THE ALGAE OF MCKINNEY MARSH

A Thesis

Submitted to

the Division of Biology

Emporia State University, Emporia, Kansas

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

---

by

Don D. Seaton

December 1977

AN ABSTRACT OF THE THESIS OF

Don D. Seaton for the Master of Science

in Biology presented on December, 1977

Title: The Algae of McKinney Marsh

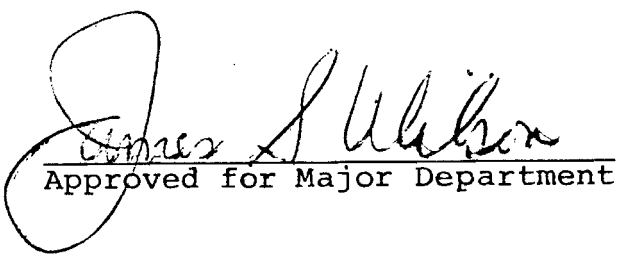
Abstract approved:

A total of 58 species of algae were collected from McKinney Marsh during the study period. These made up 4 phyla, 12 orders, 23 families, and 42 genera. Of the 58 species found, 17 were reported new to the state.

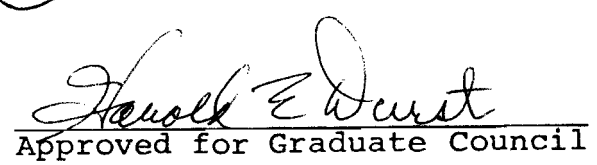
Annual precipitation patterns differed from those of the past five years. With rainfall 8 inches below normal by August, the Marsh dried and remained dry for the rest of the year.

Selected physiocochemical factors (pH, dissolved oxygen, and water temperature) were measured weekly. Of these pH is believed to be the most important in determining what groups of algae were present.

Certain expected patterns of seasonal periodicity were observed. The Marsh was dominated by the Chlorophyta and Euglenophyta, and to a lesser extent by the Chrysophyta; the anticipated development of a large blue-green population in late summer was not found due to the drying of the Marsh.



Approved for Major Department



Approved for Graduate Council

ACKNOWLEDGMENTS

I wish to thank Dr. James S. Wilson for his advice and constructive criticism during the course of this study. I would also like to express appreciation to Drs. John Ransom and Robert Boles for serving on my committee. For his help in verification of the algae I wish to thank Dr. Rufus H. Thompson at the University of Kansas. In addition, I want to thank fellow researcher Steve Cringan for the use of the map of McKinney Marsh. I also want to express my appreciation to Mr. J. C. McKinney, owner, for the preservation of a unique and interesting habitat.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Several studies have been done in the past on algal populations from various habitats in Kansas. In all, 392 species of algae have been reported. Thompson (1938) reported 211 new species from a variety of habitats in eastern Kansas. The latest one by Reinke (1975) described 54 new species from a salt marsh. Other additions have come from Bailey (1932), McNaught (1920), Smyth (1891), and Wujek (1965). Mentzer (1940) described 30 species for Lyon county, mostly from ponds and the Cottonwood River. Since Kansas has few marshy areas of any size, most comparable collections have been from semi-permanent pools, ditches, and ox-bow lakes. No studies have been made on a freshwater habitat such as occurs at McKinney Marsh.

McKinney Marsh lies in the southeastern part of Lyon county approximately 1km west and 3km south of Neosho Rapids, Kansas (Fig. 1). It is adjacent to the western side of the Flint Hills National Wildlife Refuge, which surrounds John Redmond Reservoir in the flood plain of the Grand (Neosho) River.

The marsh substrate is composed of a heavy sediment of mud and detritus, while being surrounded by gravel pits from past dredging operations. This variation in soil type allows for a large and varied plant community in and around

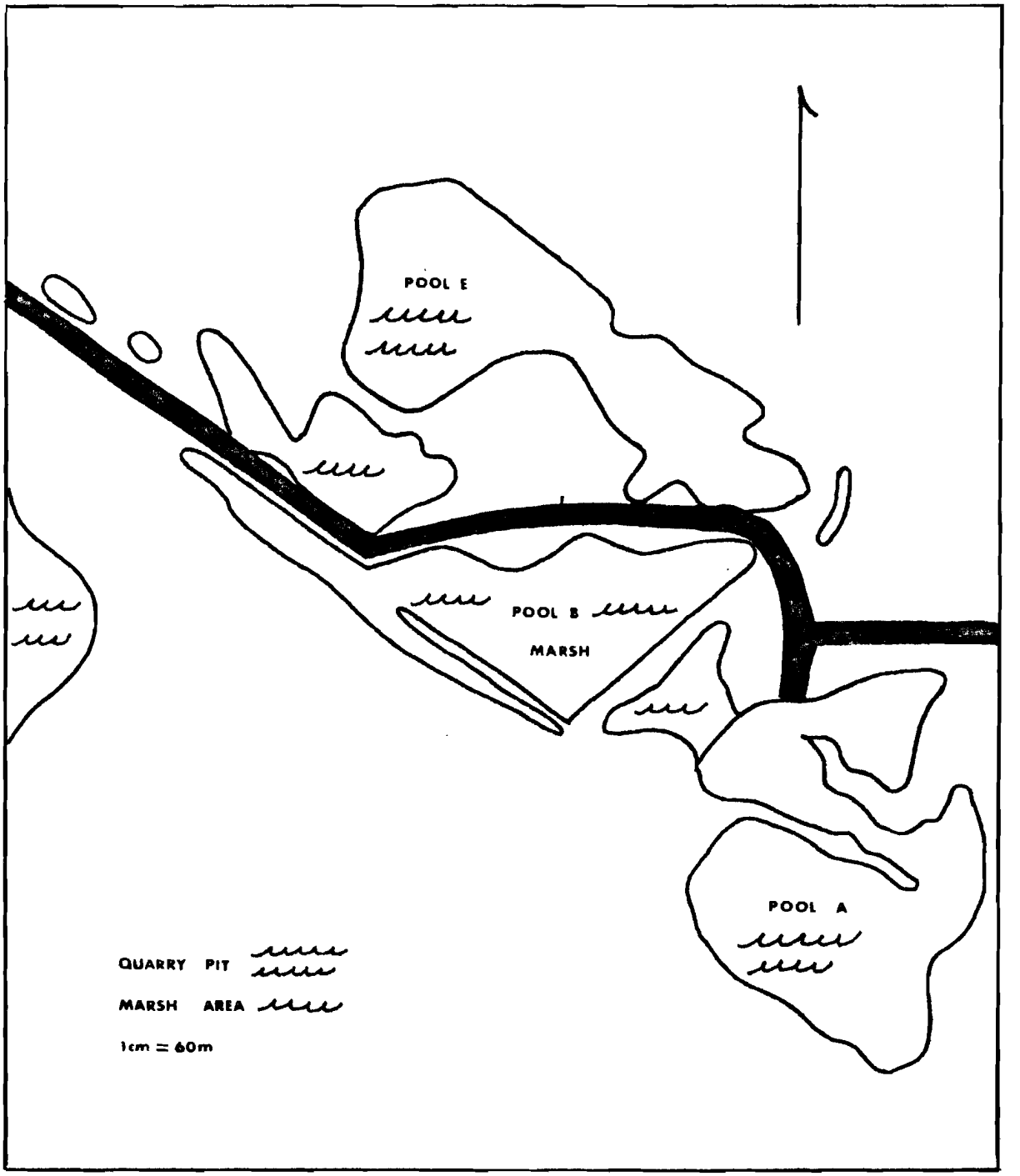


Figure 1. Map of McKinney Marsh

the Marsh. The area provides habitat for blackbirds, ducks, and a variety of shorebirds. Several species of fishes have been observed with Mosquitofish (Gambusia affinis), Channel Catfish (Ictalurus punctatus), Yellow Bullhead (Ictalurus natalis), Carp (Cyprinus carpio) being most abundant. The purpose of this study was to construct a species list of the algae of McKinney Marsh and to observe any changes in the algal populations that might be related to pH, dissolved oxygen, and water temperature.

METHODS AND MATERIALS

Algal samples were taken at McKinney Marsh from March to December, 1976. Weekly, random samples were collected by squeezing water from algal mats and floating aquatic plants into water bottles, by removing epiphytes from leaves, stems, detritus, and by tow-net samples, the latter of which were of little value due to the dense stands of aquatic vegetation.

Samples were transported to the University using wide-mouthed plastic jugs and were then transferred to aquaria in the laboratory. All identifications were made using live specimens. Photomicrographs were taken as vouchers using a Kodak Pony 35 mm camera on a Bausch & Lomb Dynazoom microscope.

Generic determination of the algae were made using Smith's Freshwater Algae of the United States (1950), Prescott's Algae of the Western Great Lakes Area (1962), and his How to Know the Freshwater Algae (1970). Sources used for species identification were Prescott et al. (1962), A Synopsis of the North American Desmids (1975), Johnson (1944), Euglena of Iowa, Tiffany and Britton (1952), Algae of Illinois, Allegre and Johnson (1943), A survey of the genus Phacus (Protozoan, Euglenoidina), and Desikachary (1959), Cyanophyta.

Dissolved oxygen, pH, and water temperature were taken weekly. Water temperature and dissolved oxygen were recorded with a YSI oxygen meter and pH was taken with a Beckman pH meter.

RESULTS AND DISCUSSION

A total of 58 species of algae was collected from McKinney Marsh during the study period. Included were four phyla, 12 orders, 23 families, and 42 genera. Of these 58 species, 17 were reported as new to the state (Table I). Plates of species found and a key to the genera, both present and expected at the Marsh, were made (see Appendix).

