1964

A Preliminary Survey of the Algae of Cheyenne Bottoms in Kansas

Henry J. McFarland
Fort Hays State University

Edward A. Brazda
Fort Hays State University

Ben H. McFarland
Fort Hays State University

fort hays studies

science series no. 2
october 1964

McFarland, Henry J.
Brazda, Edward A.
McFarland, Ben H.

A Preliminary Survey of the Algae of Cheyenne Bottoms in Kansas

fort hays studies—new series
science series no. 2
october, 1964

Fort Hays Kansas State College

Hays, Kansas

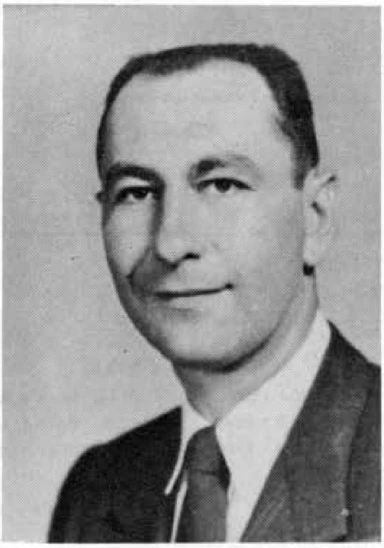
Fort Hays Studies Committee

STOUT, ROBERTA
SPANGLER, ROBERT J.
WALKER, M. V.
KEMPER, ROBERT
Marc T. Campbell, ***chairman***

Library of Congress Card Catalog No. 64-63577

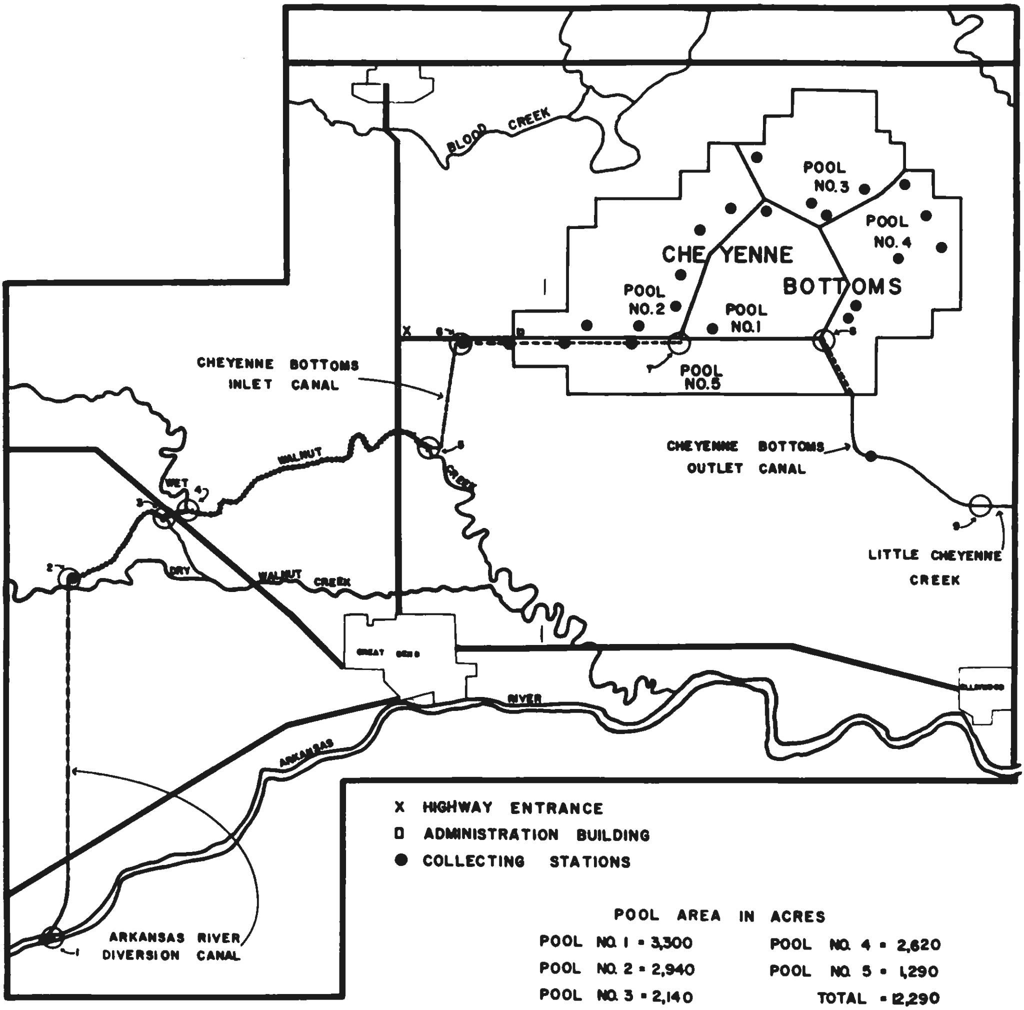
Biographical Sketch of the Authors

Henry J. McFarland received his Bachelor of Science and his Master of Science Degrees from Kansas State Teachers College, Emporia. He previously held positions at Dodge City Junior College, Peru State Teachers College and Oklahoma City University. He joined the staff as Assistant Professor of Biology at Fort Hays Kansas State College in 1948. He has done graduate work at the University of Oklahoma, University of Colorado and University of Michigan. He has been engaged in research on freshwater algae of western Kansas for a number of years along with many of his graduate students who have done work on taxonomy, ecology and culturing of these little known aquatic plants.



Edward A. Brazda received his Bachelor of Science Degree and his Master of Science Degree (1961) from Fort Hays Kansas State College. Currently he is Instructor of Biology at St. Mary of the Plains College, Dodge City. He has done research on the algae of Ellis, Ford and Barton Counties.

Ben H. McFarland received his Bachelor of Science Degree and his Master of Science Degree (1959) from Fort Hays Kansas State College. He has done graduate work at Montana State University. He is currently Teacher of Sciences at Hill City High School. He has done research on the algae of Ellis, Edwards and Trego Counties.



1 ARKANSAS RIVER DIVERSION DAM
2 CANAL DISCHARGE INTO DRY WALNUT CREEK
3 DRY WALNUT CREEK DIVERSION DAM
4 DISCHARGE INTO WET WALNUT CREEK
5 WET WALNUT CREEK DIVERSION DAM
6 DROP STRUCTURE
7 DISCHARGE INTO CHEYENNE BOTTOMS
8 CHEYENNE BOTTOMS DISCHARGE
9 END OF OUTLET CANAL

DISTANCE	IN MILES
1 - 2	6.5
2 - 3	2.5
3 - 4	.5
4 - 5	7.0
5 - 6	2.2
6 - 7	4.0
TOTAL	22.7

CHEYENNE BOTTOMS

Frontispiece. (Fig. 1) Map showing collecting stations.

Acknowledgments

The authors wish to express appreciation for the helpful assistance of Dr. Gerald W. Tomanek for his suggestions relative to the problem. The authors are also indebted to Dr. Howard Reynolds, Dr. Floyd Kinsinger and Dr. Paul Graber for helpful assistance.

Expenses of the study of Cheyenne Bottoms were partially defrayed by a grant to Fort Hays Kansas State College from the Kansas Forestry, Fish and Game Commission.

Table of Contents

List of Figures

Introduction

Very little work has been done on the study of algae in western Kansas. The purpose of this study was to classify and describe some of the algae of the Cheyenne Bottoms Wildlife Refuge, Barton County, Kansas. The study was conducted over a two year period starting May 23, 1960. In this study 66 species and 7 varieties are described representing 4 divisions, 6 classes, 14 orders, 26 families and 43 genera of algae when following the classification of Smith (1950) with certain modifications according to Prescott (1951). Represented were 5 varieties, 27, species, 2 genera and 1 family new to the state of Kansas. Specimens preserved are in the Elam Bartholomew Herbarium of Fort Hays Kansas State College and the private herbarium of Henry J. McFarland.

Abstract

The purpose of this study was to classify and describe some of the algae of Cheyenne Bottoms Wildlife Refuge, Barton County, Kansas. The general geographic location is northeast of Great Bend, Kansas. A natural basin has been converted by dikes into a group of pools. Collections of algae were made within the five pools of the area as well as along the Inlet Canal and the Arkansas River Diversion Dam and the Outlet Canal leading into Little Cheyenne Creek. Taxonomic descriptions are given for 66 species and 7 varieties which represent 4 divisions, 6 classes, 14 orders, 26 families and 43 genera. Represented were 5 varieties, 27 species, 2 genera and 1 family new to the state of Kansas. Eleven plates of photomicrographs and drawings with 76 figures are included. The study was made over a two year period starting in May, 1960.

A Preliminary Survey of the Algae of Cheyenne Bottoms in Kansas

Location and Extent of the Area

Cheyenne Bottoms Wildlife Refuge is a state and federal project made possible by the Robinson-Pittman act of 1942. By 1949, the present 18,710 acres had been purchased at a cost of $408,725.00.

Cheyenne Bottoms is a natural, oval depression about 6 miles wide and 10 miles long in Barton County, Kansas, occupying 18,650 acres with five pools, three diversion dams and 22.7 miles of canals, creeks and control locks for regulating the flow of water. Pool 1 occupies the center of the cluster of lakes with Pool 2 on the west, Pool 3 on the north, Pool 4 on the east and Pool 5 on the south. Pool 1 has an area of 3,300 acres; Pool 2, 2,940 acres; Pool 3, 2,140 acres; Pool 4, 2,620 acres and Pool 5, 1,290 acres with a total of 12,290 acres. The Arkansas River Diversion Canal runs from the Arkansas River at a point 1.5 miles south of Dundee straight north 6.5 miles to Dry Walnut Creek and along it for a distance of 2.5 miles to the Dry Walnut Creek Diversion Dam. The water then goes through a 54 inch conduit 0.5 mile long under Highway 96 to the north side to a point 3.5 miles southeast of Heizer and then along Wet Walnut Creek 7 miles to a point 3 miles north of Great Bend to the Wet Walnut Creek Diversion Dam which directs the water into Cheyenne Bottoms by way of the Cheyenne Bottoms Inlet Canal. The Arkansas River Diversion Dam is 1.5 miles south of Dundee, the Dry Walnut Diversion Dam is 3 miles southeast of Heizer on the south side of Highway 96 while the Wet Walnut Creek Diversion Dam is 3 miles north of Great Bend east of Highway 281. The Cheyenne Bottoms Outlet Canal runs 5.5 miles from the southeast part of the Cheyenne Bottoms area into Little Cheyenne Creek 3.5 miles north of Ellinwood. Blood Creek just south of Hoisington and Deception Creek 2.5 miles east of Hoisington drain into Cheyenne Bottoms. The surrounding hills about 100 feet high together with the intervening gullies constitute a watershed directing the water into Cheyenne Bottoms. Most of the water supplying the area comes from Wet Walnut Creek but the Arkansas River water if plentiful is used as needed. The east and southeast limits of the area were probably blocked off by wind drifted sand which prevented natural drainage until the Cheyenne Bottoms Outlet Canal was built leading into Little Cheyenne Creek. Twenty-three miles of dikes were built surrounding Pool 1 separating it from other pools and also separating these pools from each other. Atop these dikes are two-lane roads which provide ready access into and out of the area. Roads bring traffic from Highway 281 on the west, Highway 4 on the north and Highway 96 on the south.

Pools 2, 3 and 4 have blinds and hunting is permitted in season. Fishing is allowed in all pools. The level of the water in the various pools can be controlled by appropriate gates located along the dikes.

Origin of Cheyenne Bottoms

Probably the eastern and southern drainage of this area was blocked by huge deposits of sand while the subterranean salt deposits were leached out and the whole area subsided leaving the "Bottoms" as it is today. There is some belief that a river at one time passed through the area and eroded the land to form Cheyenne Bottoms. Blood Creek and Deception Creek might have played an important part in Cheyenne Bottoms history. It bears repeating, however, that these are all theories and all factors might have contributed a share. Information of the area has been gained from the State Geological Survey, from oil well drilling and from natural deposits of sand and silt in the vicinity. The depth of water in the "Bottoms" area is from a few inches to a few feet. Frontispiece (Fig. 1) shows the present general plan of the area.

Present Importance

At present Cheyenne Bottoms serves as a great game refuge, especially for water fowl such as pelicans, gulls, killdeer, avocets, ducks, herons and sandpipers together with fish such as carp, catfish, bullheads and others. The presence of water in Cheyenne Bottoms raises the water table for the surrounding area. Aside from hunting and fishing the area offers some recreation for bird lovers and picnickers. Facilities for picnicking are limited and for camping very limited. The watershed of the area should be protected from contamination which would be augmented by campers.

Distribution of Algae

Algae are widely distributed in sea and fresh-water habitats. They are plentiful in rivers, brooks, ponds, lakes and oceans and in moist places such as upon the bark of trees, soil, fences or buildings. Many forms are invisible except with the microscope. Algae in one form or another are found from pole to pole and from deep valley to high mountains. In Cheyenne Bottoms algae are found as plankton in the various pools, epiphytic on higher vegetation, clinging to other algae, epizoic on fish, turtles or other animals or growing upon mud, rocks, plant stems, bridge pilings, debris or shore line.

Forms of Algae

The forms of algae in Cheyenne Bottoms are most varied from single celled types of filamentous or branched colonial kinds. The genera *Phacus, Navicula, Synedra, Closterium, Pleurosigma, Phacotus, Pinnularia, Nitzschia, Golenkinia, Spirulina, Euglena, Trachelomonas, Cyclotella* and *Gloeothece* are single celled types. The diatoms have silicified frustules made of two distinguishable halves fit together like a pill box. They may be long and linear in which case they belong to the Order Pennales (Figs. 53-66) or disc-like with radial symmetry in which case they belong to the Order Centrales (Figs. 51-52). In the figures you may be looking at the valve view, which is the face of the frustule (this is the view shown most often by diatomists in illustrations) or you may be looking at the girdle view, which is the side view where the seam of the two frustules meet. The illustrations of diatoms are unusual in this paper because they were all photographed in the living condition. Usually most diatomists kill the diatoms in the process of cleaning in order to show detail of the silica wall which are the main classifying feature.

Diatoms are often possessed with weak powers of locomotion but are devoid of cilia and flagella. They apparently move by the flow of cytoplasm along the side of the frustule. The cytoplasm appears to be in friction with the surrounding water or substratum. The cells have single nuclei and usually one or two or many chromatophores. The walls may also contain pectic compounds and in some cases cellulose. The frustules are quite durable and persist after the death of the plants. Viewed from girdle side the overlap of the valves may be observed and in this view the frustule is usually truncate at the extremities. Viewed from valve side the frustule may be round or tapering towards the extremities.

The genera *Trachelomonas, Euglena, Phacus* and *Lepocinclis* are usually very motile but are propelled by flagella (Figs. 42-48) located at the anterior end of the cell. Chloroplasts, a nucleus and sometimes pyrenoid bodies appear within the cell. *Euglena* is metabolic while *Phacus* and *Lepocinclis* have rigid periplasts. *Trachelomonas* (Fig. 48) has a lorica which may be colorless or if impregnated with iron, yellow or red. These deposits may obscure other features of the cell.

Phacotus lenticularis (Figs. 2 and 3) is biflagellate and quite motile showing first a front, oval view and then a double convex view as it tumbles in the water.

Golenkinia radiata (Fig. 17) has a spherical cell with a single chromatophore which fills the cell. Numerous setae project radially from the cell to considerable distance. Locomotion is not apparent in the vegetative state.

Spirulina major (Fig. 68) consists of very long spirals without cross walls. The cells are blue-green in color, possessed of oscillatoria like movements and the entire plant is a single cell.

Gloeothece rupestirs (Fig. 67) consists of oval cells contained in large numbers within a jelly-like matrix. Motility of the cells is lacking.

Filamentous algae includes some Cyanophyta (blue-greens) and Chlorophyta (greens) both divisions of which are present within Cheyenne Bottoms. The genera *Anabaena, Lyngbya, Cylindrospermum* and *Oscillatoria* are "blue-greens" of a filamentous nature which occur within the "Bottoms" area. *Anabaena* and *Oscillatoria* are often possessed of moderate powers of locomotion while *Lyngbya* and *Cylindrospermum* can move to lesser degrees. The genera *Pithophora* (Figs. 14-16) and *Cladophora* (Fig. 11) represent branching types of "green algae" while *Rhizoclonium* (Fig. 12), *Spirogyra* (Figs. 29-30) and *Sirogonium* (Figs. 31-35) represent for the most part unbranched, non-motile types.

Colonial non-filamentous types are represented by the genera *Scenedesmus* (Figs. 24-27), *Gloeocystis* (Fig. 4), *Pediastrum* (Figs. 18-21), *Gloeothece* (Fig. 67) and *Hydrodictyon* (Fig. 22). *Scenedesmus* consists of two, four, eight or more cells held together usually in a linear series. *Pediastrum* consists of a number of cells coalesced into a flat plate. *Hydrodictyon* consists of a number of cells articulated at the ends to form a net structure with meshes five or six sided. *Gloeocystis* (Fig. 4) and *Gloeothece* (Fig. 67) consists of a number of cells imbedded in a gelatinous matrix. *Nostoc* (Fig. 74) and *Gloeotrichia* (Figs. 76-77) are also colonial but consist of filaments held together by a gelatinous substance. *Gloeothece, Nostoc* and *Gloeotrichia* are "bluegreens" while *Scenedesmus, Gloeocystis, Pediastrum* and *Hydrodictyon* are Chlorophyceae. *Entermorphia intestinalis* (Fig. 10) is a multicellular type of alga with a hollow tube-like body held in place on the substratum by holdfasts.

Methods Used in the Study

Collections were made one to four times each month for a period of two years beginning May 23, 1960, within the confines of

Cheyenne Bottoms Wildlife Refuge, the Cheyenne Bottoms Inlet Canal and above the Arkansas River Diversion Dam. Water was diverted from the Arkansas River during June, 1960, and from the Wet Walnut Creek on many occasions. The specimens were identified, photomicrographed and preserved specimens were filed. Table 1 lists the collecting points. Many of the collecting stations represent collecting points straight out from one of the many bridges that lead out to the duck blinds. Other collecting stations represent points along the edge of pools, inlet canal and other points as described. All bridge numbers and pool numbers are official numbers assigned to the bridges or pools and maps showing the bridges and pools and surrounding areas are usually available from the Cheyenne Bottoms Administration Building and from the Chamber of Commerce of surrounding towns in the area. Most collection samples were either collected as free floating or as attached algae on the numerous sedges, rushes or bottom mud or debris. The Frontispiece (Fig. 1) shows the pools and related areas.

TABLE 1. Collecting stations.

STATIONS	Location and Description
A	Bridge 2, Pool 2.
B	0.3 mile east from the southwest corner of Pool 1 in Pool 1.
C	At northern part of Pool 1 at road intersections.
D	0.5 mile east from the Administration Building in Inlet Canal.
E	1.5 miles east from Administration Building in Inlet Canal.
F	Northeast corner of Pool 1 at road intersections of Pools 1, 3 and 4.
H	Bridge 10, Pool 3.
I	Bridge 20, Pool 4.
J	Bridge 19, Pool 4.
K	Bridge 14, Pool 4.
N	Bridge 16, Pool 4.
O	North of Bridge 5, Pool 2.
P	Bridge 8, Pool 3.
Q	Bridge 5, Pool 2.
R	Bridge 3, Pool 2.
S	Bridge 13, Pool 3.
T	Bridge 7, Pool 2.
U	Bridge 4, Pool 2.
V	Bridge 6, Pool 2.
W	Bridge 11, Pool 3.
X	Outlet Canal.
Y	Bridge 18, Pool 4.
Z	Arkansas River Diversion Dam, 1 mile south of Dundee.
AA	Canal discharge into Dry Walnut Creek, 5 miles north of Dundee.
BB	West edge of Cheyenne Bottoms in Inlet Canal, southwest of Administration Building, west of main bridge.
CC	Inlet Canal Drop Structure, 0.5 mile west of Administration Building.
DD	Bridge 1, Pool 2.

Classification of Algae

Logically it appears that eight divisions are worthy of consideration. Four of the eight divisions of algae were found in Cheyenne Bottoms. Classification of the algae is according to Smith (1950) with certain modification according to Prescott (1951). Such a classification is here presented with emphasis placed on the species at Cheyenne Bottoms.

