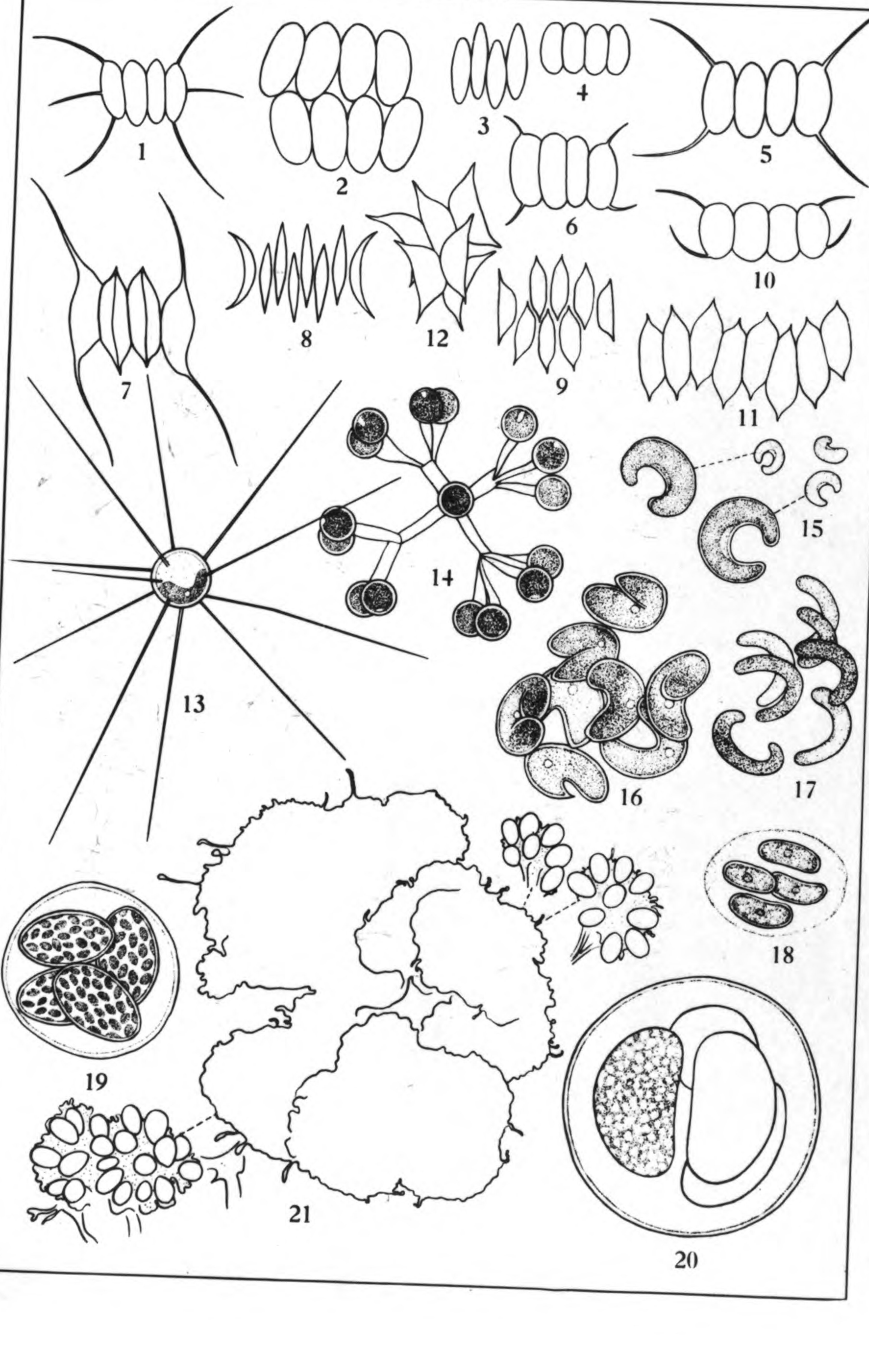

PLATE 11

PLATE-11

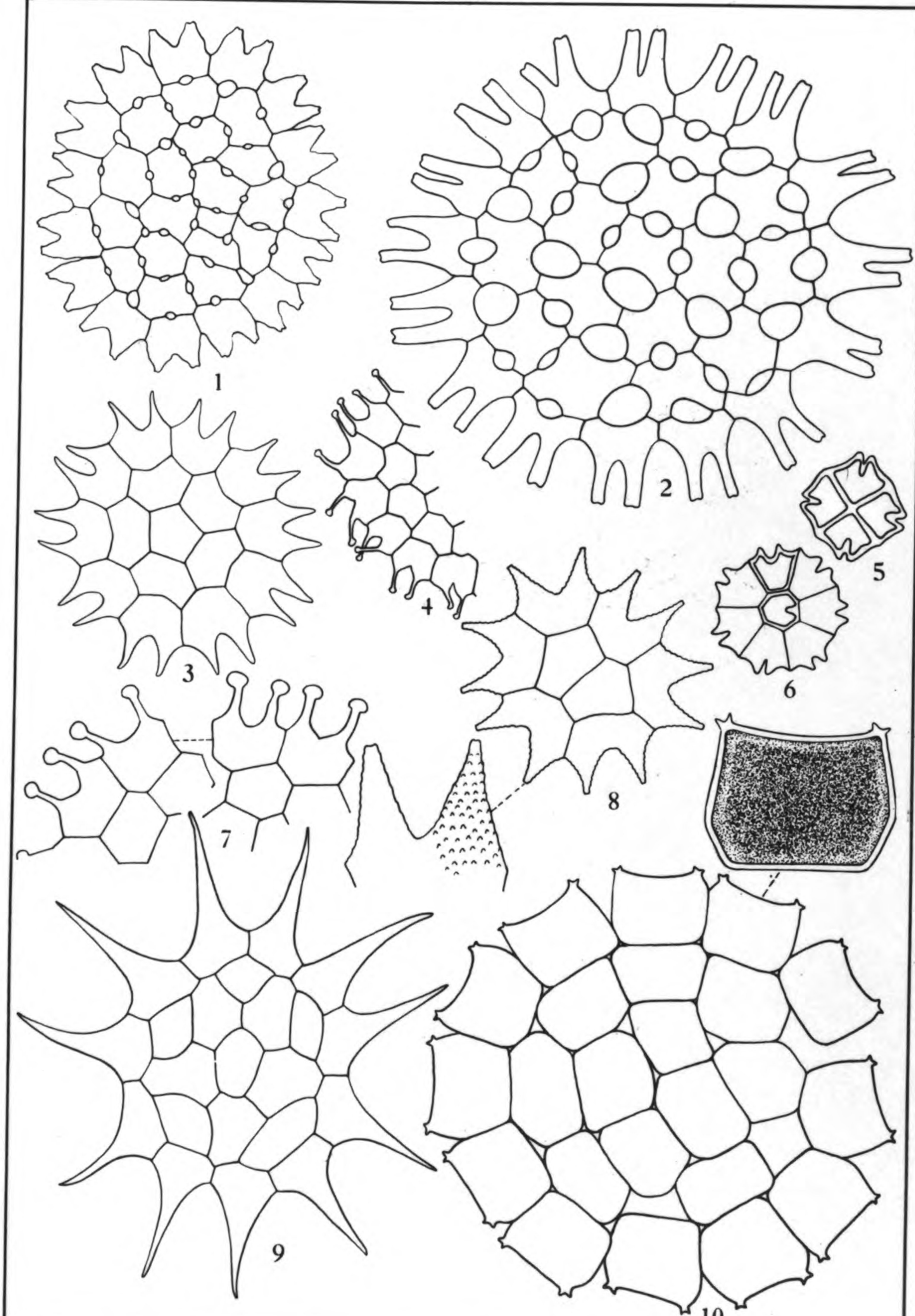