Amounts of precipitation differed considerably from that of the last five years (Table II). By the end of March, 1976, the Marsh was reduced to a few isolated pools and channels and it was not until the spring rains came in April, May, and June that it was filled. It was again dry by late August having received runoff from only 2.40 inches of summer rain. At that time the Lyon county area was already approximately eight inches below normal rainfall. The Marsh remained dry for the rest of the year as only five more inches of precipitation occurred.

Many factors can affect growth, reproduction, and periodicity of algal populations. Such factors as light, dissolved oxygen, pH, water temperature and dissolved nutrients, including trace elements, can play a role. Variations in pH, dissolved oxygen, and water temperature were recorded on each weekly trip to the Marsh.

Table I. Algal species reported as new to Kansas from McKinney Marsh.

Species
Anabena oscillarioides
Ankistrodesmus spiralis
Coleochaete orbicularis
Cylindrospermum musicola
Euglena cyclopicola
Euglena oxyuris
Lagerheimia ciliata
Pediastrum simplex var. *duodenarium*
Phacus monilata
Phacus torta
Polyedriopsis spinulosa
Scenedesmus acutiformis
Scenedesmus arcuatus
Sorastrum spinulosum
Stigeoclonium subsecundem
Ulothrix tenuissima
Zygnema pectinatum

Table II. Annual rainfall accumulations in Lyon county for the last five years. Average yearly rainfall is 33.14.

Year	Rainfall in inches
1971	42.32
1972	33.89
1973	63.32
1974	29.46
1975	32.90
1976	22.20

The pH value is believed to be a limiting factor in the relative abundance of certain groups of algae. At McKinney Marsh it ranged from 7.1 in early spring to 6.3 throughout the summer. Prescott (1962), using data from Michigan lakes, showed that with a pH above 7, numbers increased but kinds of species decreased. When below 7, species were numerous but populations low. In addition, he noted that acid lakes have by far a larger percentage of green algae and almost no blue-greens. Data from the present study tended to support Prescott's findings. With a pH below 7, many species were present and few large populations existed. In late spring when the pH was below 7, numerous (five or more) species of Scenedesmus, Pediastrum, Euglena, and Phacus were found. As expected, the green algae were more common than the blue-greens during the summer, although more blue-green populations might have occurred in late summer and fall, when they are normally more abundant, if water had been available.

Water temperature can play an important part of the periodicity of certain algae. At the Marsh it ranged from a low of 15 C in March to a high of 34 C in August. Smith (1952) observed the early development of certain algae in the spring was correlated with their capacity to grow vigorously at low temperatures. He also noted that physiological processes such as time of fruiting in various species of Spirogyra was modified by low temperature.

This may account for the fact that, although present during much of the study, the one identifiable species of Spirogyra in fruiting form occurred only in the summer months.

Oxygen can be a limiting factor for phytoplankton and other aquatic organisms. Dissolved oxygen levels at the Marsh ranged from 14.0 ppm in early spring to 0.0 ppm in late August. Prescott (1962) stated that when large growths of algae exist in shallow water, and oxygen supplies are low, the available supply of oxygen may be reduced below normal tolerance levels of aquatic life. He also found that by increasing or decreasing oxygen content, algae act as agents in determining the quality and kinds of animal life a body of water can support at different trophic levels. Cringan (1977) suggested that low oxygen content of the water at McKinney Marsh may have affected the survival rate of Odonates. Gaufin (1967) collected data which showed that dissolved oxygen concentration of 1-5 ppm could be lethel to many types of organisms. At the time when oxygen content was at 0.0 ppm, (in a large part due to shallow water and high water temperatures, along with rapid decomposition, and plant and animal respiration) few algal species at the Marsh were observed; but the ones that were found were abundant. It was also at that time that the blue-green species Anabena oscillarioides was found blooming. It is quite possible that low oxygen, along with eutrophic conditions and high water temperature, could have been favorable to this blue-green.

In general, the pattern of periodicity was similar to that of other studies. Smith (1952) stated that practically all studies on periodicity of the phytoplankton showed that there was a spring maximum in the fall, a late summer and early fall maximum of Cyanophyceae, and an early summer maximum of Chlorophyceae. In the early spring at the Marsh, there was a predominence of filamentous green algae such as Zygnema pectinatum, several unidentified Spirogyra spp., and the Chrysophyte Vaucheria sessilis. A diatom pulse was observed in the spring with Gomphonema sp., Fragilaria sp., Pinnularia sp., and Navicula sp., being the most common. At that time two desmids Closterium ehrenbergii var. ehrenbergii and Cosmarium sp. were also present in large numbers.

With the late spring rains and warming temperatures of early summer other species became abundant. Such tychoplankton forms as Scenedesmus quadricauda and Pediastrum tetras were commonly found and the former remained a dominant as long as there was water in the Marsh. In addition several Euglenophytes, Trachelomonas volvocina, Euglena viridis, and Phacus acuminata were high in number and remained so until the Marsh dried. With the rise in water temperature and the decrease of the water level of the summer period the Euglenophytes became the dominant motile forms. The common filamentous form of this period was Pithophora oedogonia, a thick mat-forming species which

remained abundant in the area until the Marsh was dry.

Blue-green algae were not abundant during the study. Cylindrospermum musicola was the first Cyanophycean form to appear during the early spring. In late July, Anabena oscillarioides was found in "bloom" conditions. Normally one would expect to find the blue-greens more dominant in late summer and early fall; however, this could not be observed as the Marsh was completely dry by late August.

The length of this study was designed to include the four seasons but drought conditions eliminated fall and winter collections. Lack of water from late March to late April may have eliminated, or shortened the appearance of some spring species. Considering the number of species collected during this abbreviated study and the richness of the habitat, another study including all seasons would probably provide many additions to this species list.

The following species described for McKinney Marsh uses the arrangement of Prescott's (1970) based on the taxonomic scheme of Bourrelly. Included is a short description of the species and whether it was abundant, common, or rare in occurrence at the Marsh. Some species show a wide diversity in size and appearance due to a variety of factors. Size ranges in micrometers are included for that reason; however, the ones in parentheses indicate the sizes of these species found at the Marsh.

Description of Species

PHYLUM CHLOROPHYTA

SUB-PHYLUM CHLOROPHYCEAE

Order Volvocales

Family Volvocaceae

Pandorina morum (Muell.) Bory

Colony ovate, composed of 8-16 cells, compactly arranged and enclosed by a common gelatinous envelope; chloroplast a parietal cup; flagella 2, arising from the anterior end of the envelope; colony as much as 220u in diameter; cells 10-15(15)u in diameter, 12-17(13)u long. Common.

Plate I, Number 1, x500.

Order Chlorococcales

Family Chlorococcaceae

Polyedriopsis spinulosa Schmidle

Unicellular, free-floating, tetragonal, the angles truncately rounded and furnished with a tuft of 6 long tapering setae; sides concave; chloroplast a parietal plate with 1 pyrenoid; cells 12-25(18)u in diameter; setae 40u long. Rare.

Plate I, Number 2, x500.

Family Palmellaceae

Sphaerocystis Schroeteri Chodat

Colony in the form of spherical clusters within the colonial envelope; chloroplast cup-shaped and covering most of the wall; 1 pyrenoid contained in the chloroplast; colony up to 500u in diameter; cells 6-20(16)u in diameter. Rare.

Plate I, Number 3, x1000.

Family Oocystaceae

Ankistrodesmus convolutus Corda

Cells solitary, fusiform in shape, twisted and sigmoid; apices sharply pointed and twisted in different directions; cells 3-4.5(3)u in diameter, 15-25(17)u long. Common.

Plate I, Number 4, x1000.

Ankistrodesmus falcatus (Corda) Ralfs

Cells needle-like, in clusters; chloroplasts 1, a parietal plate without pyrenoids; cells 2-6(3.5)u in diameter, 25-100(33)u long, sometimes longer. Rare.

Plate I, Number 5, x1000.

Ankistrodesmus falcatus var. mirabilis (West & West) G.S. West

Cells sigmoid, apices gradually tapering to fine points; cells solitary; cells 2-3u in diameter, as much as 150(15)u long. Common.

Plate II, Number 1, x1000.

Ankistrodesmus spiralis (Turner) Lemmermann

Cells spindle-shaped, spirally twisted into bundles of 4 cells; chloroplast a parietal plate without a pyrenoid; cells 2-3u in diameter, 25-35(27)u long. Rare.
Plate II, Number 2, x1000.

Lagerheimia ciliata (Lag.) Chodat

Cells oblong-ovate with 6 tapering setae at each pole; chloroplasts 4 with each having 1 pyrenoid; cells 6-18(6)u in diameter, 10-21(12)u long; setae 15-20u long. Rare.
Plate II, Number 3, x1000.

Kirchneriella contorta (Schmidle) Bohlin

Free-floating colonies; cells usually 16 twisted, arcuate with broad convex apices, lying irregularly scattered throughout the gelatinous envelope; chloroplast covering the entire cell wall; cells 1-2u in diameter, 5.8-14(6)u long. Rare.
Plate II, Number 4, x1000.

Selenastrum gracile Reinsch

Colonies of 8-64 sickle-shaped cells in irregular arrangement but with the convex surfaces apposed; apices of the cells sharply pointed; chloroplast a parietal plate without a pyrenoid; cells 3-5(3.6)u in diameter, 19-28(26)u between apices. Common.
Plate II, Number 5, x430.