Division CHLOROPHYTA (green algae)
- Class CHLOROPHYCEAE (lower green algae)
  - Order VOLVOCALES (vegetative and reproductive cells motile)
    - Family PHACOTACEAE (unicellular, biflagellate with two valved cells)
      - *Phacotus lenticularis* (Ehr.) Stein, p. 11
  - Order TETRASPORALES (plants non-motile in vegetative condition)
    - Family PALMELLACEAE (spherical or ovate cells in amorphous or definite colonies)
      - *Gloeocystis gigas* (Kütz.) Lagerheim, p. 11
    - Family TETRASPORACEAE (cells imbedded in mucilage, have two pseudocilia)
      - *Tetraspora gelatinosa* (Vauch.) Desvaux, p. 11
      - *Tetraspora cylindrica* (Whal.) C. A. Agardh, p. 12
  - Order ULOTRICHALES (usually uninucleate, one chloroplast)
    - Family ULOTRICHACEAE
      - *Ulothrix aequalis* Kütz., p. 12
      - *Ulothrix tenerrima* Kütz., p. 13
      - *Ulothrix zonata* (Weber and Mohr) Kütz., p. 13
  - Order ULVALES (cells uninucleate, forming solid cylinder, hollow tubes or sheets)
    - Family ULVACEAE (forming hollow tubes, ribbons or plates one cell thick)
      - *Entermorpha intestinalis* (L.) Grev., p. 14
  - Order CLADOPHORALES (multinucleate filamentous cylindrical cells)
    - Family CLADOPHORACEAE (only family in this order)
      - *Cladophora glomerata* (L.) Kütz., p. 14
      - *Rhizoclonium hieroglyphicum* (C. A. Agardh) Kütz., p. 15
      - *Basicladia chelonum* (Collins) Hoffman and Tilden, p. 15
      - *Pithophora varia* Wille, p. 16
  - Order CHLOROCOCCALES (single celled or multicellular colonies, no filaments)
    - Family MICRACTINIACEAE (cells sperical with one to several long setae)
      - *Golenkinia radiata* (Chod.) Wille, p. 16
    - Family CHARACIACEAE (Elongated single cells or jointed to form radiating colonies)
      - *Schroederia judayi* G. M. Smith, p. 17

Family HYDRODICTYACEAE (zoospores appose and develop to form coenobium)

Pediastrum simplex (Meyen) Lemmermann, p. 17

Pediastrum duplex Meyen, p. 17

Pediastrum boryanum (Turpin) Meneghini, p. 18

Pediastrum boryanum var. *longicorne* Raciborski, p. 18

Hydrodictyon reticulatum (L.) Langerheim, p. 19

Family OOCYSTACEAE (reproduction by autospores only, single celled or in colonies of no fixed number)

Ankistrodesmus falcatus (Corda) Ralfs, p. 19

Family SCENEDESMACEAE (reproduction by autospores only, cells remain attached in multiples of 2)

Scenedesmus opoliensis Richter var. *mononensis* Chod., p. 20

Scenedesmus abundans (Kirchner) Chod., p. 20

Scenedesmus acuminatus var. *minor* G. M. Smith, p. 21

Scenedesmus dimorphus (Turpin) Kütz., p. 21

Scenedesmus bijuga (Turpin) Langerheim, p. 21

Actinastrum hantzschii var. *fluviatile* Schroeder, p. 22

Order ZYGNEMATALES (no flagellated reproductive cells but have zygospores; single celled or unbranched filaments)

Family ZYGNEMATACEAE (cylindrical cells in filaments, have conjugation)

Spirogyra singularis Nordst., p. 22

Spirogyra neglecta (Hassall) Kütz., p. 22

Sirogonium floridanum (Transeau) G. M. Smith, p. 23

Sirogonium sticticum (English Botany) Kütz., p. 23

Family DESMIDIACEAE (cell walls with pores; in cell division walls break at definite place to show semicells)

Closterium acutum (Lyngb.) Bréb. var. *linea* (Perty) West and West, p. 24

Closterium acerosum (Schrank) Ehr., p. 24

Closterium moniliferum (Bory) Ehr., p. 25

Closterium lanceolatum Kütz., p. 26

Closterium incurvum Bréb., p. 26

Class CHAROPHYCEAE (higher green algae)

Order CHARALES (erect thallus with nodes and internodes, nodes with whorled branches)

Family CHARACEAE (nucules with five tube cells in left-hand spiral)

Chara braunii Gmelin, p. 27

Division EUGLENOPHYTA (mostly free-swimming flagellated cells)

Class EUGLENOPHYCEAE (only one class in division)

Order EUGLENALES (flagellated cell dominant in life cycle)

Family EUGLENACEAE (mostly with chloroplasts, granular swelling on flagellum within reservoir)

Euglena elastica Prescott, p. 27

Phacus pyrum (Ehr.) Stein, p. 28

Phacus acuminata Stokes, p. 28

Phacus longicauda (Ehr.) Dujardin, p. 29

Phacus torta Lemmermann, p. 29

Phacus pleuronectes (Mueller) Dujardin, p. 29

Trachelomonas hispida (Perty) Stein, p. 30

Division CHRYSOPHYTA (chromatophores yellow-green to golden brown)
Class XANTHOPHYCEAE (yellow-green chromatophores)
Order HETEROSIPHONALES (cells multinucleate and siphonaceous)
Family VAUCHERIACEAE (tubular and sparingly branched when branching)
Vaucheria sessilis (Vaucher) DeCondolle, p. 30
Class BACILLARIOPHYCEAE (diatoms with walls mostly of silica and two halves like a soap dish or petri dish)
Order CENTRALES (mostly cells are circular but may be polygonal or irregular in shape, markings are mostly radial from a central point, no raphe or pseudoraphe)
Family COSCINODISCACEAE (cells disc or cylindrical shaped, without horns or prominent spines, single cells or often filamentous as in *Melosira*)
Melosira varians C. A. Agardh, p. 31
Cyclotella striata (Kütz.) Cl. & Grun., p. 32
Order PENNALES (mostly cells that are elongate, valves bilaterally symmetrical to median axis or asymmetrical, with raphe and pseudoraphe)
Family FRAGILARIACEAE (have no costa or internal septa)
Synedra ulna (Nitz.) Ehr., p. 32
Family NAVICULACEAE (valves symmetrical in both axes; lanceolate, elliptical or boat-shaped)
Navicula cuspidata Kütz., p. 33
Navicula cuspidata var. *ambigua* (Ehr.) Cleve, p. 34
Pinnularia viridis Nitz., p. 34
Pleurosigma delicatulum W. Sm., p. 35
Amphiprora alata (Ehr.) Kütz., p. 35
Family GOMPHONEMATACEAE (longitudinally symmetrical in valve view but girdle view transversely asymmetrical)
Gomphonema olivaceum (Lyngb.) Kütz., p. 36
Family NITZSCHIACEAE (has one eccentric keel near one of the lateral margins)
Bacillaria paradoxa Gmelin, p. 36
Nitzschia reversa W. Sm., p. 37
Family SURIRELLACEAE (raphe marginal and on both margins)
Surirella robusta var. *splendida* (Ehr.) Van Heurek, p. 37
Surirella ovalis Bréb., p. 38
Division CYANOPHYTA (blue-green algae)
Class MYXOPHYCEAE (CYANOPHYCEAE) (only class in the division)
Order CHROOCOCCALES (usually producing no endospores, non-filamentous)
Family CHROOCOCCACEAE (non-pseudofilamentous when colonial, some genera unicellular)
Gloeothece rupestris (Lyngb.) Bornet, p. 38
Order OSCILLATORIALES (genera that are filamentous and multicellular)
Family OSCILLATORIACEAE (reproduce from hormogonia only)
Spirulina major Kütz., p. 39
Oscillatoria limosa (Roth) C. A. Agardh, p. 40
Oscillatoria agardhii Gom., p. 40
Oscillatoria tenuis C. A. Agardh, p. 41
Lyngbya versicolor (Wartmann) Gom., p. 41

Family NOSTOCACEAE (trichomes surrounded by a sheath)
Anabaena helicoidea Bernard, p. 42
Anabaena oscillarioides Bory, p. 42
Nostoc linckia (Roth) Bornet and Thuret, p. 43
Cylindrospermum majus Kütz., p. 44
Family RIVULARIACEAE (trichomes attenuated)
Gloeotrichia natans (Hedw.) Rab., p. 44

Chlorophyta

The Chlorophyta includes both freshwater and saltwater types. They range from unicellular to filamentous, platelike and even multicellular types similar to higher plants in many ways. Chloroplasts and definite nuclei are present. Most of the Chlorophyta possess chlorophyll a, chlorophyll b, carotin and xanthophyll. Starch is the final product of photosynthesis in most cases. Vacuoles and cellulose cell walls are present and in some species pyrenoids or protein bodies are evident. These plants were found in all pools of Cheyenne Bottoms. They exist as plankton or grow attached to the substratum. The Chlorophyta includes two classes: 1. Chlorophyceae, the so called green algae and Charophyceae, the higher types of green algae. The Charophyceae includes *Chara, Nitella* and *Tolypella* all of which are much like higher plants. *Chara braunii* was found at Cheyenne Bottoms. The Chlorophyceae is represented in the area by *Cladophora glomerata, Rhizoclonium hieroglyphicum, Hydrodictyon reticulatum,* several species of *Spirogyra, Closterium, Pediastrum, Scenedesmus* and others.

The photosynthetic pigments are localized in grass-green chromatophores. The protoplast may be naked or enclosed within a wall made of cellulose inside and pectose outside. The green chloroplast may be masked with other pigments. Asexual methods of reproduction such as spore formation or cell division as well as sexual reproduction are evident. Zoospores, aplanospores and akinetes are sometimes formed. Vegetative cell division results in an increase in size of the colonies.

Family PHACOTACEAE

Phacotus lenticularis (Ehr.) Stein *in:*

SMITH, The fresh-water algae of the U. S., p. 88, fig. 32. 1950.
THOMPSON, A preliminary survey of the fresh-water algae of Eastern Kansas, Univ. Kansas Sci. Bull., 25(1):19, pl. 3, fig. 7. 1938.
TIFFANY and BRITTON, The algae of Illinois, p. 14, pl. 1, figs. 1, 2. 1952.
WEST and FRITSCH, A treatise on the British fresh-water algae, p. 83, fig. 13A-C. 1927.

Phacotus lenticularis Ehr. *in:*

Fritsch, Structure and reproduction of the algae. Vol. 1, p. 88, fig. 15L-M. 1956.

FIGS. 2, 3.

This unicellular alga belongs to Volvocales; cells biflagellate, double convex, flattened, round or oval front view, groove around the edge in side view where overlapping cell walls meet, thin wing often visible in front view; cell will thick, dark, impregnated with calcium carbonate. Parietal chloroplast has pyrenoids, clear area and red eyespot near anterior end. Reproduction by zoospores, 2-8 escaping along edge when cell splits. Cells 10 microns wide by 10-14 microns long, 7 microns thick. Collected June 27, 1960, Station B, Pool 1.

Family PALMELLACEAE

Gloeocystis gigas (Kütz.) Lagerheim *in:*

PRESCOTT, Algae of the Western Great Lakes area, p. 84, pl. 3, fig. 16. 1951.
SMITH, The fresh-water algae of the U. S., p. 353, fig. 236A. 1933.
TIFFANY and BRITTON, The algae of Illinois, p. 21, pl. 3, fig. 24. 1952.

FIG. 4.

Gloeocystis gigas belongs to order Tetrasporales because cells are immobile and divide vegetatively; colonial gelatinous sheath lamellose, 31-50 microns or more in diameter; cells imbedded within sheath in groups of 2-8, diameter 10-12 microns, globose; parietal chromatophores, one pyrenoid, brownish-green because of oil content, otherwise green; tychoplanktonic habit, living in shallow water intermixed with other algae. Species scarce but found in June 1960 at Cheyenne Bottoms, Station B, Pool 1. This is the first report of the species from Kansas except the unpublished masters thesis of McFarland (1959).

Family TETRASPORACEAE

Tetraspora gelatinosa (Vaucher) Desvaux *in:*

MCNAUGHT, The algae of Kansas reservoirs, Trans. Kansas Acad. Sci., 29:160. 1920.
PRESCOTT, Algae of the Western Great Lakes area, p. 88, pl. 5, figs. 3, 4. 1951.
SMITH, The fresh-water algae of the U. S., pp. 122-124. 1950.
THOMPSON, A preliminary survey of the fresh-water algae of Eastern Kansas, Univ. Kansas Sci. Bull., 25(1):21, pl. 4, fig. 3. 1938.
TIFFANY and BRITTON, The algae of Illinois, p. 22, pl. 4, fig. 33. 1952.

FIG. 5.

Watery, gelatinous thallus produces inflated air filled bullate sacs or expanded sheets. Globular and bullate characteristic of older thallus chief identifying feature; gelatinous matrix structureless, although some sheaths observed were lamellose immediately around individaul cells. Thallus at first attached, soon floats free, expanding usually into a thin sheet or thin walled sac, 20 or more cm diameter with hundreds of round cells; cells 8-12 microns diameter each possessed of two very long, hollow, slender pseudocilia having no function in locomotion but according to some authorities useful in exchange of gases. Chief habitat quiet backwater in lake or stream; spherical cells have single chloroplast which fills cell, one nucleus, one conspicuous pyrenoid, divides in two planes; cells often appearing in groups of twos and fours or widely scattered. This Cheyenne Bottoms species found during February 1961 at Station BB, Entrance Canal.

Tetraspora cylindrica (Wahl.) C. A. Agardh *in:*

PRESCOTT, Algae of the Western Great Lakes area, p. 88, pl. 5, figs. 1, 2. 1951.
SMITH, The fresh-water algae of the U. S. pp. 122-124, fig. 61A-B. 1950.
THOMPSON, A preliminary survey of the fresh-water algae of Eastern Kansas, Univ. Kansas Sci. Bull., 25(1):21, pl. 4, fig. 5. 1938.
TIFFANY and BRITTON, The algae of Illinois, p. 22, pl. 4, fig. 32. 1952.

FIG. 6.

Thallus cylindrical and lobed, 1-2 cm diameter, 15-30 cm long, has general appearance of *Entermorphia intestinalis*, narrowed at place of attachment, consists of rather firm mucilage which streams out in flowing water. Cells appear in groups of twos or fours, 7-14 microns diameter, each with two pseudocilia; pseudocilia very fine and long. Pseudocilia must be stained with gentian violet before they become visible, do not function as cilia or flagella but according to some authorities may function in exchange of gases. Cells have single nucleus and cup shaped massive chloroplast, single pyrenoid; matrix watery and structureless except slight sheaths around individual cells. This species collected February 1961, Station BB, Inlet Canal, Cheyenne Bottoms.

Family ULOTRICHACEAE

Ulothrix aequalis Kütz. *in:*

COLLINS, The green algae of North America, Tufts College Studies, 2(3):184. 1909.
HYLANDER, The algae of Connecticut, State Geol. and Natural Hist. Survey, 42:124-125, pl. 18, fig. 33. 1928.
MANNONI, A survey of the green algae of Crawford County, Kansas, Trans. Kansas Acad. Sci., 35:187, pl. 2, fig. 37. 1932.
PRESCOTT, Algae of the Western Great Lakes area, p. 96, pl. 6, fig. 1. 1951.

FIG. 7.

Filaments long, cylindrical cells, no constriction at cross walls; chromatophores parietal plates extending about 4/5 around cell near middle; one pyrenoid in each cell. Cells 12.4-17.7 microns diameter by 24.8-31.8 microns long, forming bright green mats on submerged old leaves and sedge stems, walls thin and smooth. At Cheyenne Bottoms this species found at Station S, Pool 3, Bridge 13, Nov. 4, 1960.

Ulothrix tenerrima Kütz. *in:*

COLLINS, The green algae of North America, Tufts College Studies, 2(3):183. 1909.

HYLANDER, The algae of Connecticut, State Geol. and Natural Hist. Survey, 42:124, pl. 18, fig. 30. 1928.

PRESCOTT, Algae of the Western Great Lakes area, pp. 96-97, pl. 6, fig. 12. 1951.

SMITH, The fresh-water algae of the U. S., pp. 142-144. 1950.

TIFFANY and BRITTON, The algae of Illinois, p. 26, pl. 4, fig. 38. 1952.

FIG. 8

Filaments unbranched, attached, not attenuated; thin walled cells are 6.2-7.1 microns wide by 10.6-17.7 microns long, uninucleate, one pyrenoid, chloroplast zonate on one side of cell. Colony consists light green, silky masses of various sizes; filament has basal holdfast. This species at Cheyenne Bottoms found during February 1961 at Station CC, Drop Structure and Station BB, Entrance Canal. The width and length of the cells differ from the literature as this species is supposed to be about 7-9 microns wide and about 6-15 microns long but it still seems to fit this species in other respects. This is a new species for the state.

Ulothrix zonata (Weber and Mohr) Kütz. *in:*

COLLINS, The green algae of North America, 2(3):184-185. 1909.

HYLANDER, The algae of Connecticut, State Geol. and Natural Hist. Survey, 42:124-125, pl. 18, fig. 32. 1928.

PRESCOTT, Algae of the Western Great Lakes area, p. 97, pl. 6, fig. 14. 1951.

SMITH, The fresh-water algae of the U. S., pp. 142-144, fig. 76. 1950.

TIFFANY and BRITTON, The algae of Illinois, p. 26, pl. 4, figs. 35, 36. 1952.

WEST, A treatise on the British fresh-water algae, pp. 73-76, fig. 20A-B. 1904.

FIG. 9

Filaments large and stout; cells 24.8 microns wide by 67.3 microns long on those measured but can vary from 11-45 microns in width by 10-100 microns in length for this species; band-like, parietal chromatophores with 1-4 pyrenoids; slight constriction at cross walls and some inflation of cells; cells short with thick walls, especially near the holdfast, may change character with age becoming thick walled and relatively shorter compared with diameter. This species attached to dead submerged leaves and sedge or bulrush stems. Station S, Pool 3, Bridge 13, Nov. 4, 1961. This species is new for the state.

Family ULVACEAE

Entermorpha intestinalis (L.) Grev. *in:*

COLLINS, The green algae of North America, Tufts College Studies, 2(3):204-205. 1909.

SMITH, The fresh-water algae of the U. S., pp. 188-190, fig. 115A-D. 1950.

Entermorpha intestinalis (L.) Link *in:*

FRITSCH, The structure and reproduction of the algae, Vol. 1, pp. 214-216, fig. 63B. 1956.

HYLANDER, The algae of Connecticut, State Geol. and Natural Hist. Survey, 42:134-135, pl. 21, fig. 14. 1928.

WARD and WHIPPLE, Fresh-water biology, p. 161, fig. 210. 1945.

WEST, A treatise on the British fresh-water algae, p. 97, fig. 35L. 1904.

FIG. 10

Common, variable species occur in both fresh and brackish waters; thallus elongated and tubular, 0.4-1.5 cm wide by 8-16 cm long in specimens observed, however, may be many times larger; cells not arranged in longitudinal series (as in some species) but mixed (Fig. 10) cells measuring 10.5-14.0 microns in diameter; parietal chloroplasts with one pyrenoid; membrane of tubular layer consists of single layer of cells; frond simple or with few branches from the base if branched, may be constricted and have intestinal appearance as indicated by name. Young plants attached but later may become free floating; cells uninucleate with one pyrenoid; heterothallic and reported by good authority that the male plants have orange-yellow fertile parts while females have yellowish-green tinge; previously identified by the authors in collections from the Arkansas River in Ford County in June 1959; not found at Cheyenne Bottoms proper but found at Station Z, Arkansas River Diversion Dam which supplies water for Cheyenne Bottoms. This is the first member of the family Ulvaceae reported in the state so it represents a new family, genus and species to Kansas.

Family CLADOPHORACEAE

Cladophora glomerata (L.) Kütz. *in:*

PRESCOTT, Algae of the Western Great Lakes area, p. 138, pl. 20, figs. 8, 9; pl. 21, figs. 1, 2. 1951.

TIFFANY and BRITTON, The algae of Illinois, p. 45, pl. 13, fig. 93. 1952.

WEST, A treatise on the British fresh-water algae, pp. 105-106, fig. 40. 1904.

FIG. 11

Main axis cells large, 45-150 microns wide by 300-1,000 microns long; cells of the branches grade off to 35-60 microns wide by 150-360 microns long. Plants in glomerate clusters up to several feet in length. Cell walls of different thickness; light to dark green or bright green in mass, filaments attached forming fluffy, arbuscular plants which stream out in the water; branches regular, crowded in distal parts and slightly attenuated towards apices of the branches which are bluntly pointed. Older plants coarse and wiry; occurs only in well aerated waters, specimens much varied; filaments often swollen at the nodes, cells multinucleate and chloroplasts reticulate and parietal. Species was not found within Cheyenne Bottoms proper but was found at Stations AA, BB and CC which is along the Inlet Canal. Probably the commonest branched alga in western Kansas.

Rhizoclonium hieroglyphicum (C. A. Agardh) Kütz. *in:*

PRESCOTT, Algae of the Western Great Lakes area, p. 142, pl. 23, fig. 3. 1952.
THOMPSON, A preliminary survey of the fresh-water algae of Eastern Kansas, Univ. Kansas Sci. Bull., 25(1):27. 1938.
TIFFANY and BRITTON, The algae of Illinois, p. 46, pl. 13, fig. 91. 1952.

FIG. 12

Cells 31 microns wide by 180-315 microns long, limits may be 10-52 microns wide by 25-350 microns long; filaments long, wiry and unbranched except very rare short branches single celled in length; chloroplasts vary with the age of plant from very dense to open reticulate. Filaments usually slightly wavy, green or yellow-green, very common in standing or slowly moving water, anchored by hapteron; found at Cheyenne Bottoms only during June, 1960, in fairly stagnant water but common along Inlet Canal.

Basicladia chelonum (Collins) Hoffman and Tilden *in:*

PRESCOTT, Algae of the Western Great Lakes area, p. 143, pl. 23, figs. 8-12. 1951.
SMITH, The fresh-water algae of the U. S., pp. 217-218, fig. 134. 1950.
THOMPSON, A preliminary survey of the fresh-water algae of Eastern Kansas, Univ. of Kansas Sci. Bull., 25(1):27, pl. 5, fig. 9. 1938.
TIFFANY and BRITTON, The algae of Illinois, p. 48, pl. 13, fig. 89. 1952.

FIG. 13

Thallus coarse, erect; attached plant with rhizoidal anchoring organs fastening it to back of turtle upon which it grows. Specimens collected growing upon back of Painted Turtle (*Chrysemys picta* Schneider) which was probably several years old. It was crossing the road between pools at Cheyenne Bottoms; growth abundant with filaments one inch in length, branched sparingly near the base where the cells were more narrow and longer than distal cells. Distal cells measured 34.4 microns wide by 141 microns long while proximal cells less wide but longer. General appearance of cell reminds one of *Rhizoclonium hieroglyphicum.* Cells multinucleate with reticulate, parietal chloroplasts; holdfast char-

This species found widely distributed at Cheyenne Bottoms, never abundant.

Family CHARACIACEAE

Schroederia judayi G. M. Smith *in:*

PRESCOTT, Algae of the Western Great Lakes area, p. 256, pl. 57, figs. 5, 6. 1951.

SMITH, Phytoplankton of the Inland Lakes of Wisconsin, Part 1, Wis. Geol. and Nat. Hist. Survey, Bull. 57, p. 137, pl. 32, figs. 9-11. 1920.

SMITH, The fresh-water algae of the U. S., pp. 508-509. 1933.

Lambertia judayi (G. M. Smith) Korschik *in:*

HORTOBAGYI, Algen aus den Fischteichen von Buzsák IV, Nova Hedwigia, 4(1-2):30-31, pl. 39, figs. 469-473. 1962.

Fusiform cells measure 6.9 microns wide by 59.0 microns long, arcuate or straight with narrow poles terminating in setae with bifurcate branch or small disc at one end; body of cell measured 35 microns long. This alga looks like detached free-floating *Characium.* This alga was abundant in June 1960 at Station B, Pool, 1, Cheyenne Bottoms. This is a new species for the state of Kansas.

Family HYDRODICTYACEAE

Pediastrum simplex (Meyen) Lemmermann *in:*

PRESCOTT, Algae of the Western Great Lakes area, p. 227, pl. 50, fig. 2. 1951.

Pediastrum simplex Meyen *in:*

COLLINS, The green algae of North America, Tufts College Studies, 2(3):177. 1909.

TIFFANY and BRITTON, The algae of Illinois, p. 110, pl. 30, figs. 290, 291. 1952.

Cells measured about 10.4 microns wide but can be 7-20 microns wide and 15-30 microns long, four, five or six sided; marginal cells each having single spines projecting outward. Walls may be smooth or punctuate forming coenobia of 8 or more cells which may be perforate or entire; colony free-floating, monostromatic and disc shaped. This species usually found intermixed with other algae or free-floating at Station B, Pool 1, Cheyenne Bottoms, abundant in June 1960. *P. simplex* var. *radians* was found by Thompson (1938) in Kansas but *P. simplex* (Meyen) Lemmermann is new for the state.

Pediastrum duplex Meyen *in:*

PRESCOTT, Algae of the Western Great Lakes area, p. 223, pl. 48, fig. 4. 1951.

SMITH, Phytoplankton of the inland lakes of Wisconsin, Part 1, Wis. Geol. and Nat. Hist. Survey, Bull. 57, p. 171, pl. 46, figs. 14-16. 1920.

TIFFANY and BRITTON, The algae of Illinois, p. 112, pl. 30, fig. 300. 1952.

FIG. 18

Coenobia a flat plate with 8-128 cells, usually with 16 or 32 cells; 16 celled colony of fig. 18 is 56.6 microns diameter; two projections or spines extending out from the marginal cells. Cells quadrate, 10.6 microns in diameter in figure 18 and about 6.1 microns thick; colony perforate in the center and cell walls smooth. This alga was found as thycoplankton at Bridge 11, Station W, Pool 3 and other places within Cheyenne Bottoms.

Pediastrum boryanum (Turpin) Meneghini *in:*

PRESCOTT, Algae of the Western Great Lakes area, p. 222, pl. 47, fig. 9; pl. 48, figs. 1, 3. 1951.

SMITH, Phytoplankton of the inland lakes of Wisconsin, Part 1, Wis. Geol. and Nat. Hist. Survey, Bull. 57, pp. 169-170, pl. 46, fig. 1. 1920.

TIFFANY and BRITTON, The algae of Illinois, p. 112, pl. 30, figs. 295, 296. 1952.