PLATE 12

PLATE-12

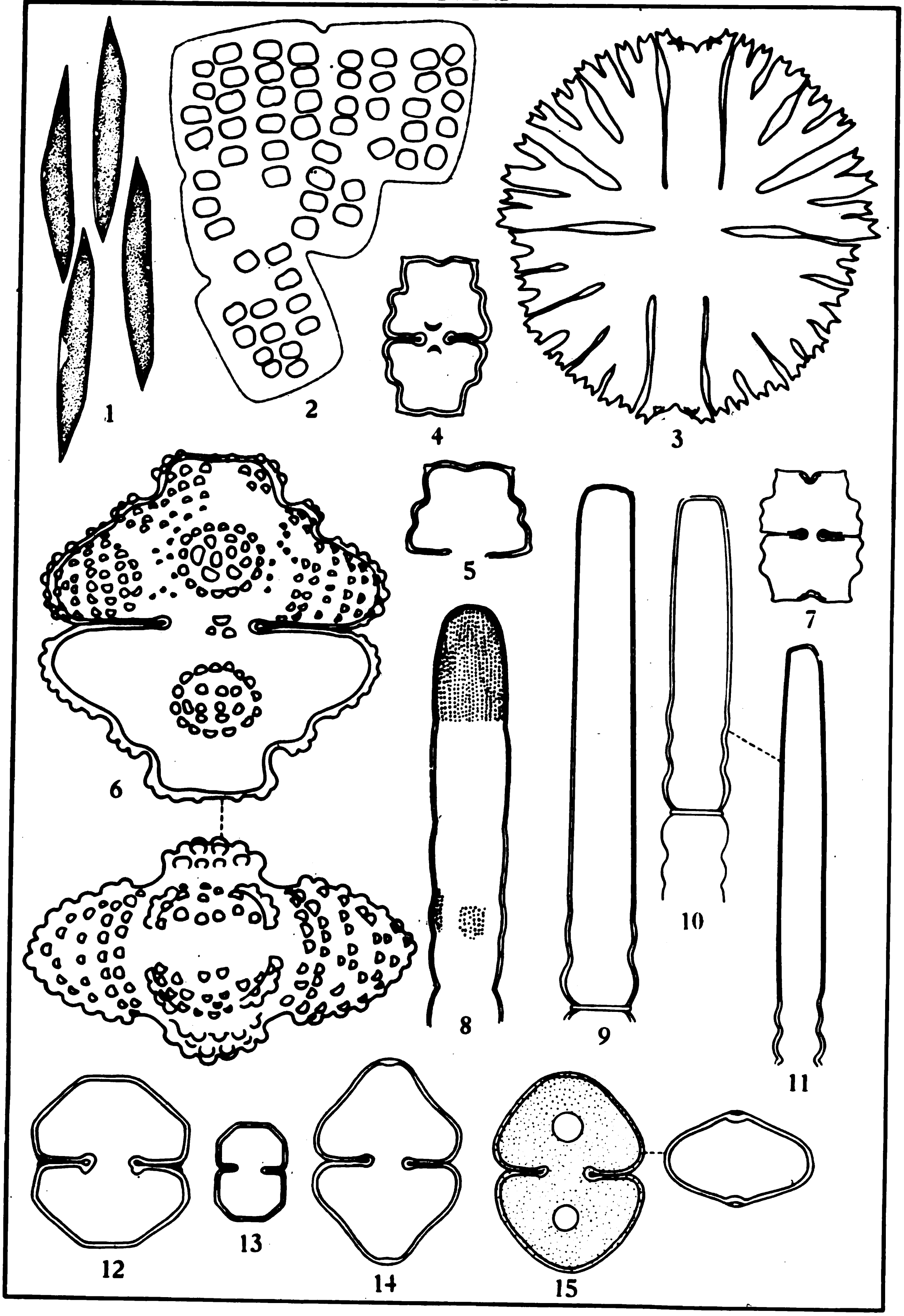

PLATE 13

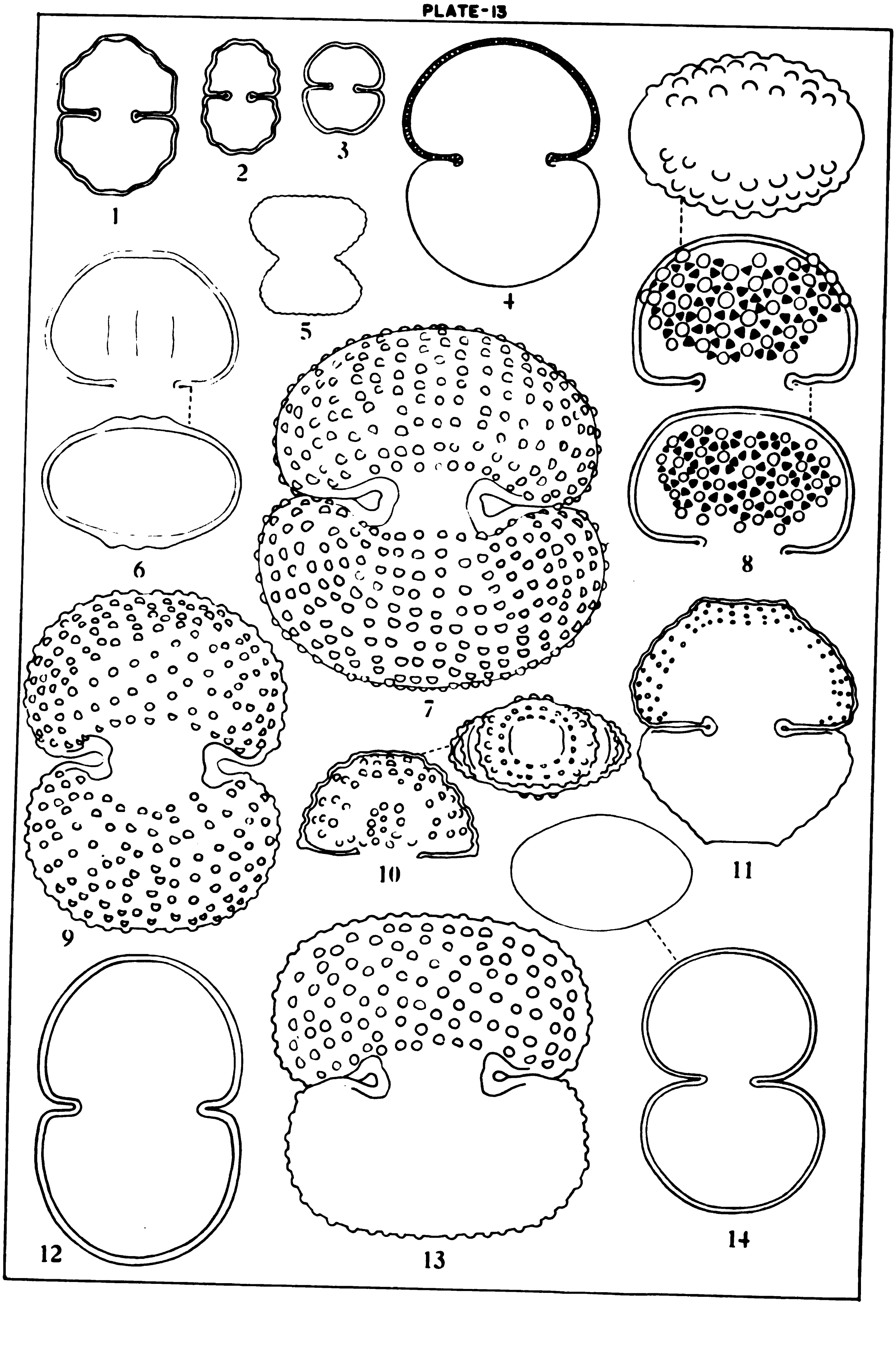
PLATE-13
1
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14

PLATE 14

Fig.