Family Dictyosphaeriaceae

Dimorphococcus lunatus A. Braun

Cells in groups of 4 on the ends of fine, branched threads composed of the fragments of the mother cell wall; the two inner cells of the quartet ovate, the outer two cells cordate; chloroplast 1, a parietal plate nearly covering the cell wall; cells 4-15(6)u in diameter, 10-25(12)u long. Rare.

Plate II, Number 6, x1000.

Family Scenedesmaceae

Coelastrum microporum Naegeli in A. Braun

Coenobium spherical, composed of 8-64 sheathed globose cells; cells interconnected by a very short, scarcely discernible gelatinous processes, leaving small intercellular spaces; cells 8-20(14)u in diameter including the sheath. Common.

Plate II, Number 7, x600.

Coelastrum sphericum Naegeli

Coenobium ovoid; cells conical, the narrow end directed outward; cells adjoined without process along the lower lateral wall, forming interstices which are equal to or greater than the diameter of the cells; cells up to 25u in diameter. Common.

Plate II, Number 8, x1000.

Crucigenia rectangularis (A. Braun) Gay

Colony free-floating; consisting of ovate or oblong cells, very regularly arranged about a rectangularly central space in two pairs, with the apices adjoining; chloroplasts 1-4 parietal discs with 1 pyrenoid; cells 4-7(4)u in diameter, 5-10(10)u long. Common.
Plate III, Number 1, x1000.

Crucigenia tetrapedia (Kirch.) West & West

Colony free-floating; consisting of four triangular cells cruciately arranged about a minute central space; the outer free wall and lateral wall straight with angles acutely rounded; cells 4.5-9(4.5)u in diameter. Rare.
Plate III, Number 2, x600.

Scenedesmus acutiformis Schroeder

Colony arranged in a single series of 4 fusiform-elliptic cells sharply pointed; inner cells with a single facial longitudinal ridge, outer cells with 2-4 longitudinal ridges; cells 7-8(6)u in diameter, 16-22.5(19)u long. Rare.
Plate III, Number 3, x600.

Scenedesmus arcuatus Lemmermann

Colony a curved (usually double) series of 4-16 oblong-ovate individual cells with lateral walls in contact along 1/3 to 1/2 their length; cell wall without spines or teeth; poles of the cell wall broadly rounded; cells 4-8(7)u in diameter,10-15(12)u long. Rare.

late III, Number 4, x600.

cenedesmus bijuga (Turp.) Lagerheim

Colony composed of 2-8 cells in a single flat eries; cells ovate or oblong without teeth or spines; ells 4-8(5)u in diameter, 8-16(13)u long. Rare.
late III, Number 5, x600.

cenedesmus dimorphus (Turp.) Kuetzing

Colony composed of 4 fusiform cells arranged in a ingle series; the inner cells with straight, sharp apices, he outer cells lunate, strongly curved, with acute apices; ells 3-6(3.5)u in diameter, 16-22(19)u long. Rare.
late III, Number 6, x1000.

cenedesmus obliques (Turp.) Kuetzing

Colony composed of 4 fusiform cells arranged in a ingle series; apices of cells apiculate, walls smooth; ells 4.2-9(6)u in diameter, 16-28(24)u long. Common.
late III, Number 7, x600.

cenedesmus quadricauda (Turp.) deBrebisson

Colony consisting of 4 oblong-cylindric cells sually in a straight series; outer cells with a curved pine at each pole, inner cells without spines; cells -18(3.6)u in diameter, 9-35(12)u long. Abundant.
late III, Number 8, x600.

Scenedesmus quadricauda var. longispina (Chod.) G. M. Smith

Colony differing from the typical by the greater length of the spines; cells 3.5-5(3.5)u in diameter, 8-11(13) u long; spines 7.5-10(8)u long. Common.

Plate III, Number 9, x600.

Family Hydrodictyaceae

Pediastrum duplex Meyen

Colony 8-128 celled, walls smooth, with lens-shaped spaces between the inner cells, the outer margin concave and extended into 2 tapering, blunt-tipped processes; cells 15u in diameter. Common.

Plate III, Number 10, x500.

Pediastrum duplex var. calathram (A. Braun) Lagerheim

Colony with larger perforations than above; walls with deep emarginations; apices of lobes of peripheral cells truncate; cells 12-20(14)u in diameter. Common.

Plate III, Number 11, x500.

Pediastrum simplex var. duodenarium (Bailey) Rabenhorst

Colony perforate, with their inner margins concave; peripheral cells forming a stout process; cells 11-15(11)u in diameter, 27-28(27)u long. Rare.

Plate IV, Number 1, x500.

Pediastrum tetras (Ehrenb.) Ralfs

Colony entire; peripheral cells crenate, with a deep

incision in the outer free margin; their lateral margins adjoined along 2/3 of their length; cells 8-16(12)u in diameter. Common.

Plate IV, Number 2, x1000.

Pediastrum tetras var. tetraodon (Corda) Rabenhorst

Colony 4 cells, outer margins with deep incisions, the lobes extended into sharp, horn-like processes; cells 12-15(12)u in diameter, 16-18(18)u long. Common.

Plate IV, Number 3, x1000.

Sorastrum spinulosum Naegeli

Colony spherical, free-floating consisting of 4-32 rhomboidal, reniform, or broadly cuneate cells attached to a common center; outer free wall straight, with two short spines at each angle, 5.2u long; cells 8-20(10)u in diameter, 6-18(8)u long. Common.

Plate IV, Number 4, x600.

Order Ulotrichales

Family Ulotrichaceae

Ulothrix tenuissima (Weber & Weber) Kuetzing

Filament attached, usually long, composed of cylindrical cells that are shorter than wide; chloroplast a broad band encircling about 2/3 of the circumference of the cell, containing 2 pyrenoids; cells 16-20(17)u in diameter. Rare.

Plate IV, Number 5, a, x750; b, x1000.

Family Cylindrocapsaceae

Cylindrocapsa geminella Wolle

Filaments long, composed of ovate or oblong cells in lamellate mucilage; chloroplast 1 to each cell, a massive dense body containing a central pyrenoid; cells 12-18(16)u in diameter, 18-30(25)u long. Rare.

Plate IV, Number 6, x500.

Order Ulvales

Family Ulvaceae

Schizomeris Leiblleinii Kuetzing

Filaments stout, macroscopic, 50u wide in the multiserate upper portion of the frond; cells 17(15)u in diameter. Rare.

Plate V, Number 1, x600.

Order Chaetophorales

Family Chlorosarcinaceae

Stigeoclonium polymorphum (Franke) Hoering

Filaments short and sparsely branched arising from an extensive prostrate, pseudoparenchymous or monostromatic and radiating portion; upright branches ending in long tapering setae; cells quadrangular in the basal portion, cylindrical in the vertical branches; cells 4-10(6)u in diameter, 6-12(11)u long. Rare.

Plate V, Number 2, x750.

Stigeoclonium subsecundem Kuetzing

Filaments elongate and sparingly branched; the branches gradually tapering to fine points, alternate, and sometimes short; cells elongate and cylindric but with slight constrictions at the cross wall; cells 12-18(13)u in diameter and up to 75(62)u long. Abundant in early spring.
Plate V, Number 3, x350.

Family Coleochaetaceae

Coleochaete orbicularis Pringsheim

Thallus composed of regular, circular, monostromatic disc of branching filaments radiating from the center and adjoined laterally; cells quadrangular; cells 12-15(14)u in diameter, 12-20(19)u long. Common.
Plate V, Number 4, x1000.

Order Siphonocladales

Family Cladophoraceae

Cladophora glomerata (L.) Kuetzing

Filaments successively and regularly branched, the branches crowded in the upper portions; cells slightly attenuated toward the apices of the branches, which are bluntly pointed; main axis 75-100(85)u in diameter, 6-7 times the diameter in length; cells in the branches 35-50 (48)u in diameter, 3-6 times the diameter in length. Abundant in early spring.

Plate VI, Number 1, x75.

Pithophora oedogonia (Mont.) Wittrock

Filaments slender, branching mostly solitary; cells long and cylindrical; akinetes cylindrical and slightly swollen to cask shaped when terminal; filaments 45-70(60)u in diameter, as much as 20 times the diameter in length; akinetes when terminal, 57-144u in diameter, 95-380(320)u in length. Abundant.

Plate VI, Number 2, x200.

Rhizoclonium hieroglyphicum (Ag.) Kuetzing

Filaments long, unbranched; fastened to the substrate by unicellular, rhizoidal branches at the base. Chloroplast a parietal, reticulate sheet that covers the entire cell wall and contains numerous pyrenoids which are placed at certain intersections of the reticulum; cells 10-40(17)u in diameter, 2-8 times as long as broad. Abundant.

Plate VI, Number 3, x150.

Order Zygnematales

Family Zygnemataceae

Spirogyra protecta Wood

Vegetative cells with replicate end walls; chloroplast solitary making 4 to 5 turns; conjugation by tubes from both gametangia; fertile cells slightly enlarged,

sterile cells becoming inflated during conjugation; vegetative cells 32-36(32)u in diameter, 120-475(140)u long. Rare.

Plate VII, Number 1, x200.

Zygnema pectinatum (Vauch.) C. A. Agardh

Filaments forming light green, cottony masses; zygospores formed in the tubes; spores 38u in diameter; vegetative cells 30-37(38)u in diameter, up to 80(48)u long; median spore wall brown and pitted, 35-50u in diameter. Common in early spring.

Plate VII, Number 2, x225.

Family Desmidiaceae

Cosmarium sp.