FIGS. 19, 20

Coenobia compact with smooth or granulated walls and cells are 5 to 6 sided, 7-30 microns in diameter. This species lacks the open spaces in the colony possessed by *Pediastrum duplex*. Coenobia of fig. 19 is 76 microns in diameter while the coenobia of fig. 20 is 55 microns in diameter; marginal cells with short spines but marginal cells varying depending upon the variety; figure 20 represents *P. boryanum* but in Cheyenne Bottoms figure 19 represents a variety found in too small a quantity to determine accurately.

Pediastrum boryanum var. *longicorne* Raciborski *in:*

PRESCOTT, Algae of the Western Great Lakes area, p. 222, pl. 47, fig. 10. 1951.

SMITH, Phytoplankton of the inland lakes of Wisconsin, Part 1, Wis. Geol. and Nat. Hist. Survey, Bull. 57, p. 170, pl. 46, fig. 9. 1920.

THOMPSON, A preliminary survey of the fresh-water algae of Eastern Kansas, Univ. Kansas Sci. Bull., 25(1):31, pl. 6, fig. 19. 1938.

TIFFANY and BRITTON, The algae of Illinois, p. 112, pl. 30, fig. 297. 1952.

FIG. 21

Coenobium a flat plate of usually 8 or more cells; colony of fig. 21 having an over-all diameter of 55 microns with two projections or spines extending out from the marginal cells 6.9 microns and terminating in a swollen knob while cells of the center and margins are 4-6 sided. Spines in this variety differ from *P. boryanum* by having longer spines and having the knobs on the spine tips rather than the shorter truncate spines. This alga found as tychoplankton at Bridge 20, Station 1, Pool 4 and other places in October and November, 1960.

Hydrodictyon reticulatum (L.) Lagerheim *in:*

PRESCOTT, Algae of the Western Great Lakes area, p. 219, pl. 47, fig. 1. 1951.

SMITH, The fresh-water algae of the U. S., pp. 486-487, fig. 326. 1933.

THOMPSON, A preliminary survey of the fresh-water algae of Eastern Kansas, Univ. Kansas Sci. Bull., 25(1):32. 1938.

THOMPSON, Algae. *In:* Edmondson's Fresh-water biology, p. 134, fig. 6.126. 1959.

TIFFANY and BRITTON, The algae of Illinois, p. 110, pl. 29, fig. 289. 1952.

FIG. 22

Thallus may range in size from microscopic in young plants to macroscopic in older plants, composed of cylindrical cells adjoined at their ends to form a net with 5 or 6 sided meshes; chloroplast a parietal plate or reticulum covering entire inner wall; one or many pyrenoids and multinuclei in each cell. Cells may be up to 250 microns in diameter and one cm in length, cells observed quite large measuring 93 microns wide by 542 microns long, with parietal chloroplasts and numerous nuclei and pyrenoids in each cell, green or yellow-green; nets several cm in diameter. This species collected outside Cheyenne Bottoms at "Arkansas River Dam Site," Station Z, which supplies water to Cheyenne Bottoms; collected October 28, 1960.

Family OOCYSTACEAE

Ankistrodesmus falcatus (Corda) Ralfs *in:*

HORTOBAGYI, Algen aus den Fischteichen von Buzsák IV, Nova Hedwigia, 4(1-2):22, pl. 36, figs. 408, 409. 1962.

PRESCOTT, Algae of the Western Great Lakes area, p. 253, pl. 56, figs. 5, 6. 1951.

SMITH, Phytoplankton of the inland lakes of Wisconsin, Part 1, Wis. Geol. and Nat. Hist. Survey, Bull. 57, p. 134, pl. 32, fig. 1. 1920.

SMITH, The fresh-water algae of the U. S., pp. 506-507, fig. 347. 1933.

TIFFANY and BRITTON, The algae of Illinois, p. 114, pl. 31, fig. 307. 1952.

WEST and FRITSCH, A treatise on the British fresh-water algae, p. 130, fig. 40A. 1927.

FIG. 23

Cells fusiform with acute apices; measuring 3.4-3.6 microns in diameter by 53 microns in length in those of fig. 23 but this species can be 1.5-6 microns by 20-100 microns; cells solitary, curved, lunate, arcuate or straight, sometimes grouped in loose aggregates; single parietal chloroplast occupying cavity of cell; cell wall thin with no gelatinous layer and pyrenoids may or may not be present; reproduce by two, four or eight autospores; cells usually uninucleate. *Ankistrodesmus* belongs to the Order Chlorococcales. This alga found at Cheyenne Bottoms especially in those pools in which water remains undisturbed for long periods, Station B, June, 1960.

Family SCENEDESMACEAE

Scenedesmus opoliensis Richter var. *mononensis* Chod. *in:*

HORTOBAGYI, Algen aus den Fischteichen von Buzsák III: Scenedesmus-Arten, Nova Hedwigia, 2(1-3):182, pls. 28, 29; figs. 328-332. 1960.

FIG. 24

Colony may consist of 2 or 4 cells. In the 4-celled colony the middle cells usually have no spines (Fig. 24) while the terminal cells have a single long spine on each pole that is straight or variously bent. Cells in variety *monensis* are nearly always shorter in the middle cells than the terminal cells as shown in fig. 24 while in *Scenedesmus opoliensis* all cells are characterized by equal length. Poles of middle cells rounded off or blunt-ended spindle shaped, never truncate. Middle cells sometimes appearing almost oblong-cylindric as in fig. 24. Cells 3.5 to 7 microns wide and cell length 10.6 to 27.5 microns. The variety *monensis* in western Kansas is easily identified by the unusually long spines that are 17 to 24 microns long. Pyrenoids sometimes noticeably large. Terminal cells seem to taper gradually outward from the cell walls and along the base of the spine as in fig. 24 or the terminal cell poles are truncate-bulbous in shape with the spines appearing to come off more abruptly from the rather flattened terminal surface of the bulb (this form not pictured). The characteristic short middle cells, long spines and general shape of the terminal cells places this as *Scenedesmus opoliensis* var. *mononensis*. It is common and widely distributed in western Kansas but appears not to be described or listed in the algae of Kansas, its surrounding states or in any of the limited amount of literature we have available for the Western Hemisphere. This species and variety is new for Kansas and was found mixed with other algae at Cheyenne Bottoms, Station K, Pool 4 during July, 1960.

Scenedesmus abundans (Kirchner) Chod. *in:*

PRESCOTT, Algae of the Western Great Lakes area, p. 274, pl. 61, fig. 21. 1951.
SMITH, The fresh-water algae of the U. S., p. 272, fig. 191G. 1950.
SMITH, Phytoplankton of the inland lakes of Wisconsin, Part 1, Wis. Geol. and Nat. Hist. Survey, Bull. 57, p. 157, pl. 39, figs. 23-25. 1920.
TIFFANY and BRITTON, The algae of Illinois, p. 123, pl. 35, fig. 365. 1952.

FIG. 25

Coenobia a flat plate of 2, 4 or 8 cells in single series in lateral contact throughout their length, cells ovoid to oblong-ellipsoid with one or two spines at terminus of each end cell and usually several spines on the outer face of cell. Middle cells for the most part devoid of spines, although, single spines project from the poles of some cells. Cells measured 3.5 microns wide by 10.4 microns in length while the spines were 10.4 microns long; coenobia usually four cells but two and eight celled coenobia not uncommon. This species appeared in some abundance during Feb., 1961, at Station BB in Canal entrance to Cheyenne Bottoms.

Scenedesmus acuminatus var. *minor* G. M. Smith *in:*

PRESCOTT, Algae of the Western Great Lakes area, p. 275, pl. 62, fig. 16. 1951.

Cells 4-4.3 microns wide by 27.6-28.0 microns long with coenobium of four moon shaped cells with pointed ends; walls smooth without spines. This is a new species for Kansas. This species rare in Cheyenne Bottoms but collected in June, 1960, at Station B, Pool 1.

Scenedesmus dimorphus (Turpin) Kütz. *in:*

PRESCOTT, Algae of the Western Great Lakes area, p. 277, pl. 63, figs. 8, 9. 1951.

SMITH, Phytoplankton of the inland lakes of Wisconsin, Part 1, Wis. Geol. and Nat. Hist. Survey, Bull. 57, pp. 151-152, pl. 37, figs. 15-17. 1920.

THOMPSON, A preliminary survey of the fresh-water algae of Eastern Kansas, Univ. Kansas Sci. Bull., 25(1):37, pl. 8, fig. 13. 1938.

TIFFANY and BRITTON, The algae of Illinois, p. 123, pl. 35, fig. 370. 1952.

FIG. 26

Cells mostly 3.2-3.4 microns by 14-21.3 microns but in some collections much larger as in fig. 26 which has cells 10.4 microns in width by 27.6 microns long. Thompson lists them even larger, as much as 30-40 microns long. Cells 4 or 8 in a series to form a colony, cells pointed at the apices, inner cells fusiform and the outer cells lunate, all with smooth walls. This species widely distributed in Cheyenne Bottoms and especially at Station R, Bridge 3, Pool 2. Collected October, 1960.

Scenedesmus bijuga (Turpin) Lagerheim *in:*

PRESCOTT, Algae of the Western Great Lakes area, p. 276, pl. 63, figs. 2, 7. 1951.

SMITH, Phytoplankton of the inland lakes of Wisconsin, Part 1, Wis. Geol. and Nat. Hist. Survey, Bull. 57, p. 152, pl. 37, figs. 18-20. 1920.

THOMPSON, A preliminary survey of the fresh-water algae of Eastern Kansas, Univ. Kansas Sci. Bull. 25(1):37, pl. 8, fig. 14. 1938.

TIFFANY and BRITTON, The algae of Illinois, p. 123, pl. 35, fig. 371. 1952.

Scenedesmus bijuga (Turpin) Wittr. *in:*

COLLINS, The green algae of North America, Tufts College Studies, 2(3):168. 1909.

FIG. 27

Coenobia a flat plate of cells in single series of 2 to 8 cells attached to each other along full length of their edges; colony of eight cells measured 41 microns in length with cells being 5.1 microns wide by 13.8 microns long but cells can be 4-8 microns wide by 7-18 microns long, granular contents; smooth walls without spines or teeth; poles broadly rounded. Cells are oblong-ellipsoid to ovoid. This species widely distributed at Cheyenne Bottoms but never in quantity at any one place. Appeared in October 1961 at Station R, Pool 2, Bridge 3.

Actinastrum hantzschii var. *fluviatile* Schroeder *in:*

PRESCOTT, Algae of the Western Great Lakes area, p. 282, pl. 65, fig. 1. 1951.
TIFFANY and BRITTON, The algae of Illinois, p. 120, pl. 33, fig. 328. 1952.

FIG. 28

Cells spindle shaped and sharply pointed at the ends, measuring 3.5 microns wide by 17.7 microns long; colonies of 4-8 cells radiate from common center. Cells 3-6 times longer than broad with parietal chromatophores. This is a new variety for Kansas. Rare at Cheyenne Bottoms but found at Station 1, Pool 4, Bridge 20 during July, 1960.

Family ZYGNEMATACEAE

Spirogyra singularis Nordst. *in:*

PRESCOTT, Algae of the Western Great Lakes area, p. 320. 1951.
RANDHAWA, Zygnemaceae, p. 295, fig. 251. 1959.
TIFFANY and BRITTON, The algae of Illinois, pl. 43, fig. 454. 1952.
TRANSEAU, The Zygnemataceae, p. 151, pl. 21, fig. 4. 1951.

FIGS. 29, 30

Vegetative cells 32-41 microns wide by 141-165 microns long, plane end walls; 1 chromatophore making 3-7 turns per cell; conjugation sclariform with tube formed by both gametangia but male forms about two-thirds of it. Zygotes ellipsoid, not compressed, 62 microns long with outer wall smooth and hyaline, middle wall mostly light green or yellow or green tinged with yellow; fertile cells cylindric and not enlarged or inflated. *S. singularis* was abundant at Cheyenne Bottoms especially in early winter with lesser amounts in late winter. Collected station V, Pool 2, Bridge 6, Sept., 1962. This is a new species for Kansas.

Spirogyra neglecta (Hassall) Kütz. *in:*

CZURDA, Zygnemales. In: A. Pascher's Süsswasserflora von Mitteleuropa, 9:190-191, fig. 200. 1932.
RANDHAWA, Zygnemaceae, pp. 324-325, fig. 308. 1959.
TIFFANY and BRITTON, The algae of Ilinois, p. 152, pl. 45, figs. 476, 477. 1952.
TRANSEAU, The Zygnemataceae, p. 175, pl. 27, figs. 14, 15. 1951.

Vegetative cells measure 52.0-77.5 $\times$ 97-135 microns in length, 3 chromatophores making 1.5 turns within cell; zygotes measure

60-75 microns wide and 90-127 microns long, ovoid with smooth yellow median wall; fertile cells inflated; end walls of vegetative cells plane. Conjugation tubes formed equally by each gametangia, conjugation scalariform but might be lateral; spores sometimes at right angles to filament, as viewed from end view round. This alga is a new species to Kansas and appeared in September, 1960, in great abundance at Cheyenne Bottoms, Station S, Bridge 13, Pool 3.

Sirogonium floridanum (Transeau) G. M. Smith *in:*

RANDHAWA, Zygnemaceae, pp. 429-430. 1959.
SMITH, The fresh-water algae of the U. S., pp. 556-557. 1933.
TRANSEAU, The Zygnemataceae, pp. 233-234. 1951.

Spirogyra floridana Transeau *in:*

CZURDA, Zygnemales. In: A. Pascher's Süsswasserflora von Mitteleuropa, 9:145. 1932.

FIGS. 31-33

Members of this genera resemble *Spirogyra;* cells have plane end walls and 4-5 chromatophores, straight or making ½ turn within the cell; conjugation occurs directly between filaments without conjugation tubes, walls of two adjacent cells adhere and walls disintegrate allowing the transmission of male gamete. *S. floridanum* vegetative cells measure 75-77 microns wide by 321 microns long; receptive gametangia inflated, resulting zygotes ellipsoid, 75 microns wide by 135 microns long; median walls of the zygote smooth and yellow. This alga present in large quantity during mid-October, 1960, Pool 2, Station R, Bridge 3. This species over-all larger than *Sirogonium sticticum* which appeared in great quantities during May and June, 1961, in Pool 3. This is a new genus for Kansas.

Sirogonium sticticum (English Botany) Kütz. *in:*

PRESCOTT, How to know the fresh-water algae, p. 95, fig. 146. 1954.
RANHAWA, Zygnemaceae, pp. 424-425, fig. 508. 1959.
SMITH, The fresh-water algae of the U. S., p. 302, fig. 213. 1950.
TIFFANY and BRITTON, The algae of Illinois, pp. 162, 164, pl. 50, fig. 531. 1952.
TRANSEAU, The Zygnemataceae, p. 233, pl. 40, figs. 1-4. 1951.

Spirogyra stictica (English Botany) Wille *in:*

COLLINS, The green algae of North America, Tufts College Studies, 2(3):119. 1909.
CZURDA, Zygnemales. In: A. Pascher's Süsswasserflora von Mitteleuropa, 9:144, fig. 142. 1932.

FIGS. 34, 35

Vegetative cells measured 31-48 microns wide by 82-127 microns long which is smaller than *Sirogonium floridanum* which was found in the same general area during mid-October, 1960. *Sirogonium* *sticticum* was found in great abundance during May and June, 1961, in all of Pool 3. Receptive gametangia inflated, resulting zygotes ellipsoid 56-59 microns wide by 75.0-77.7 microns long; inflated female cells 75 microns wide; zygotes with median yellow walls. This is a new species and genus for the state.

Family DESMIDIACEAE

Closterium acutum (Lyngb.) Bréb. var. *linea* (*Perty*) West and West *in:*

TAFT, Desmids of Oklahoma II, Trans. Am. Microscop. Soc., 53(2):96, pl. 6, fig. 5. 1934.

WEST and WEST, A monograph of the British Desmidiaceae, Vol. 1, pp. 178-179, pl. 23, fig. 15. 1904.

FIG. 36

Cells measure 10.6 microns wide by 201-213 microns long; 4 or 5 pyrenoids in each semicell, unevenly spaced while terminal vacuoles have two large moving granules; cells straight or when slightly curved the curve is only near the apices; apices acutely rounded; walls smooth and colorless; protoplast irregular in outline; inner margin is not tumid as in the closely similar *Closterium subulatum,* also different from the type species in not being curved or slightly curved. *C. subulatum* usually has only 3 pyrenoids while *C. acutum* var. *linea* often has more.

The specimens observed fits var. *linea* because of the straight margins but differs from the literature by being slightly wider. It is similar to Taft's descriptions in being longer than the West and West variety. This is a new species for Kansas. Collected at Cheyenne Bottoms February 27, 1961, Station DD, Bridge 1, Pool 2. This variety was scarce.

Closterium acerosum (Schrank) Ehr. *in:*

COOK, British Desmids, p. 20, pl. 9, fig. 1. 1887.

HOMFELD, Beitrag zur kenntnis der Desmidiaceen Nordwestdeutschlands besonders ihrer zygoten. In: Kolkwitz, R. Pflanzenforschung, 12:16. 1929.

IRÉNÉE-MARIE, Flore Desmidiale de la region de Montreal, pp. 71-72, pl. 6, figs. 9, 11. 1939.

MIGULA, Die Desmidiazeen, p. 14, pl. 2, fig. 8. 1911.

SAUNDERS, Part I. Protophyta-Phycophyta. In: Flora of Nebraska, 1:38, pl. 5, fig. 1. 1894.

TAFT, Desmids of Oklahoma II, Trans. Am. Microscop. Soc., 53(2):96, pl. 6, fig. 4, 1934.

THOMPSON, A preliminary survey of the fresh-water algae of Eastern Kansas, Univ. Kansas Sci. Bull., 25(1):41, pl. 9, fig. 11. 1938.

TIFFANY and BRITTON, The algae of Illinois, p. 169, pl. 52, fig. 550. 1952.

WEST and G. S. WEST, A monograph of the British Desmidiaceae, Vol. 1, pp. 146-148, pl. 18, figs. 2-5. 1904.

WOLLE, Desmids of the U. S. and list of American Pediastrums, pp. 42-43; pl. 7, figs. 7, 11; pl. 10, figs. 1, 2. 1892.

FIG. 37

Cells are eight to sixteen times longer than wide, 22-46 × 200-450 microns with 7-14 pyrenoids per semicell; tapering towards the ends to rounded-truncate apices; usually curved with outer margin showing an arc while inner margin nearly straight or slightly concave; usually no median girdle but prominent terminal vacuole with moving granules; cell wall smooth and colorless refracting the green of the cytoplasm but becoming brown or yellow with age; chromatophores ridged. This species found in Pool 1 and other pools numerous times.

Closterium moniliferum (Bory) Ehr. *in:*

COOK, British Desmids, p. 24, pl. 12, fig. 3. 1887.

IRÉNÉE-MARIE, Flore Desmidiale de la region de Montreal, p. 66, pl. 5, figs. 1, 2. 1939.

MIGULA, Die Desmidiazeen, p. 12, pl. 1, fig. 35. 1911.

SAUNDERS, Part I. Protophyta-Phycophyta. In: Flora of Nebraska, 1:39, pl. 5, fig. 2. 1894.

TAFT, Desmids of Oklahoma, Biol. Survey, 3(3):282, pl. 1, fig. 3. 1931.

TIFFANY and BRITTON, The algae of Illinois, pp. 172-173, pl. 52, fig. 549. 1952.

WEST and G. S. WEST, A monograph of the British Desmidiaceae, Vol. I, pp. 142-143, pl. 16, figs. 15, 16. 1904.

WEST, G. S., Algae. Volume I. Myxophyceae, Peridinieae, Bacillarieae, Chlorophyceae, together with a brief summary of the occurrence and distribution of fresh-water algae, pp. 367-368, fig. 231E. 1916.

WOLLE, Desmids of the U. S. and list of American Pediastrums, pp. 48-49, pl. 8, fig. 16. 1892.

FIG. 38

Cells measure 28-57 microns wide by 170-345 microns long, having 4-9 pyrenoids per semicell; smooth and colorless cell walls; chromatophores have about 5 or 6 ridges visible at a time and two terminal vacuoles possessed of numerous moving granules of gypsum; outer margin of cell moderately curved 100 to 130 degrees of arc with the inner margin slightly inflated. Details of cell structure often obscured by heavy pigmentation. Common in Cheyenne Bottoms and probably the commonest *Closterium* in many areas of Kansas along with *Closterium acerosum.* Collected Station A, Pool 2 during May, 1960. This is a new published species for Kansas but was listed and described in the unpublished masters thesises of Sherman, McFarland and Brazda (Sherman, 1949; McFarland, 1959; Brazda, 1961).

Closterium lanceolatum Kütz. *in:*

HOMFELD, Beitrag zur kenntnis der Desmidiaceen Nordwestdeutschlands besonders ihrer zygoten. In: Kolkwitz, R. Pflanzenforschung, 12:20. 1929.

IRÉNÉE-MARIE, Flore Desmidiale de la region de Montreal, p. 72, pl. 2, figs. 12-15. 1939.

MIGULA, Die Desmidiazeen, pp. 11-12, pl. 1, fig. 33. 1911.

TAFT, Desmids of Oklahoma, Bio. Survey, 3(3):283, pl. 1, fig. 2. 1931.

SAUNDERS, Part I. Protophyta-Phycophyta. In: Flora of Nebraska, 1:38. 1894.

TIFFANY and BRITTON, The algae of Illinois, p. 173, pl. 52, fig. 552. 1952.

WEST and G. S. WEST, A monograph of the British Desmidiaceae, Vol. I, pp. 149-150, pl. 17, figs. 9, 10; pl. 18, fig. 7. 1904.

WOLLE, Desmids of the U. S. and list of American Pediastrums, p. 40, pl. 9, fig. 14. 1892.

FIG. 39

Cells measure 28-48 microns wide and 5 to 7 times the width in length, almost straight but outside curve of 30-55 degrees of arc and inner margin straight or slightly convex, no median girdle, wall smooth with no striations; 5-7 pyrenoids per semicell, terminal vacuoles containing moving granules; chromatophores with 7-8 ridges. This species scarce but widely scattered at Cheyenne Bottoms in May and June, 1960.

Closterium incurvum Bréb. *in:*

IRÉNÉE-MARIE, Flore Desmidiale de la region de Montreal, p. 69, pl. 7, figs. 13, 14. 1939.

TAFT, Desmids of Oklahoma, Bio. Survey, 3(3):282, pl. 1, fig. 12. 1931.

WEST and G. S. WEST, A monograph of the British Desmidiaceae, Vol. I, pp. 136-137, pl. 15, figs. 28-30. 1904.

FIG. 40

Cells 6-8 times longer than wide measuring 15-26 microns wide by 120-138 microns long, moon shaped, outside curve of around 175 degrees of arc; walls smooth; one chloroplast in each semicell connected by protoplasmic bridge at girdle; two pyrenoids in each semicell; ends of cells are hyaline appearing empty; terminal vacuoles with active gypsum crystals; inner margin of cell not tumid and wall colorless. This species appears larger than reported by West. Taft found his to be larger than those reported by West and he suggested that this should possibly be considered a variety of *C. incurvum* but those found at Cheyenne Bottoms are still larger so it is no doubt a variety. This species appeared in large quantity at Cheyenne Bottoms, Station Q, Pool 2, Bridge 5; October 7, 1960. A new species for Kansas.

Family CHARACEAE

Chara braunii Gmelin *in:*

DAILY, The Characeae of Indiana, Butler Univ. botan. studies, 11:19-20. 1953.

DAILY and KIENER, The Characeae of Nebraska—additions and changes, Butler Univ. botan. studies, 13(1):40. 1956.