PLATE-14

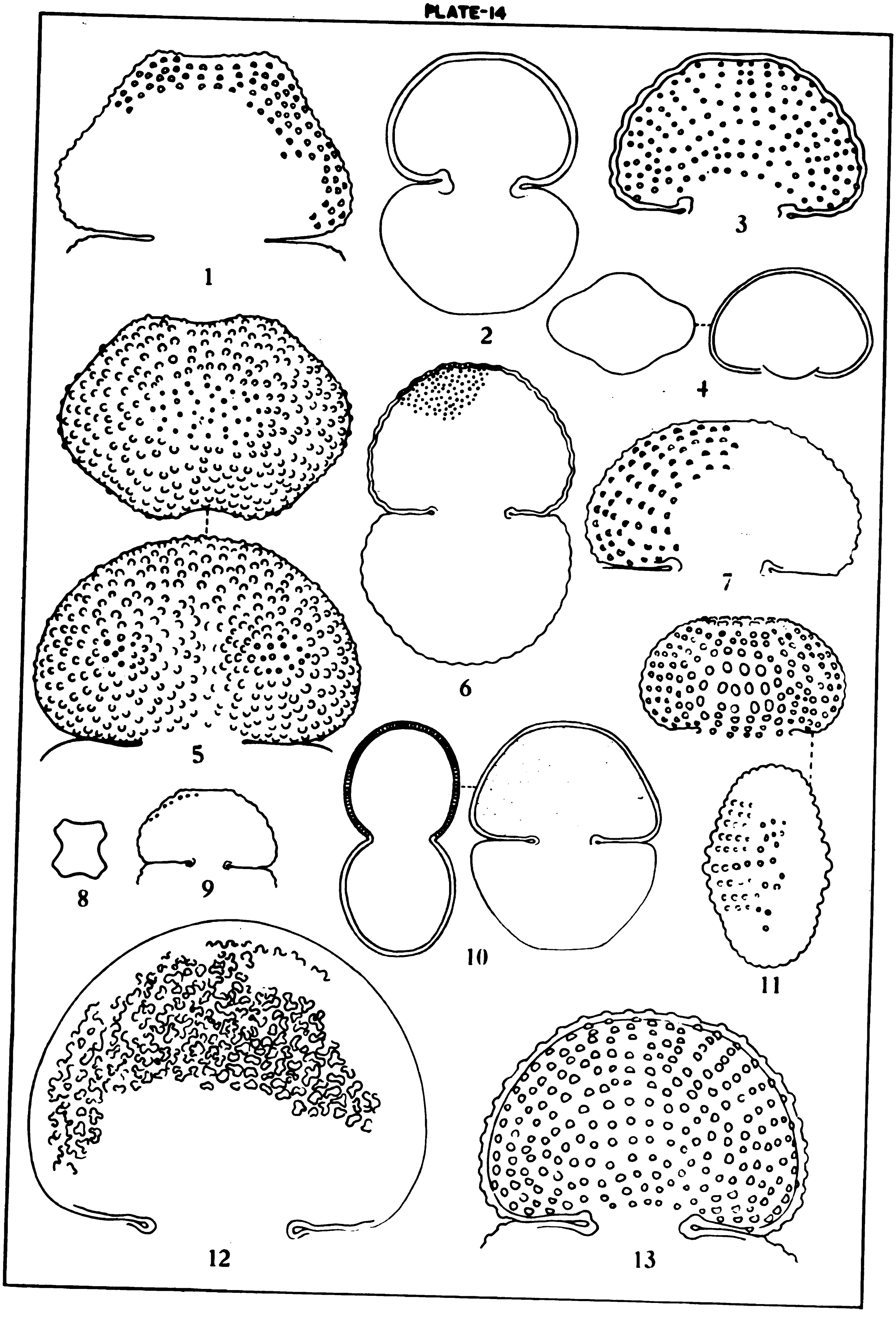


PLATE 15

PLATE-15

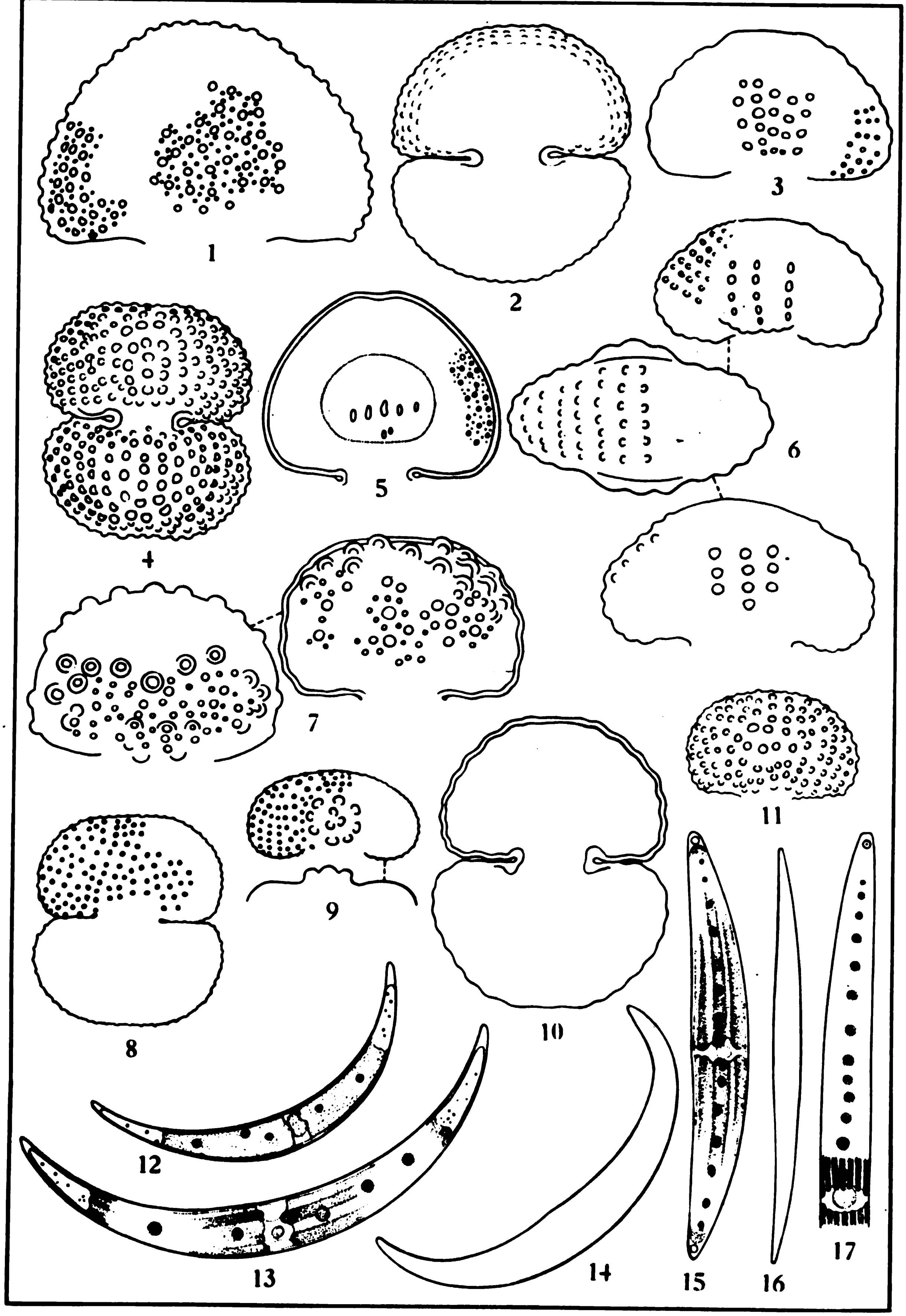


PLATE 16

	Fig.
Closterium pseudolunula	1 & 2
Closterium acerosima var. tumidum	3
Closterium Leibleinii	4
Closterium moniliferum	5
Staurastrum polymorphum	6
Staurastrum punctulatum	7
Staurastrum floriferum	8
Staurastrum chaetoceras	9
Staurastrum granulosum	10
Staurastrum bienneanum var. ellipticum	11
Staurastrum Brebissonii	12