Cells compressed, wider than long, 23u in diameter, with deep median constriction; isthmus 8u wide; each semicell with one large pyrenoid; free-floating and solitary. Abundant.

Plate VII, Number 3, x600.

Closterium ehrenbergii var. ehrenbergii Meneghini

Cells 4-7 times longer than broad, stout, moderately curved; ventral margin concave but inflated in the midregion, dorsal wall strongly convex, gradually attenuated to obtusely rounded poles; chloroplast with from 3-10 longitudinal ridges, and with numerous, scattered pyrenoids;

terminal vacuoles with numerous granules; 40-172(72)u in diameter, 210-880(567)u in length. Common.
Plate VII, Number 4, x170.

Pleurotaenium ehrenbergii var. ehrenbergii (Breb.) DeBary

Cells relatively large, 13-30 times longer than broad, slightly constricted; semicells with a somewhat conspicuous basal inflation; margins rounded with truncate apices, bearing a ring of 7-10 conical or rounded tubercules; chromatophores numerous, longitudinal bands; several pyrenoids. Cells 18-35(40)u in diameter, 240-650(585)u long; apices 14-33(33)u wide. Common.
Plate VII, Number 5, x225.

PHYLUM EUGLENOPHYTA

Order Euglenales

Family Euglenaceae

Euglena acus Ehrenberg

Body slightly metabolic, elongate, ending in a long, fine tapering point, narrowed and truncate at the anterior end; chloroplasts numerous, disc-like; paramylon bodies 2 to several long rods; cells 8-18(10)u in diameter, 52-175(80)u in length. Common.
Plate VIII, Number 1, x500.

Euglena cyclopicola Gichelhorn

Body cylindrical, rounded anteriorly and posteriorly;

chloroplast discoidal; paramylon bodies numerous, oval; found attached to Cyclops and Daphnia; cells 9-14(12)u in diameter, 16-32(21)u long. Rare.

Plate VIII, Number 2, a, motile form; b, resting cysts attached to Microcrustaceae, x500.

Euglena oxyuris Schmarda

Body cylindrical or flattened, usually twisted; evident spiral groove the entire length of body; chloroplast discoidal; cells 19-45(33)u in diameter, 140-490(170)u long. Common.

Plate VIII, Number 3, x500.

Euglena proxima Dangeard

Body metabolic, fusiform, narrowed posteriorly to a blunt tip; periplast spirally striated; chloroplasts irregular shaped discs; paramylon bodies numerous small rods; cells 14.5-19(24)u in diameter, 70-85(72)u long. Common.

Plate VIII, Number 4, x500.

Euglena spirogyra Ehrenberg

Body slightly metabolic; elongate cylindric and twisted, narrowed posteriorly and extended into a sharp, bent tail piece; periplast brownish, spirally striated; chloroplast numerous; paramylon bodies 2 flattened rings; cells 10-26(18)u in diameter, 80-150(90)u long. Rare.

Plate VIII, Number 5, x500.

Euglena tripteris (Dug.) Klebs

Body rigid, elongate-cylindric and twisted, narrowing posteriorly to form a sharp tip; periplast finely striated; paramylon 2 thick rods, one anterior and one posterior to the central nucleus; cells 7-10(15)u in diameter, 70-90 (90)u long. Rare.
Plate VIII, Number 6, x500.

Euglena viridis Ehrenberg

Body variously shaped, highly metabolic, usually fusiform, rounded anteriorly, the largest diameter posterior of mid-body regions; pellicle has various striations present; chloroplasts are spindle-shaped and 6 or more; cells 14-20(16)u in diameter, 40-65(54)u long. Abundant.
Plate VIII, Number 7, x500.

Phacus acuminata Stokes

Body suborbicular in outline, broadly rounded posteriorly; paramylon bodies 1-2 ring-like discs; cells 20-30(19)u in diameter, 25-40(24)u long. Abundant.
Plate IX, Number 1, x500.

Phacus longicauda (Ehrenb.) Dujardin

Body ovoid to pyriform, tapering posteriorly to a long, sharp pointed caudus; periplast longitudinally striated; paramylon body a circular plate; cells 45-70(42)u in diameter, 85-170(120)u long. Common.
Plate IX, Number 2, x500.

Phacus monilata Stokes

Body slightly ovoid and flattened; periplast covered with wart-like processes in rows; chromatophores discoid; flagellum approximately body length; cells 32-39(30)u in diameter, 43-54(40)u long. Rare.
Plate IX, Number 3, x500.

Phacus pleuronectes (Muell.) Dujardin

Body broadly ovoid in outline, slightly spiral and produced posteriorly to form a stout, sharp caudus, anterior end rounded; periplast longitudinally striated; cells 29-70(31)u in diameter, 40-100(44)u long. Common.
Plate IX, Number 4, x500.

Phacus torta Lemmermann

Body spirally twisted along longitudinal axis; 1 large discoid paramylon body; spine almost the length of the body; flagellum as long as the body; cells 40-44(38)u in diameter, 80-100(80)u long. Common.
Plate IX, Number 5, x500.

Trachelomonas armata (Ehrenb.) Stein

Test broadly ovoid, posterior end bearing a circular row of relatively long spines, without a terminal spike; flagellum twice cell length; test 22(23)u in diameter, 38-40(40)u long, including spines. Common.
Plate IX, Number 6, x1000.

Trachelomonas hispida (Perty) Stein

Test ovate, wall uniformly covered with small sharp-pointed warts; flagellum aperature slightly raised; test 15-26(19)u in diameter, 20-42(26.4)u long. Abundant.
Plate X, Number 1, x1000.

Trachelomonas pulchra var. elongata (Swirenko) Pascher

Test broadly ellipsoidal, anterior and posterior poles with short dull spines; flagellum 3 times the length of the lorica; test 26-30(32)u in diameter, 35-39(39)u long. Abundant.
Plate X, Number 2, x1000.

Trachelomonas volvocina Ehrenberg

Test globose, wall yellowish brown; flagellum aperature without a collar, flagellum 2 times cell length; test 16-20(14)u in diameter. Abundant.
Plate X, Number 3, x1000.

PHYLUM CHRYSOPHYTA

SUB-PHYLUM XANTHOPHYCEAE

Order Vaucheriales

Family Phyllosiphonaceae

Vaucheria geminata (Vauch.) DeCandolle

Filaments coarse and branched, 80-100(82)u in diameter, oogonia in pairs borne laterally near the end of a short stipate branch of the main axis with 1 circinate antheridium,

60-80(65)u in diameter, 70-90(80)u long. Rare.
Plate X, Number 4, x150.

Vaucheria sessilis (Vauch.) DeCandolle

Filaments somewhat slender, 50-58(58)u in diameter, with irregular branching; monoecious, oogonia in pairs, ovoid to subglobose with the pore in a short beak and directed upward; oogonia 70-85(78)u in diameter; antheridia circinate on a short pedicel between 2 oogonia. Common.
Plate X, Number 5, x150.

SUB-PHYLUM CHRYSOPHYCEAE

Order Ochromonadales

Family Synuraceae

Synura uvella Ehrenberg

Free-swimming colony of 64-128 short pyriform cells which have several short, sharp spines in the anterior region of the wall; cells 8-17(10)u in diameter, 20-35(25)u long. Abundant.
Plate X, Number 6, x1000.

SUB-PHYLUM BACILLARIOPHYCEAE

Order Pennales

Family Fragilariaceae

Fragilaria sp.

Frustules rectangular in girdle view, attached side by side; valve view fusiform with poles narrowed. Abundant.

Plate X, Number 7.

Family Achnanthaceae

Achnanthes sp.

Frustules naviculate in girdle view, without septa; in valve view narrowly elliptic with undulate margins. Abundant.

Plate X, Number 8.

Family Naviculaceae

Caloneis sp.

Frustules rectangular in girdle view; in valve view elongate cigar shaped with margins of the valve in a parallel line which crosses transverse striae. Common.

Plate XI, Number 1.

Frustulia sp.

Girdle view rectangular; valve view linear elliptic; 2 chromatophores on opposite sides of the girdle connected by a cytoplasmic bridge. Common.

Plate XI, Number 2.

Navicula sp.

Frustules rectangular in girdle view; cigar-shaped with narrowly rounded poles, striae convergent toward the central area. Abundant.

Plate XI, Number 4.

Pinnularia sp.

Frustules rectangular in girdle view; naviculoid with broadly rounded poles in valve view, with prominent transverse costae. Common.

Plate XI, Number 4.

Gomphoneis sp.

Frustules are cuneate in outline in girdle view; valves straight with one pole broader than the other; having a longitudinal line next to both lateral margins. Common.

Plate XI, Number 5.

Gomphonema sp.

Frustules in girdle view cuneate in outline; in valve view cells are straight with one pole broader than the other; frustules usually epiphytic and borne at the tips of gelatinous stalks.

Plate XI, Number 6.

Family Cymbellaceae

Cymbella sp.

Frustules lunate in valve view with a slight swelling in the midregion; solitary and free-floating. Common.

Plate XI, Number 7.

PHYLUM CYANOPHYTA

Order Nostocales

Family Nostocaceae

Anabena oscillarioides Bory

Filaments straight and solitary; cells barrel shaped or truncate globose, 4-6(6)u in diameter, 7.8-8(8)u long; heterocysts ovate or round, 6-8(8)u wide, 6-10(10)u long; gonida cylindrical developing on both sides of the heterocysts, 8-10(10)u wide, 20-40(20)u long. Rare.
Plate XI, Number 8, x750.