HORN AF RANTZIEN, Charophyta reported from Latin America, Arkiv for botanik, 1(5):386-387. 1951.

PRESCOTT, Algae of the Western Great Lakes area, pp. 336-337, pl. 81, fig. 1. 1951.

WOOD, R. D., The Characeae, 1951. The botan. review, 18(5):323. 1952.

Chara coronata Ziz. *in:*

DAILY, The Characeae of Nebraska, Butler Univ. botan. studies, 6:155, 157; pl. 2C. 1944.

WOODS, Part II. Coleochaetace, Characeae. In: Flora of Nebraska, 1:125, pl. 30, figs. 1-7. 1894.

FIG. 41

Class Charophyceae to which *Chara braunii* belongs known as stoneworts because of calcareous material accumulating on the thallus. This deposit white and brittle sometimes on *C. braunii* collected; nodes and internodes apparent; stems uncorticated with bracts shorter than oogonia which measured 225-375 microns wide by 450-775 microns long; oogonium showed 8-10 turns while crown of oogonium had 5 cells and below were the orange colored antheridia which measured 225-300 microns in diameter. Plants bright green but not extensively coated with lime, monoecious with antheridium and oogonium present at same node. Fruitifications on adaxial of leaves. This species collected during June and July, 1961, at Station A and T, Pool 2.

Euglenophyta

The division Euglenophyta consists of cells having numerous disc like chloroplasts, food reserves in the form of paramylum bodies, a flagellum or flagella for locomotion and usually a red eye spot. Cell division is the usual method of reproduction. The genera *Euglena, Phacus, Lepocinclis* and *Trachelomonas* were represented at Cheyenne Bottoms.

Family EUGLENACEAE

Euglena elastica Prescott *in:*

GOJDICS, The Genus Euglena, p. 96, pl. 10, fig. 3A-B. 1953.

PRESCOTT, Algae of the Western Great Lakes area, p. 392, pl. 86, figs. 10-12. 1951.

FIGS. 42, 43

Cells metabolic measuring 16 microns wide by 77 microns in length, changing shape, often rolling into a ball when conditions unfavorable, spindle shaped or sometimes swollen in the middle being tapered to conically rounded apices but caudus lacking and flagellum not quite as long as the body; chloroplasts many and irregularly round or ovoid; pyrenoids probably lacking while short rod shaped paramylum bodies present; pigment body (stigma) present near anterior end of cell; formed bright green water blooms at Station C at northern end of Pool 1 and also other places within Cheyenne Bottoms during spring and summer of 1960, bloom quite thick and tough and dried to a heavy crust. A new species for Kansas.

Phacus pyrum (Ehr.) Stein *in:*

PRESCOTT, Algae of the Western Great Lakes area, p. 402, pl. 88, fig. 22. 1951.
THOMPSON, A preliminary survey of the fresh-water algae of Eastern Kansas, Univ. Kansas Sci. Bull., 25(1):54, pl. 11, fig. 17. 1938.
TIFFANY and BRITTON, The algae of Illinois, p. 323, pl. 88, 1021. 1952.

FIG. 44

Cells pyriform, 12.4-13.0 microns wide by 24.8 microns long with straight caudus 16 microns long at the posterior end; chloroplasts oval discs and eyespot (stigma) present; anteriorly two papillae between which the flagellum emerges; paramylum bodies may be present. This alga found during October, 1960, Station K, Pool 4, Bridge 14.

Phacus acuminata Stokes *in:*

PRESCOTT, Algae of the Western Great Lakes area, p. 396, pl. 88, fig. 4. 1951.
THOMPSON, A preliminary survey of the fresh-water algae of Eastern Kansas, Univ. Kansas Sci. Bull., 25(1):54, pl. 11, fig. 14. 1938.
TIFFANY and BRITTON, The algae of Illinois, p. 323, pl. 88, fig. 1024. 1952.

FIG. 45

This genus a close relative of Euglena with flattened rigid body; oval outline with greatest width below the middle of the periplast, measuring 24.8 microns in diameter by 35.4 microns long with short unicinate posterior spine and anterior flagellum which is about body length; flagellum difficult to see; shallow dorsal furrow extending 0.5-0.7 body length; longitudinal striations which may not be evident except with special staining; one pyramylum body near middle of cell and sometimes smaller one near base of spine; stigma sensitive to light near anterior or flagellum end; locomotion rapid and narrow edge of cell evident as it rolls over. This species requires more aerated, less stagnant conditions than most *Euglena*. Found in May, 1960, Station C, Pool 1 where *Euglena elastica* was usually collected.

Phacus longicauda (Ehr.) Dujardin *in:*

PRESCOTT, Algae of the Western Great Lakes area, p. 400, pl. 87, fig. 1. 1951.
THOMPSON, A preliminary survey of the fresh-water algae of Eastern Kansas, Univ. Kansas Sci. Bull., 25(1):53, pl. 11, fig. 11. 1938.
TIFFANY and BRITTON, The algae of Illinois, p. 323, pl. 88, fig. 1022. 1952.

FIG. 46

Cells ovoid with long tapering caudus measuring 21-60 microns wide by 32-125 microns long; caudus about one-half length of body; smooth with slightly spiraled striations; anterior broadly rounded with slight groove or fold extending from anterior end; has a stigma, one large pyramylum body; discoid chloroplasts and flagellum at anterior end of about body length; cell slightly flattened and rigid, not metabolic. This species collected at various stations during March, 1961.

Phacus torta Lemmermann *in:*

TIFFANY and BRITTON, The algae of Illinois, p. 323, pl. 88, fig. 1023. 1952.

Phacus tortus (Lemmermann) Skvortzow *in:*

PRESCOTT, Algae of the Western Great Lakes area, p. 404, pl. 88, fig. 20. 1951.

Cells measure 45 microns wide by 85 microns long, twisted about long axis; longitudinally striate with posterior spine (caudus) 45 microns long and flagellum about half to two-thirds body length; one large paramylum body, discoid chloroplasts and red eyespot in the compressed cell. This species is new for Kansas. Collected June, 1961, Station J, Pool 4, Bridge 19.

Phacus pleuronectes (Mueller) Dujardin *in:*

PRESCOTT, Algae of the Western Great Lakes area, p. 402, pl. 88, fig. 16. 1951.
TIFFANY and BRITTON, The algae of Illinois, p. 323, pl. 88, fig. 1019. 1952.
WEST and FRITSCH, A treatise on the British fresh-water algae p. 413, fig. 173H. 1927.

FIG. 47

Cells broadly ovoid with short uncinate posterior spine 12 microns long; cells 31 microns wide by 41 microns long exclusive of the spine; longitudinal striations present but mostly obscured with chloroplasts; one large paramylum body present towards posterior end; periplast metabolic; pigment spot visible towards anterior end; single flagellum as long or longer than body. This is a new species for Kansas and was found during June, 1961, intermingled with other algae.

Trachelomonas hispida (Perty) Stein *in:*

PRESCOTT, Algae of the Western Great Lakes area, p. 414, pl. 83, fig. 35. 1951.
THOMPSON, A preliminary survey of the fresh-water algae of Eastern Kansas, Univ. Kansas Sci. Bull., 25(1):56, pl. 12, fig. 6. 1938.
THOMPSON, Algae. In: Edmondson's Fresh-water biology, p. 123, fig. 6.12. 1959.

FIG. 48

Euglenoid cells enclosed within red or brown (on occasion tan or colorless) lorica or test, obscuring green color of the protoplast and pigment spot; single flagellum extends through small opening of test at anterior end which makes alga extremely motile. Test measures 17-31 microns wide by 20-34 microns long; wall decorated with fine spinelike projections which along the edge of lorica deceptively appears hirsute; no apparent collar around flagellum where it leaves the test, although most observers report that such a collar may be present. *T. hispida* appeared in stagnant water at Station K, Pool 4, Bridge 14, October, 1960.

Chrysophyta

The members of the Division Chrysophyta have yellowish-green to golden-brown color because of carotenes and xanthophylls. The iodine test for starch is negative. Two classes are represented at Cheyenne Bottoms in this study, Xanthophyceae by *Vaucheria sessilis* and Bacillariophyceae by many Centrales and Pennales diatoms. The Xanthophyceae (Heterokontae) are yellow-green in color. The Bacillariophyceae have cell walls made of silica consisting of two overlapping halves that fit together like a "pill box." Those with circular valves are classed in the Order Centrales while those cells which are bilaterally symmetrical having decorations on the frustule arranged bilateral to a longitudinal axis are classed in the Order Pennales. The Class Chrysophyceae (golden brown) had no local representation at Cheyenne Bottoms.

Family VAUCHERIACEAE

Vaucheria sessilis (Vaucher) de Condolle *in:*

COLLINS, The green algae of North America, 2(3):425. 1909.
HYLANDER, The algae of Connecticut, State Geol. and Natural Hist. Survey, 42:143, pl. 20, fig. 9. 1928.
PRESCOTT, Algae of the Western Great Lakes area, p. 294, pl. 68, fig. 5. 1951.
PRESCOTT, How to Know the fresh-water algae, p. 124, fig. 199B. 1954.
THOMPSON, A preliminary survey of the fresh-water algae of Eastern Kansas, Univ. Kansas Sci. Bull., 25(1):39, pl. 9, fig. 2. 1938.
TIFFANY and BRITTON, The algae of Illinois, p. 213, pl. 36, fig. 378. 1952.
VENKATARAMAN, Vaucheriaceae, pp. 68-69, fig. 46A. 1961.

FIGS. 49, 50

Long considered a Chlorophyta, *Vaucheria* is now classed as Xanthophyceae in the Division Chrysophyta. *Vaucheria sessilis* filaments 60-67 microns wide, coenocytic, sparingly branched, multinucleate, forming velvety densely tufted mats; usually two but sometimes one oogonia appears, sessile or on very short stalks on the filament; oogonium ovoid or oblongovoid, 64 microns wide by 90 microns long with short superior or oblique beaked opening to permit entrance of sperms. Filaments monoecious and antheridium appears near oogonia or between two oogonia on short pedicel on same filament as in fig. 49. Antheridia circinate or hooked and 45 microns wide by 120 microns long, opening directed towards oogonia; grows attached in moving water or free floating after breaking away from parent colony; plants become dirty green with age. *Vaucheria* readily picks up debris so it is difficult to get a good look at it on the microscope. Found during February, 1961, Station CC which is "Drop Structure" at canal entrance.

Family COSCINODISCACEAE

Melosira varians Agardh *in:*

FRITSCH, The structure and reproduction of the algae. Vol. 1, pp. 619, 633; figs. 200I, 206F, 214A-C. 1956.

HUBER-PESTALOZZI, Das phytoplankton des Süsswassers. Systematik und biologie. In: Thienemann, A. Die Binnengewasser, 16(2):377-378, fig. 447A-D. 1942.

REIMANN, BINDUNG, bau und zusammenhang der Bacillariophyceenschalen, Nova Hedwigia, 2(1-3):356-358, pl. 64-67, figs. 3, 5-8, 11, 14. 1960.

SCHÖNFELDT, Diatomaceae Germaniae, p. 72, pl. 1, fig. 5. 1907.

SMITH, The fresh-water algae of the U. S., pp. 205, 216; figs. 134, 136A-C. 1933.

TIFFANY and BRITTON, The algae of Illinois, p. 221, pl. 59, fig. 673. 1952.

VAN HEURCK, A treatise on the Diatomaceae, Translated by Wynne E. Baxter, p. 441, fig. 165; pl. 18, fig. 611. 1962.

WEST and FRITSCH, A treatise on the British fresh-water algae, p. 354, fig. 146C-E. 1927.

WOLLE, Diatomaceae of North America, pl. 57, figs. 11-15. 1890.

Lysigonium varians (Agardh) De Toni *in:*

BOYER, The Diatomaceae of Philadelphia and vicinity, p. 17, pl. 1, figs. 18, 19. 1916.

ELMORE, The Diatoms (Bacillarioideae) of Nebraska, Univ. Studies, 21(1-4): 37, pl. 1, figs. 1-5. 1921.

FIG. 51

This Centrales diatom filamentous with cylindrical cells 13.4-24.8 microns wide by 23.0-24.8 microns long; cells in pairs; cell composed of two valves which makes the cells appear paired; cells slightly longer than wide. During formation of microspores cells may extend in length so that the two semicells are separated by intervening cytoplasm incased by the plasma membrane (See Fritsch, Fig. 214C, p. 636). Auxospores are formed with one end in hypotheca and other end in epitheca (See Fritsch, Fig. 206, p. 618). Valves with very fine punctae, sulcus absent. This alga collected at Station BB, Inlet Canal, west of bridge during November and December, 1960.

Cyclotella striata (Kütz.) Cl. and Grun. *in:*

ELMORE, The Diatoms (Bacillarioideae) of Nebraska, Univ. Studies, 21(1-4): 39, pl. 1, fig. 22. 1921.

Cyclotella striata (Kütz.) Grun. *in:*

BOYER, The Diatomaceae of Philadelphia and vicinity, p. 19, pl. 2, fig. 9. 1916.

HUBER-PESTALOZZI, Das phytoplankton des Süsswassers. Systematik und biologie. In: Thienemann, A. Die Binnengewasser, 16(2):396-397, fig. 481A-B. 1942.

VAN HEURCK, A treatise on the Diatomaceae, Translated by Wynne E. Baxter, p. 446, pl. 22, fig. 651. 1962.

WOLLE, Diatomaceae of North America, pl. 66, figs. 16, 17. 1890.

Cyclotella striata Kütz. *in:*

SCHÖNFELDT, Diatomaceae Germaniae, pp. 79-80, pl. 3, fig. 329. 1907.

FIG. 52

Cells discoid, circular in valve view, solitary and free floating; central area of frustule smooth with scattered punctae and peripheral zone 4-6 microns wide with radial striae. Diameter of cells 18-26 microns and 10.6 microns thick; 6-7 striations in 10 microns as markings on the shell; chromatophores small and discoid. Habitat pelagic often intermixed with other algae. Widely distributed within Cheyenne Bottoms but found in quantity at Station R, Pool 2, Bridge 3. This is a new species for Kansas.

Family FRAGILARIACEAE

Synedra ulna (Nitz.) Ehr. *in:*

BOYER, The Diatomaceae of Philadelphia and vicinity, p. 47, pl. 11, figs. 4, 7, 11. 1916.

ELMORE, The Diatoms (Bacillarioideae) of Nebraska, Univ. Studies, 21(1-4): 55, pl. 3, figs. 116-130. 1921.

HUBER-PESTALOZZI, Das phytoplankton des Süsswassers. Systematik und biologie. In: Thienemann, A. Die Binnengewasser, 16(2):459-460, fig. 537A. 1942.

SCHÖNFELDT, Diatomaceae Germaniae, pp. 105-106. 1907.

TIFFANY and BRITTON, The algae of Illinois, p. 237, pl. 63 fig. 713. 1952.

VAN HEURCK, A treatise on the Diatomaceae, Translated by Wynne E. Baxter, p. 310, pl. 10, fig. 409. 1962.

FIG. 53

Frustules many times longer than broad, elongate-rostrate or capitate; striations distinct 8.7 per 10 microns. In girdle view cells have widened extremities but in valve view poles narrowed. Cells on occasion may be 9.6 microns wide by 50-272 or more microns long. Pseudoraphe visible on the valve side as a hyaline area down the midline of valve, may have clear area towards middle with central nodule and polar nodules near poles of cell, none of which clearly visible. Valves finely striated from each side up to pseudoraphe; girdle view elongated, non-attenuated with truncate apices. Plate-like chromatophores sometimes highly colored having indented or undulated edges. This species found in old cultures but may be found intermixed with other algae. Specimens were especially abundant in Inlet Canal, Station E, during early June, 1960.

Family NAVICULACEAE

Navicula cuspidata Kütz. *in:*

BOYER, Synopsis of North American Diatomaceae. Part II.—Naviculatae, Surirellatae; Pro. of the Acad. of Nat. Sci. Phila., 79:366. 1927.

SCHÖNFELDT, Diatomaceae Germaniae, p. 145, pl. 8, fig. 90. 1907.

TIFFANY and BRITTON, The algae of Illinois, p. 254, pl. 68, fig. 789. 1952.

VAN HEURCK, A treatise on the Diatomaceae, Translated by Wynne E. Baxter, p. 214, pl. 4, fig. 190. 1962.

Navicula fulva (Nitz.) Ehr. *in:*

ELMORE, The Diatoms (Bacillarioideae) of Nebraska, Univ. Studies, 21(1-4): 84, pl. 10, figs. 369-373, 378-380, 382. 1921.

FIGS. 54, 55

Frustules measured 17.7 microns wide by 63.7 microns long; has central hyaline axial area plainly visible on valve side; longitudinal lines parallel to the axial area; punctate transverse lines traverse the valve at right angles to the longitudinal lines. Cell described as rhombo-lanceolate, tapering sharply to rounded ends; central and polar nodules present although they are not readily observable; protoplasmic bridge connecting the chromatophores which may be green or highly colored with browns in the neighborhood of girdle, central nodule and nucleus located in this area; volutin globules appear along the raphe on either side of protoplasmic bridge, none of protoplasmic features readily observable. Cells have weak powers of locomotion as in all diatoms. These boat-shaped diatoms appeared in many collections from Cheyenne Bottoms but appeared in numbers during June, 1960, Station A, Pool 2, in shallow water along shore.

Navicula cuspidata var. *ambigua* (Ehr.) Cl. *in:*

BOYER, Synopsis of North American Diatomaceae. Part II.—Naviculatae, Surirellatae; Pro. of the Acad. of Nat. Sci. Phila., 79:366. 1927.

BOYER, The Diatomaceae of Philadelphia and vicinity, p. 100, pl. 26, fig. 3. 1916.

HUSTEDT, Die Kieselalgen. In: Rabenhorst's Kryptogamen-flora von Deutschland, Osterreich und der Schweiz, 7(3):62-64, fig. 1206B. 1961.

SCHÖNFELDT, Diatomaceae Germaniae, p. 145. 1907.

TIFFANY and BRITTON, Algae of Illinois, p. 254, pl. 68, fig. 790. 1952.

Navicula ambigua Ehr. *in:*

VAN HEURCK, A treatise on the Diatomaceae, Translated by Wynne E. Baxter, p. 214, pl. 4, fig. 192. 1962.

FIG. 56

Valves broadly lanceolate with rostrate, slightly capitate ends; transverse and longitudinal striations; longitudinal lines parallel to the long axis, 22-26 per 10 microns while punctate transverse striations about 18 per 10 microns. Variety *ambigua* usually smaller than *Navicula cuspidata* and ends are entirely different. Cells measure 15-20 microns wide by 40-50 microns long. This variety found in all pools. This is a new variety for Kansas.

Pinnularia viridis (Nitz.) Ehr. *in:*

TIFFANY AND BRITTON, The algae of Illinois, p. 262, pl. 70, fig. 809. 1952.

Pinnularia Viridis Nitz. *in:*

BOYER, The Diatomaceae of Philadelphia and vicinity, p. 104, pl. 29, fig. 2. 1916.

SCHÖNFELT, Diatomaceae Germaniae, p. 177, pl. 12, fig. 211. 1907.

Pinnularia viridis Kütz. *in:*

FRITSCH, The structure and reproduction of the algae. Vol. I., figs. 194B-F, 197A-C. 1956.

Navicula viridis (Nitz.) Kütz. *in:*

ELORE, The Diatoms (Bacillarioideae) of Nebraska, Univ. Studies, 21(1-4):65, pl. 6, figs. 185-191. 1921.

VAN HEURCK, A treatise on the Diatomaceae, Translated by Wynne E. Baxter, p. 165, pl. 2, fig. 70. 1962.

WEST, A treatise on the British freshwater algae, figs. 125D, 136B, 137D-E. 1904.

FIGS. 57, 58

Cells linear-elliptic or slightly oval without inflations and with rounded ends in valve view but with truncatae ends and rounded corners in girdle view. In valve view cells 15-25 microns wide by 80-100 microns long but may vary from these. Striking diatom because of the rich golden-brown color nearly filling cell; very common in collections from all parts of Cheyenne Bottoms. Have weak powers of locomotion; raphe undulate; cell has chromatophores, a central nodule and two polar nodules while the costae are heavy with about 5-7 in 10 microns.

Pleurosigma delicatulum W. Sm. *in:*

BOYER, Synopsis of North American Diatomaceae. Part II.—Naviculatae, Surirellatae; Pro. of the Acad. of Nat. Sci. Phila., 79:472-473. 1927.

CHOLNOSKY, Beiträge zur kenntnis der Diatomeenflora non Natal (Südafrika), Nova Hedwigia, 2(1-3):113. 1960.

SCHÖNFELDT, Diatomaceae Germaniae, p. 131, pl. 7, fig. 68. 1907.

SMITH, The fresh-water algae of the U. S. pp. 253-254, fig. 177. 1933.

Gyrosigma delicatulum (W. Sm.) Elmore *in:*

ELMORE, The Diatoms (Bacillarioideae) of Nebraska, Univ. Studies, 21(1-4):105, pl. 13, figs. 512-513. 1921.

FIG. 59

Sigmoid in valve view; has naviculoid elongated frustule; raphe also sigmoid and ends of frustule obstuse or attenuated; small central nodule; striations decussate with lines crossing in three directions, however, they are so fine it takes a good oil-immersion lens to show them; two chromatophores plate-like lay next to girdle. Specimens measure 14-19 microns wide by 139-162 microns long, chromatophores highly colored with several pyrenoids. In valve view sigmoid nature evident while chromatophores lay along outer margins often connected by an isthmus with central axis of cell largely clear. In girdle view overlapping of valves evident on the ends while the chromatophores largely fill frustule. This diatom widely distributed and in evidence during mid-October, 1960, Pool 2, Station R, Bridge 3.

Amphiprora alata (Ehr.) Kütz. *in:*

BOYER, Synopsis of North American Diatomaceae. Part II.—Naviculatae, Surirellatae; Pro. of the Acad. of Nat. Sci. Phila., 79:483. 1927.

ELMORE, The Diatoms (Bacillaricideae) of Nebraska, Univ. Studies, 21(1-4):107, pl. 14, figs. 522-525. 1921.

SCHÖNFELDT, Diatomaceae Germaniae, p. 129, pl. 6, fig. 67. 1907.

VAN HEURCK, A treatise on the Diatomaceae, Translated by Wynne E. Baxter, p. 262, fig. 52, pl. 5, fig. 289. 1962.

FIGS. 60, 61

Frustules free floating, solitary; naviculoid in valve view with sigmoid raphe while in girdle view broadly linearelliptic with a twist about the longitudinal axis (fig. 60); median constriction giving cell an hourglass appearance. Cells striated with truncate ends; terminal and central nodules not always in evidence; 20-48 microns in diameter by 50-130 microns long; striations 11-16 in 10 microns; broader in girdle view than valve view; chromatophores may be one or two with incised margins. Girdle view of fig. 61 shows one in the process of dividing. Found intermixed with other algae at Station R, October, 1960 and other areas. This is a new species for Kansas.

Family GOMPHONEMATACEAE

Gomphonema olivaceum (Lyngb.) Kütz. *in:*

BOYER, Synopsis of North American Diatomaceae. Part II.—Naviculatae, Surirellatae; Pro. of the Acad. of Nat. Sci. Phila., 79:296. 1927.

ELMORE, The Diatoms (Bacillariacideae) of Nebraska, Univ. Studies, 21(1-4):113, pl. 15, figs. 571-574. 1921.

VAN HEURCK, A treatise on the Diatomaceae, Translated by Wynne E. Baxter, p. 274, pl. 7, fig. 315. 1962.