PLATE-16

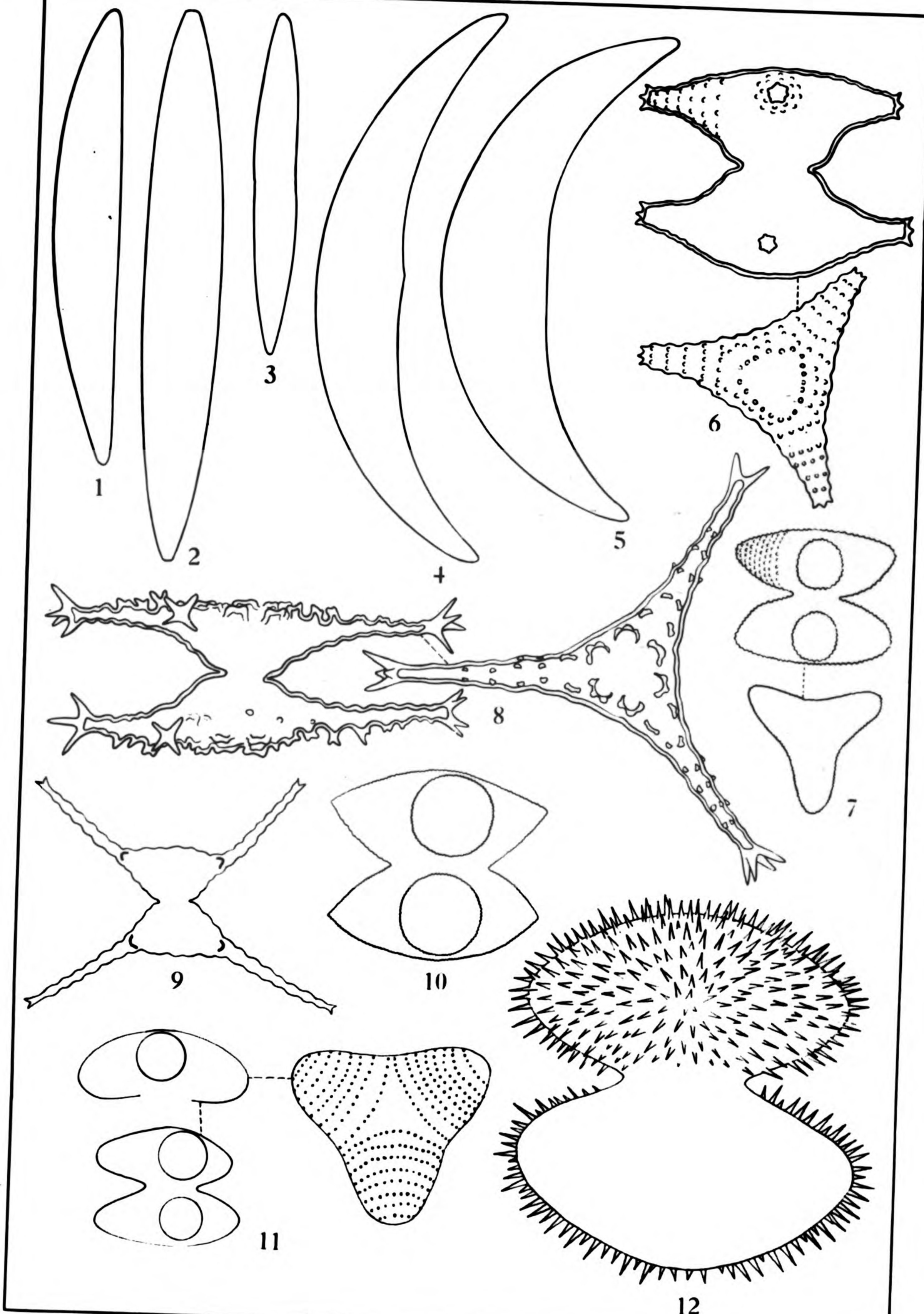


PLATE 17

	Fig.
Staurastrum Johnsonii	1
Staurastrum paradoxum	2
Staurastrum striolatum	3
Staurastrum longiradiatum var. *elevatum*	4
Staurastrum disputatum	5
Staurastrum quebecense var. *ornatum*	6 & 7
Staurastrum planctonicum	8
Staurastrum sebaldii var. *ornatum*	9