Cylindrospermum musicola Kuetzing

Filaments entangled in a mucous expanse, forming dark-green patches on submerged aquatics; cells quadrate with slight constrictions at the cross walls; cells 3.5-5.5(3.6)u in diameter, 4-6.5(7)u long; gonida broadly ovate with thick smooth walls; 9-12(10)u wide, 16-20(16)u long. Common in early spring.
Plate XI, Number 9, x660.

SUMMARY

1) A total of 58 species of algae was collected from McKinney Marsh from March to December, 1976. These included four phyla, 12 orders, 23 families, and 42 genera.
2) Of the 58 species found, 17 were new to Kansas.
3) Annual precipitation patterns differed from those of the past five years. With rainfall eight inches below normal by August, the Marsh dried and remained dry for the rest of the year.
4) Selected physiocochemical factors (pH, dissolved oxygen, and water temperature) were measured weekly. Of these, pH was believed to be the most important in determining what groups of algae were present.
5) Certain expected patterns of seasonal periodicity were observed. The Marsh was dominated by the Chlorophyta and Euglenophyta, and to a lesser extent by the Chrysophyta; the anticipated development of a large blue-green population in late summer was not found due to the drying of the Marsh.

LITERATURE CITED

LITERATURE CITED

Allegre, C. F., and T. L. Jahn. 1943. A survey of the genus Phacus (Protozoan, Euglenoidina). Trans. Amer. Micros. Soc. 62:233-243.

Bailey, L. L. 1932. Filamentous green algae of Labette County, Kansas. Trans. Kans. Acad. Sci. 35:190-195.

Cringan, M. S. 1977. Dragonflies and damselflies of McKinney Marsh. Unpublished Masters Thesis. Emporia Kansas State College. 44 p.

Desikachary, T. 1959. Cyanophyta. Times of India Press, Bombay, India. 686 p.

Gaufin, A. R., and R. Clubb and R. Newell. 1974. Studies on tolerance of aquatic insects to low oxygen concentrations. Great Basin Nat. 34:45-59.

Johnson, L. P. 1944. Euglena of Iowa. Trans. Amer. Micros. Soc. 63(2):97-134.

Mentzer, L. 1940. Preliminary study of freshwater algae of Lyon County, Kansas. Trans. Kans. Acad. Sci. 43:143-145.

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

Prescott, G. W. 1962. Algae of the western Great Lakes area. Ed. II, William C. Brown., Dubuque, Iowa. 977 p.

_____ 1970. How to know the freshwater algae. Ed. II, William C. Brown Co., Dubuque, Iowa. 348 p.

Prescott, G. W., H. T. Croasdale and W. C. Vinyeard. 1975. A synopsis of North American desmids. Part II. Desmidiaceae: Placodermae. Section 1. Univ. Nebraska Press, Lincoln, Nebraska. 275 p.

Reinke, D. 1975. Algae of the Big Salt Marsh. Unpublished Masters Thesis. Univ. Kansas. 44 p.

Smith, G. M. 1950. The freshwater algae of the United States. McGraw-Hill, New York. 719 p.

Smyth, B. B. 1891. Additions to the flora of Kansas. Trans. Kans. Acad. Sci. 13:103.

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

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

Wujek, D. E. 1965. A contribution to the diatom flora of Kansas. Southwestern Nat. 10(1):39-41.

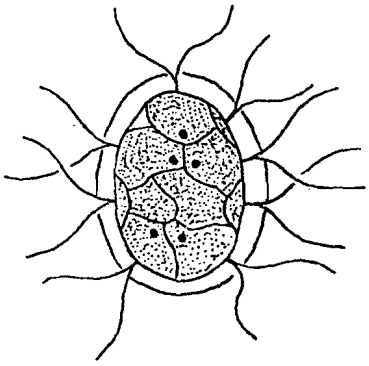
APPENDIX

EXPLANATION OF PLATES AND KEY

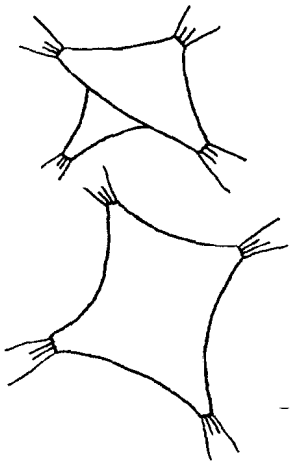
The drawings for the plates were borrowed from Tiffany and Britton (1952), Prescott (1962), Allegre and Johnson (1943), and Johnson (1944) and depict only the species as observed at the Marsh. Power of magnification is given at the end of each species description.

Key characters used in this key were taken from Prescott (1962), (1970). Genera included in the key are primarily those found at the Marsh along with others expected. Algae, being cosmopolitan in distribution, may be found most any place at any time when physiocochemical factors allow. This key should not be taken as all inclusive or exclusive as to what genera may occur at the Marsh.