FIG. 62

Cells clavate with broad apex and narrow base which is often attached to a stalk. Colony of cells imbedded in gelatinous mass attached to substratum in swiftly moving water. Stipitate frustule; cuneate in girdle view, measures 13.4-14.0 microns wide by 28.3-31.0 microns long. Size variations could deviate, however, and be from 5-20 microns diameter by 8-45 microns long. Axial area narrow and central area irregular without stigma; striations radiate, 11-14 in 10 microns and finely punctate; frustule free of dots in central area. This alga very abundant as clear or brown gelatinous masses growing on bottom of Entrance Canal, Station BB, west of bridge and at Station Z on bottom of the Arkansas River just above Diversion Dam; abundant during November, 1960.

Family NITZSCHIACEAE

Bacillaria paradoxa Gmelin *in:*

FRITSCH, The structure and reproduction of the algae. Vol. I., p. 590, figs. 187F, 200G-H. 1956.

HUBER-PESTALOZZI, Das phytoplankton des Süsswassers. Systematik und biologie. In: Thienemann, A. Die Binnengewässer, 16(2):469-470, fig. 558A-B. 1942.

Homoeocladia paxillifer (Müller) Elmore *in:*

ELMORE, The Diatoms (Bacillarioideae) of Nebraska, Univ. Studies, 21(1-4): 143, Pl. 20, figs. 761-763. 1921.

Nitzschia paxillifer (Müller) Heib. *in:*

BOYER, Synopsis of North American Diatomaceae. Part II.—Naviculatae, Surirellatae; Pro. of the Acad. of Nat. Sci. Phila., 79:509. 1927.

FIGS. 63, 64

Cells linear; in girdle view 5.7 microns wide by 114 microns long with apices 3.5 microns wide. Cells attenuated and slightly rostrate in valve view. Organized into a stratum so that cells move longitudinally back and forth extending into long chains or condensed into flat plate within which cells rest side by side; striations 17-24 in 10 microns; central carina has 6-8 round dots in 10 microns. Movements autonomic being mostly expanded during day and contracted at night but stimulation will cause approximation to form compact ribbon shaped colonies, individuals responsive to light and temperature. This species found during February, 1961, at Station DD, Bridge 1, Pool 2.

Nitzschia reversa W. Sm. *in:*

BOYER, Synopsis of North American Diatomaceae. Part II.—Naviculatae, Surirellatae; Pro. of the Acad. of Nat. Sci. Phila., 79:525-526. 1927.

Nitzschia longissima Ralfs var. *reversa* (W. Sm.) Van Heurck *in:*

VAN HEURCK, A treatise on the Diatomaceae. Translated by Wynne E. Baxter, p. 405. 1962.

FIG. 65

Cells lanceolate in valve view, 6-7 microns wide by 76-86 microns long; keel puncta not observed and striations fine; beaks curved in opposite directions; about 20-24 microns long and about half the body length; *N. reversa* is quite similar to *Nitzschia acicularis* which was found elsewhere in Kansas but *N. acicularis* the authors have found is smaller being only 5-7 microns wide and 51.9-57.0 microns long with beaks about 8-10 microns long, differs from *N. reversa* with beaks always straight while *N. reversa* always have apices bent in opposite directions on the two ends. According to Boyer the puncta are missing in *N. Reversa* and present in *N. acicularis*. This diatom widely distributed at many stations during most times of the year in 1960, 1961 and 1962. This is a new species for Kansas.

Family SURIRELLACEAE

Surirella robusta Ehr. Var. *splendida* (Ehr.) Van Heurck *in:*

ELMORE, *The Diatoms* (Bacillarioideae) of Nebraska, Univ. Studies, 21(1-4): 149. 1921.

HUBER-PESTALOZZI, Das phytoplankton des Süsswassers. Systematik und biologie. In: Thienemann, A. Die Binnengewässer, 16(2):509, fig. 620B-C. 1942.

PATRICK, A taxonomic distributional study of some Diatoms from Siam and the Federated Malay States, Pro. of the Acad. of Nat. Sci. Phila., 88:437. 1936.

Surirella splendida (Ehr.) Kütz. *in:*

BOYER, The Diatomaceae of Philadelphia and vicinity, p. 125, pl. 35, fig. 3. 1916.

BOYER, Synopsis of North American Diatomaceae. Part II.—Naviculatae, Surirellatae; Pro. of the Acad. of Nat. Sci. Phila., 79:536. 1927.

TIFFANY and BRITTON, The algae of Illinois, p. 294, pl. 79, fig. 924. 1952.

Cells not isopolar, measuring 60 microns wide by 105 microns long; round in end view with four wings extending out from the cell; poles broadly rounded and costae 1.4-2.1 in 10 microns; clear edge around cell and 15 microns wide where costae are visible; not spirally twisted and spaces between costae broad. Variety *splendida* smaller than *Surirella robusta* Ehr. and costae more closely packed. Cells free floating, showing some motility; chromatophore covers most of frustule except along edge. Collected outside Cheyenne Bottoms at Station Z on October 28, 1960, at Arkansas River Diversion Dam.

Surirella ovalis Bréb. *in:*

BOYER, The Diatomaceae of Philadelphia and vicinity, p. 126, pl. 35, fig. 5, pl. 39, fig. 11. 1916.

BOYER, Synopsis of North American Diatomaceae. Part II.—Naviculatae, Surirellatae; Pro of the Acad.. of Nat. Sci. Phila., 79:541. 1927.

ELMORE, The Diatoms (Bacillarioideae) of Nebraska, Univ. Studies, 21(1-4):150, pl. 21, fig. 802. 1921.

TIFFANY and BRITTON, The algae of Illinois, p. 296, pl. 79, fig. 922. 1952.

FIG. 66

Frustule ovate-elliptical or broadly ovate measuring 17.8-24.0 microns wide by 24.9-35.1 microns long with 5-6 costae per 10 microns, species very variable as to shape and size; costae short, marginal and perpendicular to margin. Cells not isopolar; cuneate in girdle view. Similar cells should be compared to the many varieties of S. *ovalis*. Found at Station BB on November 4, 1960, along canal which discharges water into Cheyenne Bottoms. This is a new species for Kansas, although, in the past several varieties of this species have been found but were listed as separate species. Common in Western Kansas.

Cyanophyta

The Division Cyanophyta (blue-green algae) has a combination of pigments producing a characteristic blue-green color scattered throughout the cytoplasm but with no definite chromatophores. There is but one class, the Myxophyceae (Cyanophyceae). Sexual reproduction is lacking and motility is absent in many species and limited in others.

Family CHROOCOCCACEAE

Gloeothece rupestris (Lyngb). Bornet *in:*

DESIKACHARY, Cyanophyta, p. 127, pl. 25, fig. 4. 1959.

GEITLER, Cyanophyceae. In: L. Rabenhorst's Kryptogamen-flora von Deutschland, Österreich und der Schweiz. 14(1):221-222. 1932a.

PETERSEN, The fresh-water Cyanophyceae of Iceland. In: The botany of Iceland, 2(2):261-263. 1928.

PRESCOTT, Algae of the Western Great Lakes area, p. 462, pl. 103, figs. 2, 3. 1951.

TILDEN, Minnesota algae, Vol. 1, the Myxophyceae of North America and adjacent regions including Central America, Greenland, Bermuda, the West Indies and Hawaii, p. 26, pl. 2, fig. 4. 1910.

Coccochloris stagnina Sprengel *in:*

DROUET, Myxophyceae. In: Edmondson's Fresh-water biology, p. 96, fig. 5.1. 1959.

DROUET and DAILY, Revision of the Coccoid Myxophyceae, Butler University botanical studies, 12:15-28. 1956.

Anacystis rupestris (Lyngb.) Drouet and Daily *in:*

TIFFANY and BRITTON, The algae of Illinois, p. 331, pl. 89, fig. 1039. 1952.

FIG. 67

Probably one of the many varieties of *Gloeothece rupestris* since cells are larger than ordinary. Specimens collected at Bridge 5, Station Q, Pool 2, September, 1960, and at Station R, Pool 2, Bridge 3, October, 1960; have cells that before division are ovoid or ovoid-cylindrical dividing in plane perpendicular to long axis. Cells measure 7 x 10.5 microns, light blue-green, contained within homogenous gelatinous matrix of irregular shape; colony later turns brown with age; eutropic in habit being in shallow water below surface a few inches. This is a new species for Kansas.

Family OSCILLATORIACEAE

Spirulina major Kütz. *in:*

DESIKACHARY, Cyanophyta, p. 196, pl. 36, fig. 13. 1959.

DROUET, Myxophyceae. In: Edmondson's Fresh-water biology, p. 114, fig. 5.43. 1959.

GEITLER, *Cyanophyceae.* In: L. Rabenhorst's Kryptogamen-flora von Deutschland, Osterreich und der Schweiz. 14(2):930, fig. 595. 1932a.

GOMONT, Monographie des Oscillariées (Nostocacées homocystées). Ann. Sci. Nat., Ser. VIII., Botan., 16:251-252, pl. 7, fig. 29. Reprinted In: J. Cramer's and H. K. Swann's Historiae naturalis classica, XIX. 1962.

HYLANDER, The algae of Connecticut, State Geol. and Natural Hist. Survey, 42:46, pl. 3, fig. 1. 1928.

PRESCOTT, Algae of the Western Great Lakes area, p. 480, pl. 108, fig. 11. 1951.

THOMPSON, A preliminary survey of the fresh-water algae of Eastern Kansas, Univ. Kansas Sci. Bull., 25(1):11, pl. 1, fig. 20. 1938.

TIFFANY and BRITTON, The algae of Illinois, p. 354, pl. 97, fig. 1124. 1952.

TILDEN, Minnesota algae, Vol. 1, the Myxophyceae of North America and adjacent regions including Central America, Greenland, Bermuda, the West Indies and Hawaii, pp. 87-88, pl. 4, fig. 46. 1910.

WEST, A treatise on the British freshwater algae, p. 336, fig. 155B. 1904.

FIG. 68

Trichomes have no cross walls, pale blue in color, loosely spiraled, very active and long commonly exceeding several hundred microns, measure 1.2-1.7 microns wide while spirals measure 2.5-4.0 microns in width and the distance between spirals measure 2.8-5.0 microns; found widely distributed at Cheyenne Bottoms but especially in Pool 1 and Pool 4 during September and October, 1960, found on muddy shores or intermixed with other algae especially other "blue-greens".

Oscillatoria limosa (Roth) C. A. Agardh *in:*

BÖCHER, Studies on the sapropelic flora of the Lake Flynders with special reference to the Oscillatoriaceae, Det Kgl. Danske Videnskabernes Selskab, biologiske Meddelelser, 21(1):15. 1949.

DESIKACHARY, Cyanophyta, pp. 206-207, pl. 42, fig. 11. 1959.

DROUET, Myxophyceae. In: Edmondson's Fresh-water biology, p. 113. 1959.

GEITLER, Cyanophyceae. In: L. Rabenhorst's Kryptogamen-flora von Deutschland, Österreich und der Schweiz. 14(2): 944, fig. 598D. 1932a.

GOMONT, Monographie des Oscillariées (Nostocacées homocystées). Ann. Sci. Nat., Ser. VIII., Botan., 16:210-213, pl. 6, fig. 13. Reprinted In: J. Cramer's and H. K. Swann's Historiae naturalis classica, XIX. 1962.

PETERSEN, The fresh-water Cyanophyceae of Iceland. In: The botany of Iceland, 2(2):274. 1928.

PRESCOTT, Algae of the Western Great Lakes area, p. 489, pl. 109, fig. 17. 1951.

TIFFANY and BRITTON, The algae of Illinois, p. 342, 344; pl. 93, fig. 1076. 1952.

TILDEN, Minnesota algae, Vol. 1, the Myxophyceae of North America and adjacent regions including Central America, Greenland, Bermuda, the West Indies and Hawaii. pp. 65-66, pl. 4, fig. 6. 1910.

FIG. 69

Cells decidely blue-green, becoming brown with age, granular; forming films on substratum or becoming free floating as colonies or solitary. Trichomes do not taper but the apical cell is rotund; cells measure 11.5 microns wide by 2.7 microns long and trichomes not constricted at cross walls. This species present in many collections from Cheyenne Bottoms such as Station 1, Bridge 20, Pool 4, July, 1960.

Oscillatoria agardhii Gomont *in:*

DESIKACHARY, Cyanophyta, pp. 235-236. 1959.

GEITLER, Cyanophyceae. In: L. Rabenhorst's Kryptogamen-flora von Deutschland, Österreich und der Schweiz. 14(2):974, fig. 621. 1932a.

GOMONT, Monographie des Oscillariées (Nostocacées homocystées). Ann. Sci. Nat., Ser. VIII., Botan., 16:205-206. Reprinted In: J. Cramer's and H. K. Swann's Historiae naturalis classica, XIX. 1962.

PRESCOTT, Algae of the Western Great Lakes area, p. 484, pl. 108, figs. 15, 16. 1951.

TIFFANY and BRITTON, The algae of Illinois, p. 346, pl. 94, fig. 1082. 1952.
TILDEN, Minnesota algae, Vol. 1, the Myxophyceae of North America and adjacent regions including Central America, Greenland, Bermuda, the West Indies and Hawaii, p. 62, pl. 4, fig. 2. 1910.

Cells measure 4-6 microns broad by 2.5-4.0 microns long and are coarsely granulate with pseudovacuoles. Trichomes straight, no constrictions at cross walls, tapering towards the ends which are pointed or slightly capitate, free floating or forming blue-green masses in the water. Apex of the trichome shows considerable variation from one specimen to another. This species found during June and July, 1961, at Station CC, Drop Structure.

Oscillatoria tenuis C. A. Agardh *in:*

GEITLER, Cyanophyceae. In: L. Rabenhorst's Kryptogamen-flora von Deutschland, Österreich und der Schweiz. 14(2):959, fig. 611F-G. 1932a.
GOMONT, Monographie des Oscillariées (Nostocacées homocystées). Ann. Sci. Nat., Ser. VIII., Botan., 16:220-221, pl. 7, figs. 2, 3. Reprinted In: J. Cramer's and H. K. Swann's Historiae naturalis classica, XIX. 1962.
MCNAUGHT, Algae of Kansas reservoirs, Trans. Kansas Acad. Sci., 29:151-152, pl. 2, fig. 3. 1920.
PRESCOTT, Algae of the Western Great Lakes area, p. 491, pl. 110, figs. 8, 9, 14. 1951.
TIFFANY and BRITTON, The algae of Illinois, p. 346, pl. 93, fig. 1074. 1952.
TILDEN, Minnesota algae, Vol. 1, the Myxophyceae of North America and Adjacent regions including Central America, Greenland, Bermuda, the West Indies and Hawaii. pp. 71-72, pl. 4, figs. 17-18. 1910
WOLLE, Fresh-water algae of the U. S., p. 313. 1887.

FIG. 70

This alga found in practically every part of the Cheyenne Bottoms area attached to objects in water or to substrata, may be free floating or intermixed with other algae; trichomes straight or slightly flexuous at anterior end, they do not taper nor are they capitate; end cell convex and smooth. Cells not as long as broad being 7 microns wide by 3.5 microns long; slightly constricted at cross walls with granules along cross walls; color blue-green either singly or as mass.

Lyngbya versicolor (Wartmann) Gomont *in:*

DESIKACHARY, Cyanophyta, p. 311, pl. 53, fig. 6. 1959.
GEITLER, Cyanophyceae. In: L. Rabenhorst's Kryptogamen-flora von Deutschland, Österreich und der Schweiz. 14(2): 1059, fig. 656F. 1932a.
GOMONT, Monographie des Oscillariées (Nostocacées homocystées). Ann. Sci. Nat. Ser. VIII., Botan., 16:147, pl. 4, figs. 4, 5. Reprinted In: J. Cramer's and H. K. Swann's Historiae naturalis classica, XIX. 1962.
HYLANDER, The algae of Connecticut, State Geol. and Natural Hist. Survey, 42:47-48, pl. 3, fig. 27. 1928.
PRESCOTT, Algae of the Western Great Lakes area, p. 504, pl. 113, fig. 4. 1951.
TIFFANY and BRITTON, The algae of Illinois, p. 339, pl. 92, figs. 1061, 1062. 1952.

TILDEN, Minnesota algae, Vol. 1, the Myxophceae of North America and adjacent regions including Central America, Greenland, Bermuda, the West Indies and Hawaii. pp. 116-117, pl. 5, fig. 35. 1910.

FIG. 71

Cells 2.2-3.1 microns wide by 2.4-6.2 microns long have clear cell walls with yellow-brown sheaths 1.8-2.4 microns thick; not constricted at cross walls and the ends of trichomes rounded, without calyptra; plant mass soft, attached at first but later free; trichomes much entangled and lubricous. This is a new species for the state. Found in Pool 2 at Bridge 4, Station U, September 17, 1960.

Family NOSTOCACEAE

Anabaena helicoidea Bernard *in:*

PRESCOTT, Algae of the Western Great Lakes area, pp. 515-516, pl. 116, fig. 8. 1951.

FIG. 72

Trichomes spirally twisted, free floating, solitary or in masses; vegetative cells ovate or barrel shaped measuring 3.5-4.3 microns in diameter by 5.0-8.6 microns long; heretocysts 3.5-6.9 microns in diameter by 5.0-6.9 microns long and nearly globose or slightly oval in shape; akinetes measure 6.9-10.4 microns in diameter by 13.8-17.3 microns long; trichomes do not taper and without branches; heterocysts intercalary. This alga found at Station K, Bridge 14, Pool 4 in some abundance during October, 1960. The species should be compared with *Anabaena flos-aquae* which is quite similar and common in Kansas. This is a new species for Kansas.

Anabaena oscillarioides Bory *in:*

BORNET and FLAHAULT, Revision des Nostocacées hétérocystées contenues dans les principaux herbiers de France, 7(7):233-236. Reprinted In: Later Starting Point Books, I. 1959.

GEITLER, Cyanophyceae. In: L. Rabenhorst's Kryptogamen-flora von Deutschland, Österreich und der Schweiz. 14(2)886-887, fig. 567E. 1932a.

PRESCOTT, Algae of the Western Great Lakes area, p. 517, pl. 117, figs. 8-10. 1951.

TIFFANY and BRITTON, The algae of Illinois, p. 357, pl. 99, fig. 1137. 1952.

TILDEN, Minnesota algae, Vol. 1, the Myxophyceae of North America and adjacent regions including Central America, Greenland, Bermuda, the West Indies and Hawaii. pp. 193-194, pl. 9, fig. 20. 1910.

FIG. 73

Cells broadly barrel shaped 5.2 microns wide by 5.2-6.9 microns long; heterocysts 5.9-6.9 microns wide by 8.6 microns long; akinetes single or in groups of two on both sides of heterocyst, ovoid or cylindric, smooth and yellow-brown, 6.9 microns wide by 10.3-15.0

microns long; filaments slightly tapered towards ends. There is little doubt that this species is *oscillarioides* but the heterocysts did not exceed 15 microns in length but in most other respects it is identical, it should probably be considered a variety of *A. oscillarioides.* Filaments were straight and solitary or forming thin gelatinous films on aquatic higher plants or substratum or floating free in water after a time; apical cells rotund. This is a new species for Kansas. Found during September, October and November, 1960, at Station I, Bridge 20, Pool 4.

Nostoc linckia (Roth) Bornet and Thuret *in:*

BORNET and FLAHAULT, Revision des Nostocacées hétérocystées contenues dans les principaux herbiers de France, 7(7):192-193. Reprinted In: Later Starting Point Books, I. 1959.

DESIKACHARY, Cyanophyta, p. 377. 1959.

DROUET, Myxophyceae. In: Edmondson's Fresh-water biology, p. 101, fig. 5.17. 1959.

GEITLER, Cyanophyceae. In: L. Rabenhorst's Kryptogamen-flora von Deutschland, Österreich und der Schweiz. 14(2):838, fig. 528B. 1932a.

PRESCOTT, Algae of the Western Great Lakes area, p. 523, pl. 119, figs. 14-16. 1951.

TILDEN, Minnesota algae, Vol. 1, the Myxophyceae of North America and adjacent regions including Central America, Greenland, Bermuda, the West Indies and Hawaii, p. 166, pl. 7, fig. 1. 1910.

WEST, Algae, Vol. 1. Myxophyceae, Peridinieae, Bacillarieae, Chlorophyceae, together with a brief summary of the occurrence and distribution of freshwater algae, fig. 31A-B. 1916.

FIG. 74

Colonies granular, punctate with globose cells when young becoming irregularly expanded, fenestrate and torn with age, firm and tough; at first blue-green and changing to dirty-green with age; trichomes flexuous, abruptly contorted and entangled within confluent transparent matrix; colonies appear loosely attached at first to sedges and other aquatic vegetation becoming free floating euplankton; mucous trichomes have vegetative cells which are short, subglobose or barrel shaped 3.5-4.5 microns in diameter and flattened where they articulate with adjacent cells; heterocysts slightly larger than vegetative cells 5.2-5.5 microns long; gonidia occur singly or in pairs remote from heterocysts appearing somewhat spherical and are more granular and very slightly larger than vegetative cells being 6.9 microns wide by 10.4 microns long. *N. linckia* collected quite widely in Pool 2, Bridges 3, 4, 5 and 6; Stations R, U, Q and V, during 1960. This is a new species for Kansas but Sherman (1949:31) in his unpublished thesis listed it for Crawford County.

Cylindrospermum majus Kütz. *in:*

Bornet and Flahault, Revision des Nostocacées hétérocystées contenues dans les principaux herbiers de France, 7(7):252. Reprinted In: Later Starting Point Books, I. 1959.

Desikachary, Cyanophyta, pp. 360, 362, pl. 80, fig. 1. 1959.

Prescott, Algae of the Western Great Lakes area, p. 530, pl. 122, figs. 11, 12. 1951.

Smith, The fresh-water algae of the U. S. p. 92. 1933.

Thompson, A preliminary survey of the fresh-water algae of Eastern Kansas, Univ. Kansas Sci. Bull., 25(1):14, pl. 2, fig. 3. 1938.

Tiffany and Britton, The algae of Illinois, p. 362, pl. 100, fig. 1145. 1952.

Tilden, Minnesota algae, Vol. 1, the Myxophyceae of North America and adjacent regions including Central America, Greenland, Bermuda, the West Indies and Hawaii, p. 199, pl. 10, fig. 4. 1910.

Tilden, The algae and their life relations, p. 99, fig. 45B. 1937.

West, A treatise on the British freshwater algae, p. 329. 1904.

Fig. 75

Vegetative cells nearly quadrate being slightly longer than wide 3.5 microns wide by 5.2-6.9 microns long; constricted at cross walls and pale green in color; plant mass mucous and expanded with age becomes darker in color; heterocysts either smooth or hairy are 6.0 microns wide by 11.6 microns long; akinetes occur next to heterocysts and may be reasonably smooth but are usually rough and punctate with granular contents while some have short papilla. Akinetes single and ellipsoid, 4.3-6.9 microns wide by 10.6-17.3 microns long. Collected Station V, Bridge 6, Pool 2 during September, 1960, and Station Q, Bridge 5, Pool 2 during October, 1960.

Family RIVULARIACEAE

Gloeotrichia natans (Hedw.) Rab. *in:*

Bornet and Flahault, Revision des Nostocacées hétérocystées contenues dans les principaux herbiers de France, 7(4):369-371. Reprinted In: Later Starting Point Books, I. 1959.

Desikachary, Cyanophyta, pp. 561-562, pl. 118, figs. 7, 15. 1959.

Fritsch, The structure and reproduction of the algae. Vol. 2., fig. 309C. 1952.