PLATE-17

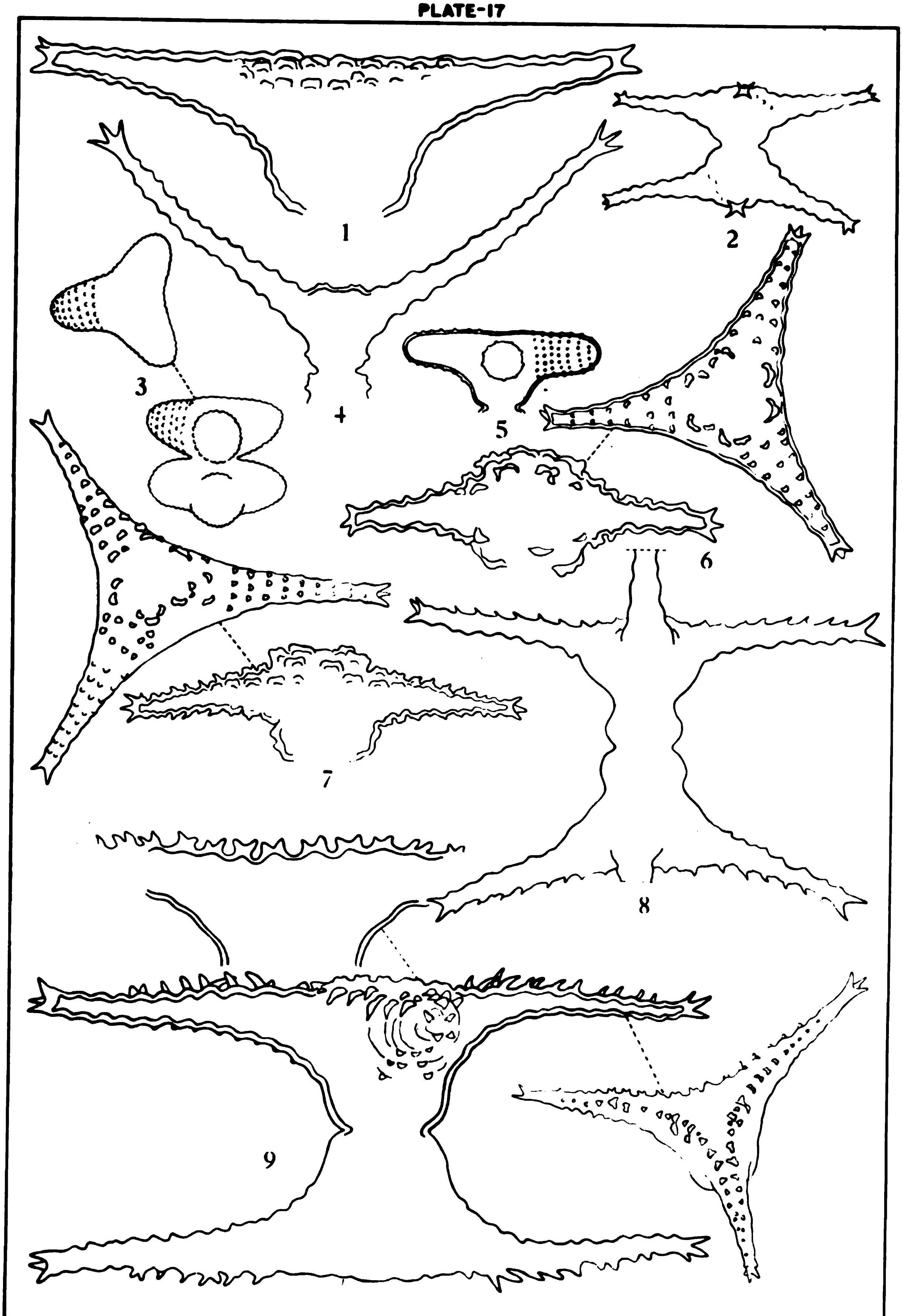


PLATE 18

PLATE-18

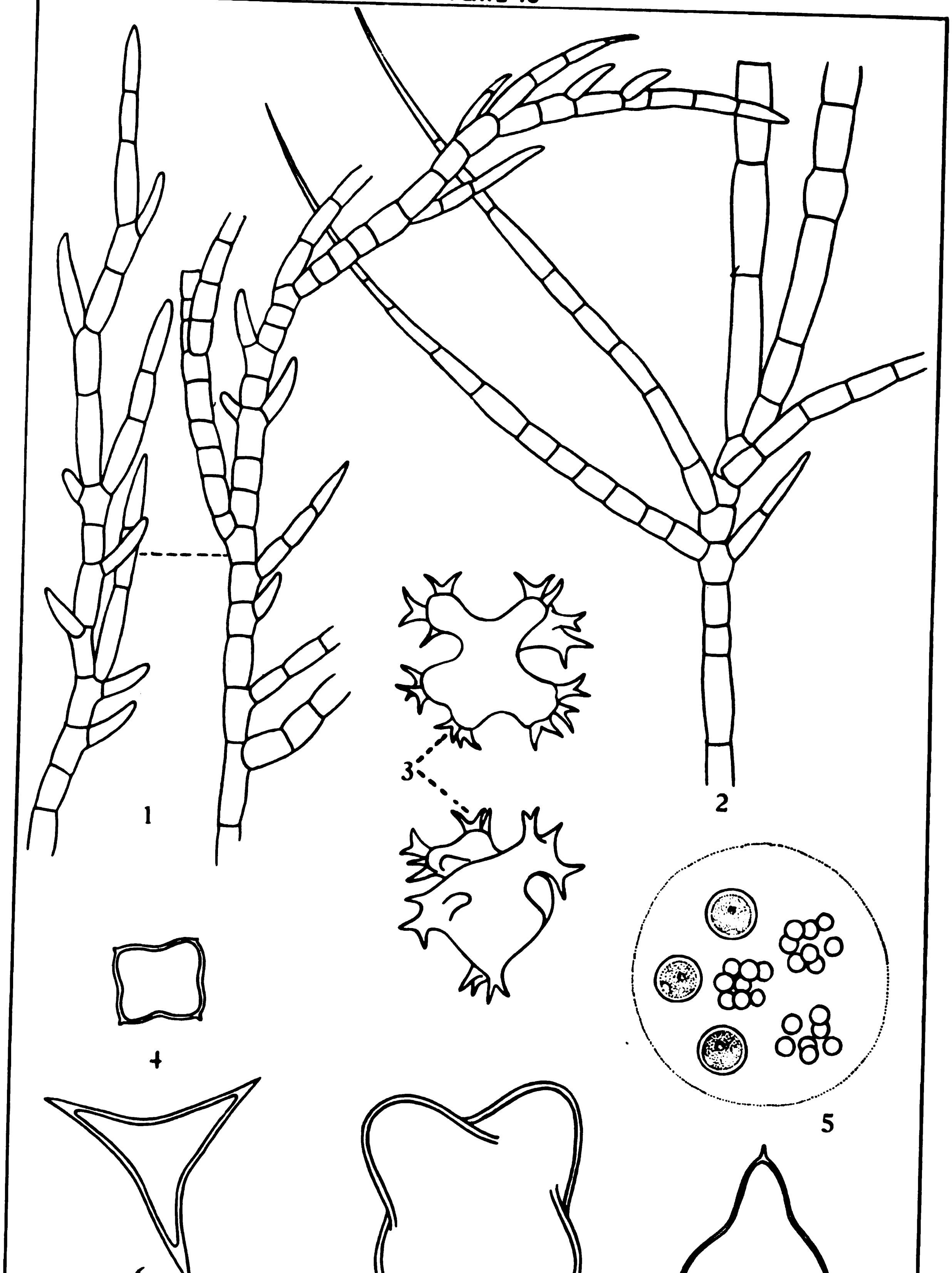
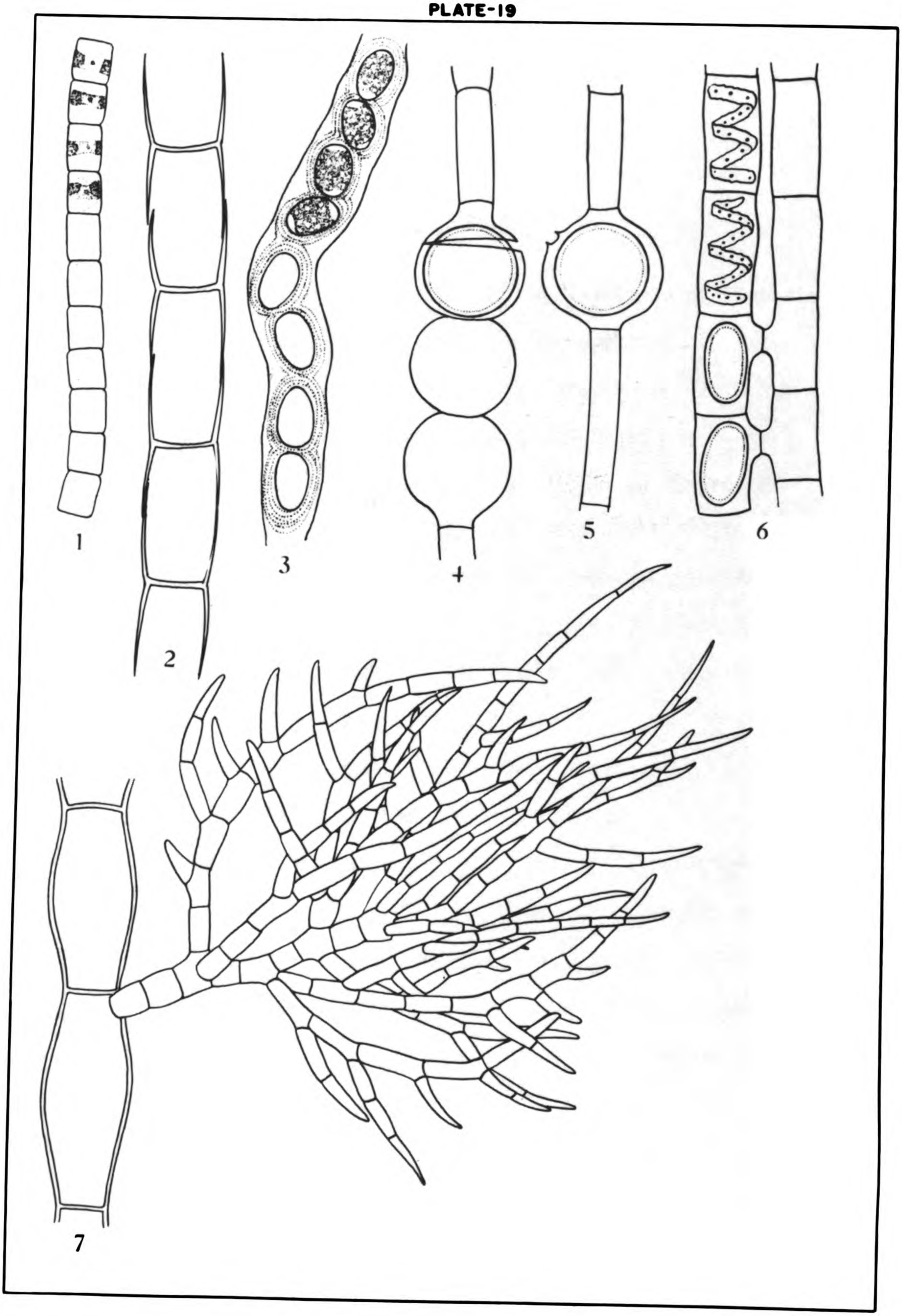


PLATE 19

	Fig.
Ulothrix tenerrima	1
Microspora elegans	2
Cylindrocapsa geminella	3
Oedogonium Pringsheimii	4
Oedogonium globosum	5
Spirogyra Porticalis	6
Draparnaldia glomorata	7

PLATE-19



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