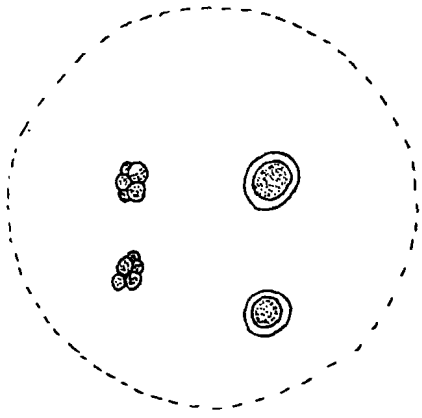
PLATE I



1

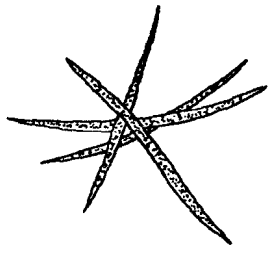


2



3

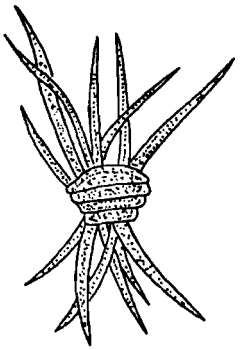
4



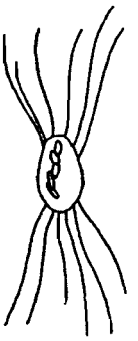
5

PLATE II

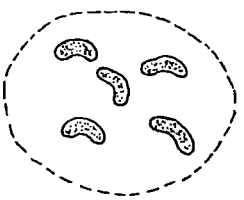
1



2

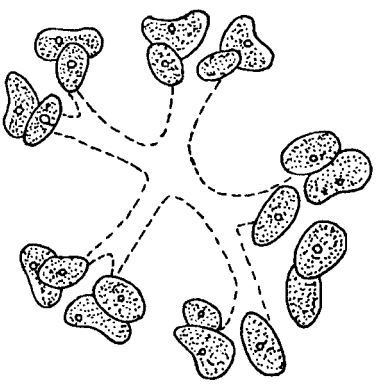


3

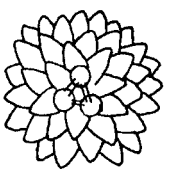


4

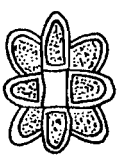
5



6



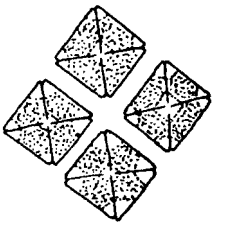
7



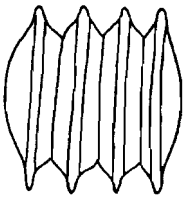
8

PLATE III

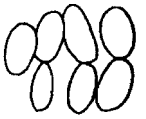
1



2

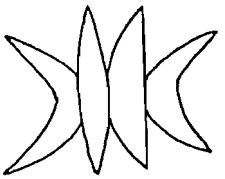


3

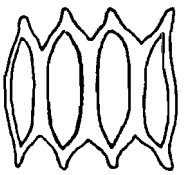


4

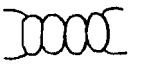
5



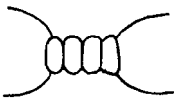
6



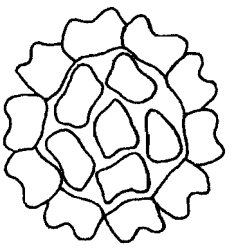
7



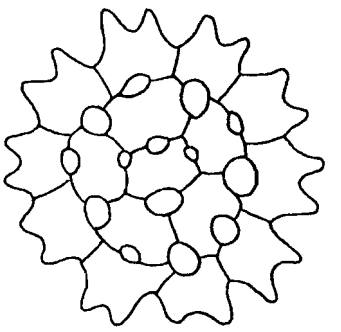
8



9

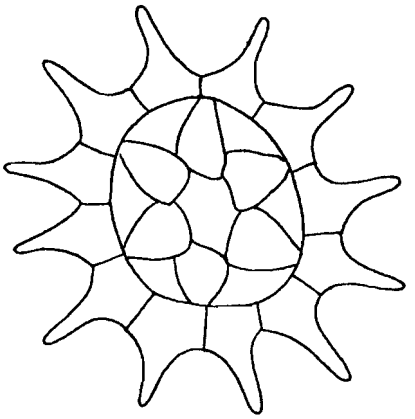


10

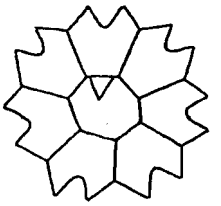


11

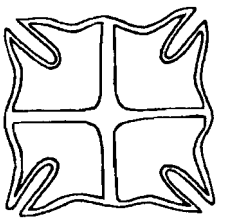
PLATE IV



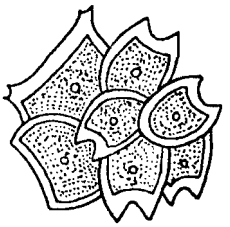
1



2



3

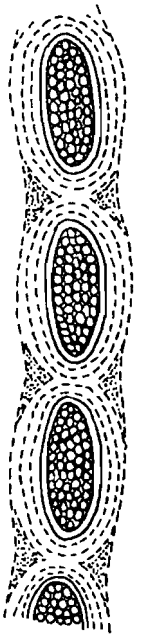


4

a

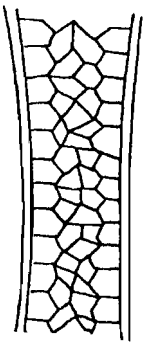
b

5

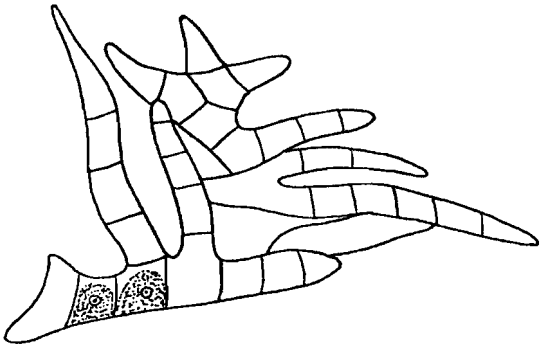


6

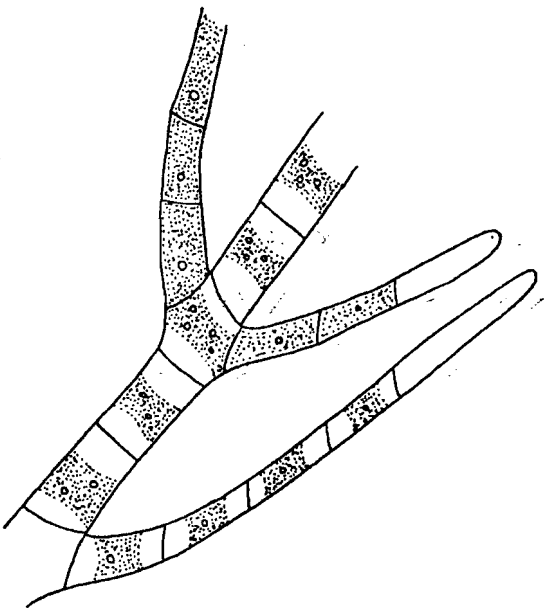
PLATE V



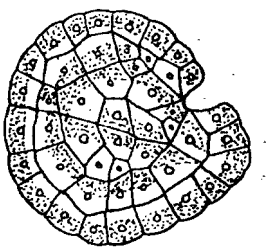
1



2

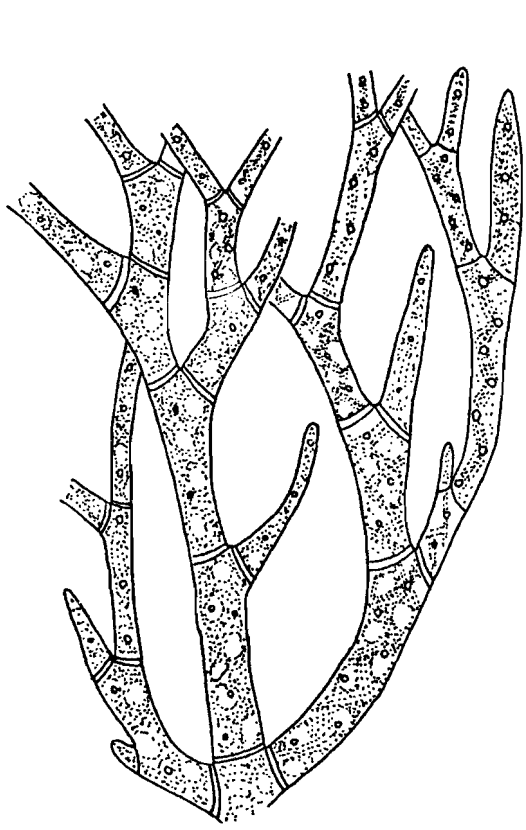


3

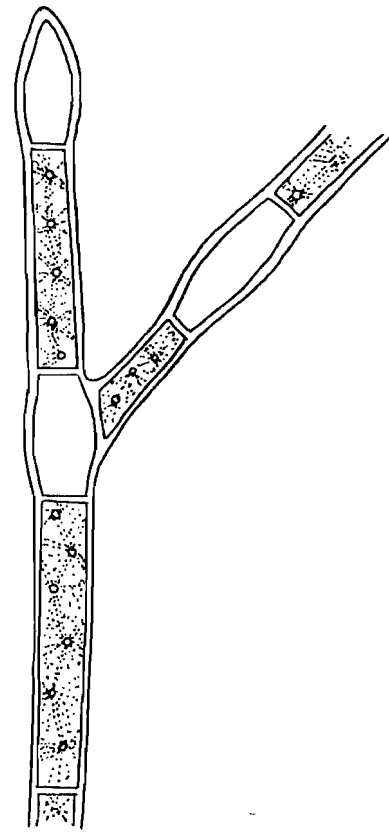


4

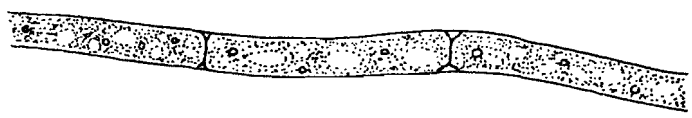
PLATE VI



1

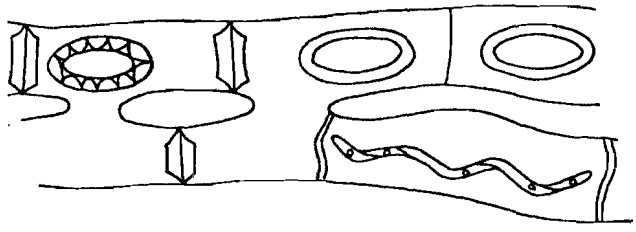


2

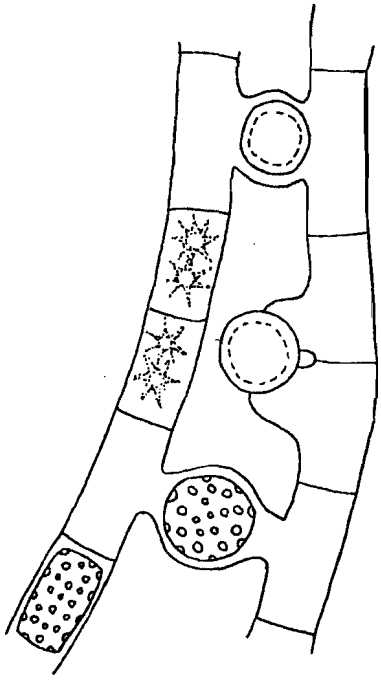


3

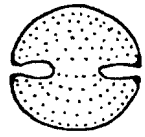
PLATE VII



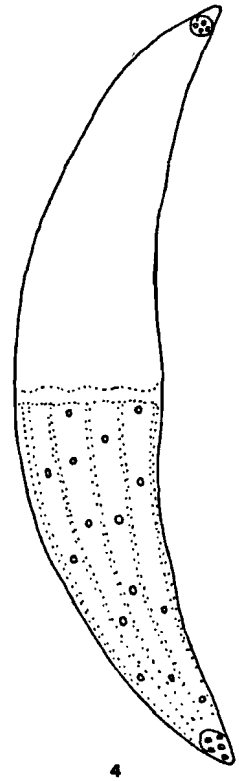
1



2



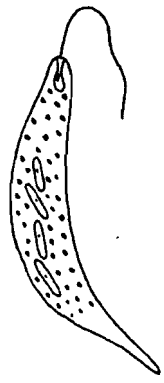
3



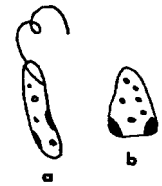
4

5

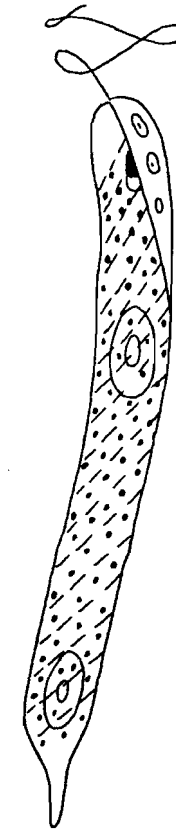
PLATE VIII



1



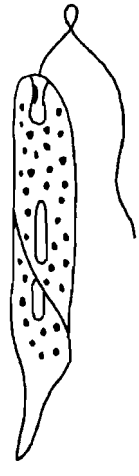
2



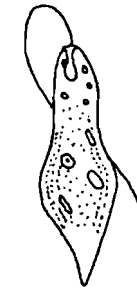
3

4

5