Geitler, Cyanophyceae. In: L. Rabenhorst's Kryptogamen-flora von Deutschland, Österreich und der Schweiz. 14(1):639, fig. 406, 407. 1932a.

Prescott, Algae of the Western Great Lakes area, p. 559, pl. 134, figs. 6, 7. 1951.

Smith, The fresh-water algae of the U. S., pp. 108-109. 1933.

Tiffany and Britton, The algae of Illinois, p. 376, pl. 106, figs. 1171, 1172. 1952.

Rivularia natans (Hedw.) Welwitsch *in:*

Tilden, Minnesota algae, Vol. 1, the Myxophyceae of North America and adjacent regions including Central America, Greenland, Bermuda, the West Indies and Hawaii, p. 285, pl. 19, fig. 7, pl. 20, figs. 1-3. 1910.

Figs. 76, 77

Rivularia and *Gloeotrichia* are very similar because of attenuated trichomes but *Rivularia* grows attached and has no akinetes while *Gloeotrichia* has akinetes. *Gloeotrichia natans* may become planktonic; colonies several cm in diameter, solid or hollow and spherical or somewhat irregular in shape; mucilage of colony colorless and trichomes radiate throughout parent colony; akinetes single next to heterocyst which is terminal at basal or broad end of trichome; colonies soft and gelatinous, globose or bullate while the filaments radiate evenly at first, later becoming somewhat entangled. Cells barrel shaped or subglobose below but become quadrate and subcylindric distally; basal cells have diameter of 11 microns and the distal end of the trichomes tapers to cells with diameters of about 3.5 microns; heterocysts ovate with diameter of 6-12 microns; akinetes single 10-14 microns wide by 14-41 microns long with thick wall and lamellated sheath which is sometimes folded extending about one-half way up trichome and widens above to funnel shape. Collected Stations Q and R, September, 1960.

Literature Cited

Böcher, Tyge W. 1949. Studies on the sapropelic flora of the Lake Flanders with special reference to the Oscillatoriaceae. Det. Kgl. Danske Videnskabernes Selskab, biologiske Meddelelser, 21(1):1-46.

Bornet, E. and C. Flahault. 1959. Revision des Nostocacées hétérocystées contenues dans les principaux herbiers de France. Ann. Sci. Nat. Botan., Ser. VIII., 3:323-381, 4:343-373, 5:51-129, 7:177-262. Reprinted In: Later Starting Point Books, I., J. Cramer, Weinheim, Bergstr., Germany.

Boyer, C. S. 1916. The Diatomaceae of Philadelphia and vicinity. J. B. Lippincott Co., Philadelphia. 143 pp.

——— 1927. Synopsis of North American Diatomaceae, Part 2. Pro. of the Acad. of Nat. Sci. Phila., 79:229-583.

Brazda, Edward A. 1961. A study of the algae of Cheyenne Bottoms Wildlife Refuge. Unpublished master's thesis, Fort Hays Kansas State College. 100 pp.

Cholnosky, B. J. 1960. Beiträge zur kenntnis der Diatomeenflora von Natal (Südafrika). Nova Hedwigia, 2(1-3):1-128.

Collins, F. S. 1909. The green algae of North America. Tufts Coll. Studies, 2(3):80-480.

Cook, M. C. 1887. British Desmids. Williams and Norgate, London; F. A. Brockhaus, Leipzic; Westermann & Co., N. Y. 205 pp.

Czurda, V. 1932. Zygnemales. In: A. Pascher's Süsswasserflora von Mitteleuropa, 9:1-232.

Daily, Fay K. 1944. The Characeae of Nebraska. Butler Univ. botan. studies, 6:149-171.

——— 1953. The Characeae of Indiana. Butler Univ. botan. studies, 11:5-49.

——— and Walter Kiener. 1956. The Characeae of Nebraska—additions and changes. Butler Univ. botan. studies, 13(1):36-46.

Desikachary, T. V. 1959. Cyanophyta. Indian Council of Agricultural Research, New Delhi. 686 pp.

Drouet, F. 1959. Myxophyceae. In: Edmondson's Fresh-water biology. John Wiley and Sons, Inc., N. Y.

——— and W. A. Daily. 1956. Revision of the Coccoid Myxophyceae. Butler Univ. botan. studies, 12:1-218.

Elmore, Clarence J. 1921. The Diatoms (Bacillarioideae) of Nebraska. Univ. Studies, 21(1-4):22-215.

Fritsch, F. E. 1952. The structure and reproduction of the algae, Vol. 2. Cambridge Univ. Press, London and N. Y. 939 pp.

——— 1956. The structure and reproduction of the algae, Vol. 1. Cambridge Univ. Press, London and N. Y. 791 pp.

Geitler, L. 1932. Der formwechsel der pennaten Diatomeen (kieselalgen). Archiv fur protistenkunde, 78:1-26, Gustav Fischer, Jena.

——— 1932a. Cyanophyceae. In: L. Rabenhorst's Kryptogamenflora von Deutschland, Österreich und der Schweiz, 14(1-2):1-1196, Akademische Verlagsgesellschaft m. b. H., Leipzig.

Gojdics, M. 1953. The Genus Euglena. Univ. of Wisc. Press. 268 pp.

Gomont, M. 1962. Monographie des Oscillariées (Nostocacées homocystées). Ann. Sci. Nat., Ser. VIII., Botan., 15:263-368, 16:91-204. Reprinted In: J. Cramer's and H. K. Swann's Historiae naturalis classica, XIX. J. Cramer, Weinheim, Germany; Wheldon & Wesley, Ltd., Codicote, Herts, England; Hafner Publishing Co., N. Y.

Homfeld, H. 1929. Beitrag zur kenntnis der Desmidiaceen Nordwestdeutschlands besonders ihrer zygoten. In: R. Kolkwitz's Pflanzenforschung, 12:1-96, Gustav Fisher, Jena.

Horn af Rantzien, H. 1951. Charophyta reported from Latin America, Arkiv för botanik utgivet av. K. Svenska Vetenskapsakademien, 1(5):355-411, Almqvist & Wiksells Boktryckeri Ab, Stockholm. Hortobagyi, Von T. 1960. Algen aus den Fischteichen von Buzsák III: Scenedesmus-Arten. Nova Hedwigia, 2(1-3):173-190, J. Cramer, Weinheim, Germany.

——— 1962. Algen aus den Fischteichen von Buzsák IV. Nova Hedwigia, 4(1-2):21-53, J. Cramer, Weinheim, Germany.

Huber-Pestalozzi, G. 1942. Das phytoplankton des Süsswassers. Systematik und biologie. In: A. Thienemann's Die Binnengewässer. Bd. XVI, 2 Teil, 2 Halfte: Diatomeen. pp. 347-549, E. Schweizerbart'sche Verlagsbuchhandlung (Erwin Nagele), Stuttgart.

Hustedt, F. 1961. Die Kieselalgen. In: Rabenhorst's Kryptogamen-flora von Deutschland, Österreich und der Schweiz, Band 7, Teil 3, Lieferung 1, Akademische Verlagsgesellschaft Geest & Portig K.-G., Leipzig. 160 pp.

Hylander, C. J. 1928. The algae of Connecticut. State Geol. and Natural Hist. Survey, Bull. 42. 245 pp.

Irénée-Marie, F. 1939. Flore Desmidiale de la region de Montreal. Laprairie, Canada. 547 pp.

Latta, B. F. 1950. Geology and ground-water resources of Barton and Stafford Counties, Kansas. Univ. Kansas, State Geol. Survey, 88:1-288.

Mannoni, Socrates A. 1932. A survey of the green algae of Crawford County, Kansas. Trans Kansas Acad. Sci., 35:179-189.

McFarland, B. H. 1959. A preliminary survey of the algae of Ellis and Trego Counties, including methods and materials used in preservation. Unpublished master's thesis, Fort Hays Kansas State College. 73 pp.

McNaught, J. B. 1920. Algae of Kansas reservoirs. Trans. Kansas Acad. Sci., 29:142-177.

Migula, W. 1911. Die Desmidiazeen. Handbucher für die proktische naturwissenschaftliche Arbeit VI. Franckh'sche Verlagshandlung, Stuttgart. 65 pp.

Patrick, R. 1936. A taxonomic distributional study of some Diatoms from Siam and the Federated Malay States. Pro. of the Acad. of Nat. Sci. Phila., 88:367-471.

Peterson, J. B. 1928. The fresh-water Cyanophyceae of Iceland. In: L. Rosenvinge's and E. Warming's The botany of Iceland, 2(2):249-324. J. Frimodt, Copenhagen; Wheldon & Wesley, Ltd., Codicote, Herts, England.

Prescott, G. W. 1951. Algae of the Western Great Lakes area. Bull. 31. Cranbrook Inst. Sci., Bloomfield Hills, Michigan. 946 pp.

——— 1954. How to know the fresh-water algae. Wm. Brown Co., Dubuque, Iowa. 211 pp.

Randhawa, M. S. 1959. Zygnemaceae. Indian Council of Agricultural Research, New Delhi. 478 pp.

Reimann, B. 1960. Bidung, bau und zusammenhang der Bacillariophyceenschalen. Nova Hedwigia, 2(1-3):349-373, J. Cramer, Weinheim, Germany.

Saunders, D. 1894. Part I. Protophyta-Phycophyta. In: Flora of Nebraska, 1:15-68. Univ. of Nebraska, Lincoln.

Schönfeldt, H. Von. 1907. Diatomaceae Germaniae des süfswassers und des brackwassers. W. Junk, Berlin. 263 pp.

Sherman, T. 1949. Algae of College Lake, Pittsburg, Kansas. Unpublished master's thesis. Kansas State Teachers College, Pittsburg. 52 pp.

Smith, G. M. 1920. Phytoplankton of the inland lakes of Wisconsin, Part 1. Wis. Geol. and Nat. Hist. Survey, Bull. 57. 243 pp.

——— 1933. The fresh-water algae of the United States. First edition. McGraw-Hill Book Company, Inc., N. Y. 716 pp.

——— 1950. The fresh-water algae of the United States. Second edition. McGraw-Hill Book Company, Inc., N. Y. 719 pp.

Taft, Clarence E. 1931. Desmids of Oklahoma. Univ. of Oklahoma biol. survey bull., 3(3):269-323.

——— 1934. Desmids of Oklahoma II. Trans Am. Microscop. Soc., 53(2):95-101.

Thompson, R. H. 1938. A preliminary survey of the fresh-water algae of Eastern Kansas. Univ. Kansas Sci. Bull., 25(1):5-83.

——— 1959. Algae. In: Edmondson's Fresh-water biology. pp. 115-170. John Wiley and Sons, Inc. N. Y.

Tiffany, L. H. and M. E. Britton. 1952. The algae of Illinois. Univ. Chicago Press. 407 pp.

Tilden, Josephine E. 1910. Minnesota algae, Vol. 1, the Myxophyceae of North America and adjacent regions including Central America, Greenland, Bermuda, the West Indies and Hawaii. Univ. of Minnesota Press. 319 pp.

——— 1937. The algae and their life relations. Second edition. Univ. of Minnesota Press. 500 pp.

Transeau, E. N. 1951. The Zygnemataceae. Ohio State Univ. Press, Columbus. 327 pp.

Van Heurck, H. 1962. A treatise on the Diatomaceae. Translated by Wynne E. Baxter. Wheldon & Wesley, Ltd., Codicote, Herts, England; J. Cramer, Weinheim, Germany. 558 pp.

Venkataraman, G. S. 1961. Vaucheriaceae. Indian Council of Agricultural Research, New Delhi. 112 pp.

Ward, H. B. and G. C. Whipple. 1945. Fresh-water biology. John Wiley and Sons, Inc., N. Y. 1111 pp.

West, G. S. 1904. A treatise on the British fresh-water algae. Cambridge Univ. Press, London. 372 pp.

——— 1916. Algae. Vol. 1. Myxophyceae, Peridinieae, Bacillarieae, Chlorophyceae, together with a brief summary of the occurrence and distribution of fresh-water algae. Cambridge Univ. Press, London. 475 pp.

——— and F. E. Fritsch. 1927. A treatise on the British fresh-water algae. Second edition. Cambridge Univ. Press, London. 534 pp.

West, W. and G. S. West. 1904-1912. A monograph of the British Desmidiaceae. Vol 1-4. Ray Society, London.

——— ; West, G. S. and N. Carter. 1923. A monograph of the British Desmidiaceae. Vol. 5. Ray Society, London.

Wolle, F. 1887. Fresh-water algae of the United States. The Comenius Press, Bethlehem, Pa. 364 pp.

——— 1890. Diatomaceae of North America. The Comenius Press, Bethlehem, Pa. 112 pp.

——— 1892. Desmids of the United States and list of American Pediastrums. Moravian Publication Office, Bethlehem, Pa. 182 pp.

Wood, R. D. 1952. The Characeae, 1951. The botan. review, 18(5): 317-353.

Woods, Albert F. 1894. Part II. Coleochaetaceae, Characeae. In: Flora of Nebraska, 1:117-128. Univ. of Nebraska, Lincoln.

PLATE 1

PLATE 1

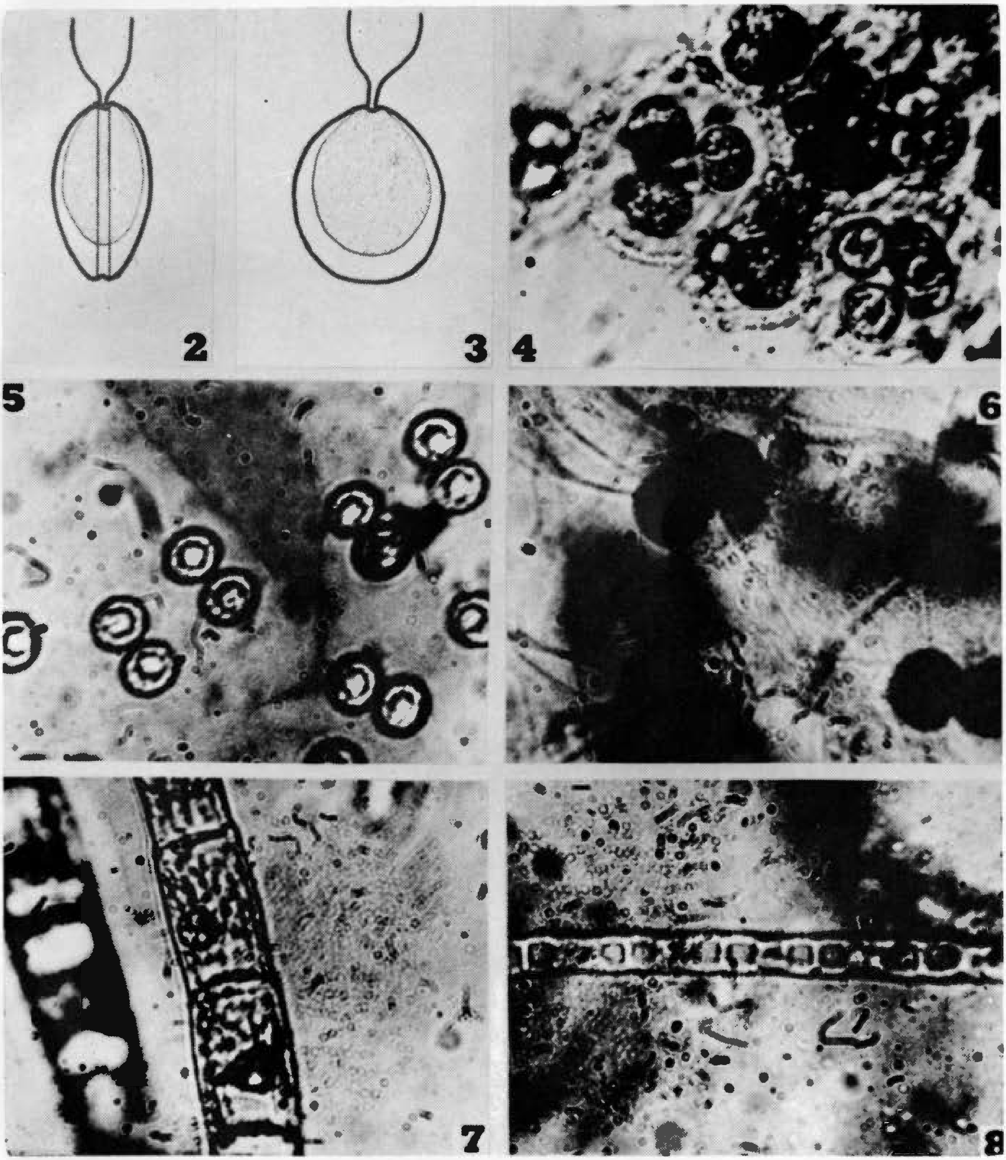


PLATE 2

PLATE 2

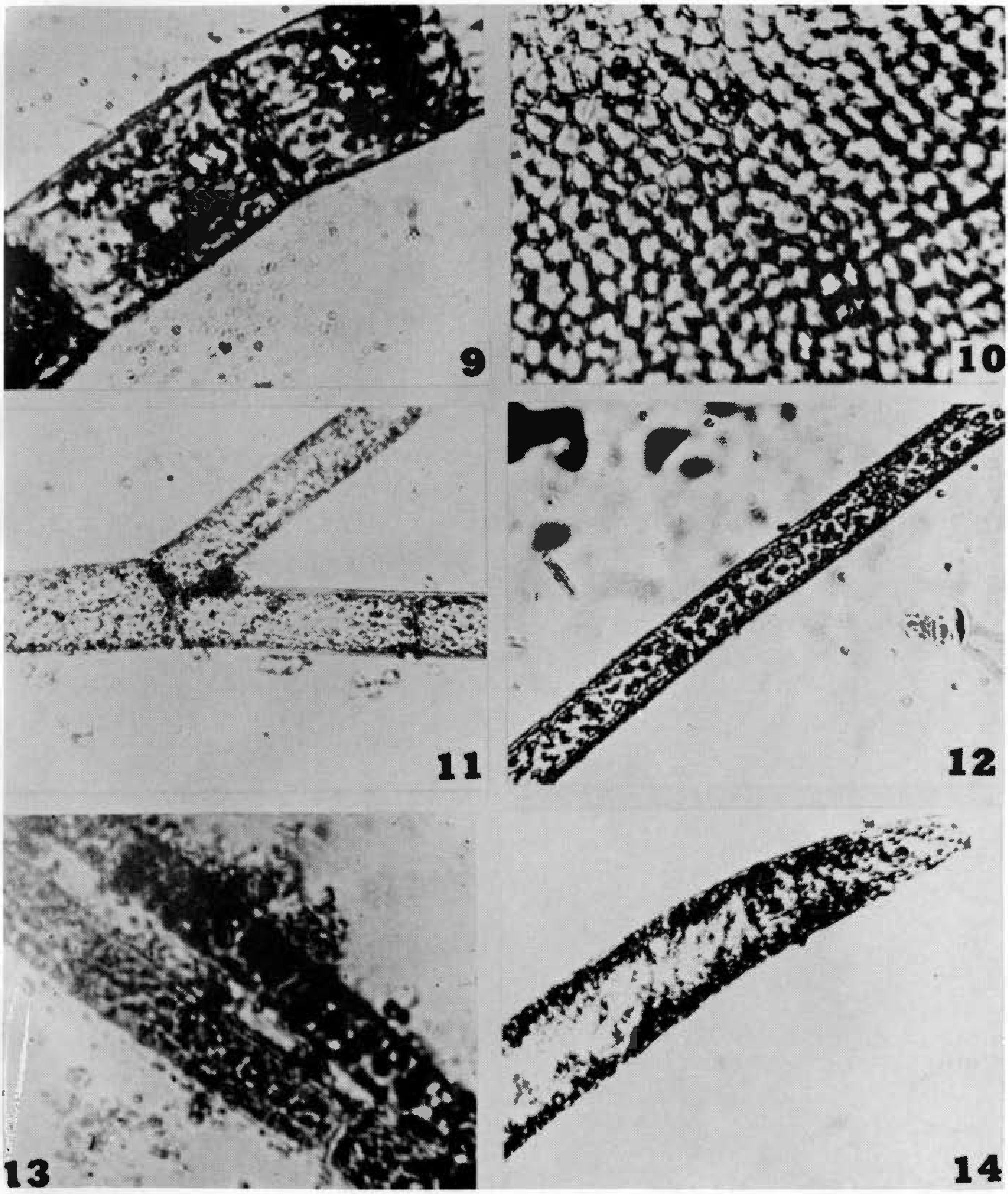


PLATE 3

PLATE 3

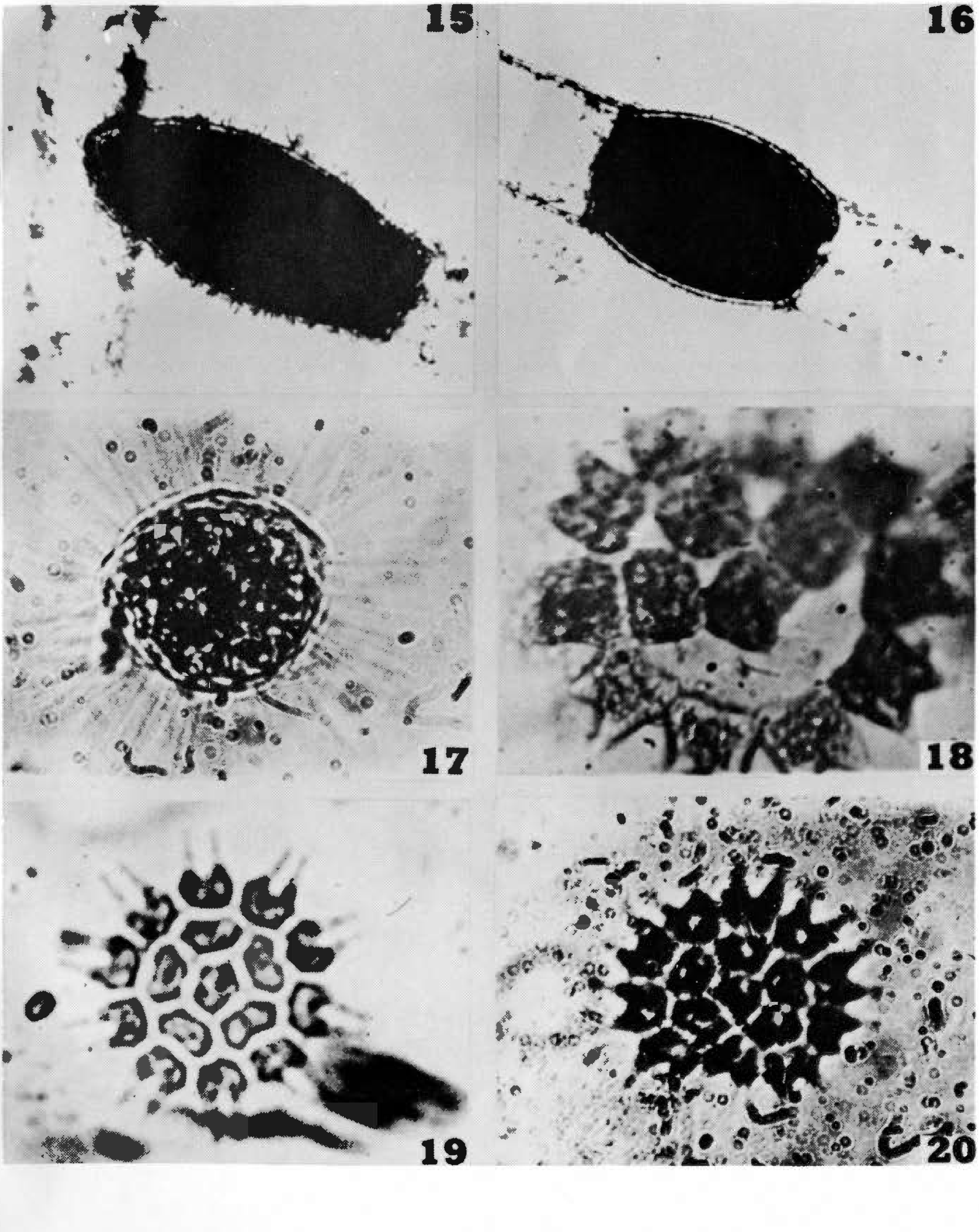


PLATE 4

FIGS.		PAGE
21.	*Pediastrum boryanum* var. *longicorne.* Coenobium is a flat plate with two knobbed projections extending from the marginal cells that are extra long and often crooked.	18
22.	*Hydrodictyon reticulum.* The meshes of the net are 3–6 sided.	19
23.	*Ankistrodesmus falcatus.* These non-motile cells are fusiform with acute apices. Drawing.	19
24.	*Scenedesmus opoliensis* var. *mononensis.* Colony of four cells showing the very long spines and longer terminal cells (compared to the median cells) characteristic of this variety.	20
25.	*Scenedesmus abundans.* The coenobia of two to four cells in series is a flat plate with several spines on each terminal cell and a lesser number on the median cells.	20
26.	*Scenedesmus dimorphus.* Colony of four cells with pointed apices.	21