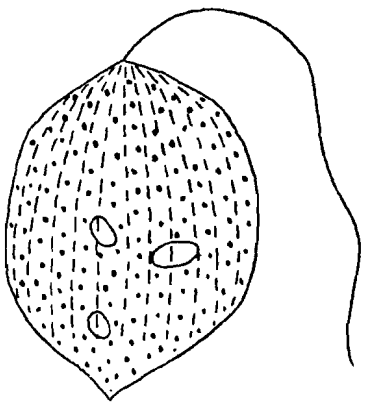


6

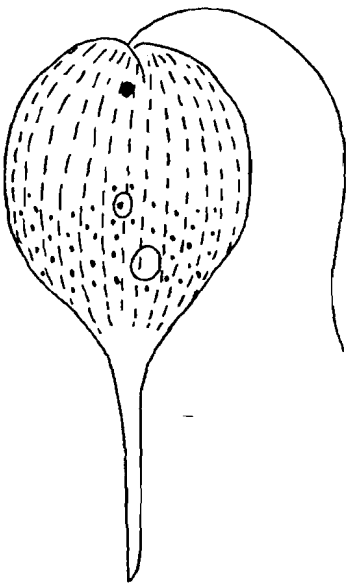


7

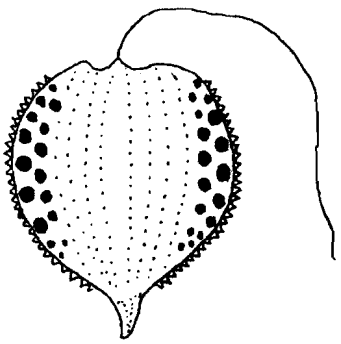
PLATE IX



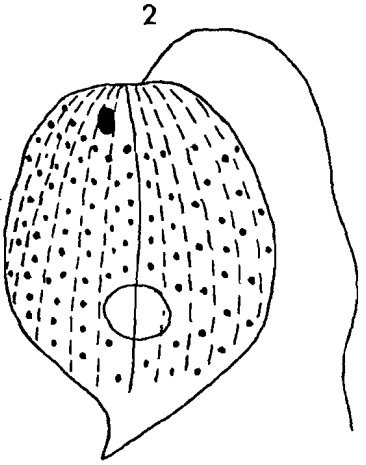
1



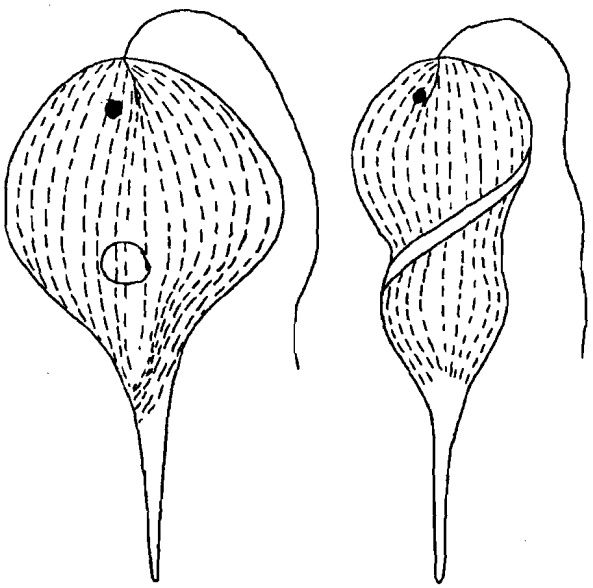
2



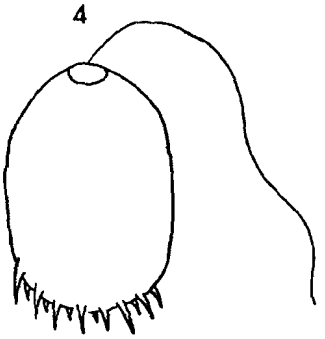
3



4

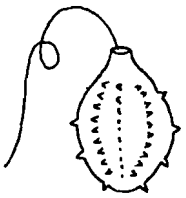


5

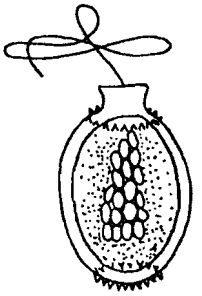


6

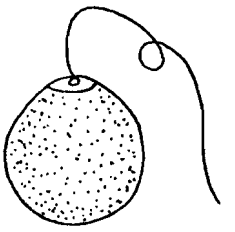
PLATE X



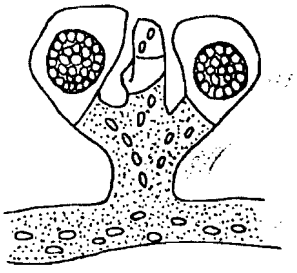
1



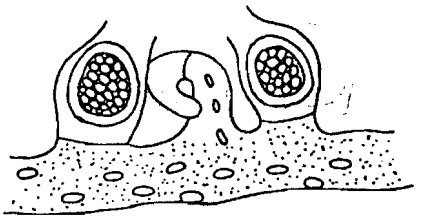
2



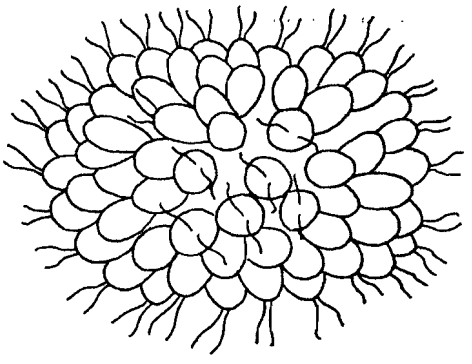
3



4



5

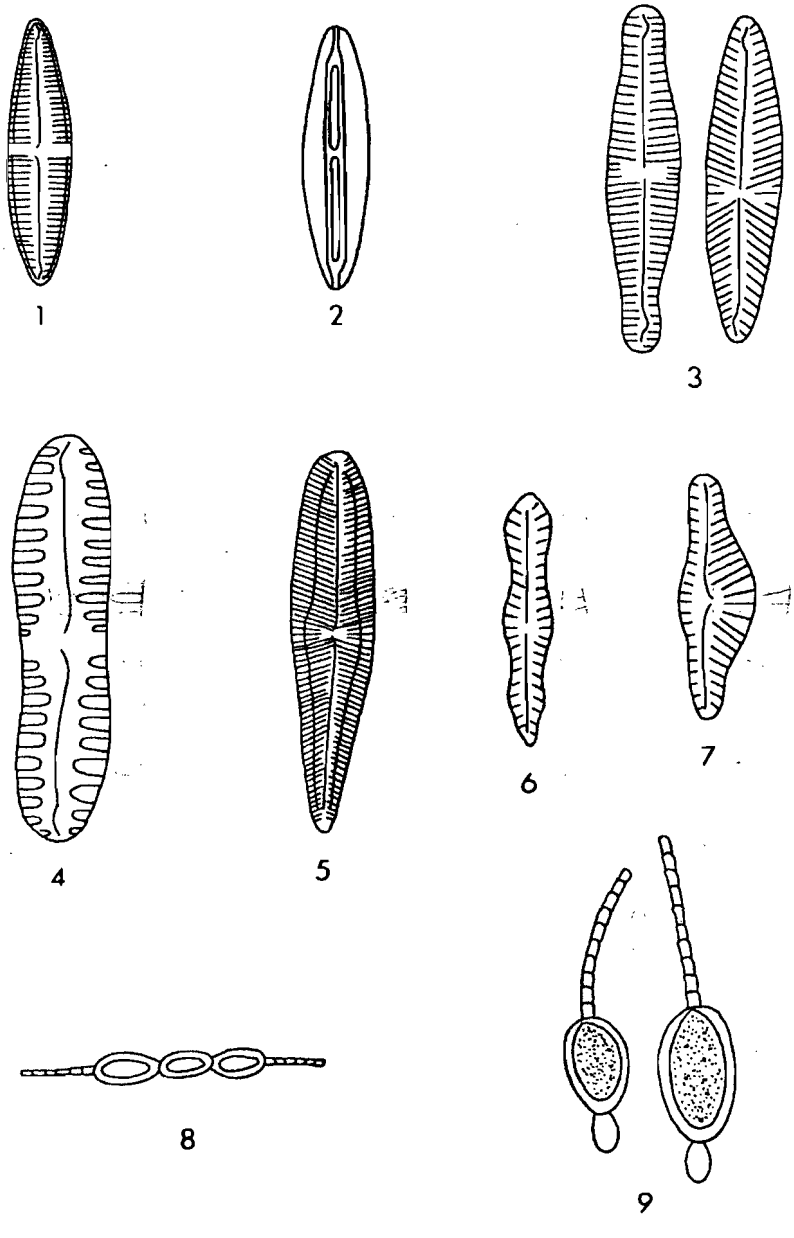


6

7

8

PLATE XI



KEY TO THE GENERA OF ALGAE AT MCKINNEY MARSH

1a Plants macroscopic, growing erect, with stem-like axis bearing whorls of branches and forked leaves clearly visible to the unaided eye . . . . . Family Characeae 2

1b Plants microscopic or, if macroscopic, with cellular structures and branches not visible to the unaided eye 3

2a Plants coarse, usually rough with lime, odiferous, microscopically showing lateral globules (antheridia) and below, the oval nucules (oogonia). . . . . Chara

2b Plants delicate, or, if relatively stout, having no rough lime deposits, not ill-smelling . . . . . Nitella

3a Cells containing chloroplasts (bodies with green pigments predominating) or chromatophores (bodies with colors other than green predominating). 4

3b Cells without chloroplasts or chromatophores, with pigments in solution and more or less evenly diffused throughout the entire protoplast. . . . CYANOPHYTA 51

4a Plant grass green; photosynthetic product starch; iodine test positive 5

4b Plant not grass green, usually light green or yellowish-brown; iodine test negative. . CHRYSOPHYTA . 48

5a Plants swimming in the vegetative state, solitary or colonial. 6

5b Plants not motile in the vegetative state, filamentous, colonial, or solitary 13

6a Cells with numerous disc-like chloroplasts; food reserves in the form of variously shaped colorless or white paramylon bodies; iodine test negative; red eye spot present; body movement slightly to highly metabolic . . . . . EUGLENOPHYTA 7

6b Cells with 1 cup-shaped or star-shaped chloroplast, usually containing 1 or more conspicuous pyrenoids; food reserve starch; iodine test positive; mobile by fine, often obscure, flagella . . CHLOROPHYTA (in part) . . . 10

7a Cells inclosed in a brown shell (test or lorica), variously shaped and decorated, often collared, with a flagella at the anterior end . . . Trachelomonas

7b Cells not inclosed in a test 8

8a Cells flattened as seen from the side, often twisted, broadly fusiform or nearly round in outline as seen from the front; paramylon in the form of discs or rings . . . . . Phacus

8b Cells not flattened, either elongate, fusiform, or oval to round; paramylon bodies different from above 9

9a Cells round, oval, rigid, pear-shaped; paramylon bodies 2 to 4 large lateral rings; tailpiece, if present, a short sharp projection . . . . . Lepocinclis

9b Cells elongate, fusiform or nearly cylindrical, or metabolic; paramylon either in large or small rods or sticks; tailpieces often present . . . . . Euglena

10a Plant a colony of 4 or more cells, either closely adjoined or free from one another within a gelatinous envelope. . . . CHLOROPHYTA (in part) . . . 11

10b Plant 1-celled, inclosed in a gelatinous sheath with 2 flagella at the anterior end. . . . . Chlamydomonas

11a Colony spheroidal or oval; cells pear-shaped, crowded together with the broad ends of the flagella directed outward. . . . . Pandorina

11b Colony globular or broadly ovoid; cells evenly spaced, not crowded. 12

12a Colonies macroscopic, containing hundreds of thousands of cells, commonly of two types. . . . . Volvox

12b Colonies small, not macroscopic, much fewer-celled, the cells all the same size and arranged in tiers . . . . . Eudorina

13a Plant a filament (cells in continuous or interrupted series) with or without branches, with a flat expanse, or an attached cushion with the flat branches closely compressed so that the basic filamentous plan is not nearly evident 34

13b Plant not filamentous, composed of solitary cells or a colony of 2 or more cells inclosed by mucilage, or cells variously adjoined in other forms 14

14a Cells solitary or gregarious but not adjoined to form colonies 28

14b Cells adjoined to form colonies. 15

15a Colony of cells invested by a common mucilage. 16

15b Colony not inclosed by mucilage. 18

16a Cells bean-shaped and ovoid, arranged in groups of 4s at the ends of branching mucilaginous strands . . . . . Dimorphococcus

16b Cells not so arranged at the ends of branching strands. 17

17a Cells globular and without distinct sheaths; chloroplast cup-shaped with a conspicuous pyrenoid; colony often including clusters of smaller daughter cells. . . . . .Sphaerocystis

17b Cells decidedly curved, with the 2 poles nearly touching one another, arranged irregularly in groups of 4s with the convex walls opposed .Kirchneriella

18a Cells crescent-shaped or needle-shaped 19

18b Cells not as above 20

19a Cells strongly crescent-shaped, closely clustered but not entangled. . . . . .Selenastrum

19b Cells straight, needle-shaped, or slightly crescent-shaped, loosely entangled, occasionally solitary . . . . . Ankistrodesmus

20a Cells attached either along their side or end walls to form definite patterns, nets, triangular clusters or short rows. 21

20b Cells attached otherwise, or if adjoined by lateral walls, then not forming definite patterns 27

21a Cells arranged in flat, circular, or rectangular plates 22

21b Cells not arranged in flat plates. 24

22a Cells forming circular plates (sometimes irregularly subcircular), the marginal cells sometimes different in shape than those within Pediastrum

22b Cells not arranged in circular plates. 23

23a Cells arranged in 4s to form quadrate plates, the outer margins entire . . . . . Crucigenia

23b Cells in multiples of 2, the outer free walls deeply incised . . . . . Pediastrum

24a Cell wall with spines. . . . . .Scenedesmus

24b Cell wall without spines 25

25a Colony spherical or polygonal, cells arranged in hollow, spherical, many-sided colonies and adjoined by interconnecting protuberances of the mucilangelous sheath. . . . . Coelastrum

25b Cells not forming hollow colonies and not so adjoined. 26

26a Cells ovoid, ellipsoid, or fusiform, adjoined by their lateral walls to form a row of 4 in a single or double series, in which the cells are alternating. . . . . .Scenedesmus

26b Cells sickle-shaped, fusiform, or crescent-shaped, twisted about one another. . . . . Ankistrodesmus

27a Cells pear-shaped, bean-shaped, or somewhat crescent-shaped and not bearing long needle-like spines . . . . . .Sorastrum

27b Cells different than above and bearing long needle-like spines. . . . . Golenkinia

28a Cells crescent-shaped or sickle-shaped, with sharp pointed or narrowly rounded, tapering tips. 29

28b Cells some other shape 30

29a Cells free-floating; 2-horned, each bearing a chloroplast within . . . . . Closterium

29b Cells attached by slender stipe to other algae or microfauna; not 2-horned, bearing only 1 chloroplast . . . . . .Characium

30a Cells elongate, 10 or more times longer than wide, usually cylindrical or nearly so, with margins smooth or undulate. . . . .Pleurotaenium

30b Cells oval, circular, pyramidal, trapezoidal or star-shaped, not more than 3 times the width in length. 31

31a Cells constricted in the midregion 32

31b Cells not constricted in the midregion 33

32a Cells with 2 or more radiating arms so that the cells are star-shaped or triangular; semicells transversely oval, pyramidal or urn-shaped . . . . . .Staurastrum

32b Cells without radiating arms; semicells compressed or rounded when seen from the top or side. . . . . .Cosmarium

33a Cells oval or ellipsoid, spined at the poles or the equator . . . . . .Lagerheimia

33b Cells angular, trapeziform, or polygonal, with tufted spines at the angles of the cells. . . . . .Polyedriopsis

34a Plant a microscopic unbranched filament, attached or free-floating, or a macroscopic thallus in the form of an expanded sheet, a tube or a tree-like gelatinous and beaded growth. 35

34b Plant a branched filament, a coenocytic tube (without cross walls) or an attached cushion or disc in which the branching habit is obscure. 44

35a Chloroplast parietal, net-like or ring-like, with pads and thin areas or, if axial, plants in the form of a macroscopic thallus. 38

35b Chloroplast axial, a broad band, star-shaped, or, if parietal, ribbon-like 36

36a Chloroplasts 2, star-shaped, each containing a large central pyrenoid . . . . . .Zygnema

36b Chloroplasts not as above. 37

37a Cell sap purplish; chloroplast 1, band-like and often twisted. . . . . .Mougeotia

37b Cell sap not purplish; chloroplasts spiraled . .Spirogyra

38a Plant a short tuft of usually branched, erect filaments or attached discs. . . . . .Coleochaete

38b Thallus not in the form of a cushion or erect filaments. 39

39a Filaments thick-walled, uniseriate in basal portion and becoming multiseriate above. . . .Schizomeris

39b Filaments of cells in one series throughout. 40

40a Chloroplast a parietal network, usually close and dense; pyrenoids many and conspicuous. . . . 41

40b Chloroplast otherwise; pyrenoids few or lacking. 42

41a Cells cylindrical, usually 4 times longer than wide; ring-like scars absent at the cross walls. . . . . Rhizoclonium

41b Cells not quite cylindrical, slightly larger at the anterior end, usually less than 3 times longer than wide; ring-like scars present at the cross walls . . . . . Oedogonium

42a Chloroplast a parietal plate, a ring or band which either encircles or nearly encircles the cell . . . . . Ulothrix

42b Chloroplast massive and dense, or a parietal sheet of thick and thin areas, or a branched, beaded thread 43

43a Cells quadrate or oval to sub-globose, inclosed in a stratified, laminated gelatinous sheath. . . . . .Cylindrocapsa

43b Chloroplast a perforated and padded sheet or a branched beaded ribbon; end walls H-shaped at the ends of the filaments; iodine test positive (often needed to distinguish from Tribonema) . . . . . Microspora

44a Filament multicellular with cross walls 45

44b Filaments without cross walls (except for reproductive structures). 48

45a Plants prostrate, growing horozonitally, mostly epiphytic and forming discs or flat expansions; thallus composed of slender, repeatedly branched setae-bearing filaments 46

45b Plants erect, free floating or attached 47

46a End cells spine-tipped. . . . . .Stigeoclonium

46b End cells without spines. . . . . Draparnaldia

47a Cells cylindrical, not akinete bearing. . . . Pithophora

47b Cells barrel-shaped, akinete bearing. . . . . Cladophora

48a Chromatophores yellow, yellow-brown, or dark golden brown; plants motile. 49

48b Chromatophores not yellow-brown; plants filamentous, non-motile 50

49a Cells not flagellated, not forming globular colonies Diatoms

49b Cells flagellated, forming globular colonies. . . Synura

50a Filaments multicellular, with numerous cross walls . . . . . .Tribonema

50b Filaments unicellular, without cross walls. . .Vaucheria

51a Cells of 2 types; trichome (filament) movement absent 52

51b Cells all of 1 type; trichome movement present . . . . . Oscillatoria

52a Trichomes with large cells (heterocysts) scattered throughout. . . . . .Anabena

52b Trichomes with terminal heterocysts and adjacent spores . . . . . .Cylindrospermum