PLATE 4

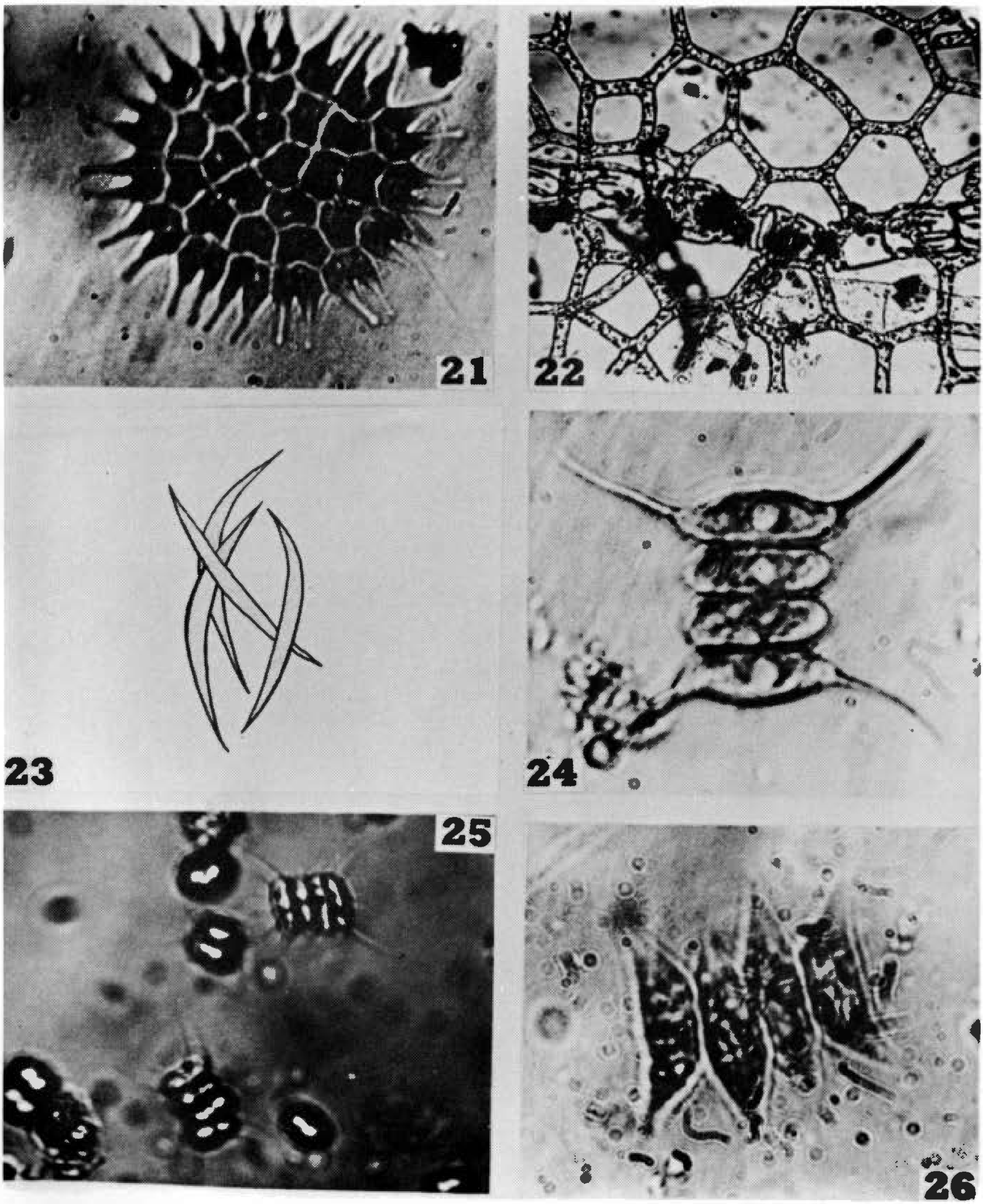


PLATE 5

PLATE 5

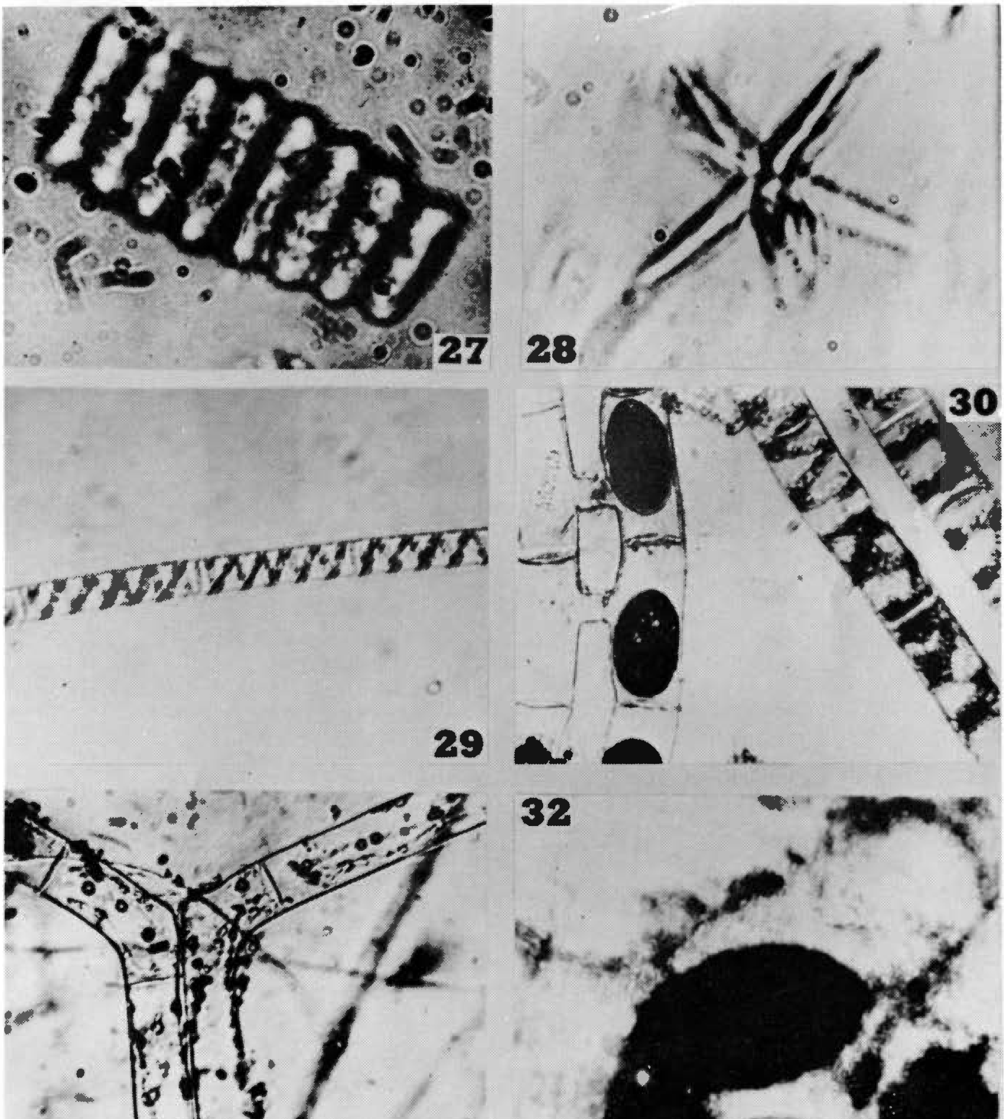


PLATE 6

Figs.		Page
33.	*Sirogonium floridanum.* Cells of a vegetative filament have plane end walls and chromatophores making about ½ turn within the cell. . . .	23
34, 35.	*Sirogonium sticticum.* Zygotes shown within inflated cells. The linear chloroplasts make only about ½ turn within the cell. Median wall of zygote yellow.	23
36.	*Closterium acutum* var. *linea.* Cells with 4 or 5 pyrenoids unevenly spaced within each semicell together with a terminal vacuole and acutely rounded apices.	24
37.	*Closterium acerosum.* A slightly curved cell which has ridged chromatophores and terminal vacuoles.	24
38.	*Closterium moniliferum.* This is a curved cell which has 4–9 pyrenoids within each semicell and ridged chromatophores.	25
39.	*Closterium lanceolatum.* The cells are moon shaped with a moderate curve and have 5–7 pyrenoids per semicell.	26
40.	*Closterium incurvum.* A moon shaped cell which has two pyrenoids and one chloroplast in each semicell.	26

PLATE 6

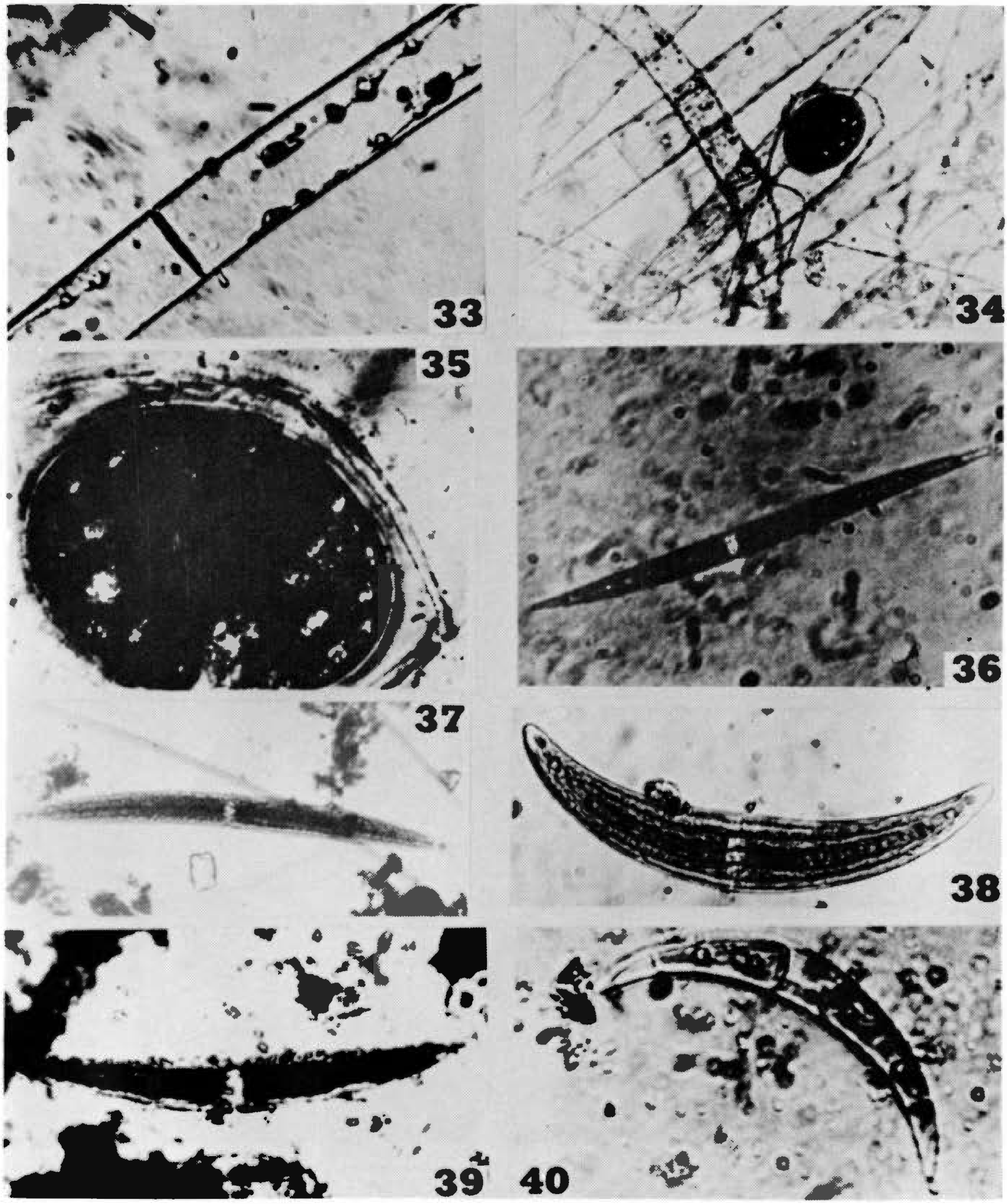


PLATE 7

Figs.		Page
41.	*Chara braunii.* The stems are uncorticated and the oogonium is distal to the spherical antheridium. The oogonium shows 8–10 spirals and there are five cells in the crown	27
42, 43.	*Euglena elastica.* The spindle shaped, very metabolic cells have single flagellum present at the anterior end and a red eyespot is near the base of the visible flagellum. The dark broadly oval cells in fig. 42 are *Trachlemonas hispida*	27
44.	*Phacus pyrum.* The periplast is spirally ribbed with a straight finely pointed caudus	28
45.	*Phacus acuminata.* The oval cell has a unicinate posterior spine, longitudinal striations and discoid chloroplasts	28
46.	*Phacus longicauda.* The cell is ovoid with long tapering caudus, stigma, one large paramylum body, longitudinal striations, discoid chloroplasts and it is not metabolic	29

PLATE 7

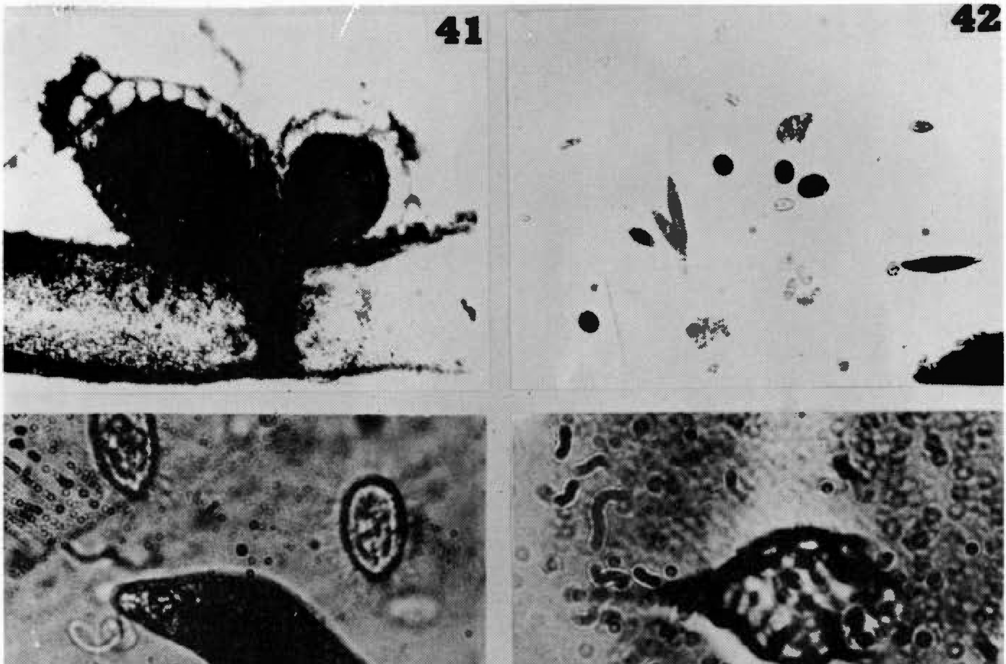


PLATE 8

Figs.		Page
47.	*Phacus pleuronectes.* This broadly ovoid cell has a short uncinate posterior spine, longitudinal striations, one large paramylon body near the posterior end and a red eyespot near the anterior end.	29
48.	*Trachelomonas hispida.* This species has an enlarged red or brown test or lorica enclosing the living amoeboid protoplast	30
49, 50,	*Vaucheria sessilis.* The oogonia are sessile on the filament with one antheridium between them and vegetative filaments (Fig. 50) are coenocytic, sparingly branched, multinucleate and velvety, forming tufted mats.	30
51.	*Melosira varians.* This Centrales filamentous diatom has cylindrical cells. Girdle view shown, would appear round in valve view.	31
52.	*Cyclotella striata.* Valve view showing striations.	32

PLATE 8

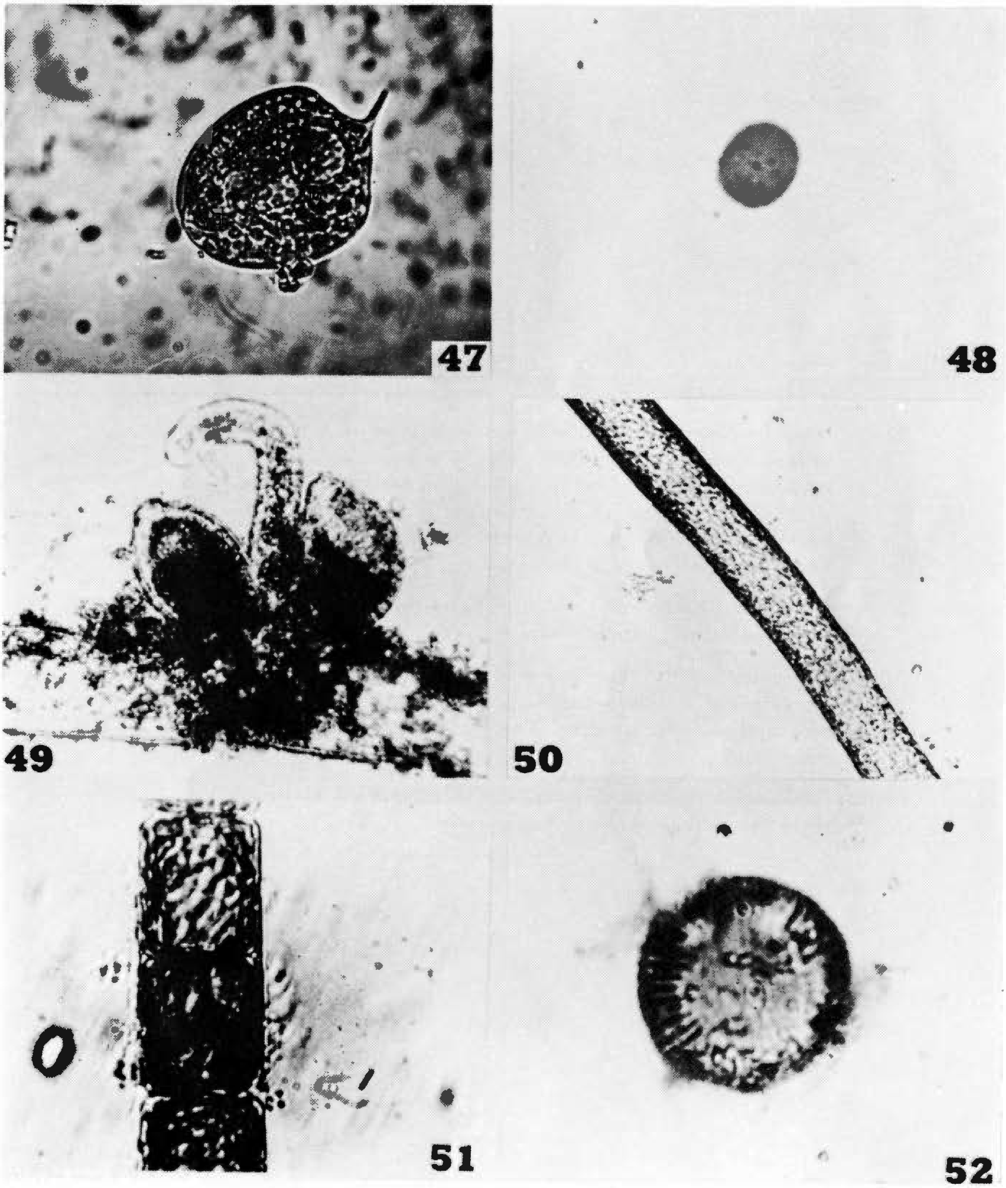


PLATE 9

Figs.		Page
53.	*Synedra ulna.* Girdle view, shows broadened extremities, frustule markings and chloroplasts	32
54, 55.	*Navicula cuspidata.* Cell is rhombolanceolate tapering to rounded ends in valve view of Fig. 54. Fig. 55 enlarged valve view showing transverse striations; food reserves shown are usually in the form of oil droplets and volutin. The cells may or may not be highly colored having the green pigments masked by diatomin, a brown pigment which modifies the chlorophyll	33
56.	*Navicula cuspidata* var. *ambigua.* Valve broadly lanceolate with rostrate and slightly capitate ends	34
57, 58.	*Pinnularia viridis.* Valve view in fig. 57 showing rounded ends and costae plainly visible while in girdle view of fig. 58 shows truncate ends and rounded corners. The golden-brown chloroplast fills the cell	34
59.	*Pleurosigma delicatulum.* Sigmoid in valve view as pictured with plate-like chromatophores next to girdle	35

PLATE 9

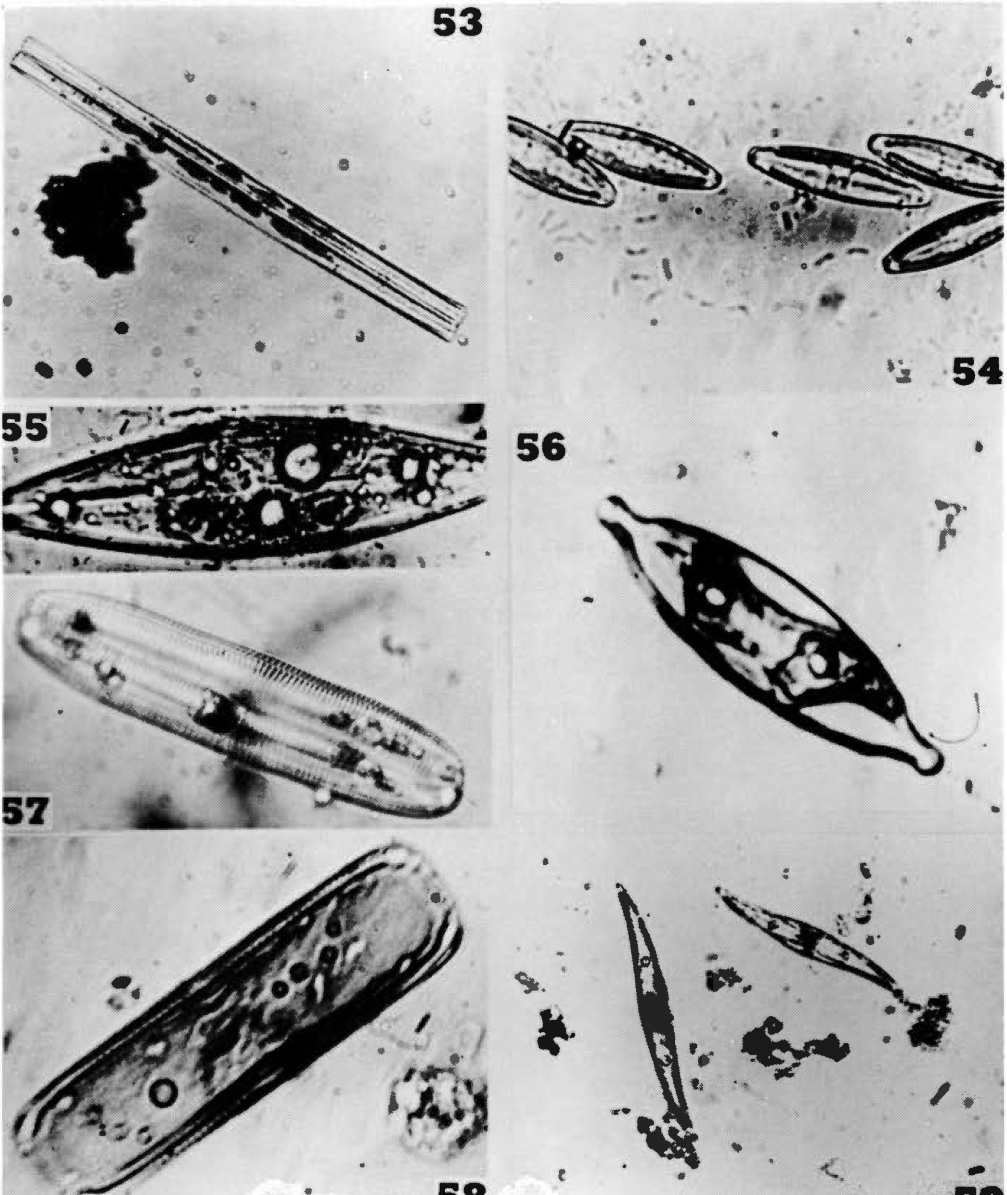


PLATE 10

FIGS.		PAGE
60, 61.	*Amphiprora alata.* Figures showing girdle view with hourglass appearance with cell of fig. 61 in the process of division.	35
62.	*Gomphonema olivaceum.* Pictured are clavate cells in girdle view with broad apex and narrow base (sometimes attached with stalks).	36
63, 64.	*Bacillaria paradoxa.* Valve view showing linear cells organized into a stratum within which the cells rest side by side (Fig. 63) or may slide past each other (Fig. 64) to form long chains which then condense back into a flat plate.	36
65.	*Nitzschia reversa.* The lanceolate cells have apices bent in opposite directions in this valve view.	37

PLATE 10

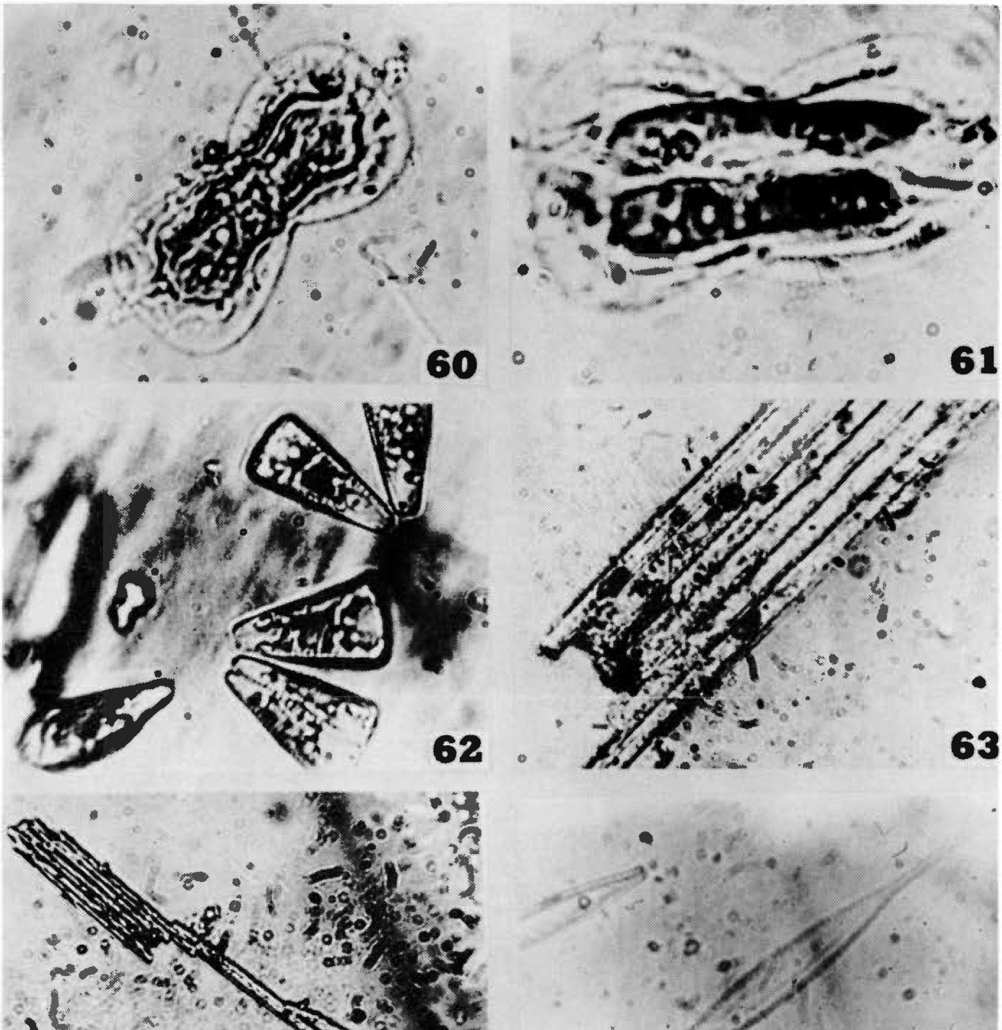


PLATE 11

FIGS. PAGE

66. *Surirella ovalis.* The broadly ovate frustule has short marginal costae perpendicular to the margin of the cell and a consolidated plate like chloroplast. Valve view shown. 38

67. *Gloeothece rupestris.* The cells are oviod-cylindrical forming a colony of irregular shape being held together by a gelatinous matrix. 38

68. *Spirulina major.* The spiral trichome is without cross walls and very long. 39

69. *Oscillatoria limosa.* This species is a decided blue green becoming brown with age. The trichome does not taper and the apical cell is rotund. The cross walls are evident and the cells are granular. 40

70. *Oscillatoria tenuis.* The trichome is slightly flexuous at the anterior end but not capitate or tapering. 41

71. *Lyngbya versicolor.* The cells are not constricted at the cross walls and filaments unbranched. The end of the trichome is rounded. 41

PLATE 11

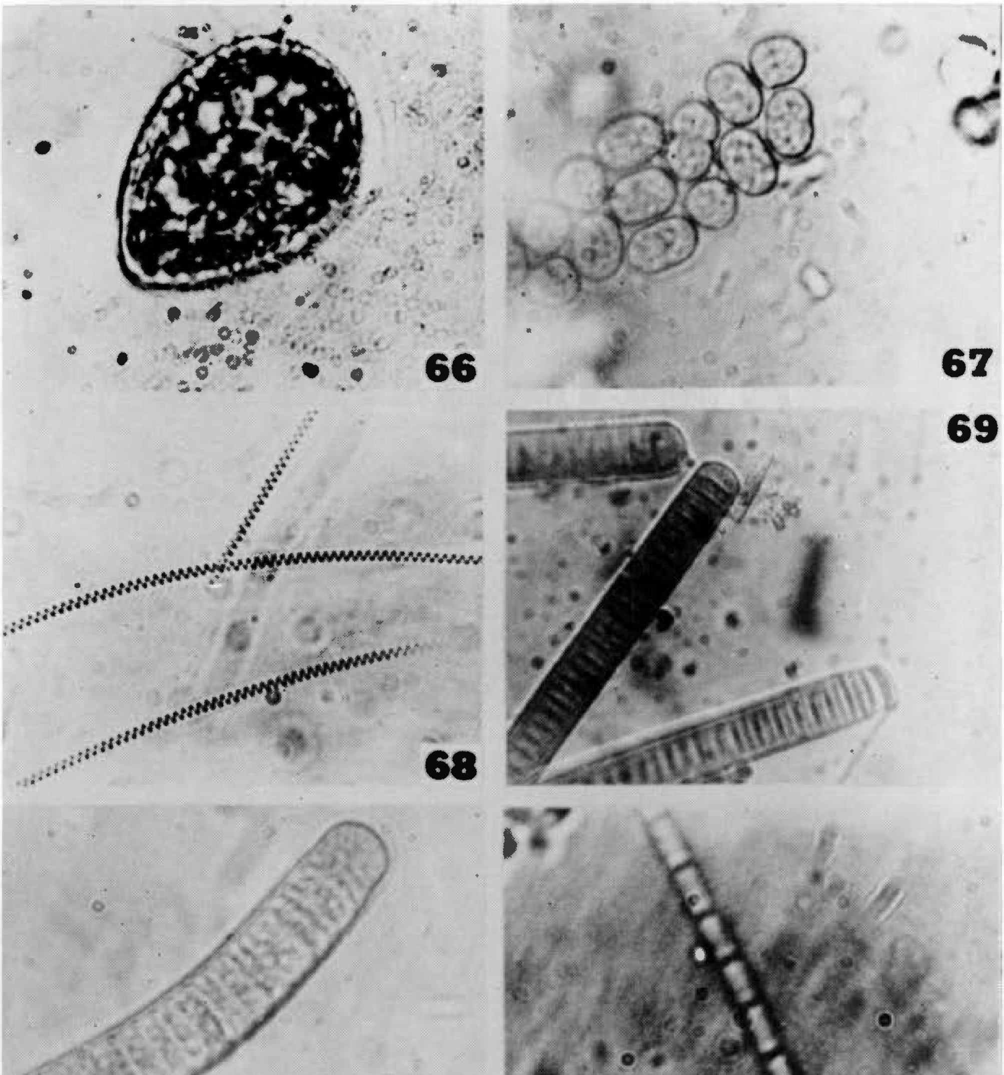
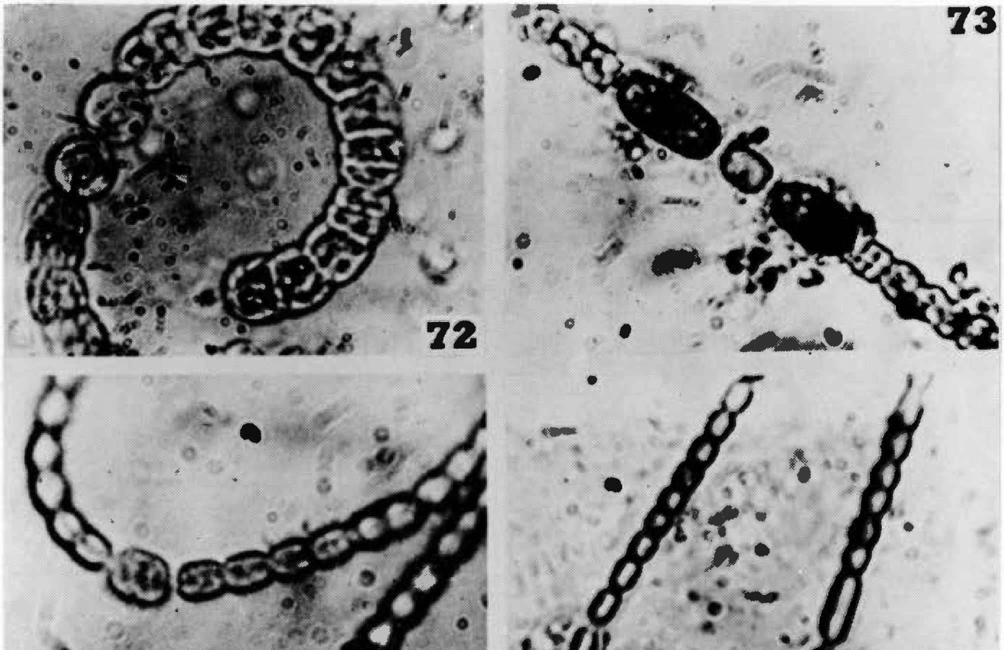


PLATE 12

FIGS.		PAGE
72.	*Anabaena helicoidea.* The trichome is spirally twisted............	42
73.	*Anabaena oscillarioides.* The akinetes appear on each side of the heterocyst flanked by the barrel shaped vegetative cells...........	42
74.	*Nostoc linckia.* The flexuous trichomes have cells which are granular and globose, sub-globose or barrel shaped.......................	43
75.	*Cylindrospermum majus.* The vegetative cells are quadrate and constricted at the cross walls while the akinetes are adjacent to the terminal heterocysts...	44
76, 77.	*Gloeotrichia natans.* Shown in Fig. 76 are attenuated trichomes with terminal heterocysts but akinetes have not yet developed in this picture. The trichomes radiate throughout the parent colony imbedded within a clear jelly like matrix. The heterocyst is located at the broad end of the attenuated trichome and next to it is the akinete. Note the sheath coming from the heterocyst in fig. 77............	44

PLATE 12



Index and Glossary

Entermorpha
intestinalis, 5, 7, 14, 52.
Entire: not toothed or rough, but smooth.
Epiphytic: growing on a plant but not parasitic.
Epitheca: the larger, older half of the frustule of a diatom cell.
Epizoic: attached or growing on animals but not parasitic.
Euglena 4, 8, 27.
elastica, 27, 62.
Euglenales, 8.
Euglenoid: metabolic and flagellated like *Euglena.*
Euglenophyceae, 8.
Euglenophyta: a division of algae having euglenoid movement and flagellum for locomotion, 14, 64.
Euplankton: floating, open water plankton.
Eutropic: pertaining to older lakes which are productive of organisms becoming more shallow as sediment fills the lake.
Fenestrate: with openings or windows.
Filamentous: a linear arrangements of cells to form a thread of algae, etc.
Fish, 3.
Flagella: stout, long and whip-like organelles, usually few in number (1-3 or more) extending from the pellicle of protista.
Flexuous: capable of bending; not rigid.
Fragilariaceae, 9, 32.
Frond: a leaf like thallus.
Fruitification: organ producing gametes.
Frustule: the shell of a diatom, 4.
Fusiform: an elongate body broad in the middle tapering towards the ends.
Gametangia: organ producing sex cells.
Gamete: a sex cell; an egg or sperm.
Girdle: a band or belt in diatoms, *Closterium* and other algae usually median forming a tranverse band across or around the cell.
Girdle view: a lateral or side view of a diatom showing an overlapping of the two wall sections of the frustule, 4.
Globose: globe shaped.
Gloeocystis 5.
gigas, 7, 11, 50.
Gloeothece 4, 5.
rupestris, 5, 9, 38, 70.
Gloeotrichia 5, 10, 44, 72.
natans, 44, 72.
Glomerate: existing as compact clusters.
Golenkinia 4, 5.
radiata, 5, 16, 54.
Gomphonema
olivaceum, 9, 36, 68.
Gomphonemataceae, 9, 36.
Gonidia: asexual reproductive cells found in certain blue-green algae.
Granular: composed of or like grains.
Granulate: roughened with grains or granules.
Great Bend, 2.
Gyrosigma
delicatulum, 9, 35.
Habitat: place where an organism lives.
Hapteron: a finger like anchoring organ.
Heizer, 2.
Heterocyst: a specialized cell in Myxophyceae larger than the regular vegetative cells useful in forming hormogonia as it disintegrates.
Heterogametes: gametes that are unlike in shape, activity or size which will unite to form a zygote.
Heterosiphonales, 9.
Heterothallic: from two different thalli, the reproductive cells being borne on different plants.
Hirsute: with hairs, pubescent.
Holdfast: the basal cell of a filament modified for anchoring the plant.
Homoeocladia
paxillifer, 36.
Hormogonia: short chains of cells in Myxophyceae that grow into new trichomes.
Hyaline: clear and transparent or colorless.
Hydrodictyaceae, 17.
Hydrodictyon 5.
reticulatum, 8, 19, 56, 108.
Hypotheca: the smaller, younger half of the frustule of a diatom cell.
Incised: cut in from the margin.
Intercalary: appearing between cells.
Internode: the area on a stem between two nodes.

Isogametes: gametes or sex cells that are alike in size, activity or shape which will unite forming a zygote.
Isopolar: with poles of a cell equal or alike on each end.
Isthmus: a constricted area; between the two halves or semicells of desmids.
Keel: a projecting ridge found on the frustule of diatoms.

Lamellated: composed of layers or plates.
Lamellose: with layers.
Lanceolate: lance-shaped with subparallel sides but tapering towards the apex.
Lateral conjugation: the union of the contents of two contiguous cells within a filament.

Lorica: a test or shell around the living protoplasm as in *Trachelomonas*.
Lubricous: slippery.
Lunate: crescent-shaped like a new moon.

Macroscopic: visible to the unaided eye.
Matrix: investing materials, especially mucilaginous material surrounding a colony of cells or an individual cell.

Metabolic: capable of changing shape.
Metachromatin: granular inclusions in algae, probably identical to volutin.

Micron: a thousandth part of a millimeter.
Microspores: small spores formed by repeated divisions of the cell content before liberation as in some diatoms.
Monoecious: male and female organs present within the same plant.
Monostromatic: a prostrate thallus one cell in thickness.
Mucous: watery and slippery.

Naviculoid: shaped like the diatoms in genus *Navicula* or boat shaped.

Node: the raised area on a stem from which the leaves or branches originate.
Nodule: a knob.
Non-motile: not capable of movement.

Oblique: slanting, neither upright or horizontal.
Obtuse: blunt.

Oogonium: a structure giving rise to an egg or eggs.

Oval: ovate; broadly elliptical with equally rounded poles.
Ovate: oval.
Ovoid: shaped like an egg.

Papilla: a nipple-like extention.
Paramylum: a carbohydrate food reserve found in euglenoids.
Parietal: lying on the periphery or near the outside of a cell.
Pectose: a gelatinous substance found in the cell walls of diatoms or other algae.

Pedicel: a stalk.

Pelagic: living at or near the surface.
Pennales: an Order of diatoms having elongate valves, 4. 9, 30.
Perforate: pierced with holes.
Periplast: the covering or peripheria part of the cell, especially euglenoids (*Euglena*, etc.).
Phacotaceae, 7, 11.
Phacotus
  lenticularis, 4, 10, 50.
Phacus 4
  acuminata, 8, 28, 62.
  longicauda, 8, 29, 62.
  pleuronectes, 8, 29, 64.
  pyrum, 8, 28, 62.
  torta, 8, 29.
  tortus, 29.
Phytoplankton: free floating plants.
Pigment: a substance which imparts color.
Pinnularia 4.
  viridis, 9, 34, 66.
Pithophora 5.
  varia, 7, 16, 52, 54.
Plankton: floating or drifting small organisms.
Pleurosigma 4.
  delicatulum, 9, 35, 66.
Polar nodules: enlarged spaces in the terminals of the raphe of diatoms appearing as highly refractive areas.
Polygonal: many sided in shape.
Pools.
  size, 2, 3.
  location, 2, 3.
Posterior: tail end.
Protoplasm: the physical basis of life or the living material of the cell.
Proximal: nearer the center or midline; opposite of distal.
Pseudocilia: false cilia not used for locomotion.
Pseudoraphe: a clear area in a diatom which resembles a raphe.
Pseudovacuoles: false vacuoles; small spaces filled with gas or liquids which appear red; causing buoyancy to create water bloom in "blue green" algae.
Punctae: small pores, points or depressions in diatoms or other algae; spaced close together they appear as striations.
Punctate: having punctae.
Pyrenoid: a protein body within a chloroplast which collects and holds starch.
Pyriform: pear-shaped.
Quadrate: square or rectangular.
Radial symmetry: regular disposition of parts about a common center such as a pie cut from the center to the outer edge with each part similar.
Raphe: a narrow slit in the valve of many Pennales diatoms connecting with the central pores and polar nodules, visible on the valve side as a line.
Reticulate: like a net, having meshes.
Reticulum: a network or arranged in a network.
Rhizoclonium 5.
  hieroglyphicum, 7, 15, 52.
Rhizoidal: root like.
Rhombo-lanceolate: an elongated oblique angled shape with rounded ends, adjacent sides not parallel.
Rivularia 44.
  natans, 44, 72.
Rivulariaceae, 10, 44.
Rostrate: having a beak.
Rotund: plumply rounded.
Scenedesmaceae, 8, 20.
Scenedesmus 5, 10.
  abundans, 8, 20, 56.
  acuminatus var. *minor*, 8, 21.
  bijuga, 8, 21, 58.
  dimorphus, 8, 21, 56.
  opoliensis var. *mononensis*, 8, 20, 56.
Schroederia
  judayi, 7, 17.
Sclariform: having conjugation tubes connecting two filaments; ladder like.
Semicell: one-half a desmid cell.
Sessile: attached directly with no stalk.
Setae: stiff hairs or tails on certain protista.
Sheath: a covering which may be a thin membrane or a mucilagenous secretion of the cell.
Sigmoid: like the letter S in shape.
Silica: silicon dioxide.
Silicified: composed of silica (silicon dioxide).
Siphonaceous: tubular in form with no cross walls.
Sirogonium 5.
  floridanum, 23, 58, 60.
  sticticum, 23, 60.
Spindal shaped: fusiform.

Stagnant: foul due to decay.
Stigma: a red colored light-sensitive spot found in flagellates and other unicellular organisms.
Stipitate: having a stalk.
Striae: lines of very fine punctae in diatoms; fine lines or ridges.
Striate: with lines or layers.
Striation: a line or layer.
Subcylindrical: not quite cylindrical with laterial sides mostly parallel except near the ends.
Subglobose: not quite a globe in shape.
Substratum: an under layer such as rock or earth.
Sulcus: a groove or depression.
Superior: high in position as for example the pores in the walls of the oogonia of Vaucheriaceae and certain Oedogoniales.

Terminal vacuole: a space in the cytoplasm near the end of a *Closterium* cell filled with granules of gypsum which are in motion.
Test: a lorica.

Thallus: the body of an alga.

Trichome: a thread of cells without a sheath in Myxophyceae.
Truncate: flat or flatly rounded at the terminals.
Tumid: swollen.

Tychoplankton: floating or free living organisms in shallow water near shore usually intermingled with other organisms.

Uncorticated: no layer of cells outside.
Undulate: wave like, with a wavy margin.
Unicinate: with a hooked tip.
Valve: one of the two parts of a diatom shell.
Valve view: a view of a diatom shell from the bottom or the top on the broader surface of the valve.

Vegetative: more concerned with growth and nutrition than reproduction.
Volutin: cellular inclusions which are so-called metachromatin granules straining easily with nuclear stains.

Water bloom: masses of algae floating at or near the surface of water forming a profuse mat; common with "blue-green and green" algae.

Whorled: spiral designed.

Xanthophyll: a yellow pigment often associated with chlorophyll.
Zonate: with bands or concentric layers.
Zoospore: a motile spore.

Zygospore: a resting spore formed by the union of gametes.
Zygote: fertilized egg or a cell resulting from the union of gametes.

30-2680